PROJECT MANUAL

CITY OF FERNDALE
FERNDALE, MICHIGAN

MARTIN ROAD PARK SERVICE BUILDING
FERNDALE, MICHIGAN

BIDS AND PERMITS REVISED

DECEMBER 31, 2025

N/S PROJECT NO. 2024008
MDNR SPARK GRANT # ARPA-0093
CPF HUD GRANT # B-23-CP-MI-0816
MI ENHANCEMENT GRANT

ARCHITECT:

NEUMANN / SMITH ARCHITECTURE

PROJECT	MARTIN ROAD PARK SERVICE BUILDING FERNDALE, MICHIGAN
OWNER	CITY OF FERNDALE FERNDALE, MICHIGAN
ARCHITECT	NEUMANN / SMITH ARCHITECTURE 400 GALLERIA OFFICENTRE; SUITE 555 SOUTHFIELD, MICHIGAN 48034
MECHANICAL/ ELECTRICAL/ PLUMBING ENGINEER	PETER BASSO ASSOCIATES, INC. 5145 LIVERNOIS, SUITE 100 TROY, MICHIGAN 48098

SECTION 00 0107 - SEALS PAGE

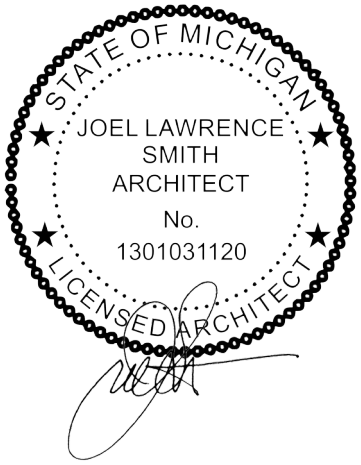
PART 1 - GENERAL

1.01 ARCHITECTURAL

I hereby certify this plan, specification, or report was prepared by myself or under my direct supervision and I am a duly Registered Architect under the laws of the State of Michigan.

Joel L Smith, AIA

Date 08/22/2025 Registration No. 130-10-31120

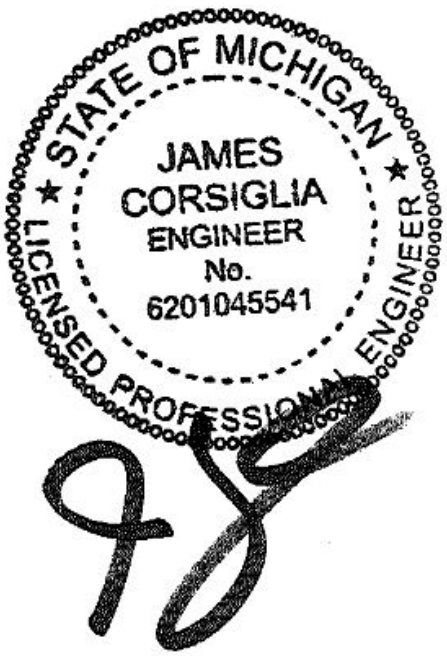


1.02 STRUCTURAL

I hereby certify this plan, specification, or report was prepared by myself or under my direct supervision and I am a duly Registered Engineer under the laws of the State of Michigan.

James Corsiglia

Date 08/15/2025 Registration No. 6201045541

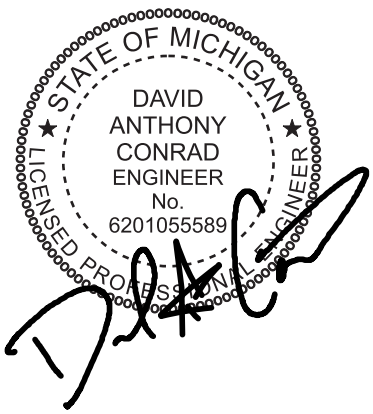


1.03 MECHANICAL

I hereby certify this plan, specification, or report was prepared by myself or under my direct supervision and I am a duly Registered Engineer under the laws of the State of Michigan.

_____

Date _____ Registration No. _____



1.04 ELECTRICAL

I hereby certify this plan, specification, or report was prepared by myself or under my direct supervision and I am a duly Registered Engineer under the laws of the State of Michigan.

_____

Date _____ Registration No. _____

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

Bids and Permits Revised December 31, 2025	Firm	Section	Title
		Division 00 – Procurement and Contracting	
X	N/S	00 0101	Project Title Sheet
X	N/S	00 0107	Seals Page
X	N/S	00 0110	Table of Contents
X	N/S	00 1113	Advertisement for Bids
X	N/S	00 2113	Instructions to Bidders
X	N/S	00 4100	Bid Form
X	N/S	00 4325	Substitution Procedures During Bidding
X	N/S	00 5200	Agreement Form
X	N/S	00 7200	General Conditions
X	N/S	00 7300	Supplementary Conditions
X	CSC	00 3132	Geotechnical Data
		Division 01 – General Requirements	
X	N/S	01 1100	Summary of Work
X	N/S	01 2300	Alternates
X	N/S	01 2500	Substitution Procedures
X	N/S	01 2500.13	Substitution Request Form
X	N/S	01 2600	Contract Modification Procedures
X	N/S	01 2613	Requests for Interpretation (RFI)
X	N/S	01 2900	Payment Procedures
X	N/S	01 3113	Project Coordination
X	N/S	01 3119	Project Meetings
X	N/S	01 3323	Shop Drawings, Product Data and Samples
X	N/S	01 3323.13	Authorization for Release of Electronic File Transfer
X	N/S	01 4000	Quality Requirements
X	N/S	01 4216	Definitions
X	N/S	01 5000	Temporary Facilities and Controls
X	N/S	01 6000	Common Product Requirements
X	N/S	01 7123	Field Engineering
X	N/S	01 7329	Cutting and Patching
X	N/S	01 7423	Final Cleaning
X	N/S	01 7700	Closeout Procedures
X	N/S	01 7829	Final Site Survey
X	N/S	01 7839	Project Record Documents
		Division 02 – Existing Conditions	
X	N/S	02 4116	Structure Demolition
		Division 03 - Concrete	
X	CSC	03 3300	Cast-In-Place Concrete
X	N/S	03 3313	Architectural Cast-In-Place Concrete

Bids and Permits Revised December 31, 2025	Firm	Section	Title
X	N/S	03 4846	Precast Concrete Copings and Sills
		Division 04 - Masonry	
X	N/S	04 2000	Unit Masonry
X	CSC	04 2010	Reinforced Unit Masonry
		Division 05 - Metals	
X	CSC	05 1200	Structural Steel
X	N/S	05 1213	Architecturally Exposed Structural Steel Framing
X	CSC	05 3100	Steel Roof Deck
X	N/S	05 4000	Cold-Formed Metal Framing
X	N/S	05 5000	Metal Fabrications
X	N/S	05 5133	Prefabricated Ladders
X	CSC	05 8010	Post-Installed Anchors
		Division 06 - Wood, Plastics and Composites	
X	N/S	06 1000	Rough Carpentry
X	N/S	06 1643	Gypsum Board Sheathing
		Division 07 – Thermal and Moisture Protection	
X	N/S	07 1113	Bituminous Dampproofing
X	N/S	07 2100	Thermal Insulation
X	N/S	07 2700	Air Barriers
X	N/S	07 4213	Metal Wall Panels
X	N/S	07 5400	Thermoplastic Membrane Roofing
X	N/S	07 6200	Sheet Metal Flashing and Trim
X	N/S	07 7100	Roof Specialties
X	N/S	07 7123	Manufactured Gutters and Downspouts
X	N/S	07 8600	Firestopping
X	N/S	07 9200	Joint Sealants
		Division 08 - Openings	
X	N/S	08 1113	Hollow Metal Doors and Frames
X	N/S	08 4113	Aluminum Framed Entrances and Storefronts
X	N/S	08 5619	Pass-Thru Windows
X	N/S	08 7100	Door Hardware
X	N/S	08 8000	Glazing
		Division 09 - Finishes	
X	N/S	09 0561	Common Work Results for Flooring Preparation
X	N/S	09 2116	Gypsum Board Assemblies
X	N/S	09 5100	Acoustical Ceilings
X	N/S	09 6500	Resilient Flooring
X	N/S	09 6723	Fluid-Applied Flooring
X	N/S	09 6813	Tile Carpeting

Bids and Permits Revised December 31, 2025			
	Firm	Section	Title
X	N/S	09 9100	Painting
X	N/S	09 9600	High Performance Coatings
X	N/S	09 9713.13	Thermal Barrier Coating
X	N/S	09 9723.16	Concrete Floor Sealer
		Division 10 - Specialties	
X	N/S	10 1419	Dimensional Letter Signage
X	N/S	10 1423	Panel Signage
X	N/S	10 2113.19	Plastic Toilet Compartments
X	N/S	10 2813	Toilet Accessories
X	N/S	10 4116	Emergency Key Cabinets
X	N/S	10 4400	Fire Protection Specialties
		Division 11 - Equipment - Not Used	
		Division 12 - Furnishings	
X	N/S	12 2400	Roller Window Shades
		Divisions 13 through 19 - Not Used	
		Division 20 - Mechanical General Requirements	
X	PBA	20 0500	Mechanical General Requirements
X	PBA	20 0510	Basic Mechanical Materials and Methods
X	PBA	20 0513	Motors
X	PBA	20 0519	Meters and Gages
X	PBA	20 0529	Hangers and Supports
X	PBA	20 0547	Mechanical Vibration Controls
X	PBA	20 0553	Mechanical Identification
X	PBA	20 0700	Mechanical Insulation
		Division 21 - Fire Suppression - Not Used	
		Division 22 - Plumbing	
X	PBA	22 0523	General Duty Valves for Plumbing
X	PBA	22 1116	Domestic Water Piping
X	PBA	22 1119	Domestic Water Piping Specialties
X	PBA	22 1123	Domestic Water Circulation Pumps
X	PBA	22 1316	Sanitary Waste and Vent Piping
X	PBA	22 1319	Drainage Piping Specialties
X	PBA	22 1413	Storm Drainage Piping
X	PBA	22 3300	Electric Domestic Water Heaters
X	PBA	22 4200	Plumbing Fixtures
X	PBA	22 4500	Emergency Plumbing Fixtures
X	PBA	22 4700	Drinking Fountains, Water Coolers and Cuspidors
		Division 23 - Heating, Ventilating, and Air Conditioning (HVAC)	
X	PBA	23 0500	Common Work Results for HVAC

Bids and Permits Revised December 31, 2025			
	Firm	Section	Title
X	PBA	23 0593	Testing, Adjusting, and Balancing
X	PBA	23 0933	Temperature Controls
X	PBA	23 2300	Refrigerant Piping
X	PBA	23 3113	Metal Ducts
X	PBA	23 3300	Duct Accessories
X	PBA	23 3433	Air Curtains and Door Heaters
X	PBA	23 3713	Diffusers, Registers, and Grilles
X	PBA	23 7210	Light Commercial Air-To-Air Energy Recovery Equipment
X	PBA	23 8126	Split-System Air-Conditioning Units
X	PBA	23 8219	Fan-Coil Units
X	PBA	23 8239	Electrical Wall and Ceiling Heaters
X	PBA	23 8241	Propeller Fan Unit Heaters - Steam, Hot Water, Electric
		Divisions 24 and 25 - Not Used	
		Division 26 - Electrical	
X	PBA	26 0010	Electrical General Requirements
X	PBA	26 0519	Conductors and Cables
X	PBA	26 0526	Grounding and Bonding
X	PBA	26 0529	Hangers and Supports for Electrical Systems
X	PBA	26 0533	Raceways and Boxes
X	PBA	26 0553	Electrical Identification
X	PBA	26 0923	Lighting Control Devices
X	PBA	26 0943	Lighting Control Systems
X	PBA	26 2200	Dry-Type Transformers (600 V and Less)
X	PBA	26 2416	Panelboards
X	PBA	26 2726	Wiring Devices
X	PBA	26 2813	Fuses
X	PBA	26 2816	Enclosed Switches and Circuit Breakers
X	PBA	26 5119	LED Interior Lighting
X	PBA	26 5700	Luminaire Product Data
		Divisions 27 Through 30 – Not Used	
		Divisions 31 – Earthwork	
X	CSC	31 2020	Earthwork For Buildings
		Divisions 31 – Earthwork	

SECTION 00 1113 - ADVERTISEMENT FOR BIDS

PROJECT IDENTIFICATION

PROJECT: MARTIN ROAD PARK SERVICE BUILDING

Martin Road Park Service Building

Ferndale,Michigan 48220

OWNER: CITY OF FERNDALE

Ferndale Parks and Recreation

1938 Burdette Street

Ferndale, Michigan 48220

ARCHITECT: NEUMANN/SMITH ARCHITECTURE

400 Galleria Officentre

Suite 555

Southfield, Michigan 48034

SEALED BIDS

Sealed Bids for the Martin Road Park Service Building will be received at the City Clerks office of the City of Ferndale, 300 East Nine Mile Road, Ferndale, Michigan 48220 until 2:00 PM local time, 1-26-2026.

Address Bids to:

City Clerk's Office
RE: Request for Proposals Martin Road Park Service Building
300 E. Nine Mile Road
Ferndale, MI 48220

TYPE OF PROPOSAL

Proposals are requested and will be received as "Single Lump Sum Proposals".

Bids shall remain firm for 90 days.

The City of Ferndale reserves the right to accept or reject any or all bids, in whole or in part, and to waive any informalities, therein when such waiver is in the interest of the City of Ferndale, and to award the contract to other than the low bidder.

Refer to Document 00 2113 - Instructions to Bidders, and Document 00 4100 - Bid Form, for additional requirements.

FUNDING

State funds (Michigan Department of Natural Resources Spark Grant and Michigan Enhancement Grant), and HUD Community Project Funding funds are being used to assist in construction and relevant State or Federal requirements will apply.

WAGE REQUIREMENTS

The City of Ferndale requires that all employees receive a minimum hourly wage for all contracts over $25,000 per City Ordinance No. 933.

Davis-Bacon Act, as amended (40 U.S.C. 3141-3148) and Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708) will be required. In accordance with the statute, contractors are required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the U.S. Secretary of Labor.

BID OPENING

Opening of Bids received on time will be conducted by the Owner in public and read aloud.

BIDDING PROCEDURES

Bidders are entitled to one electronic copy of documents free of charge.

Documents will be available throgh BidNet Direct https://www.bidnetdirect.com/

Submit Bids on the form included in the Bidding Documents.

BID SECURITY

Bid Security is required. Refer to Document 00 2113 - Instructions to Bidders

PERFORMANCE AND PAYMENT BONDS

Performance and Payment Bonds are required. Refer to Document 00 2113 - Instructions to Bidders

WAIVER OF CLAIM

Each bidder agrees to waive any claim it has or may have against the Owner, Architect / Engineer, and their respective Employees, arising out of or in connection with the administration, evaluation, or recommendation of any bid.

NONDISCRIMINATION

The City of Ferndale does not discriminate in its employment or any other programs or activities based on sex, race, color, age, height, weight, marital status, national origin, religion, arrest record, or disability. Reasonable accommodations will be provided for qualified individuals with a disability, if requested.

SIGNATURE

For: City of Ferndale

By: Neumann/Smith Architecture

END OF SECTION HTTPS://WWW.BIDNETDIRECT.COM/

SECTION 00 2113 - INSTRUCTIONS TO BIDDERS

PROJECT IDENTIFICATION

PROJECT: MARTIN ROAD PARK SERVICE BUILDING

Martin Road Park Service Building

Ferndale, Michigan 48220

OWNER: CITY OF FERNDALE

Ferndale Parks and Recreation

1938 Burdette Street

Ferndale, Michigan48220

ARCHITECT: NEUMANN / SMITH ARCHITECTURE

400 Galleria Officentre; Suite 555

Southfield, Michigan 48034

BIDDING DOCUMENTS

Documents to Bidders

1. One electronic set of documents consisting of f the Drawings, and the Project Manual will be available free of charge to each prime Bidder. Documents are available on BidNet Direct https://www.bidnetdirect.com/

Review of Documents

Immediately upon receipt of the Project Manual and Drawings (which are referred to hereinafter as the "Documents"), Bidders shall carefully check over same to confirm it has a complete set of documents as listed in the Project Manual "Table of Contents" and "List of Drawings"; notify Architect immediately, in writing, of any discrepancies. No allowance will be made after receipt of Bid for claims based on incomplete documents at time of bidding.

Bidders shall also notify the Architect immediately if any apparent errors or discrepancies are discovered in the Documents.

Owner and Architect in making copies of Bidding Documents available on the above terms do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

Addenda - Additional Information

The Architect will issue written Addenda to document interpretations, corrections and changes required in the Bidding Documents during the Bidding period, if such are found. No oral instructions or interpretations will be considered binding on the Owner unless confirmed in written form by an Addendum.

All questions regarding clarification or interpretation of the documents shall be directed to Mr. Brandon Markham, Neumann Smith Architecture, telephone (248) 352-8310.

Inquires received within 4 days of Bid Opening will not be given consideration.

Addenda will be posted on BidNet.

Failure of the Architect to send, or the Bidder to receive, any such clarifications shall not relieve the Bidder from obligation under his Bid as submitted.

Substitutions

The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimensions, appearance and quality to be met by any proposed substitution.

No substitution will be considered prior to receipt of Bids unless a written request for approval has been received by the Architect at least _____ days prior to the date for receipt of Bids. Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. Include a statement setting forth changes in other materials, equipment or other portions of the Work including changes in the Work of other contracts that incorporation of the proposed substitution would require. The burden of proof of the merit of the proposed substitution is upon the proposer.

The Architect's decision of approval or disapproval of a proposed substitution shall be final.

If the Architect approves a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.

For substitutions after receipt of Bids, refer to Section 01 2500 - Substitution Procedures, for procedures to allow use of products, materials, and methods other than those specifically stated in the Project Manual.

QUALIFICATION OF BIDDERS

To demonstrate qualifications to perform the Work, each Bidder must be prepared to submit within five days after Bid opening upon Owner's request detailed written evidence such as financial data, previous experience, references, present commitments and other such data as requested by the Owner. Each Bid must contain evidence of Bidder's qualification to do business in the state where the Project is located or covenant to obtain such qualification prior to award of the contract.

1.01 EXAMINATION OF CONTRACT DOCUMENTS AND

It is the responsibility of each Bidder before submitting a Bid:

To examine thoroughly the Contract Documents and other related data identified in the Bidding Documents;

To visit the site to become familiar with the general, local and site conditions that may affect cost, progress, performance or furnishing of the Work;

To consider Federal, State and Local Laws and Regulations that may affect cost, progress, performance or furnishing of the Work;

To study and carefully correlate Bidder's knowledge and observations with the Contract Documents and such other related data; and

To promptly notify Architect of all conflicts, errors, ambiguities or discrepancies which Bidder has discovered in or between the Contract Documents and such other related documents.

SUBMISSION OF BIDS

Preparation of Bids

Bid Form shall have all blank spaces completely filled out, by typewriting or manually in ink. Bid shall state the Lump Sum Base Bid price in both words and figures, and shall be signed personally by the Bidder, by a partner or by a duly authorized officer for a corporation, and shall give Bidder's name and business address. In the event of a discrepancy between the written amount and the numerical amount, the written amount shall govern.

Completed Bid Form shall be free of interlineation, alteration or erasure, and shall contain no recapitulation of the work to be done except as instructed by the Architect.

The Bid shall contain an acknowledgment of receipt of all Addenda (the numbers of which must be filled in on the Bid Form).

Bids which are not signed by the individual making them should have attached hereto a power of attorney, evidencing authority to act as agent for the person for whom it is signed.

Bids which are signed for a partnership must be executed in the partnership name and signed by a partner, whose title must appear under the signature or by an attorney-in-fact. If signed by an attorney-in-fact, evidence of authority to sign the bid shall be attached.
Bids which are signed for a corporation should have the correct corporate name thereupon and the signature of the president President or Vice-President (or other corporate officer accompanied by evidence of authority to sign). In addition, a signed Secretary's Certificate, or corporate seal must be affixed and attested by the secretary or an assistant secretary evidencing the authority of the Officer to contract in the name of the corporation shall be included. Any proposal submitted by a corporation shall bear its seal.

All names must be typed or printed in black ink below the signature.
Evidence of authority to conduct business as an out-of-state corporation in the state where the Work is to be performed shall be provided in accordance with "Qualifications of Bidders" above.
Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids.
If, within twenty-four hours after Bids are opened, any bidder files a duly signed, written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its bid, that Bidder may withdraw its Bid and the Bid security will be returned. Thereafter, that Bidder will be disqualified from further bidding on the Work to be provided under the Contract Documents.

METHOD OF SUBMISSION

Bid shall be submitted in triplicate on the form provided, in a sealed opaque envelope clearly marked on the outside with the Bidder's Name, the Project Name and Contract Title as noted above.

If the bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it.

Bids may also be dropped off at the front counter of city hall during business hours.

Each copy of the submitted Bid Form shall have Bidder's original signature.

Envelope shall be addressed as follows:

Attention: City Clerk's Office
RE: Request for Proposals Martin Road Park Service Building
300 E. Nine Mile Road
Ferndale, MI 48220

TIME OF SUBMISSION

Sealed bids for the above-noted Contract will be received by the Owner in accordance with the requirements outlined hereinafter, until **2:00 PM, local time, January 26, 2026**

Bids submitted after the above time and date will not be accepted.

LUMP SUM BASE BID PRICE

Bid shall be based only upon the materials, construction and equipment named or described in the Contract Documents.

Bid shall be for the complete work as required by the Contract Documents.

Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

TAXES

The Owner is exempt from State sales tax, with the exception of materials or equipment which are used to produce the Project, but do not remain a part of the Project. Bidder shall determine and include in its Bid all applicable State taxes, and shall include all other taxes for the Work or portions there of, which are legally enacted at the time of Bid submission or conclusion of negotiations, whether or not yet effective or merely scheduled to go into effect. Owner will provide successful bidder with tax id number for use in the purchase of materials and equipment to be put in place as part of the finished Work.

PERMITS AND FEES

Bidder shall include the cost of the General Building Permit and all other permits and fees required by authorities having jurisdiction in the Lump Sum Base Bid amount.

ALTERNATES/UNIT PRICES

Alternate/Unit Prices, if required by the Bid Form, shall be clearly stated and shall include all charges for General Conditions, incidental expenses, applicable taxes, insurance, overhead and profit. If no change is required for Alternates in the Lump Sum Base Bid amount, write "No Change".

FEES FOR CHANGES IN THE WORK

The fee charges, expressed as a percentage of the cost, for changes in the work, when done by his own organization and when done by Subcontractors under his contract, are stated in the Bid Form. Fees shall include all charges for supervision, on-site superintendence, overhead and profit. Charges for taxes, social security payments and insurance shall be computed separately and shall not be subject to percentage fee.

BID SECURITY

Bid Security is required for the Work of this Contract and shall be in an amount of not less than 5 percent of the Lump Sum Base Bid amount.

Bid Security shall be executed on form acceptable to the Owner, such as AIA Document A310, "Bid Bond".

The Owner reserves the right to retain the Bid Security of the Bidders to whom an award is being considered until the following:

a. Contract has been awarded and Bonds furnished.
b. Specified time has elapsed, and Bids may be withdrawn.
c. All Bids have been rejected.

The selected Bidder shall forfeit his Bid Security to the Owner as liquidated damages for failure to enter into a Contract with the Owner.

If the selected Bidder fails to execute and deliver the Agreement and furnish the required Performance and Payment Bonds within ***fifteen*** days after the Notice of Award, Owner may annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of the seventh day after the Effective Date of the Agreement or the 90th day after the Bid opening, whereupon Bid Security furnished by such Bidders will be returned. Bid security with Bids which are not competitive will be returned within seven days after the Bid opening.

PERFORMANCE AND PAYMENT BONDS

Performance and Payment Bonds are required for the Work of this Contract equal to 100% of the Contract amount, and the cost of such Bonds shall be included in the Lump Sum Base Bid Price.

Bonds shall be executed on form acceptable to the Owner, such as AIA Document A312, "Performance Bond and Payment Bond".

CONTRACTS WITH SUB-BIDDERS

All contracts made by the successful Bidder with Sub-Bidders shall be covered by the terms and conditions of the Contract. The successful Bidder shall see to it that his Sub-Bidders are fully informed in regard to these terms and conditions.

TIME OF COMPLETION

The Bidder will be required, if awarded a Contract, to complete the Work on or before the contract completion date stated in the Bid Form.

SITE VISIT

Bidders Representatives may visit the Project Site to inspect areas in which the Work will be performed.

Bidders may visit the park freely. Appointments to access the storage building can be obtained by contacting James Jameson Jjameson@ferndalemi.gov

OPENING OF BIDS

Opening of Bids received on time will be conducted by the Owner in Public and read aloud. Bid opening will be December 1, 2025 at 2:00 PM

Bids received after due date and time may be returned by the Owner unopened.

An abstract of the Bids will be made available to Bidders.

Bids shall remain valid for acceptance by the Owner for a period of not less than 90 days, commencing on and including the date set for receipt as stated in the Bid Form. The Owner may, in its sole discretion, release any Bid and return the Bid security prior to that date.

The Owner reserves the right to accept or reject any and all Bids, to waive any irregularities, and to award a Contract to whom ever it may elect, , including without limitation the rights to reject any or all non-conforming, non-responsive, unbalanced or conditional Bids and to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not reasonable or the Bidder is unqualified or of doubtful financial ability to meet any other pertinent standard or criteria established by Owner. Owner also reserves the right to waive all informalities not involving price, time or changes in the Work and to negotiate contract terms with the Successful Bidder. Discrepancies between the multiplication of units of work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between words and figures will be resolved in favor of the words.

In evaluating Bids, Owner will consider the qualifications of Bidders, whether or not the bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

Owner may consider the qualifications and experience of subcontractors, suppliers, and other persons and organizations proposed for those portions of the Work as to which the identity of Subcontractors, Suppliers, and other persons and organizations must be submitted as provided in the Supplementary Conditions. Owner also may consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.

Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, suppliers, and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to Owner’s satisfaction within the prescribed time.

If the contract is to be awarded, it will be awarded to lowest Bidder whose evaluation by Owner indicates to Owner that the award will be in the best interests of the Project. Bid alternates will be considered in making this evaluation.

If the contract is to be awarded, Owner will give Successful Bidder a Notice of Award within 90 days after the day of the Bid opening.

FORM OF AGREEMENT

The form of agreement for the Work shall be AIA Document A101 - 2017, "Standard Form of Agreement Between Owner and Contractor", where the basis of payment is a stipulated sum.

When Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with all other written Contact Documents attached. Within fifteen days thereafter, contractor shall sign and deliver the required number of counterparts of the Agreement and attached documents to Owner with the required Bonds. Within 30 days thereafter Owner shall deliver one fully signed counterpart to Contractor..

RETAINAGE

Provisions concerning retainage are set forth in the Agreement.

END OF DOCUMENT

SECTION 003132 - GEOTECHNICAL DATA

1.01 JOB CONDITIONS

A. General:

1. Geotechnical Investigations, the Geotechnical Report, were conducted at the site for which the Owner is furnishing data regarding conditions in the area where work is to be performed under the Contract.

    a. Such investigations were made for the purpose of study and design.

2. Bidder and those Sub-bidders affected by site conditions shall be fully responsible for reviewing the Geotechnical Report and for any deductions or conclusions made on the basis of the information furnished by the Owner, and for any site inspections and geotechnical investigations made by Bidder or Sub-bidders.

3. Geotechnical Report is furnished by the Owner only for information and the convenience of Bidders. It is expressly understood and agreed that the Architect and Owner assume no responsibility whatsoever in respect to the sufficiency or accuracy of the investigations made, the records thereof, or of the interpretation set forth therein, and there is no warranty or guaranty, either expressed or implied, that the conditions indicated by such investigations or records thereof are representative of those existing throughout such areas, or any part thereof, or that unforeseen conditions may not occur, or that materials other than, or in proportions different from those indicated, may not be encountered.
4. It is the responsibility of the Bidder and Sub-bidders to make additional geotechnical investigations, if, after reviewing the Geotechnical Report and from deductions or conclusions made thereof, further data is required to determine site conditions and to properly provide for required construction.

    a. Such additional investigations shall be at no additional cost to Owner.
    b. Additional investigations shall be undertaken only upon Owner's written authorization.
    c. When additional investigations are performed, the site shall be restored to condition preceding such investigation and acceptable to the Owner.
    d. Bidder and Sub-bidders shall provide insurance protecting and holding Owner and Architect harmless from claims arising from this additional investigation work due to bodily injury, including death, and due to property damage to Owner's or other's property.

B. Geotechnical Investigation Report:
1. A copy of the Geotechnical Report prepared by G2 Consulting Group is included in the Project Manual for use and convenience to Bidder.

END OF SECTION

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CONSULTING GROUP

Report on Geotechnical Investigation

Proposed Martin Road Park Service Building
1615 E. Lewiston Avenue
Ferndale, Michigan 48220

Latitude 42.465542° N
Longitude -83.116162° W

Prepared for:

Giffels Webster
1025 East Maple Road, Suite 100
Birmingham, Michigan 48009

G2 Project No. 250182
April 3, 2025

g2consultinggroup.com

Headquarters	1866 Woodslee St	Troy, MI 48083	P 248.680.0400	F 248.680.9745
Ann Arbor	1350 Eisenhower Pl	Ann Arbor, MI 48108	P 734.390.9330	F 734.390.9331
Chicagoland	1186 Heather Dr	Lake Zurich, IL 60047	P 847.353.8740	F 847.353.8742

CONSULTING GROUP

April 3, 2025

Mr. Scott A. Ringler, P.E., LEED-AP
Partner Emeritus
Giffels Webster
1025 East Maple Road, Suite 100
Birmingham, Michigan 48009

Re: Report on Geotechnical Investigation
Proposed Martin Road Park Service Building
1615 E. Lewiston Avenue
Ferndale, Michigan 48220
G2 Project No. 250182

Dear Mr. Ringler:

We have completed the geotechnical investigation for the proposed service building to be constructed within Martin Road Park located in the City of Ferndale, Michigan. This report presents the results of our observations and analyses and our recommendations for earthwork operations, foundation design, and construction considerations as they relate to the geotechnical conditions on site.

As always, we appreciate the opportunity to be of service to Giffels Webster and look forward to discussing the recommendations presented. In the meantime, if you have any questions regarding our report or any other matter pertaining to the project, please contact us.

Sincerely,

G2 Consulting Group, LLC

Jeffrey M. Hayball, P.E.
Project Manager

Noel J. Hargrave-Thomas, P.E.
Principal

JMH/NJHT/ljv

Enclosures

EXECUTIVE SUMMARY

We understand the proposed project includes construction of a new service building within Martin Road Park located at 1615 E. Lewiston Avenue, Ferndale, Michigan. The proposed building will be a slab-on-grade, single-story structure with an approximate footprint of 3,000 square feet with a covered patio. An existing restroom building, pavilion, Portland cement concrete sidewalks, and associated underground utilities are present within the footprint of the proposed building and will be demolished. The existing grades, final grades, and building loading conditions were not available upon completion of this proposal.

Approximately 12 inches of silty clay topsoil are present at the ground surface of the borings. Stiff silty clay fill with trace organic matter, underlies the topsoil within boring SB-2 and extends to an approximate depth of 3 feet. Native stiff to hard silty clay is present below the topsoil within boring SB-1 and silty clay fill within boring SB-2 and extends to the explored depth of 20 feet. No measurable groundwater was observed within the borings during or upon completion of drilling operations.

The existing silty clay fill present within the upper 3 feet within boring SB-2 is not suitable for support of building. Therefore, we recommend building foundations extend through the existing silty clay fill, where encountered, and bear within the stiff to very stiff native silty clay. We recommend the proposed structure be supported on shallow foundations and bear within the existing native stiff to very stiff silty clay soils. Foundations for the proposed building bearing within the native cohesive soils or engineered fill placed over native soils during utility demolition can be designed for a net allowable bearing capacity of 3,000 psf.

Provided the potential for settlement of the floor slab can be tolerated, we anticipate the existing fill soils and engineered fill used to raise site grades can be utilized for support of the building floor slab. A subgrade modulus (k) of up to 90 pounds per cubic inch (pci) may be used in the design of floor slab supported on the silty clay fill and engineered fill to raise site grades. If the potential for settlement cannot be tolerated, the existing silty clay fill must be completed removed within the building footprint and a minimum of 5 feet beyond to the underlying native stiff to very stiff silty clay soils and replaced with engineered fill. Floor slabs supported on the engineered fill placed on native soils can be designed based on a subgrade modulus of 150 pci.

We anticipate foundations can be excavated neat within the existing cohesive soils. However, the contractor should be prepared to over excavate and form the foundations if sloughing or caving soils are encountered. All excavations should be backfilled with engineered fill when supporting overlying structures such as floor slabs. The sides of spread and/or strip footings must be constructed straight and vertical to reduce the risk of frozen soil adhering to the concrete and raising the foundations.

Where excavations extend below a depth of 5 feet and are to be entered by a human, we recommend a maximum slope of one horizontal unit to one vertical unit (1H:1V) within the stiff cohesive soils and 3/4H:1V within the very stiff to hard cohesive soils in dry conditions. Where seepage from excavation cuts is observed, the slopes must be flattened sufficiently to achieve stability, but in no case left steeper that 3H:1V at and below the seepage level.

This summary is not to be considered separate from the entire text of this report with all the conclusions and qualifications mentioned herein. Details of our analysis and recommendations are discussed in the following sections and in the Appendix of this report.

PROJECT DESCRIPTION

We understand the proposed project includes construction of a new service building within Martin Road Park located at 1615 E. Lewiston Avenue, Ferndale, Michigan. The proposed building will be a slab-on-grade, single-story structure with an approximate footprint of 3,000 square feet with a covered patio. An existing restroom building, pavilion, Portland cement concrete sidewalks, and associated underground utilities are present within the footprint of the proposed building and will be demolished. The existing grades, final grades, and building loading conditions were not available upon completion of this proposal.

Once the proposed grading plans and project design become available, G2 should re-evaluate our recommendations provided herein for the final concept plan. We assume loading conditions for the structure will be subject to isolated interior foundations loads ranging from 50 to 100 kips and perimeter foundation loads ranging from 1 to 2 kips per linear foot.

The purpose of our exploration is to determine and evaluate the general subsurface conditions at the site and to develop related foundation recommendations for the support of the proposed building, floor slab design, site preparation, and construction considerations as they relate to the project.

SCOPE OF SERVICES

The field operations, laboratory testing, and engineering report preparation were performed under the direction and supervision of a licensed professional engineer. Our services were performed according to generally accepted standards and procedures in the practice of geotechnical engineering. Our scope of services for this project is as follows:

1. As directed, we drilled a total of two (2) soil borings, SB-1 and SB-2, within the footprint of the proposed building, extending to a depth of 20 feet each.

2. We performed laboratory testing on representative samples obtained from the soil borings. Laboratory testing included visual engineering classification, natural moisture content, organic matter content (loss-on-ignition), dry density, and unconfined compressive strength determinations.

3. We prepared this engineering report. The report includes recommendations regarding foundation types suitable for the soil conditions encountered, allowable bearing capacities of the anticipated bearing soil layers, estimated settlement, and construction considerations related to site preparation and foundation construction.

FIELD OPERATIONS

Giffels Webster (GW) in conjunction with G2 Consulting Group, LLC (G2), selected the number, depth, and location of the soil borings. The soil boring locations were determined in the field by G2 using conventional surveying techniques. The approximate soil boring locations are shown on the Soil Boring Location Plan, Plate No. 1. Ground surface elevations of each soil boring location were not available upon completion of this report. We recommend ground surface elevation at the soil boring location be surveyed so the subsurface conditions can be referenced by elevation during construction. In addition, we recommend a topographic survey be performed.

The soil borings were drilled using an all-terrain vehicle (ATV) mounted rotary drilling rig. Continuous flight, 3-1/4-inch inside diameter, hollow-stem augers were used to advance the boreholes to the explored depths. Soil samples were obtained at intervals of 2-1/2 feet within the upper 10 feet and at 5 feet intervals below 10 feet. These samples were obtained by the Standard Penetration Test method (ASTM D 1586), which involves driving a 2-inch diameter split-spoon sampler into the soil with a 140-pound weight falling 30 inches. The sampler is generally driven three successive 6-inch increments with the number of blows for each increment recorded. The number of blows required to advance the

sampler the last 12 inches is termed the Standard Penetration Resistance (N). Blow counts for each 6-inch increment and the resulting N-values are presented on the individual soil boring logs.

Soil samples were placed in sealed containers in the field and brought to our laboratory for testing and classification. During field operations, the drilling crew maintained logs of the encountered subsurface conditions, including changes in stratigraphy and observed groundwater levels. The final boring logs are based on the field logs supplemented by laboratory soil classification and test results. After completion of drilling operations, the boreholes were backfilled with auger cuttings.

LABORATORY TESTING

Representative soil samples were subjected to laboratory testing to determine soil parameters pertinent to foundation design and construction. An experienced geotechnical engineer classified the samples in general conformance with the Unified Soil Classification System.

Laboratory testing included natural moisture content, organic matter content (loss-on-ignition), dry density, and unconfined compressive strength determinations. The organic matter content of representative samples was determined in accordance with ASTM Test Method D 2974, "Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils". The unconfined compressive strengths were determined by ASTM Test Method D2166 and using a spring-loaded hand penetrometer. Per ASTM D2166, the unconfined compressive strength of cohesive soils is determined by axially loading a small cylindrical soil sample under a slow rate of strain. The unconfined compressive strength is defined as the maximum stress applied to the soil sample before shear failure. If shear failure does not occur prior to a total strain of 15 percent, the unconfined compressive strength is defined as the stress at a strain of 15 percent. The hand penetrometer estimates the unconfined compressive strength to a maximum of 4-1/2 tons per square foot (tsf) by measuring the resistance of the soil sample to the penetration of a calibrated spring-loaded cylinder.

The results of the moisture content, organic matter content, dry density, and unconfined compressive strength laboratory tests are indicated on the soil boring logs at the depths the samples were obtained. Unconfined Compressive Strength Test are shown graphically on Figure No. 3 within the Appendix. We will hold the soil samples for 60 days from the date of this report. If you would like the samples, please let us know.

SITE CONDITIONS

The proposed building is located within Martin Road Park, 1615 E Lewiston Avenue, Ferndale, Michigan. An existing single-story, slab-on-grade restroom, pavilion, Portland cement concrete sidewalks, grass, and associated underground utilities are present within the footprint of the proposed building. A topographic survey was not available upon completion of this report. However, it appears the site is relatively flat based on G2's site visit. A pickleball court is present to the west of the proposed building and a splash pad is present to the northeast. A bituminous concrete pathway is present on the north side of the site. Residential properties are present to the south as an existing school is present to the north.

SOIL CONDITIONS

Approximately 12 inches of silty clay topsoil are present at the ground surface of the borings. Silty clay fill with trace organic matter, underlies the topsoil within boring SB-2 and extends to an approximate depth of 3 feet. Native silty clay is present below the topsoil within boring SB-1 and silty clay fill within boring SB-2 and extends to the explored depth of 20 feet.

The silty clay fill is stiff in consistency with a moisture content of 25 percent, an organic matter content of 3.8 percent, and an unconfined compressive strength of 3,000 pounds per square foot (psf). The

native silty clay is stiff to hard in consistency with natural moisture contents ranging from 12 to 26 percent, dry densities ranging from 94 to 105 pounds per cubic foot (pcf), and unconfined compressive strengths ranging from 3,000 to 9,000 psf.

The stratification depths shown on the soil boring logs represent the soil conditions at the boring locations. Variations may occur between borings. Additionally, the stratigraphic lines represent the approximate boundaries between soil types. The transition may be more gradual than what is shown. We have prepared the boring logs on the basis of laboratory classification and testing, as well as field logs of the soils encountered.

The Soil Boring Location Plan, Plate No. 1, Soil Boring Logs, Figure Nos. 1 and 2, and Unconfined Compressive Strength Test, Figure No. 3, are presented in the Appendix. The soil profiles described above are generalized descriptions of the conditions encountered at the boring locations. General Notes Terminology defining the nomenclature used on the boring logs and elsewhere in this report are presented on Figure No. 4.

GROUNDWATER CONDITIONS

Groundwater observations were performed during drilling operations and upon removal of the drilling augers. No measurable groundwater was observed within the borings during or upon completion of drilling operations.

An estimate of the historical groundwater levels can be made based on the color transition of the soil from brown, indicating an aerobic condition where free-oxygen is available, to gray, indicating an anerobic condition where no free-oxygen is available. This color transition at the borings locations was encountered at depths ranging from 8 to 10-1/2 feet.

Fluctuations in perched and long-term groundwater levels should be anticipated due to seasonal variations and following periods of prolonged precipitation. It should also be noted that groundwater observations made during drilling operations in predominantly cohesive soils are not necessarily indicative of the static groundwater level. This is due to the low permeability of such soils and the tendency of drilling operations to seal off the natural paths of groundwater flow.

SITE PREPARATION

We anticipate earthwork operations will consist of stripping the site of topsoil, trees, vegetation, and concrete sidewalk within the proposed building, demolishing the restroom and pavilion structures present within the footprint of the proposed building, removal of associated foundations and any abandoned utilities within the footprint of the proposed building, proof rolling the exposed subgrade, placing engineered fill to raise site grades, preparing subgrade for floor slab support, and excavating for building foundations. We recommend all earthwork operations be performed in accordance with comprehensive specifications and be properly monitored in the field by qualified personnel under the direction of a licensed engineer.

The existing structures present within the footprint of the proposed building should be demolished and associated foundations or any existing utilities located within the proposed structure footprint or within the influence of proposed foundations must be completely removed and the resulting excavations backfilled with engineered fill. Utilities to be abandoned that lie outside the building and zone of influence of proposed foundations can be abandoned in place by backfilled completely with grout.

At the start of the earthwork operations, any topsoil, vegetation, trees, and concrete pavement, must be completely removed in their entirety from within the footprint of the proposed building. Following removal of the surficial topsoil, vegetation, and pavement and prior to placement of engineered fill, the

exposed cohesive subgrade should be proof rolled with a fully loaded dump truck and evaluated for stability by a qualified geotechnical engineer. Any areas that are unstable should be undercut to stable ground and backfilled with engineered fill.

Engineered fill should be free of organic matter, frozen soil, clods, or other harmful material. Frozen material should not be used as fill, nor should fill be placed on a frozen subgrade. Engineered fill should be placed in uniform horizontal layers, not more than 9 inches in loose thickness. The engineered fill should be compacted to achieve a density of at least 95 percent of the maximum dry density as determined by the Modified Proctor compaction test (ASTM D 1557). Any cohesive engineered fill material should be placed and compacted at moisture contents within 3 percent above and 1 percent below the moisture content. Any granular engineered fill material should be placed and compacted at moisture contents within 2 percent above or below the optimum moisture content.

We recommend using an imported granular engineered fill within confined areas such as adjacent to foundation walls or utility trenches. Granular engineered fill is generally more easily compacted than cohesive soils within these confined areas. Additionally, the proper placement and compaction of backfill within these areas is imperative to provide adequate support for overlying floor slabs.

FOUNDATION RECOMMENDATIONS

The existing silty clay fill present within the upper 3 feet within boring SB-2 is not suitable for support of building. Therefore, we recommend building foundations extend through the existing silty clay fill, where encountered, and bear within the stiff to very stiff native silty clay. We recommend the proposed structure be supported on shallow foundations and bear within the existing stiff to very stiff native silty clay soils. Foundations for the proposed building bearing within the native cohesive soils or engineered fill placed over native soils within demolition excavation can be designed for a net allowable bearing capacity of 3,000 psf.

Continuous wall or strip footings constructed should be at least 12 inches in width and isolated spread footings should be at least 30 inches in their least dimension. To achieve a change in the level of a strip footing, the footing should be gradually stepped at a grade no steeper than two units horizontal to one unit vertical. If required to construct foundation at different levels, adjacent spread footings should be designed and constructed so the least lateral distance between them is equivalent to or more than the difference in their bearing levels. We recommend all strip and spread footings be suitably reinforced to minimize the effects of differential settlements associated with local variations in subsoil conditions.

Exterior footings should bear at a minimum depth of 3-1/2 feet below finished grade for protection against frost heave. Interior foundations can bear at shallower depths provided they are protected from frost during construction and suitable bearing soils are present. We recommend a G2 engineer be on site during construction to observe the excavations, measure the bearing depths, observe foundation installation, and verify the adequacy of the bearing soils.

If the recommendations outlined in this report are adhered to, total and differential settlements for the completed structures should be within 1 inch and 1/2 inch, respectively. We expect settlements of these magnitudes are within tolerable limits for the type of structures proposed.

FLOOR SLAB RECOMMENDATIONS

Up to approximately 3 feet of silty clay fill with an organic matter content of 3.8 is present within soil boring SB-2 performed within the footprint of the proposed building. Provided the potential for settlement of the floor slab can be tolerated, we anticipate the existing fill soils and engineered fill used to raise site grades can be utilized for support of the building floor slab. A subgrade modulus (k) of up to 90 pounds per cubic inch (pci) may be used in the design of floor slab supported on the silty clay fill and engineered fill to raise site grades.

If the potential for settlement cannot be tolerated, the existing silty clay fill must be completed removed within the building footprint and a minimum of 5 feet beyond to the underlying native stiff to very stiff silty clay soils and replaced with engineered fill. Floor slabs supported on the engineered fill placed on native soils can be designed based on a subgrade modulus of 150 pci. We recommend the concrete floor slab be suitably reinforced and separated from the foundation system to allow for independent movement.

We recommend at least 4 inches of clean coarse sand or pea gravel be placed between the subgrade and the bottom of the floor slab for use as a capillary break. If greater protection against vapor transmission is desired, a vapor barrier consisting of 10-mil plastic sheeting, or equivalent, may be placed on top of the granular subbase directly below the floor slab.

CONSTRUCTION CONSIDERATIONS

We expect foundation excavations will extend to a minimum of 3-1/2 feet below final grades. No measurable groundwater was observed within the borings during drilling operations. Therefore, we anticipate construction excavations will generally be performed in the dry. However, we anticipate any groundwater or surface water runoff accumulations can be controlled with pumping from properly constructed sumps.

We anticipate foundations can be excavated neat within the existing cohesive soils. However, the contractor should be prepared to over excavate and form the foundations if caving or sloughing soils are encountered. The sides of spread and/or strip footings must be constructed straight and vertical to reduce the risk of frozen soil adhering to the concrete and raising the foundations. All excavations should be backfilled with engineered fill when supporting overlying structures such as floor slabs.

Where excavations extend below a depth of 5 feet and are to be entered by a human, we recommend a maximum slope of one horizontal unit to one vertical unit (1H:1V) within the stiff cohesive soils, and 3/4H:1V within the very stiff to hard cohesive soils in dry conditions. Where seepage from excavation cuts is observed, the slopes must be flattened sufficiently to achieve stability, but in no case left steeper that 3H:1V at and below the seepage level. If the temporary construction slopes are to be maintained during the rainy season, berms are suggested along the tops of the embankments to prevent runoff water from entering the excavation and eroding the slope faces. The soils exposed in slope faces should be inspected by qualified personnel so modifications of the slopes can be made if variations in the soil or water conditions occur. If sufficient space for open cut consideration is not available trench box shoring may be used.

All excavations should be safely sheeted, shored, sloped, or braced in accordance with MI-OSHA requirements. If material is stored or equipment is operated near an excavation, stronger shoring must be used to resist the extra pressure due to the superimposed loads.

GENERAL COMMENTS

We have formulated the evaluations and recommendations presented in this report relative to site preparation and foundations on the basis of data provided to us relating to the project location, type of structure, and anticipated surface grades for the proposed development. Once proposed grades and loading conditions have been determined, G2 must be notified so we can review the recommendations presented within our report. Any significant changes in scope to this project should be brought to our attention for review and evaluation with respect to the prevailing subsurface conditions.

The scope of the present investigation was limited to evaluation of subsurface conditions for the support of the building foundations and other related aspects of the development. No chemical, environmental, or hydrogeological testing or analyses were included in the scope of this investigation. If changes occur in the design, location, or concept of the project, the conclusions and recommendations contained in

this report are not valid unless G2 Consulting Group, LLC reviews the changes. G2 Consulting Group, LLC will then confirm the recommendations presented herein or make changes in writing.

We have based the analyses and recommendations submitted in this report upon the data from soil borings performed at the approximate locations shown on the Soil Boring Location Plan, Plate No. 1. This report does not reflect variations that may occur between the actual boring locations and the actual structure locations. The nature and extent of any such variations may not become clear until the time of construction. If significant variations then become evident, it may be necessary for us to re-evaluate our report recommendations.

Soil conditions at the site could vary from those generalized on the basis of soil borings made at specific locations. It is, therefore, recommended that G2 Consulting Group, LLC be retained to provide soil engineering services during site preparation, excavation, and foundation construction phases of the proposed project. This is to observe compliance with the design concepts, specifications, and recommendations. Also, this allows design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction.

APPENDIX

Legend

Soil Borings performed by 2G Drilling on March 21, 2025

Soil Boring Location Plan

Proposed Martin Road Park Service Building
1615 E. Lewiston Avenue
Ferndale, Michigan 48220

2G CONSULTING GROUP

Project No. 250182	
Drawn by: JMH	
Date: 4/2/25	Plate No. 1
Scale: NTS	

Project Name: Proposed Martin Road Park Service Building

Project Location: 1615 E. Lewiston Avenue
Ferndale, Michigan 48220

G2 Project No. 250182

Latitude: N/A Longitude: N/A

Soil Boring No. SB-1

CONSULTING GROUP

SUBSURFACE PROFILE

SOIL SAMPLE DATA

DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (12 inches) 1.0							
		Fill: Stiff Dark Brown Silty Clay with trace sand, gravel, and organic matter (Organic Matter Content = 3.8%) 3.0		S-1	3 2 2	4	24.8		3000*
5		Stiff Mottled Brown and Gray Silty Clay with trace sand and gravel	5	S-2	2 3 6	9	25.6	94	3270
		5.5		S-3	6 11 17	28	15.2		9000*
		Hard Brown Silty Clay with trace sand and gravel 8.0							
10			10	S-4	8 10 14	24	18.5		8000*
15		Very Stiff to Hard Gray Silty Clay with trace sand and gravel	15	S-5	6 8 11	19	12.8		7000*
20		20.0	20	S-6	10 11 11	22	13.5		6000*
25		End of Boring @ 20 ft	25						

Total Depth: 20 ft
Drilling Date: March 21, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Torres

Drilling Method:
3-1/4 inch inside diameter hollow stem augers

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
Borehole collapsed at 17 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 1

SOIL / PAVEMENT BORING 250182.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 4/2/25

Project Name: Proposed Martin Road Park Service Building

Project Location: 1615 E. Lewiston Avenue
Ferndale, Michigan 48220

G2 Project No. 250182

Latitude: N/A Longitude: N/A

Soil Boring No. SB-2

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (12 inches) 1.0							
		Stiff to Very Stiff Brown and Gray Silty Clay with trace sand and gravel, frequent sand partings		S-1	5 5 6	11	18.9		3000*
5			5	S-2	5 5 7	12	22.4	103	4400
		5.5							
		Hard Brown Silty Clay with trace sand and gravel		S-3	11 17 21	38	17.1		9000*
10			10	S-4	13 15 26	41	15.8		9000*
		10.5							
		Hard Gray Silty Clay with trace sand and gravel		S-5	9 16 19	35	12.9		9000*
15			15						
				S-6	10 13 18	31	11.5		9000*
20		20.0	20						
		End of Boring @ 20 ft							
25			25						

Total Depth: 20 ft
Drilling Date: March 21, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Torres

Drilling Method:
3-1/4 inch inside diameter hollow stem augers

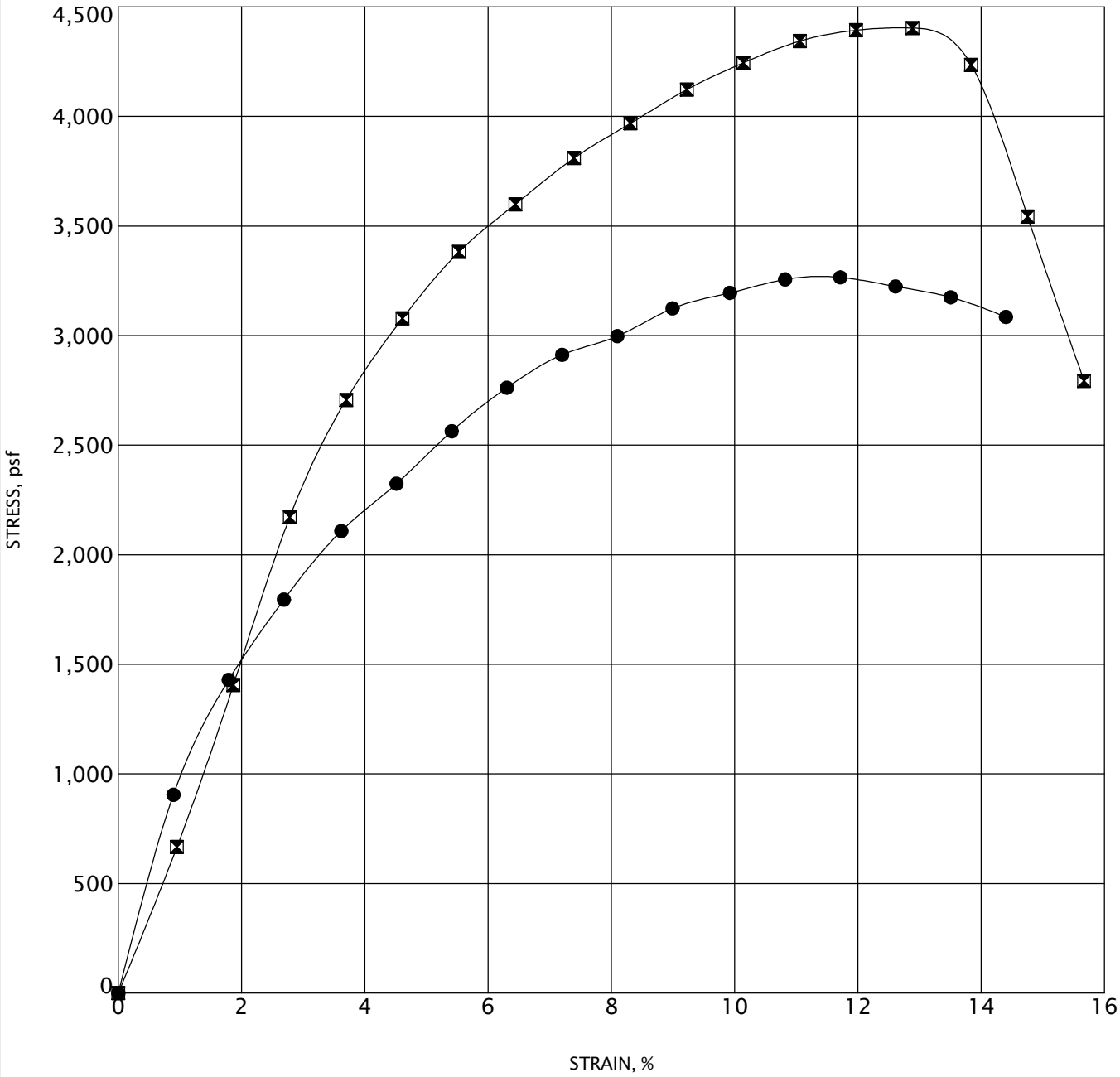
Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
Borehole collapsed at 17 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 2

SOIL / PAVEMENT BORING 250182.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 4/2/25



Specimen			Classification	MC%	γ_d	UC
●	SB-1	S-2	Brown and Gray Silty Clay	26	94	3270
⊠	SB-2	S-2	Brown and Gray Silty Clay	22	103	4400

CONSULTING GROUP

UNCONFINED COMPRESSIVE STRENGTH TEST

Project Name: Proposed Martin Road Park Service Building

Project Location: 1615 E. Lewiston Avenue
Ferndale, Michigan 48220

G2 Project No.: 250182

Figure No. 3

US_UNCONFINED 250182.GPJ 20140820 G2 CONSULTING DATA TEMPLATE.GDT 4/2/25

CONSULTING GROUP

GENERAL NOTES TERMINOLOGY

Unless otherwise noted, all terms herein refer to the Standard Definitions presented in ASTM D 653.

PARTICLE SIZE

Boulders		- greater than 12 inches
Cobbles		- 3 inches to 12 inches
Gravel	- Coarse	- 3/4 inches to 3 inches
	- Fine	- No. 4 to 3/4 inches
Sand	- Coarse	- No. 10 to No. 4
	- Medium	- No. 40 to No. 10
	- Fine	- No. 200 to No. 40
Silt		- 0.005mm to 0.074mm
Clay		- Less than 0.005mm

CLASSIFICATION

The major soil constituent is the principal noun, i.e. clay, silt, sand, gravel. The second major soil constituent and other minor constituents are reported as follows:

Second Major Constituent (percent by weight)	Minor Constituent (percent by weight)
Trace - 1 to 12%	Trace - 1 to 12%
Adjective - 12 to 35%	Little - 12 to 23%
And - over 35%	Some - 23 to 33%

COHESIVE SOILS

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modifier, i.e. sandy clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohesionless soils, i.e. silty clay, trace sand, little gravel.

Consistency	Unconfined Compressive Strength (psf)	Approximate Range of (N)
Very Soft	Below 500	0 - 2
Soft	500 - 1,000	3 - 4
Medium	1,000 - 2,000	5 - 8
Stiff	2,000 - 4,000	9 - 15
Very Stiff	4,000 - 8,000	16 - 30
Hard	8,000 - 16,000	31 - 50
Very Hard	Over 16,000	Over 50

Consistency of cohesive soils is based upon an evaluation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

COHESIONLESS SOILS

Density Classification	Relative Density %	Approximate Range of (N)
Very Loose	0 - 15	0 - 4
Loose	16 - 35	5 - 10
Medium Compact	36 - 65	11 - 30
Compact	66 - 85	31 - 50
Very Compact	86 - 100	Over 50

Relative Density of cohesionless soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

SAMPLE DESIGNATIONS

AS - Auger Sample – Cuttings directly from auger flight
BS - Bottle or Bag Samples
S - Split Spoon Sample - ASTM D 1586
LS - Liner Sample with liner insert 3 inches in length
ST - Shelby Tube sample - 3 inch diameter unless otherwise noted
PS - Piston Sample - 3 inch diameter unless otherwise noted
RC - Rock Core - NX core unless otherwise noted

STANDARD PENETRATION TEST (ASTM D 1586) - A 2.0 inch outside-diameter, 1-3/8 inch inside-diameter split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).

SECTION 00 4100 - BID FORM

CONTRACT:GENERAL CONTRACT

PROJECT: Martin Road Park Service Building

Ferndale, Michigan 48220

BIDDER:

COMPANY NAME:_____

ADDRESS: _____

TELEPHONE (_____) _____

CONTACT _____

TO:

City Clerk's Office

RE: Request for Proposals Martin Road Park Service Building

300 E. Nine Mile Road

Ferndale, MI 48220

BID FOR:

General Contract

Martin Road Park Service Building

LUMP SUM BASE BID

The Undersigned, having familiarized itself with all local conditions to be encountered affecting the cost of the work and having examined the Contract Documents does hereby propose to enter into an agreement with the Owner to provide all of the labor, materials, tools, equipment, and services necessary to complete the General Trades Contract Work for Martin Road Park Service Building all in accordance with the Contract Documents dated _____, 20____.

For the Lump Sum Base Bid price of:

_____ Dollars ($ _____)

The amount shown above shall be both in words and in figures. In case of discrepancy, the amount shown in words shall govern.

Said Lump Sum Base Bid price to be subject to all of the terms and conditions of the Contract Documents..

The Undersigned affirms the bid is based upon the materials and construction, equipment, etc., named or described in the drawings or in the specifications unless otherwise indicated under "Exceptions to Documents".

TAXES

The Undersigned affirms all Federal, State and Local taxes of whatever character and description are included in the Lump Sum Base Bid price.

PERMITS AND FEES

The Undersigned affirms all costs for all permits and fees, including the General Building Permit, required by authorities having jurisdiction are included in the Lump Sum Base Bid price.

ALTERNATE PRICES

The Undersigned submits for consideration by the Owner, the following Alternate Prices. If the Alternate Price is accepted by the Owner, the variation becomes part of the Contract and the amount quoted is added to or deducted from the Lump Sum Base Bid Price.

Refer to Section 01 2300 - Alternates, for additional requirements.

Alternate No. 1

Provide electrical power and lighting for Owner's prefabricated pavilion. Coordinate installation of electrical with Owners vendor. Coordinate installation of electrical with Owner's pavilion vendor. Coordinate with Owner and Owner's vendor for installation of pavilion. Refer to Electrical documents for additional information.

Add $ _____

Alternate No. 2

Provide 6 inch deep circular concrete sidewalk and connection to pavilion (Alternate No. 1), including all excavation and sub base work. Refer to Drawings and Specification sections for location and configuration.

Add $ _____

Alternate No. 3

Remove Panelboard RP-K from project scope. All devices currently circuited to RP-K shall be re-circuited to LP-BB. Maintain same type of circuit breakers for each device as originally specified for RP-K. Refer to Electrical Documents for additional information.

Deduct $ _____

SEPARATE PRICES

The Undersigned offers such separate prices listed below as an advisory price to the Owner for accounting purposes.

Separate prices shall be part of (and included in) the Lump Sum Base Bid Price.

Each separate price shall include all costs of incorporating the separate price materials and/or workmanship into the Project, including the cost of coordination and supervision, General and Supplementary Conditions, and all other incidental items.

Number	Description	Write in separate price below
Separate Price No.1	Demolition and Earthwork/Site Prep	
Separate Price No. 2	Building Construction	
Separate Price No. 3	Access Pathway/Paving	
Separate Price No. 4	Utilities	
Separate Price No. 5	Landscaping/Site Restoration	
Separate Price No. 6	Signage	

BID SECURITY

Accompanying this Bid is a / Certified Check / Money Order / Bid Bond / payable to the Owner, in the amount of 5 percent of the Lump Sum Base Bid:

_____ Dollars ($ _____).

The amount shown above shall be both in words and in figures. In case of discrepancy, the amount shown in words shall govern.

PERFORMANCE AND PAYMENT BOND

Deliver to the Owner, within 15 calendar days after Notice of Award , the executed Performance and Payment Bonds, in an amount equal to 100% of the Lump Sum Base Bid Price, naming the Owner, in accordance with the General and Supplementary Conditions.

The Undersigned affirms that the cost of said Bonds is $ _____ and is included in the Lump Sum Base Bid Price.

The submittal form for the Performance and Payment Bonds shall be A.I.A. Form A312 or similar form acceptable to the Owner.

ADDENDA

The Undersigned acknowledges the following Addenda, covering revisions to the Contract Documents, and the cost, if any, of such revisions has been included in the quoted Lump Sum Base Bid proposal:

Addendum No. _____Dated _____
Addendum No. _____Dated _____
Addendum No. _____Dated _____

CONTRACTOR AND MAJOR SUBCONTRACTOR BREAKDOWN

The Undersigned submits the following list of major Subcontractors for the work of this Project in accordance with the General Conditions, and attests these will be the Subcontractors performing the work under the following list of trades and work categories. The list shall include the full name of the firm. The Undersigned attests that no Subcontractor shall be substituted for one listed herein, except by written approval of the Owner.

The Owner reserves the right to reject any and all Subcontractors prior to award of Contract.

Trade or Work Category	Proposed Sub-Contractor
Contract Conditions and General Requirements	
General Trades Work, excluding below:	
Site Work, including Excavation Work	
Foundation Work	
Unit Masonry Work	
Structural Steel and Metal Deck Work	
Manufactured Wall Panels	
Preformed Metal Siding	
Roofing	
Glass and Glazing	
Mechanical Trades Work	
Plumbing	
HVAC	
Electrical Trades Work	

LOCAL BUSINESS /UNION PARTICIPATION

The City of Ferndale shall procure goods and services by competitive bidding and preferences shall be granted to Ferndale businesses and/or Union businesses whenever feasible.

Is your business located in the City of Ferndale? (Please check one)

_____YES _____ NO

Does your Business employ union workers (Please check one)

_____YES _____ NO

If Yes, please state Union and Local _____

REFERENCES

Contractor shall provide three recent references for work performed similar in nature to the proposed work. Contractors bidding this project shall have a minimum of ten (10) years of experience in construction projects of this size, scope and complexity. Bidder may submit on separate form.

1	Municipality	Contact person	Phone Number	Type and amount of work
2				
3				
4				

CHANGES IN THE WORK

For authorized changes in the work, involving additions to or omissions from the work, the Undersigned agrees to perform or omit, or to cause to be performed or omitted by his Sub-Bidder's, such authorized work at net cost to him, plus the following percentages to be added to the cost or credit to the Owner.

Such fees shall constitute the full compensation payable to the Contractor and shall include all the Contractor's cost for on-site superintendence, supervision, overhead and profit. Charges for taxes, social security payments and insurance shall be computed separately and shall not be subject to percentage fee.

Additions/Omissions

Work performed by Bidder's own forces; maximum 15 % for additions.

Additions		Omissions	
	%		%

Work performed by Sub-Bidders own forces; maximum 15 % for additions.

Additions		Omissions	
	%		%

Sub-Bidder's percentage fees for Contract Modification's shall be as follows:

Work performed by Sub-Bidders own forces; maximum 15 % for additions.

Additions		Omissions	
	%		%

The Undersigned agrees the percentage fee the Sub-Bidder adds or deletes for its work shall not exceed the amount indicated above.

Maximum difference of percentage fee stated above between Additions and Omissions shall be 5 percent.

TIME OF COMPLETION

The Undersigned agrees, if awarded the Contract, to complete the whole of work within _____ consecutive calendar days from the date of the notice to proceed, in accordance with requirements of the General Conditions.

SUBSTITUTIONS

The Undersigned submits for consideration of the Owner and/or the Architect the following Substitutions. Each item being offered is a substitute for the referenced specified item used in compiling the Lump Sum Base Bid price. Each addition and/or deduction in price shall have been computed in conformance with the requirements of the General Conditions.

The additions/deductions in price are separate from, and are not part of the Lump Sum Base Bid price.

Substitutions shall be accepted by the Owner 10 working days prior to Bid Due Date.

Refer to Section 00 4325 - Substitution Request Form - During Procurement.

Proposed Item	Proposed Substitution	ADD	DEDUCT
_____	_____	$ _____	$ _____

_____	_____	$ _____	$ _____
_____	_____	$ _____	$ _____
_____	_____	$ _____	$ _____

EXCEPTIONS TO DOCUMENTS

State whether any exceptions to the drawings and specifications are taken. Include a brief explanation of each item. Quote an addition or deduction for each item. If no exceptions are submitted, it will be understood that the Proposal conforms to the specifications. (Bidder may attach other sheets as required.)

BID TO REMAIN FIRM

The Lump Sum Base Bid Price stated in this Bid Form is guaranteed for a period of not less than 90 calendar days from the date hereof, and if authorized to proceed within that period, the Undersigned agrees to complete the Work covered by this Bid Form at the said Lump Sum Base Bid Price and as may be adjusted on the basis of finalized quantities and Unit Prices.

ACCEPTANCE AND CONTRACT

The Undersigned has carefully examined the Bidding and Contract Documents, including the Instructions to Bidders, General Conditions and Supplementary General Conditions, Drawings, Specifications and any and all Addenda issued, and agrees to be bound by all requirements thereof in the submission of this Bid, and in the performance of the Contract, if awarded the Contract based on this Bid.

Terms used in this Bid which are defined in the General Conditions or Instructions will have the meanings indicated in the General Conditions or Instructions.

AGREEMENT

The Undersigned agrees to execute a Contract with the Owner within 15 calendar days after Notice of Award.

The Undersigned affirms he is familiar with all Federal, State, and Local laws and regulations governing this Project.

EXECUTION OF CONTRACT

The Undersigned agrees:

The Owner reserves the right to reject any and all Bids, to waive any irregularities, and to award the Contract with whomever it may elect.

To enter into a formal Contract with the Owner for the performance of the awarded Work. Failure to enter into a formal Contract with the Owner, if selected, will result in forfeiture of Bid Security.

To furnish to the Owner immediately after award, Certificates of Insurance as required by the General and Supplementary Conditions.

SUBCONTRACTORS AND SUPPLIERS

The Owner reserves the right to reject any Subcontractor, Sub-subcontractor or Supplier for any reason during Bid Review and Contract Negotiation. Upon notice, the General Contractor shall remove the rejected entity and procure the services of the next highest bidder. The Owner shall adjust the General Contractor's bid accordingly. The revised General Contractor's bid shall be used in determining low bid.

ADDRESS, LEGAL STATUS, AND SIGNATURE OF BIDDER

The Undersigned does hereby designate the address given below as the legal address to which all notices, directions, or other communications may be served or mailed:

Street

_____

City _____ State _____ Zip Code _____

The Undersigned declares it has the legal status checked below:

_____ Individual
_____ Co-Partnership
_____ Corporation

State of Incorporation:

_____

States in which licensed to do business: _____

_____

This Bid Form is submitted in the name of:

_____
(Name of Bidder)

_____
(Signature of person authorized to sign contracts for Bidder)
Title _____

Signed this _____ day of _____, 20____ .

END OF DOCUMENT

SECTION 00 4325 - SUBSTITUTION PROCEDURES DURING BIDDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Administrative and procedural requirements for handling requests for substitutions made prior to bid.

1.02 DEFINITIONS

A. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.

B. Substitutions: Any product proposed by Contractor which does not meet requirements of the Contract Documents, whether in product characteristics, performance, quality, or manufacturer or brand names.

C. Base and Optional Manufacturers: Acceptable manufacturers are often listed in Part 2 of a specification section. A particular manufacturer and product are often listed as a “Design Standard”.
   1. The “Design Standard” is the manufacturer of the specific product used as the basis for design.
   2. The other manufacturers listed are “Optional” manufacturers, and manufacture a product similar to the specific product used as the design basis. Listing of a manufacturer indicates acceptance of that manufacturer as a supplier of the product, without a substitution, but only if the “optional” manufacturer’s product complies with the specified requirements, including the salient qualities provided by the “Design Standard” manufacturer’s product. Salient qualities include, but are not necessarily limited to the following:
      a. Purpose and function.
      b. Material and finish.
      c. Strength, durability and other applicable physical properties.
      d. Compatibility and performance attributes for the indicated application.
      e. Capacity and operating characteristics, where applicable.
      f. Size and configuration to the extent required for fit with adjoining and adjacent conditions and within spatial limitations.
      g. Appearance, including exposed dimensions, profile, texture, pattern and color, where visible to personnel in a finished space or from the exterior.
   3. The Contractor is responsible for costs to provide any dimensional, structural, utility and other related adjustments required to fit an “Optional” manufacturer’s product into the Work.

1.03 PRODUCT SELECTION - GENERAL

A. Certain types of products are described in Project Manual by means of trade names, catalog numbers and/or manufacturer's names. This is not intended to exclude from consideration other products which may be capable of accomplishing purpose indicated.

B. Other types of products may be considered acceptable to Owner and Architect in place of those specified.

C. Listing of a manufacturer implies acceptance of them only as supplier of a product which complies with specified item.

D. No substitution permitted after execution of Contract.

E. Conditional bids and voluntary alternates will not be considered.

1.04 REQUESTS FOR SUBSTITUTION

A. Only written requests with complete data for evaluation will be considered.
   1. Request must be received 10 working days prior to Bid Due Date

2. Requests received after the above time and date will not be considered.
3. Submit evaluation data with attached form to Architect.
4. Specifier: Select; supplier submits substitution or supplier submits substitution through Contractor.

B. A request for substitution constitutes a representation that the Contractor:
1. Has personally investigated proposed product or method, and have determined that it is equal or superior in all respects to that specified, and that it will perform intended function.
2. Will provide same warranty for substitute item as for product or method specified.
3. Will coordinate installation of accepted substitution into Work, to include building modifications if necessary, making such changes as may be required for Work to be complete in all respects.
4. Certify cost data presented is complete and includes all related cost except any redesign cost of Architect.
5. Waive all claims for additional costs or time related to substitution which subsequently become apparent or caused by substitution.
6. Will pay all Architect redesign cost and other costs caused by substitution.
7. Proposed substitution is in full compliance with applicable code requirements.
8. Acknowledge acceptance of these provisions in request.

C. For bidding purposes; base all bids on materials, equipment and procedures specified or approved by Addenda.

D. Addenda listing approved substitutions will be published.

E. No verbal or written approvals other than by Addenda will be valid.

F. Contractor sign request in space provided on form acknowledging it's acceptance of terms.

1.05 SUBSTITUTION PRIOR TO BIDDING REQUEST

A. Submit complete data substantiating compliance of proposed substitution with Contract Documents.

B. For products:
1. Product identification, including manufacturer's name.
2. Manufacturer's literature, marked to indicate specific model, type, size, and options to be considered:
a. Product description.
b. Performance and test data.
c. Reference standards.
d. Difference in power demand, air quantities, etc.
e. Dimensional differences from specified unit.
3. Full size samples if requested.
4. Architect reserves right to retain sample until physical units are installed on project for comparison purposes.
5. Requester pay all costs associated with furnishing and return of samples.
6. Architect is not responsible for loss of, or damage to, samples.
7. Name and address of at least 5 similar projects and name of Owner's representative Architect can contact; to discuss product, installation, and field performance data.

C. For construction methods:
1. Detailed description of proposed method.
2. Illustrate with drawings.

D. Itemized comparison of proposed substitute to specified item; indicate variations.

E. Effect and changes required on separate or other contracts.

F. Coordination information necessary to accommodate the proposed substitute. Include a list of changes or modifications needed to other parts of the Work and to construction performed by separate contractors.

G. Complete breakdown of costs, of proposed substitution which shall include additional costs and saving generated by proposed substitution and shall indicate amount, if any, to be deducted from Contract Sum if proposed substitution is accepted.

H. Availability of maintenance and repair services, and sources of repair or replacement items.

1.06 REJECTION OF SUBSTITUTIONS

A. Substitutions will not be considered if:
1. They are not submitted in accord with this document.
2. Acceptance will require substantial revision of Contract Documents, or building spaces.
3. Request for substitution does not indicate specific item for which request is submitted.
4. Request form is not properly executed.
5. Acceptance of manufacturer only will not be made.
6. Insufficient information submitted.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF DOCUMENT

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SECTION 00 5200 - AGREEMENT FORM

PART 1 GENERAL

FORM OF AGREEMENT

THE AGREEMENT TO BE EXECUTED IS ATTACHED FOLLOWING THIS PAGE.

1.01 RELATED REQUIREMENTS

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 00 7200 - GENERAL CONDITIONS

FORM OF GENERAL CONDITIONS

THE GENERAL CONDITIONS APPLICABLE TO THIS CONTRACT IS ATTACHED FOLLOWING THIS PAGE.

SUPPLEMENTARY CONDITIONS

REFER TO DOCUMENT 00 7300 - SUPPLEMENTARY CONDITIONS FOR AMENDMENTS TO THESE GENERAL CONDITIONS.

END OF SECTION

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SECTION 00 7300 - SUPPLEMENTARY CONDITIONS

PART 1 GENERAL

1.01 SUMMARY

A. These Supplementary Conditions amend and supplement the General Conditions defined in Document 00 7200 - General Conditions and other provisions of Contract Documents as indicated below. Provisions that are not so amended or supplemented remain in full force and effect.

B. The terms used in these Supplementary Conditions that are defined in the General Conditions have the meanings assigned to them in the General Conditions.

1.02 MODIFICATIONS TO GENERAL CONDITIONS

A. 11.1 Contractor's Insurance and Bonds

11.1.1 In the fourth line following the words "in the jurisdiction in which the Project is located", insert the words "..., and satisfactory to the Owner."

B. Article 11.1.1 is supplemented and amended as follows:

1. Worker's Compensation insurance including Employer's Liability to cover employee injuries or disease compensable under the Worker's Compensation Statutes of the states in which work is conducted under this contract; disability benefit laws, if any; or Federal compensation acts such as U.S. Longshoremen or Harbor Worker's, Maritime Employment, or Railroad Compensation Act(s), if applicable. Self-insurance plans approved by the regulatory authorities in the state in which work on this project is performed are acceptable.
2. Business Auto Liability (including owned, non-owned and hired vehicles). Include an endorsement for employer's non-ownership liability coverage and for hired vehicles coverage. Further, provide insurance coverage for liability to the public for loss resulting from injury and/or death caused by ownership, maintenance, or use of non-registered vehicles:
3. Comprehensive Automobile Liability policy to cover bodily injury and property damage arising out of the ownership, maintenance or use of any motor vehicle, including owned, non-owned and hired vehicles. In light of standard policy provisions concerning (a) loading and unloading and (b) definitions pertaining to motor vehicles licensed for road use vs. unlicensed or self-propelled construction equipment, it is strongly recommended that the Comprehensive General Liability and the Comprehensive Auto Liability be written by the same insurance carrier, though not necessarily in one policy.
4. The Contractor will purchase for the Owner an Owner's Protective Liability policy to protect the Owner, the Architect, their consultants, agents, employees, and such public corporations in whose jurisdiction the work is located for their contingent liability for work performed by the Contractor, the Subcontractor(s) or the Sub-subcontractor(s) under this contract.
5. The Contractor shall purchase a Builder's Risk-Installation Floater in a form acceptable to the Owner covering property of the project for full cost of replacement as of the time of any loss which shall include, as named insured's, (a) the Contractor, (b) all Subcontractors, (c) all Sub-subcontractors, (d) the Owner, the Engineer(s) or Architect(s), and their respective interests may provide to be at the time of loss, covering insurable property which is the subject of this contract, whether in place, stored at the job site, stored elsewhere, or in transit at the risk of the insured(s). Coverage shall be effected on an "ALL RISK" form including, but not limited to, the perils of fire, wind, vandalism, collapse, theft and earthquake, with exclusions normal to cover.
    a. The contractor may arrange for such deductibles as he deems to be within his ability to self-assume, but he will be held solely responsible for the amount of such deductible and for any co-insurance penalties. Any insured loss shall be adjusted with the Owner and the Contractor and paid to the Owner and Contractor as Trustee for the other insured's.

6. Umbrella or Excess Liability: The Owner or its representative may, for certain projects, require limits higher than those stated. The Contractor is granted the option of arranging coverage under a single policy for the full limit required or by a combination of underlying policies with the balance provided by an Excess or Umbrella Liability policy equal to the total limit(s) requested. Umbrella or Excess policy wording shall be at least as broad as the primary or underlying policy (ies) and shall apply both to the contractor's general liability and to his automobile liability insurance.
7. Limits of Liability
   a. Workers Compensation:
      Coverage A - Compensation: $500,000.00
      Coverage B - Employer's Liability: $500,000.00
   b. Business Auto Liability (including owned, non-owned and hired vehicles). Include an endorsement for employer's non-ownership liability coverage and for hired vehicles coverage. Further, provide insurance coverage for liability to the public for loss resulting from injury and/or death caused by ownership, maintenance, or use of non-registered vehicles:
      Bodily Injury: $1,000,000.00 Each occurrence
      Property Damage: $500,000.00 Each occurrence
      Combined Single Limit: $1,000,000.00 each occurance
   c. Comprehensive Auto Liability
      Bodily Injury: $1,000,000.00 Each Occurrence
      Property Damage: $500,000.00 Each Occurrence
      Combined Single Limit: $1,000,000.00 Each Occurrence.
   d. Owner's Protective Liability
      Bodily Injury: $1,000,000.00 each occurrence
      Property Damage: $500,000.00 Each Occurrence
      Property Damage: $500,000.00 Aggregate
      Combined Single Limit: $1,000,000.00 Each Occurrence.
   e. Umbrella or Excess Liability: $1,000,000.00
   f. Provide policies that are endorsed to provide that at least 30 days written notice shall be given to the Owner and Architect of cancellation or Intent not to Renew.
   g. Evidence of Coverage
      1) Prior to commencement of the Work, the Contractor shall furnish one copy each of Certificate of Insurance herein required for each copy of the Agreement which shall specifically set forth evidence of all coverage required. The form of the Certificates shall be AIA Document G705, Certificate of Insurance. The Contractor shall furnish to the Owner copies of all endorsements that are subsequently issued amending coverage or limits. The Owner reserves the right to request complete copies of policies it deemed necessary to ascertain details of coverage not provided by the certificates. Such policy copies shall be "Originally Signed Copies" and so designated.
   h. Umbrella or Excess Liability
      1) Insurance required for the Contractor shall include the following as additional insured:
         (a) City of Ferndale, its employees, its City Council and individual members thereof, agents and/or authorized representatives for the City.
         (b) Neumann/Smith Architecture and their consultants, agents, employees and/or authorized representatives.
   i. Qualification of Insurers

1) In order to determine financial strength and reputation of insurance carriers, all companies providing the coverage required shall be licensed or approved by the Insurance Bureau of the State of Michigan and shall have a financial rating not lower than X1 and a policyholder's service rating no lower than B+ as listed in A.M. Best's Key Rating Guide, current edition. Companies with ratings lower than B+:X1 will be acceptable only upon written consent of the Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 1100 - SUMMARY OF WORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 PROJECT

A. The City of Ferndale intends to demolish an existing restroom and storage building and construct a new concessions/service building at Martin Road Park in Ferndale, Michigan. The project includes building construction and associated site work, including but not limited to utilities, concrete, accessibility improvements, and other related improvements necessary for a fully functional facility.

B. This project is funded in part by Michigan Department of Natural Resources (MDNR) SPARK, MDNR Land and Water Conservation Fund (LWCF), and HUD grant funds and will be bid and constructed in accordance with all applicable local, state, and federal requirements, including any grant-related compliance obligations.

C. This project is subject to the Davis-Bacon Act and the Contract Work Hours and Safety Standards Act. Contractors must pay prevailing wages in accordance with U.S. Department of Labor wage determinations. The Owner will bid, monitor, and inspect the Construction Work.

D. All construction shall be phased so as to maintain Owner’s operations. Refer to the Owner's bidding information for additional descriptions and requirements.

E. The Work is being issued by the Architect to the Owner and Contractor in a single General Contract Package.

F. Owner will be employing a testing agency to perform whole building air leakage testing required by energy code.

1.03 CONTRACTS

A. The Owner will solicit lump-sum proposals for the Work. The extent of work shall be fully described by the Contract Documents. Refer to the Owner’s bidding information for additional descriptions and requirements.

B. Work for the complete construction of the Project will be under a single General Contract awarded by the Owner.
   1. The successful General Contractor will manage the construction of the Project and assume responsibility for coordination, phasing, and monitoring of the Work.

C. Important Notice to all Bidders and Contractors:
   1. The “Contract Documents”, as defined in the General Conditions, include “The Drawings”. Although Drawings are grouped and identified by classification of Work, the Contractor shall be responsible for his work as specified herein and as indicated on the Drawings.
   2. Contractors are also advised they are responsible for all Work shown in any of the documents and they must execute the Work of their trade on all drawings, not just the trade specific drawings.
      a. Hence all architectural, structural, mechanical, plumbing, fire protection, electrical controls or security electronics work is not necessarily shown on the drawings which depict that specialty or particular area of work (i.e., plumbing may be on architectural drawings, etc.).
      b. This means all contractors or subcontractors of any tier, are responsible for all work specified or shown anywhere in the drawings and no additional monies will be allowed for work shown anywhere within the Contract Documents.
   3. Contractors are further advised they are to provide complete and functional systems wherever it is reasonably inferable that the drawing or specification INTENDS to depict the same.

a. Example: A lavatory in a bathroom which is shown on the architectural drawings shall be plumbed for hot and cold domestic water and drain waste even if not shown on the plumbing drawings. A similar standard shall apply to all trades.

4. Contractors are directed to use indicated dimensions for determining material quantities and for other reasons. No additional monies will be allowed due to contractors using "Scaling Instruments" to determine material quantities or for other reasons.

D. Related Sections
1. Some sections of the Specifications (Divisions 01 through 49) may include a paragraph with this title.
2. This paragraph is an aid to the Project Manual and is NOT INTENDED to include all sections which may be related. It is the Trade Contractor's obligation to coordinate all sections whether indicated under "Related Sections" or not.

1.04 REFERENCED STANDARDS

1.05 OCCUPANCY BY OWNER

A. The Owner reserves the right to occupy and to place and install equipment in completed areas of the building prior to Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the Work.
1. Obtain a Certificate of Occupancy from local building officials and/or other authorities having jurisdiction prior to Owner occupancy.
a. Final Certificate of Occupancy shall be a complete and unencumbered Certificate. All fee's, if any, for inspections, testing, surveys, etc., shall be the responsibility of the Contractor.
2. Prior to partial Owner occupancy, mechanical and electrical systems shall be fully operational. Upon occupancy, the Owner will operate and maintain mechanical and electrical systems serving occupied portions of the building.

1.06 CONTRACTOR USE OF PREMISES

A. General: During the construction period the Contractor shall have full use of work area for construction operations, as indicated on Architectural Site Plan.
1. The Contractor's use of the Site is limited only by the Owner's right to perform work or retain other contractors on portions of the Project.
2. Work and personnel on site will not be permitted on weekends, holidays, before 7:00 am or after 7:00 pm Monday through Saturday, unless authorized in writing by Owner.

B. Limit use of premises to construction activities in areas indicated; allow for Owner occupancy and public use. Coordinate use under direction of Owner and Architect.
1. Maintain legal, protected fire egress at all times.
2. Move any stored materials, equipment or products, which interfere with operations of the Owner.

C. Confine operations to areas within Contract limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.

D. Keep driveways and entrances serving the premises clear and available to the Owner, Owner's employee's, and General Public at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.
1. Provide access for emergency vehicles at all times.
a. Do not block or close roadways, or fire lanes without providing auxiliary and /or temporary access to Site for emergency vehicles. Provide Owner and local fire department minimum 48 hours notice.
b. Fire hydrants shall remain accessible at all times.
2. Contractor's personnel shall park in designated areas only.

E. Maintain the existing buildings in a weathertight condition throughout the entire construction period. Repair any damage caused by demolition operations. Take all precautions necessary to protect the building and occupants during demolition operations.

F. Owner Regulations: All construction personnel shall observe the following Owner regulations at all times when on the Project Site:
   1. Devices not specifically required for construction operations that are capable of generating audible noise such as radios, cassette or CD players, or similar equipment will not be permitted on site.
   2. Require construction site personnel to be fully and properly dressed at all times. Bare torsos, legs, and feet are prohibited.
   3. Smoking will not be permitted in the existing building. Do not permit smoking on site except in vehicles.
   4. Maintain strict discipline and good order among construction site personnel. Do not permit loud talking or use of profane language. Use of profane language is cause for immediate dismissal.
   5. Drugs, alcohol, other offensive materials, and firearms are prohibited and cause for dismissal and/or criminal prosecution.
   6. Do not permit construction site personnel to access or utilize existing building facilities including vending machines, drinking fountains and toilet rooms except as specifically directed.

PART 2 PRODUCTS - NOT APPLICABLE

PART 3 EXECUTION - NOT APPLICABLE

END OF SECTION

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SECTION 01 2300 - ALTERNATES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements governing Alternates.
   1. The Owner reserves the right to accept or decline alternates.
   2. The Owner reserves the right to accept, decline, and/or enter negotiations to modify Voluntary Alternates proposed by the Contractor and/or any subcontractor.

1.03 DEFINITIONS

A. Definition: An alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to, or deducted from, the Base Bid amount if the Owner decides to accept a corresponding change in the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
   1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate the Alternate into the Work. No other adjustments are made to the Contract Sum.

1.04 PROCEDURES

A. Coordination: Modify or adjust affected adjacent Work as necessary to completely and fully integrate that Work into the Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.

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

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

D. Schedule: A "Schedule of Mandatory Alternates" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials necessary to achieve the Work described under each alternate.
   1. Only principle items of Work are highlighted in each mandatory alternate. Include as part of each alternate, miscellaneous devices, appurtenances, and similar items incidental to or required for a complete installation whether or not mentioned as part of the alternate.
   2. Voluntary alternates, as proposed by the Bidder, are as shown on the Proposal Form submitted by such Bidder.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 SCHEDULE OF MANDATORY ALTERNATES

Alternate No. 1: Pavilion

Provide electrical power and lighting for Owner's prefabricated pavilion. Coordinate installation of electrical with Owners vendor. Coordinate installation of electrical with Owner's pavilion vendor. Coordinate with Owner and Owner's vendor for installation of pavilion. Refer to Electrical documents for additional information.

Alternate No. 2: Sidewalk extension

Provide 6 inch deep circular concrete sidewalk and connection to pavilion (Alternate No. 1), including all excavation and sub base work. Refer to Drawings and Specification sections for location and configuration.

Alternate No. 3: Omit Panel Board RP-K

Remove Panelboard RP-K from project scope. All devices currently circuited to RP-K shall be re-circuited to LP-BB. Maintain same type of circuit breakers for each device as originally specified for RP-K. Refer to Electrical Documents for additional information.

END OF SECTION

Advancement of Construction Technology

SUBSTITUTION REQUEST

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 yrs old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached - REQUIRED BY A/E

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

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SUBSTITUTION REQUEST
(Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

_____

A/E's REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01 25 00.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 25 00.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐ _____

_____

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_____

_____

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_____

SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements for handling requests for substitutions made after award of the Contract.

1.03 DEFINITIONS

A. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.

B. Substitutions: Requests for changes in products, materials, assemblies, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions". The following are NOT considered substitutions:
   1. Substitutions requested by Bidders during the bidding period, and accepted prior to award of Contract, are considered as included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.
   2. Revisions to Contract Documents requested by the Owner or Architect.
   3. Specified options of products and construction methods included in Contract Documents.
   4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.04 REQUESTS FOR SUBSTITUTION

A. Substitutions: For a period of 15 working days after Subcontract Award, Architect will consider written requests from Contractor for substitution of products. Requests received more than 15 working days after Subcontract award may be considered or rejected at the discretion of the Architect.
   1. Architect will consider substitutions after 15 days of Subcontract award only if one of the following conditions applies.
      a. Specified products are no longer manufactured.
      b. Owner will realize an additional cost savings over and above the original Bid cost.
      c. Owner will receive a superior product to those specified and/or realize a significant maintenance and operating cost savings.
      d. Overall construction time will be reduced (not just the time for the trade offering the substitution.

B. A request for substitution constitutes a representation that the Contractor:
   1. Has investigated the proposed product and determined it is equal to or exceeds the quality level in all respects of the specified product and that it will perform adequately in the application intended.
   2. Will provide the same warranties or bonds for substitution as for product specified.
   3. Will coordinate installation as an accepted substitution into the Work, and make such other changes as may be required to make the work complete in all respects with no additional cost to the Owner or other contractors.
   4. Waives all claims for additional costs or time extension under his responsibility which may subsequently become apparent.
   5. Will pay all Architect’s and Engineer’s redesign cost, special inspections, and all other cost caused by substitutions.

C. Submit a separate request for each product. Each request shall be on a separate "Substitution Request" form, use CSI/CSC Form 13.1A a sample of which is included at the end of this Section. Provide complete data, drawings and samples as appropriate, with each request, including:
   1. Comparison of qualities of proposed substitution with that specified.
   2. Changes required in other elements of work because of substitution.
   3. Effect on construction schedule.
   4. Cost data comparing proposed substitution with product specified.
   5. Any required license fees or royalties.

D. Architect will be judge of acceptability of proposed substitution except where cost is involved.

E. Substitutions WILL NOT be considered when they are indicated or implied on shop drawings or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Architect will review requests for substitutions with reasonable promptness and notify Contractor in writing of decision to accept or reject requested substitution.

1.05 SUBMITTAL REQUIREMENTS

A. Submit one electronic copy of each request for substitution for consideration. Submit requests on the "Substitution Request" form included at the end of this Section and in accordance with procedures required for Change Order proposals.
   1. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
      a. Certification by the Contractor and Supplier that the substitution proposed is equal-to or exceeds the specified product in every significant respect to that required by the Contract Documents, and will perform adequately in the application indicated.

B. For products:
   1. Product identification, including manufacturer's name.
   2. Manufacturer's literature, marked to indicate specific model, type, size, and options to be considered:
      a. Product description.
      b. Performance and test data.
      c. Reference standards.
      d. Difference in power demand, air quantities, etc.
      e. Dimensional differences from specified unit.
   3. Full size samples if requested.
   4. Architect reserves right to retain sample until physical units are installed on Project for comparison purposes.
   5. Requester pay all costs of furnishing and return of samples.
   6. Architect is not responsible for loss of, or damage to, samples.
   7. Name and address of at least 3 similar projects and name of Owner's Representative Architect can contact; to discuss product, installation, and field performance data.

C. For construction methods:
   1. Detailed description of proposed method.
   2. Illustrate with drawings.

D. Itemized comparison of proposed substitute to specified item; indicate variations including size, weight, durability, and visual effect.

E. Data relating to changes in construction schedule.

F. Effect and changes required on separate or other contracts.

G. Coordination information necessary to accommodate the proposed substitute. Include a list of changes or modifications needed to other parts of the Work and to construction performed by separate contractors.

H. Complete breakdown of costs, of proposed substitution which shall include additional costs and saving generated by proposed substitution and shall indicate amount, if any, to be deducted from Contract Sum if proposed substitution is accepted.

I. Availability of maintenance and repair services, and sources of repair or replacement items.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

A. Conditions: Contractor's substitution request will be received and considered by the Architect when the following conditions are satisfied, as determined by the Architect; otherwise requests will be returned without action except to record noncompliance with these requirements.
   1. Extensive revisions to Contract Documents are not required.
   2. Proposed changes are in keeping with the general intent of Contract Documents.
   3. The request is timely, fully documented and properly submitted.
   4. The specified products or method of construction cannot be provided within the Contract Time. Request will not be considered if product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
   5. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
   6. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear, including but not limited to costs incurred by the Owner due to redesign and re-engineering that the Architect and Engineers must engage in to modify Contract Documents and any (re)submissions to the Authorities Having Jurisdiction (AHJ) to accommodate the Substitution..
   7. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certified that the proposed substitution will provide the required warranty.

B. Substitutions WILL NOT be considered if:
   1. Substitutions are not submitted in conformance with this Section.
   2. Acceptance will require substantial revision to the Contract Documents, or building spaces.
   3. Request for substitution does not indicate specific item for which request is submitted.
   4. Request Form is not properly executed
   5. Acceptance of manufacturer only will not be made.
   6. Requested directly by a Subcontractor or supplier.
   7. Insufficient information submitted.

C. Architect’s Action: Within one week of receipt of the request for substitution, the Architect will request additional information or documentation necessary for evaluation of the request. Within 2 weeks of receipt of the request, or one week of receipt of the additional information or documentation, which ever is later, the Architect will notify the Contractor of acceptance or rejection of the proposed substitution. Acceptance will be in the form of a Change Order.
   1. If a decision on use of proposed substitute cannot be made or obtained within the time allocated, use the product specified by name.

D. The Contractor's submittal and Architect's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

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Advancement of Construction Technology

SUBSTITUTION REQUEST

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 yrs old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached - REQUIRED BY A/E

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

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SUBSTITUTION REQUEST
(Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

_____

A/E's REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01 25 00.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 25 00.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐ _____

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SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements for handling and processing Contract Modifications.

1.03 MINOR CHANGES IN THE WORK

A. Supplemental instructions authorizing minor changes in the Work not involving an adjustment to the Contract Sum or Contract Time may be issued by the Architect on AIA Form G710, Architect's Supplemental Instructions.

1.04 CHANGE ORDER PROPOSAL REQUEST

A. Owner Initiated Proposal Requests: Proposed changes in the Work that will require adjustment to the Contract Sum or Contract Time will be issued by the Architect with a detailed description of the proposed change and supplemental or revised drawings and specifications, if necessary.
   1. Proposal requests issued by the Architect are for information only. Do not either stop work in progress or execute any proposed change based on any description or instruction. Continue work in areas surrounding the proposed change as possible, but only to the extent it will not increase the Contract Sum or Contract Time.
   2. Unless otherwise indicated in the proposal request, submit an estimate of the cost necessary to execute the proposed change to Owner/Architect for his review within 21 days of receipt of the proposal request.
      a. Include a list of quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental and amounts of trade discounts.
      c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

B. Contractor Initiated Change Order Proposal Requests: When latent or other unforeseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a request for a change to the Owner/Architect.
   1. Include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.
   2. Include a list of quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
   3. Indicate applicable taxes, deliver charges, equipment rental and amounts of trade discounts.
   4. Comply with requirements in Section 01 2500 - Substitution Procedures, if the proposed change in the Work requires substitution of one product or system for a product or system specified.

1.05 CONSTRUCTION CHANGE DIRECTIVE

A. When the Owner and the Contractor are not in total agreement on the terms of a Change Order Proposal Request, the Architect may issue a Construction Change Directive on AIA Form G714 instructing the Contractor to proceed with a change in the work for subsequent inclusion in a Change Order.

1. The Construction Change Directive will contain a complete description of the change in the work and designate the method to be followed to determine change in the Contract Sum or Contract Time.

B. Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
   1. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.06 CHANGE ORDER PROCEDURES

A. Upon Owner's approval of a Request for Change Order, Contractor will issue a Change Order with Architect’s concurrence for signatures of the Owner and Contractor as provided in the Conditions of the Contract.

PART 2 PRODUCTS - NOT APPLICABLE

PART 3 EXECUTION - NOT APPLICABLE

END OF SECTION

SECTION 01 2613 - REQUEST FOR INTERPRETATION (RFI)

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements for handling and processing Requests For Information.

1.03 DEFINITIONS

A. Definitions used in this article are not intended to change or modify the meaning of other terms in the Contract Documents.

B. Request for Interpretation (RFI): A request for information by the Contractor to the Architect of Record for clarification of intent of any portion of the Contract Documents after the Award of Contract and during the construction of the Project.

C. The following are NOT Requests for Information.
   1. Change Orders.
   2. Construction Change Directives.
   3. Substitution Request.
   4. Bulletin.
   5. Field Order.
   6. Shop Drawings.
   7. Normal questions contained in a typical shop drawing submittal.
   8. Clarifications during Bidding.

D. Day: For purpose of processing RFI's, a day is a working day and excludes weekends and holidays.

1.04 REQUESTS FOR INTERPRETATION (RFI'S) DURING CONSTRUCTION

A. RFI's are logged-in at the Architect's Office, not necessarily with same date as indicated by the Contractor on RFI form. The response time will commence upon the date of receipt by the Architect.
   1. RFI's received on or after a Friday after 2:00 PM are to be dated the following Monday, holidays excepted.
   2. RFI's received on any day after 2:00 PM will be dated received the following Working Day.

B. Requests for Interpretation (RFI): If clarification of any portion of Construction Documents is required, submit a Request for Interpretation to the Architect of Record and the Owner's Representative in accordance with the following procedures:
   1. RFI Format:
      a. Submit on a standard form developed by the Contractor.
      b. RFI's shall be sequentially numbered; and include the following:
         1) Date
         2) Project name and number
         3) Contractor's name, address, telephone number and fax number.
         4) Description of subject and discipline (trade) in question.
         5) Adequate space for Architect of Record to respond, sign, and date.
      c. Contractor shall submit a copy of the format to the Architect of Record and Owner's Representative at start of Project for review and comment.
      d. .Pdf comment protocol: Comments and/or mark-ups on Shop Drawings, Product Data and Samples shall follow assigned color designations.

C. RFI Inquiry:

1. Clearly state and completely define the issue requiring interpretation. Provide drawing and detail numbers, specification section numbers and paragraphs, sketches and other reference information.
2. Provide potential solutions to issues when possible.
3. Provide cost and schedule implications, if any.
4. Ambiguous RFI's will be returned to Contractor without action taken.

D. RFI Submission Process:
1. The Contractor shall submit an RFI, in writing, to Architect of Record immediately with a copy to the Owner's Representative when any issue requiring clarification arises.
   a. Unless specifically stated on RFI, the Architect of Record and the Owner will assume adjustments to the Contract Amount and the Project Schedule are NOT REQUIRED.
2. The Architect of Record will review and respond only to RFI's received in writing from the Contractor.
3. Submit electronic copy of each RFI and Architect of Record response, including any supplemental drawings and additional instructions, to the Owner's Representative for record purposes.
4. The Contractor shall allow seven (7) working days for the Architect of Record to review and respond to the RFI.
5. RFI's submitted to the Architect of Record without following these submission procedures will result in rejection of the submission.

E. RFI Log:
1. Contractor shall maintain an RFI log indicating the RFI number, subject, date, response date and impact, if any on schedule and cost.
2. Contractor shall publish the log at least bi-monthly to the Architect of Record and Owner's Representative.

PART 2 PRODUCTS - NOT APPLICABLE

PART 3 EXECUTION - NOT APPLICABLE

END OF SECTION

SECTION 01 2900 - PAYMENT PROCEDURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements for handling and processing Contractor's applications for payment.

1.03 SCHEDULE OF VALUES

A. Coordinate preparation of Schedule of Values with preparation of Construction Schedule.
   1. Prepare Schedule of Values, typed, on AIA Form G703 - Application and Certificate for Payment Continuation Sheet.
   2. Correlate line items in schedule of values with other required administrative schedules and forms including:
      a. Construction schedule.
      b. Application for payment form.
      c. List of subcontractors.
      d. List of products.
      e. List of principal suppliers and fabricators.
      f. Schedule of submittals.
   3. Submit Schedule of Values to Contractor within 7 days after contract award.
      a. Schedule of Values shall be approved by the Contractor prior to Initial Application for Payment.
   4. Submit schedule of values to Owner/Architect at the earliest feasible date, but in no case later than 30 days before the date scheduled for submittal of initial application for payment.
   5. Provide separate schedule of values for each phase of the Project.

B. Use the Table of Contents of this Project Manual to establish the format for Schedule of Values.
   1. Provide a breakdown of Contract Sum in sufficient detail to facilitate continued evaluation of applications for payment and progress reports. Break principal subcontract amounts down into several line items.
   2. Round amounts off to nearest whole dollar adjusted to total Contract Sum.
   3. Provide separate line items on Schedule of Values for each part of the Work where an application for payment may include materials and equipment purchased or fabricated and stored but not yet installed.
   4. Show line items for indirect costs and margins on actual costs only to extent that such items will be listed individually in applications for payment. Each item in the schedule of values and applications for payment shall be complete including its total cost and proportionate share of general overhead and profit margin.
   5. Provide separate line items on Schedule of Values for the following Division 01, “General Requirements” cost items. The aggregate total value of Division 01 Requirements and all other line items shall be equal to the total Contract Sum. Provide separate break down for Labor and Material for each item as required by the Contractor.
      a. Performance and Labor and Material Payment Bonds.
      b. Mobilization and demobilization.
      c. Project closeout at 5 percent, or amount agreed to by Contractor.
      d. Field supervision and layout, Barricades and Safety precautions, Temporary Office and equipment (by month).
      e. Shop drawings and Samples.
   6. Update and resubmit the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.04 APPLICATIONS FOR PAYMENT

A. Each application for payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
   1. The initial application for payment, application for payment at time of substantial completion, and final application for payment involve additional requirements.
   2. Submit construction schedule update including narrative with each application for payment.

B. Applications for Payment WILL NOT be processed until the Schedule of Values is submitted and approved.

C. Applications for Payment WILL NOT be processed until reviewed and approved by the Contractor. Review of proposed invoice shall be done in person with the Contractor not less than 5 days before monthly Progress Payment date.
   1. Percentage completion of a line item will be the percent complete projected through the end of the month.
   2. Obtain approval of the Contractor prior to purchasing material for early payment of material stored.
      a. Material must be incorporated in the final work.
      b. Multiple unit items must be inventoried each month.
      c. Submit electronic copy of the Supplier Invoice.
      d. Submit electronic copy of the executed “Materials Stored Payment Form”, along with Contractor required proof of title and insurance.
   3. Material stored offsite will not receive consideration for payment until complete documentation of legal title, insurance, material supply bond, and property security is approved by Contractor.
   4. Stored Material Payment will not be considered for common readily available items

D. Progress payments will be made monthly, on date determined by Owner, for construction work performed in the preceding thirty days.
   1. Payments to Trade Contractors will be made within 10 days of receipt of payment by Contractor from Owner.

E. Use AIA Form G702 and G703 - Application and Certificate for Payment for application for payment.
   1. Electronic facsimiles of standard forms are acceptable if they are of like content and size, subject to approval by Contractor.

F. Retainage: Ten (10) percent of the estimated amounts will be retained until Substantial Completion.
   1. The balance of the retained percentage will be paid thirty (30) days after Owner's acceptance of Work, providing that all requirements of the Contract are met.

G. Complete every entry on form including notarization and execution by person authorized to sign legal documents on behalf of Contractor. Incomplete applications will be returned without action.
   1. Listing of items on Application for Payment shall match listing on Schedule of Values and Contractor's construction schedule. Use updated schedules if revisions have been made.
   2. Include amounts of Change Orders and Construction Change Directives issued prior to last day of the construction period covered by the application.

H. Submit electronic copy of each Application for Payment to Architect. Include waivers of lien and sworn statements.
   1. Transmit each copy with transmittal form listing attachments and recording appropriate information related to the application in manner acceptable to Architect and/or Contractor.

I. Submit Waivers of Lien and Sworn Statements from every entity who may lawfully be entitled to file a mechanics lien arising out of the Contract and related to Work covered by the Payment.

1. Submit partial waivers of lien with each monthly Application for Payment on each item for the amount previously requested less the deduction for retainage on each item. Show both the amount requested and the deduction for retainage.
2. Submit final or full waivers when an application shows an item is complete.
3. Submit final application for payment with or preceded by final waivers and sworn statements from every entity involved with performance of Work covered by the application who could lawfully be entitled to a lien.
4. Waiver Forms: Submit waivers of lien on forms acceptable to Owner and/or Contractor.
5. Sworn Statement Forms: Submit sworn statements on forms acceptable to Owner and/or Contractor.

J. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first application for payment include the following as applicable:
1. List of subcontractors.
2. List of principal suppliers and fabricators.
3. Schedule of values.
4. Contractors construction schedule.
5. Schedule of principal products.
6. Submittal schedule.
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Electronic copies of building permits including applicable trade permits.
10. Electronic copies of authorizations and licenses from governing authorities for performance of the Work.
11. Initial progress report.
12. Report of preconstruction meeting.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.
15. Initial settlement survey and damage report.

K. Application for Payment at Substantial Completion: Following issuance of Certificate of Substantial Completion, submit an application for payment. Reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work. Administrative actions and submittals that must precede or coincide with this application include:
1. Occupancy permits and similar approvals.
2. Warranties and maintenance agreements.
3. Test/adjust/balance records.
4. Maintenance instructions.
5. Meter readings.
6. Start-up performance reports.
7. Change-over information related to Owner's occupancy, use, operation and maintenance.
8. Final cleaning.
9. Application for reduction of retainage and consent of surety.
10. Advice on transferring insurance coverages.
11. Final progress photographs.
12. List of incomplete work recognized as exceptions to Architect's Certificate of Substantial Completion.

L. Final Payment Application Administrative actions and submittals which must precede or coincide with submittal of the final application for payment include the following:
1. Completion of project closeout requirements including those specified in Section 01 7700 - Closeout Procedures.
2. Completion of items specified for completion after Substantial Completion.
3. Assurance that unsettled claims will be settled as acceptable to Owner and Architect.

4. Assurance that work not complete and accepted will be completed without undue delay as acceptable to Owner and Architect.
5. Transmittal of required project construction records to Owner.
6. Certified property survey.
7. Proof that taxes, fees and similar obligations have been paid.
8. Removal of temporary facilities and controls.
9. Removal of surplus materials, rubbish and similar elements.
10. Change of lock cylinders to Owner's access.

1.05 RECOMMENDATION FOR PAYMENT BY THE ARCHITECT

A. Issuance of Recommendation For Payment by the Architect, constitutes a representation by the Architect to the Owner, based on his observations at the Project Site, as provided in the Owner-Architect Agreement, and data comprising the Application For Payment, the Work has progressed to the point indicated; to the best of his knowledge, information and belief, the quality of Work is in accordance with the Contract Documents (subject to evaluation of the Work for conformance with the Contract Documents upon substantial completion, to the results of any subsequent test required by or performed under the Contract Documents, to minor deviations from the Contract Documents correctable prior to completion, and to any specific qualifications stated in this certificate); and the Contractor is entitled to payment in the amount recommended.

B. However, by issuing a Certificate of Payment, the Architect shall not thereby be deemed to represent that he has made exhaustive or continuous on-site inspections to check the quality of Work or that he has reviewed the construction means, methods, techniques, sequences or procedures, or has made any examination to ascertain or for what purpose the Contractor has used monies previously paid on account of the Contract sum.

C. A Recommendation For Payment or a progress payment does not constitute acceptance of Work not in accordance with Contract Documents.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE

END OF SECTION

SECTION 01 3113 - PROJECT COORDINATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements for project coordination.

B. Employ and pay for services of a full-time project superintendent for duration of construction work.
   1. Provide additional administrative and supervisory personnel including services of a project manager and expeditor as required for performance of the work including coordination of subcontractors.

1.03 QUALITY ASSURANCE

A. Project Coordinator Qualifications: Not less than five years experience performing project coordination work on projects of similar size and scope.

B. Coordination: Coordinate construction activities included under various Sections of these Specifications to assure efficient and orderly installation of each part of the work. Coordinate construction operations included under different Sections of the Specifications that are dependent upon each other for proper installation, connection and operation.
   1. Where installation of one part of the work is dependent on installation of other components, either before or after its own installation, schedule construction activities in sequence required to obtain best results.
   2. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the work.

D. Conservation: Coordinate construction activities to ensure operations are carried out with consideration given to conservation of energy, water and materials.

1.04 PROJECT COORDINATION

A. Each contractor is responsible for coordinating its construction operations with those of other contractors and related parties. Coordinate operations with operations of other contractors, including those in other Sections and Bid Packages to ensure proper installation, connection, sequence, operation, in an efficient and orderly fashion.
   1. Schedule construction operations in the sequence required to obtain the best results without resulting in rework.
   2. Coordinate installation of components with other contractors to ensure proper performance of equipment and to maintain accessibility for required maintenance, service and repair.
   3. Coordinate and make provision to accommodate installation of items scheduled for later installation.

B. Coordinate work of subcontractors including that related to:
   1. Temporary facilities and controls.
   2. Work specified in Divisions 02 through 49 of the specifications.

C. Coordinate schedules of subcontractors and material suppliers as required to:
   1. Verify timely deliveries and materials and products for installation by other subcontractors.
   2. Verify labor and materials are adequate to maintain schedules.

D. Conduct conferences with subcontractors and other concerned parties as necessary to:
   1. Maintain coordination and schedules.
   2. Resolve matters in dispute.

E. Participate in project meetings to ensure coordination and to:
   1. Report on progress of work.
   2. Recommend needed changes in schedules.

F. Coordinate temporary facilities and controls as required to:
   1. Verify installation, operation and maintenance complies with governing codes and regulations.
   2. Verify adequacy of facilities and controls for construction activities and operations.

G. Coordinate shop drawings, product data and submittals. Review for compliance with requirements of Contract Documents prior to submittal.
   1. Verify field dimensions and clearances.
   2. Verify relation to available space.
   3. Verify settings of anchorages including anchor bolts.
   4. Review effects of changes in work with subcontracts and other contracts.
   5. Verify compatibility of equipment with work of other subcontracts.
   6. Verify motor voltages and control characteristics.
   7. Coordinate controls and interlocks to verify voltages and phase, and wiring of pneumatic electric switches and relays.

H. Prepare coordination drawings as required to assure coordination of work and to resolve conflicts prior to installation. Where exposed construction ceilings are indicated provide coordination drawings as part of shop drawing submittals. Coordinate location and finish appearance of all materials exposed to view.

I. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
   1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
   2. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
   3. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
      a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
   4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
      a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
      b. Digital Data Software Program: Drawings are available in most current version of AutoCAD .dwg format using only AutoDesk software and/or 3D Autodesk Revit files. Refer to BIM Execution plan for version.
      c. Contractor shall execute a data licensing agreement. The form is included at the end of Section 01 3323 - Shop Drawings, Product Data, and Samples.

J. Observe required testing, maintain records of tests and record:
   1. Testing agency and name of inspector.
   2. Subcontract work being tested.
   3. Representatives present.
   4. Date and time of testing.
   5. Type of products or work being tested.
   6. Types of tests and results.
   7. Any retesting required.

K. Verify subcontractors are maintaining accurate project record documents.

L. Review proposals and requests for substitutions, modifications and changes.
   1. Verify compliance with requirements.
   2. Verify compatibility with work and equipment of other subcontracts.
   3. Recommend action.

M. Verify work complies with requirements of Contract Documents.
   1. Maintain record of observed deficiencies and discrepancies.
   2. Promptly report deficiencies and discrepancies to Architect.

N. Assemble documentation associated with any claims or disputes.

O. Attend equipment start-up.
   1. Verify services and connections are complete and equipment is in operable condition.
   2. Observe testing, adjusting and balancing.
   3. Record results including time and date of start-up.

P. Coordinate inspection and acceptance of equipment.
   1. Prior to inspection, verify equipment is clean, tested and operational.
   2. Assist inspector and prepare list of items to be completed or corrected.
   3. Should acceptance and operation of equipment constitute the beginning of any specified guarantee period, prepare and transmit written notice.

Q. Coordinate inspection and acceptance of work.
   1. Prior to inspection verify work is complete and ready for acceptance
   2. Assist inspector and prepare list of items to be completed or corrected.
   3. Should acceptance of work constitute the beginning of any specified guarantee period, prepare and transmit written notice.

R. Assemble project record documents.

S. Submit electronic copies of lists, tests and operating logs to Architect.

1.05 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
   1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Coordination Drawings must be project specific. Include the following information, as applicable:
      a. Prepare sections, elevations, and details as needed to describe relationship of systems and components.
      b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
      c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
      d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
      e. Show location and size of access doors required for access to concealed dampers, valves and other controls.
      f. Indicate required installation sequences.

g. Indicate dimensions shown on the Drawings and dimensions of existing conditions, or previously installed materials, where applicable. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:
   1. Floor Plans and Reflected Ceiling Plans:
      a. Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work.
      b. Show locations of ceiling-mounted devices relative to other ceiling structures.
      c. Provide section drawings where required to adequately represent the Work.
   2. Plenum Space:
      a. Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work.
      b. Locate components within ceiling plenum to accommodate layout of light fixtures and other ceiling mounted equipment.
      c. Indicate areas of conflict between light fixtures, alarm devices, HVAC equipment and other components.
   3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
   4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
   5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
   6. Mechanical and Plumbing Work:
      a. Show sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
      b. Show dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
      c. Show fire-rated enclosures around ductwork.
   7. Electrical Work:
      a. Indicate runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
      b. Indicate light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
      c. Indicate panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
      d. d. Location of pull boxes and junction boxes dimensioned from column center lines.
   8. Fire-Protection System: Show locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

C. Review: Engineer will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Engineer determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Engineer will so inform Contractor, who shall make changes as directed and resubmit.

D. Coordination Drawing Submittal: Prepare coordination drawings in accordance with requirements for Shop Drawings. Refer to Section 01 3323 - Shop Drawings, Product Data, and Samples. Prepare digital files in .pdf format.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

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SECTION 01 3119 - PROJECT MEETINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements for project meetings including pre-construction conference, coordination meetings and progress meetings.

B. Contractor is specifically responsible for:
   1. Preparing agenda for each meeting which includes specified topics.
   2. Providing written notice of each meeting including agenda to all attendees not less than four days in advance of meeting date.
   3. Making physical arrangements for each meeting.
   4. Presiding at each meeting.
   5. Recording minutes of each meeting including but not limited to all significant proceedings, decisions, action required and persons assigned to action.
   6. Reproducing and distributing minutes of each meeting to all attendees and other parties affected by decisions made at meeting not later than three days after each meeting.

1.03 PRE-CONSTRUCTION CONFERENCE

A. Schedule a pre-construction conference and organizational meeting for the Project at project site or other convenient location no later than 15 days after execution of Agreement and prior to commencement of construction activities. Conduct meeting to review goals, responsibilities and personnel assignments.

B. Contractor shall submit the following prior to meeting and such additional items as Architect may direct:
   1. Signed Contract.
   2. Bonds as required.
   3. Proof of insurance.
   4. Required permits.
   5. Preliminary construction schedule.
   6. List of subcontractors.
   7. Schedule of values.
   8. Preliminary payment schedule.
   9. Project directory.
   10. Safety plan and name of Safety Officer.

C. Attendees: Owner, Architect and its consultants, Contractor and its project manager, project coordinator and project superintendent, major subcontractors, manufacturers and suppliers. Other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.

D. Agenda: Discuss items of significance that could affect progress including such topics as:
   1. List of subcontractors, manufacturers and suppliers.
   2. Tentative construction schedule.
   3. Critical work sequencing.
   4. Designation of responsible personnel.
   5. Procedures for processing field decisions and Change Orders.
   6. Procedures for processing applications for payment.
   7. Distribution of Contract Documents.
   8. Submittals of shop drawings, product data and samples, including that at exposed construction ceilings, coordination drawings will be required as part of the shop drawing process to facilitate the locations and finish appearances of all materials exposed to view.

9. Preparation of record documents.
10. Use of premises.
11. Office, work and storage areas.
12. Temporary facilities and controls.
13. Equipment deliveries and priorities.
14. Safety procedures.
15. First aid.
16. Security.
17. Housekeeping.
18. Working hours both within and outside of the Building.

E. Record meeting results and distribute copies within 24 hours to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.04 COORDINATION MEETINGS

A. Conduct project coordination meetings at regularly scheduled times convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation meetings.

B. Request representation at each meeting by every party currently involved in coordination or planning for construction activities involved.

C. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
1. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
2. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
3. Review present and future needs of each contractor present, including the following:
   a. Interface requirements.
   b. Sequence of operations.
   c. Resolution of BIM component conflicts.
   d. Status of submittals.
   e. Deliveries.
   f. Off-site fabrication.
   g. Access.
   h. Site utilization.
4. Temporary facilities and controls.
5. Work hours.
6. Hazards and risks.
7. Progress cleaning.
8. Quality and work standards.
9. Change Orders.

D. Record meeting results and distribute copies within 24 hours to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.05 PROGRESS MEETINGS

A. Conduct progress meetings at Project site at regularly scheduled intervals, but not less frequently than every other week. Notify Owner and Architect of scheduled meeting dates. Coordinate dates of meetings with preparation of payment requests. Prepare construction schedule update for each meeting to discuss.

B. Attendees: In addition to representatives of Owner, Architect and Contractor, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the Project and authorized to conclude matters relating to progress.

C. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to current status of the Project.
   1. Contractor's Construction Schedule: Review progress since the last meeting.
      a. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule.
      b. Determine how construction behind schedule will be expedited, at no additional cost to the Owner; secure commitments from parties involved to do so.
      c. Discuss whether schedule revisions are required to ensure current and subsequent activities will be completed within the Contract Time.
   2. Review present and future needs of each entity present, including such items as:
      a. Interface requirements.
      b. Time.
      c. Sequence of operations
      d. Resolution of BIM component conflicts.
      e. Status of submittals
      f. Status of sustainable design documentation
      g. Deliveries.
      h. Off-site production quotas and fabrication problems.
      i. Access.
      j. Site utilization.
      k. Temporary facilities and services.
      l. Hours of work.
      m. Hazards and risks.
      n. Housekeeping.
      o. Quality and work standards.
      p. Change Orders.
      q. Documentation of information for payment requests.

D. Reporting: Record meeting results including agreements and disagreements, and distribute copies of minutes of each meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form, of progress since previous meeting and report.
   1. Schedule Updating: Revise construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

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Project Name

Project Number

Date Issued

Documents Issued

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Date	Date

Copies:

Neumann/Smith Project File

Client's Representative

SECTION 01 3323 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Submittals of shop drawings, product data and samples as required by Contract Documents. Receive, check and coordinate all submittals of all contractors for compliance with Contract Documents prior to submission to Architect, as provided herein.
   1. Submittals of products, materials and methods not specified or pre-approved at time of Bidding will be REJECTED.
   2. Architect will dispose of submittals in excess of requested number of copies.

B. Unless notified or indicated otherwise, the Architect shall review all shop drawings and other submittals. Allow two weeks for review.

C. Architect WILL NOT REVIEW
   1. Submittals not specified.
   2. Submittals not reviewed by Contractor; including Contractor stamp with signature, date and comments.
   3. Submittals made after work is delivered to site and/or installed
   4. Submittal resubmissions unless resubmission is required by Architect.

1.03 DEFINITIONS

A. Shop Drawings: Drawings, diagrams, schedules and other data specifically prepared for the Work by the Contractor or any subcontractor, manufacturer, supplier or distributor, to illustrate some portion of the work. Shop Drawings include coordination drawings indicating the location and finish appearance of all materials exposed to view at exposed construction ceilings.

B. Product Data: Illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate a material, product or system for some portion of the work.

C. Samples: Physical examples which illustrate materials, equipment or workmanship and establish standards by which the work will be judged.

1.04 SUBMITTAL SCHEDULE

A. After acceptance by the Contractor of the Contractor's Construction Schedule, prepare a complete Schedule of Submittals. Submit schedule no later than 30 days before Initial Application for Payment.
   1. Coordinate Submittal Schedule with the list of subcontracts, Schedule of Values and the list of products as well as Contractor's Construction Schedule.
   2. Architect WILL NOT guarantee time period for review of submittals until Submittal Schedule is received from Contractor. Review period may vary up to 6 weeks prior to receipt of such schedule by Architect.
   3. The Contractor shall allow 10 working days for Architect review of Shop drawings, Samples and Product Data.

B. Prepare the schedule in chronological order. Provide the following information:
   1. Scheduled date for the first submittal.
   2. Related Specification Section number.
   3. Submittal category.
   4. Name of the subcontractor.
   5. Description of the part of the Work covered.
   6. Scheduled date for resubmittal.
   7. Scheduled date for the Architect's final release or approval.

C. Distribution: Following Architect's response to initial submittal, print and distribute copies to the Architect, Owner, subcontractors, and other parties required to comply with submittal dates indicated.
   1. Post copies in the Project meeting room and temporary field office.
   2. When revisions are made, distribute to same parties and post in same locations. Delete parties from distribution when their assigned part of the Work has been completed and are no longer involved in construction activities.

D. Schedule Updating: Revise the schedule after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with each meeting report.

E. Shop Drawings, Submittals and Samples are logged in at the Architect's office not necessarily with the same date indicated by the Contractor on the Transmittal. The response time will commence upon the date of receipt by the Architect.
   1. Shop Drawings, Product Data and Samples received on or after a Friday after 2:00 PM will be dated received the following Working Day.
   2. Shop Drawings received on any day after 2:00 PM will be dated received the following Working Day.

1.05 SUBMITTAL REQUIREMENTS

A. Coordinate preparation and processing of submittals with performance of the work, so work will not be delayed by submittals. Coordinate and sequence different categories of submittals for the same work, and for interfacing units of work, so one will not be delayed for coordination with another. No extension of time will be allowed because of failure to properly coordinate and sequence submittals.
   1. Transmit each submittal from Contractor to Architect using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.
   2. .pdf documents must be unencrypted (unlocked) to allow for processing of shop drawings (stamping). Documents received that do not allow the stamping of the electronic file will not be reviewed and will be returned to sender. Time will not accrue against the allowable time for submittal review.
   3. Submit related Shop Drawings, Product Data and Samples in the same submittal. Provide sub-numbers to the submittals to allow for separate return of the materials to expedite processing.
   4. Tested assembly submittals: Where product data is being submitted for products that are part of a tested assembly, such as NFPA 285 compliant assemblies or firestopping assemblies, submit product data for all components of the assembly at the same time, to Architect for review.

B. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Design data.
   3. Shop drawings.
   4. Samples for selection.
   5. Samples for verification.

C. When the following are specified in individual sections, submit them for information, meaning for Architect's knowledge as contract administrator or for Owner.
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.
   5. Manufacturer's instructions.
   6. Manufacturer's field reports.
   7. Field engineering daily reports.
   8. Other types indicated.

D. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

E. Large Format Submittals: Submit 1 print and 1 electronic copy (.pdf format) of each shop drawing, including fabrication, erection, layout and setting drawings and such other drawings as required under various sections of the Specifications, until final acceptance is obtained. Prepare drawings legibly, drawing plans, elevations, sections and details in scales required and on drawing sheets not larger than 30" X 42" nor smaller than 24" X 30".
   1. Architect will review shop drawings returning electronic copy to Contractor.

F. Small Format Submittals (8-1/2" x 11" or 11" x 17"): Submit electronic copies (.pdf format) of manufacturer's descriptive product data including catalog sheets for materials, equipment and fixtures, showing dimensions, performance characteristics and capacities, wiring diagrams and controls, schedules, and other pertinent information as required. Where printed materials describe more than one product or model, clearly identify which is to be furnished.

G. Submit electronic copies of manufacturer's descriptive product data including catalog sheets for materials, equipment and fixtures, showing dimensions, performance characteristics and capacities, wiring diagrams and controls, schedules, and other pertinent information as required. Where materials describe more than one product or model, clearly identify which is to be furnished.
   1. Shop Drawings must be specific to the project and NOT generalized manufacturers information.
   2. Product Data must be specific to project, if generic manufacturers literature is used, take care to CLEARLY indicate what is applicable to project.

H. Submit samples cured and finished as specified and identical to product proposed for use. Include generic description, source product name or manufacturer, and compliance with requirements. Submit samples for kind, color, pattern, and texture for comparison to actual units delivered and installed. Coordinate with Architect the number of samples to be delivered to the Architect. Retain one copy of the approved sample at the site.

I. Shop drawings, product data and samples shall be dated, including Contractor and subcontractor dates of submittal and approval, and marked to show the names of the Project, Architect, Contractor, origination Subcontractor, manufacturer or supplier, and separate detailer, if pertinent. Shop drawings shall completely identify specification section and locations at which materials or equipment are to be installed. Clearly label product data and samples to identify what each item is being submitted for, using same nomenclature in contract documents.
   1. Reproductions of Contract Drawings as Shop Drawings are strictly PROHIBITED.

J. Shop drawings, product data and samples shall be accompanied by an electronic transmittal letter containing project name, Contractor's name, number of drawings, and samples, titles and other pertinent data. Transmittal shall bear signature of the Contractor as evidence he checked same and found them in conformance with the Contract Documents.

K. The Contractor shall review, approve and submit, with reasonable promptness and in such sequence as to cause no delay in the work or in the work of the Owner or any separate Contractor, all shop drawings, product data and samples required by the Contract Documents.

L. By approving and submitting shop drawings, product data and samples, the Contractor represents he has determined and verified all materials, field measurements, and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the work and the Contract Documents.

M. The Contractor shall not be relieved of responsibility for deviation from the requirements of the Contract Documents by the Architect's acceptance of shop drawings, product data or samples, unless the Contractor has specifically informed the Architect and Owner in writing of such deviation at time of such deviation. The Contractor shall not be relieved from responsibility for errors or omissions in the shop drawings, product data or samples by the Architect's acceptance thereof.

N. Direct specific attention, in writing or on re-submitted shop drawings, product data or samples, to revisions other than those requested by the Architect on previous submittals.

O. No portion of the work requiring submission of a shop drawing, product data or sample shall be commenced until the submittal has been accepted by the Architect. Such portions of work shall be in accordance with approved submittals.

P. The Architect will review shop drawings, product data and samples.

Q. Contractor is responsible for obtaining and distributing required prints of shop drawings, product data, and samples, to his subcontractors and material suppliers; after as well as before final approval. Make prints of reviewed shop drawings from transparencies which carry Architect's appropriate stamp.

R. Obtain copies of all shop drawings, product data and samples submitted to date and accepted from other Contractors.

S. Shop drawings both large and small format shall be electronically organized for submission in complete sets.

T. Submit all specified submissions for a division of work at one time in complete packages unless arrangements are made beforehand. Incomplete and multiple submittals will be rejected.

U. BIM File Incorporation: Develop and incorporate Shop Drawing files into Building Information Model established for Project.
   1. Prepare Shop Drawings using the same digital data software program, version, and operating system as the original Drawings.
   2. Refer to Section 01 3113 - Project Coordination, for requirements for coordination drawings.

V. .Pdf comment protocol: Comments and/or mark-ups on Shop Drawings, Product Data and Samples shall follow assigned color designations.

1.06 USE OF CONTRACT DRAWINGS

A. The Architect may provide electronic CAD files of Drawings to the Contractor and Sub-Contractors, upon request, for use as backgrounds in preparation of Contractor’s Shop Drawings for this Project ONLY.

B. The Architect will provide electronic base files of Floor Plans, Reflected Ceiling Plans, and Elevations ONLY. Wall sections and details WILL NOT be released. Contract document files WILL NOT be released.

C. The Contractor shall read, endorse, and return the Architect’s waiver form, “Authorization for Release of Electronic File Transfers”, prior to release of any electronic CAD files by the Architect. A copy of the Waiver Form is included at the end of this Section.

D. The release of electronic CAD files by the Architect is solely for the convenience of the Contractor. The Architect shall not be responsible for the completeness or accuracy of these electronic CAD files. These electronic CAD files are not necessarily updated to reflect subsequent Bid Packages, addenda, bulletins, or other project revisions.

1.07 ARCHITECT'S ACTION

A. Except for submittals for the record, for information and similar purposes, where action and return on submittals is required or requested, Architect will review each submittal, mark to indicate action taken, and return promptly.

1. Compliance with specified characteristics is Contractor's responsibility, and not considered part of Architect's review and indication of action taken.
2. Acceptance does not authorize any change in the Contract Documents unless specifically stated in a separate letter or Change Order.

B. Action Stamp: Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked to indicate the action taken.
1. Review Stamp Terminology: Correction or comments made on shop drawings during this review do not relieve contractor from compliance with requirements of the Drawings and Specifications. This review is conducted only for the confirmation of general conformance with the design concept of the Project and general compliance with the information given in the Contract Documents.
a. The Contractor is responsible for:
1) Confirming and correlating all quantities and dimensions.
2) Selecting fabrication processes and techniques of construction.
3) Coordinating his work with that of all other trades.
4) Performing his work in a safe and satisfactory manner.
2. Design Build Review Stamp Terminology: Review of information on these documents is made to insure compliance with the architectural design concept of this project. Comments and/or corrections refer to aesthetic issues only with no intent to review or alter engineering design content. Design build contractor shall coordinate his work with that of all trades.
3. Submittal Action:
a. Reviewed - where no comment made.
b. Reviewed with Comments - where comments indicated on submittal qualifying, modifying, or otherwise changing it; however, submittal can be used for ordering, fabrication and erection.
c. Revise and Resubmit - Submittal not in conformance; revise and resubmit.
d. Submit Record Copy - Provide record copy of submittal.
e. Rejected - Submittal not required or not in conformance. Revise and resubmit.

C. Other Action: Where a submittal is primarily for information or record purposes, for special processing or other Contractor activity, the submittal will be returned, marked "Action Not Required".

1.08 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file , signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. Review of Delegated Design Submittals: Architect will review Delegated Design submittals only for the limited purpose of checking for conformance with information given and design concept.

D. BIM File Incorporation: Incorporate delegated design drawing and data files into Building Information Model established for Project.
1. Prepare delegated design drawings in the same format as used for the Project.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Submittals.

B. Quality assurance.

C. References and standards.

D. Testing and inspection agencies and services.

E. Contractor's design-related professional design services.

F. Mock-ups.

G. Tolerances.

H. Manufacturers' field services.

I. Defect Assessment.

1.03 REFERENCE STANDARDS

1.04 DEFINITIONS

A. Contractor's Professional Design Services (Delegated Design): Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.

1. Design Services Types Required:
    a. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.

B. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.05 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES (DELEGATED DESIGN)

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Base design on performance and/or design criteria indicated in individual specification sections.

1. Submit a Request for Interpretation to Architect if the criteria indicated are not sufficient to perform required design services.

C. Scope of Contractor's Professional Design Services: Refer to Sections in divisions 00 through 49.

1.06 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.

1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
    a. Full name.
    b. Professional licensure information.

c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.

C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
2. Include required product data and shop drawings.
3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications:
1. Prior to start of work, submit agency name, address, and telephone number, and names of full time Registered Engineer and responsible officer.

B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.08 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

D. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.09 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform specified testing.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 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 manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

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

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

C. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.

D. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.

E. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

F. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

G. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
   1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
   2. Make corrections as necessary until Architect's approval is issued.

H. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

I. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

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

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

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

3.04 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

B. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:

1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency may not approve or accept any portion of the Work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.
   4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
   5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
   6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION

SECTION 01 4216 - DEFINITIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. This Section defines various terms used throughout the Contract Documents.

1.03 DEFINITIONS

A. Addendum: An Addendum is a written and/or graphic instrument issued by the Owner's Representative prior to award of Contract which modifies or interprets the Bidding Documents by additions, deletions, clarifications, or corrections. The Bidding Documents for the original Work shall govern the work described therein, unless modified by the Addendum. All costs or credits due to the Addendum shall be incorporated into the Bidder's Proposal Form for Addenda issued prior to the Owner's receipt of Bids, and by letter on Bidder's letterhead modifying Bid Form amounts for Addenda issued after Owner's receipt of Bids. Letter shall be signed by, and as for the original Bid Form submission.

B. Alternate Price: A variation to the Base Bid amount stated on the Proposal Form to cover a variation in the Contract Requirements. If the Alternate Price is accepted by the Owner, the variation becomes a part of the Contract, and the amount quoted is then added to, or deducted from, the Lump Sum Base Bid amount to determine the Contract Sum. Variations may include a change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

C. Awardee: A Bidder selected to enter into a Contract with the Owner for Work included under the Bidder's Proposal, until such time as he is awarded a Contract and becomes a Subcontractor to the Contractor.

D. Base Bid: The Bid amount before any Alternate Price or Substitution is considered.

E. Bid: As used in the Instructions to Bidders: A Proposal prepared and submitted as required herein.

F. Bidding Documents: A term used for the Advertisement, Instruction to Bidders, Proposal Form, Contract, Bid Security, and the proposed Contract documents including any and all addenda.

G. Bulletin: A written and/or graphic instrument issued by the Owner's Representative, after award of the Contract, used to solicit a proposal for a change in the Work which may affect cost and/or time. The Contract Documents for the original Work Shall Govern the work described unless modified by the Bulletin. A Bulletin is NOT AN ORDER to do the work, But a request to submit a quotation. Changes to the Contract Amount or time shall be adjusted by a Construction Change Directive or Change Order.

H. Complete: Where used, it shall mean "Complete with connections, supports, attachments, and incidental items necessary for a finished and properly operating assembly or operation".

I. Connect: The term shall mean "to bring service(s) to point of installation and make final connections of the service(s) to the installed equipment, and provide miscellaneous auxiliary appurtenances necessary to make operable for its intended use."

J. Construction Issue: A written and/or graphic instrument issued by the Owner's Representative to provide the Contractor a method for obtaining expedient additions, revisions, or clarifications of Drawings and Specifications during the Design and Construction process.

K. Contract Documents: Drawings and Specifications setting forth in detail the requirements for construction of the Project.

L. Days and/or Calendar Days: Days listed on the calendar, including Saturdays, Sundays, and legal holidays where the Project is located.

M. Directed: Terms such as “directed”, “requested”, “authorized”, “selected”, “approval”, “satisfactory”, “accepted”, “required”, and “permitted” are used without reference to specific entity, they shall mean “as directed by the Architect or Contractor”, and similar phrases. However, no implied meaning shall be interpreted to extend the Owner’s, Architect’s, or Contractor’s responsibility into the Contractor’s area of construction supervision, administration, means, or methods.

N. Drawing: Plans, Sections and detail drawings, both large and small scale, furnished by the Architect for the purpose of giving instructions and showing the Work to be done.

O. Experienced: Unless otherwise defined in the technical specifications, means having successfully completed a minimum of 5 previous Projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with the requirements of authorities having jurisdiction.

P. Field Order: A directive to make changes in the Work that is issued to the Contractor. Contractual obligations are the same as those for a Construction Change Directive.

Q. Furnish: To supply (only) to another party for their use or installation, including cost of delivery to the jobsite.

R. Hours of Work: Standard hours of work for the Project shall be proposed by the Subcontractor, subject to approval of the Contractor, and shall be for all standard working days. Hours of work other than these ”standard hours of work” will be considered “premium time hours” and shall include, if any, cost penalty. Work to be performed on “premium time hours” requires written permission from the Owner’s representative and shall be requested a minimum 48 hours prior to such need.

S. Indicated: Graphic representations, notes, or schedules on the Drawings, or other Paragraphs or Schedules in specifications, and similar requirements in the Contract Documents. Where terms such as “shown”, “noted”, “scheduled”, and “specified” are used, it is to help locate the reference. No limitation on location is intended except as specifically noted.

T. Install: To unload, temporarily store, distribute, uncrate, unpack, assemble, erect, and anchor into the intended final positions. The installer shall provide all miscellaneous hardware and supplies required to anchor and support securely, connect, clean-up, and dispose of rubbish.

U. Installer: The Contractor or entity engaged by the Contractor, as an employee, subcontractor, or contractor of lower tier for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

V. Not-In-Contract / NIC: Work not included in this Contract.

W. Owner’s Representative: Person's designated to act on the Owner’s behalf with regard to the work used in reference hereto.

X. Packaged Equipment: Equipment or Product that is complete with all integral components, including, but not limited to, piping, conduit, wiring, main power disconnect, starter, control transformer, relays, and controls fully mounted and completely interconnected ready for installation at final location and to receive final connection of mechanical and electrical services. For shipping of “Packaged Equipment” too large for completed assembly, the assembly may be “broken down” into shippable subassemblies requiring only minimal reassembly, refastening, reconnection, etc. Any piping and/or electrical connections required between subassemblies shall be provided with quick-connect fittings which do not require special tools to secure the connections.

Y. Per: “in accordance with the requirements of”.

Z. Plan(s): The terms shall read to mean “Contract Drawings”.

AA. Product: Materials, systems, and equipment.

BB. Project: The total construction of which the work performed under the Contract Documents may be the whole or a part.

CC. Project Manual: The volume(s) assembled for the Work which may include Introductory Information, Bidding Requirements, Contract Forms, Conditions of the Contract, the Specifications, and Reference Materials.

DD. Project Site / Site: The space available for the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project Site is shown on the drawings and may or may not be identical with the description of the land upon which the Project is to be built.

EE. Provide: To furnish, install, and connect, complete and ready for intended use.

FF. Regulations: Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

GG. Request for Information (RFI): A request for information by the Contractor to the Architect of Record for clarification of intent of any portion of the Contract Documents after the Award of Contract and during the construction of the Project.

HH. Review: Where used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the duties and responsibilities of the Architect as stated in the General Conditions and Supplementary Conditions. Such review shall not release the Contractor from responsibility to fulfill Contract requirements unless otherwise provided in the Contract Documents.

II. Supplier: As used herein; A firm or organization furnishing or delivering products directly to the jobsite, and because of such direct delivery, could be construed under the lien laws of the State in which the work is being performed as having lien rights against funds due the Contractor. Suppliers of materials and equipment, delivering to Contractor or Subcontractor on an open account basis and not having lien rights on the Work, will not be considered suppliers within the meaning of the Contract Documents.

JJ. Testing Agency: An independent entity engaged to perform specific inspections or tests, either at the project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

KK. Trades: The use of titles such as "Carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter". It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

LL. Trade Specialists: Certain Sections of the Specifications require that specific construction activities be performed by specialists who are recognized experts in the operations to be performed. The Specialists must be engaged for those activities, and assignments are requirements over which the Contractor has no choice or option.

MM. Unit Price: An amount proposed by Bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to, or deducted from, the Contract Sum by appropriate modification, if the estimated quantities of Work required by the Contract Documents are increased or decreased.

NN. Work: (Capitalized) The construction services required by the Contract Documents, whether completed or partially completed, and including all other labor, materials, equipment and other services provided or to be provided by the Contractor too fulfill the Contractor's obligations. The Work may constitute the whole or part of the Project.

OO. work: (Lower Case) Activity to do or perform something, a specific task being a part or phase of some larger activity, or something that results from a particular manner or method, working, operating, or devising.

PP. Working Days: Standard working days for the Project shall be all calendar days except Saturdays, Sundays, and legal holidays where the Project is located and shall invoke no cost or time penalties. Working days other than “standard working days” will be considered “premium working days” and shall include, if any, cost penalty. Work to be performed on “premium working days” requires written permission from the Owner’s Representative, and shall be requested a minimum 48 hours prior to such requirement.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. This Section specifies requirements for temporary services and facilities, and for related administrative and procedural controls.
   1. Responsibility for temporary facilities and controls is Contractor's, unless otherwise indicated.
   2. Use of alternative temporary facilities equivalent to those specified is Contractor's options, subject to Architect's acceptance.

B. The types of temporary facilities and controls required for the project include (but are not necessarily limited to) the following:
   1. Temporary site access.
   2. Construction parking.
   3. Storage.
   4. Field office.
   5. Site use.
   6. Temporary sanitary facilities.
   7. Temporary water service and distribution.
   8. Temporary electric power service, distribution and lighting.
   9. Temporary heating and ventilating.
   10. Temporary fire protection.
   11. Dust and pollution control.
   12. Security.
   13. Construction aids.
   14. Barricades, warning signs and lights.
   15. De-watering facilities.
   16. Temporary enclosure.
   17. Cleanup.
   18. Rodent and Pest Control
   19. Safety.
   20. Environmental Protection.

1.03 REFERENCES

A. ANSI A10 - Construction and Demolition Standards; current editions.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

D. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Temporary Utilities: Submit test reports inspections, meter readings, and similar procedures performed on temporary utilities.

C. Reports and Permits: Submit copies of whatever inspection reports, certificates, permits and similar documentation that may be required or issued in connection with support facilities.

1.05 QUALITY ASSURANCE

A. Regulations: Comply with governing regulations, utility company requirements and recommendations for construction of temporary facilities including (but not necessarily limited to) code compliances, permits, inspections, testing and health and safety compliance.
   1. Comply with pollution, environmental protection and conservation regulations for the use of water and energy, and for control of dust, air pollution, noise and similar nuisances.

B. Standards: Comply with NFPA 241, ANSI A10.
   1. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electrical service. Install service in compliance with NFPA 70.

C. Trade Jurisdictions: The assigned responsibilities for installation and operation of temporary facilities are not intended to interfere with normal application of trade regulations and union jurisdictions applicable to the work.

1.06 PROJECT CONDITIONS

A. Schedule Uses: Provide temporary facilities ready for use at each location, at time first needed to avoid delays in performance of the work. Maintain, expand and modify as needed through progress of work, and remove when no longer needed or replaced by authorized use of complete permanent facilities.

B. Temporary Use of Permanent Facilities: Regardless of previously assigned responsibilities for temporary facilities, the Installer of each permanent facility shall assume the responsibility for its operation, maintenance and protection during use as a construction facility prior to Owner's acceptance and assumed operation of facility. Contractor shall continue to pay all costs thereof.

C. Conditions of Use: Operate, maintain, control and protect temporary facilities in manner which will prevent overloading, freezing, pollution, contamination of water source, flooding, unsanitary conditions, hazardous exposures, fire, diseases, erosion of site, damage or deterioration of completed work, public nuisances, and similar deleterious effects including inconvenience to Owner, disruption of existing services or altering service characteristics in any way as a consequence of use.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT FOR TEMPORARY FACILITIES

A. Provide either new or used materials and equipment, which are in substantially undamaged serviceable condition. Provide materials and equipment which are recognized in the construction industry by compliance with appropriate standards as being suitable for intended use, and capable of being maintained properly through course of anticipated use at project site.

B. Where a portion of temporary service is provided by utility company, provide remainder with matching and compatible material and equipment. Comply with recommendations of utility company.

C. Electrical Service: Except for any exterior overhead service, protect temporary electrical wiring by providing metal conduit, tubing, or armored cable or equivalent protective raceways and metal enclosures for wiring devices and switchgear. Comply with applicable NEMA Standards and governing regulations.

D. Electrical Power Cords: Use only grounded extension cords, "hard service" type where exposed to abrasion and traffic. Use single lengths or tape intermediate connections with waterproof electrical tape, or use waterproof connectors.

E. Electrical Outlets: Provide property configured NEMA polarized outlets to prevent insertion of 110/120 volt plugs into higher voltage outlets. Provide outlets equipped with ground-fault circuit interruptions with reset buttons for connection of power tools.

F. Lamps and Light Fixtures: Provide general service type incandescent lamps of wattage indicated or required for adequate illumination. Where exposed to breakage by construction operations, protect lamps with guard cages or tempered glass enclosures. Provide exterior type fixtures where exposed to weather or moisture.

G. Heating Units: Provide temporary heating units which have been tested and labeled by UL, FM, FIA, or a recognized trade association related to fuel being consumed (AGA, NEMA or other).

H. Water Hoses: Where shut-off nozzles are used at discharge of water hoses, provide heavy-duty abrasion resistant hoses with a pressure rating greater than maximum pressure of water distribution system. Where non-potable water is used, provide adequate warning sign on discharge end of each length of hose.

I. Tarpaulins: Waterproof and fire-retardant type, UL labeled with an ASTM E84 flame-spread of 15 or less. Provide translucent type (laminated polyethylene with nylon reinforcement or similar) for temporary enclosure where work is being or will be performed, so as to admit maximum daylight (and reduce need for temporary lighting).

J. Self-Contained Toilet Units: Single occupant, self-contained units, chemical, aerated recirculation type fully enclosed with a glass fiber reinforced polyester shell or similar non-absorbent material, properly vented and maintained in operation.

K. Fire Extinguishers: Provide Type A fire extinguishers for temporary offices and similar spaces where there is minimal danger of electrical fires or grease-oil-flammable liquid fires. Otherwise provide either type ABC dry chemical extinguishers or a combination of several extinguishers recommended by NFPA for exposure in each case.

L. Plywood: Provide exterior type, prime and finish painted. For visual barriers, safety barriers, sidewalk bridges and similar direct-contact uses, provide minimum 5/8 inch thick plywood.

M. Water: Provide potable water approved by local health authorities.

N. Open Mesh Fencing: Provide minimum 11 gage, galvanized 2-inch chain link type fencing 6 feet high. Provide steel posts, 1-1/2 inch I.D. for line post, 2-1/2 inch I.D. for corner posts.

O. Temporary Offices: Provide prefabricated, mobile units or similar job-built construction with lockable entrances, operable windows, and serviceable finishes. Provide heating and air conditioning units adequate for size of facility.

PART 3 EXECUTION

3.01 CONTRACTOR USE OF PREMISES

A. Confine operations to areas within the Contract Limits. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.
   1. Maintain Legal, protected fire egress at all times.
   2. Provide access for emergency vehicles at all times.
   3. Do not block or close roadways, driveways, entrances, or fire lanes.
   4. Move any stored materials, equipment or products, which interfere with operations of the Owner.
   5. Smoking will not be permitted in building. Comply with Owner’s existing policy regarding smoking on building grounds.

B. Comply with governing regulations, utility company requirements and recommendations for construction of temporary facilities including (but not necessarily limited to) code compliances, permits, inspections, testing and health and safety compliance.

C. Maintain the premises free of accumulation of waste material or rubbish caused by construction operations at all times. Remove all waste materials and rubbish on a daily basis. Remove all tools, construction equipment, machinery and surplus materials at completion of work.

3.02 INSTALLATION OF TEMPORARY FACILITIES

A. General: Use qualified tradespeople for installation of temporary facilities. Locate facilities where they will serve the total project construction work adequately and result in minimum interference with performance of the work. Relocate, modify and extend facilities as required during course of the work to properly accommodate entire work of project.
   1. Except as otherwise indicated, changeover from use of temporary facilities to use of permanent facilities at the earliest feasible date in each portion of the building, so as to minimize hazards and interference with performance of the work commonly associated with temporary facilities.
      a. Do not use permanent water piping for distribution of non-potable water.
   2. Wherever feasible, engage the utility company to install temporary service to project, or at a minimum to make connection to existing utility service.
      a. Use qualified tradespeople for installation of each service.
      b. Locate services where they will not interfere with total project construction work, including installation of temporary services as installed for required period of use; and relocate, modify or extend as necessary from time to time during that period as required to accommodate total project construction work.

B. Temporary Site Access: Enter site only as directed by Owner. Arrange in advance with Owner for deliveries requiring other access.
   1. Construct and maintain temporary roads and access drives as required. Provide road materials as required. At conclusion of work remove all temporary construction and restore site to preconstruction condition.
   2. Do not allow vehicles to track mud, dirt or debris.
   3. Provide street cleaning and snow removal as required and as directed by owner.

C. Construction Parking: Park only within site staging area. Control as required for orderly use.
   1. Do not permit parking on sidewalks, lawns or undesignated parking areas.
   2. Construct and maintain temporary parking lot for construction personnel as required and directed by Owner.

D. Storage: Store materials and equipment and stage operations only within site staging area.
   1. Suitably store materials so as not to interfere with building operations, not be exposed to weather where damage could result, or not invite tampering or theft. Storage is at Contractor's risk, except as provided under insurance.
   2. Provide substantial temporary enclosures for secure storage areas. Provide locking entrances to prevent unauthorized entry, vandalism, and theft.

E. Field Office: Provide and maintain temporary field office facilities at job site sized to accommodate Contractor's supervisory staff. Allocate space within Contractor's own site office trailer for use by Architect as needed.
   1. Remove field and temporary offices when no longer required.
   2. Locate and construct shanties, sheds and temporary facilities provided at the Contractors convenience as acceptable to Architect. Maintain in good condition and neat appearance.

F. Barricades, Warning Signs and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed provide lighting, including flashing red or amber lights.

G. Enclosure Fence: When excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated, or enclose entire site or the portion determined sufficient to accommodate construction operations. Install in manner to prevent people, dogs and other animals from easily entering the site, except by the entrance gates.
   1. Provide open-mesh, chain-link fencing with posts set in a compacted mixture of gravel and earth.
   2. Fence shall be minimum 6 feet high.

H. Site Use: Work and personnel on site will not be permitted on weekends, holidays, before 7:00 am or after 7:00 pm Monday through Saturday, unless authorized in writing by Owner. No work will be permitted on Sundays, unless autorized in writing by Owner.
   1. As far as possible, confine work operations within Contract and Staging limits. Restore all operation areas to preconstruction condition unless other work shown or required.

I. Temporary Sanitary Facilities: Comply with governing regulations including safety and health codes for type, number, location, operation and maintenance of fixtures and facilities, but provide not less than specified requirements. Install sanitary facilities in locations not visible to the general public which will best serve needs of personnel at project site and as approved in writing by Owner..
   1. Supply and maintain toilet tissue, paper towels, paper cups and similar disposable materials as appropriate for each sanitary facility, and provide appropriate wastes paper containers for used materials.
   2. Toilets: Provide self-contained toilet units shielded for privacy. Pit-type privies are not permitted.
      a. Use of Owner's facilities is not permitted.

J. Temporary Water Service and Distribution:
   1. Service: Provide and install potable water service and distribution piping, of sizes and pressures adequate for temporary construction purposes, including construction processes, fire protection, drinking, sanitary facilities, and cleaning required during construction period (until permanent service is in use).
   2. Distribution: Provide minimum 1 inch (pipe size) primary distribution piping for temporary water to each location of use. For construction use of water, provide 1 inch hose outlets with vacuum breaker and 3/4 inch hose adaptor. Space outlets so that every area of work requiring water can be reached within 100 feet length of hose.
   3. Contractor shall pay for all water consumed.

K. Temporary Electric Power Service, Distribution and Lighting:
   1. Service: Provide and install weatherproof, grounded electric power service of size, capacity and power characteristics required for temporary uses including construction machinery, tools and equipment, lighting, heating (to extent required, if any), alarms, communication devices and initial operation and testing of work which requires power must be test operated or placed in service ahead of time permanent power service is available.
      a. Install service and grounding in compliance with National Electrical Code (NFPA 70). Include transformers, overload protected disconnect and main distribution switchgear as may be required.
   2. Distribution: Provide a weatherproof, grounded, temporary power distribution system sufficient to accommodate performance of entire work of project, including but not necessarily limited to use of equipment, and electrical construction machines, temporary electrical heating where required, operation of test equipment and test operation of building equipment and systems which cannot be delayed until permanent power connections (pumps, HVAC equipment and similar equipment). Provide circuits of adequate size and proper power characteristics for each use.
      a. Provide overload-protected disconnect switch for each temporary power circuit, located at power distribution center.
      b. For general use of power hand tools and task lighting, provide temporary 4-gang outlets, spaced so that each area of work can be reached with a 100 ft. extension cord. Provide separate 110-120 volt, 20 amp circuit for each 4-gang outlet (4 outlets per circuit).
      c. Provide metal conduit, tubing or armored cable for protection of temporary power wiring, except at Contractor's option and where permitted by Code, wiring of circuits not exceeding 110-120 volt, 20 amp rating may be non-metallic sheathed cable in areas where located overhead and exposed for surveillance. Provide metal enclosures or boxes for wiring devices.

3. Lighting: Provide a general weatherproof, grounded temporary lighting system in every area of construction work. Provide sufficient illumination for safe work and traffic conditions.
    a. Provide overload-protected disconnect switch for each temporary power circuit located at power distribution center.
    b. For general temporary lighting in construction areas, provide not less than one 200 watt incandescent lamp per 1,000 square feet of floor area, uniformly distributed or provide equivalent illumination of a similar nature. Provide not less than 100 watt incandescent lamps in corridors and similar trafficways, spaced not more than 50 feet apart, except provide one lamp at each stairway or ladder landing.
4. Contractor shall pay for all power consumed.

L. Temporary Heating and Ventilating: Provide temporary heat required by construction activities for curing and drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity, and to extent required by any other contractor or trade. In the event of any dispute regarding the necessity, quantity or location of heat, the Architect will be the final arbiter.
1. Use only types of heating and ventilating units which pose no hazard.
2. Maintain areas surrounding heating devices clear and free from any hazardous materials.
3. Contractor shall supply sufficient supervision over the operation of all heating devices consistent with safety of personnel and adjacent occupied facilities.
4. Use of gasoline-burning space heaters, open flame, or similar type heating devices are prohibited.
5. Remove temporary heating and ventilating equipment and related connecting and supporting appurtenances when no longer required. Repair damage to new construction and complete new construction wherever affected by such equipment or its removal.
6. Contractor shall pay for all fuel or energy.

M. Temporary Fire Protection: During construction period and until time certain protection needs may be fulfilled by permanent facilities, Contractor shall install and maintain whatever types and forms of fire protection facilities may be needed to adequately protect against fire losses which are reasonably predictable and controllable.
1. Except as otherwise indicated or required, comply with the applicable recommendations of NFPA 10 for each area of each construction activity when combustible materials, flammable liquids, and similar exposures to possible fires are present.
2. Locate extinguishers where most convenient and effective for intended purposes, but provide not less than one on each floor at or near each usable stairwell.
3. Store combustible materials in recognized fire-safe locations and containers.

N. Dust and Pollution Control: Provide protection facilities, operate temporary facilities, conduct construction activities, and enforce strict discipline for personnel at project site in ways and by methods which comply with environmental protection regulations, and which minimize the possibility that air might be contaminated or polluted or that other undesirable effects might result from performance of the work at project site.

O. Security: Do no allow unauthorized persons on site including building construction areas. Carefully monitor and control all access to the site. Lock all doors and gates when not in use and after working hours.

P. Construction Aids: Provide scaffolding, ramps, runways, staging, temporary stairs, ladders, sheeting, shoring, cross-lot bracing, bridges, guard rails, barriers, closures, demolition waste chutes, platforms, swing stages and temporary partitions. Design, construction and maintenance of construction aids is sole responsibility of Contractor. Provide facilities as required to accommodate performance of entire work of project.
1. Provide temporary stairs where ladders are not adequate for performance of the work.

Q. Hoists and Elevators: Use elevator as directed by Owner, otherwise provide adequate hoisting facilities for both materials and employees; do not allow employees to ride hoists which comply with only requirements for material hoisting. Selection of type, size and number of hoisting facilities for temporary use at project site is Contractor's option.

R. Temporary Enclosure: Provide temporary enclosure of materials, equipment, work in progress and completed portions of work, so as to afford protection for both the work and employees from whatever deleterious effects may result from general exposure, foul weather, other construction operations and similar activities.
   1. Where heat is needed and permanent building enclosure is not complete, provide temporary enclosures, where there are no other provisions for containment of heat. Coordinate temporary enclosures with ventilating and drying-of-the-work requirements so as to avoid dangerous conditions and deleterious effects.
   2. Provide enclosure by securely installing tarpaulins or other equivalent measures, using a minimum of wood framing or other combustible materials. Individual openings of 25 sf or less may be closed with plywood or similar materials. Close floor/deck openings with substantial load-bearing wood framed or similar temporary construction, or provide barriers or handrails with warning signs and lights.
   3. Where temporary wood/plywood enclosures exceed 100 sf in area, use fire retardant treated wood/plywood (UL labeled "A") for main sheathing, and use a minimum of non-treated wood framing and trim; or use other equivalent fire-resistive materials.

S. Cleanup: Maintain the premises free of accumulation of waste material or rubbish caused by construction operations at all times. Remove all waste materials and rubbish, tools, construction equipment, machinery and surplus materials at completion of work.
   1. Establish and enforce a daily system for collecting and disposing of waste materials from construction areas and elsewhere at the project site. Do not hold collected materials at the site for periods of more than 7 days, nor for periods of more than 3 days during hot weather (when daily temperatures can be expected to rise above 80 degrees F).
   2. Comply with requirements of NFPA 241 for removal of combustible waste materials and debris. Handle hazardous, dangerous, or unsanitary materials separate from other waste materials. Dispose of materials in lawful manner.
   3. Refer to Section 01 7423 - Final Cleaning for final cleaning requirements.

T. Rodent and Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest control company to recommend practices to minimize attraction and harboring of rodents, roaches and other pests. Employ this service to perform extermination and control procedures at regular intervals so the Project will be relatively free of pests and their residues at Substantial Completion. Perform control operations in a lawful manner using environmentally safe materials.

U. Safety:
   1. Establish safety provisions as necessary:
      a. For the protection from injury to employees engaged in the execution of this Contract and to the General Public using the existing adjacent facilities.
      b. To prevent damage to property, materials and equipment; and
      c. To avoid work interruptions in the performance of the Contract.
   2. Comply with applicable requirements of OSHA, State department of OSHA, EPA and any other government entity having jurisdiction.
   3. Maintain an accurate record of all accidents resulting in personal injury or property damage; properly investigate the cause of same; and take corrective action wherever necessary.
   4. Develop an integrated accident and fire prevention program for construction operations and activities which includes Contractor and Subcontractors.
      a. Consult with Safety Engineer of insurance carrier and submit in writing, "A Construction Safety Plan" outlining the Contractor's plan for accident and fire prevention on work to be done under this Contract.

b. Designate a person in his organization with authority and responsibility to administer the accident and fire prevention program on work to be performed under this Contract.

V. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.03 OPERATIONS AND TERMINATIONS

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of facilities to essential uses so as to minimize waste and abuse.

B. Maintenance Operations: Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on 24-hour-per-day basis where required to achieve indicated results in the work, and avoid possibility of damage to the work and temporary facilities. Prevent water filled piping and vessels from freezing, whether temporary or permanent, by draining, insulating or heating.

C. Termination and Removal: When need has ended for each temporary construction facility, or for a substantial element of the facility, or when it has been replaced by authorized use of a permanent facility, or when not later than time of Substantial Completion, promptly remove temporary facility, unless directed by Architect to retain for longer period of time.
   1. Complete work which may have been delayed because of interference with temporary facilities.
   2. Repair damaged work, clean exposed surfaces, and replace work which cannot be satisfactorily restored.
   3. Except as otherwise indicated, materials and equipment of temporary facilities remain property of Contractor.

END OF SECTION

SECTION 01 6000 - COMMON PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements governing the Contractor's selection of products and their use in the Project.

B. General product requirements.

C. Transportation, handling, storage and protection.

D. Procedures for Owner-supplied products.

E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.03 RELATED REQUIREMENTS

A. Section 01 2500 - Substitution Procedures

B. Section 01 3323 - Shop Drawings, Product Data, and Samples

1.04 DEFINITIONS

A. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.

B. Base and Optional Manufacturers: Acceptable manufacturers are often listed in Part 2 of a specification section. A particular manufacturer and product are often listed as a “Design Standard” or "Basis of Design".

1. The “Design Standard” or "Basis of Design" is the manufacturer of the specific product used as the basis for design.
2. The other manufacturers, or manufacturers and products listed are “Optional” manufacturers, and manufacture a product similar to the specific product used as the design basis. Listing of a manufacturer indicates acceptance of that manufacturer as a supplier of the product, without a substitution, but only if the “optional” manufacturer’s product complies with the specified requirements, including the salient qualities provided by the “Design Standard” manufacturer’s product. Salient qualities include, but are not limited to the following:
    a. Purpose and function.
    b. Material and finish.
    c. Strength, durability and other applicable physical properties.
    d. Compatibility and performance attributes for the indicated application.
    e. Capacity and operating characteristics, where applicable.
    f. Size and configuration to the extent required for fit with adjoining and adjacent conditions and within spatial limitations.
    g. Appearance, including exposed dimensions, profile, texture, pattern and color, where visible to personnel in a finished space or from the exterior.
3. The Contractor is responsible for costs to provide any dimensional, structural, utility and other related adjustments required to fit an “Optional” manufacturer’s product into the Work.

1.05 SYSTEM PERFORMANCE REQUIREMENTS

A. Generally provide products, materials and equipment that:

1. Comply with specified standards and related requirements.
2. Comply with requirements for size, make, type and quality specified, or as specifically directed in writing by Architect.
3. Where manufactured and fabricated products:

a. Design, fabricate and assemble per best engineering and shop practices.
b. Manufacture like parts of duplicate units to standard sizes and gages, and to be interchangeable.
c. Provide two or more items of the same kind as identical and by the same manufacturer.
d. Provide products that are suitable for service conditions.
e. Provide equipment capacities, sizes and dimensions shown or specified unless variations are specifically authorized in writing.

4. Do not use products, materials or equipment for any purpose other than that for which they are designed unless otherwise indicated or specified.

1.06 QUALITY ASSURANCE

A. Source Limitations: To the greatest extent possible, provide products of the same kind from a single source.

B. Compatibility of Options: When Contractor is given option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Deliver, store and handle products per manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.
1. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged or sensitive to deterioration, theft or other losses.
2. Deliver products to site in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storage, unpacking, protecting and installing.
3. Protect moisture sensitive materials, including but not limited to wood materials, from the accumulation of moisture.
a. Avoid storing materials where they are exposed to rain, snow or standing water.
b. Keep materials covered. Make sure coverings are ventilated to prevent the accumulation of condensation.
c. "Dry-in" the structure as quickly as possible. Make sure weather resistive barrier is intact to keep installed materials from being exposed to excess moisture once removed from protective storage.
d. Immediately remove standing water and snow from moisture sensitive materials, including but not limited to wood framing and sheathing.
4. Store products at site in manner to facilitate inspection and measurement of quantity or counting of units.
5. Store heavy materials away from Project structure in manner that will not endanger supporting construction.

B. Arrange deliveries of products in accordance with construction schedules. Coordinate to avoid conflict with work and conditions at site.
1. Deliver products in undamaged condition in manufacturer's original containers or packaging with identifying labels intact and legible.
2. Immediately on delivery inspect shipments to assure compliance with requirements of Contract Documents and accepted submittals, quantities are correct, and products are properly protected and undamaged.

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

D. Store products per manufacturer's instructions with seals and labels intact and legible.
1. Store products subject to damage by elements in weather-tight enclosures.
2. Maintain temperature and humidity within ranges required by manufacturer's instruction.

E. Protect installed product from damage due to exposure to the elements. For example, if product is UV sensitive protect from sunlight; if product is moisture sensitive protect from rain, snow and condensation.

F. Exterior Storage: Store fabricated products above ground on blocking or skids to prevent soiling or staining. Cover products subject to deterioration with impervious sheet covers and provide adequate ventilation to avoid condensation.

G. Arrange storage in manner to provide easy access for inspection. Make periodic inspections of stored products to assure products are maintained under specified conditions and free from damage or deterioration.

PART 2 PRODUCTS

2.01 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with Contract Documents, are undamaged, and unless otherwise indicated, unused at time of installation.
   1. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for intended use and effect.

B. Product Selection Procedures: Product selection is governed by Contract Documents and governing regulations, not by previous Project experience. Procedures governing product selection include the following:
   1. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide product indicated. No substitutions will be permitted.
   2. Semi-proprietary Specification Requirements: Where two or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted.
      a. Where one product and manufacturer is named as the "Design Standard" or "Basis of Design" and other manufacturers or manufacturers and products are specified by name, other manufacturer’s equivalent product may be acceptable, subject to compliance with Contract requirements, including specifications of the product designated as the "Design Standard" or "Basis of Design", as determined by Architect.
      b. Specific equivalent manufacturer’s products shall be identified in the initial submittal period.
   3. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements. Use products of listed manufacturers but verify compliance with specified characteristics.
   4. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products with these requirements, and are recommended by manufacturer for application indicated. Verify proposed product complies with performance requirements.
      a. Manufacturer's recommendations may be contained in published product literature or by manufacturer's certification of performance.
   5. Compliance with Standards, Codes and Regulations: Where Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with standards, codes or regulations specified.
   6. Visual Matching: Where Specifications require matching an established Sample, the Architect's decision will be final on whether a proposed product matches satisfactorily.
   7. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern and texture from the product line selected.

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

2.03 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 OWNER-SUPPLIED PRODUCTS

A. Owner's Responsibilities:
   1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
   2. Arrange and pay for product delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:
   1. Review Owner reviewed shop drawings, product data, and samples.
   2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
   3. Handle, store, install and finish products.
   4. Repair or replace items damaged after receipt.

3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

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

F. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

3.03 STORAGE AND PROTECTION

A. Store and protect products in accordance with manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

D. For exterior storage of fabricated products, place on sloped supports above ground.

E. Provide off-site storage and protection when site does not permit on-site storage or protection.

F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

G. Comply with manufacturer's warranty conditions, if any.

H. Do not store products directly on the ground.

I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

J. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

K. Prevent contact with material that may cause corrosion, discoloration, or staining.

L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

3.04 INSTALLATION OF PRODUCTS

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

B. Handle, install, connect, clean, condition and adjust products per manufacturer's instructions and in conformance with specified requirements.
   1. Should project conditions or specified requirements conflict with manufacturer's instructions, consult with Architect for further direction.
   2. Do not proceed with work without clear instructions.

C. Protection after Installation: Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.

END OF SECTION

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SECTION 01 7123 - FIELD ENGINEERING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements for field engineering.

1.03 QUALITY ASSURANCE

A. Surveyor/Civil Engineer: Engage of Land Surveyor or Professional Civil Engineer registered in the state where the project is located to perform surveying services required.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing control points. Survey, locate and stake property line corners.

B. Verify layout information showed on drawings in relation to property survey and existing benchmarks before proceeding to layout the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.
   1. Do not change or relocate benchmarks or control points without prior written approval.
   2. Promptly replace lost or destroyed project control points. Base replacements on original survey control points.

C. Establish and maintain a minimum of two permanent benchmarks on the site referenced to data established by survey control points.
   1. Record benchmark locations with horizontal and vertical data on Project Record Documents.

D. Existing Utilities and Equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction.
   1. Prior to construction verify the location and invert elevation at points of connection of sanitary sewer, storm sewer and water service piping.

3.02 LAYOUT

A. Establish benchmarks and markers to set lines and levels at each story of construction and elsewhere as needed to properly locate each element on the Project working from lines and levels established by the property survey. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale drawings to determine dimensions.
   1. Advise parties engaged in construction activities of marked lines and levels provided for their use.
   2. As construction proceeds, check every major element for line, level and plumb.

B. Surveyor's Log: Maintain a surveyor's log of control and other survey work. Make log available for reference.
   1. Record deviations form required lines and levels and advise Architect when deviations that exceed indicated or recognized tolerances are detected. Record deviations that are accepted and not corrected on Project Record Drawings.
   2. On completion of foundation walls, major site improvement, and other work requiring field engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations on construction and site work.

C. Site Improvements: Locate and layout site improvements including pavement, stakes for grading, fill and topsoil placement, utility slopes and invert elevations by instrumentation and similar appropriate means.

D. Building Lines and Levels: Locate and lay out batter boards for structures, building foundations, column grids and locations, floor levels and control lines and levels required for mechanical and electrical work.

E. Existing Utilities: Furnish information necessary to adjust, move or relocate existing structures, utility poles, lines, services or other appurtenances located in or affected by construction. Coordinate with local authorities having jurisdiction.

END OF SECTION

SECTION 01 7329 - CUTTING AND PATCHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements for cutting and patching.

1.03 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing cutting and patching procedures well in advance of time cutting and patching will be performed and request approval to proceed when the following conditions are involved.
   1. Structural integrity of any element of the Project.
   2. Integrity of weather exposed or moisture sensitive element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate contractor.

B. Cutting and patching proposal shall include the following information, as applicable, in the proposal:
   1. Identification of Project.
   2. Location and description of affected work.
   3. Reason for cutting, patching, and/or alteration requirement and anticipated results in terms of changes to existing construction. Include in the building's appearance and other significant visual elements.
   4. Alternatives to cutting, patching, and/or alteration requirement.
   5. Effect on work by Owner or separate contractor.
   6. Written permission of affected separate contractors.
   7. Date and time work will be executed.
   8. Products to be used and firms or entities that will perform the work.
   9. Utilities that will be disturbed or affected. Indicate how long service will be disrupted.
   10. Where cutting and patching involves reinforcement of structural elements, furnish details and engineering calculations to show reinforcement is integrated with original structure.
   11. Approval by Architect to proceed with cutting and patching does not waive the Architect's right to later require complete removal and replacement of a part of the work found to be unsatisfactory.

1.04 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in manner that would reduce their load-carrying capacity or load-deflection ratio.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in manner that would result in reducing their capacity to perform as intended, or result in increased maintenance or result in decreased operational life or safety.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in manner that would, in the Architect's opinion, reduce the building's aesthetic qualities or result in visual evidence of cutting and patching.
   1. Remove and replace work cut and patched in a visually unsatisfactory manner.

1.05 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 PRODUCTS

2.01 MATERIALS

A. Use materials identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding if unsafe or unsatisfactory conditions are encountered.
   1. Meet at Project Site with parties involved in cutting and patching before proceeding, including mechanical and electrical subcontractors. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
   2. Start of cutting and patching work will be construed as Contractor's acceptance of conditions within a particular area.

3.02 PREPARATION

A. Temporary Support: Provide temporary support of work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
   1. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
   2. Avoid cutting existing pipe, conduit or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them.

3.03 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
   1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent cutting and patching required to restore surfaces to their original condition.

B. Cutting: Cut existing construction using methods least likely to damage adjoining construction being retained.
   1. In general where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. To avoid marring existing finished surfaces cut or drill from the exposed or finished side into concealed surfaces.
   3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
      a. Pneumatic tools are not allowed.
      b. Do not pound or make openings with hammers.
   4. By-pass utility services such as pipe or conduit before cutting where services are shown or required to be removed, relocated or abandoned.
      a. Cut off pipe or conduit in walls or partitions to be removed.
      b. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
   1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.

2. Restore finishes of patched areas and extend finish restoration into retained adjoining construction in manner to eliminate evidence of patching and refinishing.
3. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces to provide an even surface of uniform color and appearance. Remove existing floor and wall finish materials and replace with new materials, if necessary, to achieve uniform color and appearance.
    a. Where patching occurs in a smooth painted surface extend final paint coat over entire unbroken area containing the patch to the nearest control joint or change in plane whichever is greater.
4. Fit work tight to pipes, sleeves, ducts, conduit, and other penetrations through the work.
5. At penetrations of fire-rated walls, partitions, ceilings, or floor construction, completely seal voids with UL rated firestopping systems to restore integrity of fire-rated element. Provide escutcheon plates where exposed to view.
6. Patch spray-applied fireproofing to restore integrity of fire-rated elements at locations where fireproofing has been removed during demolition and/or for attachment of new construction.

3.04 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Completely remove paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION

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SECTION 01 7423 - FINAL CLEANING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements for final cleaning at Substantial Completion.
   1. Additional special cleaning requirements for specific elements of Work are specified in individual Section in Divisions 02 through 49.

1.03 QUALITY ASSURANCE

A. Environmental Requirements: Conduct cleaning and waste disposal operations in compliance with local laws and ordinances. Comply with federal and local environmental and anti-pollution regulations.
   1. Do not dispose of volatile wastes such as mineral spirits, oil or paint thinner in storm or sanitary drains.
   2. Burning or burying of debris, rubbish or other waste material on premises will not be permitted.

PART 2 PRODUCTS

2.01 MATERIALS

A. Use cleaning material and agents recommended by the manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents potentially hazardous to health or property, or might damage finish surfaces.

PART 3 EXECUTION

3.01 FINAL CLEANING

A. Provide final cleaning operations when required. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of work to condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's instructions for cleaning operations.

B. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion for the entire Project or for a portion of the Project.
   1. Clean Project Site, including landscape development areas of rubbish, waste materials, litter and foreign substances. Sweep paved areas to broom clean condition; remove stains, chemical spills, and other foreign deposits. Rake grounds which are neither planted or paved, to a smooth, even textured surface. Remove stains, spills and other foreign deposits.
   2. Remove tools, construction equipment, machinery and surplus materials from the site.
   3. Clean interior hard-surfaced finishes to a dirt-free condition, free of dust, stains, films and similar foreign substances.
   4. Remove debris and surface dust from limited access spaces including plenums, shafts, equipment vaults, and similar spaces.
   5. Broom clean concrete floors in unoccupied spaces.
   6. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo if required.
   7. Professionally clean transparent materials, including mirrors and glass in doors and windows, both interior and exterior surfaces. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch the surfaces.
   8. Remove labels that are not permanent labels. Clean all permanent labels.

9. Touch-up and otherwise repair and restore marred exposed finishes and surfaces. Replace finishes and surfaces which cannot be satisfactorily repaired or restored, or show visible evidence or repair or restoration. Do not paint over UL and similar labels including mechanical and electrical identification plates.
10. Wipe surfaces of mechanical and electrical equipment, elevator equipment and similar equipment clean. Remove excess lubrication, paint and other foreign substances.
11. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
12. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers and grilles. Clean ducts, blowers and coils if units were operated without filters during construction.
13. Clean light fixtures, lamps, globes and reflectors to function with full efficiency. Replace burned out bulbs and defective and noisy starters in fluorescent fixtures.
14. Leave Project clean and ready for occupancy.

C. Pest Control: Engage an experienced licensed or bonded exterminator to make a final inspection of Project and to rid of rodents, insects and other pests. Comply with regulations of local authorities having jurisdiction.

D. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during remainder of construction period.

E. Compliances: Comply with safety standards and governing regulations for cleaning operations. Remove waste materials from site and dispose of in lawful manner.
1. Where extra materials of value remain after completion of associated construction have become the Owner's property, dispose of these materials to Owner's best advantage as directed.

END OF SECTION

SECTION 01 7700 - CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements for project closeout.

1.03 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following, listing exceptions in the request:
   1. In the Application for Payment that coincides with, or first follows the date Substantial Completion claimed, show 100 percent completion for the portion of Work claimed as substantially complete. Include supporting documentation for completion as required and a statement showing an accounting of change to the Contract Sum. Comply with requirements of the General Conditions.
      a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction and reasons the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specified warranties, maintenance agreements, final certifications and similar documents as required by the General Conditions.
   4. Obtain and submit releases enabling Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
   5. Submit record documents including maintenance manuals, damage or settlement survey, property survey and similar final record information.
   6. Deliver tools, spare parts, extra stock and similar items to Owner.
   7. Make final changeover of permanent locks and transmit keys to Owner. Advise Owner's personnel of changeover in security provisions.
   8. Complete start-up testing of systems and instruction of Owner’s operating and maintenance personnel. Discontinue or change over and remove temporary facilities from site, along with construction tools, mockups and similar elements.
   9. Complete final cleaning requirements including touch-up painting.

B. Inspection Procedures: On receipt of a request for inspection, Architect will either proceed with inspection or advise Contractor of unfilled requirements. Architect will prepare the Certificate of Substantial Completion following inspection, or advise Contractor of construction that must be completed or corrected before the certificate will be issued.
   1. Architect will repeat inspection when requested and assured the Work has been substantially completed.
   2. Results of the completed inspection will form the basis of requirements for final acceptance.

C. Operating and Maintenance Procedures:
   1. Operating instructions shall include necessary printed directions for correct operation, adjustment, servicing, and maintenance of movable parts. Operating instructions shall include complete integration of new systems with existing systems and how they are to operate together, in series, sequence, etc. Also, include a suitable parts list, approved shop drawings, and diagrams showing parts location and assembly.
   2. Arrange for each installer of equipment requiring regular maintenance to meet with Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:
      a. Maintenance manuals.

b. Record documents.
c. Spare parts and materials.
d. Tools.
e. Lubricants.
f. Fuels.
g. Identification systems.
h. Control sequences.
i. Hazards.
j. Cleaning.
k. Warranties and bonds.
l. Maintenance agreements and similar continuing commitments.

3. As part of instruction for operating equipment, demonstrate the following procedures:
   a. Start-up.
   b. Shutdown.
   c. Emergency operations.
   d. Noise and vibration adjustments.
   e. Safety procedures.
   f. Economy and efficiency adjustments.
   g. Effective energy utilization.

D. Upon Architect's approval and prior to issuance of final payments, submit electronic copies of maintenance manuals.

1.04 FINAL REVIEW

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following, listing exceptions in request:
   1. Submit final payment request with releases and supporting documentation not previously submitted and accepted. Comply with requirements of the General Conditions. Include certificates of insurance for products and completed operations.
   2. Submit an updated final statement, accounting for final additional changes to Contract Sum.
   3. Submit a certified copy of Architect's final inspection list of items to be completed or corrected, stating each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by Architect.
   4. Submit record drawings and similar final record documents.
      a. Each drawing shall be labeled "Project Record", dated and signed by the Contractor.
      b. Each project record document shall be labeled "Project Record Document".
   5. Submit consent of surety to final payment.
   6. Submit evidence of final continuing insurance coverage complying with insurance requirements.

B. Re-inspection Procedure: Architect will re-inspect Work upon receipt of notice the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to Architect.
   1. Upon completion of reinspection, Architect will prepare Certificate of Final Acceptance, or advise Contractor of incomplete Work or of obligations not been fulfilled but required for final acceptance.
   2. If necessary, reinspection will be repeated for final acceptance.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01 7829 - FINAL SITE SURVEY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements for final site survey.

1.03 RELATED SECTIONS

A. Section 01 7123 - Field Engineering.

1.04 QUALITY ASSURANCE

A. Surveyor/Civil Engineer: Engage of Land Surveyor or Professional Civil Engineer registered in the state where the Project is located to perform surveying services required.

1.05 SUBMITTALS

A. Final Site Survey: Submit electronic copies of final property survey to the Owner at completion of the Project.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 EXAMINATION

A. Site Survey: Before Substantial Completion prepare a property survey showing significant features (real property) for the Project. Include a certification on the survey signed by Land Surveyor or Professional Civil Engineer to the effect that principal metes, bounds, lines and levels of the Project are accurately positioned as shown on the survey.
   1. Verify the location and invert elevation at points of connection of sanitary sewer, storm sewer and water service piping.

B. Recording: At Substantial Completion have the property survey recorded by or with local governing authorities as the official "property survey".

END OF SECTION

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SECTION 01 7839 - PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Administrative and procedural requirements for project record documents.
   1. Additional project record document requirements are specified in individual Sections in Division 02 through 49.

B. Record Documents including:
   1. Record Drawings
   2. Record Specifications
   3. Record Product Data
   4. Maintenance and Operation Data and Manuals

1.03 DEFINITIONS

A. Project Record Documents: Contract drawings, specifications, and shop drawings, indicating "As-Built" conditions and actual products selected for use.

1.04 RECORD DOCUMENT SUBMITTALS

A. General: Do not use record documents for construction purposes, protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for Architect's reference during normal working hours.

B. Provide Record Documents to the Owner or designated Owners Representative within 90 days after the date of the acceptance of each system or the Date of Substantial completion, whichever is earlier. Systems include, Building Envelope, HVAC, Service Water, Power, lighting and other equipment as defined in the applicable energy code.

C. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark set to show the actual installation where installation varies substantially from Work originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements difficult to measure and record at a later date.
   1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of Work.
   2. Mark new information important to Owner, but not shown on Contract Drawings or Shop Drawings, including the following:
      a. Changes made by addenda, change orders, supplemental instructions, or other modifications.
      b. Significant changes and selections made during the construction process.
      c. Significant detail not shown in the original Contract Documents.
      d. Physical measurements locating underground utilities and appurtenances, dimensionally referenced to permanent surface improvements.
      e. Location of internal utilities and appurtenances concealed in building structure, referenced to visible and accessible features of the building.
   3. Note related Change Order numbers, Field Order numbers, and other contract modifications, where applicable.
   4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.

D. Record Specifications: Maintain one complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.
   1. Legibly mark and record at each “Product” section of each Specification Section, the description of the actual products installed, including the following:
      a. Manufacturer’s name and product model and number.
      b. Product substitutions or alternates utilized.
      c. Changes made by Addenda, Bulletin or Construction Change Directive.
   2. Upon completion of the Work, submit record Specifications to Architect for Owner's records.

E. Record Product Data: Maintain one copy of each Product Data submittal. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site, and from manufacturer's installation instructions and recommendations.
   1. Legibly mark each Product Data submittal indicating actual product number and model installed in the Work.
   2. Note related Change Orders.
   3. Markup applicable record drawings and Specifications.
   4. Upon completion of markup, submit complete set of record Product Data to Architect for Owner's records.

F. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and submittals in connection with actual performance of the Work.
   1. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference.
   2. Submit to Architect for Owner's records.

1.05 OPERATION AND MAINTENANCE DATA

A. Provide Operation and Maintenance Manuals to the Owner or designated Owners Representative within 90 days after the date of the acceptance of each system or the Date of Substantial completion, whichever is earlier. Systems include, Building Envelope, HVAC, Service Water, Power, lighting and other equipment as defined in the applicable energy code.

B. Operation and Maintenance Manuals shall be in accordance with industry-accepted standards and shall include at minimum the following:
   1. Building Envelope:
      a. For each component of the building envelope requiring maintenance provide operation and maintenance manuals. Clearly identify routine maintenance requirements.
   2. For Heating, Ventilating and Air Conditioning provide:
      a. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
      b. Operation and Maintenance manuals for each piece of equipment and system requiring maintenance. Clearly identify routine maintenance requirements.
      c. Names and addresses of service agencies for each piece of equipment.
      d. HVAC controls system maintenance and calibration information, including wiring diagrams, schematics and control sequence descriptions. Permanently record desired or field determined set points on control drawings at control devices or for digital control systems in programming comments.
      e. Provide a complete narrative of how each system is intended to operate including set points.

3. Service Water Heating:
    a. For each component of the service water heating system requiring maintenance provide operation and maintenance manuals. Clearly identify routine maintenance requirements.
4. For Power Systems provide:
    a. Submittal data stating equipment rating and selected options for each piece of equipment requiring maintenance.
    b. Operation and maintenance manuals for each piece of equipment requiring maintenance. Clearly identify routine maintenance requirements.
    c. Names and addresses of service agencies for each piece of equipment.
    d. Provide a complete narrative of how each system is intended to operate.
5. For Lighting Systems provide:
    a. Submittal data indicating all selected options for each piece of lighting equipment including but not limited to lamps, ballasts, drivers and lighting controls.
    b. Operation and maintenance manuals for each piece of lighting equipment and lighting controls with routine maintenance clearly identified, including but not limited to a recommended relamping/cleaning program and a schedule for inspecting and re-calibrating all lighting controls.
    c. Provide a complete narrative of how each system is intended to operate including recommended settings.

C. In addition to information listed above, Operation and Maintenance Manuals shall contain:
1. An index cross referencing specification numbers for each item.
2. Operating instructions.
3. Emergency instructions.
4. Spare parts list.
5. Copies of warranties.
6. Wiring diagrams.
7. Recommended maintenance procedures and “turn around” cycles.
8. Inspection and system-test procedures.
9. Copies of applicable Shop Drawings.
10. Copies of applicable Product data.
11. Fixture lamping schedule.
12. Maintenance drawings and diagrams.
13. Listing of required maintenance materials.
14. Precautions against improper maintenance.
15. All organized by Specification Section.
16. For each piece of equipment or work portion, provide names, addresses, and phone numbers of the following parties:
    a. Contractor/installer.
    b. Manufacturer.
    c. Nearest dealer/supplier.
    d. Nearest agency capable of supplying parts and service.
17. Insulation Installation Documentation

D. Commence preparation of manuals after Shop Drawings and Product Data submittals have been accepted.

E. Submit electronic copies of maintenance manuals to Architect for Owner's records.

F. Provide electronic copies of Operation and Maintenance Manuals in .pdf format. Provide one locked copy to prevent inadvertent deletion or modification of materials and one unlocked copy to allow the manual to be used by the Owner as a living documentation for the maintenance of the building. Upon Owner's request provide paper copies of all Operation and Maintenance materials including Warranty information. When paper copies are requested organize operation and maintenance data into suitable sets of manageable size.

1. Finished manuals shall be a .pdf with bookmarks and a hyperlinked table of contents with bookmarks identifying each particular portion or item of Work. Title sheet of electronic copy shall indicate the following information:
    a. Project name and address.
    b. Owner’s name.
    c. Name and address of Architect.
    d. Name and address of Contractor.
    e. Name and address of Contractor.
    f. Date of Submission.
2. When Owner requests paper copies provide finished manuals organized in heavy-duty loose-leaf type 3-ring binders with hardboard covers and titled tabs identifying each particular portion or item of Work.
    a. Provide binders with pocket folders for folded sheet information.
    b. Provide each binder a detailed Table of Contents referring to index tabs.
    c. Mark appropriate identification on front and spine of each binder.
    d. Each manual label on front cover or spine shall indicate the following information.
        1) Project name and address.
        2) Owner’s name.
        3) Name and address of Architect.
        4) Name and address of Contractor.
        5) Name and address of Contractor.
        6) Date of Submission.

1.06 WARRANTY SUBMITTALS

A. Include originals, if a paper copy of the operation and maintenance manuals are provided; or locked .pdf if electronic copies are provided of each warranty in operation and maintenance manuals, indexed separately on Table of Contents.

B. Provide locked electronic copies of warranties in .pdf format. Upon Owner's request provide paper copies of all Warranty information. When paper copies are requested bind warranties in heavy-duty loose-leaf type 3-ring binders with hardboard covers and titled tabs identifying each particular portion or item of Work.
    1. Cover for paper copies: Identify each binder with typed or printed title WARRANTIES, with title of Project; name, address and telephone number of Contractor; and name of responsible company principal.
    2. Provide .pdf with bookmarks and a hyperlinked table of contents with bookmarks identifying each particular portion or item of Work.
    3. Each bookmarked/tabbed section (electronic/paper) shall indicate the following information.
        a. Name and address of Contractor.
        b. Name and address of Contractor.
        c. Contact person and phone number for warranty work.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Maintenance Drawings shall include the following:
   1. Include the location and performance data for each piece of equipment
   2. General configuration of the duct and pipe distribution systems, including sizes
   3. The terminal air or water design floe rates
   4. Single line diagram of the building electrical distribution system
   5. Floor plans indicating location and area served for all distribution
   6. Location of each luminaire
   7. Control & circuiting for each piece of lighting equipment

E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

F. Operating and Maintenance Instructions:
   1. Operating instructions shall include necessary printed directions for correct operation, adjustment, servicing, and maintenance of movable parts. Operating instructions shall include complete integration of new systems with existing systems and how they are to operate together, in series, sequence, etc. Also, include a suitable parts list, approved shop drawings, and diagrams showing parts location and assembly.

3.02 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
   2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.03 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. Arrange for each installer of equipment requiring regular maintenance to meet with Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:
   1. Maintenance manuals.
   2. Record documents.
   3. Spare parts and materials.
   4. Tools.
   5. Lubricants.
   6. Fuels.
   7. Identification systems.
   8. Control sequences.
   9. Hazards.
   10. Cleaning.
   11. Warranties and bonds.
   12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:
   1. Start-up.
   2. Shutdown.

3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

C. For Each Item of Equipment and Each System:
1. Description of unit or system, and component parts, including size and selected options.
2. Identify function, normal operating characteristics, and limiting conditions.
3. Include performance curves, with engineering data and tests.
4. Complete nomenclature and model number of replaceable parts.

D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

E. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

F. Include color coded wiring diagrams as installed.

G. Provide data indicating all selected options for each piece of lighting equipment, including but not limited to lamps, ballasts, drivers and lighting controls.

H. Provide operation and maintenance manuals for each piece of lighting equipment and lighting controls with routine maintenance clearly identified, including, as a minimum a recommended relamping/cleaning program and a schedule for inspecting and recalibrating all lighting controls.

I. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

J. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

K. Provide servicing and lubrication schedule, and list of lubricants required.

L. Include manufacturer's printed operation and maintenance instructions.

M. Include sequence of operation by controls manufacturer.

N. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

O. Provide control diagrams by controls manufacturer as installed, including the following:
1. HVAC controls system maintenance and calibration information, including wiring diagrams, schematics and control sequence descriptions. Permanently record on control drawings located at control devices; or if controls are digital, in the programming comments, the desired or field determined setpoints.

P. Provide a complete narrative of how each system is intended to operate. For HVAC controls include set points in narrative setpoints. For lighting systems include recommended settings.

Q. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

R. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

S. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

T. Include test and balancing reports.

U. Provide for each piece of equipment/system the names and addresses of at least one service agency.

V. Additional Requirements: As specified in individual product specification sections.

3.04 WARRANTIES

A. Obtain warranties and bonds, executed in electronic format by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, and contain full information.

C. Retain warranties until time specified for submittal.

D. Include originals, if a paper copy of the operation and maintenance manuals are provided; or locked .pdf if electronic copies are provided of each warranty in operation and maintenance manuals, indexed separately on Table of Contents.

E. Provide locked electronic copies of warranties in .pdf format. Upon Owner's request provide paper copies of all Warranty information. When paper copies are requested bind warranties in heavy-duty loose-leaf type 3-ring binders with hardboard covers and titled tabs identifying each particular portion or item of Work.
   1. Cover for paper copies: Identify each binder with typed or printed title WARRANTIES, with title of Project; name, address and telephone number of Contractor; and name of responsible company principal.
   2. Provide .pdf with bookmarks and a hyperlinked table of contents with bookmarks identifying each particular portion or item of Work.
   3. Each bookmarked/tabbed section (electronic/paper) shall indicate the following information.
      a. Name and address of Contractor.
      b. Name and address of Contractor.
      c. Contact person and phone number for warranty work.

END OF SECTION

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SECTION 02 4116 - STRUCTURE DEMOLITION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Demolition of existing structure and removal of materials from site.

B. Disconnecting and removal of identified utilities.

C. Refer to items as scheduled at end of section.

1.03 RELATED SECTIONS

A. Section 01 5000 - Temporary Facilities and Controls: Barriers, Fences and Landscape Protection.

B. Section 01 7839 - Project Record Documents.

C. Section 31 1000 - Site Clearing: Clearing outside periphery of structures.

D. Section 31 2000 - Earth Moving: Backfilling below-grade areas where demolition items are removed.

1.04 DEFINITIONS

A. Demolish: Completely remove and legally dispose of off-site.

B. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.

C. Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner. Include fasteners or brackets needed for reattachment elsewhere.

D. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.

E. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in locations indicated.

F. Existing to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during demolition and then cleaned and reinstalled in their original locations.

1.05 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at Contractor's option.

1.06 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data and Samples, for submittal procedures.

B. Proposed dust-control and noise-control measures.

C. Schedule of demolition activities indicating the following:
   1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity.
   2. Dates for shutoff and capping of utility services.
   3. Dates of temporary interruption of utility services.

D. Shop Drawings: Indicate demolition; location and construction of barricades, fences, and temporary work.

E. Inventory of items to be removed and salvaged.

F. Inventory of items to be removed by Owner.

G. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by demolition operations.

H. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating all refrigerant that was present was recovered and recovery was performed according to EPA regulations.
   1. Include name and address of technician and date refrigerant was recovered.

I. Project Record Documents: Identify and accurately record actual locations of capped utilities.

1.07 QUALITY ASSURANCE

A. Demolition Firm: Company specializing in type of work required by this Section, with minimum 5 years of documented experience.

B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

1.08 PRE-DEMOLITION CONFERENCE

A. Schedule a Pre-Demolition Conference minimum two weeks prior to delivery, to discuss sequence, schedule, demolition procedures, regulatory requirements, and safety precautions to be followed during demolition operations.
   1. Meet at the Project Site with the following parties in attendance.
      a. Architect.
      b. Owner’s Representative.
      c. Contractor.
      d. Demolition Contractor.
      e. Other parties concerned with demolition work.
   2. Review coordination and environmental controls required for demolition work.
   3. Review procedures for noise control and dust control.
   4. Review procedures for protection of adjacent buildings.
   5. Review items to be salvaged and returned to Owner.
   6. Tour representative areas of the structure to be demolished.
      a. Inspect and discuss conditions to be encountered.
      b. Discuss preparation work required to be performed by other trades.
   7. Proceed with demolition work only when everyone concerned agrees that required ambient conditions can be maintained.

B. Contractor shall record discussion, including agreement or disagreement on significant matters. Furnish copies of report to all parties present within 5 days after meeting date.
   1. If substantial disagreements exist at conclusion of meeting, determine how disagreements will be resolved, and set date and time to reconvene meeting.

1.09 REGULATORY REQUIREMENTS

A. Conform to applicable code for demolition of structures, safety of adjacent structures, dust control.
   1. Conform with hauling and disposal regulations of authorities having jurisdiction.

B. Obtain required permits from authorities having jurisdiction.

C. Notify affected utility companies before starting work and comply with their requirements.

D. Do not close or obstruct roadways without permits.

E. Conform to applicable regulatory procedures when hazardous or contaminated materials are discovered.

F. Test soils around buried tanks for contamination.

1.10 PROJECT CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of Work.

B. Owner assumes no responsibility for actual condition of buildings to be demolished.
   1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Asbestos is NOT expected to be encountered in the course of this Contract. If any materials suspected of containing asbestos are encountered, do not disturb the materials. Immediately notify the Architect and the Owner.
   1. Asbestos will be removed by Owner before start of Work.

D. Storage or sale of removed items or materials on-site will not be permitted.

1.11 SCHEDULING

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations.

B. Perform work between the hours of ____ and ____.

PART 2 PRODUCTS

2.01 SOIL DEFINITIONS

A. Satisfactory soil materials are defined as those complying with ASTM D 2487 soil classification groups GW, GP, GM, SM, SW and SP.

B. Unsatisfactory soil materials are defined as those complying with ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH and PT.
   1. Unsatisfactory soils include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

2.02 SOIL MATERIALS

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

B. Backfill and Fill Materials: "Satisfactory" soil materials free of clay, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
   1. Granular Backfill: Clean, natural, coarse bankrun sand, conforming to requirements for MDOT Class II or ASTM C 33, No. 67 materials; 100% passing a 1 inch sieve and retained on a No. 8 sieve.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. Survey the condition of the building to determine whether removing any element might result in a structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during demolition.

E. Perform surveys as the Work progresses to detect hazards resulting from demolition activities.

3.02 UTILITY SERVICES

A. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
   1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to governing authorities.
      a. Provide not less than 72 hours' notice to Owner if shutdown of service is required during changeover.

B. Owner will arrange for disconnecting and sealing indicated utilities serving structures to be demolished before start of demolition work, when requested by Contractor.

C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving structures to be demolished.
   1. Owner will arrange to shut off indicated utilities when requested by Contractor.
   2. Arrange to shut off indicated utilities with utility companies.

D. Utility Requirements: Refer to Divisions 21 thru 27 for shutting off, disconnecting, removing, and sealing or capping utility services. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.03 PREPARATION

A. Provide, erect, and maintain temporary barriers and security devices at locations indicated.

B. Protect existing landscaping materials, appurtenances, and structures that are not to be demolished.

C. Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during demolition operations.

D. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of buildings to be demolished and adjacent buildings to remain.
   1. Strengthen or add new supports when required during progress of demolition.

3.04 EXPLOSIVES

A. Explosives: Use of explosives will not be permitted.

3.05 DEMOLITION REQUIREMENTS

A. Conduct demolition to minimize interference with adjacent structures.

B. Cease operations immediately if adjacent structures appear to be in danger. Notify Architect and authority having jurisdiction; do not resume operations until directed.

C. Conduct operations with minimum interference to public or private accesses. Maintain protected egress and access at all times.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

D. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around demolition area.
   1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
   2. Protect existing site improvements, appurtenances, and landscaping to remain.
   3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

E. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.

F. Sprinkle demolition areas with water to minimize dust and dirt. Provide hoses and water connections for this purpose.
   1. Do not create hazardous or objectionable conditions, such as ice, flooding, and pollution, when using water.

G. Remove and transport debris in manner that will prevent spillage on adjacent surfaces and areas.
   1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level.

H. Clean adjacent buildings and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before start of demolition.

3.06 DEMOLITION

A. Disconnect and cap designated utilities within demolition areas. Remove disconnected utilities.
   1. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations.

B. Building Demolition: Demolish buildings completely and remove from the site. Use methods required to complete Work within limitations of governing regulations and as follows:
   1. Locate demolition equipment throughout the building and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   2. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
   3. Small buildings may be removed intact when permitted by Architect and approved by authorities having jurisdiction.
   4. Demolish concrete and masonry in small sections.
   5. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
   6. Break up and remove concrete slabs on grade, unless otherwise shown to remain.
   7. Remove air-conditioning equipment without releasing refrigerants.

C. Below-Grade Construction: Demolish foundation walls and other below-grade construction, as follows:
   1. Completely remove below grade construction, including foundation walls and footings.

D. Remove materials to be retained or re-installed in manner to prevent damage. Store and protect in accordance with requirements of Section 01600.

E. Filling Below-Grade Areas: Completely fill below-grade areas and voids resulting from demolition of buildings and pavements with soil materials according to requirements specified herein.
   1. Compact fill to 95 percent maximum density per ASTM D 1557, Modified Proctor.

F. Rough grade and compact areas affected by demolition to maintain site grades and contours.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

A. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Disposal: Dispose of demolished materials at designated spoil areas on Owner's property.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them in an EPA-approved landfill.

D. Do not burn or bury materials on site. Leave site in clean condition.

E. Remove temporary work.

3.08 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION

SECTION 03 3000 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

B. Drawings indicate final constructed work.

C. Concrete paving and walks are specified in Division 32.

D. Mechanical finishes and concrete floor toppings are specified in other Division 3 Sections.

1.03 QUALITY ASSURANCE

A. Codes and Standards:

1. Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
    a. ACI 211.1-91, (R 2009) “Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete”, reapproved 2009.
    b. ACI 301-16, “Specifications for Structural Concrete”, 2016.
    c. ACI 302.1R-15, “Guide for Concrete Floor and Slab Construction”.
    d. ACI 304 R-00, (R 2009) “Guide for Measuring, Mixing, Transporting and Placing Concrete”, reapproved 2009.
    e. ACI 304.2R-17, (R 2017) “Placing Concrete by Pumping Methods”.
    f. ACI 305 R-10, “Hot Weather Concreting”, 2010.
    g. ACI 306 R-16, “Cold Weather Concreting”, 2016.
    h. ACI 309 R-05, “Guide for Consolidation of Concrete”, 2005.
    i. ACI 315-315R-18, “Details and Detailing of Concrete Reinforcing”, 2018.
    j. ACI 318-14, “Building Code Requirements for Reinforced Concrete”, 2014.
    k. Concrete Reinforcing Steel Institute (CRSI), “Manual of Standard Practice”, 2018.
    l. ACI 347-R14, “Guide to Formwork for Concrete”, 2014.
    m. ACI SP-66(04) “ACI Detailing Manual”, 2004.
2. Contractor shall have available on the Project site for the duration of the Work, the ACI standards listed in the preceding paragraph.

B. Requirements of Regulatory Agencies: Comply with air pollution regulations of governing authorities.

C. Concrete Testing Service for Mix Designs and Material Evaluation:

1. Engage a testing laboratory to perform material evaluation tests, to design and test concrete mixes when using the “Trial Mix” option.

D. Installation of Post-Installed Reinforcing:

1. Installers of post-installed reinforcing utilizing adhesive anchoring systems shall be certified from the ACI/CRSI Adhesive Anchor installation Certification Program.
2. Refer to Division 5 Section “Post-Installed Anchors” for adhesive anchoring system requirements.

E. Responsibility of Contractor:

1. The Contractor shall be fully responsible for:
   a. The design, strength, safety and adequacy of all formwork, shoring, bracing and all methods of construction,
   b. The mix design, strength, slump, consistency, finish and general quality of concrete.
   c. The specifying herein of requirements for formwork or construction methods, water/cement ratios, slump, preliminary approvals by the Architect, inspection testing and quality control performed by the testing agency, or any other requirements of the Specifications shall be the minimum acceptable, and shall not eliminate, lessen or restrict in any manner the responsibility of the Contractor for all construction methods and for providing concrete in the completed structure that fully meets the strength, appearance and all other requirements of the Specifications and Drawings.
2. Materials and installed work may require testing and retesting at any time during progress of work.
   a. Retesting of rejected materials installed shall be done at Contractor's expense.

1.04 ACTION SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data:

1. Submit admixture requirements as outlined in Part II of this specification.

C. Concrete Mix Design:

1. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of work.
   a. Testing for material certification of compliance with ASTM and MDOT Standards shall be performed not more than 90 days from receipt of submittal by the Architect.
   b. Product data for concrete materials including but not limited to the following shall be submitted to the Architect:
      1) Portland cement.
      2) Fly ash.
      3) Slag cement (GGBF).
      4) Silica fume.

5) Normal weight aggregates.

6) Fine aggregates.

2. No concrete may be placed until the appropriate design mix has been approved by the Architect.

D. Joint Layout:

1. Submit proposed location of:
   a. Construction joints.
   b. Shrinkage control joints.
2. Do not place concrete until Architect has approved joint locations.

E. Shop Drawings:

1. Submit shop drawings for reinforcement, for fabrication, bending, and placement of concrete reinforcement. Comply with ACI SP-66, “ACI Detailing Manual”; showing:
   a. Bar schedules,
   b. Stirrup spacing,
   c. Diagrams of bent bars,
   d. Arrangement of concrete reinforcement.
2. Reinforcement Shop Drawings shall include:
   a. Setting plans,
   b. Wall elevations,
   c. Column elevations
   d. Beam elevations
   e. Layout of slab reinforcing
      1) For flat-slab and two way reinforced concrete buildings show top reinforcing on separate sheets than bottom reinforcing.
   f. Shop drawings shall include details of sequencing requirements at the intersections of:
      1) Beams and slabs
      2) Beams framed orthogonally or diagonally with each other
      3) Columns and beams
      4) Columns, beams and slabs as applicable
   g. Bending diagrams,
   h. Cutting lists,
   i. Other information so as to completely and unambiguously define and establish the location, spacing, size, length, shape, splicing, keying at construction joints and all other pertinent information as required.
3. Drawings shall show grades of reinforcing steel.
4. Wall reinforcing shall be detailed on wall elevations.

5. Each shop drawing shall show splice length for every size and type of bar used.
6. Indicate type, size and location of all accessories required for the proper assembling, placing and support of the reinforcement.
7. Show and detail reinforcing around all openings, depressions, construction and control joints, trenches, sleeves, inserts and other project requirements affecting reinforcing details and placing.
8. Coordination With Other Trades:
    a. The Contractor shall provide a single set of drawings indicating size and location of items to be included in the cast-in-place concrete.

F. Reports:
1. Submit concrete design mixes based on criteria:
    a. Laboratory test reports of trial mixes.
    b. Statistical analysis for consecutive samples from field experience in accordance with ACI 318 requirements.

G. Certificates:
1. Materials certificates in lieu of materials laboratory test reports are permitted.
    a. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.
2. Provide admixture manufacturer's written certification that:
    a. Chloride ion content complies with specified requirements.
    b. Admixtures are compatible with other admixtures, finish materials, etc.

PART 2 - PRODUCTS

2.01 FORM MATERIALS

A. Forms for Smooth Finish:
1. Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints

B. Forms for Areas other than Smooth or Architectural Exposed Finish:
1. Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Forms for Cylindrical Columns and Supports:
1. Metal, fiberglass-reinforced plastic, or paper or fiber tubes. Provide paper or fiber tubes of laminated plies with water-resistant adhesive and wax-impregnated exterior for weather and moisture protection.

2. Provide units with sufficient wall thickness to resist wet concrete loads without detrimental deformation.

D. Form Coatings:

1. Provide commercial formulation form-coating compounds low VOC that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

E. Form Ties:

1. Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to exposed surface.

2. Provide ties that, when removed, will leave holes not larger than 1-inch diameter in concrete surface.

2.02 REINFORCING MATERIALS

A. Reinforcing Bars:

1. ASTM A 615, Grade 60, deformed.

2. ASTM A 706, Grade 60, deformed, for reinforcement which is welded.

3. All reinforcing bars shall be produced, manufactured and fabricated in USA.

B. Steel Wire: ASTM A 1064, plain, cold-drawn steel.

C. Welded Wire Reinforcing (WWR): ASTM A 1064, welded steel wire fabric.

1. WWR shall be in sheets, not rolls.
   a. All reinforcing bars shall be produced, manufactured and fabricated in USA.

D. Deformed Steel Wire: ASTM A 1064.

E. Mechanical Splices:

1. Type 1: Develop at minimum 125 percent of specified minimum yield strength, fy, of the rebar products:
   a. Products:
      1) “Bar-Lock S/CA” Series (D-250-SCA); Dayton Superior; www.daytonsuperior.com.
      2) “Bar Grip – Standard Type 1” Series, Bar-Splice Products, www.barsplice.com.

F. Structural Fibers, Synthetic:

1. Synthetic macro-fiber reinforcement; engineered 100 percent virgin polyolefin fibrillated fibers specifically manufactured for use as concrete reinforcement and so certified by the manufacturer and containing no reprocessed olefin materials; meet requirements of ASTM C 1116.
   a. “Tuf-Strand SF”, Euclid Chemical; www.euclidchemical.com.

G. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Use wire-bar-type supports complying with CRSI specifications.

1. Individual and continuous slab bolsters and chairs shall be of a type to suit the various conditions encountered and must be capable of supporting a 300-lb. concentrated load without measurable permanent deformation of the reinforcement or supports or indentation of the supporting surface.
2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1).
3. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
    a. For slab-on-grade with vapor retarders, use supports that will not damage the vapor retarder.
4. Support Reinforcement for slabs on grade by steel supports designed for the purpose or precast concrete bricks. Wood blocks, stones, brick chips, etc., are not permitted.

2.03 CONCRETE MATERIALS

A. All concrete materials shall be produced, manufactured and fabricated in USA.

B. Portland Cement: ASTM C 150, Type I, Low Alkali.

1. Use for slabs (on grade, elevated, roof) and any concrete surfaces to receive an adhered finish.
    a. “Low alkali cement” may be used in any application areas at Contractor’s discretion.
2. Limit equivalent alkalis to 0.6 percent for concrete in slabs (grade and elevated). Reference: Table 2, ASTM C 150.
3. Use one brand of cement for each type of concrete mix throughout project.

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

1. Use only for areas not to receive an adhered finish, such as foundations, exposed walls and columns.
    a. Contractor may use “low alkali cement” at its discretion for these applications.
2. Use only for applications other than slabs.
3. Use one brand of cement for each type of concrete mix throughout project unless otherwise acceptable to Architect.

D. Cementitious Materials:

1. Fly Ash: ASTM C 618, Type C or F, with alkali less than 1.5%.
    a. For air entrained concrete restrict loss on ignition to less than 1.5%.
    b. Do not use fly ash in:
        1) Slabs to receive an adhered finish.
        2) Structural elements exposed to view.

c. Fly ash containing ammonia shall be mitigated prior to shipment to the concrete producer.

1) Dosage of mitigation agent to be appropriate to amount of ammonia in fly-ash.

d. Maximum Dosage: 25% (by weight) of cementitious materials when no slag cement is used.

2. Slag Cement: ASSTM C989, Grade 100 or 120.

a. Maximum Dosage: 40% (by weight) of cementitious materials when no fly-ash is used.

b. Do not use in structural elements exposed to view.

3. Cementitious materials consisting of both Fly-Ash and Ground Granulated Blast Furnace Slag:

a. Limitations for use as described for Fly Ash apply. (See above).

b. Except for mass concrete, maximum amount of the combinations is 50% (by weight) of cementitious materials, with a maximum amount of Fly Ash of 15%.

1) For example:

a) 35% GGBF and 15% Fly Ash,

b) 40% GGBF and 10% Fly Ash.

E. Normal Weight Aggregates: ASTM C 33 and as herein specified. Provide aggregates from a single source for exposed concrete. Combined aggregate gradation shall be a uniform well graded mixture, with all sieve sizes represented.

1. Restriction: The use of Blast Furnace Slag as an aggregate is not permitted.

2. For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.

3. For slabs use aggregate certified as non-alkali-reactive.

4. Maximum designated sizes of normal weight aggregate shall be as follows:

a. 1-1/2” for concrete in slabs-on-grade 5” or greater thickness.

b. Pea-gravel 3/8” for sections less than 2” thick.

c. 3/4” for all other concrete.

F. Fine Aggregates ASTM C 33, MDOT 2NS.

1. Fineness modulus 2.0 to 3.0 for pumped concrete.

G. Water: ASTM C 1602 and Potable.

H. Admixtures

1. General:

a. Admixtures for concrete shall not contain intentionally-added chlorides.

b. The Contractor shall certify that admixtures are:

1) Compatible with any other admixtures used in the concrete mix

2) Compatible with concrete components such as fly-ash and or slag, either one or both if used in the proposed concrete mix.

3) Compatible with any required adhesive for a given floor finish.

c. Admixture dosage shall take into account:

1) Type of cement

2) Fineness of sand

3) Temperature and wind conditions at time of concrete placement

4) Any other items affecting the performance as listed on the admixture-manufacturer's written instructions.

d. Mix design shall contain the admixtures which will be used for the concrete.

e. Substitution or addition of admixtures from those listed in the mix design or deviation of admixtures from the mix design shall be in accordance with Division 01, Section "Substitutions".

2. Air-Entraining Admixture: ASTM C 260.

a. Products:

1) Use manufacturer's product for specific design mix.

a) Products vary depending on the types of admixtures and cementitious materials in the design mix.

2) Use products by one the following manufacturers:

a) Euclid Chemical; www. euclidchemical.com.

b) BASF Corporation; www.master-builders-solutions.basf.us.

c) Sika Corp. www.sikacorp.com.

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

a. Products:

1) "Eucon MR"; Euclid Chemical; www.euclidchemical.com.

2) "Master Pozzolith" Series or "MasterPolyheed" Series; BASF Corporation, www.master-builders-solutions.basf.us.

4. High-Range Water-Reducing Admixture (HRWR, Superplasticizer): ASTMC494, Type F.

a. Products:

1) "Eucon 37"; Plasto 5000; Eucon Series; Euclid Chemical; www.euclidchemical.com.

2) "MasterRheobuild 1000" or "MasterGlenium" Series; BASF Corporation; www.master-builders-solutions.basf.us.

3) "Sikament 300"; Sika Corp.;www.sikacorp.com.

5. Water-Reducing, Accelerating Admixture: ASTM C 494, Type C or E. Admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory of at least one year duration using an acceptable accelerated corrosion test method such as that using electrical potential measures.

a. Products:

1) "Accelguard 80"; Accelgaurd 90; Euclid Chemical; www.euclidchemical.com.

2) "MasterSet FP 20" (formerly "Pozzutec 20+") or "MasterSet AC 534" (formerly "Pozzolith NC 534"); BASF Corporation; www.master-builders-solutions.basf.us.

6. Water-Reducing, Retarding Admixture: ASTM C 494, Type B or D.

a. Products:

1) "Eucon Retarder 75"; Euclid Chemical; www.euclidchemical.com.

2) "MasterSet R" Series or "MasterSet DELVO" Series; BASF Corporation; www.master-builders-solutions.basf.us.

3) "Plastiment"; Sika Corporation; www.sikacorp.com.

7. Workability-Retaining Admixture: ASTM C 494, Type S.

a. Shall retain concrete workability without affecting time of setting or early-age strength development.

b. Products:

1) "MasterSure Z 60"; BASF Corporation; www.master-builders-solutions.basf.us.

2) "Plastol AMP-X3"; Euclid Chemical; www.euclidchemical.com

2.04 RELATED MATERIALS

A. Control Joint Filler:

1. Filler not exposed to U.V.

a. The joint filler shall be a 2 component , 100% solids compound , with either one of these 28 day Shore Hardnesses (ASTM D 2240): Shore A 90, Shore D 50

b. Products:

1) "Euco 700"; Euclid Chemical; www.euclidchemical.com

2) "Sikadur 51 SL", Sika; www.sikaconstruction.com

3) "Sure Fil J52"; Dayton Superior; www.daytonsuperior.com.

2. Filler exposed to U.V.

a. The joint filler shall be a 2 component polyurea 100% solids compound, with a 28 day shore hardness (ASTM 2240) of 80-100.

b. Products indicated below may be used at contractors option at locations not exposed to UV.

c. Products:

1) "EUCO QWIKjoint UVR", Euclid Chemical; www.euclidchemical.com.

2) "MasterSeal CR 100" BASF Corporation; www.master-builders-solutions.basf.us.

B. Pre-Formed Isolation Joint Material:

1. Apply around columns and other base isolation applications.
2. Unless otherwise restricted, contractor may choose one of the following materials:
    a. Asphalt.
        1) Restriction:
            a) Use for dry conditions only. Do not use in areas subject to moist/wet conditions.
            b) Do not use in exterior applications.
    b. Polyethylene.
    c. Recycled rubber.
3. Asphalt: Preformed bituminous type per ASTM D 994; 3/8 inch min. thick.
    a. Provide one of the following including factory approved materials:
        1) “Servicised Code 1301”, W.R. Grace; www.na.graceconstruction.com
4. Polyethylene: Preformed closed-cell isomeric polymer type per ASTM D 1752, ½ inch min. thick unless otherwise shown.
    a. Provide one of the following including factory approved materials:
        1) “Expand-O-Foam 1380 Series”, Williams Products Inc.; www.williamsproducts.net
5. Recycled Rubber:
    a. Provide:
        1) Reflex rubber expansion joint filler; J. D. Russell Co.; www.jdrussellco.com.
6. Sealants: Refer to Division 7 Section “Joint Sealants”.

C. Reglets:
1. Provide 26 gage, Type 304 stainless steel rectangular reglet polyurethane foam filled with 1/2 inch opening by 1-1/2 inches deep.
2. Fill reglet or cover face opening to prevent intrusion of concrete or debris.
3. Seal joint with polyurethane sealant as specified in Division 7 - after installing flashing or membrane material.

D. Dovetail Anchor Slots:
1. Hot-dip galvanized sheet steel, not less than 0.0336 inch thick (22 gage) with bent tab anchors.
2. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.

E. Sleeve Piping:
1. Refer to Mechanical Drawings.

F. Non-Shrink Grout: CRD-C 621, factory pre-mixed grout.
1. Products: Non-shrink, non-staining, non-metallic grout providing placement versatility: Plastic flowable. Provide one of the following:

a. “MasterFlow 100”, BASF Corporation, www.master-builders-solutions.basf.us.

b. “NS Grout” Euclid Chemical; www.euclidchemical.com.

c. “1107 Advantage Grout”; Dayton Superior; www.daytonsuperior.com.

2. Products: Non-Metallic High Flow Grout. High flow grout is designed for use where high tolerance, high strength and high fluidity are required. High flow grout shall comply with ASTM C 1107 and CRD C 621. Provide one of the following:

a. “Hi-Flow Grout”; Euclid Chemical; www.euclidchemical.com.

b. “MasterFlow 928”; BASF Corporation; www.master-builders-solutions.basf.us.

c. “Sure Grip High Performance Grout”; Dayton Superior; www.daytonsuperior.com.

G. Vapor Retarder:

1. Comply with ASTM E 1745-09, Class A.

2. Provide one of the following:

a. “Stego Wrap 15 10 Mil” – Stego Industries; www.stegoindustries.com.

b. “Vapor Block 15 10 Mil” – Raven Industries; www.vaporblock.com.

3. Provide manufacturer’s recommended mastics, gusset tape and perimeter edge-seal accessories for a complete installation.

H. Non-Slip Aggregate Finish:

1. Provide fused aluminum oxide granules or crushed emery as abrasive aggregate for non-slip finish, with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide.

a. Use material that is factory-graded, packaged, rustproof, and nonglazing and is unaffected by freezing, moisture, and cleaning materials.

2. Products:

a. “Emery Non-Slip”; Dayton-Superior; www.daytonsurperior.com

b. “MasterTop 120SR” (formerly Frictex”); BASF Corporation; www.master-builders-solutions.basf.us.

I. Moisture-Retaining Cover: One of the following, complying with ASTMC171.

1. Waterproof paper.

2. Polyethylene-coated burlap (skid resistant).

J. Dissipating Curing Compounds:

1. Removal required if flooring material is applied to area.

2. Removal procedure to comply with the applied flooring manufacturer’s requirements.

3. Products shall comply with ASTM 309, Type 1:

a. “Kurez DR Vox”, Euclid Chemical; www.euclidchemical.com.

b. “Clear Resin Cure J11W”, Dayton Superior; www.daytonsuperior.com.

K. Rapid Dissipating Curing Compound:

1. Removal required if flooring material is applied to area.

2. Removal procedure to comply with applied flooring manufacturer's requirements.
3. Products shall comply with ASTM 309.
    a. "Clear Cure VOCJ7WB", Dayton Superior; www.daytonsuperior.com.
    b. "Kurez DR VOX"; Euclid Chemical; www.euclidchemical.com

L. Dissipation Curing Compound – Cleaner:
1. Products:
    a. "Citrus Clean J48", Dayton Superior; www.daytonsuperior.com.
    b. "Euco Clean + Strip", Euclid Chemical; www.euclidchemical.com.

M. Self-Leveling Compound:
1. Free-flowing, self-leveling, pumpable, cement-based compound for applications from one inch thick to feathered edges.
2. Products:
    a. "Super Flo-Top"; Euclid Chemical; www.euclidchemical.com
    b. "MasterTop 110SL, (formerly MasterTop 110 Plus Underlayment), BASF Corporation, www.master-builders-solutions.basf.us.
    c. "Econolevel"; Dayton Superior; www.daytonsuperior.com.
3. Primer: Manufacturer's recommended product for substrate conditions.
4. Aggregate: For application of excess thicknesses where manufacturer recommends coarse aggregate or coarse sand to be added.
    a. Well-graded, washed gravel or coarse sand, sized to meet manufacturer's requirements for maximum depth.

N. Bonding Compound:
1. Interior (Polyvinyl Acetate Base):
    a. "Euco Weld"; Euclid Chemical; www.euclidchemical.com.
    b. "Weld-Crete"; Larsen Products Corp.;www.larsenproducts.com
    c. "PVA Bonding Agent J41" Dayton Superior; www.daytonsuperior.com.
2. Exterior (Acrylic Latex Base):
    a. "Acrylic Bonding Agent J40" Dayton Superior; www.daytonsuperior.com.
    b. "Tammsweld"; Euclid Chemical; www.euclidchemical.com

O. Epoxy Bonding Compound/Adhesives:
1. Standard Working Time (90 minutes +/-): ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material "Type"; "Grade"; and "Class" to suit project requirements
    a. Products:
        1) "Dural 452 Epoxy Line"; Euclid Chemical; www.euclidchemical.com
        2) "MasterEmaco ADH Series" (formerly "Concresive" Series), BASF Corporation; www.master-builders-solutions.basf.us

3) "Sikadur 32 Hi-Mod Series"; Sika Corp.; www.sikaconstruction.com.

4) "Sure Bond J58"; Dayton Superior; www.daytonsuperior.com.

2. Long Term Working Time (16 hours +/-): Three component water based epoxy-cementitious bonding agent.

a. Products:

1) "Duralprep A.C.", Euclid Chemical, www.euclidchemical.com.

2) "MasterEmaco P 124" (formerly "Emaco P24"), BASF Corporation www.master-builders-solutions.basf.us.

3) "Armatec 110 EpoCem", www.sikaconstruction.com.

4) "Perma Prime 3C"; Dayton Superior; www.daytonsuperior.com.

P. Sealer:

1. Interior Slabs:

a. General:

1) Acrylic, high solids liquid membrane sealer.

a) Minimum Solids Content: 20%.

b) Non-yellowing to ultraviolet exposure.

c) Provide glossy finish.

b. Products:

1) Cure-And-Seal complying with ASTM C-1315.

a) "Super Diamond Clear VOX", Euclid Chemical; www.euclidchemcial.com

b) "Cure & Seal 1315 J22WB", Dayton Superior; www.daytonsuperior.com.

c) "MasterKure CC 250SB" (formerly Kure N Seal 25LV"), BASF Corporation; www.master-builders-solutions.basf.us.

2) Sealer complying with ASTM C-1315.

a) "Ultra Seal EF", Dayton Superior; www.daytonsuperior.com.

b) "EverClear VOX"; Euclid Chemical; www.euclidchemical.com

2. Exterior Slabs

a. Definition: "Exterior Slab", slab located outside the "conditioned" (heated/air conditioned) space; such as sidewalks not shown on civil documents, slabs underneath building overhangs, slabs underneath canopies.

b. General:

1) Siloxane or silane penetrating sealer.

c. Products:

1) "Baracade Silane 40"; Euclid Chemical; www.euclidchemical.com.

2) "MasterProtect H 440" (formerly Enviroseal 20"), BASF Corporation; www.master-builders-solutions.basf.us

3) "Weather Worker 40% J29"; Dayton Superior Co.; www.daytonsuperior.com.

2.05 PROPORTIONING AND DESIGN OF MIXES

A. General:

1. Concrete Mix Design:

a. Mix designs shall take into account seasonal variations in climatic conditions.

b. Mix design shall be directed to reducing the amount of cementitious materials.

c. See section "Concrete Materials" for required use applications for low-alkali-cement.

d. See section "Concrete materials" for limits of use for cementitious materials.

e. Alkali Restriction:

1) Limit total alkali from all sources (cement, aggregate, etc.) for floor slab and exterior usage to 5 pounds per cubic yard.

f. Chloride Restrictions:

1) Calcium chloride or admixtures containing intentionally added chlorides are prohibited.

g. Basic mix proportions shall be established by the Contractor in accordance with ACI 211.1 and Section 5.3, (field experience or trial batches) of ACI 318 with constituents to be used in the project.

B. Normal Weight Concrete:

1. Definition

a. w/cm: water/(cement + cementitious materials) ratio by weight.

b. Shrinkage measured at 28 days, ASTM C157 modified, 7 day moist cured.

2. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:

a. Compressive strength, as shown on drawings, no air entrainment:

1) w/cm 0.50 maximum. Use for foundations, grade beams, and other areas not requiring air entrainment.

b. Compressive strength, as shown on drawings; with air entrainment.

1) w/cm, 0.45 maximum. Use for concrete at loading dock, exterior slabs, and other exposed to the elements concrete.

2) w/cm 0.50 maximum, shrinkage 0.04% maximum, use for interior slabs (on-grade and elevated).

3) w/cm 0.40 maximum, shrinkage 0.04% maximum. Use for precast slab topping and all reinforced concrete subject to de-icers, salt spray and brackish water.

C. Adjustment to Concrete Mixes:

1. Mix design adjustments may be requested by Contractor.
    a. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

D. Admixtures:
1. Use admixtures for water reduction and set control in strict compliance with manufacturer's directions.
    a. Use water-reducing admixtures in concrete as required for placement and workability.
    b. Use HRWR in concrete for parking structure slabs, concrete required to be watertight, and concrete with w/cm ratios of less than 0.45.
    c. Add specified accelerating/retarding admixtures for proper finishing as required by environmental conditions, such as temperature, wind, humidity, exposure to direct sun-light, etc.
        1) Water-reducing admixtures for concrete with w/cm ratios of 0.45 and higher may be one of the following:
            a) Water-reducing.
            b) Mid-range.
            c) High-range.
2. Air-entraining admixtures.
    a. Use air-entraining admixture in exterior exposed concrete.
    b. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent from the following:
    c. Exterior concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure:
        1) 4.5 percent (moderate exposure); 5.5 percent (severe exposure) 1-1/2-inch max. aggregate.
        2) 4.5 percent (moderate exposure); 6.0 percent (severe exposure) 1-inch max. aggregate.
        3) 5.0 percent (moderate exposure); 6.0 percent (severe exposure) 3/4-inch max. aggregate.
        4) 5.5 percent (moderate exposure); 7.0 percent (severe exposure) 1/2-inch max. aggregate.
    d. Concrete walls above grade and concrete foundation walls covered with waterproofing or dampproofing:
        1) 4.0 percent.
    e. Other concrete (not exterior exposed) or to receive a surface hardener: 3 percent maximum air-content.

E. Slump Limits for Normal-Weight Concrete:

1. Proportion and design mixes to result in concrete slump at point of truck-discharge as follows:
    a. Ramps, slabs, and sloping surfaces: Not more than 4 inches.
    b. Reinforced foundation systems: Not less than 2 inches and not more than 4 inches.
    c. Concrete containing HRWR: Not more than 8 inches after addition of HRWR to 2-inch to 3-inch slump concrete.
    d. Other concrete: Not more than 5 inches.

2.06 CONCRETE MIXING

A. Ready-Mix Concrete: Concrete shall be mixed and delivered in accordance with the requirements set forth in the "Standard Specifications for Ready-Mixed Concrete" (ASTM Designation C-94).
1. "Discharge Time": Is time frame from the introduction of mixing water until completion of the discharge at the job site.
2. Mixing: When a truck mixer or agitator is used for transporting concrete, the concrete shall be delivered to the site of the work and discharged completely within 90 minutes during normal temperatures.
    a. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 90 minutes to 75 minutes.
    b. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
3. Add fiber concrete reinforcement to concrete materials at the time concrete is batched in amounts indicated on the Contract Documents in accordance with written manufacturer's requirements for uniform and complete dispersion of fibers.
4. Concrete Containing Integral Waterproofing:
    a. Mix in accordance with manufacturer's written instructions.
    b. Use Xypex C-1000 for concrete using only Portland cement for cementitious material.
    c. Use Xypex-500 for concrete with fly-ash or GBBF, either one or both.
    d. Use minimum 350 pounds of Portland cement for any mix containing Integral Waterproofing.
    e. Use the greater of 10 pounds per cubic yard or 2% of the weight of Portland cement.
    f. Amount of integral waterproofing to be in accordance with manufacturer's written instructions.

B. Delivery Tickets:
1. With each load of concrete delivered to the job there shall be furnished by the ready-mixed producer duplicate delivery tickets, one for the Contractor and one for the Architect-Engineer.

2. Delivery tickets shall provide the following information:
    a. Date
    b. Name of ready-mixed concrete plant.
    c. Job location.
    d. Contractor.
    e. Type and brand name of cement.
    f. Class and cement/cementitious material content in pounds per cu.yd. of concrete.
        1) Types and amounts of cementitious materials.
    g. Truck number.
    h. Time dispatched.
    i. Amount of concrete in load, in cu. yds.
    j. Admixtures in concrete.
    k. Maximum sizes of aggregate.
    l. Type and amount of fibers in concrete.
    m. Type and amount of field-added hydration-controlling admixture.

PART 3 - EXECUTION

3.01 EXAMINATION AND ACCEPTANCE OF CONSTRUCTION IN PLACE

A. Examine construction in place. Notify the Owner's Representative in writing of conditions detrimental to the proper and timely completion of the work. Defects which may influence satisfactory completion and performance of the work shall be corrected in accordance with the requirements of the applicable section of the specifications and in a manner acceptable to the Owner's Representative, prior to commencement of the work. Commencement will be construed as construction in place being acceptable for satisfying the requirements of this section.

3.02 PREPARATION

A. Field Measurements and Tolerances:
    1. Take field measurements to verify or supplement dimensions shown. Be responsible for accurate fit of specified Work.
    2. If any concrete surface is placed or finished outside of the tolerances specified, or if inserts are misplaced or omitted, any remedial work shall be performed by the Contractor at his expense. The cost of evaluation and redesign of remedial work by the Architect shall be borne by the Contractor.

3.03 FORMS

A. Restrictions:
    1. Formwork shall accommodate dowels shown on the structural drawings or the shop drawings, either one or both; therefore any proposed drilling of post-installed anchors in order to simplify form work to what in the Contractor’s opinion may be equal strength of dowels is not acceptable.

B. General:

1. Design, erect, support, brace, and maintain formwork to support vertical and lateral, static and dynamic loads that might be applied until concrete structure can support such loads.
2. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position.
3. Maintain formwork construction tolerances complying with ACI 301 and ACI 117.
4. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures.
    a. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work.
    b. Use selected materials to obtain required finishes.
    c. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
5. Fabricate forms for easy removal without hammering or prying against concrete surfaces.
    a. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.
6. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
7. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
8. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete.
    a. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar.
    b. Locate temporary openings in forms at inconspicuous locations.
9. Chamfer exposed corners and edges, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

C. Provisions for Other Trades:

1. Provide openings in concrete formwork to accommodate work of other trades.
    a. See “Coordination With Other Trades” in Part 1 of this Section.
2. Size and location of openings, recesses, and chases from trades shall be as indicated on the Architect approved Coordination Drawings.
3. Accurately place and securely support items built into forms.
4. Comply with tolerances required by other trades and equipment manufacturer's requirements for tolerances of formwork, sleeves and embedded items.

D. Form Cleaning and Tightening:

1. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms and bracing before concrete placement as required to prevent mortar leaks and maintain proper alignment.

E. Following leveling, compaction and tamping of granular base for slabs on grade, place vapor retarder sheeting with longest dimension parallel with direction of pour.

1. Extend vapor retarder to edge including overlap with edge detail.
2. Lap joints 6 inches and seal vapor barrier joints with manufacturers' recommended mastic and pressure-sensitive tape.
    a. Apply seam tape to clean and dry vapor retarder.
3. Repair any damaged areas in vapor retarder with material of equal or better permeance, puncture resistance and tensile strength.
4. Avoid the use of non-permanent stakes driven through vapor retarder.
    a. If non-permanent are driven through vapor retarder, repair as “damaged area”.
5. Seal around penetrations and openings as shown on the Drawings.
    a. Verify seal methods and materials are in compliance with vapor barrier manufacturer’s written recommendations.

3.04 REINFORCEMENT

A. Fabrication of Reinforcement: Reinforcement shall be accurately formed to dimensions on the approved shop drawings, details and schedules.

B. Fabrication shall not commence until shop drawings, details, and schedules have been approved by the Architect.

C. Reinforcement shall be bent cold and shall not be heated for any purpose.

D. Bars shall not be formed in a manner injurious to the bars. Bars with kinks or bends not shown on the Drawings and bars reduced in section will be rejected.

E. Reinforcement of ASTM A 615 grade shall not be welded.

F. Placing Reinforcement:

1. Reinforcing shall be accurately placed and rigidly secured in position in accordance with the CRSI requirements for Recommended Practice for Placing Reinforcing Bars and Recommended Practice for Placing Bar Supports and with further requirements specified herein and on the Drawings.
2. Tie reinforcing with annealed #18 gauge (min.) wire, and bend all wire back beyond general plane of reinforcing.
3. Spacing: Minimum clear distances between parallel bars (except in columns and multiple layers of bars in beams) shall be equal to nominal diameter of bars. Clear spacing, in no case, shall be less than one-inch or 1-1/3 times maximum size of coarse aggregate.
4. Avoid cutting or puncturing vapor retarder during reinforcement placement.
5. Bending, tack welding, cutting or substituting reinforcement in the field, other than shown on the Contract Drawings, in any manner is prohibited, unless specific written approval for each case is given by the Architect.
6. At the time the concrete is placed, all reinforcement shall be free from excessive rust scale, or other coatings which might destroy or reduce the bond.

7. Avoid exposure of reinforcement to the weather for any considerable length of time before placing of concrete. The Contractor shall be responsible for protecting exposed concrete and any other materials against staining from exposed reinforcement.
8. Reinforcement shall be spliced only as shown on the Drawings or approved by the Architect.
9. Mechanical splicing shall be done in accordance with manufacturer's instructions. Manufacturer shall provide competent technical staff at the job site to demonstrate and instruct in the use of the splicing process and to assist in solving field problems.

3.05 JOINTS

A. Construction Joints:

1. Locate and install construction joints as indicated.
2. If joints are not indicated, locate at 1/4 to 1/3 points of spans and so as not to impair strength and appearance of the structure.
    a. For exposed to view areas submit proposed locations to Architect.
    b. Architect’s written approval is required before placing concrete.
3. Provide keyways at least 1-1/2 inches deep in construction joints in walls and between walls and footings.
4. Place construction joints perpendicular to main reinforcement.
5. When attaching new construction to existing, use epoxy bonding agent on existing concrete surfaces that will be joined with fresh concrete.
    a. It is the Contractor’s responsibility to choose the type of epoxy bonding agent with adequate working time for the specific application.

B. Isolation Joints in Slabs-on-Ground:

1. Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.
    a. Pre-formed isolation joint material shall be held down to accommodate isolation joint sealant. 2:1 width to depth ratio shall be provided or in accordance with manufacturer’s written instructions.

C. Contraction (Control) Joints in Slabs-on-Ground:

1. Construct control joints in slabs-on-ground to form panels of patterns as shown.
    a. Use saw cuts 1/8 inch wide by 1/4 slab depth.
    b. Saw cut as soon as possible after slab finishing as may be safely done without dislodging aggregate.
2. Control joints in slabs-on-ground may also be created by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface.
    a. Tool slab edges round on each side of insert.
    b. After concrete has cured, remove inserts and clean groove of loose debris.

3. If joint pattern is not shown, provide joints not exceeding 25 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays).

3.06 INSTALLATION OF EMBEDDED ITEMS

A. Set and build into work anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete.

B. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

C. The installation of all inserts required by other trades shall be coordinated with, or shall be installed prior to, the placing of reinforcing steel.

D. Install anchor bolts, embeds, etc., furnished by other Sections. Set accurately and secure to prevent displacement.

E. Install dovetail anchor slots in concrete columns where masonry abuts and as shown on the drawings.

F. Embedded Conduit:

1. Embed no pipes or electrical conduit in any structural concrete.

2. Provide sleeves for pipes passing through concrete.

G. Reglets:

1. Install reglets to receive top edge of foundation sheet waterproofing and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

3.07 FORMS FOR SLABS

A. Set edge forms, bulkheads, and intermediate screed strips for slabs to obtain required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.08 PREPARATION OF FORM SURFACES

A. Coat contact surfaces of forms with an approved form-coating compound before reinforcement is placed.

B. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

C. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

D. Remove water, dirt, debris, saw dust, and foreign substances from form surfaces prior to placing concrete.

3.09 PREPARATION OF CONCRETE PLACEMENT

A. Prior to placing concrete verify that work for Division 3 and other trades in the area of proposed concrete placement are completed.

B. Contractor’s Inspection Before Placing Concrete:

1. Concrete on formwork. Verify:

a. Removal of debris, dust, saw dust, and foreign substances.
b. Completeness of:
1) Formwork.
2) Reinforcing.
3) Items to be embedded.
c. Reinforcing was not damaged nor dislodged by work of other trades.
d. Reinforcing has the proper cover.
e. Removal of water.

2. Slab-on-grade with vapor barrier. Verify:
a. Removal of moisture.
b. Removal of debris and foreign substances.
c. Reinforcing to be complete and not damaged by work of other trades.
d. Repair of defects in vapor barrier.
e. Sealing around penetrations and openings in vapor barrier.
f. Sealing at termination of vapor barrier.

C. Contractor/Testing Agency Coordination:
1. Prior to placing concrete the Contractor shall verify that:
a. The required inspections are completed.
b. Any remedial work required and accepted by the Independent Inspection Agency is completed and accepted by the Independent Inspection Agency.

3.010 CONCRETE PLACEMENT

A. General:
1. Concreting shall not be continued when the air temperature is below 45 degrees F. unless the aggregates and/or water are heated to produce a placing temperature of the concrete between 60 degrees F. and 90 degrees F. and unless adequate provisions are in place for maintaining protection against freezing of the concrete for at least 7 days after placing.
2. No concrete shall be placed on frozen subgrade.
3. Comply with ACI 304, “Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete,” and as herein specified.
4. Addition of water after the batch will not be permitted.
a. Increase slump for workability by adding water reducing admixtures.
5. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness.
a. If a section cannot be placed continuously, provide construction joints as herein specified.
6. Deposit concrete to avoid segregation at its final location.

7. Concrete shall be deposited with a minimum of rehandling and shall be spaded adjacent to forms and joints.
8. Place concrete simultaneously against both sides of the isolation joints.

B. Placing Concrete in Forms:

1. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
2. Place concrete to avoid segregation of aggregates, and as close to the final location as possible. Avoid horizontal movement of concrete.
3. Where cement paste-aggregate-separation is a problem for high vertical drops or heavily reinforced columns, either one or both, place minimum two (2) inch of fine aggregate and cement grout over the full area of the bottom of the columns prior to concrete placement.
4. Do not shovel spilled concrete back into buckets or hoppers for subsequent use.
5. Concrete shall have an unrestricted free vertical drop. The stream of concrete shall not fall over reinforcing, ties or embedded items.
    a. Use a tremie or chute if reinforcement is constricted enough to prevent the concrete free vertical drop.
6. Tremies or chutes shall have a diameter of at least 8 times the maximum aggregate size for the top 6 to 8 feet and may be tapered to at least 6 times the maximum aggregate size.
7. Remove loose, dried mortar or concrete paste from embedded items and reinforcing if placement involved multiple placements with a horizontal contraction joint.
8. Consolidation: Consolidate concrete by mechanical vibrating equipment supplemented by hand spading, rodding or tamping.
    a. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
    b. Immediately after depositing concrete, spade next to forms, work around reinforcement and into angles of forms.
    c. Compact concrete with mechanical vibrator applied directly into concrete at approximately 1-1/2 foot intervals.
    d. Mechanical vibrator shall be power driven, hand operated type (with minimum frequency of 5,000 cycles per minute) having an intensity sufficient to cause flow or settlement of concrete into place.
    e. Vibrate concrete to produce thorough compaction, complete embedment of reinforcement and concrete of uniform and maximum density without segregation of mix.
9. Vibrating concrete:
    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine.

c. Place vibrators to rapidly penetrate placed layer and at least 6 inches into immediately preceding layer.

d. Do not insert vibrators into lower layers of concrete that have begun to set.

e. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

C. Placing Concrete Slabs:

1. Do not place concrete on surfaces containing water.

2. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

3. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

4. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

5. If buggies are used, runways shall be planked.

6. Maintain reinforcing in proper position during concrete placement.

a. Do not damage nor dislocate reinforcing (bars and WWF, either one or both) during concrete placement.

7. Place and finish concrete in strict accord with fibrous and steel fiber concrete reinforcement manufacturer's written instructions and recommendations.

8. Slabs on Metal Deck:

a. Deck has been selected from standard tables for unshored-economical conditions. The tables were developed using the weight of concrete +20 pounds per square foot.

1) In order to stay within this loading avoid piles of concrete during bucket or pump placement.

D. Cold-Weather Placing:

1. Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

2. 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.

3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

4. Only use a specified accelerator.

E. Hot-Weather Placing:

1. Hot weather conditions are a product of some or all of the following:
   a. Temperature.
   b. Humidity.
   c. Wind-speed.
2. Use hot-weather applications when rate of evaporation approaches 0.2 lb/ft^2 or sq. ft./hour for standard Portland cement mix.
   a. Use ACI 305R Figure 2.1.5 to calculate the rate of evaporation (attached).
   b. Concrete mixes containing ultra-fine pozzolans or other cementitious materials are governed by a lower evaporation rate. See ACI 305, Section 2.1.4 thru 2.1.6.
3. When hot weather conditions exist that would impair quality and strength of concrete, place concrete in compliance with ACI 305R and as herein specified.
4. Cool ingredients before mixing to maintain concrete temperature at time of placement 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. Use of liquid nitrogen to cool concrete is Contractor's option.
5. 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 embedment in concrete.
6. Fog spray forms, reinforcing steel, and subgrade without vapor barrier just before concrete is placed.
7. Use water-reducing retarding admixture when required by one or more of the following:
   a. high temperatures,
   b. low humidity,
   c. wind
   d. other adverse placing conditions.

3.011 FINISH OF FORMED SURFACES

A. Rough Form Finish:
   1. Repair and patch defective areas. Chip off or rub down fins and other projections exceeding 1/4 inch in height.

B. Smooth Form Finish:
   1. For formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

C. Related Unformed Surfaces:
   1. At tops of walls, horizontal offsets, and similar unformed surfaces occurring 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.

3.012 MONOLITHIC SLAB FINISHES

A. Levelness of unshored slab:

1. Unshored slabs shall meet the levelness requirements:
   a. Slab F_F= 50; with a minimum local value of F_F=35.
   b. Slab F_L = 35; with a minimum local value of F_L=25.

B. Measurements for Flatness/Levelness:

1. Slabs shall be measured in accordance with ASTM E-1155 “Standard Test Method for determining floor flatness and levelness using the “F- number” system (inch-pound units).
   a. Measurements shall be performed within 72 hours after placement.
      1) For measurements with the straight edge method the minimum number of measurements in each orthogonal direction: 1% of the placement area in square feet.
         a) A placement of 7,500 sf requires a minimum of 75 readings in each orthogonal dimension.
   b. On floors with more than one concrete placement for slabs, each placement shall meet the minimum F_F and F_L specified and local values.
      1) Using several placements to average values is not permitted.

C. Scratch Finish:

1. Apply scratch finish to monolithic slab surfaces to receive composite concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.
2. After placing slabs,
   a. Plane surface to tolerances of:
      1) 1/2” in 10 feet for floor for un-shored construction.
      2) Floor flatness (FF) of 15 and floor levelness (FL) of 13 for shored construction.
   b. Slope surfaces uniformly to drains where required.
   c. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

D. Float Finish:

1. Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified; slab surfaces to be covered with
   a. resilient flooring, carpeting
   b. ceramic or quarry tile.
   c. membrane or elastic waterproofing, membrane or elastic roofing,
   d. concrete floor topping
   e. sand-bed terrazzo

f. or thin-set

g. as otherwise indicated.

2. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, when concrete has stiffened sufficiently to permit operation of power-driven floats, or both.

a. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.

b. Refer to ACI 302.1R-15 for finishing requirements.

c. Check and level surface plane to specified tolerances.

1) Cut down high spots and fill low spots.

d. Uniformly slope surfaces to drains.

e. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

E. Trowel Finish:

1. Apply trowel finish to only monolithic slab surfaces to be exposed to view, covered with paint, or other thin film finish coating system.

2. After floating, begin first trowel finish operation using a power-driven trowel.

a. Begin final troweling when surface produces a ringing sound as trowel is moved over surface.

b. Consolidate concrete surface by final hand-troweling operation.

c. Refer to ACI 302.1R-15 for finishing requirements.

d. Produce surface free of trowel marks, uniform in texture and appearance, and with surface leveled to specified tolerances.

e. Grind smooth surface defects that would telegraph through applied floor covering system.

F. Trowel and Fine Broom Finish:

1. Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

G. Nonslip Broom Finish:

1. Apply nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

2. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

H. Nonslip Aggregate Finish:

1. Apply nonslip aggregate finish to concrete stair treads, platforms, ramps, sloped walks, and elsewhere as indicated.

2. After completion of float finishing and before starting trowel finish, uniformly spread 25 lbs. of dampened nonslip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as herein specified.
3. After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose nonslip aggregate.

I. Sealer Finish:

1. Verify floor cleanliness and preparation to meet manufacturer's requirements.
2. Apply in accordance with manufacturer's written directions.

3.013 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying and against injury from heat, cold and defacement of any nature during construction operations. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations.
2. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep continuously moist for not less than 7 days.
    a. Concrete, particularly exposed surfaces, shall be treated immediately after concreting or finishing is completed to provide continuous moist curing regardless of ambient air temperatures.
    b. Have on the site, ready for use, sufficient and adequate equipment for protecting the concrete from any and all forms of damage by the elements, including equipment for enclosing, heating, and shading the concrete.
    c. Note: The purpose of moist curing is to continuously provide additional available water to the concrete to permit hydration of cement. Periodic sprinkling is not effective in curing, and will not be accepted as meeting curing requirements.
3. Curing shall be in accordance with ACI 301 procedures.
    a. Avoid rapid drying at end of final curing period.

B. Curing Methods:

1. General:
    a. Slabs to receive another finish or floor covering are limited to:
        1) Moist curing.
        2) Moisture-retaining cover curing.
        3) Curing with dissipating curing compound.
2. Perform curing of concrete by one of the following methods:
    a. Moist curing.
    b. Moisture-retaining cover curing.
    c. Combinations moist curing and moisture-retaining cover curing.
    d. Application of a dissipating curing compound.

3. Restrictions:
    a. Do not use membrane forming curing compound for slabs to receive another finish or floor covering unless the compatibility of floor finishes with specific curing compound is verified by the Contractor in writing.
        1) Use water based compound if required by local ordinances.
4. Provide moisture curing by following methods:
    a. Keep concrete surface continuously wet by covering with water.
    b. Use continuous water-fog spray.
    c. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet.
        1) Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.
5. Provide moisture-retaining cover curing as follows:
    a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    b. During application do not drag covers over the finished concrete not covered. Take precautions to prevent the covers from being displaced. If it is necessary to remove a cover for any reason, so not expose the concrete slab for more than 1/2 hr. Do not stain the newly finished slab.
6. Provide dissipating curing compound to interior slabs as follows:
    a. Apply specified dissipating curing compound to concrete slab as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared).
        1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions
        2) Recoat areas subjected to rainfall within 3 hours after initial application.
        3) Maintain continuity of coating and repair damage during curing period.

C. Curing Formed Surfaces:
1. Cure formed concrete surfaces by moist curing with forms in place for full curing period or until forms are removed.
2. After forms are stripped, wet down all column and wall surfaces thoroughly and cover with insulating blankets during cold weather and quilted covers, cotton mats or other approved covers at other times so that the concrete is kept continuously wet and at minimum temperature of 50 degrees F for 7 days (or for 350 day degrees) after it is placed.
3. Forms may be kept in place to effect curing.
    a. Absorbent wood forms shall be kept continuously wet while in-place.
4. If forms are removed, continue curing by methods specified above, as applicable.

a. Exception: Where formed surfaces do not receive the application of another finish material, sealer products may be used.

D. Curing Unformed Surfaces:

1. Unformed surfaces such as floors and tops of columns, walls, etc., shall be moist cured at a minimum temperature of 50 degrees F. for seven days (or for 350 day degrees) as follows:

a. If the concrete shows any signs of drying out before it is hard enough to allow ponding or covering without marring the finish, immediately provide a fog spray of water over the floor surface until the concrete can be ponded or covered.

3.014 TEMPERATURE RECORDS:

A. Keep a permanent record showing the date and the outside and concrete temperatures for all concreting operations (including curing). Take thermometer readings at the start of work in the morning, at noon, and again late in the afternoon. Record the location of all concrete placed and cured during such periods, all in such a manner as to show any effect the temperature may have had on the construction.

3.015 COLD WEATHER PROTECTION:

A. When the air temperature is at or below 40 degrees F. or when weather reports indicate that the temperature may fall below 40 degrees F., within the 24 hr. period following placement of concrete, take all adequate and proper measures as required to maintain the temperature of the concrete between 50 degrees F. and 70 degrees F. for the specified curing period and to protect the concrete against damage by freezing or the cold, including but not limited to the following:

1. Foundation concrete may be cured by balanced backfill on all sides to a minimum depth of 18” for average temperatures over 32 degrees F. Cure and protect exposed foundation surfaces as specified herein.
2. Ascertain that the requirements for heating of aggregates and water have been followed.
3. Heat formwork, reinforcing and underlying subgrades with live saturated steam so as to raise the temperature well above the freezing point. Concrete surfaces shall be covered to prevent direct contact with the steam.
4. After placing of concrete, protect against cold by means of tight covering and supply of sufficient heat, where required, to maintain the concrete at a temperature of 50 to 70 degrees F. for at least 7 days after placement of concrete or for at least 3 days if air entrained concrete is used. The concrete shall not be protected with salt, hay, manure, or any other material containing live or organic acids. Concrete shall be kept continually moist during the curing periods.
5. The section to be concreted shall be completely housed or enclosed wherever practicable before placing of concrete, in a manner that will insure the maintenance of the required temperatures. Such enclosures shall be left in place for the curing period.
6. High early strength cement may not be used unless specifically approved by the Architect.
7. Accelerating admixtures may be used, provided they meet the specified non-corrosive, non-chloride requirements.

8. Except as modified above, follow procedures as outlined in ACI 306.

3.016 HOT WEATHER PROTECTION:

A. Take special care during the concreting operations during hot or dry weather. Wet forms just before placing of concrete and keep exposed surface continually damp. Take special precautions in placing of slabs in unshaded locations so as to prevent flash setting of concrete. Provide a continuous fog spray of water immediately after screeding and maintain in moist condition and take such other protective measures as required to prevent damage from flash setting of concrete. Do not use retardant admixtures, other than the specified water reducing agent, without specific approval of the Architect. Except as modified above, follow procedures as outlined in ACI 305.

3.017 PROTECTION OF FLOORS

A. Protect floors, both treated and untreated, from damage and wear until the remainder of the construction period.

1. Use protective methods and materials, including but not limited to temporary covering.
2. For floors that have received treatment, coordinate protection method with floor-treatment-manufacturer and installer.
    a. Receive written approval of proposed method from both, manufacturer and installer.
    b. Installer's recommendations shall in no case be less than those of the manufacturer.

3.018 CLEANING

A. Slabs:

1. Concrete slabs and steps not receiving additional finishes should be thoroughly cleaned by scrubbing with a good detergent or vegetable oil soap.
2. Concrete slabs cured with "dissipating curing compound" shall be cleaned as follows:
    a. Where permitted by floor covering manufacturer, scrub the floor with dissipating curing compound cleaner and stiff bristle, then rinse well with clean water.
    b. Where dissipating curing compound cleaner is not acceptable to floor covering manufacturer, use mechanical equipment to remove dissipating curing compound.
    c. After proper clean-up, follow the written requirements of the covering manufacturer for the recommended surface preparation for the particular covering product to be applied.

3.019 REMOVAL OF FORMS

A. Remove forms only after concrete has attained sufficient strength to support its own weight, construction live loads thereon, and lateral loads, all without excessive deflection or damage to the structure. See ACI 347 "Recommended Practice for Concrete Formwork" for detailed discussion of form removal.

B. Leave forms and supports in place for not less than the following periods of time. Where strength gain may have been retarded, or when necessary to protect surfaces from construction

operations, etc., or where more restrictive requirements are shown on the Drawings, leave forms in place longer.

1. Vertical Surfaces - Concrete must reach 100 day degrees and must attain a strength of not less than 50 percent of the specified strength. Where such forms support formwork for slab or beam soffits removal time of these elements shall govern.
2. Horizontal Surfaces - Except as noted below, concrete must reach 350 day degrees and must attain a strength of not less than 75 percent of specified strength.
3. (Definition of Day Degrees: Total number of day times mean daily air temperature at surfaces of concrete. For example, 5 days at a temperature of 60 degrees F. equals 300 day degrees. Days or fractions of days in which temperature is below 50 degrees F. shall not be included in the calculation of day degrees.)

C. If high early strength cement is approved by the Architect, minimum times for curing, protection and form removal will be reduced per strength gain tests as approved by the Architect.

D. Verification of in-place concrete strengths shall be through an in situ, non-destructive method, unless minimum day degrees are exceeded by 25%, and cylinder tests verify required strength.

E. Verification of day degrees shall be through a surface or an embedded thermometer and under the weather enclosure when the temperature falls below 50 degrees F.

3.020 REUSE OF FORMS

A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated, or otherwise damaged and patched form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

B. When forms are extended for continuous concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets.

3.021 MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs:

1. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

3.022 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas:

1. When acceptable to Architect repair and patch defective areas with cement mortar immediately after removal of forms.
2. Cut out honeycomb, rock pockets, voids over 1 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 3/4 inch. Make edges of cuts square and perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching or patching concrete mortar before bonding compound has dried. Cure in same manner as adjacent concrete.
3. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. Repair of Formed Surfaces:

1. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect.
2. Surface defects as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning.
3. Flush out form tie holes, fill with dry-pack mortar, or precast cement cone plugs secured in place with bonding agent.
4. Repair concealed formed surfaces that contain defects that affect the durability of concrete.

C. Repair of Unformed Surfaces (Flatwork):

1. Test flatwork for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope.
2. Repair finished flatwork that contain defects that affect durability of concrete. Surface defects, as such, include crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
3. Correct high areas in flatwork by grinding after concrete has cured at least 14 days.
4. Correct low areas by either cutting out low areas or by filling-in with specified self-leveling compound.
    a. The option of replacing or repairing is at the discretion of the Architect.
    b. Cutting out and slab replacement.
        1) For areas not receiving another finish, provide repair to blend into adjacent concrete.
    c. Filling-In:
        1) Use specified self-leveling compound.

2) Prepare surfaces and apply primer as required in manufacturer's written instructions.

a) Do not scarify slabs.

3) For slab areas not receiving another finish, provide repair to blend into adjacent concrete.

4) Cure and protect as required in manufacturer's written instruction.

5. Repair isolated random cracks by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.

6. Place dry-pack before bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

D. Perform structural repairs with prior written approval of Architect for method and procedure, using specified epoxy adhesive and mortar.

E. Repair methods not specified above may be used, subject to written acceptance of Architect.

3.023 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. Testing Agency:

1. Refer to Contract Documents for Independent Testing Agency's administrative requirements.

3.024 ACCEPTANCE OF COMPLETED WORK

A. Those portions of the structure that do not meet the Contract requirements based on appearance or for any other aesthetic reason shall be corrected or removed and replaced as directed by the Architect or Owner and all costs of corrections, removal and replacement, shall be at the Contractor's expense.

1. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

2. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength (f_c'), and no individual strength test result falls below specified compressive strength by more than 500 psi when f_c' is 5000 psi or less; or by more than $0.10f_c'$ when f_c' is more than 5000 psi.

3. If any strength test of laboratory cured cylinders fall below the required strength level, or if observations or other evidence indicates deficiencies in protection or in curing, or if the concrete is suspected of having been frozen, steps shall be taken to assure that load carrying capacity of the structure is not jeopardized.

4. If, in the judgment of the Architect based on data from test-cylinders, and in-situ concrete cores, the ultimate load carrying capacity or durability has been significantly reduced, the concrete shall be removed and replaced at the Contractor's expense.

a. Core-drilling may only be undertaken with Architect's review and approved comments to the Contractor's proposed scope (extend and number of cores).

b. Non-destructive concrete evaluation procedures such as swiss hammer, windsor probe, etc. are not acceptable as a tool to determine the in-situ strength of concrete.

END OF SECTION

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SECTION 03 3313 - ARCHITECTURAL CAST-IN-PLACE CONCRETE

17/PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Architectural Cast-In-Place Concrete as indicated on the Drawings.
   1. Smooth Rubbed finish.

1.03 DEFINITIONS

A. Reveal: The projection of the coarse aggregate from the matrix after exposure.

1.04 REFERENCES

A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

B. ACI 301 - Specifications for Concrete Construction; 2020.

C. ACI 347R - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

D. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

E. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements; 2021.

F. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

G. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.

H. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars; 2025.

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, joint systems, and others as requested by Architect.
   1. Submit data for form liners, form ties, and accessories for architectural concrete.

C. Material Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Architect. Material certificates shall be signed by Manufacturer and Contractor, certifying each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride complies with specification requirements.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed architectural concrete similar in material, design, and extent to this Project and with a record of successful performance.

B. Work Quality: Contractor is responsible for correction of concrete work which does not conform to specified requirements, including strength, tolerances and finishes. Correct deficient concrete as directed by Architect.

C. Project Site Records: Maintain the following Project Site records for architectural cast-in-place concrete to ensure consistency.
   1. Batch time.
   2. Truck arrival time.
   3. Weather conditions.
   4. Ambient temperature.

5. Slump.
6. Air content.
7. Total mixing time.
8. Amount of water added, if any.
9. Time truck discharge is completed.

1.07 PRE-INSTALLATION CONFERENCE

A. Schedule a pre-installation conference at the Project site, minimum two weeks prior to start of architectural concrete work, with the following parties in attendance. Owner and Architect may decline to attend at their discretion.
   1. Owner's Representative.
   2. Architect.
   3. Contractor.
   4. Architectural Cast-in-Place Concrete Supplier.
   5. Architectural Cast-In-Place Concrete Contractor.
   6. Other interested parties.

B. Review methods and procedures related to architectural cast-in-place concrete including, but not limited to, the following:
   1. Inspect and discuss condition of subgrade and preparatory work performed by other trades.
   2. Review mock-ups approved by Architect.
   3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review required inspecting, testing, and certifying procedures.
   5. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions.

C. Contractor shall record discussion, including agreement or disagreement on significant matters. Furnish copies of report to all parties present within 5 days after meeting date.
   1. If substantial disagreements exist at conclusion of meeting, determine how disagreements will be resolved, and set date and time to reconvene meeting.

1.08 MOCK-UPS

A. General: Prior to installing architectural cast-in-place concrete, construct mockups for selection of each finish required to demonstrate aesthetic effects as well as qualities of materials and execution.
   1. Construct mock-ups minimum 30 days prior to start of Work using same personnel, materials, and techniques to be used for Project work.
   2. Construct mock-ups to demonstrate the following:
      a. SMooth Rubbed finish for exposed exterior vertical surfaces.

B. Build mock-ups to comply with the following requirements, using materials indicated for Work.
   1. Locate mockups on-site in location indicated or, if not indicated, as directed by Architect.
   2. Size of mock-ups shall be minimum 20 inches diameter by 3 feet high.
   3. Construct minimum 3 mock-ups to demonstrate range of color, once color is approved, use mockups to demonstrate range and uniformity of abrasive blast finish. Provide additional mock-ups, if requested by Architect.
   4. Notify Architect 7 days in advance of the dates and times when mock-ups will be constructed.
   5. Obtain Architect's approval of mock-ups and final selection of finish level before start of Work.
   6. Retain and maintain selected mock-ups during construction in an undisturbed condition as a standard for judging the completed Work.
      a. When directed, demolish and remove mockups from Project site.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Refer to Section 03 3000 - Cast-in-Place Concrete; for standard concrete formwork materials.

B. Forms for Architectural Concrete: Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.
   1. For Architectural Concrete, use overlaid plywood, APA grade trademarked “HIGH DENSITY OVERLAY (HDO)”.

2.02 CONCRETE MATERIALS

A. Refer to Section 03 3000 - Cast-in-Place Concrete; for concrete materials, reinforcing, concrete mixes, placement procedures, finishes, and testing.

B. Portland Cement: ASTM C150/C150M, Type I or Blended Hydraulic Cement ASTM C595/C595M, Type 1L
   1. Color: Gray.
   2. Use one brand of cement throughout the project, unless otherwise acceptable to Architect.

C. Normal Weight Aggregates: ASTM C33/C33M.
   1. Fine Aggregates: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.
      a. Dune sand, bank run sand and manufactured sand are not acceptable.
   2. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
      a. Crushed stone, processed from natural rock or stone.
      b. Washed gravel, either natural or crushed. Use of pit or bank run gravel not permitted.
      c. Maximum Aggregate Size: Not larger than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, nor three-fourths of minimum clear spacing between individual reinforcing bars or bundles of bars.

D. Supplementary Cementitious Materials: Ground granulated blast furnace slag, ASTM C989/C989M, Grade 100.

E. Corrosion-Inhibiting Admixture: Minimum 30% by mass, calcium nitrite admixture conforming to ASTM C94/C94M, Type C. Dosage rate as recommended by manufacturer.

2.03 MIXES

A. Refer to Section 03 3000 - Cast-in-Place Concrete; for concrete proportions and design requirements, except as follows;
   1. Provide architectural cast-in-place concrete with 35 percent supplementary cementitious material replacement of portland cement.

B. DO NOT add water to mix in field after leaving batch plant. Water shall remain constant from batch to batch to ensure consistent color.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting placement of architectural cast-in-place concrete. Do not proceed with application until unsatisfactory conditions have been corrected.

3.02 PLACING CONCRETE

A. Concrete placement is specified in Section 03 3000 - Cast-in-Place Concrete.

3.03 FINISHES, GENERAL

A. Coordinate form removal with Section 03 3000 - Cast-in-Place Concrete.

B. Maintain uniformity of special finishes over construction joints, unless otherwise indicated.

3.04 FORMS

A. Design, erect, support, brace and maintain formwork, per ACI 301, to support vertical and lateral, static and dynamic loads that might be applied until such loads can be supported by concrete structure.
   1. Construct formwork as required so concrete members and structures are of correct size, shape, alignment, elevation and position. Maintain formwork construction tolerances complying with ACI 117 and ACI 347R
   2. Provide Class A tolerances for concrete exposed to view.

B. Design formwork to be readily removable without impact, shock or damage to architectural cast-in-place concrete surfaces and adjacent materials.

C. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

D. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Retighten forms and bracing after concrete placement as required to eliminate mortar leaks and maintain proper alignment.

3.05 SMOOTH RUBBED FINISH

A. Begin with 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. Apply smooth rubbed finish not later than one day after form removal. Moisten concrete surfaces and rub with carborundum brick or other abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

3.06 PROTECTION, REPAIRS AND CLEANING

A. Protect architectural cast-in-place concrete from damage to visible faces during other construction activities, including but not limited to preventing holes being put into concrete for the support of non-permanent construction, such as temporary protection.

B. Repair damaged architectural concrete-finished surfaces to match color, texture, and uniformity of surrounding surfaces and to match repairs to approved mockups.

C. Clean surfaces of architectural concrete finishes after treatment to remove stains, markings, dust, and debris.

D. Wash and rinse surfaces according to architectural concrete finish applicator's recommendations. Protect other Work from staining or damage due to cleaning operations.
   1. Do not use cleaning materials or processes that could change the appearance of concrete finishes.

3.07 FIELD QUALITY CONTROL

A. Refer to Section 03 3000 - Cast-in-Place Concrete.

END OF SECTION

SECTION 03 4846 - PRECAST CONCRETE COPINGS AND SILLS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Precast concrete copings

1.03 REFERENCES

A. ACI 211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.

B. ACI 301 - Specifications for Concrete Construction; 2020.

C. ACI 305R - Guide to Hot Weather Concreting; 2020.

D. ACI 306R - Guide to Cold Weather Concreting; 2016.

E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

G. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

H. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).

I. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

J. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

K. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).

L. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements; 2021.

M. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

N. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.

O. CRSI (DA4) - Manual of Standard Practice; 2024.

P. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products; 2013.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Manufacturer's information on accessory products, including but not limited to admixtures, coloring agents, and inserts/plates.

C. Shop drawings detailing fabrication and installation of precast concrete copings. Indicate member dimensions and cross-sections; locations, sizes, and types of reinforcement, and lifting devices necessary for handling and erection.

1. Indicate locations and details of anchorage devices to be embedded in other construction. Furnish templates, if required, for accurate placement.

D. Samples, approximately 12 by 12 by 2 inches, to illustrate quality of finishes, colors, and textures of exposed precast concrete copings.

1.05 DELIVERY, STORAGE, AND PROTECTION

A. Store units at Project site to prevent cracking, distorting, warping, staining, or other physical damage, and with markings visible.

B. Lift and support units only at designated lifting or supporting points as shown on final shop drawings.

C. Deliver anchorage items to be embedded in other construction before starting such work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 PRODUCTS

2.01 FORMWORK

A. Forms: Provide forms and form facing materials that are nonreactive with concrete and will produce required finish surfaces.

2.02 MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Cement: Provide natural or white color cement as required to produce color indicated.
   1. Provide one of the following:
      a. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold weather construction.
      b. Blended Hydraulic Cement: ASTM C595/C595M, Type IL(10).
   2. Acquire cement for entire project from same source, unless otherwise acceptable to Architect.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 5S. Provide aggregates from a single source.

D. Coloring Agent: ASTM C979/C979M, synthetic mineral oxide pigments or colored water-reducing admixtures, color stable, nonfading, resistant to lime and other alkalis.
   1. Manufacturers: Subject to compliance with requirements, provide one of the following products:
      a. Davis Colors; Davis Color/Mix-Ready
      b. Lanxess; Bayferrox
      c. Sika Corporation; Chromix Admixtures
      d. Solomon Colors, Inc.; Solomon Dry Integral Colors
   2. Color: Custom color to match color masonry.

E. Water, ASTM C1602/C1602M : Potable; free from deleterious material that may affect color stability, setting, or strength of concrete.

F. Admixtures, General: Provide admixtures for concrete that contain not more than 0.1 percent chloride ions by mass of portland cement or cementitious material.
   1. Air-Entraining Admixture: ASTM C260/C260M, certified by manufacturer to be compatible with other required admixtures.
   2. Water-Reducing Admixture: ASTM C494/C494M, Type A.
   3. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

2.03 ACCESSORIES

A. Provide anchors of type and size required to support precast concrete coping units and to sustain imposed loads. Fabricate from the following metals for conditions indicated:
   1. Stainless Steel: ASTM A666, Type 304, temper as required to support loads imposed without exceeding allowable design stresses.

B. Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

2.04 MIXES

A. Normal-Weight Concrete: Proportion mixes by either laboratory trial batch or field test data methods per ACI 211.1 and ACI 301, to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28-Day): 5000 psi.
   2. Maximum Water-Cement Ratio at Point of Placement: 0.40.

B. Color Admixture: Mix per manufacturer's recommendations. Mix until color is uniformly dispersed and bags have disintegrated.
   1. Color admixture dosage rate shall be as recommended by Admixture Manufacture to achieve selected color.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content of 5 percent, plus or minus 1-1/2 percent.

D. Other Admixtures: Use water-reducing and high-range water-reducing admixtures according to manufacturer's directions.

2.05 FABRICATION

A. Formwork: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete placing operations. Maintain formwork to provide completed precast concrete coping units of shapes, lines, and dimensions indicated, within fabrication tolerances per PCI MNL-117.

B. Built-In Anchorages and Embedded Items: Accurately position built-in anchorage devices and other embedded items required and secure to formwork.

C. Reinforcement: Comply with CRSI (DA4) for fabricating, placing, and supporting reinforcement.

D. Concrete Mixing: Comply with PCI MNL-117. Following concrete batching, no additional water may be added.

E. Concrete Placement: Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast units. Comply with PCI MNL-117 for measuring, mixing, transporting, and placing concrete.
   1. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures per PCI MNL-117.
   2. Per ACI 306R procedures for cold-weather concrete placement.
   3. Per ACI 305R procedures for hot-weather concrete placement.

F. Identify pickup points of precast concrete coping units, complying with final shop drawings.

G. Cure concrete per PCI MNL-117 by moisture retention without heat or by accelerated heat curing, using low-pressure live steam or radiant heat and moisture.

2.06 FINISHES

A. Finish exposed-face surfaces of precast concrete coping units as follows:
   1. Smooth-surface finish free of pockets, sand streaks, and honeycombs, with uniform color and texture.

B. Finish unformed surfaces by trowel, unless otherwise indicated. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.

2.07 SOURCE QUALITY CONTROL

A. Defective Work: Precast concrete coping units that do not conform to requirements, including strength, manufacturing tolerances, and finishes, are unacceptable. Replace with precast concrete coping units that meet requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements, including installation tolerances, true and level bearing surfaces, and other conditions affecting performance of precast concrete coping units. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install precast concrete coping units plumb, level, and in alignment.
   1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.

B. Anchor precast concrete coping units in position by pinning, grouting, or as otherwise indicated. Remove temporary shims, wedges, and spacers as soon as possible after anchoring and grouting are completed.

C. Grouting Connections and Joints: After precast concrete coping units have been placed and secured, grout open spaces at connections, and joints as follows:
   1. Grout Type: Cement grout.
   2. Pack spaces with stiff grout material, tamping until voids are completely filled. Promptly remove grout material from exposed surfaces before it hardens.

3.03 CLEANING

A. Clean exposed surfaces of precast concrete coping units after erection to remove dirt, stains and other markings.
   1. Wash and rinse per precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
   2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes.

END OF SECTION

SECTION 04 2000 - UNIT MASONRY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Concrete unit masonry.

B. Decorative concrete unit masonry.

C. Concealed embedded flashing.

1.03 PRODUCTS INSTALLED BUT NOT FURNISHED

A. Steel lintels for unit masonry are specified in Section 05 5000 - Metal Fabrications.

1.04 REFERENCE STANDARDS

A. ACI 315 - Guide to Presenting Reinforcing Steel Design Details; 2018.

B. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.

C. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

E. ASTM A580/A580M - Standard Specification for Stainless Steel Wire; 2023.

F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

G. ASTM A635 / A635M - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for; 2015.

H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

I. ASTM A740 - Standard Specification for Hardware Cloth (Woven or Welded Galvanized Steel Wire Fabric); 2021.

J. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process; 2022a.

K. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.

L. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.

M. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2022.

N. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2022.

O. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2023a.

P. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

Q. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

R. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

S. ASTM C1623 - Standard Specification for Manufactured Concrete Masonry Lintels; 2017a.

T. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

U. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2023.

V. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

W. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

X. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

Y. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements; 2021.

Z. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2017.

AA. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.

BB. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2023.

CC. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.

DD. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.

EE. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018.

FF. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017.

GG. ASTM D2287 - Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds; 2012.

HH. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.

II. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2020.

JJ. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2022.

KK. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2022.

LL. BIA Technical Notes No. 20 - Cleaning Brickwork; 2018.

MM. NCMA TEK 03-01C - All-Weather Concrete Masonry Construction; Current Edition.

NN. NCMA TEK 8-02A - Removal of Stains from Concrete Masonry; Current Edition.

OO. NCMA TEK 08-04A - Cleaning Concrete Masonry; Current Edition.

PP. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Provide manufacturer's product data for each different masonry unit, accessory and other manufactured product indicated.

C. Shop Drawings: Submit shop drawings for fabrication and installation of the following: unit masonry reinforcing bars.
   1. Reinforcing Steel: Detail bending and Placement of masonry reinforcing bars. Comply with ACI 315.
   2. Fabricated Flashing: Details of corner units, end dam units, and other special applications.

D. Samples: Submit full size samples of each different exposed masonry unit, all colored masonry mortar, and select accessories, at Architect's request. Indicate full range of exposed color, texture and dimensions to be expected in completed work.

E. Material Certificates:
   1. Submit material certificates for each different masonry product required signed by manufacturer and Contractor certifying each material complies with requirements.
   2. Mix designs for mortar, standard grout and self-consolidating grout.

F. Material Test Reports (prior to fabrication): Submit test reports from a qualified independent testing laboratory employed and paid by Contractor indicating and interpreting test results relative to compliance of mortar, grout mixes and masonry units with requirements indicated.
   1. Test Reports shall have been performed within 18 months of Contract date. Test Reports more than 18 months old are not acceptable.

G. Masonry Material Cleaning Plan: Include products and techniques for each masonry product and each assembly being constructed for this Project. Prior to submission, Cleaning Plan shall be signed and approved by:
   1. Contractor.
   2. Mason Contractor.
   3. All masonry unit manufacturers.
   4. Cleaning materials supplier and manufacturer.
   5. Cleaning Subcontractor.

H. Weather Procedures Certification: Submit written Statement certifying construction procedures utilized for cold weather and hot weather conditions comply with requirements specified in referenced unit masonry standard.

I. Supervisor Certification: Copy of Supervisor Certification for grouting reinforced masonry.

1.06 QUALITY ASSURANCE

A. Industry Standards: Comply with recommendations of National Concrete Masonry Association (NCMA), American Concrete Institute (ACI), and American Society of Civil Engineers (ASCE) as applicable.

B. Supervisor Certification: Masonry supervisor responsible for placement of grouted reinforced masonry shall hold a current certification from Masonry Institute of Michigan (MIM) or International Masonry Institute (IMI) training program for reinforced unit masonry assemblies.

C. Unit Masonry Standard: Comply with TMS 402/602, except as otherwise indicated.

D. Material Test Reports on Clay Masonry products prior to delivery to site: Provide material test reports on actual clay masonry products that have been fabricated for the project. Provide tests per ASTM C216 sampled in accordance with ASTM C67. Architect will reject acceptance of brick outside of specified performance requirements. Provide a report on the following:
   1. Dimensional Tolerances
   2. Compressive Strength
   3. Hot Water Absorption
   4. Cold Water Absorption.

E. Single-Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or uniform blend within the accepted range for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

F. Single-Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality from one manufacturer for each cementitious component and from one source and producer for each aggregate.

1.07 MASONRY INSPECTION

A. Inspections: Masonry work shall be inspected per MBC Chapter 17, TMS 402/602 and ASTM C140/C140M.

1. Inspections shall be performed by a Certified Masonry Inspector employed by an independent Testing/Inspection Agency acceptable to Architect.
2. The following require special inspections:
    a. Unit layup Periodic
    b. Reinforcing bar placement: Periodic
    c. Grout placement: Continuous
    d. Other components as stated in Code.

1.08 MOCK-UP

A. Field-Constructed Mock-Ups: Prior to installation of unit masonry, erect sample wall panels to further verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mock-up to comply with the following requirements, using materials indicated for final unit of work:
    1. Locate mock-up on site as directed by Architect.
    2. Size: Approximately 8 feet long by 6 feet high.
    3. Typical exterior face brick wall; include face and backup wythes, and through wall flashing, as well as accessories utilizing each brick type in pattern directed by Architect.
    4. Typical exterior brick-veneer wall; include face brick, cold formed metal studs, sheathing, air infiltration barrier, veneer ties, flashing, weep holes, and cavity drainage material.
    5. Notify Architect one week in advance of the date and time when mock-up will be erected.
    6. Protect mock-up from the elements with weather-resistant membrane.
    7. Retain and maintain mock-up during construction in undisturbed condition as standard for judging completed unit masonry work.
        a. When directed, demolish and remove mock-up from Project site.

B. Grout Demonstration Panel: For self-consolidating grout, construct a separate "Grout Demonstration Panel". The panel shall be representative of the actual wall construction.
    1. Evaluation Criteria for panel shall include the following:
        a. Compressive strength.
        b. Bond to masonry units.
        c. Grout consolidation.

1.09 PRE-INSTALLATION CONFERENCE

A. Schedule a pre-installation conference at the Project site, minimum two weeks prior to start of masonry work, with the following parties in attendance. Owner and Architect, may decline to attend at their discretion.
    1. Owner’s Representative.
    2. Architect.
    3. Contractor.
    4. Masonry Contractor, including Project Supervisor.
    5. Masonry Inspector.
    6. Testing Laboratory.
    7. Authorities having jurisdiction.
    8. Other interested parties.

B. Review methods and procedures related to masonry construction including, but not limited to, the following:
    1. Review submittals, including
        a. CMU.
        b. Reinforcing steel shop drawings.
        c. Masonry accessories.
        d. CMU/precast concrete lintels.
        e. Grout type, proportions, and mix designs.
    2. Review
        a. Masonry inspection procedures.

b. Grout and grouting procedures.
c. Mortar and grout testing procedures.
d. Vertical and horizontal steel reinforcing shop drawings, splice lengths, and bar positioners.
e. Movement joint locations and details.
f. Flashing details.
g. Hot/cold weather procedures.
h. Approved Masonry Material Cleaning Plan.
i. Coordination issues with other trades.
j. Protection of and scheduling of non-masonry construction that will interfere with masonry work.
k. Job-Site storage and staging areas.

3. Review mock-ups for work quality and materials.
4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
5. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions.

C. Contractor shall record discussion, including agreement or disagreement on significant matters. Furnish copies of report to all parties present within 5 days after meeting date.
1. If substantial disagreements exist at conclusion of meeting, determine how disagreements will be resolved, and set date and time to reconvene meeting.

1.10 DELIVERY, STORAGE, AND PROTECTION

A. Deliver masonry materials to project site in undamaged condition.

B. Store masonry units off the ground, under cover, and in a dry location to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air-dried condition. Minimize condensation in shrink-wrapped pallets of units. Do not use saturated concrete masonry units as defined by NCMA TEK 03-01C

C. Store cementitious materials off the ground, under cover, and in dry location.

D. Store aggregate where grading and other required characteristics can be maintained and contamination avoided.

E. Store masonry accessories including metal items to prevent corrosion and accumulation of dirt and oil.

1.11 PROJECT CONDITIONS

A. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
1. Extend cover minimum 24 inches down both sides and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover minimum 24 inches down face next to constructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar and soil from staining the face of masonry to be left exposed or painted. Remove immediately any grout, mortar and soil that comes in contact with such masonry.
1. Protect base of walls from rain-splashed mud and mortar spatter by means of coverings spread on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes from mortar droppings.

1.12 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Construction: Comply with referenced standard and the following:
   1. Do not use frozen materials or materials mixed or coated with ice or frost.
   2. Do not build on frozen subgrade or setting beds.
   3. Do not lay masonry units that are wet or frozen.
   4. Remove and replace masonry damaged by freezing conditions. Replaced work shall match in-place work.

B. Hot Weather Construction: Comply with referenced standard and the following:
   1. Protect unit masonry work when temperature and humidity cause excessive evaporation of water from mortar and grout.
   2. Provide artificial shade and windbreaks as required.
   3. Do not proceed with masonry work when temperatures exceed 100 degF.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. General: Comply with requirements indicated below applicable to each form of concrete masonry unit required.
   1. Provide special shapes where indicated and as follows:
      a. For lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
      b. Bullnose units for exposed outside corners unless otherwise indicated.
   2. Size: Manufacturer to specified dimensions of 3/8 inch less than nominal widths by nominal heights by nominal lengths indicated on Drawings.
   3. Core Construction: Two or three at Contractor's option unless otherwise shown Coordinate with wall reinforcement spacing.
   4. Exposed Faces: Manufacturer's standard color and texture unless noted otherwise. Where CMU or DCMU must be cut, conceal cut face in wall assembly, presenting finished faces to view.

B. Hollow Load-Bearing Concrete Masonry Units: ASTM C90, and as follows:
   1. Minimum compressive prism strength: 2000 psi.
   2. Weight classification: Normal weight.

C. Decorative Concrete Masonry Units (DCMU): ASTM C90, and as follows:
   1. Minimum compressive prism strength: 2000 psi.
   2. Weight classification: Normal weight.
   3. Aggregate for DCMU: Provide aggregates in DCMU containing no iron or other materials that will oxidize and cause discoloration of DCMU over time.
   4. Finish: Exposed faces of the following descriptions matching color, pattern, and texture of Architect’s sample.
      a. Standard smooth face finish, scored vertically so when laid in running bond appear as stacked bond.
         1) DCMU1: Concrete Products Group; Spec-Brik Structural Masonry Units - Chesapeake Blend
         2) DCMU2: Fendt Builder's Supply, Inc.; Smooth Face Finish - No. 407
   5. Integral Water Repellant: Provide units produced with liquid polymeric, integral water-repellant admixture that does not reduce flexural bond strength, when tested according to ASTM C1072. Units made with integral water repellant, when tested as a wall assembly made with mortar containing integral water-repellant manufacturer’s mortar additive, per ASTM E514/E514M, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.

a. Use water repellent admixtures for masonry units, mortar and grout by a single manufacturer.

6. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Decorative Concrete Masonry Units:
      1) Best Block Company.
      2) National Block Company.
   b. Integral Water Repellant:
      1) GCP Applied Technologies; Dry Block.

2.02 CONCRETE AND MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.
   1. Prefabricated lintels shall conform to ASTM C1623.

2.03 MORTAR AND GROUT MATERIALS

A. Cement: Provide natural or white color cement as required to produce mortar color indicated.
   1. Provide one of the following:
      a. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold weather construction.
      b. Blended Hydraulic Cement: ASTM C595/C595M, Type IL(10).
   2. Acquire cement for entire project from same source, unless otherwise acceptable to Architect.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

D. Aggregate for Mortar: ASTM C144; for joints less than 1/4 inch, use aggregate graded with 100 percent passing No. 16 sieve.

E. Aggregate for Grout: ASTM C404.

F. Water: Clean and potable.

G. Water-Repellant Admixture: Liquid water-repellant mortar admixture intended for use with CMU/DCMU, containing integral water repellant for mortar by same manufacturer as water repellant in CMU/DCMU.

2.04 REINFORCING STEEL

A. General: Provide reinforcing steel complying with requirements of referenced unit masonry standard and with this article.

B. Steel Reinforcing Bars: Billet steel, ASTM A615/A615M, Grade 60.
   1. Reinforcing Bars Positioners: Provide reinforcing bar positioners to assist with reinforcing placement in the center of the masonry unit.

2.05 JOINT REINFORCEMENT

A. General: Provide joint reinforcement per ASTM A951/A951M, formed from the following:
   1. Galvanized carbon steel wire: ASTM A1064/A1064M, galvanized per ASTM A153/A153M, Class B-2 coating, for interior and exterior walls.

B. Description: Welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet, complying with requirements indicated below.
   1. Wire Diameter for Side Rods: 0.1483 inch (9 gage).
   2. Wire Diameter for Cross Rods: 0.1483 inch (9 gage).
   3. Wire Diameter for Eyes and Pintles: 3/16 inch.

4. For single-wythe masonry provide type as follows with single pair of side rods:
   a. Ladder design with perpendicular cross rods spaced not more than 16 inches o.c.
5. For multiwythe masonry provide type as follows:
   a. Cavity Masonry Walls.
      1) Ladder design with perpendicular side rods and adjustable double eye and pintle type ties.
         (a) Provide one side rod for each face shell of hollow masonry units more than 4 inches in nominal width.
         (b) Perpendicular cross rods spaced not more than 16 inches o.c.
         (c) Adjustable eye and pintle ties spaced not more than 16 inches o.c.
      2) Ladder design with perpendicular cross rods spaced not more than 16 inches o.c. and number of side rods as follows:
         (a) Provide one side rod for each face shell of hollow masonry units more than 4 inches in nominal width plus one side rod for each wythe of masonry 4 inches or less in nominal width.
         (b) Provide integral drips on cross rods at cavity walls.

C. Manufacturers: Subject to compliance with requirements, provide joint reinforcement by one of the following:
   1. Heckman Building Products, Inc.
   2. Hohmann & Barnard, Inc.
   3. Wire-Bond

2.06 TIES AND ANCHORS, GENERAL

A. General: Provide ties and anchors specified in subsequent articles that comply with requirements for metal and size of referenced unit masonry standard and of this article.

B. Galvanized Carbon Steel Wire: ASTM A1064/A1064M, galvanized per ASTM A153/A153M, Class B-2 coating.
   1. Wire Diameter: 0.1875 inch.

C. Stainless Steel Wire: ASTM A580/A580M.
   1. Wire Diameter: 0.1875 inch.

D. Galvanized Steel Sheet: ASTM A1008/A1008M cold-rolled carbon steel sheet, hot-dip galvanized after fabrication per ASTM A924/A924M, Class B2 (for unit lengths over 15 inches) and Class B3 (for unit lengths under 15 inches) and Class B3 (for unit lengths under 15 inches), for sheet metal ties and anchors.
   1. Sheet Thickness: 0.0747 inch (14 gage).

E. Galvanized Heavy-Thickness Steel Sheet: ASTM A635 / A635M hot-rolled carbon steel sheet hot-dip galvanized after fabrication per ASTM A924/A924M, Class B3, for rigid anchors fabricated from steel sheet or strip with a thickness of 0.180 inch and greater.

F. Manufacturers: Subject to compliance with requirements, provide products of the following:
   1. Heckman Building Products, Inc.
   2. Hohmann & Barnard, Inc.
   3. Wire-Bond

2.07 BENT WIRE TIES

A. Individual units prefabricated from bent wire to comply with requirements indicated below.

B. Tie Shape for Hollow Masonry Units Laid with Cell Vertical: Rectangular with closed ends and not less than 4 inches wide.

C. Tie Shape for Solid Masonry Unit Construction: Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long.

D. Type of Masonry Where Coursing Between Wythes Align: Unit ties bent from one piece of wire.

E. Type for Masonry Where Coursing Between Wythes Does Not Align: Adjustable ties composed of two parts, one with pintles, the other with eyes, maximum misalignment 1-1/4 inches.

F. Type for Masonry Where Wythes Are Different Materials: Adjustable ties composed of two parts, one with pintles, the other with eyes, maximum misalignment 1-1/4 inches.

2.08 WALL INTERSECTION TIES

A. Rigid wall ties: Provide Z-straps of form and length indicated, fabricated from metal strips of the following width and thickness:
   1. 1-1/2 inches wide by 1/4 inch thick.
   2. Galvanize per ASTM A153/A153M.

B. Wire Mesh Wall Tie: ASTM A740 welded wire mesh, 1/2 inch by 1/2 inch mesh of 16 gauge hot dip galvanized steel wire, ASTM A153/A153M.
   1. Hohmann and Barnard, Inc.; MWT Mesh Wall Tie
   2. Wirebond; Mesh Wall Tie #1900
   3. Heckman Building Products; Wire Mesh Wall Tie (269)

2.09 POSTINSTALLED ANCHORS

A. Chemical, expansion or undercut anchors as indicated or required, with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E488/E488M, conducted by a qualified independent testing laboratory.
   1. Corrosion Protection: Stainless steel components per ASTM F593 and ASTM F594, Group 1, alloy 304 or 316 for bolts and nuts; alloy 304 or 316 anchors.

B. For Postinstalled Anchors in Concrete: Capability to sustain, without failure, a load equal to 4 times load imposed by masonry.

C. For Postinstalled Anchors in Grouted Concrete Masonry Units: Capability to sustain, without failure, a load equal to 6 times load imposed by masonry, per ASTM E488/E488M.

2.10 EMBEDDED FLASHING MATERIALS

A. Metal Drip Edges: ASTM A666, Type 304, stainless steel, 0.0156 inches thick.
   1. Metal Configuration: Extend at least 3 inches horizontally into wall and 1/2 inch out from exterior face of wall with outer edge bent down, a minimum of 20 degrees and hemmed. Near grade cut drip edge flush with face of masonry or use a flush end drip plate.
   2. Sealant : One part non-skinning butyl sealant conforming to ASTM C1311.

B. Metal Inside Corners, Outside Corners and End Dams: ASTM A666, Type 304, stainless steel, 0.018 inches thick.
   1. Metal Configuration: soldered seams and joints.
   2. Minimum dimensions as follows:
      a. Height: 4 inches
      b. Outside Corners: 6 inches deep by 10 inches.
      c. End dam: 4 inches by 4 inches
      d. Inside corner: 4 inches by 6 inches.

C. Sheet Metal Flashing: Fabricate from the following metal complying with requirements specified in Section 07 6200 - Sheet Metal Flashing and Trim, and as follows:
   1. Stainless Steel: 0.0156 inch thick.
   2. Fabricate through-wall metal flashings embedded in masonry with ribs formed in dovetail pattern at 3 inch intervals along length of flashing to provide a three-way integral mortar bond and weep-hole drainage.

D. Membrane flashing - Laminated Flashing: Manufacturer's standard asphalt-free laminate flashing of type indicated below:
   1. Stainless Steel-Fabric Laminate: Stainless steel sheet, laminated to a polymer scrim with asphalt free adhesive.
      a. Stainless steel type: 304, ASTM A666.

b. Fabric: Polymer fabric; laminated back face of stainless steel core.
c. Size: Manufacturer's standard width rolls.

2. Self-Adhering Stainless Steel-Fabric Laminated Flashing:
   a. Adhesive: Non-asphaltic, non-drool.
   b. Stainless steel type: 304, ASTM A666.
   c. Fabric: Polymer fabric; laminated back face of stainless steel core.
   d. Size: Manufacturer's standard width rolls.
3. Provide prefabricated inside corners, outside corners and end dams in lieu of field fabricated inside corners, outside corners and end dams at contractors option.

E. Adhesive for Flashing: Type recommended by manufacturer of flashing material for use indicated.

F. Products: Subject to compliance with requirements, provide one of the following:
1. Metal Flashing:
   a. Cheney Flashing Co., Inc.; Cheney Flashing (Dovetail).
2. Stainless Steel Fabric Laminate Flashing:
   a. Hohmann and Barnard, Inc.; Mighty-Flash
   b. York Mfg., Inc.; Multi-flash SS
3. Self-adhered Stainless Steel Fabric Laminate Flashing:
   a. Hohmann and Barnard, Inc.; Mighty-Flash SA
   b. York Mfg., Inc.; York 304
   c. Wire-Bond; Bond-N-Flash
4. Stainless Steel, Inside/Outside corners and end dams:
   a. Hohmann and Barnard, Inc.; Stainless Steel Corners and End Dams
   b. Wire-Bond: Corners and End Dams

2.11 MISCELLANEOUS MASONRY ACCESSORIES

A. Bond Breaker Strips: Asphalt-saturated organic roofing per ASTM D226/D226M, Type I (No. 15 asphalt felt).

B. Preformed Control-Joint Gaskets: Designed to fit standard sash block unit and maintain lateral stability in masonry wall; size and configuration as indicated.
1. Styrene-Butadiene Rubber: ASTM D2000, Designation M2AA-805.
2. Polyvinyl Chloride: ASTM D2287, General Purpose Grade, Type PVC-65406.

C. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene.

D. Isolation Material:
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Williams Products; Econ-o-foam

E. Termination Bar: Minimum 0.019 inch thick by 1-1/8 inch high stainless steel termination bar with stainless steel fasteners; 5/16 inch holes 8 inches on center. Stainless steel, ASTM A666, Type 304.
1. Fasteners: Provide fastener of stainless steel or other metal compatible with flashing and termination bar material with attached neoprene washer. If fastener provided doesn't have a neoprene washer then provide sealant bead covering each fastener.
2. Provide solid backing (strapping) on metal studs behind termination bars, to allow fastening at all holes in termination bar. Refer to Section 05 4000 - Cold-Formed Metal Framing.
3. Product:
   a. Hohmann and Barnard; T2 Stainless steel termination bar
   b. Heckmann Building Products; 1050 Stainless steel termination bar
   c. Wirebond; 4210 Stainless steeel termination bar

F. Grout Retainer: Mesh screen, width of CMU less 1 inch, for use at bottom of open cells of CMU to retain grout without use of special shaped unit.

G. Cavity Drainage Material: Reticulated, non-absorbent mesh, made from polyethylene strands and shaped to maintain drainage at weep holes without being clogged with mortar droppings.
   1. Provide thickness to fill cavity. Refer to Drawings - Cavity depth may vary dependent on location.
   2. Subject to compliance with requirements, provide the following:
      a. Mortar Net USA Ltd.; Mortar Net.
      b. MasonPro; ProNet
      c. Hohmann and Barnard; Mortar Trap

H. Weep Vents: 3/8 inch thick cellular butyrate plastic, unit ultraviolet-resistant, sized to fill head joints with outside face held back 1/8 inch from exterior face of masonry.
   1. Color: As selected by Architect.
   2. Products: Subject to compliance with requirements, provide the following:
      a. Advanced Building Products; Mortar Maze Weep Vents.
      b. Wire-Bond; Cell Vent.
      c. Hohmann and Barnard, Inc.; Quadro-Vent.
      d. Heckmann Building Products, Inc.; No. 85 Cell Vent

I. Sealant for Flashing and termination bars, not in contact with weather resistive barrier: Solvent-based, single component, non-sag, non-skinning, non-hardening, non-bleeding; non-vapor-permeable; intended for fully concealed applications.

J. Sealant for masonry tie penetrations through weather resistive barrier and sealant for flashing and termination bars in contact with weather resistive barrier: Refer to Section(s) 07 2500 - Weather Barriers and 07 2526 - Gypsum Board Weather-Resistant Barrier and Air Barrier System. Seal using sealant/flashing material acceptable to product manufacturer providing weather resistive barrier.

K. Compressible Joint Filler: Closed cell neoprene, ASTM D1056. Compression: 25 percent or 50 percent.
   1. Hohmann and Barnard; NS Closed Cell Neoprene Sponge
   2. Wirebond; #3300 Expansion Joint

2.12 CAVITY WALL INSULATION

A. Refer to Section 07 2100 - Thermal Insulation, for insulation placed in masonry cavity walls.

2.13 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of trisodium phosphate (1/2 cup dry measure) and laundry detergent (1/2 cup dry measure) dissolved in one gallon of water.

B. Construction Cleaning materials:
   1. Brick: Provide one of the following cleaning solutions in accordance with Brick manufacturer's recommendations:
   2. Decorative CMU: Prosoco; Custom Masonry Cleaner
   3. Standard CMU: Prosoco; Sure Klean 600

2.14 SURFACE WATER REPELLANT

A. Surface Water Repellant: Manufacturer's standard-strength, breathable penetrating water repellant for porous masonry surfaces without darkening or discoloring masonry surfaces.
   1. Field apply to all exposed decorative CMU with integral water repellant.
   2. Product: Subject to compliance with requirements, provide the following:
      a. ProSoCo, Inc.; Sure Clean Weather Seal Siloxane WB Concentrate

2.15 MORTAR AND GROUT MIXES

A. General: Do not add admixtures including coloring pigments, air-entraining agents, accelerating or retarding agents, anti-freeze compounds, or other admixtures, unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.

B. Mortar for Unit Masonry: ASTM C270, Property Specification.
   1. Use Type S mortar for all masonry above grade.
   2. Use Type N mortar for interior load bearing and non-load bearing partitions and other uses not indicated.
   3. Use Type S mortar for reinforced masonry.
   4. Use integral water repellant for all CMU/DCMU masonry exposed to exterior. Provide dosage as recommended by water repellant manufacturer for each mortar type.

C. Standard Grout Mix: ASTM C476
   1. Fine or coarse grout per TMS 402/602, Grout Space Requirements, based on height and CMU cell size.
   2. Provide grout with slump of 8 inches to 11 inches, per ASTM C143/C143M.
   3. Provide 2,000 psi, 28 day compressive strength unless otherwise indicated.
   4. Grout for hollow metal door frames slump must not exceed 4 inches, per ASTM C143/C143M. Hand trowel grout into frames, do not pump.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of unit masonry.

B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Comply with TMS 402/602, except where exceeded by Contract Documents.

B. Thickness:
   1. Build cavity walls and other masonry construction to full thickness shown.
   2. Build single-wythe walls to actual thickness of masonry units, using units of nominal thickness indicated.

C. Build chases and recesses as shown or required to accommodate items specified in this and other Sections of the Specifications. Provide not less than 8 inches of masonry between chase or recess and jamb of openings and between adjacent chases and recesses.

D. Leave opening for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.

E. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting where possible.

F. Anchor Bolts: Set 3/4 inch diameter anchor bolts at exterior and interior bearing walls as indicated on structural drawings.

G. Cleaning Reinforcing: Remove rust, mud, ice and other coatings from reinforcing prior to placing.

3.03 CONSTRUCTION TOLERANCES

A. Comply with construction tolerances of TMS 402/602, unless stricter tolerances are indicated..

1. For vertical lines, such as vertical corners, door jambs, reveals, and movement joints: Maximum from plumb; 1/4 inch in 20 feet.
2. For horizontal lines, such as lintels, sills, parapets, and reveals: Maximum from level; 1/4 inch in 20 feet.
3. Joint Thickness:
   a. Bed Joints: Plus or minus 1/8 inch.
   b. Head Joints: Minus 1/8 inch, plus 1/8 inch.

3.04 LAYING MASONRY WALLS

A. Lay out of walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate location openings, movement type joints, returns and offsets. Avoid the use of less-than-half size units at corners, jambs and where possible at other locations.

B. Lay up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.

C. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond patterns unless indicated otherwise; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
   1. Standard CMU: Standard 1/2 running bond.
   2. Decorative CMU: 1/2 running bond.

D. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

E. Stopping and Resuming Work: In each course, rack back 1/2 unit length for one-half running bond or 1/3 unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

F. Built-In Work: As construction progresses, build-in items specified under this and other Sections of the Specifications. Fill in solidly with mortar around built-in items.
   1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
   2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
   3. Fill cores in hollow concrete masonry units with grout 3 courses (24 inches) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

G. Non-loadbearing Interior Partitions: Build full height of story to underside of solid floor or roof structure above and as follows:
   1. Install pressure-relieving joint filler in joint between top of partition and underside of structure above.

3.05 MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units as follows:
   1. With full mortar coverage on horizontal and vertical face shells.
   2. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be filled with grout.
   3. For starting course on footings where cells are not grouted, spread out mortar bed, including areas under cells.
   4. Maintain joint widths indicated, except for minor variations required to maintain bond alignment. If joint width not indicated, use 3/8 inch width.
   5. Point score joints in DCMU with mortar to match standard tooled mortar joints.
   6. Remove mortar joint protrusions extending 1/2 inch or more into masonry cells to receive grout.

B. Lay hollow cmu units with face shells fully bedded in mortar and with head joints of depth equal to bed joints. Fully mortar cross webs where cells are to be grouted, unless all cells are grouted.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

D. Cut joints flush for masonry walls to be concealed or to be covered by other materials, unless otherwise indicated.

3.06 BONDING OF MULTIWYTHE MASONRY

A. Bond multiwythe walls together using one of the following methods:
   1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 1.77 sq. ft. of wall area spaced not to exceed 16 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
      a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
      b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.
   2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
      a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
      b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.
      c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in back-up wythe attached to adjustable eye and pintle type ties to allow for differential movement regardless of whether bed joints align.

3.07 CAVITIES/AIR SPACES

A. Keep cavities/air spaces clean of mortar droppings and other materials during construction. Strike joints facing cavities/air spaces flush.

B. Batter mortar beds away from cavity to minimize mortar protrusions into cavity.

C. Tie exterior wythe to backup with continuous horizontal joint reinforcing or individual metal ties as shown.

D. Place cavity drainage material immediately above embedded flashing.

3.08 CAVITY-WALL AND MASONRY-CELL INSULATION

A. Refer to Section 07 2100 - Thermal Insulation.

3.09 HORIZONTAL JOINT REINFORCEMENT

A. General: Provide continuous horizontal joint reinforcement as indicated. Where there are dissimilar masonry materials install continuous horizontal joint reinforcement in horizontal joint between those materials. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inches elsewhere. Lap reinforcing minimum 6 inches.
   1. Space reinforcement maximum 16 inches o.c. vertically.
   2. Space reinforcement maximum 8 inches o.c. vertically, in foundation walls and parapet walls.
   3. Provide reinforcement maximum 8 inches above and below wall openings and extending minimum 12 inches beyond openings.
   4. Provide reinforcement at all joints between brick veneer and cast stone and manufactured stone masonry.

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners and wall intersections by use of wire mesh wall ties, prefabricated "L" and "T" sections or by field fabrication of corner from straight horizontal reinforcing

D. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

E. Wall intersections: Provide Wire Mesh Wall ties or continuous joint reinforcement at wall intersections at 16 inches on center

3.10 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts faces of structural members to comply with the following:
   1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
   2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
   3. Space anchors as indicated, but not great than 24 inches o.c. vertically and 32 inches o.c. horizontally.

3.11 MOVEMENT JOINTS

A. Install control and expansion joints in unit masonry assemblies where indicated. Build in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. Form control joints in concrete masonry as follows, using bond breaker strips and filled joint:
   1. Location and spacing of control joints shall comply with industry standards.
   2. Fit bond breaker strips into hollow contour in ends of block units on one side of control joint. Fill the resultant core with grout and rake joints in exposed faces.
   3. Install preformed control-joint gaskets designed to fit standard sash block.

C. Build in horizontal pressure-relieving joints where indicated; construct joints by either leaving an air space or inserting nonmetallic 50 percent compressible joint filler of width required to permit installation of sealant and backer rod specified in Section 07 9200 - Joint Sealants.
   1. Locate horizontal pressure-relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

3.12 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and wherever openings of more than 1'-0" for brick size units and 2'-0" for block size units are shown without structural steel or other supporting lintels.
   1. Provide prefabricated lintels per ASTM C1623, or formed-in-place masonry lintels. Temporarily support formed-in-place lintels.
      a. For hollow concrete masonry unit walls, use specially formed bond beam units with reinforcement bars placed as indicated and filled with course grout.

C. Provide minimum bearing at 8 inches at each jamb, unless otherwise indicated.

3.13 FLASHING, WEEP HOLES, AND VENTS

A. Install embedded flashing and weep holes in masonry at base of walls, shelf angles, lintels, ledges, other obstructions to the downward flow of water in wall, and where indicated.

B. Prepare masonry surfaces smooth and free from projections that could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with adhesive/sealant/tape as recommended by flashing manufacturer before covering with mortar.

C. Clean and prime all surfaces to receive masonry flashing.

D. Install flashings as follows:
   1. At lintels, extend flashing minimum 4 inches into masonry at each end. Extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 12 inches, and flashed into air barrier with transition material.
      a. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2 inches, unless otherwise indicated.
   2. At heads and sills, extend flashing a minimum 4 inches into masonry at each end. Turn up ends not less than 2 inches to form an end dam.
   3. At masonry veneer walls, extend flashing from exterior face of veneer, through veneer, up face of sheathing at least 12 inches lapped onto and sealed to air barrier using method approved by both masonry flashing manufacturer and air barrier system manufacturer to ensure product compatibility. Fasten to face of interior wythe with termination bar. Provide fasteners not greater than 8 inches on center.
   4. At base of masonry cavity walls, extend flashing from exterior face of exterior wythe, through exterior wythe, up face of interior wythe at least 8 inches and fasten with a termination bar. Fasten to face of interior wythe with termination bar. Provide fasteners not greater than 8 inches on center.
   5. At step flashing, turn up ends not less than 2 inches to form an end dam, at the ends of each step.
   6. Cut off fabric flashing flush with face of wall after masonry wall construction is completed. Seal fabric flashing to sheet metal flashing with minimum 2 continuous beads of butyl sealant. At flashings within 42 inches of grade only, trim flashing flush with the face of the wall. All fabric flashing will be adhered to a stainless steel drip with a minimum of 2 continuous beads of butyl sealant.
      a. Stainless Steel Drip edges extending from face of wall shall be hemmed.
   7. Extend sheet metal flashings 1/2 inch beyond face of wall and turn down to form a drip. At sheet metal flashings within 42 inches of grade only, trim flashing flush with the face of the wall.
      a. Drip edges extending from face of wall shall be hemmed.
   8. Provide bead of butyl sealant at top of all termination bars. If fastener provided doesn't have a neoprene washer then provide butyl sealant bead covering each fastener.

E. Install reglets and nailers for flashing and other related construction where shown to be built into masonry.

3.14 REINFORCED UNIT MASONRY INSTALLATION

A. Install reinforced unit masonry to comply with requirements of referenced unit masonry standard.

B. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.
   1. Construct formwork to conform to shape, line, and dimensions shown. Make sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads placed on them during construction.

C. Temporary Wind Bracing
   1. Provide temporary masonry wall bracing to OSHA Construction Safety Standards, Part 2: Masonry Wall Bracing.
   2. The limited access zone shall be equal to the height of the wall to be constructed plus four feet, and shall run the entire length of wall.
   3. Provide temporary wind bracing at masonry foundation walls and at other interior and exterior masonry free-standing walls exceeding 8’-0” in height according to OSHA maximum unsupported wall heights.

4. Bracing may be of metal or wood material capable of resisting uniform lateral wind pressures of 70 miles per hour.
5. Engineer and construct temporary wind bracing system as part of base contract.

D. Placing Reinforcement: Comply with TMS 402/602.

E. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
1. Grout cores of all masonry at locations of vertical reinforcement, bond beams, bearing plates, anchors and embedded items.
2. Comply with TMS 402/602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
3. Vertical grout pour heights:
a. Standard Grout: Not more than 48 inches.

3.15 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

B. Testing Agency: Contractor will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports. Perform inspections as required by TMS 402/602 . Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
1. Payment for these services will be made by Owner.
2. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.
3. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof, unless otherwise required by TMS 402/602.

D. Clay Masonry Unit Test: For each type of unit provided, per ASTM C67.

E. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C140/C140M.

F. Mortar Test (Property Specification): For each mix provided, per ASTM C780.

G. Grout Test (Compressive Strength): For each mix provided, per ASTM C1019. Do not use cardboard forms unless written approval is obtained based on comparative preconstruction testing performed with units used for this project.

3.16 REPAIRING, POINTING AND CLEANING

A. Remove and replace masonry units that are loose chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units and in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings, and adjacent construction to provide a neat, uniform appearance. Prepare joints for application of sealants.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears prior to tooling joints.

D. Final cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
2. Comply with manufacturer's specifications and recommendations for use of masonry cleaner products.

3. Test cleaning methods on sample wall panel; leave 1/2 panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
4. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
5. Wet wall surface with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clean water.
6. Clean brick by means of bucket and brush hand-cleaning method described in BIA Technical Notes No. 20, first using job-mixed detergent solution. If result is not satisfactory, use proprietary acidic cleaner applied in compliance with directions of acidic cleaner manufacturer.
7. Clean concrete masonry by means of cleaning method indicated in NCMA TEK 8-02A and NCMA TEK 08-04A applicable to type of stain present on exposed surfaces.

E. Protection: Provide final protection and maintain conditions, in manner acceptable to installer to ensure unit masonry is without damage and deterioration at time of Substantial Completion.

END OF SECTION

SECTION 04 2010 - REINFORCED UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Requirements for unit masonry and general construction requirements of Division 4 Section "Unit Masonry Assemblies" apply to this Section.

1.02 SUMMARY

A. Reinforced Unit Masonry work is indicated on drawings and in schedules.

1.03 ACTION SUBMITTALS

A. Product Data:
   1. None required.

B. Shop Drawings:
   1. Submit shop drawings for fabrication, bending, and placement of reinforcing bars.
   2. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures".
   3. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.

C. Grouting Procedure:
   1. Submit proposed grouting procedures with at minimum the following information:
      a. Use of fine or coarse grout.
         1) When using both types of grout, indicate respective areas of use.
      b. Lift Heights:
         1) Proposed lift height as it applies to the type of grout and block size.
      c. Grout Consolidation Method:
         1) If more than one method is proposed, indicated respective area of use.
      d. Location of cleanouts as applicable.

D. Test Reports:
   1. Submit the following reports directly to the Architect from the testing services, with a copy to the Contractor:
   2. Test reports of compressive strength of masonry units and grout.
   3. Test reports of compressive strength of masonry prisms.
   4. Field reports of in-place reinforcing inspection, grout space and grouting inspection.
   5. Field reports of consistency and mixing of mortar and grout.
   6. Field reports verifying proper curing methods.
   7. Field reports verifying proper anchorage to structure (where applicable).
   8. Test reports of other tests as required.
   9. All test reports and field reports shall indicate whether the work is in accordance with project specifications and referenced codes.

E. Samples:

1. None required.

1.04 QUALITY ASSURANCE

A. Contractor's Qualifications:

1. Firms shall have a minimum of 5 years experience in placing of reinforced masonry.
2. Foremen responsible for the placement of reinforced masonry shall be qualified on the basis of having passed one of the listed training programs:
   a. Masonry Institute of Michigan (MIM) "Reinforcing Walls and Grouting of Hollow Unit Masonry".
   b. International Masonry Institute (IMI) "Grouting and Reinforced Masonry Training Course".

B. Installers of post-installed reinforcing utilizing adhesive anchoring systems shall be certified from the ACI/CRSI Adhesive Anchor Installation Certification Program. Refer to Division 5 section “Post-Installed Anchors” for adhesive anchoring system requirements.

C. Codes and Standards:

1. Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
   a. TMS 402/602, Building Code Requirements and Specifications for Masonry Structures.
   b. NCMA TEK Manual.

D. Masonry Testing Service for Material Evaluation:

1. Contractor shall employ and pay for a qualified independent testing laboratory design grout mixes and evaluate masonry materials.

E. Responsibility of Contractor:

1. The Contractor alone shall be fully responsible for the design, strength, safety and adequacy of all formwork, shoring, bracing and all methods of construction, and for the strength, consistency, finish and general quality of masonry.
2. The specifying herein of requirements for construction methods, preliminary approvals by the Architect, inspection testing and quality control performed by the testing agency, or any other requirements of the Specifications shall be construed as the minimum acceptable, and shall not eliminate, lessen or restrict in any manner the responsibility of the Contractor for all construction methods and for providing masonry in the completed structure that fully meets the strength, appearance and all other requirements of the Specifications and Drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:

1. For alignment of cells to receive reinforcement and grout, block shall be 2-cell units, with a recommended open end at one side.

B. Reinforcement Bars:

1. ASTM A 615 – Grade 60, deformed, except as otherwise indicated.
   a. Reinforcing bars to be welded, shall conform to ASTM A706.
   b. Where No. 2 bars are shown, provide plain, round, carbon steel bars, ASTM A 675, Grade 80.
   c. All reinforcing bars shall be produced, manufactured and fabricated in USA.
2. Shop-fabricate reinforcement bars which are shown to be bent or hooked.

C. Reinforcing Bar Positioners:

1. For Vertical Bars:

a. Bars at center of block:

1) D/A 811; Dur-O-Wal, www.dur-o-wal.com

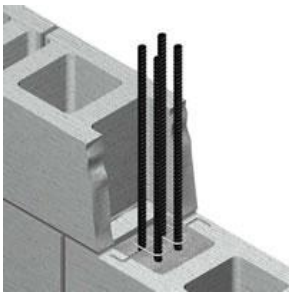
2) #RB Rebar Positioner, Hohmann & Barnard, Inc., www.h-b.com

3) Figure 8 Rebar Positioner, Masonry Reinforcing Corp. of America, www.wirebond.com

b. Bars near face of block:

1) General:

a) Positioners to place rebars with ½ inch cover to inside face of block.



2) Products: Products may require adjustments to manufacturer's standards.

3) Provide dimensions to manufacturer at time of order. Note: Delivery time may be affected by items "not off the shelf".

a) D/A 811; Dur-O-Wal, www.dur-o-wal.com

b) Double Figure 8 Rebar Positioner, Masonry Reinforcing Corp. of America, www.wirebond.com

2. For Horizontal Bars in Bond Beams:

a. Galvanized.

b. Bottom Reinforcing:

1) Use standard chairs or bolsters for spacing, supporting and fastening bars in place. Use wire bar type supports complying with CRSI recommendations.

D. Mechanical Type Tension Splices and Accessories:

1. Develop 125% tensile strength of rebar.

a. Lenton Rebar Splices; Erico Products, Inc., www.erico.com.

b. DS-Bar-Lock Coupler System; Dayton Superior; www.daytonsuperior.com

E. Grout:

1. Comply with ASTM C 476.

2. Unless otherwise indicated, use type (fine or coarse) that will comply with dimensions and pour heights listed in Part 3 – Execution of this Section.

3. Slump: 8 to 11 inches, in accordance with ASTM C 143, except for units with Integral Waterproofing.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

C. Do not proceed with masonry installation until construction that masonry is dependant-on is satisfactory and that unsatisfactory conditions have been corrected.

3.02 PLACING REINFORCEMENT

A. General:

1. Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcing bars with bends not shown on Drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
2. Position reinforcement accurately at the spacing indicated.
    a. Support and secure vertical bars against displacement.
    b. Except at splices, where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 1" (whichever is greater).
        1) For columns, piers and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2", whichever is greater.
        2) Provide lateral ties as indicated.
3. Place reinforcement and ties in grout spaces prior to grouting.
4. Splice reinforcement bars where shown.
5. Do not splice at other points unless acceptable in writing to the Architect.
6. Support vertical reinforcing with reinforcing bar positioners.
    a. Locate reinforcing bar positioners as shown on the drawings.
7. Avoid welding of splices.
    a. Where required on drawings, comply with the requirements of AWS D1.4 for welding materials and procedures.
8. Embed metal ties in mortar joints as work progresses, with a minimum mortar cover of 5/8" on exterior face of walls and 1/2" at other locations.
9. Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 5/8" on exterior face of walls and 1/2" at other locations.
    a. Lap units not less than 6" at ends.
    b. Use prefabricated "L" and "T" units to provide continuity at corners and intersections.
    c. Cut and bend units as recommended by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

B. Anchoring:

1. Anchor reinforced masonry work to supporting structure as indicated.
2. Anchor reinforced masonry walls with non-reinforced masonry where they intersect.

3.03 MASONRY INSTALLATION, GENERAL

A. General:

1. Refer to Division 4 Section "Unit Masonry Assemblies" for general installation requirements of unit masonry.
2. Construct grout spaces free of mortar droppings, debris, loose aggregates, and any material deleterious to masonry grout.

3.04 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY

A. General:

1. Do not wet concrete masonry units (CMU).
2. Lay CMU units with full-face shell mortar beds.
3. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells.
4. Solidly bed cross-webs of starting courses in mortar. Maintain head and bed joint widths shown, or if not shown, provide 3/8" joints.
5. Where solid CMU units are shown, lay with full mortar head and bed joints.

B. Walls:

1. Pattern Bond:
   a. Unless otherwise noted, lay CMU wall units in 1/2-running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.
   b. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted. Keep cavities free of mortar.
   c. Solidly bed webs in mortar where adjacent to reinforced cores or cells.
   d. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcing bars.
   e. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.
   f. Where all vertical cores are not shown to be grouted, Contractor may elect to fill all vertical cores with grout. In which case, requirements for mortar bedding of cross-webs and closing of core spaces below bond beams do not apply.

C. Columns, Piers and Pilasters:

1. Use CMU units of the size, shape and number of vertical core spaces shown. If not shown, use units which provide minimum clearances and grout coverage for number and size of vertical reinforcement bars shown.
2. Provide pattern bond shown, or if not shown, alternate head joints in vertical alignment.

3.05 GROUTING

A. Preparation of Grout Spaces:

1. Prior to grouting, inspect and clean grout spaces.
2. Remove dust, dirt, mortar droppings, loose pieces of masonry and other foreign materials from grout spaces.
3. Clean reinforcing and adjust to proper position.
4. Clean top surface of structural members supporting masonry to ensure bond.

5. After final cleaning and inspection, close cleanout holes and brace closures to resist grout pressures.

B. Grout Placement:

1. Definitions:
   a. Grout-Lift: The amount of grout placed in a single continuous operation.
   b. Grout-Pour: The height of masonry to be grouted prior to construction of additional masonry.
      1) A grout-pour may be composed of one grout-lift or a number successively placed grout-lifts.
2. Placing Time – Place grout within 1 ½ hr from introducing water in the mixture and prior to initial set.
3. Confinement – Confine grout to the areas indicated on the Project Drawings. Use material to confine grout that permits bond between masonry units and mortar.
4. Grout Pour Height – Do not exceed the maximum grout pour height given in the below table, “Grout Space Requirements”.
5. Grout Lift Height:
   a. Place grout in lifts not exceeding 5 ft. and meeting grout space requirements.
   b. Where the following conditions and grout space requirements are met, grout may be placed in lifts not exceeding 12.67 ft.
      1) The masonry has cured for at least 4 hours.
      2) The grout slump is maintained between 10 and 11 in.
      3) No intermediate reinforced bond beams are placed between the top and the bottom of the pour height.
         a) Costs for the demonstration panel and testing are the Contractor’s responsibility.
6. Grout Space Requirements
   a.

Grout Type	Maximum Grout Pour Height, ft	Minimum Width of Grout Space, Between Widths in. *	Minimum Grout Space Dimensions for Grouting Cells of Hollow Units, in. x in.
Fine	1	¾	1 ½ x 2
Fine	5	2	2 x 3
Fine	12	2 ½	2 ½ x 3
Fine	24	3	3 x 3
Coarse	1	1 ½	1 ½ x 3
Coarse	5	2	2 ½ x 3
Coarse	12	2 ½	3 x 3
Coarse	24	3	3 x 4

   b. *Grout space dimension is the clear dimension between any masonry protrusion and shall be increased by the diameters of the horizontal bars within the cross section of the grout space.

c. EXAMPLE: Wall system consisting of 2 wyths of concrete brick with 2 ¾" clear space (10" out to out). The clear space is to be grouted. In the clear space are #8 bars vertical and #6 bars horizontal.

1) Determine maximum pour height for fine and coarse grout. Net clear dimension = 2 ¾ - ¾ (#6) = 2.0"

2) Fine Grout: Maximum height = 5' (from table, fine grout, 5' height requires 2" space + diameter of horizontal bar.

3) 2 + ¾ = 2 ¾. This meets minimum space requirements of (2" + diameter of horizontal bar) for 5 feet height.

4) Coarse Grout: Same requirement.

7. Consolidation – Consolidate grout at the time of placement.

a. Consolidate grout pours 12 in. or less in height by mechanical vibration or by puddling.

b. Consolidate pours exceeding 12 in. in height by mechanical vibration, and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.

3.06 QUALITY CONTROL AND TESTING DURING CONSTRUCTION

A. Quality Control and Testing Agency:

1. Refer to contract drawings for Testing Agency's administrative requirements.

3.07 ACCEPTANCE OF COMPLETED WORK

A. Those portions of the structure that do not meet the Contract requirements based on appearance or for any other aesthetic reason shall be corrected or removed and replaced as directed by the Architect or Owner and all costs of corrections, removal and replacement, shall be at the Contractor's expense.

1. Corrections that do not meet the satisfaction of the Architect shall be removed and replaced.

2. If any laboratory strength tests fall below the required strength level by more than 300 psi, or if observations or other evidence indicates deficiencies in protection or in curing, or if the masonry is suspected of having been frozen, steps shall be taken to assure that load carrying capacity of the structure is not jeopardized.

3. If, in the judgment of the Architect or Owner, the ultimate load carrying capacity or durability has been affected, the reinforced masonry shall be removed and replaced at the Contractor's expense.

END OF SECTION

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SECTION 05 1200 - STRUCTURAL STEEL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Extent of structural steel work is shown on Drawings, including schedules, notes and details.

B. Structural steel is that work defined in AISC "Code of Standard Practice" and as otherwise shown on Drawings.

C. Venting holes for the galvanizing process are not shown on the structural documents. These holes are the contractor's responsibility.

D. Delegated Design:

1. Design of the following items is delegated to the contractor.
    a. Connections.

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

1. Division 3 Section "Cast-In-Place Concrete" for installation of embedded items in concrete.
2. Division 4 Section "Unit Masonry" for installation of embedded items in masonry.
3. Division 5 Section "Steel Joists" for steel joists.
4. Division 5 Sections "Steel Roof Deck" for installation of shear connectors.
5. Division 5 Section "Metal Fabrications" for loose bearing plates, stairs and miscellaneous steel framing.
6. Division 9 Section "Painting" for field painting exposed steel.

1.03 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:

1. AISC 360-16 "Specification for Structural Steel Buildings", including "Commentary" and Supplements there to issued.
2. AISC 303-16 "Code of Standard Practice for Steel Buildings and Bridges", including "Commentary" and Supplements there to issued.
3. AISC 341-16 "Seismic Provisions for Structural Steel Buildings", including "Commentary" and Supplements there to issued.
4. RCSC 2014 "Specifications for Joints using High-Strength Bolts".
5. AWS D1.1 - 2015 "Structural Welding Code".
6. ASTM A 6-17a "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".
7. To the extent that any provisions contained in any of the aforementioned codes and standards conflict with any other terms, requirements or definitions contained in the Contract Documents, then the terms, requirements or definitions contained elsewhere in the Contract Documents shall control.

B. Fabricator and Erector Qualifications:

1. Firms which have had a minimum of 5 years successful experience in fabrication and erection of steel structural buildings of this type and size.
2. The fabricator shall have a quality control program of either one of the following:
    a. Be certified for the AISC Quality Program. AISC Certified fabricators shall be considered pre-approved.

b. Maintains a program with an approved independent inspection or quality agency to conduct periodic in-plant inspections at the fabricator's plant.

1) Provide back-up documentation for a period of at least three (3) years preceding the issue date of the construction documents.

3. For the case where the fabricator does not have an approved quality control program, the Independent Testing Agency as part of the work of Section "Testing and Inspection Services – Building" shall verify fabrication standards and procedures.

a. The Owner has the right to be reimbursed for any and all shop inspections by the Independent Testing Agency, including but not limited to travel time and expense, overnight accommodation if required, shop inspection and report writing.

1.04 DELEGATED DESIGN

A. The contractor is responsible to engage the services of a qualified delegated design professional.

B. Delegated Design Professional Requirements:

1. Professional Engineer licensed in the State of Michigan.

2. Experienced in the design of connections for structural steel.

C. Design of Connections:

1. Forces are shown on the Drawings.

a. Columns are designed as “clean columns”.

1.05 ACTION SUBMITTALS

A. Product Data:

1. Submit producer's or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

2. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.

a. Furnish certificate of compliance with specified ASTM Standards.

3. High-strength bolts (each type), including nuts and washers.

a. Furnish certificate of compliance with ASTM Standards.

B. Signed and Sealed Calculations:

1. Submit signed and sealed calculations by the Delegated Design Professional for required delegated design items.

2. Submit calculations concurrent with affected shop drawings.

a. Shop drawings submitted without proper calculation back-up may be rejected as incomplete.

3. Calculations are submitted for general review only.

a. The Architect will not conduct a formal or detailed review, but will confirm only that the calculations have been performed.

b. The Contractor shall retain full responsibility for the completeness and accuracy of the submitted calculations and may not rely upon subsequent review of the calculations by the Architect.

C. Shop Drawings:

1. `Submit shop drawings for fabrication and assembly of structural steel members. Provide details, procedures, diagrams and schedules as necessary for fabrication and assembly in shop and field.

a. Coordinate with submittal requirements of Section "Submittal Procedures".

b. Provide key plan that indicates the sequencing of multiple submittals.

c. Provide submittal dates of each sequence.

2. Submit standard details for approval before preparation of Detail Drawings. Consistently use standard details on Detail Drawings where appropriate.

a. Identify slip critical connections.

3. Include details of cuts, connections, camber, holes, surface prep, shop finish (paint/galv.) and other pertinent data.

4. Indicate welds by standard AWS symbols, and show size, length, and type of each weld. Identify shop and field welds.

a. Use prequalified joints for penetration welds. Indicate joint designation number, and preparation and assembly details for welding.

5. Show design forces (shear, axial forces and moments) on the shop drawing individual piece details.

6. Show grid lines for column detail sheets.

7. Show general location (15 feet +/-) of beams.

8. Some dimensions indicated on the contract drawings are subject to change with specific requirements for equipment manufacturers. To name a few: elevator shafts, grillages for mechanical equipment, roof openings below equipment.

a. Shop drawings shall be coordinated with purchased equipment requirements prior to submittal to Architect.

b. Contractor shall indicate all dimensional adjustments.

9. Shop drawings containing details from delegated design requirements shall be have an accompanying letter from the Delegated Design Professional that the connections affected by Delegated Design on the shop drawings were reviewed and approved to be in accordance with the calculations.

a. For shop drawings furnished in multiple submittals, each submittal shall contain the Delegated Design Professional’s letter.

b. The letter shall specifically list the drawings reviewed.

10. Where cold galvanizing is permitted by Architect, submit locations of members to be cold-galvanized.

11. A complete set of the shop drawings reviewed and initialed by the Architect, shall be made available to:

a. Shop and field inspector.

b. Contractors of other trades, as far as such Drawings pertain to their work.

12. Architect's signature on the shop drawings is to be interpreted only as review of the general design of details. This review does neither relieve Contractor of the necessity of correcting such details on the drawings and completed work as may thereafter be found deficient in strength or otherwise faulty, nor does it relieve Contractor of the responsibility for field measured and calculated dimensions on the shop drawing.

D. Test Reports:

1. Field Test Reports from Independent Testing Laboratory.

1.06 SEQUENCING

A. Supply anchor bolts, bearing plates and other anchorage items to be embedded in or attached to other construction. Supply without delaying the work.

1. Provide setting diagrams, templates, instructions, and directions for installation.
2. Provide anchor rod template with target arrows for column center lines, stamped for column location, orientation and elevation.
    a. Templates may be plywood or thin-steel-plate.
        1) Thin-steel-plate of sufficient rigidity to prevent dimensional distortion during the installation process.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports.

B. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures.

C. Protect steel members and packaged materials from erosion and deterioration. If bolts and nuts become dry or rusty, clean and relubricate before use.
    1. Do not relubricate ASTM F1852 and ASTM F2280 twist-off tension control bolt assemblies, except by manufacturer of bolt assembly where used in pretensioned and/or slip critical applications.

D. Repair or replace damaged materials or structures as directed by the Owner's Representative.

PART 2 - PRODUCTS

1.

2.02 MATERIALS

A. Tubular Sections, (HSS Round, HSS Rectangular) shall be manufactured in USA.

B. Architecturally Exposed Steel:
    1. For work that is noted as Architecturally Exposed Structural Steel, use only materials that are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
    2. Remove minor blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and applying surface finishes.

C. Steel Shapes, Plates, and Bars:
    1. All structural steel shall be produced, manufactured and fabricated in USA.
    2. Structural steel shall be newly rolled steel conforming to the standards listed herein. Yield strength requirements are shown on the drawings.
    3. Provide ASTM grade for required yield strengths as follows:

	Required Yield Strength (F_y, KSI)	ASTM Grade
Rolled Shapes (W, WT, C)	36	A36 or A992
	50	A572, Grade 50 or A992
HSS Square, Rectangular	46	A500, Grade B
HSS, Round	42	A500, Grade B
HSS Square, Rectangular	50	ASTM A1085
HSS Round	50	ASTM A1085
Plates, Bars, Rods	36	A36

	50	A572, Grade 50
All Other Shapes	36	A36

D. High Strength Bolts:
   1. All structural steel shall be produced, manufactured and fabricated in USA.
   2. Type 1, Heavy-hex bolts Group A or Group B, heavy-hex carbon steel nuts, and Type 1, hardened carbon-steel washers plain finish.
      a. Exception: Round heads are acceptable twist-off bolts.
      b. Group A:
         1) Bolts: ASTM A 325, ASTM F 1852
         2) Nuts: ASTM A 563 Grade C
         3) Washers: ASTM F 436, Type 1
      c. Group B:
         1) Bolts: ASTM A 490, ASTM F 2280
         2) Nuts: ASTM A 563, Grade DH
         3) Washers: ASTM F436, Type 1
   3. Where indicated as galvanized, provide fasteners that are zinc coated, either mechanically deposited complying with ASTM B 695, Class 55, or hot-dip galvanized complying with ASTM A 153. Nuts to be galvanized and lubricated. Washers to be galvanized.
      a. ASTM F 1852 may only be mechanically galvanized.
      b. Do not galvanize Group B bolts.

E. Direct Tension Indicators: ASTM F 959.
   1. All structural steel shall be produced, manufactured and fabricated in USA.
   2. Direct tension indicator washers may be used at Contractor's option. Use Type A325 and A490 for A325 and A490 bolts respectively.
   3. Use at Contractor's option for Slip Critical connections.

F. Electrodes for Welding: Comply with AWS Code.
   1. All structural steel shall be produced, manufactured and fabricated in USA.
   2. For high-strength low-alloy steel and existing steel, provide electrodes, welding rods and filler metals equal in strength and compatible in appearance with parent metal joined.
   3. Comply with AWS requirements.

G. Anchor Devices:
   1. All structural steel shall be produced, manufactured and fabricated in USA.
   2. Headed Studs (Not the composite beam shear connectors): ASTM A 108, Grade 1015 thru 1020. Cold finish carbon steel, AWS D1.1, Type B.

H. Anchor Rods:
   1. All structural steel shall be produced, manufactured and fabricated in USA.
   2. Hex-headed bolt and carbon-steel nut.
   3. Provide ASTM grade for required yield strengths as follows:

Required Yield Strength (F_y, KSI)	ASTM Grade

36	ASTM F1554, Grade 36
55	ASTM F1554, Grade 55
55 - Weldable	ASTM F1554, Grade 55-S1
105	ASTM F1554, Grade 105

4. Size and grade requirements as shown on drawings.
5. Washers, A36.

I. Paint - Shop Primer - (Non-exposed steel):
1. Paint for shop primer shall be VOC compliant, be lead and chromate free, and have not less than 50 percent solids per volume.
2. Color: Light gray, off-white, brown or red.
3. Products/Manufacturers: Provide one of the following:
   a. #10-99 primer/Tnemec
   b. Kem Kromik/Sherwin Williams
   c. 960/Rustoleum

J. Paint - Shop Primer - (Architecturally Exposed Steel):
1. As above for non-exposed steel, except in light gray or white color.

K. Cold Galvanizing (Exposed Steel):
1. Cold galvanizing is a limited substitution for hot-dip galvanizing. Limitations for this application are listed in Part 3 – EXECUTION, of this Specification.
2. Products:
   a. Zinc Clad 5; Sherwin-Williams, www.sherwin-williams.com/protective.
   b. Tnemec-Zinc, Series 90E-92; Tnemec; www.tenemec.com.
   c. ZRC Cold Galvanizing Compound; ZRC Worldwide; www.zrcworldwide.com.

L. Paint - Shop Primer (Exposed Steel):
1. Series 66 Epoxi-Prime/Tnemec Co., Inc., for temperature application above 50 deg. F.
2. Series 161 Theme-Fastprime/Tnemec Co., Inc., for temperature application above 35 deg. F.

M. Galvanizing Repair Paint:
1. SSPC - Paint 20 with dry film a minimum of 79 percent zinc by dry-weight.
   a. Zinc Clad II/Sherwin Williams, www.sherwin-williams.com/protective.
   b. Tnemec - Zinc 90E-92, www.tenemec.com.
2. ZRC Cold Galvanizing Compound by ZRC Worldwide, www.zrcworldwide.com.

N. Nonmetallic Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with CE-CRD-C621.
1. Products:
   a. Euco N.S.; Euclid Chemical Co.
   b. Masterflow 928; Master Builders.
   c. Sika Grout 212, Sika Corp.

O. Bituminous Coating:
1. Carboline; Bitumastic 50

2. Karnak; 83 AF

2.03 DETAILS AND CONNECTIONS

A. Details shown are typical; similar details apply to similar conditions, unless otherwise indicated.

B. Verify tie-in dimensions between existing and new construction without causing delay in the work.

C. The Architectural and Structural Drawings are cooperative. Any structural items shown or referred to on the Architectural Drawings are to be included as if shown on the Structural Drawings.

D. Promptly notify Architect whenever members sizes and connections requirements for any portion of structure are not clearly indicated.

E. Weld or bolt shop connections, at contractor's option, unless otherwise indicated.

F. Bolt field connections, except where welded connections or other connections are indicated.

G. Design and detail connections to resist the required loads and reactions. Details shall supplement and be consistent with details shown on the drawings. Proper account of eccentricity shall be taken in the design of connections so that there is no overstressing of any material, either in the connections themselves or in the connected members.

1. The use of oversized and slotted holes in the load direction for bearing bolts is not permitted.

H. Holes for Other Work:

1. Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members. Show all required holes on the shop drawings.

PART 3 - EXECUTION

3.01 FABRICATION

A. Shop Fabrication and Assembly:

1. Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on approved shop drawings.

a. Items with more stringent requirements than AISC Specifications may be indicated in the Contract Documents.

1) Note: These items are not labeled "more stringent than AISC".

2. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.

3. Where shop painting is required, complete assembly, including welding of units, before start of shop painting.

B. Connections:

1. Bolted Connections:

a. Install threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts".

b. Connection type: Bearing-type, unless indicated to be slip critical.

1) Limit fastening of bearing-type connections to snug-tight only.

2) See note in paragraph "Shop Painting" for painting of faying surfaces.

2. Holes for Connections:

a. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

1) Remove burrs from faying surfaces of bearing-type connections.

b. The use of burnt holes for bolted connections is prohibited. Violation of this clause will be sufficient cause for the rejection of the whole member into which such holes were burnt.

c. Where an outer face of the bolted parts has a slope of more than 1 to 20 with respect to a plane normal to the bolt axis, a smooth beveled washer shall be used to compensate for the lack of parallelism.

3. Welded Connections:

a. Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

b. No welds shall be applied to flanges of tension members perpendicular to the direction of stress.

c. Turn side and end fillet welds around corners for a minimum length of twice the nominal size of the weld. To assure compliance, detail shall be indicated on shop drawings. Length of end returns are not to be included in the calculated welded length.

d. Parts to be joined shall be brought into contact as close as possible. If the separation exceeds 1/16 inch, the size of the weld shall be increased by the amount of separation.

e. Material thicker than 3/4 inch shall be preheated before welding per the requirements of the American Welding Society.

f. Where distortions are likely to occur due to uneven heating or shrinking of the member, a program for special preheating and cooling and a proper sequence for the welding progress shall be worked out by the Contractor to ascertain alignment of the final product and to prevent build-up of initial stresses.

3.02 GALVANIZING

A. Items to be galvanized are generally indicated on the Drawings.

B. Galvanize items after fabrication.

C. Provide holes in members to be galvanized as required for dipping and venting purposes.

1. Holes shall be plugged after galvanizing.

a. For exposed to view members, plugs shall be ground smooth and finished in accordance with AISC requirements for AESS.

1) In the finished products plugs shall have an “invisible” appearance.

2. If galvanized members are to be painted, do not quench.

D. Galvanizing shall be hot dip per ASTM A123 with these minimum coating thicknesses:

Steel Category Thickness Grade	Steel Thickness	Min. Coating (µM)
Rolled Sections	Less than 1/4"	85
Rolled Sections	1/4" or more	100
Pipe & Tube Sections	Less than 1/4"	75
Pipe & Tube Sections	1/4" or more	100

E. Use galvanizing repair paint for connections within galvanized construction and for touch-up of damaged galvanized surfaces.

F. Prepare surfaces to be repaired/touched-up in accordance with paint manufacturer's written instructions.

3.03 SHOP PAINTING

A. Definitions:

1. Non-exposed steel is defined as steel not exposed to view or to the elements, located within the air/vapor-barrier of the heated/conditioned building envelope.
2. Exposed steel is defined as steel which is located outside of or straddling the air/vapor-barrier of the heated/conditioned building envelope.
    a. Exposed steel may or may not be directly exposed to the elements.
3. Architecturally Exposed Structural Steel is defined as steel that is exposed to view requiring additional metal finishing.
    a. Architectural Exposed Structural steel may or may not be exposed to the elements.
4. Locations of air/vapor barrier for purposes of steel painting/galvanizing:
    a. Bottom of roof-deck/slab.
    b. Interior face of exterior wall sheathing.

B. General:

1. In general, structural steel is covered with one of the following: fire-proofing, paint or galvanizing.
2. Specifics are:
    a. Paint steel indicated as “architecturally exposed”.
    b. Galvanize steel as indicated or specified.
    c. Paint steel to receive intumescent fire-resistive material with the compatible primer.
    d. Structural steel to receive sprayed-on fire-protection is not painted. Exception:
        1) Paint the contact areas (faying surfaces) of both beam and connection angle for “bearing-type” connections

C. Cleaning and Preparation:

1. After inspection and before shipping, clean steel work, painted or unpainted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC).
2. Painted Steel:
    a. Clean non-exposed steel indicated to be painted in accordance with SSPC-SP3, "Power-Tool Cleaning".
3. Unpainted Steel:
    a. Unpainted steel without fireproofing shall be free of grease, salt, dirt and other deleterious substances.
4. Galvanized Steel:
    a. Prepare for hot dip galvanizing by the three step process of:
        1) caustic cleaning
        2) acid pickling
        3) fluxing.
    b. Surfaces to be repaired or touched up with galvanizing repair paint shall be cleaned and prepared in accordance with the repair paint manufacturer's written instructions.

5. Cold-Galvanized Steel:
    a. Steel permitted to be cold-galvanized shall be prepared in accordance with SSPC-SP6, commercial blast-cleaning, with a minimum surface profile of 2.0 mils.

D. Cold-Galvanizing:
1. Contractor shall submit for approval to Architect the proposed locations to receive cold-galvanizing.
    a. Do not fabricate any members subject to proposed cold-galvanizing until receiving written approval from Architect.
2. Cold-galvanizing may be used as a substitute for hot-dip galvanizing for the following conditions:
    a. Member is not immersed.
    b. Member is exposed to the atmospheric elements only.
        1) Member is not in an area subject to road-salts or other corrosive elements.
3. Apply cold-galvanizing in strict compliance with manufacturer's written instructions.
4. Minimum dry-film thickness: 3.5 mils.

E. Painting:
1. Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions. Use painting methods that result in full coverage of joints, corners, edges, and exposed surfaces.
2. If for any reason any surface to receive field welds or slip critical bolts is painted, remove such paint completely to within stated limits before field welding or bolting.
3. If any machine finished surface is painted, remove such paint completely, and touch up specified finish if required, before shipping or erection.
4. Non-Exposed Steel:
    a. Apply one prime coat of paint to dry, clean surfaces by brush, spray or roller with no running or sagging.
    b. The coverage rate per coat shall not be more than 400 sq.ft. per gal. resulting in a minimum wet film thickness of 4 mils and providing a minimum dry film thickness of 2.5 mils.

3.04 ERECTION

A. Examination:
1. Prior to erection use Licensed Surveyor to:
    a. Verify column grid.
    b. Determine elevations of concrete and masonry bearing surfaces.
    c. Determine location and installation technique (straight; at a skew, etc.) of anchor rods or similar devices.
2. Report discrepancies with proposed corrective measures to Architect.
    a. If corrective measures are required, do not proceed with erection until corrective measures are approved by Architect, and subsequent corrections have been made.

B. Temporary Bracing:
1. The Contractor shall be fully responsible for the design, strength, safety and adequacy of all temporary bracing and all methods of construction. The specifying herein of requirements for bracing or construction methods, or any other requirements of the Specifications shall be construed as the minimum acceptable, and shall not eliminate, lessen or restrict in any manner the responsibility of the Contractor for all construction methods and for the safety

and stability of the structural steel work at all stages of erection, until such time as the permanent bracing system becomes effective.

2. Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads.
3. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.
4. Remove temporary members and connections after permanent members are in place, final connections are made, and baseplates are grouted.

C. Temporary Planking:

1. Provide temporary planking and working platforms as necessary to effectively complete work.

D. Setting Bases and Bearing Plates:

1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
2. Tighten anchor rods after supported members have been positioned and plumbed.
3. Grout solid between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
    a. Comply with manufacturer's written instructions.

E. Field Assembly:

1. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
2. Level and plumb individual members of structure within specified AISC tolerances, unless more stringent requirements are indicated on the drawings.
3. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
4. Splice members only where indicated and accepted on shop drawings.

F. Field Bolting: Similar procedures as for shop fabrication.

1. Do not enlarge unfair holes in members by burning or by using drift pins. Drill or ream holes that must be enlarged to admit bolts. Refer to Fabrication for additional requirements.
    a. Do not use oversized hole in the direction of loading.
    b. Increase bolt size to match enlarged hole.
        1) Where one bolt in a connection was increased, increase the other bolts in the connection, too.
2. Tighten connection only after the drift pin is removed.
    a. Limit bearing-type connection to snug-tight only.

G. Field Welding: Similar procedures as for shop welding.

1. At subfreezing temperatures, preheat all metal located within 3 inches of the weld to a minimum temperature of about 70 degrees fahrenheit. No welding shall be done at temperatures below zero degrees fahrenheit. No welding shall be done during rain, snow, or when the surfaces are covered with ice, unless the operator and the working area are properly protected.

H. Gas Cutting:

1. Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members that are not under stress, as acceptable to Architect. Finish gas-cut sections equal to a sheared appearance when permitted.

I. Bituminous Coating:

1. Do not apply bituminous coating over surfaces that are not clean or have other finishes applied.
2. Apply bituminous coating in accordance with coating manufacturer's written instructions.

J. Touch-Up:

1. Paint:
   a. Immediately after erection, clean field welds, slip critical bolted connections, and abraded areas. Clean and prepare in accordance with paint manufacturer's written requirements.
   b. Apply paint using same material as used for shop painting.
   c. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils for non-exposed steel and 4.0 mils for exposed steel.
2. Galvanizing:
   a. Immediately after erection is completed, clean field welds and abraded areas.
      1) Clean and prepare with cold-galvanizing compound manufacturer’s written instructions.
   b. Apply to provide a minimum dry-film thickness of 4.0 mils.
3. Where cold-galvanizing was permitted to be substituted for galvanizing apply touch-up in strict accordance with cold-galvanizing manufacturer’s written instructions.
   a. Apply to provide a minimum dry-film thickness 4.0 mils.

3.05 QUALITY CONTROL

A. Quality Control and Testing:

1. Refer to contract drawings for "Quality Control - General" and "Testing and Inspection Services - Building" for requirements.

B. Corrective Work:

1. Correct deficiencies in structural steel work which inspections and laboratory test reports have indicated to be not in compliance with requirements.
2. Perform additional tests, at Contractor's expense, as may be necessary to show compliance of corrected work.
3. Contractor shall submit to the Architect for approval Drawings showing reasons for and details of proposed corrective work, and receive approved Drawings prior to performing the corrective work.
4. Replace with new work where proposed repair methods are not acceptable to Architect.
   a. The option of repair or replace is at the discretion of the Architect.

END OF SECTION

SECTION 05 1213 - ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).

B. Requirements apply to members noted on the Drawings as AESS, including schedules, notes and details showing size and location of members, typical connections and types of steel required.

1.03 REFERENCE STANDARDS

A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2022, with Errata (2025).

B. AISC 360 - Specification for Structural Steel Buildings; 2022, with Errata (2025).

C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2023.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

F. ASTM A1085/A1085M - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS); 2015.

G. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.

H. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

J. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel; 1997 (Ed. 2004).

K. SSPC-Paint 25BCS - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Blast Cleaned Steel; 1997 (Ed. 2004).

L. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

M. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation meeting
   1. Schedule a pre-installation conference minimum two weeks prior to delivery, and installation, of architecturally exposed structural steel and associated work.
      a. Meet at the Project Site with the following parties in attendance. Owner and Architect, may decline to attend at their discretion.
         1) Architect.
         2) Owner’s Representative.
         3) Contractor.
         4) AESS Fabricator/Supplier.
         5) AESS Installer.

6) Other parties concerned with performance of AESS.

b. Review coordination and environmental controls required for proper installation and ambient conditioning in areas to receive work.

c. Tour representative areas where AESS is to be installed.
   1) Inspect and discuss conditions to be encountered.
   2) Discuss preparation work required to be performed by other trades.

d. Proceed with AESS installation only where everyone concerned agrees that required conditions can be maintained.

2. Contractor shall record discussion, including agreement or disagreement on significant matters. Furnish copies of report to all parties present within 5 days after meeting date.
   a. If substantial disagreements exist at conclusion of meeting, determine how disagreements will be resolved, and set date and time to reconvene meeting.

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product data and compatibility information: Provide product data and preparation of steel for coating as described in this section and in Section 09 9100 - Painting and 09 9600 - High Performance Coatings.

C. Shop Drawings: Detailing for fabrication of AESS components. Comply with shop Drawing requirements of Section 05 1200 - Structural Steel Framing.
   1. Provide erection documents clearly indicating which members are AESS members and the AESS category of each part.
   2. Include details that clearly identify AESS requirements found in this specification. Provide connections for AESS consistent with concepts shown on drawings.
   3. Indicate welds by AWS A2.4 symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined by the designated AESS category.
   4. Indicate orientation of hollow structural section (HSS) seams and mill marks (where applicable).
   5. Indicate type, size, finish and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tensioned shear/bearing connections. Indicate orientation of bolt heads.
   6. Indicate which surfaces or edges are exposed and what class of surface preparation is being used.
   7. Indicate special tolerances and erection requirements as noted on drawings or defined by the designated AESS category.
   8. Indicate vent or drainage holes for HSS members.

D. AESS 3 Samples: Provide samples of specific AESS characteristics. Samples may be small size samples or components of conventional structural steel demonstrating specific AESS characteristics, including surface preparation, sharp edges ground smooth, continuous weld appearance, weld show through, and fabrication mark removal.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: In addition to those qualifications listed in other Division 05 Sections, including but not limited to Structural Steel and Metal Fabrications, engage a firm experienced in fabricating AESS similar to that indicated for this project, with a record of successful in service performance as well as sufficient production capacity to fabricate AESS without delaying the Work.

B. Erector Qualifications: In addition to those qualifications listed in other Division 05 Sections, including but not limited to Structural Steel and Metal Fabrications, engage an experienced Erector who has completed AESS work similar in material design and extent to that indicated for this Project and with a record of successful in service performance.

C. Comply with applicable provisions of AISC 303, Section 10 for the designated AESS category.

D. Contractor to engage a quality assurance agency per requirements of AISC 360, Chapter N and AISC 303, Section 10.

1.07 BID REVIEW MOCK-UP

A. At the time of bids, prior to award of Contract, provide a mock up of each type of AESS finish specified. Mock up shall demonstrate the following as applicable to each level of AESS:
   1. Adherence to tolerance requirements
   2. Quality of welds.
   3. Finishing of welds, including ground smooth, filled, and blended.
   4. Removal of Mill marks and piece marks along with filling and smoothing techniques.
   5. Grinding of sheared edges
   6. Welds used to close gaps and demonstration of closed access holes.
   7. Removal of field welding aids and grinding, smoothing and filling of blemishes.

1.08 MOCK-UP

A. Minimum 4 weeks prior to fabrication and delivery of architecturally exposed structural steel, construct mock-up to verify, and to demonstrate, quality of work, quality of materials, aesthetic effects, tolerances, and execution.

B. Provide mock-ups for AESS 3, AESS 4, and AESS C of nature and extent indicated in Contract Documents.

C. Mock-ups shall comply with the following requirements, using materials indicated for completed work.
   1. Locate mockup on site in location determined by Architect.
   2. Build mockup for architecturally exposed structural steel using same type of steel and connections as specified for final work. Use full size members and connections.
   3. Mock-up to be complete with specified finish system.
   4. Obtain Architect's approval of mock-up prior to starting fabrication of architecturally exposed structural steel.
   5. Maintain mockup during construction in an undisturbed condition as the standard of quality for judging the completed Work.

D. Locate mock-ups where directed. Mock-ups to be full-size unless Architect approves smaller models. Alternatively, when a mock-up is not practical, the first piece of an element or connection can be used to determine acceptability.

E. Notify Architect 7 days in advance of dates and times when mock-ups will be available for review.

F. Demonstrate applicable AESS characteristics for specified category of AESS on elements and joints in mock-up.

G. Build mock-ups using member sizes and materials indicated for final work.

H. Mock-up to demonstrate weld quality, contouring of welds at aligned walls of members, specified surface preparation, and finish coating.

I. HSS members to extend at least 6 inches from joint in mock-up.

J. Obtain Architect’s written approval of mock-ups before starting fabrication.

K. Retain and maintain mock-ups during construction in an undisturbed condition as a standard for judging completed work.

L. Approved mock-ups in an undisturbed condition at Date of Substantial Completion may become part of completed work.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Handle finished pieces in accordance with Section 10 of AISC 303, using nylon-type slings, or chains with softeners, or wire ropes with softeners such that they are not damaged.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. Use special care in handling to prevent twisting or warping of AESS members.

C. Delivery and storage: Keep steel members off ground, under cover and dry. Protect steel members from erosion and deterioration. Use care to prevent twisting or warping of AESS members.

D. Erect pieces using methods such that they are not damaged.
   1. Provide padding as required to protect while rigging and aligning members frames.
   2. Weld tabs for temporary bracing and safety cabling only at points concealed from view in the completed structure or where approved by Architect during the pre-installation meeting.
   3. Methods of removing temporary erection devices and finishing the AESS members shall be approved by Architect prior to erection.

1.10 PROJECT CONDITIONS

A. Field Measurements: Where AESS is indicated to fit against walls and other construction, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with manufacturer of steel without field measurements. Coordinate other construction to ensure actual dimensions correspond to guaranteed dimensions.

1.11 COORDINATION

A. Coordinate installation of anchors for AESS members that connect to the work of other trades. Furnish setting drawings, templates and directions for installing anchors, including sleeves, concrete inserts, anchor bolts and items with integral anchors that are to be embedded in concrete or masonry. Deliver such items to the project site in time for installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Comply with Section 05 1200, except as amended in this section for aesthetic purposes.

B. Architecturally Exposed Structural Steel: For fabrication of work exposed to view, use only materials which are smooth and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trades names and roughness. Remove such blemishes by grinding or by welding and grinding, prior to cleaning, treating and application of surface finishes.

C. Compatibility: The Contractor shall submit all components/procedures of the paint system for AESS as a single coordinated submittal. As a minimum identify required surface preparation, primer, intermediate coat and finish coat. Coordinate all items with Section 09 9100 - Painting and 09 9600 - High Performance Coatings.
   1. Shop primer for steel scheduled to receive coatings specified in Section 09 9100 - Painting:
      a. Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in SSPC-Paint 25/SSPC-Paint 25BCS; selected for good resistance to normal atmospheric corrosion, compatible with, and capable of providing a sound foundation for field-applied topcoats despite prolonged exposure.
   2. Shop primer for steel scheduled to receive coatings specified in Section 09 9600 - High Performance Coatings:
      a. Refer to primer specified in Section 09 9600 - High Performance Coatings.

2.02 FABRICATION

A. Fabricate and assemble AESS in shop to greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by Architect. Detail AESS assemblies to minimize field handling and expedite erection.

B. Permissible tolerances for member depth, width, out of square, and camber and sweep to be as specified in ASTM A6/A6M, ASTM A500/A500M, and ASTM A1085/A1085M.

C. For curved structural members, whether composed of a single standard structural shape or built-up, the as-fabricated variation from theoretical curvature to be equal to or less than standard camber and sweep tolerances permitted for straight members in applicable ASTM standard.

D. Use special care in handling and shipping of AESS both before and after shop painting to minimize damage to any shop finish. Use nylon-type slings or softeners when using chains or wire rope slings.

E. Bolted Connections:
   1. Make in accordance with Section 05 1200. Provide bolt type and finish as noted herein.

F. Welded Connections:
   1. Comply with AWS D1.1/D1.1M and Section 05 1200.
   2. Assemble and weld built-up sections by methods that will maintain alignment of members without warp exceeding tolerances of this section.

G. Surface Preparation:
   1. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
   2. Remove backing and run out tabs.

H. Fabricate AESS in accordance with categories defined in AISC 303, as follows:
   1. AESS 1: Basic elements.
   2. AESS 2: Feature elements viewed at a distance greater than 20 feet (feature elements not in close view).
   3. AESS 3: Feature elements viewed at a distance less than 20 feet (feature elements in close view).
   4. AESS 4: Showcase elements with special surface and edge treatment beyond fabrication (showcase elements).

2.03 PAINT SYSTEM

A. Compatibility: All components/procedures of AESS paint system to comply with coating system specified, submitted, and approved per Section 09 9100 - Painting and 09 9600 - High Performance Coatings . As a minimum, identify required surface preparation, primer, intermediate coat (if applicable), and finish coat. Primer, intermediate coating, and finish coating to be from a single manufacturer combined in a system documented by manufacturer with adequate guidance for fabricator to procure and execute.

B. Primer: As specified in Section 09 9100 - Painting and 09 9600 - High Performance Coatings. Primer to comply with all federal standards for VOC, lead and chromate levels.

2.04 SHOP PRIMING

A. Surface Preparation:
   1. Comply with SSPC-SP 6/NACE No.3.
   2. Coordinate required surface profile with approved paint submittal prior to beginning surface preparation.
   3. Prior to blasting, remove any grease and oil using solvent cleaning to meet SSPC-SP 1.
   4. Remove weld spatter, slivers and similar surface discontinuities.
   5. Ease sharp corners resulting from shearing, flame cutting or grinding.

B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted with slip-critical connections.

1. Extend priming of members partially embedded in concrete or mortar to a depth of 2 inches.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop primer to surfaces that are inaccessible after assembly or erection.

2.05 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by hot-dip process to AESS indicated for galvanizing according to ASTM A123/A123M. Fabricate such that all connections of assemblies are made in the field with bolted connections where possible.

2.06 MATERIALS

A. General: Meet requirements of 05 1200 as amended below.

B. Tension Control, High-Strength Bolts, Nuts, and Washers: Per section 05 1200, Tension Control Bolts. Provide standard carbon steel finish rounded bolt heads with twist off bolts; ASTM F3125/F3125M.

2.07 SOURCE QUALITY CONTROL

A. Structural Requirements:
   1. Comply with quality control requirements per AISC 360, Chapter N and AISC 303, Section 10. Refer to Section 05 1200 for additional requirements.
   2. Quality assurance agency to review work for compliance with requirements of AISC 360, Chapter N and AISC 303, Section 10.

B. AESS 1 and 2 Acceptance: Architect to observe AESS in the shop at a viewing distance consistent with final installation and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

C. AESS 3 Acceptance: Architect to observe AESS in the shop at a viewing distance consistent with final installation and determine acceptability based on approved mock-up. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Erector to check all AESS members upon delivery for twist, kinks, gouges or other imperfections which may result in rejection of appearance of member. Coordinate remedial action with fabricator prior to erecting steel.
   1. Notify Contractor immediately in writing of unsatisfactory conditions detrimental to AESS.
   2. Coordinate remedial action with fabricator PRIOR to erecting steel.
   3. Do not proceed with AESS until satisfactory conditions have been corrected in an acceptable manner to the Architect.

3.02 PREPARATION

A. Provide connections for temporary shoring, bracing and supports only where noted on approved fabrication documents. Temporary connections not shown are to be made at locations not exposed to view in final structure or as approved by Architect.

B. Handle, lift and align pieces using nylon straps or chains with softeners required to maintain appearance of AESS through process of erection.

3.03 ERECTION

A. AESS 1 and 2: Basic elements; feature elements not in close view:

1. Employ special care to handle and erect AESS. Erect finished pieces using nylon straps or chains with softeners such that they are not damaged.
2. Place weld tabs for temporary bracing and safety cabling at points concealed from view in completed structure or where approved by Architect during pre-installation meeting. Obtain Architect approval of methods for removing temporary devices and finishing AESS members prior to erection.
3. AESS Erection Tolerances: Erect to standard frame tolerances for structural steel per Chapter 7 of AISC 303.
4. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
5. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
6. Remove all backing and run out tabs.
7. When temporary braces or fixtures are required to facilitate erection, take care to avoid any blemishes, holes or unsightly surfaces resulting from use or removal of such temporary elements.
8. Bolted Connections: Align bolt heads on same side of connection as indicated on approved fabrication or erection documents.
9. Welded Connections: Comply with AWS D1.1/D1.1M and Section 05 1200. Appearance and quality of welds to be consistent. Employ methods that will maintain alignment of members without warp exceeding tolerance of this section.
10. Remove weld spatter exposed to view.
11. Grind off projections larger than 1/16 inch at field butt and plug welds.
12. Continuous Welds: Where continuous welding is noted on drawings, provide continuous welds of a uniform size and profile.
13. Do not enlarge holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts. Replace connection plates that are misaligned where holes cannot be aligned with acceptable final appearance.
14. Splice members only where indicated.
15. Obtain permission for any torch cutting or field fabrication from Architect. Finish sections thermally cut during erection to a surface appearance consistent with mock-up.

B. AESS 3: Feature elements in close view:
1. Erect to requirements of AESS 1 and 2 and as follows:
2. Field Welding: Weld profile, quality, and finish to be consistent with mock-ups approved prior to fabrication.
3. Provide a continuous appearance to all welded joints including tack welds. Provide joint filler at intermittent welds.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Structural Requirements:
1. Comply with quality control requirements per AISC 360, Chapter N and AISC 303, Section 10. Refer to Section 05 1200 for additional requirements.
2. Quality assurance agency to review work for compliance with requirements of AISC 360, Chapter N and AISC 303, Section 10.

C. AESS 1 and 2 Acceptance: Architect to observe AESS in place and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

D. AESS 3 Acceptance: Architect to observe AESS in place and determine acceptability based on qualification data and submittals as well as on approved mock- up. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

3.05 CLEANING

A. Touch-up Painting: Complete cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint to blend with adjacent surfaces of AESS. Perform touch-up work in accordance with manufacturer's instructions and as specified in Section 09 9100 - Painting and 09 9600 - High Performance Coatings.

END OF SECTION

SECTION 05 3110 - STEEL ROOF DECK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. The extent of steel roof deck is shown on the Drawings, including basic layout and type of deck units required, and includes, but is not limited to the following:

1. Roof deck.
2. Attachment: Mechanical fasteners only.
3. Accessories and closures.
4. Coordination for top chord thickness if attachment is to joists.
    a. Notification to installer if attachment is to cold-formed joists.

B. Related Work Specified Elsewhere:

1. Division 5 Section "Structural Steel".
2. Division 5 Section "Steel Joists and Joist Girders".

1.03 QUALITY ASSURANCE

A. Codes and Standards:

1. Comply with provisions of the following codes and standards, except as otherwise shown or specified:
    a. AISI "Specification for the Design of Cold-Formed Steel Structural Members".
    b. SDI "Design Manual for Floor Decks and Roof Decks".

B. Qualification for Installing Mechanical Fasteners:

1. Installation for mechanical fasteners shall be by an operator specifically licensed by the manufacturer.

1.04 COORDINATION

A. For attachment to joists the contractor/CM shall provide a layout plan that shows location of any joist with a top chord thickness greater than 3/8”.

B. If Attached To Cold-Formed Joists:

1. Note: The geometry of the cold-formed joists is different than that of joists composed of standard angles.
2. The GC/GM, either one or both, shall inform the deck supplier if attachment is to cold-formed joists.

C. The deck installer shall select the proper powder-actuated fasteners based on the provided thickness information.

1.05 ACTION SUBMITTALS

A. Product Data:

1. ES Report, with listed diaphragm capacities.
2. Fastener Inspection Guide.
    a. Guide for inspection of fasteners.
    b. List requirements for frequency of Special Inspections.

B. Shop Drawings:

1. Roof Deck:
    a. List of manufacturer.
    b. Include all information necessary for fabrication and installation.
    c. Submit detailed drawings showing:
        1) Layout and types of deck.
        2) Fastening details.
            a) Fastener type.
            b) Fastener spacing.
        3) Conditions requiring closure panels.
        4) Supplementary framing.
        5) Cut openings.
        6) or other accessories.

C. Calculations for variances from “Basis of Design”.

D. Samples:
    1. None required.

1.06 RESTRICTIONS

A. Ceilings, light fixture, ducts, conduit or other utilities shall not be suspended from the roof deck.

B. Do not use roof deck for material storage or as a working platform.

PART 2 - PRODUCTS

2.01 GENERAL

A. Manufacturer Requirements:
    1. Manufacturer shall be a member of the Steel Deck Institute.
    2. All structural steel shall be produced, manufactured and fabricated in USA.

B. Roof Deck Spans:
    1. Where possible deck units shall be supplied to span 3 or more supports.

C. Deck Gage(s):
    1. Required types and gages are shown on the drawings.

D. Stiffener Grooves:
    1. Stiffener grooves in the top flange of roof deck are prohibited.

2.02 1-1/2-INCH ROOF DECK

A. Wide Rib, Type B:
    1. Design Properties (per 12" width, inch units):

Gage	I	Sp	Sn
22	0.16	0.18	0.19
20	0.21	0.23	0.24
19	0.25	0.27	0.28
18	0.29	0.31	0.32

16	0.37	0.40	0.41

2.03 STEEL FOR DECK UNITS

A. ASTM A 446, Grade A.

B. All structural steel shall be produced, manufactured and fabricated in USA.

C. Minimum uncoated design thicknesses, inch:

1. 22 gage 0.0295
2. 20 gage 0.0358
3. 19 gage 0.0418
4. 18 gage 0.0474
5. 16 gage 0.0598

D. Finishes:

1. ASTM A 525, Galvanized G90.

2.04 MECHANICAL FASTENERS

A. Mechanical Fasteners:

1. ES report meeting AC 43 criteria required for sidelap fasteners and deck fasteners.
   a. ES report shall show diaphragm capacity equal to or greater than values listed in SDI tables.
      1) Adjust fastener or sidelap spacing either one or both, to meet SDI requirements if necessary.
2. Sidelap Connection Between Deck Units:
   a. S-SLC 01 or S-SLC 02 by Hilti, www.hilti.com.
      1) Select as appropriate for material thickness.
      2) Finish: Electroplated zinc coating, ASTM B633, SC1, Type III, 5µm or better.
   b. #10 TEKS/1 by ITW Buildex Inc., www.itwbuildex.com.
3. Deck fasteners to supporting steel:
   a. Powder Actuated Fasteners:
      1) X-HSN24 or X-ENP-19 Series by Hilti, www.hilti.com.
         a) Select as appropriate for deck gauge and base-material thickness.

2.05 ALTERNATE DECK FASTENING SYSTEM

A. Proposed alternates not meeting the “Roof Diagram Basis of Design” description require signed and sealed calculations.

1. Calculation show:
   a. Capacity based on “Basis of Design”.
   b. Alternate products capacity.
2. Signed and sealed by a Professional Engineer licensed in the State of Michigan.

2.06 MISCELLANEOUS MATERIALS

A. Miscellaneous Steel Shapes:

1. ASTM A 36.
2. All structural steel shall be produced, manufactured and fabricated in USA.

B. Sheet Metal Accessories:

1. ASTM A 526, commercial quality, galvanized. Coating designation 275 (G90).

2. All structural steel shall be produced, manufactured and fabricated in USA.

C. Galvanizing Repair Paint:
1. SSPC - Paint 20 with dry film a minimum of 80 percent zinc by dry-weight.
a. Zinc Clad II/Sherwin Williams
b. Tnemec - Zinc 90-92
2. ZRC Cold Galvanizing compound by ZRC Chemical Company.

D. Closures:
1. Flexible Closure Strips:
a. Manufacturer's standard vulcanized, closed-cell, synthetic rubber.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Verification of Existing Conditions:
1. Examine areas and conditions under which decking is to be installed. Do not proceed with work unless conditions are correct for a proper installation.

B. Handling and Storage:
1. Handle and stack materials carefully in order to prevent deformation or damage.
2. During unloading and hoisting, take extra care to prevent damage to ends and sides of individual roof deck panels.
3. Deck shall not be placed in direct contact with the ground and shall be protected from elements and kept dry.
a. If mud, dirt, or other foreign matter is accumulated on deck, such accumulation shall be completely removed prior to erection.

C. Preparation:
1. Installation of roof deck shall not commence until corresponding steel framework has been plumbed, aligned and completed.
2. Steel surfaces to which materials, provided under this Section, are to be attached, shall be free of ice, water, oil, dirt, rust and other deleterious materials detrimental to attachment process.
3. Deck surfaces which are to receive sprayed-on fireproofing shall be free of all grease, mill oil, paraffin, dirt, salt and other contaminants which impair the adhesion of the fireproofing. Any required cleaning shall be done prior to the installation of roof deck using a suitable cleaning method compatible with the sprayed on fireproofing.

D. Placing Deck:
1. Position roof deck on supporting steel and accurately align to final position with units resting tightly on top of all supporting members. Do not stretch or contract the side lap interlocks.
2. Minimum bearing on steel supporting members shall be 2".
3. Roof deck shall have a minimum lap of 2".

E. Cutting and Fitting of Roof Deck:
1. Shop Cutting:
a. Cut roof deck to proper length before shipping to the field.
2. Field Cutting:
a. Notch to fit around columns and other similar fabrication.
b. Bevel Cuts.
c. All holes and openings which are located on the Structural Drawings.

d. Holes and openings required for work under other Sections of the Specifications, which are not located on the Structural Drawings but are indicated on the approved roof deck shop drawings, are cut by the respective trade.

3. Method and Quality of Cutting:

a. All cuts shall be neat and trim in appearance. Cut deck with metal saw, drills or cutting torch.

4. Restrictions:

a. Openings:

1) Cut no opening in roof decking unless shown on the approved roof deck shop drawings or specifically approved by the Architect in writing.

a) If an opening not shown on the Shop Drawings is required, the Contractor shall submit to the Architect a sketch drawn to scale, showing the proposed opening and all other openings and supports in the immediate area.

b) Do not cut the deck until this sketch has been reviewed and approved by the Architect.

c) Any additional reinforcement or framing required because of such an opening shall be provided at the Contractor's expense.

F. Fastening Deck Units:

1. Attach roof deck to the supporting steel in pattern as indicated on the drawings.

2. Fasten roof deck to structural support by means of mechanical fasteners only, do not weld deck.

3. Install mechanical fasteners in strict accordance with manufacturer's written instructions.

G. Closure Installation:

1. Install sheet steel closures, filler pieces, or cover plates, as appropriate, to close panel ends, where panels change direction or abut, around perimeter of roof openings, to bridge from edges of panels to supporting steel, at ridges and valleys, and at other locations where shown or otherwise required.

2. Burning or weakening of the roof decking material and/or its structural support around welds may be cause for rejection. Deficient welds shall either be repaired or replaced.

H. Field Touch-up Painting:

1. Prior to touch-up, all areas to be painted shall be thoroughly cleaned of rust, dirt and weld slag.

2. Immediately after deck has been erected, and as required subsequent thereto, all surfaces of deck where shop finish has been removed or damaged shall be refinished. Surfaces to be refinished shall include, but not limited to, abrasions, scars, cut edges and welds.

3. Touch-up paint shall extend a minimum of 2" on to undamaged finish.

4. Paint shall be uniformly applied to dry surfaces to a dry film thickness of no less than 2 mils.

3.02 QUALITY CONTROL

A. Quality Control and Testing:

1. Refer to Contract documents "Testing and Inspection Services" for requirements.

B. Corrective Work:

1. Correct deficiencies in roof deck work which inspections and laboratory test reports have indicated to be not in compliance with requirements.

2. Perform additional tests, at Contractor's expense, as may be necessary to show compliance of corrected work.

3. Contractor shall submit to the Architect for approval Drawings showing reasons for and details of proposed corrective work, and receive approved Drawings prior to performing the corrective work.
4. Replace with new work where proposed repair methods are not acceptable to Architect.
   a. The option of repair or replace is at the discretion of the Architect.

END OF SECTION

SECTION 05 4000 - COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made a part of this Section.

1.02 SECTION INCLUDES

A. Formed steel stud exterior wall and exterior soffit framing.

1.03 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).

B. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.

C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

E. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

F. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

G. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

H. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.

I. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2020.

J. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

K. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

M. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that is to be installed in or adjacent to metal framing systems, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by affected installers.

1.05 DESIGN REQUIREMENTS

A. Component Design: Calculate structural properties of cold formed metal framing in accordance with AISI S100 with loading as required by ASCE 7 and the following, whichever is most stringent:
   1. Structural Performance: Engineer, fabricate and erect cold-formed metal framing to withstand design load within limits and under conditions as follows:
      a. Design Loads:
         1) Exterior framing: 30 psf.
      b. Design framing systems to accommodate deflection of primary building structure and construction tolerances and to maintain clearances at openings.

B. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified Professional Engineer licensed in the State of Michigan, to prepare design calculations, shop drawings, and other structural data.

1.06 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Submit manufacturer's product information and installation instructions for each item of cold-formed metal framing system, including accessories.

C. Shop Drawings: Indicate component details, bearing, anchorage, loading, welds, type and location of fasteners, supplemental framing, strapping, bridging, bracing, splices, and connection details, and other accessories or items required of related work.
   1. Indicate stud and roof joist layout.
   2. Describe method for securing studs to tracks and for bolted framing connections.
   3. Provide cold-formed metal framing manufacturer's design and engineering data for required framing, including detailed structural calculations, for all members and connections.
      a. Structural calculations and shop drawings shall be prepared and sealed by a qualified Professional Engineer licensed in the State in which the Project is located
      b. Use Performance Requirements criteria as basis of calculations unless criteria for supported elements are more stringent, in which case the more stringent should be used.
      c. Verify minimum loading requirements for each connection using mechanical fasteners and verify adequacy of each proposed fastener.

1.07 QUALITY ASSURANCE

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Fire-Resistance Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, including those required for compliance with governing regulations, provide cold formed metal framing components identical to those tested as part of an assembly for fire resistance per ASTM E119 by an independent Testing and Inspection Agency acceptable to governing authorities having jurisdiction.

C. Designer Qualifications: Design framing system under direct supervision of a professional structural engineer experienced in designing this work and licensed in the State in which the Project is located.

D. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.

E. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.08 PRE-INSTALLATION MEETING

A. Schedule a pre-installation conference minimum two weeks prior to delivery, and installation, of architecturally exposed structural steel and associated work.
   1. Meet at the Project Site with the following parties in attendance. Owner and Architect, may decline to attend at their discretion.
      a. Architect.
      b. Owner's Representative.
      c. Contractor.
      d. Cold Formed Metal Framing Installer
      e. Other parties concerned with installation of Cold Formed Metal Framing
   2. Review coordination and environmental controls required for proper installation and ambient conditioning in areas to receive work.

B. Contractor shall record discussion, including agreement or disagreement on significant matters. Furnish copies of report to all parties present within 5 days after meeting date.
   1. If substantial disagreements exist at conclusion of meeting, determine how disagreements will be resolved, and set date and time to reconvene meeting.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing Components:
   1. CEMCO: www.cemcosteel.com.
   2. ClarkDietrich Building Systems: www.clarkdietrich.com.
   3. Jaimes Industries: www.jaimesind.com/#sle.
   4. MarinoWARE: www.marinoware.com/#sle.
   5. MBA Metal Framing
   6. MRI Steel Framing

B. Connectors:
   1. Same manufacturer as metal framing.

2.02 PERFORMANCE REQUIREMENTS

A. Design Requirements: Design cold-formed framing systems, components and connectors to withstand specified design loads in compliance with ICC (IBC), ASCE 7, AISI S100, and AISI S240.

2.03 MATERIALS

A. Material and Product Requirements Criteria: AISI S201.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.
   1. Structural Grade: As required to meet design criteria.

2.04 STRUCTURAL FRAMING COMPONENTS

A. Wall Studs and Soffits : AISI S240; c-shaped studs in stud-matching nominal width and compatible height.

2.05 ACCESSORIES

A. Strapping, Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
   1. Notched track: Provide in gage indicated on Drawings, but not less than that of supporting studs. Match corrosion protection of studs. Provide with web and flange sizes indicated on Drawings.
      a. Products:
         1) Clark Dietrich; Notched Track
         2) Cemco; NT - Notched track

B. Galvanizing Repair: Touch up bare steel with zinc-rich paint in compliance with ASTM A780/A780M.

C. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction. ASTM A780/A780M

2.06 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, true to line and with connections securely fastened, per manufacturer’s recommendations and the requirements of this Section.
   1. Fabricate assemblies in jig templates.
   2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed metal framing members 16 gage and heavier, by welding. Fasten all other cold-formed metal framing by screw fastening unless otherwise indicated. Wire tying of framing components is not permitted.
   a. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install per cold-formed metal framing manufacturer's instructions with screws penetrating joined members by not less than 3 exposed screw threads.
4. Fasten other materials to cold-formed metal framing by welding, bolting or screw fastenings, per manufacturer's recommendations.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery and erection stresses. Lift fabricated assemblies to prevent damage or distortion.

C. Fabrication Tolerances: Fabricate assemblies to a maximum allowable tolerance variation from plumb, level and true to line of 1/8 inch in 10 feet and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finish materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of square tolerance of 1/8 inch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements including installation tolerances and other conditions affecting performance of cold-formed metal framing. Do not proceed with installation until satisfactory conditions have been corrected.

B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION - GENERAL

A. Install structural members and connections in compliance with ASTM C1007.

3.03 INSTALLATION OF STUDS

A. Install components in accordance with manufacturers' instructions, ASTM C1007 requirements, and with final accepted shop drawings.

B. Cold-formed metal framing may be shop or field fabricated for installation, or may be field assembled.

C. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.

D. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.

E. Install load-bearing studs; brace, and reinforce to develop full strength and achieve design requirements.

F. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

G. Provide deflection allowance in stud track, directly below horizontal building framing at non-loadbearing framing.

H. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

I. Touch-up field welds and damaged corrosion-protected surfaces zinc-rich paint in compliance with ASTM A780/A780M.

J. Install cold-formed metal framing and accessories plumb, square true to line and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members 16 gage and heavier, by welding. Fasten all other cold-formed metal framing by screw fastening unless otherwise indicated. Wire tying of framing components is not permitted.
    a. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install per cold-formed metal framing manufacturer's instructions, with screws penetrating joined members by not less than 3 exposed screw threads.

K. Provide temporary bracing and leave in place until framing is permanently stabilized.

L. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

M. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.

N. Survey existing structure as required to determine theoretical working planes of stud surfaces for compliance with erection tolerances. Provide slotted connections, supplementary supports and bracing, closures and related accessories as necessary and required.

O. Carefully handle prefabricated units during erection to prevent damage and distortion.

P. Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

Q. Furnish bolts and other connectors required for securing cold-formed metal framing to supporting structure.

R. Set cold-formed metal framing assemblies to lines and elevations indicated. Align and adjust assemblies before permanently fastening. Perform necessary adjustments to compensate for discrepancies in elevation and alignment.

S. Install miscellaneous framing and connections, including kickers, web stiffeners, clip angles, continuous angles, bridging, bracing, anchors, fasteners, and stud girts, as required to provide a complete and stable framing system.
    1. Provide strapping as required to provide substrate for anchoring other components to structure, including but not limited to termination bars, including those for roofing and wall assemblies; wall panel clips, masonry and stone ties, coordinate with the work in other Sections.

T. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for the difference between temperature at time of erection and mean temperature at which the structure will be when completed and in service.

U. Touch-up field welds and damaged corrosion protected surfaces with primer.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: A qualified independent testing and inspection agency employed and paid for by the Owner will perform field quality control testing.

B. Field and shop welds are subject to inspection and testing.

C. Testing Agency will report results in writing to the Architect and Contractor.

D. Remove and replace work that does not comply with specified requirements.

E. Additional testing will be performed to determine compliance of corrected work with specified requirements.

3.05 TOLERANCES

A. Erection Tolerances: Fabricate assemblies to a maximum allowable tolerance variation from plumb, level and true to line of 1/8 inch in 10 feet.

3.06 REPAIRS AND PROTECTION

A. Galvanizing Repair: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanizing repair paint per ASTM A780/A780M and manufacturer's instructions.

B. Provide final protection and maintain conditions in manner acceptable to manufacturer and installer to ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 5000 - METAL FABRICATIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Shop fabricated steel items.

B. Loose steel lintels.

C. Steel framing and supports for applications where framing and supports are not specified in other Sections.

1.03 REFERENCE STANDARDS

A. ASME B18.21.1 - Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series); 2009 (Reaffirmed 2016).

B. ASME B18.6.3 - Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series); 2013.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

H. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2021a.

I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

J. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

K. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

L. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.

M. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.

N. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2022.

O. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2022.

P. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

R. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

S. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals; 2024.

T. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

U. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

V. SSPC-SP 3 - Power Tool Cleaning; 2024.

W. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

X. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Submit manufacturer's technical product data for the following:
   1. Paint products.

C. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, plans, elevations, sections and details where applicable.
   1. Provide templates for anchors and bolts specified for installation under other Sections.
   2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   3. Delegated Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
      a. Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
         1) Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
         2) Include required product data and shop drawings.
         3) Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
         4) Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
      b. Include the following, as applicable:
         1) Design criteria.
         2) Engineering analysis depicting stresses and deflections.
         3) Member sizes and gauges.
         4) Details of connections.
         5) Support reactions.
         6) Bracing requirements.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to this Project, with record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Welding: Qualify personnel according to the following:
   1. Certify each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. Design miscellaneous metal fabrications under direct supervision of a qualified Professional Structural Engineer experienced in design of this Work and licensed to practice in the jurisdiction in which the Project is located.

1.06 PROJECT CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other Construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.07 COORDINATION

A. Coordinate installation of anchorages for metal fabrications.
   1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, to be embedded in concrete or masonry.
   2. Deliver such items to Project site in time for installation.

B. Galvanizer must provide information to Contractor as to how the galvanized materials have been processed and which, if any surface treatment methods were used. Contractor must communicate this information to the painting contractor to facilitate the proper preparation of the substrate prior to the application of the paint.

PART 2 PRODUCTS

2.01 METALS, GENERAL

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.02 MATERIALS - FERROUS METAL

A. Steel Plates, Shapes and Bars: ASTM A 36/A 36M.

B. Steel Tube: ASTM A 500, cold formed; ASTM A 501, hot-rolled.

C. Steel Pipe: ASTM A53/A53M, standard weight (schedule 40), unless otherwise indicated or another weight required by structural loads.
   1. Provide Type S, Grade A, unless otherwise indicated, or another grade required by structural loads.
   2. Black finish, unless indicated otherwise.

D. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

E. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.03 FASTENERS

A. Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating per ASTM B633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F1554, Grade 36.

D. Machine Screws: ASME B18.6.3

E. Plain Washers: Round, carbon steel, ASME B18.21.1

F. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times load imposed when installed in unit masonry and equal to four times load imposed when installed in concrete, as determined by testing per ASTM E488/E488M, conducted by a qualified independent testing agency.
   1. Material: Carbon-steel components zinc-plated, ASTM B633, Class Fe/Zn 5.
   2. Material: Alloy Group 1 or 2 stainless-steel bolts, ASTM F593 and nuts, ASTM F594.

2.04 FABRICATION - GENERAL

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly.

B. Fabricate items with joints tightly fitted and secured.

C. Shear and punch metals cleanly and accurately. Remove burrs.

D. Ease exposed edges to approximately 1/32 inch radius, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

G. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

J. Fabricate joints exposed to weather in manner to exclude water, or provide weep holes where water may accumulate.

K. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures to preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 degF, ambient; 180 degF, material surfaces.

L. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

M. Remove sharp or rough areas on exposed traffic surfaces.

2.05 FABRICATED ITEMS

A. Loose Steel Lintels
   1. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
   2. Weld adjacent members together to form a single unit where indicated.
   3. Size lintels for equal bearing of one inch per foot of clear span but not less than 8 inches bearing on each side of opening.
   4. Galvanize loose steel lintels located in exterior walls.

B. Shelf and Relieving Angles
   1. Fabricate shelf and relieving angles from steel angles of sizes indicated and for attachment to building frame. Provide slotted holes to receive 3/4 inch bolts, spaced not more than 6 inches from ends and not more than 24 inches o.c., unless otherwise indicated.

2. For cavity walls, provide vertical channel brackets to support shelf/relieving angles from backup masonry and concrete. Align expansion joints in angles with control and expansion joints indicated in exterior wythe of cavity wall.
3. Galvanize shelf/relieving angles in exterior walls.

C. Miscellaneous Framing and Supports
1. General: Provide steel framing and supports not part of structural-steel framework as necessary to complete the Work.
2. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
   a. Fabricate units from slotted channel framing where indicated.
   b. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches wide by 1/4 inch thick by 8 inches long at 24 inches o.c., unless otherwise indicated.
   c. Furnish inserts if units must be installed after concrete is placed.
3. Galvanize miscellaneous framing and supports where indicated.

2.06 FINISHES, GENERAL

A. Comply with NAAMM AMP 500-06 "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.07 FINISHES - STEEL

A. Prime paint steel items.
1. Exceptions: Galvanize items to be embedded in concrete, items to be imbedded in masonry, and items specified for galvanized finish.
2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No.3 , "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Prime Painting: One coat.

D. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, applied fireproofing, intumescent fireproofing, and masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

E. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
1. ASTM A123/A123M, for galvanizing steel and iron products.
2. ASTM A153/A153M, for galvanizing steel and iron hardware.

2.08 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION, GENERAL

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.

D. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

E. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.

F. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

G. Field weld components as indicated on drawings.

H. Perform field welding in accordance with AWS D1.1/D1.1M.

I. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

J. Obtain approval prior to site cutting or making adjustments not scheduled.

K. After erection, prime welds, abrasions and surfaces not shop primed or galvanized .

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

3.05 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Apply by brush or spray to provide minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing per ASTM A780/A780M.

END OF SECTION

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SECTION 05 5133 - PREFABRICATED METAL LADDERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Prefabricated ladders.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

B. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).

C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

D. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.

E. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

1.04 SUBMITTALS

A. See Section01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product data: Provide manufacturer's data sheets on each product to be used.

C. Shop Drawings:

1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1.05 QUALITY ASSURANCE

A. Design under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.01 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B211/B211M, 6063 alloy, T6 temper.

B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.

C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6061 alloy, T6 temper.

D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.

E. Bolts, Nuts, and Washers: Stainless steel.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

F. Security Doors: Provide manufacturer's standard aluminum sheet security doors, furnished with continuous piano hinge and heavy duty locking hasps.
   1. Finish: To match ladder

G. Landing Platforms: Provide manufacturer's standard extruded aluminum landing platform, fabricated with channel frame and serrated treads.
   1. Finish: To match ladder

2.03 PREFABRICATED LADDERS

A. Prefabricated Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
   1. Components: Manufacturer's standard rails, rungs, treads, handrails. returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
   2. Rung Texture: Serrated
   3. Basis of Design: O'Keeffe's Inc; Model 503: www.okeeffes.com/#sle.
   4. Other Acceptable Manufacturers: Subject to compliance with requirements provide Basis of Design product or comparable product by one of the following:
      a. Alaco Ladder Company: www.alacoladder.com/#sle.
      b. Industrial Ladder & Scaffolding, Inc.: www.anyladder.com/#sle.
      c. Precision Ladders, LLC: www.precisionladders.com/#sle.

2.04 FINISHES - ALUMINUM

A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A44 Electrolytically deposited colored anodic coating not less than 0.7 mils thick; Bronze.

2.05 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Supply setting templates to the appropriate entities for steel items required to be embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

END OF SECTION

SECTION 05 8010 - POST-INSTALLED ANCHORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section including requirements pertaining to post-installed anchors and attachments to cast-in-place concrete elements, concrete-slabs on steel-deck, precast concrete components, and masonry construction. This section pertains to all other sections of these specifications that require post-installed anchors, unless specified otherwise.

B. Extent of Post-Installed Anchors – architectural, mechanical, electrical and structural work as required in specifications and drawings:

1. Including post-installed anchors specified by delegated design engineers responsible for preparation of delegated design submittals per specification requirements.

C. Related Requirements:

1. Drawing S-001 for:
    a. Statement of Special Inspection.
    b. Seismic design criteria.
    c. Guides for drilling into concrete.
2. Special Inspection and Testing matrix shown on contract drawings.

1.03 ACTION SUBMITTALS

A. Submit anchor capacities rated for cracked concrete only.

B. Product data depicting specific type, physical properties and installation procedures of proposed anchor with the details of the structural element to which Post-Installed Anchors are attached.

1. A general catalog of anchors without specific references is not acceptable.
2. Submittal for all anchor types with the following:
    a. Proposed maximum loading
    b. Position of installation (underside of slab, topside of slab, side of beam, bottom of beam, etc.)
    c. Type and compressive strength of concrete or masonry in which anchor will be installed.
    d. Minimum member thickness at attachment location.
    e. Critical edge distances when applicable.

C. Evaluation Service Reports (ESR) from the International Code Council (ICC) or International Association of Plumbing and Mechanical Officials (IAPMO):

1. ESR’s shall be compliant with the governing Building Code.
2. Mechanical Anchors: AC-193 and ACI 355.2.
3. Adhesive Anchors: AC-308 and ACI 355.4.

D. Certificate for each installer of adhesive anchoring systems in horizontal or overhead application indicating successful completion of the ACI/CRSI Adhesive Anchor Installation Certification Program.

E. Certification from anchor manufacturer indicating completion of on-site training for each anchor type utilized for each installer of post installed anchors:

1. If anchors from multiple anchor manufacturers are utilized by the same contractor, certification from each anchor manufacturer shall be submitted.

F. Where specific post-installed anchor, manufacturer, type, size and embedment requirements are given on the drawings or in specifications, substitutions may only be proposed within the following criteria:

1. Signed and sealed calculations shall be provided by the contractor, indicating the substituted anchor meets the capacity requirements of the specified/detailed anchor.
   a. Calculations shall be prepared by a Professional Engineer licensed in the State of Michigan.
2. Assume shown/specified anchors are loaded to 100% capacity when evaluated with load-adjustment factors for:
   a. Anchor geometry
   b. Embedment depth
   c. Anchor spacing
   d. Edge distance
   e. Cracked concrete (unless specifically otherwise indicated)
   f. Saturated concrete.
   g. Specified concrete properties.
3. Proposed anchors shall be designed with the same considerations as those for the evaluation of the shown/specified anchors.
4. Separate calculations are required for every variation of:
   a. Indicated manufacturer
   b. Anchor size
   c. Embedment depth
   d. Anchor spacing
   e. Edge distance
   f. Specified concrete properties

1.04 COORDINATION

A. Coordinate installation of post-installed anchors to other construction.

B. Each Contractor installing post-installed anchors shall coordinate with Owner furnished Special Inspection Agency for inspection of post-installed anchors in accordance with Division 01 section “Testing and Inspection Services – Building”.

1.05 QUALITY ASSURANCE

A. Installers of adhesive anchoring systems in horizontal or applications shall be certified from the ACI/CRSI Adhesive Anchor Installation Certification Program.

B. Installers to be properly trained by manufacturer of Post-Installed Anchor, as evidenced by a Certificate of Training.

1. Definition: Installer, the person physically installing the anchors.
   a. Not applicable to “Foreman”, if that person does not install anchors.
2. Training shall occur at the job-site.
   a. The anchor manufacturer shall conduct an on-site training seminar for each anchor product specified for the specific job.
      1) For jobs with multiple trades and multiple contracted manufacturers, each manufacturer shall conduct the on-site training seminar.

2) Each person installing an anchor device shall be trained

3) Certificate of Training shall be available at the job site for each person installing an anchor device.

4) The certificate is valid for each specific job.

a) Exception: The certificate is valid for a period of 12 months for different jobs only if the same brand and model anchor is used.

b. If anchors from multiple anchor manufacturers are utilized by the same contractor, on-site training shall occur from each anchor manufacturer.

3. Training shall precede any installation.

4. The installer shall have the certificate available for review any time during the anchor installation process.

C. Codes and Standards:

1. Comply with provisions of the codes listed below.

a. ACI 318-14, Appendix D.

b. Michigan Building Code -2015.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle Post-Installed-Anchors in strict accordance with their manufacturer's written instructions.

B. Deliver, store and handle Post-Installed-Anchors in strict accordance with their manufacturer's written instructions.

1. For adhesive anchors consider temperature, exposure to sunlight, and shelf life.

2. Keep anchor material and components in original manufacturer's packaging with label intact until needed for use.

3. Keep anchors free of dirt and debris.

4. Protect anchors from corrosion and deterioration.

PART 2 - PRODUCTS

2.01 ANCHOR MANUFACTURERS

A. Appropriate product types for cracked concrete conditions.

B. Acceptable Manufacturers:

1. Hilti (www.hilti.com).

2. DeWalt (anchors.dewalt.com/anchors).

3. Simpson Strong-Tie Anchor System (www.simpsonanchors.com).

PART 3 - EXECUTION

3.01 ATTACHMENT TO STRUCTURE

A. Anchor Rating: Anchors shall be rated for "cracked concrete", including those not applied at the theoretical "tension zone".

3.02 PREPARATION FOR DRILLING INTO CONCRETE

A. Caution when planning to drill into bottoms of joists and beams:

1. Reinforcing maybe congested because of:

a. Splice locations.

b. Amount of reinforcing required.

c. Placement of shear reinforcing.

d. Some reinforcing shifted during concrete placement.

e. Any one or more combinations of the above.

2. If bottom reinforcing of concrete beams/joists is too congested for drilling, relocated attachment to side of beam.

B. Locate existing reinforcing by non-destructive methods in the area of intended post-installed anchor locations.

C. Mark reinforcing locations on the concrete surface.

1. Extend marks 12 inches beyond proposed anchor locations.

D. Drill 1/8 inch diameter pilot-hole of the same depth as the proposed anchor.

1. If interference with reinforcing is found, adjust location and drill new pilot hole.

2. If no interference with reinforcing is found, post-installed anchors may now be installed.

3.03 INSTALLATION

A. Do not cut existing reinforcing.

1. Relocate hole when interference with reinforcing is found.

B. Installation of post-installed anchors shall be by certified installers in strict accordance with manufacturer's written instructions and ICC – ES Reports.

C. Holes for adhesive anchors:

1. Drill with hammer bits only.

a. Core-drilling is not permitted unless otherwise indicated.

2. Drill with hollow drill bits.

3.04 PATCHING

A. Patch areas where concrete cover was removed to verify rebar locations.

1. Use bonding agent and pre-mixed patching compound.

3.05 QUALITY CONTROL TESTING

A. Quality Control and Testing:

1. Refer to contract documents for "Testing and Inspection Services" for requirements.

B. Corrective Work:

1. Correct deficiencies in post-installed work which inspections and laboratory test reports have indicated to be not in compliance with requirements.

2. Perform additional tests, at Contractor's expense, as may be necessary to show compliance of corrected work.

3. Contractor shall submit to the Architect for approval Drawings showing reasons for and details of proposed corrective work, and receive approved Drawings prior to performing the corrective work.

4. Replace with new work where proposed repair methods are not acceptable to Architect.

5. The option of repair or replace is at the discretion of the Architect

END OF SECTION

SECTION 06 1000 - ROUGH CARPENTRY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Sheathing.

B. Fire retardant treated wood materials.

C. Communications and electrical room mounting boards / Plywood Backer Panels.

D. Miscellaneous wood nailers, furring, and grounds.

1.03 REFERENCE STANDARDS

A. AFPA (NDS) - National Design Specification for Wood Construction; 2018.

B. APA E30 - Engineered Wood Construction Guide; 2019.

C. APA PRP-108 - Performance Standards and Qualification Policy for Wood Structural Panels (Form E445); 2021.

D. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.

E. AFPA (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2012.

F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

H. ASTM D7438 - Standard Practice for Field Calibration and Application of Hand-Held Moisture Meters; 2020.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

J. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.

K. AWPA M4 - Standard for the Handling, Storage, Field Fabrication and Field Treatment of Preservative-Treated Wood Products; 2023.

L. AWPA U1 - Use Category System: User Specification for Treated Wood; 2021.

M. PS 1 - Structural Plywood; 2023.

N. PS 2 - Performance Standard for Wood Structural Panels; 2018.

O. PS 20 - American Softwood Lumber Standard; 2025.

P. SPIB (GR) - Standard Grading Rules; 2021.

Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

R. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; 2018.

S. WWPA G-5 - Western Lumber Grading Rules; 2025.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Provide technical data for each Fire retardant treated materials. Provide material certificates for all lumber and plywood.

1. Fire-Retardant Treatment: Include certification by treating plant that treatment material complies with specified standard and other requirements.

C. Test Reports: Indicating Moisture content prior to installation of wood products.

1.05 QUALITY ASSURANCE

A. Moisture Protection: Contractor must develop a moisture protection plan and moisture control plan for wood materials. Coordinate with manufacturers of materials. Plans should include the following:
   1. Coordination of material delivery to reduce on-site exposure time.
   2. Keeping material away from ground and method for providing sufficient clearances to provide sufficient air flow beneath packages.
   3. Process and method for end sealing exposed end grain of wood members for temporary protection. Allowable methods of protection include water repellent and primer. Coordinate these methods with Architect where material is anticipated to be exposed to view or receive finishes after installation.
   4. Wraps and tarps to protect wood from precipitation during storage and construction. Material used must not trap moisture beneath covering.

1.06 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar material. Cover all wood materials to prevent wetting. Ventilate covering to prevent the build up of condensation.
   1. In the event that wood structural members do get wet, make sure such members are completely dried out before installing or applying other building materials to prevent wood movement during the drying process from affecting those materials. Immediately remove any standing water or snow from horizontal surfaces, to allow wet surfaces to dry as quickly as possible.

C. Protect moisture sensitive materials, including but not limited to wood materials, from the accumulation of moisture.
   1. Avoid storing materials where they are exposed to rain, snow or standing water.
   2. Keep materials covered. Make sure coverings are ventilated to prevent the accumulation of condensation.
   3. "Dry-in" the structure as quickly as possible. Make sure weather resistive barrier is intact to keep installed materials from being exposed to excess moisture once removed from protective storage.
   4. Immediately remove standing water from moisture sensitive materials, including but not limited to wood framing and sheathing.
   5. End seal exposed end grains of wood members using a water repellant or primer for temporary protection. Where member is to be exposed to view in final installation or scheduled to receive finishes coordinate water repellant/primer with Architect.

D. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

1.07 PROJECT CONDITIONS

A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other work.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Lumber Standards: Comply with PS 20 and with applicable grading rules of inspection agencies certified by the American Lumber Standards Committee (ALSC) Board of Review.
   1. Grade Stamps: Factory-mark each piece of lumber with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, species, moisture content at time of surfacing and mill.

B. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.
   1. Provide dressed lumber, S4S, unless otherwise indicated.
   2. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment, for sizes 2 inches or less in thickness, unless otherwise indicated.
   3. Provide engineer wood products, including plywood and oriented strand board (OSB), glue laminated lumber and structural composite lumber with 15 percent maximum moisture content.

2.02 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated wood is indicated, comply with AWPA U1, Commodity Specification H. Identify fire-retardant-treated wood with appropriate classification marking of UL; or other testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Fire-retardant-treated wood products shall be free of halogens, sulfates, ammonium phosphate, and formaldehyde.
   2. Research or Evaluation Reports: Provide fire-retardant-treated wood acceptable to authorities having jurisdiction for which a current model code research or evaluation report exists that evidences compliance of fire-retardant-treated wood for application indicated.
   3. Fire-retardant-treated wood shall have a Flame Spread rating of 25 or less when tested per ASTM E84 or UL 723 and show no evidence of significant progressive combustion when the test is continued for an additional 20 minutes. Additionally the flame front must not progress more than 10-1/2 feet beyond the centerline of the burners at any time during the test.
   4. Moisture content for fire retardant treated materials
      a. Lumber: 19 percent.
      b. Plywood: 15 percent.

B. Interior Type A: For interior locations, use chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:
   1. Bending strength, stiffness, and fastener-holding capacities are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested by a qualified independent testing agency.
   2. No form of degradation occurs due to acid hydrolysis or other causes related to treatment.
   3. Contact with treated wood does not promote corrosion of metal fasteners.

C. Exterior Type: Use for exterior locations and where indicated. Where locations indicated are part of roofing or exterior wall assemblies provide Exterior Type.

D. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

2.03 DIMENSION LUMBER

A. General: Provide dimension lumber of grades indicated according to ALSC National Grading Rule (NGR) provisions of inspection agency listed.

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade per WCLIB (GR) or WWPA G-5 rules.

2. Boards: Southern Pine No.2 Boards per SPIB rules, or any other graded construction board per WCLIB or WWPA rules.
3. Plywood: PS 2 type, rated Structural I Plywood Sheathing.
   a. Bond Classification for exterior applications: Exterior
   b. Bond Classification for interior applications: Exposure I
4. Provide fire-retardant treated members where indicated.

2.04 CONSTRUCTION PANELS

A. Structural-Use Panel Standards: Comply with PS 1 for plywood panels and comply with APA PRP-108, Form No. E 445 for products not manufactured under PS 1 provisions.

B. Trademark : Factory-mark each construction panel with APA trademark evidencing compliance with grade requirement.

C. Species: Use only Group 1 - Any Species.

D. Provide APA Performance-Rated Panels where structural-use panels are indicated for controlled applications, complying with requirements indicated under each application for grade designation, span rating, exposure durability classification, edge detail (where applicable) and thickness.
   1. Thickness: Provide panels meeting requirements specified but not less than the thickness indicated.
   2. Span ratings: Provide panels with span ratings requires to meet "Code Plus" provisions of APA E30, "Engineered Wood Construction Guide".

E. Roof Sheathing: PS 2 type, rated Structural I Sheathing.
   1. Bond Classification: Exterior.
   2. Span Rating: 60.
   3. Performance Category: 3/4 PERF CAT.

F. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.05 ACCESSORIES

A. Fasteners and Anchors: Provide fasteners of size and type indicated to comply with requirements specified.
   1. Where rough carpentry is exposed to weather, in ground contact or in areas of high relative humidity, provide fasteners made of Hot-dipped galvanized steel per ASTM A 153/A 153M or type 304 stainless steel.
   2. Where fastener is in contact with wood preservative treated wood provide fasteners of Type 304 or 316 Stainless Steel.
   3. Recycled Content: 100% re-melted steel.
   4. Nails, Wire, Brads, and Staples: ASTM F 1667.
   5. Power-Driven Fasteners: CABO NER-272.
   6. Wood Screws: ASME B18.6.1.
   7. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M)
   8. Bolts: Steel bolts per ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
   9. Anchors: Toggle bolt type for anchorage to hollow masonry.

2.06 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System User Specification for Treated Wood determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.

2. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.
3. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment per AWPA M4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.
4. Research or Evaluation Reports: Provide fire-retardant-treated wood acceptable to authorities having jurisdiction for which a current model code research or evaluation report exists that evidences compliance of fire-retardant-treated wood for application indicated.

B. Fire Retardant Treatment:
1. Fire retardant treated wood products shall be free of halogens, sulfates, ammonium phosphate and formaldehyde.
2. Research or Evaluation Reports: Provide fire retardant treated wood acceptable to authorities having jurisdiction for which a current model code research or evaluation report exists that evidences compliance of fire retardant treated wood for application indicated.
3. Fire retardant treated wood shall have a Flame Spread rating of 25 or less when tested per ASTM E84.
4. Use chemical formulations that produce treated lumber and plywood with the following properties under conditions present after installation:
   a. Bending strength, stiffness, and fastener-holding capacities are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested by a qualified independent testing agency.
   b. No form of degradation occurs due to acid hydrolysis or other causes related to treatment.
   c. Contact with treated wood does not promote corrosion of metal fasteners.
5. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread rating of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
   a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
   b. Do not use treated wood in applications exposed to weather or where the wood may become wet.
   c. Manufacturers:
      1) Lonza Group; Dricon FRT Wood: www.wolmanizedwood.com.
      2) Hoover Treated Wood Products, Inc; Pyroguard: www.frtw.com.
      3) Koppers Performance Chemicals; FirePro: www.koppersperformancechemicals.com

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and supporting structure and conditions under which the rough carpentry work is to be installed.
1. Notify Contractor in writing of conditions detrimental to the work.
2. Do not proceed with installation until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

D. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.

E. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

F. Discard units of material with defects that impair quality of rough carpentry and those too small to use with minimum number of joints or optimum joint arrangement.

G. Apply field treatment per AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. Recommended Nailing Schedule" of AFPA (NDS) and AWC (WFCM)

I. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not fully penetrate members where opposite side is exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

J. Use hot-dip galvanized or stainless-steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.

K. Countersink nail heads on exposed carpentry work and fill holes with wood filler.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim. Form shapes shown and cut as required for true line and level of attached work.

B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

F. Locations requiring non-structural framing and blocking include but are not limited to the following:
   1. Wall brackets.
   2. Handrails.
   3. Grab bars.
   4. Towel and bath accessories.
   5. Wall-mounted door stops.
   6. Wall paneling and trim.
   7. Attachments for wall mounted equipment, partitions and accessories.
   8. Joints of rigid wall coverings that occur between studs.

3.04 INSTALLATION OF CONSTRUCTION PANELS

A. Comply with APA E30, for types of structural-use panels indicated.

B. Provide 1/8 inch space at all panel ends and edges.

C. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.

1. Nail panels to framing; staples are not permitted.
2. Comply with manufacturer's recommendations for fastener spacing. Keep perimeter fasteners minimum 3/8 inches from edges and ends of units.
3. Provide 1/8 inch gap at all side and end joints of sheathing.

D. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
3. Install adjacent boards without gaps.

3.05 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.06 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Moisture Content: Test dimension lumber for moisture content prior to installation on building. If dimension lumber exceeds 19 percent moisture content notify Architect immediately, for direction. Test wood sheathing for moisture content prior to installation. If sheathing or other composite lumber materials exceed 12 percent moisture content notify Architect immediately for direction.

C. Moisture Meter: Measure moisture content of wood using a capacitance based moisture meter (Pinless moisture meter or a meter utilizing electromagnetic field technology) that has been calibrated in accordance with ASTM D7438.

3.07 PROTECTION

A. "Dry-in" the structure as quickly as possible. Make sure weather resistive barrier is intact to keep installed materials from being exposed to excess moisture once removed from protective storage.

B. Immediately remove standing water and snow from moisture sensitive materials, including but not limited to wood framing and sheathing.

END OF SECTION

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SECTION 06 1643 - GYPSUM BOARD SHEATHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Gypsum sheathing screw-attached to cold-formed (load bearing) metal framing.

1.03 REFERENCES

A. ASTM C11 - Standard Terminology Relating to Gypsum and Related Building Materials and Systems; 2018b.

B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.

C. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018 (Reapproved 2023).

D. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2020.

F. GA-600 - Fire Resistance and Sound Control Design Manual; 2024.

1.04 DEFINITIONS

A. Gypsum Board Construction Technology: Refer to ASTM C11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.05 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Where fire-rated gypsum board sheathing assemblies are indicated, provide assemblies to comply with the following:
   1. Provide gypsum board sheathing assemblies with materials and construction identical to those of assemblies tested for fire resistance per ASTM E119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
   2. Fire Resistance Ratings: As indicated by reference to GA File Numbers in GA-600 "Fire Resistance Design Manual", to design designations in UL "Fire Resistance Directory" or in listing of other testing and inspecting agency acceptable to authorities having jurisdiction.

1.06 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Provide manufacturer's specifications and installation instructions for gypsum sheathing board, including other data as required to show compliance with these Specifications.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover, keep dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack gypsum board sheathing flat to prevent sagging.

C. Handle gypsum board sheathing to prevent damage to edges, ends and surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
   1. Gypsum Board Sheathing and Related Products:
      a. G-P Gypsum Corporation; Dens-Glass Sheathing / Dens-Glass Fireguard Sheathing
      b. Certainteed, Inc.; GlasRoc Sheathing / GlasRoc Sheathing Type X
      c. National Gypsum; eXP / eXP Fire Shield Type X
      d. United States Gypsum Company; Securock Glass-Mat Sheathing Regular Core / Securock Glass Mat Sheathing Firecode Core
      e. Continental Building Products; Weather Defense Platinum / Weather Defense Platinum Type X

2.02 GYPSUM SHEATHING

A. Glass-Mat, Water-Resistant Gypsum Sheathing: ASTM C1177/C1177M, of type and thickness indicated below; in maximum lengths available to minimize end-to-end butt joints.
   1. Type and Thickness:
      a. Regular, 1/2-inch thick, unless otherwise indicated.
      b. Fire Resistant, Type X, 5/8-inch thick.

B. Joint Treatment: Coordinate with requirements of Section 07 2700 - Air Barriers.

2.03 MISCELLANEOUS MATERIALS

A. Provide auxiliary materials for gypsum sheathing work of the type and grade recommended by the manufacturer of the gypsum board.

B. Steel Drill Screws: ASTM C954, for fastening gypsum board to cold formed steel members.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates to which sheathing attaches or abuts, and structural framing with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of gypsum sheathing assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF GYPSUM SHEATHING

A. Apply gypsum sheathing board per ASTM C1280, and manufacturer’s recommendations.

B. Install gypsum sheathing board with manufacturer's trademarked side out. Do not install imperfect, damaged or damp boards.
   1. Attach sheathing board to steel studs so leading edge or end of each board is attached to open (unsupported) edge of stud flange first.
   2. Butt boards together for a light contact at edges and ends with not more than 1/16 inch open space between boards.
   3. Do not force into place.

C. Apply sheathing board horizontal with long edge perpendicular to studs.
   1. Locate both edge or end joints over supports.
   2. Stagger end-butt joints not less than 24 inches in alternate courses of board.

D. Fasten gypsum sheathing board to supports with corrosion resistant screws. Comply with manufacturer’s recommendations for screw spacing. Keep perimeter fasteners minimum 3/8 inches from edges and ends of units.

3.03 PROTECTION

A. Provide final protection and maintain conditions, in manner suitable to Installer, to ensure gypsum sheathing assemblies are without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 07 1113 - BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Bituminous dampproofing.

1.03 REFERENCE STANDARDS

A. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).

B. ASTM D1227/D1227M - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing; 2013, with Editorial Revision (2019).

C. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; Fifth Edition, with interim updates.

1.04 SUBMITTALS

A. Product Data: Provide properties of primer, bitumen, protection material and mastics.
   1. Include recommended method of application, number of coats, coverage or thickness, and protection course.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience and approved by manufacturer.

B. Single-Source Responsibility: Obtain primary dampproofing materials and primers from one source and by a single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

1.06 FIELD CONDITIONS

A. Substrate: Proceed with dampproofing only after substrate construction and penetrating work have been completed.

B. Weather Limitations: Proceed with dampproofing only when existing and forecasted weather conditions will permit work to be performed per manufacturer's recommendations and warranty requirements.

C. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cold-Applied, Asphalt Emulsion Dampproofing (Trowel Grade):
   1. Sika Corporation; Sikalastic 314
   2. Henry; HE 785 Asphalt Emulsion Damp Proofing
   3. Karnak Corporation; Karnak 220 Fibered Emulsion Mastic
   4. Mar-Flex Systems, Inc.; Armor Block 361WB
   5. WR Meadows; Sealmastic Emulsion Type 3

B. Cold-Applied, Asphalt Emulsion Dampproofing (Semi-Mastic):
   1. Sika Corporation; Sikalastic 315
   2. Henry; 789 Fibered Asphalt Emulsion Damp Proofing
   3. Karnak Chemical Corporation; Karnak 220 Fibered Emulsion
   4. Mar-Flex Systems, Inc.; Armor Block 361WB
   5. W.R. Meadows, Inc.; Sealmastic Emulsion Type 2

C. Cold-Applied, Asphalt Emulsion Dampproofing (Spray Grade):
   1. Sika Corporation; Sikalastic 310
   2. Henry; 788 Non-fibered Asphalt Emulsion Damp Proofing
   3. Karnak Chemical Corporation; Karnak 220 Fibered Emulsion
   4. Mar-Flex Systems, Inc.; Armor Block 361WB
   5. W.R. Meadows, Inc.; Sealmastic Emulsion Type 1

2.02 APPLICATION LOCATIONS

A. Exterior, below-grade surfaces of exterior concrete walls in contact with earth or other backfill and where space is enclosed on opposite side.

B. Back side of concrete retaining walls to prevent percolating of water through the wall or facing.

C. Where indicated on Drawings.

2.03 BITUMINOUS DAMPPROOFING

A. Provide any of the following types:
   1. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
      a. Asphalt-Base Emulsion for Metal Protective Coating: ASTM D1187/D1187M, Type I - Continuous water exposure within few days after drying or Type II - Continuous weather exposure after drying.
      b. Emulsified Asphalt for Roofing Protective Coating: ASTM D1227/D1227M, Type II, Class 1 - Mineral colloid emulsifying agents with non-asbestos fibers.
      c. VOC Content: Not more than permitted by local, State, and federal regulations.
      d. Applied Thickness: 1/16 inch, minimum, wet film.

B. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

2.04 ACCESSORIES

A. Primer: Asphalt primer per ASTM D 41, for asphalt-based dampproofing.

B. Glass Fabric: Woven glass fabric, treated with asphalt, per ASTM D 1668, Type I.

C. Sacrificial and Transition Membrane: Manufacturer's recommended material for use at bottom of wall cavity and joint between CMU and concrete to prevent water infiltration and protect dampproofing from abrasion.
   1. WR Meadows; Air-Shield Thru Wall Flashing
   2. Other product as acceptable to manufacturer for this application.

D. Protection Board: Nominally, 1/8 inch thick premolded, multi-ply, semirigid board, consisting of a mineral-stabilized asphalt core sandwiched between layers of asphalt-saturated felt, and faced on one side with polyethylene film..
   1. W.R. Meadows, Inc.; PC-2 Protection Course.
   2. BASF; Masterseal 977.
   3. Other manufacturers as acceptable to dampproofing manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.

C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 PREPARATION

A. Protect adjacent surfaces not designated to receive dampproofing.

B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.

C. Do not apply dampproofing to surfaces unacceptable to manufacturer.

D. Install cant strips and similar accessories as recommended by prime materials manufacturer even though not shown.

E. Fill voids, seal joints, and apply bond breakers, if any, as recommended by prime materials manufacturer, with particular attention at construction joints.

F. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

G. Install separate flashings and corner protection stripping, as recommended by prime materials manufacturer, where indicated to precede application of dampproofing. Comply with details shown and with manufacturer's recommendations. Pay particular attention to requirements at building expansion joints, if any.

H. Protection of Other Work: Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

3.03 APPLICATION

A. Foundation Walls: Apply two coats of asphalt dampproofing.

B. Perform this work in accordance with manufacturer's instructions.

C. Prime surfaces at a rate approved by manufacturer for application indicated, and allow primer to dry thoroughly.

D. Reinforcement: At changes in plane or where otherwise shown as "reinforced," install lapped course of glass fabric in first coat of dampproofing compound before it thickens.

E. Apply vertical dampproofing down walls from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches over outside face of footing.
   1. Extend 12 inches onto intersecting walls and footings.
   2. Do not extend onto surfaces exposed to view when the Project is completed.

F. Transition membrane: Apply transition membrane to properly primed substrate, prior to application of dampproofing. Refer to transition membrane manufacturer for priming requirements. Lap dampproofing 2 inches onto transition membrane.

G. Seal items watertight with mastic, that project through dampproofing surface.

H. Immediately backfill against dampproofing to protect from damage.

3.04 CLEANING AND PROTECTION

A. Protect exterior, below-grade dampproofing membrane from damage until backfill is completed. Remove overspray and spilled materials from surfaces not intended to receive dampproofing.

END OF SECTION

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SECTION 07 2100 - THERMAL INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Board insulation at wall construction, perimeter foundation wall, and underside of floor slabs.
   1. Board insulation for masonry cavity walls is included in this Section.

B. Batt/Blanket insulation in exterior wall, ceiling, and roof construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.03 DEFINITIONS

A. Mineral Fiber Material Composition: Insulation referred to as mineral fiber block, board, and blanket insulation is composed of fibers from mineral based substances such as rock, slag, or glass and processed from the molten state into fibrous form.
   1. Based on type of insulation substance, the material will be referred to as a mineral fiber when having a rock or slag base, and is referred to as glass fiber with a glass or silica sand base, (also considered a mineral).
   2. Insulation blankets are flexible units consisting of felted, bonded, or unbonded fibers formed into rolls or flat cut pieces referred to as batts; rolls/blankets are simply longer versions of batts.
   3. For additional information about mineral fiber and the various classification types, refer to the following reference standards; ASTM C553, ASTM C612, ASTM C665, and ASTM C726.

B. Thermal Resistivity: Where thermal resistivity of insulation products are designated by "R-values", they represent the reciprocal of thermal conductivity (k-values).
   1. Thermal conductivity is the rate of heat flow through a homogenous material exactly 1-inch thick.
   2. Thermal resistivities are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

1.04 REFERENCE STANDARDS

A. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation; 2013a.

B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

D. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.

E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.

G. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board; 2017.

H. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2020.

I. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2020.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022.

L. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.

M. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2019.

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations for each product. Include data substantiating materials comply with specified requirements.

C. Record Document information: provide a document signed and dated by the insulation installer listing the following for inclusion in the record documents. Refer to Section 01 7839 - Project Record Documents.
1. Type of insulation
2. Insulation Manufacturer
3. Manufacturer's rated R-value of insulation
4. Installed thickness

1.06 QUALITY ASSURANCE

A. Fire Performance Characteristics: Provide insulation materials identical to those whose indicated fire performance characteristics have been determined per ASTM test method indicated below, by UL or other testing and inspection organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.
1. Surface Burning Characteristics: ASTM E84.
2. Fire Resistance Rating: ASTM E119.

B. UL Design Numbers: Where UL Design numbers are cited in the Contract Documents, the Contractor can obtain the specific information for each UL Design from the following web site and/or purchase a copy of the UL Fire Resistance Directory directly from Underwriters Laboratories. Web site: http://productspec.ul.com

C. Labeling of Building Envelope Insulation: Clearly identify rated R-value of insulation on each piece of building envelope insulation. Where insulation does not have an identification mark provide the rated R-value and the following on each package, shipping container or bundle of insulation:
1. Batts and Blankets: Rated r-value of insulation, length, width and thickness.
2. Boardstock: Rated R-value of insulation, length, width and thickness of the boards in the - package.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Protection From Deterioration: Do not allow insulation materials to become wet, soiled or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.

B. Protect plastic insulation as follows:
1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site ahead of installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.

B. Insulation on Inside of Concrete and Masonry Exterior Walls: Polyisocyanurate board.

2.02 MATERIALS - GENERAL

A. Provide each type of insulation required from one manufacturer.

2.03 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
5. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
6. Manufacturers: Subject to compliance with requirements provide one of the following:
   a. DuPont de Nemours, Inc; Styrofoam Brand Cavitymate Plus: building.dupont.com/#sle.
   b. Kingspan Insulation LLC; GreenGuard GG25-LG XPS Insulation Board: www.kingspan.com/#sle.
   c. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.

B. Rigid Cellular Polyisocyanurate (ISO) Thermal Insulation Board with Facers Both Sides and Water-Resistive Barrier - NOT an air barrier: Complying with ASTM C1289.
1. Classifications:
   a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
      1) Class 2 - Faced with coated glass fiber mat facers on both major surfaces of the core foam.
      2) Compressive Strength: Classes 1-2-3, Grade 1 - 16 psi (110 kPa), minimum.
      3) Thermal Resistance, R-value: At 1-1/2 inch thick; Class 1, Grades 1-2-3 - 8.4 (1.48), minimum, at 75 degrees F.
2. Flame Spread Index (FSI): Class B - 26 to 75, when tested in accordance with ASTM E84.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.

4. Comply with fire resistance requirements specified as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285. Please note: NFPA 285 is an ASSEMBLY TEST. Therefore the products provided as part of the work of this section need to be closely coordinated with other products specified in other sections to ensure that all components being provided have been tested together or have had engineering judgements or technical evaluations by entities acceptable to the Authorities Having Jurisdiction. Products requiring this coordination include but are not limited to floorline firestopping (Section 07 8600 - Firestopping), Exterior Sheathing (Section 06 1643 - Gypsum Board Sheathing), Air Barrier (Section 07 2700 - Air Barriers), Exterior Sheathing with Integral Air Barrier (Section 07 2526 - Gypsum Board Weather-Resistant Barrier and Air Barrier System), and Metal Composite Material (MCM) Panel Assemblies (Section 07 4213.23 - Metal Composite Material Wall Panels)
5. Board Thickness: 3 inches.
6. Board Edges: Square.
7. Water Vapor Permeance: 1.2 perm, maximum, at 1 inch thickness, and when tested in accordance with ASTM E96/E96M, desiccant method.
8. Products:
   a. Atlas Roofing Corporation; EnergyShield CGF Pro Wall Insulation: www.atlasroofing.com/#sle.
   b. Carlisle Coatings & Waterproofing, Inc; R2+ Matte: www.carlisleccw.com/sle.
   c. Hunter Panels, LLC; Xci CG Class A: www.hunterxci.com.

2.04 MINERAL FIBER BOARD INSULATION MATERIALS

A. Mineral Fiber Block, Board, or Blanket Thermal Insulation: Complying with ASTM C612 or ASTM C553. Unfaced unless otherwise indicated.
   1. Where indicated, provide fiberglass reinforced polypropylene facing on one side; with flame spread index of 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   3. Moisture resistance: ASTM C1104 Absorbs less than 0.03 percent by volume
   4. Non-corrosive; ASTM C665
   5. Facing: Unfaced
   6. Thermal Resistance: Minimum R-value of 4.2 degrees F hour square foot per Btu at 75 degrees F, when tested according to ASTM C518.
   7. Maximum Density: 6.0 pounds per cubic foot.
   8. Manufacturers: Subject to compliance with requirements, provide products of one of the following
      a. Johns Manville; CladStone 60 Water & Fire Block Insulation: www.jm.com/#sle.
      b. ROCKWOOL; CAVITYROCK: www.rockwool.com/#sle.
      c. Thermafiber, Inc; RainBarrier HD: www.thermafiber.com/#sle.
   9. Accessories:
      a. Fasteners: Provide any of the following mechanical fasteners as required for substrates being fastened to as well as cladding type covering insulation:
         1) Provide masonry tie wedges or clips to work with masonry ties provided in Section 04 2000 - Unit Masonry.
         2) Provide fasteners suitable for substrate (metal or wood) with washer to prevent fastener from punching through insulation.
         3) Where exterior wall is indicated to be a rated assembly provide fasteners, clips, wedges and washers of either galvanized steel or stainless steel.

2.05 MINERAL FIBER BATT INSULATION MATERIALS

A. Where batt insulation is indicated, either glass, rock or slag fiber batt insulation may be used, at Contractor's option, unless otherwise indicated by tested fire rated assembly.

B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.

1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
2. Smoke Developed Index: 50 or less, when tested in accordance with ASTM E84.
3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
4. Thermal Resistance: R-value of 3.8 per inch.
5. Thickness: As indicated on Drawings
6. Facing: Type I, Unfaced.
7. Products:
   a. CertainTeed Corporation; Fiberglass Building Insulation: www.certainteed.com.
   b. Johns Manville; Formaldehyde Free Fiberglass Insulation : www.jm.com.
   c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
   d. Knauf Insulation GmbH; EcoBatt Insulation: www.knaufinsulation.us.

2.06 ACCESSORIES

A. Insulation Fasteners: Impaling clip of galvanized steel with washer retainer and clips, to be mechanically fastened to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

B. Adhesive: Type recommended by insulation manufacturer for application, complying with fire-resistance requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

C. Examine substrates and conditions with Installer present, for compliance with requirements for insulation work. A satisfactory substrate is one that complies with requirements of the section in which substrate and related work are specified. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to the product conditions, consult the manufacturer's technical representative for specific recommendations before proceeding with the work.

B. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.

C. Apply insulation in a single layer of the required thickness, unless otherwise shown or required to make up the total thickness.

D. Stuff and chink insulation units into miscellaneous voids and cavity spaces as required to provide continuous envelope of insulation without interruption.

3.03 INSTALLATION OF FOUNDATION INSULATION

A. On vertical surfaces, set units in adhesive applied per insulation and waterproofing manufacturers written instructions. Use type of adhesive recommended by insulation and waterproofing manufacturer. Coordinate with the work of Section 07 1300 - Sheet Waterproofing.

B. Protect below-grade insulation from damage during backfilling.

C. Protect top surface of horizontal insulation (from damage during concrete work) by application of protection board.

D. Install boards as follows:.
   1. Install in running bond pattern.
   2. Butt edges and ends tightly to adjacent boards and to protrusions.

E. Extend boards over expansion joints, unbonded to foundation on one side of joint.

F. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 SEMI-RIGID BOARD INTALLATION AT EXTERIOR WALL CAVITIES

A. Install insulation in wall cavities with mechanical fasteners to studs or masonry backup. Where studs do not align with fastener locations provide metal strapping of the same gage as studs, fastened to the studs to transfer the loading to the studs. If wood studs are used fasten blocking inside the stud cavity between the studs with wood screws to provide fastening locations for insulation.

B. Stagger joints in each direction.

C. Install boards in a manner that ensures a snug compression fit with no gaps between boards.

3.05 BOARD INSTALLATION AT CAVITY WALLS

A. Apply adhesive to back of boards using adhesive pattern recommended by insulation manufacturer in writing. If installed by a trade other than the mason, provide mechanical fasteners with washers to ensure the insulation board remains in place until cladding is applied. If mason is installing install masonry anchors through insulation as the mechanical fastener.
   1. Mechanical fastening must occur at minimum every 16 inches on center in field and 12 inches on center at perimeter of boards.

B. Install boards horizontally on walls.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and protrusions.

C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.06 BOARD INSTALLATION UNDERSLAB INSULATION

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.07 BATT INSTALLATION

A. Apply insulation units of type shown to substrates by method indicated. If not otherwise indicated and except for units resting on horizontal surfaces, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Install insulation in accordance with manufacturer's instructions.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. Install with factory-applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.

F. Tape joints and ruptures in vapor barriers, using adhesive tape of type recommended by insulation manufacturer, and seal each continuous area of insulation to surrounding construction so as to ensure vapor-tight installation of the units.

G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

3.08 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation will be subjected to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

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SECTION 07 2700 - AIR BARRIERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Air barriers.

1.03 DEFINITIONS

A. Air Barrier: Airtight barrier made of material that is virtually air impermeable but water vapor permeable, both to amount as specified, with sealed seams and sealed joints to adjacent surfaces.

B. Material Transitions: Areas where the air barrier connects to beams, columns, slabs, parapets, foundation walls, roofing systems, and at the interface of dissimilar materials.

1.04 REFERENCE STANDARDS

A. ABAA T0002 - Standard Test Method for Pull-Off Strength of Adhered Air and Water Resistive Barriers Using an Adhesion Tester; 2019.

B. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2017).

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022.

E. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2019).

F. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

G. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2019.

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples for submittal procedures.

B. Product Data: Provide data on material characteristics, performance criteria, and product limitations for each product. Include data substantiating materials comply with specified requirements.

1. Submit all components of tested assemblies at the same time to Architect for Review. Coordinate with submissions under other Sections including those containing wall insulation, perimeter and floorline firestopping, air barriers, and metal composite material.
2. Submit compatibility information on fluid applied and self adhered components that must come into contact with other materials, including but not limited to water proofing, roofing materials, joint sealants and water cut-off mastics.
3. Where NFPA 285 applies submit test report or 3rd party engineering report substantiating that assembly complies with NFPA 285.

C. Shop Drawings: Submit shop drawings indicating locations and extent of Air Barrier System, including details of typical conditions, special joint conditions, intersections with other building envelope systems and materials; counterflashings and details showing bridging of envelope at substrate changes, details of sealing penetrations, and detailed flashing around windows and doors.

1.06 PRE-INSTALLATION CONFERENCE

A. Schedule a pre-installation conference at the Project site, minimum two weeks prior to start of sheathing work, with the following parties in attendance. Owner and Architect, may decline to attend at their discretion.
   1. Owner's Representative.
   2. Architect.
   3. Contractor.
   4. Air Barrier Contractor
   5. Contractors with materials that need to tie into air barrier system including but not limited to:
      a. Fenestration Contractor
      b. Door frame Installer
      c. Louver installer
      d. Installer of mechanical and electrical components that penetrate air barrier
      e. Roofing contractor
      f. Waterproofing contractor
      g. Sheathing contractor
      h. Other interested parties
   6. Review methods and procedures related to air barrier installation including, but not limited to, the following:
      a. Review submittals and field conditions, including:
         1) Substrate and accessory material types
         2) Installation instructions and substrate preparation recommendations.
         3) Locations and extent of air barrier system(s),
         4) Details of typical conditions,
         5) Special joint conditions,
         6) Intersections with other building envelope systems and materials;
         7) Counterflashings and details showing bridging of envelope at substrate changes
         8) Details of sealing penetrations
         9) Detailed flashing around windows and doors
   7. Review mock-ups for work quality and materials.
   8. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   9. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions.

B. Contractor shall record discussion, including agreement or disagreement on significant matters. Furnish copies of report to all parties present within 5 days after meeting date.
   1. If substantial disagreements exist at conclusion of meeting, determine how disagreements will be resolved, and set date and time to reconvene meeting.

1.07 QUALITY ASSURANCE

A. Single Source Responsibility: Provide each type of air barrier from a single manufacturer.

B. Provide photographic documentation of installation of air barrier prior to application of flashing materials and again after the installation of the flashing material

C. Implement the following Field Quality Control requirements. Cooperate with independent testing agencies and envelope commissioning agents engaged by the Owner. Do not cover air barrier until it has been, tested and accepted.

D. Daily Inspection: Contractor to perform and record the following daily and fill out daily worksheet.
   1. Visual inspection of the substrate prior to the application of air barrier to confirm the substrate is in accordance with the manufacturer's instructions.
   2. Visual inspection on the completed air barrier for that day and fix any deficiencies.

3. Verification of manufactures specific wet film thickness of installed work for fluid applied materials.
4. Adhesion Test - Membrane Adhesion to Substrate, ABAA T0002.

E. Daily worksheet, must include but is not limited to the following information:
1. Listing of installers
2. Project name
3. Type(s) of air barrier installed
4. Weather barrier product name and lot/batch number
5. Primer product name and lot/batch number
6. Substrate type
7. Substrate preparation required
8. Installation locations (gridlines, elevations, etc)
9. Results of visual inspection
10. Results of verification of wet film thickness, include photo documentation
11. Results of verification of adhesion testing, include photo documentation
12. Date and time of installation
13. Weather conditions

1.08 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

B. Protect material, primers and accessory materials from damage, weather, excessive temperatures and construction traffic.

C. Store accessory material and primers in a location with constant ambient temperatures not less than 40 degF, unless specifically approved by manufacturer in writing..

PART 2 PRODUCTS

2.01 GENERAL

A. Provide each type of air barrier required from one manufacturer.

2.02 AIR BARRIER MATERIALS (AIR IMPERMEABLE AND WATER VAPOR PERMEABLE)

A. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
1. Air Barrier Coating:
a. Material: Silyl-terminated polyether (STPE).
b. Wet Film Thickness (WFT): 20 mil, 0.020 inch, minimum or in accordance with manufacturer's recommendation, whichever is greater.
c. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
d. Water Vapor Permeance: 13 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method, at 73.4 degrees F.
e. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 12 months of weather exposure.
f. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
g. Sealants, Tapes and Accessories: As recommended by coating manufacturer.
h. Products:
1) GCP Applied Technologies; Perm-A-Barrier VPL 50RS UV Stable: www.gcpat.com/#sle.
2) Henry Company; Air-Bloc All Weather STPE: www.henry.com/#sle.
3) PROSOCO, Inc; R-GUARD Cat 5: www.prosoco.com/r-guard/#sle.

2.03 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Air Barrier and Adjacent Substrates: As indicated or in compliance with air barrier manufacturer's installation instructions, compliant with requirements of assembly passing NFPA 285. Products include but are not limited to the following:.
   1. Flexible Flashing Membrane, sheet or fluid applied as recommended by air barrier manufacturer.
   2. Transition Membrane, sheet or fluid applied as recommended by air barrier manufacturer**.**
   3. Fabric reinforcing, composition as required by air barrier manufacturer.
   4. Sealant, not exposed to view in finished application, as recommended by air barrier manufacturer.
   5. Sheathing joint treatment products, as recommended by air barrier manufacturer.

B. Stainless Steel Flashing: Flexible flashing with 2 mil, 0.002 inch thick Type 304 stainless steel sheet, 8 mil, 0.008 inch of butyl adhesive and siliconized release liner.
   1. Puncture Resistance, ASTM E154/E154M : 2,500 psi, minimum.
   2. Peel Adhesion, ASTM D903 : Minimum 3.5 lbf/in on application substrates.
   3. Fire Performance Characteristics, ASTM E84 : Pass; Class A
   4. Width: As required for transition configuration but not less than 6 inches.
   5. Products:
      a. Momentive Performance Materials, Inc/GE Silicones; GE Elemax SS Flashing: www.siliconeforbuilding.com/#sle.
      b. York Manufacturing, Inc.; York 304 SA
      c. Vaproshield, LLC; Vapro-SS Flashing

C. Thinners and Cleaners: As recommended by material manufacturer.

D. Primers: Manufacturer's recommended primer/adhesive for use on cut edges of sheathing to promote proper bonding of materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready for work of this section.

B. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.

C. Do not proceed with this work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.03 INSTALLATION

A. Install materials in accordance with manufacturer's installation instructions.

B. Air Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.

D. Fluid-Applied Coatings or Membranes:
   1. Prepare substrate in accordance with manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
   2. Use manufacturer approved transition material to seal to adjacent construction and to bridge joints in coating substrate.

E. Openings and Penetrations in Exterior Air Barriers:
   1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto air barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
   2. At openings with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
   3. At openings with nonflanged frames, seal air barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
   4. At head of openings, install flashing under air barrier extending at least 2 inches beyond face of jambs; seal air barrier to flashing.
   5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
   6. Service and Other Penetrations: Form flashing around penetrating item and seal to air barrier surface.
   7. Seal all penetrations through air barrier with sealant or liquid flashing approved by air barrier manufacturer. Locations required to be sealed include but are not limited to masonry tie penetrations, z-furring fastener penetrations, and all cladding penetrations.

3.04 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

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SECTION 07 4213 - METAL WALL PANELS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Manufactured metal panels for soffit panels, with related flashings and accessory components.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2020.

B. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2017.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Submit manufacturer's product specifications, standard details, certified product test results, installation instructions and general recommendations, as applicable to materials and finishes for each component of metal soffit panel system.

C. Shop Drawings: Submit small-scale layout and elevations of total project and large-scale details of edge conditions, joints, corners, penetrations, supports, anchorages, trim, flashings, closures and special details.
   1. Delegated Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
      a. Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
         1) Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
         2) Show design assumptions, basis of sizing members, connections and other information as necessary, and as may be required including metal, alloy, temper where applicable, section modulus, loading, deflection and movements
         3) Clearly show basis of compliance with performance criteria.
         4) Include required product data and shop drawings.
         5) Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
         6) Include signature and seal of design professional responsible for allocated design services on calculations and drawings.

D. Selection Samples: For each finish product specified, submit color chips/cards representing manufacturer's full range of standard and premium colors and patterns.

E. Verification Samples: Submit at least 3 samples, minimum size 6 inch square of each color and texture indicated. Where color or texture of finish will vary, include 2 or more pieces in each sample to show limits of such variations.

F. Test Reports: Submit certified test reports for required tests, recording dates, locations, method of testing, test results and interpretation of results.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in installing the products specified in this section with minimum five years of documented experience of successfully installed metal soffit panels similar in size and character to this project..
   1. Submit a list of at least five completed projects of similar nature and scope; list project names, location and Architect.

C. Design Concept: The Drawings indicate profiles, dimensional requirements, materials, fabrication and similar design requirements for metal soffit panel work.
   1. Minor deviations from these requirements will be accepted in order to utilize manufacturer's standard products when, in Architect's sole judgement, such deviations do not materially detract from the design concept or intended performance.

D. Design soffit panel attachment system under direct supervision of a qualified Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

E. Single Source Responsibility: Provide metal soffit panel system for the project that is the product of a single manufacturer.
   1. It is the responsibility of manufacturer to coordinate design of in-place system to comply with system performance requirements and ensure weatherproof integrity.
   2. Responsibility additionally includes design, furnishing and installation of anchor assemblies, support framing, related connections and/or fasteners, as required for full compliance with system performance requirements.

1.06 PRE-INSTALLATION MEETING

A. Schedule a pre-installation conference minimum two weeks prior delivery, and installation, of metal soffit panels and associated work.
   1. Meet at the Project Site with the following parties in attendance. Owner and Architect, may decline to attend at their discretion.
      a. Architect.
      b. Owner’s Representative.
      c. Contractor.
      d. Glazing Contractor.
      e. Sealant Contractor.
      f. Roofing contractor
      g. Other parties concerned with methods and procedures related to installation of metal soffit panel work.
   2. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
   3. Review structural loading limitations.
   4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   5. Review required inspecting, testing, and certifying procedures.
   6. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions.
   7. Review preparation and other requirements for installing sealant.

B. Contractor shall record discussion, including agreement or disagreement on significant matters. Furnish copies of report to all parties present within 5 days after meeting date.
   1. If substantial disagreements exist at conclusion of meeting, determine how disagreements will be resolved, and set date and time to reconvene meeting.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

B. Exercise care in unloading, storing and erecting metal soffit panels to prevent bending, warping, twisting and surface damage.

C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal soffit panels so they will not accumulate water. Do not store panels in contact with other materials that might cause staining, denting or other surface damage.

D. Prevent contact with materials that may cause discoloration or staining of products.

1.08 PROJECT CONDITIONS

A. Field Measurements: Where possible, prior to fabrication of metal soffit panels, take field measurements of structure or substrates to receive metal wall panel system. Allow for trimming metal wall panel units where final dimensions cannot be established prior to fabrication.

1.09 WARRANTY

A. Submit a written warranty executed by the Metal Panel Manufacturer and Installer agreeing to repair or replace metal soffit panel components that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
   1. Structural failures including, but not limited to, excessive deflection.
   2. Noise or vibration caused by thermal movement or wind.
   3. Adhesive or cohesive sealant failures.
   4. Failure of system to meet performance requirements.
   5. Deterioration or discoloration of metals, metal finishes, and other materials beyond normal weathering.
   6. Air and water leakage.

B. Material and Workmanship Warranty Period: 5 years from date of Substantial Completion.

C. Finish Warranty: Correct defective work within a 20 year period after Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Provide metal soffit panel systems adapted to applications indicated which have been pre-tested and certified by manufacturer to provide specified resistance to air infiltration, water penetration and structural deflection and failure when tested per AAMA 501.1.

B. Structural Performance: Design, engineer, fabricate and install metal soffit panel systems to withstand the effects of wind loads, thermal movements, building and anchorage movements and other conditions without exceeding limitations for deflection, material failure or permanent deformation of structural members.
   1. Limit deflection to L/180, with 3/4 inch maximum deflection.
   2. Structural Wind Load Criteria: Refer to Structural Drawings for structural design criteria.

C. Condensation: Fabricate metal panel system for control of condensation, including vapor inclusion of seals and provisions for breathing, venting, weeping and draining.

D. Unacceptable Conditions: Noise or vibration created by thermal movement, structural movement or wind; thermal movement transferred to building structure; and loosening, weakening or failure of fasteners, attachments or components.

E. Flatness: Fabricate panels of such flatness, when measured at approximately 70 deg F, the maximum slope of the surface at any point measured from nominal plane of the surface shall not exceed 1/16 inch.

F. Joints: Match all exposed work to produce continuity of line and design with all joints accurately aligned in all planes. Locate vertical and horizontal joints in metal panel system only as shown.

G. Secondary Metal Framing: Design secondary metal framing for metal soffit panel assembly in accordance with AISI - Standard for Cold Formed Steel Framing - General Provisions and with requirements in Specification Section 05 4000.

H. Thermal Movement: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction.

I. Provide roof edge terminations with securement tested for wind resistance in accordance with ANSI/SPRI ES-1 modified to use basic wind speeds derived from the State in which the Project is located building code Wind Load Charts.

2.02 METAL SOFFIT SYSTEM

A. Soffit System: Factory fabricated prefinished metal panel system, site assembled.
   1. Provide soffit panels.
   2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
   3. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
   4. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.

B. Soffit Panels:
   1. Basis of Design Profile: Quality Edge; Vesta Plank Soffit - Solid
      a. Other Acceptable Manufacturers: Subject to compliance with requirements provide Basis of Design product or comparable product as approved by Architect.
   2. Material: Precoated steel sheet, 0.020 inch minimum thickness.
   3. Color: 489 - Warm Teak.
   4. Texture: Smooth

C. Soffit Panels, Vented:
   1. Basis of Design Profile: Quality Edge; Vesta Plank Soffit - Full Vent
      a. Other Acceptable Manufacturers: Subject to compliance with requirements provide Basis of Design product or comparable product as approved by Architect.
   2. Material: Precoated steel sheet, 0.020 inch minimum thickness.
   3. Color: 489 - Warm Teak.
   4. Texture: Smooth

D. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

E. Expansion Joints: Same material, thickness and finish as exterior sheets; manufacturer's standard brake formed type, of profile to suit system.

F. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.03 MATERIALS

A. Precoated Sheet Steel: Provide one of the following:
   1. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Structural Steel (SS) or Forming Steel (FS), with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.04 FINISHES

A. Apply coatings either before or after forming and fabrication panels as required by coating process and as required for maximum coating performance capability. Protect coating either by application of strippable film or by packing plastic film or other suitable material between panels in manner to protect the finish properly. Furnish air-drying spray finish in matching color for touch-up.

B. Prepare, pretreat and apply coating to metal surfaces to comply with coating manufacturers written instructions.

C. Exposed Surface Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) or Fluoroethylene vinyl ether (FEVE) coating, top coat over coating manufacturer's recommended primer.
   1. Superior Performance Organic Coatings: AAMA 2605, multiple coats, thermally cured fluoropolymer system. Provide 2 coat pearlescent, mica or exotic coating system.

2.05 ACCESSORIES

A. Sealants: As specified in Section 07 9200 - Joint Sealants.

B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets, self locking bolts, end-welded studs and other suitable fasteners designed to withstand design loads.
   1. Use corrosion-resistant steel or stainless steel fasteners.
   2. Exposed fasteners are not acceptable.
   3. Do not provide exposed fasteners. Where required and acceptable to Architect, provide exposed fasteners with heads matching color of metal soffit panels.

C. Accessories: Provide components required for a complete metal soffit panel system including trim, copings, corner units, clips, flashings, sealants, gaskets and similar items. Use aluminum extrusions or sheet metal same as panels, with same finish as metal soffit panels.
   1. Sealing Tape: Precompressed, self expanding polyester polyurethane foam tape impregnated with neoprene rubber suspended in chlorinated hydrocarbons with release paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape.
   2. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.

D. Field Touch-up Paint: Where prefinished metals are cut in the field, apply touch-up paint to all cut edges to maintain corrosion resistance.

E. Bituminous Paint: Cold-applied asphalt mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

2.06 FABRICATION

A. Fabricate and finish metal soffit panels and accessories at factory to greatest extent possible by manufacturer's standard procedures and processes, as required to fulfill indicated performance requirements, demonstrated by laboratory testing. Comply with indicated profiles and dimensional requirements and with structural requirements.

B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.

C. Prepare components to receive concealed fasteners and anchor and connection devices.

D. Welding: Weld components to comply with referenced standard and Shop Drawings, unless otherwise indicated. Weld before finishing components. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
   1. Exposed welded joints shall be ground smooth so seams are not visible.

E. Dissimilar Metals: Apply bituminous coating or other permanent separation materials on concealed surfaces where metal soffit panels would otherwise be in direct contact with substrate materials which are non-compatible or could result in corrosion or deterioration of either material or finishes.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting structures and conditions under which metal soffit panels are to be installed. Notify Contractor in writing of conditions detrimental to proper completion of work.

1. Do not proceed with erection until unsatisfactory conditions have been corrected in an acceptable manner.

B. Verify that building framing members are ready to receive panels.

3.02 INSTALLATION

A. Install panels on soffits in accordance with manufacturer's instructions.

B. Comply with metal soffit panel manufacturer's instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor wall panels and other components of work securely in place, with provisions for thermal and structural movement.

C. Do not install component parts which are defective including warped, bowed, dented, abraded or otherwise damaged. Remove and replace members damaged during installation or thereafter before time of final acceptance.

D. Do not cut, trim, weld or braze component parts during erection in any manner which would damage finish, decrease strength, result in a visual imperfection, or result in a failure in performance of metal wall panels. Return component parts which require alteration to the shop for refabrication, if possible, or for replacement by new components.

E. Install component parts level, plumb, true to line and with uniform joints and reveals. Secure to structure with non-staining and non-corrosive shims, anchors, fasteners, spacers and filler. Use erection equipment that will not mar or stain finished surfaces, and will not damage component parts in any way.

F. Protect surfaces in contact with dissimilar metals with bituminous coating of approximately 30-mil dry film thickness or other suitable permanent separator on concealed contact surfaces of dissimilar materials before assembly or installation, wherever there is the possibility of corrosive or electrolytic action.. Allow to dry prior to installation.

G. Anchor component parts securely in place as shown by bolting, welding or other permanent mechanical attachment system which will comply with performance requirements and permit movements which are intended or necessary. Install slip-joint linings wherever possible to ensure movement as intended or necessary.

H. Use concealed fasteners unless otherwise indicated by Architect.

I. Accessories: Install components required for a complete metal wall panel system including trim, copings, corner units, clips, flashings, sealants, gaskets and similar items.

3.03 TOLERANCES

A. Shim and align metal soffit panel units within installed tolerance of 1/8 inch in 20'-0" on level/plumb/slope and location/line, and within 1/16 inch offset of adjoining faces and of alignment of matching profiles.

3.04 CLEANING AND PROTECTION

A. Damaged Units: Replace metal soffit panels and other components of the work which have been damaged or have deterioration beyond successful repair by means of finish touch-up or similar minor repair procedures.

B. Cleaning: Upon completion of metal soffit panel installation, clean finished surfaces as recommended by metal wall panel manufacturer, and maintain in a clean condition during construction.

1. At time of substantial completion, demonstrate proper cleaning methods and materials to Owner's maintenance personnel.

END OF SECTION

SECTION 07 5400 - THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Adhered system with thermoplastic roofing membrane.

B. Insulation, flat and tapered, mechanically and adhesively attached.

C. Vapor retarder.

D. Cover boards.

E. Membrane Flashings.

F. Roofing roofing expansion joints and walkway pads.

1.03 REFERENCE STANDARDS

A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.

B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2020.

C. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing; 2021.

D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022.

E. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2011 (Reapproved 2019).

F. FM (AG) - FM Approval Guide; current edition.

G. NRCA (RM) - The NRCA Roofing Manual; 2019.

H. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

I. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 PRE-INSTALLATION MEETING

A. Schedule a pre-roofing conference prior to start of roofing and associated work. Provide participants minimum 5 days notice prior to convening conference.

1. Meet at the Project Site, or other mutually agreed location, with the following parties in attendance. Owner and Architect, may decline to attend at their discretion.
    a. Owner's Representative.
    b. Architect.
    c. Contractor.
    d. Roofing system installer.
    e. Roofing manufacturer.
    f. Lightning Protection manufacturer
    g. Owner’s Insurer.
    h. Testing agency.
    i. Governing authorities.
    j. Installers of related work.
    k. Other parties concerned with performance of roofing system.

B. Review methods and procedures related to roofing installation, including manufacturer's written instructions.

1. Examine deck substrate conditions for compliance with requirements, including flatness and fastening.
2. Review deck loading limitations during and after roofing work.
3. Review flashings, special roofing details, roof drainage, roof expansion joints, roof penetrations, equipment curbs and supports, and condition of other construction affecting roofing work.
4. Review governing regulations and requirements for insurance, certificates, and inspection and testing procedures, as applicable.

C. Contractor shall record discussion, including agreement or disagreement on significant matters. Furnish copies of report to all parties present within 5 days after meeting date.
1. If substantial disagreements exist at conclusion of meeting, determine how disagreements will be resolved, and set date and time to reconvene meeting.

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Provide manufacturer's specifications, installation instructions and general recommendations for single ply membrane roofing materials for types of roofing required. Include data substantiating that materials comply with requirements.

C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, mechanical fastener layout, and paver location and layout.

D. Installer Certificates: Signed by roofing system manufacturer certifying Installer is approved, authorized, or licensed by manufacturer to install specified roofing system.

E. Qualification Data: Submit written information to establish installer qualifications, demonstrating capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information as required.

F. Inspection Report: Copy of report by roofing system manufacturer's representative stating roof system has been installed properly, has been satisfactorily completed, and is in conformance with manufacturers requirements.

G. Manufacturer's qualification statement.

H. Certification that Roofing System Manufacturer agrees to provide specified wind coverage with the warranty.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section with at least five years of documented experience and approved by manufacturer.

D. Performance Certification: Provide written statement from single ply membrane roofing system manufacturer stating he has reviewed the project requirements including drawings and specifications, and certifies his proposed system is suitable for the applications shown and is capable of successful performance for not less than the warranty period specified in this Section starting from the Date of Substantial Completion.

E. Weather Resistance: Single ply membrane roofing and associated work are required to be durable in normal weather exposure and not leak water.
1. After initial completion of roofing and associated work, and either during or immediately after a rain storm and before final acceptance of the work, Installer shall meet Contractor at project and inspect building for evidence of leaks in roofing and associated work.

2. Prepare written report without delay, covering inspection, and submit to Owner with copy to Architect.
3. The Installer (only) shall repair or replace roofing and associated work as required to eliminate leaks or other inability of roofing to initially withstand normal weather exposure.
4. Abnormal weather exposure is recognized to include hailstorms, lightning strikes, hurricane and tornadic winds, and other unusual phenomena of weather (as frequently covered by high protection risk insurance).

F. Insurance (and Code) Requirements: Install single ply membrane roofing to comply with insurance and Code requirements as follows, as necessary for Owner to obtain fire and extended coverage in accordance with currently published insurance specifications.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact, unless otherwise indicated.

B. Store materials in weather protected environment, clear of ground and moisture.

C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

D. Protect foam insulation from direct exposure to sunlight.

1.08 FIELD CONDITIONS

A. Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements.

B. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.09 WARRANTY

A. Comply with all warranty procedures required by manufacturer, including notifications, scheduling, and inspections.

B. Contractor's Guarantee: Correct defective Work within a two year period after Date of Substantial Completion.

C. System Warranty: Manufacturer's Warranty covering membrane, roof insulation, and other indicated components of the system, for the term indicated.
1. Limit of Liability: No dollar limitation.
2. Warranty Term: 20 years.
3. Scope of Coverage: Repair leaks in the roofing system caused by:
   a. Ordinary wear and tear of the elements.
   b. Unintentional damage due to normal rooftop inspections, maintenance, or service.
   c. Manufacturing defect in materials.
   d. Defective workmanship used to install these materials.
   e. Damage due to winds up to and including 90 mph.
   f. Hail up to 2 inches in diameter.
4. Include roof edge metal in the roof manufacturer's system warranty. Refer to Section 07 7100 - Roof Specialtiesfor edge metal.
5. For repair and replacement include costs of both material and labor in warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermoplastic Polyolefin (TPO) Membrane Materials:
1. Carlisle SynTec Systems; Sure-Weld TPO: www.carlisle-syntec.com/#sle.
2. Elevate; UltraPly TPO Membrane: www.holcimelevate.com/#sle.
3. GAF; EverGuard TPO: www.gaf.com/#sle.
4. Johns Manville: www.jm.com/#sle.

B. Insulation:
   1. Single Ply membrane manufacturer or products approved as part of their warranted system.

2.02 ROOFING

A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over insulation.
   1. Slope: Deck is sloped; provide additional slope of 1/4 inch per foot by means of tapered insulation at roof drains.
   2. Deck Type: Metal
   3. Minimum R-Value: 30; Provide a minimum of two layers of insulation of thickness required to achieve R-value or greater thickness as indicated on Drawings in a minimum of two layers.Averaging of high and low points is not permitted.

B. Additional Roofing Assembly Requirements:
   1. Refer to Structural Drawings for wind uplift requirements.
   2. Solar Reflectance Index (SRI): 78, minimum, calculated in accordance with ASTM E1980.
      a. Field applied coating may not be used to achieve specified SRI.
   3. Roof Covering External Fire Resistance Classification: UL (FRD) Class A.

C. Acceptable Insulation Types: Polyisocyanurate Board

2.03 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

A. Membrane Roofing Materials:
   1. TPO: Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M, sheet contains reinforcing fabrics or scrims.
      a. Thickness: 60 mil, 0.060 inch, minimum.
   2. Sheet Width: Factory fabricated into widest possible sheets.
   3. Color: White.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Vapor Retarder: Self-healing, self-adhering modified bitumen vapor retarder, minimum 30 mils, complying with requirements of fire rating classification, complying with requirements of fire rating classification; compatible with roofing and insulation materials.
   1. Vapor Permeability: 0.01 perm inch, measured in accordance with ASTM E96/E96M.
   2. Primer: Provide manufacturer's recommended primer for adhering vapor retarder to concrete substrate.
   3. Products:
      a. Carlisle Syntec; VapAir Seal 725TR
      b. Firestone Building Products; V-Force
      c. Johns-Manville; JM Vapor Barrier SAR
      d. GAF; GAF SA Vapor Retarder XL: www.gaf.com/#sle.

D. Flexible Flashing Material: Same material as membrane.

2.04 COVER BOARDS

A. Cover Boards: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
   1. Thickness: 5/8 inch, Type X, fire-resistant.
   2. Products:
      a. Georgia-Pacific; DensDeck: www.densdeck.com/#sle.

2.05 INSULATION

A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
   1. Classifications:
      a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
         1) Class 2 - Faced with coated polymer-bonded glass fiber mat facers on both major surfaces of core foam.

2) Compressive Strength: Classes 1-2-3, Grade 3 - 25 psi (172 kPa), minimum.
3) Thermal Resistance, R-value: At 1-1/2 inches thick; Class 2, 8.0 (1.41), minimum, at 75 degrees F.

2. Tapered Board: Slope as indicated; minimum thickness 1/2 inch; fabricate of fewest layers possible.
3. Board Edges: Square.

2.06 ACCESSORIES

A. Wood Nailers: Refer to Section 06 1000 - Rough Carpentry .

B. Cant and Edge Strips: Wood fiberboard, compatible with roofing materials; cants formed to 45 degree angle.

C. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.

D. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.

E. Membrane Adhesive: As recommended by membrane manufacturer.

F. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

G. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.

H. Insulation Adhesive: As recommended by insulation manufacturer.

I. Water Cut-Off Mastic: One component Butyl Rubber Mastic for compression seals.

J. Sealants: As recommended by membrane manufacturer.

K. Termination Bar: 1 inch wide, 26 gauge stainless steel bar pre-punched 8 inches on center which incorporates a sealant ledge to support Lap Sealant and provide increased stability for membrane terminations

L. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
1. Composition: TPO.
2. Width:30 to 36 inches
3. Surface Color: Grey or Yellow, contrasting or otherwise visually distinctive from roof membrane..
4. Products:
a. Carlisle Syntec; Sureweld TPO Walkway Pads
b. Elevate;Ultraply TPO Walkway Pad
c. Johns Manville; JM TPO Safety Walkpad
d. GAF; TPO Walkway Roll.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips and nailing strips are in place.

3.02 INSTALLATION, GENERAL

A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.

B. Do not apply roofing membrane during cold or wet weather conditions.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

F. Coordinate this work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

G. Protect adjacent construction, property, vehicles, and persons from damage related to roofing work; repair or restore damage caused by roofing work.
   1. Protect from spills and overspray from bitumen, adhesives, sealants and coatings.
   2. Particularly protect metal, glass, plastic, and painted surfaces from bitumen, adhesives, and sealants within the range of wind-borne overspray.
   3. Protect finished areas of the roofing system from roofing related work traffic and traffic by other trades.

H. Until ready for use, keep materials in their original containers as labeled by the manufacturer.

I. Consult membrane manufacturer's instructions, container labels, and Material Safety Data Sheets (MSDS) for specific safety instructions. Keep all adhesives, sealants, primers and cleaning materials away from all sources of ignition.

3.03 INSULATION - UNDER MEMBRANE

A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
   1. Extend vapor retarder under cant strips and blocking to deck edge.
   2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.

B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.

C. Attachment of Insulation:
   1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.
   2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions; "walk-in" individual roof insulation boards to obtain maximum adhesive contact.

D. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions.

E. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.

F. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

G. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.

H. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

I. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.

J. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches.

3.04 COVER BOARD APPLICATION

A. Embed coverboard in a full bed of adhesive in accordance with roofing and coverboard manufacturers instructions. 'Walk-in' boards to obtain maximum adhesive contact.

3.05 INSTALLATION - MEMBRANE

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Fully Adhered Application: Bond membrane sheet to substrate using membrane manufacturer's recommended bonding material, application rate, and procedures.

D. Overlap edges and ends and seal seams by heat welding, minimum 3 inches. Seal permanently waterproof.

E. Provide sacrificial protection membrane underneath lightning protection rods, clamps and cables. Coordinate placement of these materials with Lightning Protection Installer. Coordinate with Lightning Protection Installer to ensure they use sealants compatible with roofing membrane.

F. Protection mat: Provide protection mat under all splash blocks, and other loose laid roof accessories.

3.06 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Inspection by Manufacturer: Provide final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer specifically to inspect installation for warranty purposes (i.e. not a sales person).

C. Perform all corrections necessary for issuance of warranty.

D. Final Inspection: Manufacturer’s Technical Representative shall inspect and issue a written report to Architect stating roofing system has been installed properly and in conformance to all warranty requirements.

3.07 CLEANING

A. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

B. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

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SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, exterior penetrations, fascias, and other items indicated in Schedule.

B. Sealants for joints within sheet metal fabrications.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2020.

B. ASTM B32 - Standard Specification for Solder Metal; 2020.

C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

E. CDA A4050 - Copper in Architecture - Handbook; current edition.

F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Schedule a pre-installation conference prior to start of flashing and associated work. Provide participants minimum 5 days notice prior to convening conference.
   1. Meet at the Project Site, or other mutually agreed location, with the following parties in attendance. Owner and Architect, may decline to attend at their discretion.
      a. Owner's Representative
      b. Architect.
      c. Contractor.
      d. Installer of flashing
      e. Installer of other envelope components being flashed
      f. Testing agency.
      g. Governing authorities.
      h. Installers of related work.
      i. Other parties concerned with performance of sheet metal flashing and trim system.

B. Review methods and procedures related to roofing and wall installation, including manufacturer's written instructions.

C. Contractor shall record discussion, including agreement or disagreement on significant matters. Furnish copies of report to all parties present within 5 days after meeting date.
   1. If substantial disagreements exist at conclusion of meeting, determine how disagreements will be resolved, and set date and time to reconvene meeting.

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Submit metal manufacturer's product specifications, installation instructions and general recommendations for flashing and trim applications.

C. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details. Show expansion joint details and waterproof connections to adjoining work and at obstructions and penetrations.

D. Samples for Initial Selection: Manufacturer's color charts showing full range of colors available.

E. Samples for Verification Purposes: Submit 12 inch square samples of specified metals to be exposed as flashing or trim.
   1. Submit 12 inch long samples of fabricated sheet metal products.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Fabricator and Installer Qualifications: Show expansion joint details and waterproof connections to adjoining work and at obstructions and penetrations.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

1.08 PROJECT CONDITIONS

A. Coordinate metal flashing and trim work with adjacent work including installation of stonework and stone veneer, roofing, drains, piping, blocking, nailers, reglets, framing at openings, curbs and parapets.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper

B. Stainless Steel: ASTM A666, Type 304 alloy, soft temper; smooth No. 4 - Brushed finish.

2.02 PREFINISHED ALUMINUM SHEETS

A. Description: Factory-applied topcoat systems applied to aluminum flat sheet substrates prior to fabrication by coil coating; topcoat systems consist of primers and organic topcoats on exposed side and backing coats on unexposed side.

B. Aluminum Sheet Substrates: ASTM B209/B209M, alloy and temper as recommended by manufacturer for application.

C. Superior Performance Organic Coating System: Comply with AAMA 2605 for aluminum preparation, pretreatment, primer and finish coat system; provide thermally cured 70-percent PVDF fluoropolymer systems; tested for weathering for 10 years with 5 delta units color change maximum.
   1. Clear Topcoat: Manufacturer's clear topcoat applied over finish coat system.

2.03 FABRICATION

A. Fabricate sheet metal flashing and trim to comply with details shown and requirements of SMACNA (ASMM).

B. Fabricate for waterproof and weather-resistant performance with expansion provisions for running work sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates. Comply with material manufacturer's instructions and recommendations for forming material.

C. Form sections true to shape, accurate in size, square, and free from distortion or defects.

D. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

E. Form pieces in longest possible lengths.

F. Hem exposed edges on underside 1/2 inch; miter and seam corners.

G. Form non-moving seams in material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

1. Where seamed material is aluminum, rivet joints for additional strength.
2. Expansion Provisions: Where lapped or bayonet-type expansion provisions in work cannot be used or would not sufficiently water-weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
3. Space movement joints a maximum 10 feet o.c.
4. No joints shall be permitted within 24 inches of corners or intersections.

H. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.

I. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

J. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

K. Sealant Joints: Where moveable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant in compliance with SMACNA (ASMM) standards.

L. Separation: Provide for separation of metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

M. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not permitted on faces of sheet metal exposed to view.

N. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.
1. Size: As recommended by SMACNA (ASMM) or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.04 SHEET METAL FABRICATIONS

A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.

B. Base Flashing, where exposed to view:
1. Material: Pre-finished Aluminum
2. Thickness: Minimum, 0.040 inches .

C. Counterflashing:
1. Material: Pre-finished Aluminum
2. Thickness: Minimum, 0.040 inches .

D. Flashing receivers: Match material of flashing being received.
1. Pre-finished Aluminum: Minimum 0.040 inch.

E. Bent Metal Plate:
1. Material: Pre-finished Aluminum
2. Thickness: Minimum, 0.063 inches.

F. Through Wall Flashing: provide materials and thickness indicated in Division 04 Sections. Fabricate flashings in accordance with the requirements of this section and requirements indicated in Division 04 Sections.

G. Equipment Support Flashing:
1. Material: Stainless steel
2. Thickness: Minimum, 0.025 inches

H. Roof Penetration Flashing:
1. Material: Stainless steel
2. Thickness: Minimum, 0.025 inches

2.05 ACCESSORIES

A. Fasteners: Same material and finish as flashing metal, as recommended by manufacturer of flashing sheet for improved corrosion resistance, with soft neoprene washers.

B. Cleats: Same metal and gage as sheet being anchored 2 inches wide punched for 2 anchors.

C. Slip Sheet: 5 pound Rosin sized building paper.

D. Primer Type: Zinc chromate.

E. Protective Backing Paint: Zinc molybdate alkyd.

F. Concealed Sealants: Non-curing butyl sealant.

G. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material. Comply with Section 07 9200 - Joint Sealants.

H. Epoxy Seam Sealer: 2-part, noncorrosive, aluminum seam-cementing compound recommended by aluminum manufacturers for interior and exterior nonmoving joints, including riveted joints.

I. Adhesives: Type recommended by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.

J. Solder: ASTM B32; Sn50 (50/50) type, used with rosin flux.

K. Solder for Stainless Steel: ASTM B32; Sn50 (50/50) type, used with acid flux of type recommended by stainless steel sheet manufacturer; use a non-corrosive rosin flux over tinned surface.

L. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.

M. Touch up paint: Where prefinished metals are cut in the field, apply touch-up paint to all cut edges to maintain corrosion resistance.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which metal flashing and trim will be installed. Notify Contractor in writing of conditions detrimental to proper and timely completion of work.
   1. Do not proceed with installation until unsatisfactory conditions have been corrected in an acceptable manner.

B. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

C. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

A. SMACNA Details: Except as otherwise shown or specified, comply with applicable recommendations and details of SMACNA (ASMM).

B. Manufacturer's recommendations: Except as otherwise shown or specified, comply with recommendations and instructions of manufacturer of sheet metal being installed.

C. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2 inches (50 mm) and bed with sealant.

D. Equipment Support Flashing: Coordinate equipment support flashing installation with roofing and equipment installation. Weld or seal flashing to equipment support member.

E. Roof-Penetration Flashing: Coordinate roof-penetration flashing installation with roofing and installation of items penetrating roof. Install flashing as follows:
   1. Seal and clamp flashing to pipes penetrating roof, other than lead flashing on vent piping.

F. Roofing Cement Edges: Where compatible with roofing membrane, apply plastic cement compound between metal flashings and felt flashings. Seal edges of metal flashings to substrates with roofing cement; install bed or bead of cement in a manner which will maintain a watertight seal.

G. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

H. Install exposed sheet metal work without excessive oil canning, buckling, and tool marks, true to line and level. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-tight performance.

I. Separate dissimilar metals in area of contact with heavy application of bituminous coating or by other permanent separation, as recommended by manufacturers of dissimilar metals.

J. Expansion: Install work with provisions for thermal expansion of running trim, flashing, expansion joints and other items exposed for more than 15'-0" continuous length. Maintain a watertight installation at expansion seams. Locate expansion seams as shown, or if not shown, at the following maximum spacings for each general use:
   1. Flashing and Trim: At 10 foot intervals and 2 foot each side of corners and intersections.

K. Fabricate and install work with lines and corners of exposed units true and accurate. Form exposed faces flat and free of buckles, excessive waves and avoidable tool marks, considering temper and reflectively of metal. Provide uniform, neat seams with minimum exposure of solder, welds and sealant. Except as otherwise shown, fold back sheet metal to form hem on concealed side of exposed edges.

L. Conceal fasteners and expansion provisions where possible in exposed work, and locate so as to minimize possibility of leakage. Cover and seal work as required for a watertight installation.
   1. Provide cleat-type anchorages for metal flashing and trim where practical, arranged to relieve stresses from building movement and thermal expansion.

M. Sealed Joints: Form nonexpansion, but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA (ASMM) standards. Fill joint with sealant and form metal to completely conceal joint.

N. Seams: Fabricate nonmoving seams in sheet metal, other than aluminum, with flatlock seams. Tin edges to be seamed, form seams, and solder.

O. Seams: Fabricate nonmoving joints in aluminum with flat lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

P. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except where pretinned surface would show in finished Work.
   1. Do not use solder on the following metals:
      a. Aluminum.
   2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3. Solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.

3.04 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Advise Contractor of required procedures for surveillance and protection of completed flashing and trim. Furnish advice for period of installation of other work, and for remainder of construction period.

END OF SECTION

SECTION 07 7100 - ROOF SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Manufactured roof specialties, including copings, fascias, and gravel stops.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2020.

B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.

C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2020.

D. NRCA (RM) - The NRCA Roofing Manual; 2019.

E. SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems; 2011.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.

C. Samples: Submit two metal samples, 3 inch wide by 3 inch high, illustrating component shape, finish, and color.

1.05 WARRANTY

A. Total roofing system warranty: Edge metal is to be included as part of the Roofing Manufacturer's System Warranty. Refer to Section 07 5400 - Thermoplastic Membrane Roofing.

B. Finish Warranty: Provide 20-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Roof Edge Flashings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
   1. Configuration: Fascia, cant, and edge securement for roof membrane.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
   3. Exposed Face Height: As indicated on drawings.
   4. Fascia Cover Material: Formed aluminum sheet, 0.040 inch thick, minimum.
   5. Finish: 70 percent polyvinylidene fluoride (PVDF).
   6. Color: Custom color to match Architect's sample.
   7. Products:
      a. Hickman Edge Systems; TerminEdge Fascia: www.hickmanedgesystems.com/#sle.
      b. Carlisle Syntec Systems; SecureEdge Fascia.

c. Johns Manville; Presto-Tite Edge One Fascia System
d. Metal-Era; One Edge Fascia

B. Copings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness, and finish as cap; concealed stainless steel fasteners.
2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
3. Wall Width: As indicated on drawings.
4. Outside Face Height: As indicated on drawings.
5. Inside Face Height: As indicated on drawings.
6. Material: Formed aluminum sheet, 0.050 inch thick, minimum.
7. Finish: 70 percent polyvinylidene fluoride.
8. Color: Custom color to match Architect's sample.
9. Products:
a. Hickman Edge Systems; PermaSnap Premier Coping: www.hickmanedgesystems.com/#sle.
b. Carlisle Syntec Systems; Secure Edge Coping
c. Metal-Era Inc; Perma-Tite: www.metalera.com/#sle.
d. Johns Manville; Presto Lock

2.02 FINISHES

A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

2.03 ACCESSORIES

A. General: Provide manufacturer's standard accessories designed and manufactured to match and fit roof edge treatment system indicated.

B. Concealed Fasteners: Same metal as item fastened or other noncorrosive metal as recommended by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

B. Seal joints within components when required by component manufacturer.

C. Anchor components securely to structural substrates to withstand lateral and thermal stresses and inward and outward loading pressures.

D. Coordinate installation of components of this section with installation of roofing membrane and base flashings, vapor retarders, air barriers, roofing insulation, roofing membrane, flashing, and wall construction, as required to ensure each element of the Work performs properly and combined elements are waterproof and weathertight..

E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

F. Coordinate installation of flashing flanges into reglets.

G. Isolation: Where metal surfaces of units contact dissimilar metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces or provide other permanent separation as recommended by aluminum producer.

H. Expansion Provisions: Install running lengths to allow controlled expansion for movement of metal components in relation not only to one another but also to adjoining dissimilar materials, including flashing and roofing membrane materials, in manner sufficient to prevent water leakage, deformation, or damage.

3.03 CLEANING AND PROTECTING

A. Clean exposed metal surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

B. Protection: Provide protective measures as required to ensure work will be without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 07 7123 - MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pre-finished aluminum gutters and downspouts.

1.02 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2020.

B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

1.03 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples for submittal procedures.

B. Product Data: Provide data on prefabricated components.

C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.

D. Samples: Submit two samples, 6 inch long illustrating component design, finish, color, and configuration.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.

B. Prevent contact with materials that could cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Gutters and Downspouts:
   1. Drexel Metals Inc: www.drexmet.com/#sle.
   2. Hickman Edge Systems: www.hickmanedgesystems.com/#sle.
   3. Metal-Era Inc: www.metalera.com/#sle.

2.02 MATERIALS

A. Pre-Finished Aluminum Sheet: ASTM B209/B209M; 0.032 inch thick.
   1. Finish: Plain, shop pre-coated with polyvinylidene fluoride (PVDF) coating.
   2. Color: As indicated.

2.03 COMPONENTS

A. Gutters: SMACNA rectangular style profile.

B. Downspouts: SMACNA rectangular profile.

C. Anchors and Supports: Profiled to suit gutters and downspouts.
   1. Anchoring Devices: In accordance with SMACNA requirements.
   2. Gutter Supports: Brackets.
   3. Downspout Supports: Brackets.

D. Fasteners: Galvanized steel, with soft neoprene washers.

2.04 FABRICATION

A. Form gutters and downspouts of profiles and size indicated.

B. Fabricate with required connection pieces.

C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.

D. Hem exposed edges of metal.

E. Fabricate gutter and downspout accessories; seal watertight.

2.05 FINISHES

A. Fluoropolymer Coating: Superior Performance Organic Finish, AAMA 2605, multiple coat, thermally cured fluoropolymer finish system; color as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work.

3.02 PREPARATION

A. Paint concealed sheet metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.

B. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.

C. Connect downspouts to storm sewer system. Seal connection watertight.

END OF SECTION

SECTION 07 8600 - FIRESTOPPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Non-fire rated smoke tight air and vapor seals.

1.03 REFERENCE STANDARDS

A. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

C. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2020.

D. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

E. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).

F. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.

G. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020a.

H. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2023b.

I. ITS (DIR) - Directory of Listed Products; Current Edition.

J. FM 4991 - Approval Standard of Firestop Contractors; 2013.

K. FM (AG) - FM Approval Guide; current edition.

L. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

M. UL (DIR) - Online Certifications Directory; Current Edition.

N. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance ratings, limitations, and design sheet issued by approved testing agency or engineering judgement as applicable.
   1. Submit all components of tested assemblies at the same time to Architect for Review. Coordinate with submissions under other Sections including those containing wall insulation, perimeter and floorline firestopping, weather barriers, and metal composite material.
   2. Identify intended products and applicable UL (FRD), FM (AG), or ITS (DIR) Design No.
   3. Submit UL (FRD), FM (AG), or ITS (DIR) Design documentation.
   4. Provide engineering judgements for as built and existing conditions that deviate from UL (FRD), FM (AG), or ITS (DIR) listed assemblies. Use of Engineering Judgements are subject to approval by Authority Having Jurisdiction.

C. Shop Drawings: Show materials, installation methods, and relationships to adjacent construction for each through fire-penetration fire stop system, each type of construction condition penetrated, each type of penetrating item; and each fire resistive joint system.

1. SUBMIT SHOP DRAWINGS FOR EACH SPECIFIC INSTALLATION CONDITION. Identify intended products and applicable UL (FRD), FM (AG), or ITS (DIR) Design No. with documentation
2. Where Project conditions require modification of a qualified testing and inspection agency's system to suit a particular firestop condition, submit illustration, with modifications marked, approved by firestop system manufacturer's fire-protection engineer.

D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and capable of providing technical/consulting services during construction.

B. Installer Qualifications: Company specializing in performing the work of this section and:
1. Any of the following:
a. Recognized as a Qualified Contractor in compliance with requirements of UL (DIR) Solutions Qualified Firestop Contractor Program.
b. Approved by Factory Mutual Research Corporation under FM 4991.
c. Trained and accredited by the manufacturer. Certification program must consist of at minimum the following:
1) Minimum of one key responsible contact.
2) 9 month initial training period with regular program audits to maintain certification.
3) Field Audits by Manufacturer.

C. UL Design Numbers: Where UL Design numbers are cited in the Contract Documents the Contractor can obtain the specific information for each UL Design from the following web site and or/purchase a copy of the UL Fire Resistance Directory directly from Underwriters Laboratories. http://productspec.ul.com

D. Single-Source Responsibility: Obtain firestop systems for each kind of penetration and construction condition indicated from a single manufacturer.

E. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy".

1.06 PRE-INSTALLATION MEETING

A. Schedule a pre-installation conference minimum two weeks prior to start of seal installation and associated work.
1. Meet at the Project Site with the following parties in attendance. Owner and Architect, may decline to attend at their discretion.
a. Owner's Representative.
b. Architect.
c. Contractor.
d. Air and Smoke seal Contractor.
e. Air and Smoke seal Manufacturer's Technical Representative.
f. Installers of associated work, including architectural, mechanical, electrical, and communications trades work.
g. Other parties concerned with performance of firestopping, including authorities having jurisdiction.
2. Review submittals for each specific condition.
3. Review each application for specific Air and Smoke seal material and installation method per a UL (FRD), FM (AG), or ITS (DIR) System.

4. Tour representative areas where firestopping is to be installed.
    a. Inspect and discuss each type of condition and each type of substrate to be encountered.
    b. Discuss preparation work required to be performed by other trades and schedule.

B. Contractor shall record discussion, including agreement or disagreement on significant matters. Furnish copies of report to all parties present within 5 days after meeting date.
1. If substantial disagreements exist at conclusion of meeting, determine how disagreements will be resolved, and set date and time to reconvene meeting.

1.07 FIELD CONDITIONS

A. Comply with Air and Smoke seal manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

1.08 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure designated through-penetration firestop systems are installed per specified requirements.

B. Coordinate construction of Air and Smoke seal system installations to ensure that designated Air and Smoke seal systems are installed per specified requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements provide Basis of Design products or comparable products by one of the following:
1. Fire Shield, LLC: www.fireshieldlv.com/#sle.
2. Hilti, Inc: www.us.hilti.com/#sle.
3. Passive Fire Protection Partners: www.firestop.com/#sle.
4. RectorSeal, a CSW Industrials Company: www.rectorseal.com/firestop-solutions/#sle.
5. Specified Technologies Inc: www.stifirestop.com/#sle.

2.02 GENERAL REQUIREMENTS

A. Prohibited Materials: Do not use the following:
1. At CPVC Pipes do not use 3M CP25WB+ or 3M Fire Dam 150+. Per manufacturers information these products are NOT compatible with CPVC.
2. Do not use any firestopping materials that when in contact with CPVC pipes , fittings and adhesives joining CPVC components, will cause degradation of the piping and or piping joints. If such materials come in contact with the CPVC pipes, fittings and adhesives any costs associated with the replacement of such are the Contractor's responsibility.

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.03 NON-RATED AIR AND SMOKE TIGHT SEAL

A. Locations: Provide at underside of parapet wall cavities and other locations as indicated on Drawings
1. Products:
    a. Hilti; Light (CP572)
    b. Rectorseal; Metacaulk SAS Smoke and Acoustic Spray
    c. STI; SpecSeal Smoke ‘N’ Sound Spray
2. Provide mineral wool filler and plugs as required to fill voids in order to provide suitable substrate for application of air seal. Refer to safing insulation article for requirements.

2.04 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION

A. Blank Openings:
   1. In Concrete Floors Less than or equal to 5 inches thick or Concrete/CMU Walls less than or equal to 8 inches thick:
      a. Up to 3 Hour Construction (3 hour F and 3 hour T) (Mortar): UL System C-AJ-0015; Specified Technologies Inc. SSM mortar.
      b. 3 Hour Construction (3 hour F and 2 Hour T) (Pillows): UL System C-AJ-0061; Specified Technologies Inc. SSB Intumescent Firestop pillows.
      c. 3 Hour Construction (Up to 4 hour F and 0 hour T) (composite board): UL System C-AJ-0113; Specified Technologies Inc. Composite Sheet.
      d. Up to 3 hour Construction (3 hour F and 0 & 1/2 hour T) (Mortar): UL System C-AJ-8108; Rectorseal; Metacaulk Mortar
      e. Up to 3 hour Construction (3 hour F and 1 hour T) (Pillows): UL System C-AJ-1367; Rectorseal; Metacaulk Pillows and Metacaulk 1000
      f. Up to 3 hour Construction (2 & 4 hour F and 0 & 2 hour T) (Composite board): UL System C-AJ-8121; Rectorseal; Metacaulk Fire rated putty, Metacaulk Composite Sheet, Metacaulk Wrap Strip, Metacaulk 1000.
      g. Up to 4 hour Construction (4 hour F and 4 hour T) (Mortar): UL System C-AJ-0081; Hilti CP637 Mortar
      h. Up to 2 Hour Construction (2 hour F and 2 hour T) (Board): UL System C-AJ-0105; Hilti CP675T Firestop board.
      i. Up to 2 Hour Construction (2 hour F and 1 hour T) (Blocks and caulk): UL System C-AJ-0138; Hilti CFS-BL Firestop block with FS-ONE Sealant, FS-ONE MAX Intumescent Sealant, or CP618 Putty Stick
   2. In Concrete or CMU Walls greater than 8 inches thick:
      a. Up to 2 hour Construction (2 hour F and 2 hour T) (block): UL System C-AJ-0022; Hilti CFS-BL Firestop Block

B. Penetrations Through Floors or Walls By:
   1. Multiple metal or cable Penetrations in Large Openings:
      a. Up to 2 Hour Construction (2 hour F and 0 hour T)(Caulk): UL System C-AJ-8138; Rectorseal; Metacaulk MC 150+
      b. Up to 3 Hour Construction (3 hour F and 0 hour T)(Caulk): UL System C-AJ-8099; Hilti FS-ONE MAX Intumescent Firestop Sealant.
      c. Up to 3 Hour Construction (3 hour F and 0 hour T) (Caulk): UL System C-AJ-8110; Hilti CFS-BL Firestop Block with FS ONE Sealant, FS-ONE MAX Intumescent Sealant, CP618 Firestop Putty Stick, or CP 620 Firefoam
      d. Up to 2 Hour Construction (2 hour F, 0 hour T rating)(Caulk): UL System C-AJ-8143; Hilti FS-ONE MAX Intumescent Firestop Sealant. or FS-ONE Sealant
      e. Up to 2 Hour Construction (2 hour F and 0 to 2 hour T) (mortar): UL System C-AJ-8055; Specified Technologies Inc. product varies depending on penetrant - Refer to UL design.
   2. Uninsulated Metallic Pipe, Conduit, and Tubing:
      a. 3 Hour Construction (Up to 4 hour F and up to 3/4 hour T)(Caulk): UL System C-AJ-1079; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
      b. Up to 3 Hour Construction (3 hour F, 1/4 hour T)(Caulk): UL System C-AJ-1270; Rectorseal; Metacaulk MC150+
      c. Up to 3 Hour Construction (3 hour F, 0 hour T)(Caulk): UL System C-AJ-1248; Rectorseal; Metacaulk 835+.
      d. Up to 3 Hour Construction (3 hour F, 0 hour T)(Caulk): UL System C-AJ-1235; Rectorseal; Metacaulk MC150+.
      e. Up to 3 Hour Construction (3 hour F, 0 hour T)(Putty): UL System C-AJ-1200; Rectorseal; Metacaulk Putty Stick

f. Up to 2 Hour Construction (2 hour F, 0 hour T)(Caulk): UL System C-AJ-1115; Rectorseal; Metacaulk 835+
g. Up to 3 Hour Construction (3 hour F, 0 hour T)(Caulk): UL System C-AJ-1184; Hilti FS-ONE MAX Intumescent Firestop Sealant. or FS-ONE Sealant.
h. Up to 4 Hour Construction (4 hour F, 0 hour T), : UL System C-AJ-1215; Specified Technologies Inc. LC Endothermic Firestop Sealant.
i. Up to 3 Hour Construction (3 hour F, 0 hour T)(Caulk): UL System C-AJ-1226; Hilti FS-ONE MAX Intumescent Firestop Sealant. or FS-ONE Sealant
j. Up to 3 Hour Construction (3 Hour F, 2-3/4 hour T) (Caulk): UL System C-AJ-1597; Hilti FS-ONE MAX Intumescent Firestop Sealant, FS-ONE Sealant, CFS-S-SIL-GG, or CFS-S-SIL SL Sealant (floors only)

3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
   a. Up to 3 Hour Construction (3 hour F and 0 hour T) (device): UL System C-AJ-2106; Specified Technologies Inc. SSW wrap strips.
   b. Up to 3 Hour Construction for pipes 6 inches or smaller (3 hour F and 2-1/2 hour T - (Device and Mortar): UL System C-AJ-2269; Rectorseal; Metacaulk Pipe Collar and Metacaulk Fire Rated Mortar.
   c. Up to 3 Hour Construction for pipes 8 inches or smaller (3 hour F and 1-1/2 hour T - (caulk and wrap strip): UL System C-AJ-2265; Rectorseal; Metacaulk Wrap Strip and Metacaulk 1000
   d. Up to 2 Hour Construction (2 hour F,1-1/4 hour T)(Caulk): UL System C-AJ-2047; Rectorseal; Metacaulk wrap strip and Metacaulk 1000
   e. Up to 3 Hour Construction for pipes 6 inches or smaller. 2 hour for PVC & CPVC pipes larger than 6 inches (2 or 3 hour F and 0,2 or 3 hour T - dependent on materials) Refer to UL Design (Device and Caulk): UL System C-AJ-2109; Hilti CP 643N/644 Firestop Collar and FS-ONE MAX Intumescent Firestop Sealant, FS-ONE Sealant, CFS-S-SIL-GG, or CFS-S-SIL SL Sealant (floors only).
   f. Up to 2 Hour Construction for 2 inch or smaller pipes (2 hour F, 0, 1.25 and 2 hour T dependent on materials) Refer to UL Design (Caulk): UL System C-AJ-2567; Hilti FS-ONE MAX Intumescent Firestop Sealant, FS-ONE Sealant, CFS-S-SIL-GG, or CFS-S-SIL SL Sealant (floors only)
   g. Up to 2 Hour Construction (2hour F, 0 hour T) (Caulk): UL System C-AJ-2167; Hilti FS-ONE MAX Intumescent Firestop Sealant.

4. Electrical Cables Not In Conduit:
   a. Up to 3 Hour Construction (3 hour F, 1/2 hour T) (Caulk): UL System C-AJ-3085; Specified Technologies Inc. LC Endothermic Firestop Sealant.
   b. Up to 3 Hour Construction (3 Hour F, 0, 1, 1-1/2 and 3 hour T dependent on materials) Refer to UL Design. (Device and Caulk): UL System C-AJ-3285; Hilti CP653 and FS-ONE MAX Intumescent Firestop Sealant, FS-ONE Sealant, CFS-S-SIL-GG, CFS-S-SIL SL Sealant (floors only), or CP606 Sealant
   c. Up to 3 Hour Construction (3 hour F, 0 hour T)(Caulk): UL System C-AJ-3208; Hilti CP 618 Firestop Putty Stick.
   d. Up to 3 Hour Construction (3 hour F, 1/2 Hour T) (device): UL System C-AJ-3231; Specified Technologies Inc. EZ-Path Series 33 Fire-Rated Pathway.
   e. Up to 2 Hour Construction (2 hour F, 0 and 1/2 hour T dependent on construction)(Caulk and plug) Refer to UL Design: UL System C-AJ-3216; Hilti CFS-PL Firestop Plug and CP 618 Firestop Putty Stick
   f. Up to 2 hour Construction (2 hour F, 2 Hour T) (Device, Caulk and wrap): UL System C-AJ-3298; Hilti CP 653 Series and FS-ONE Sealant or FS-ONE MAX Intumescent Sealant
   g. Up to 2 hour Construction (2 hour F, 1/2 Hour T) (Device): UL System C-AJ-3290; Rectorseal; Metacaulk Pipe Collar
   h. Up to 3 hour Construction (3 hour F, 1 Hour T) (Putty): UL System C-AJ-3101; Rectorseal; Metacaulk Fire Rated Putty

5. Cable Trays with Electrical Cables:
   a. 3 Hour Construction (Up to 2 hour F, 0 hour T) (putty and Pillows): UL System C-AJ-4029; Specified Technologies Inc. SSB Intumescent Firestop Pillows.
   b. Up to 4 Hour Construction (4 hour F, 0 hour T) (pillows & caulk): UL System C-AJ-4049; Rectorseal; Metacaulk 1000 and Metacaulk pillows.
   c. Up to 3 Hour Construction (3 hour F, 0 hour T) (Blocks and caulk): UL System C-AJ-4093; Hilti CFS-BL Firestop Block with FS-ONE Sealant, FS-ONE MAX Intumescent Sealant, or CP 618 Firestop Putty.
   d. Up to 2 Hour Construction (2 hour F , 0 hour T) (Blocks and caulk): UL System C-AJ-4094; Hilti CFS-BL Firestop Block with FS-ONE Sealant, FS-ONE MAX Intumescent Sealant, CP 618 Firestop Putty, CP 620 Fire Foam, or CP 660 Firestop Foam.
   e. Up to 2 hour Construction (2 hour F, 0 hour T) (Caulk): UL System C-AJ-4071; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant
6. Electrical Busways:
   a. Up to 3 Hour Construction (3 hour F, 0 hour T) (Caulk): UL System C-AJ-6017; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.
   b. Up to 2 Hour Construction (2 hour F, 0 hour T) (Caulk): UL System C-AJ-6042; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.
   c. Up to 3 Hour Construction (3 hour F, 0 hour T) (Caulk): UL System C-AJ-6008; Specified Technologies, Inc.; Spec Seal LCI Sealant.
7. Insulated Pipes:
   a. Up to 2 Hour Construction (2 hour F, 1 & 1-1/2 hour T)(Caulk and wrap strip): UL System C-AJ-5078; Rectorseal; Metacaulk 1000
   b. Up to 2 Hour Construction (2 hour F, 3/4 hour T)(Caulk): UL System C-AJ-5134; Rectorseal; Metacaulk 1000
   c. Up to 2 Hour Construction (2 hour F, 0 & 3/4 hour T)(Caulk): UL System C-AJ-5284; Rectorseal; Metacaulk 1000
   d. Up to 2 Hour Construction (2 hour F, 0 and 1 hour T) (Caulk): UL System C-AJ-5091; Hilti FS-ONE IMAX intumescent Firestop Sealant.
   e. 2 Hour Construction (2 hour F, 3/4 and 1 hour T) (Caulk) : UL System C-AJ-5138; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
   f. 2 Hour Construction (2 hour F, 1 hour T) (Caulk): UL System C-AJ-5313; Specified Technologies Inc. LC Endothermic Firestop Sealant.
   g. Up to 2 Hour Construction (2 hour F, 2 hour T)(Caulk and wrap strip): UL System C-AJ-5320; Hilti FS-One Sealant or FS-One MAX Intumescent Sealant and CP-648E Wrap Strip.
   h. Up to 3 Hour Construction (3 hour F, 3 hour T)(Device): UL System F-A-5018; Hilti CP 680 Series
8. HVAC Ducts, Uninsulated and Insulated:
   a. Up to 2 Hour Construction (2 hour F, 0 hour T) (Caulk): UL System C-AJ-7111; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.
   b. Up to 2 hour Construction (2 hour F, 0 hour T) (Caulk): UL System C-AJ-7084; Hilti FS-ONE Sealant, FS-ONE MAX Intumescent Sealant, CP606 Flexible firestop sealant, CP 601S Elastomeric Firestop sealant, CFS-S SIL GG Sealant, or CFS-S-SIL SL Sealant (Floors Only)
   c. Up to 2 Hour Construction (2 hour F, 1-3/4 hour T) (Caulk): UL System C-AJ-7145; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant
   d. Up to 2 Hour Construction (2 hour F, 0 hour T) (Caulk): UL System C-AJ-7154; Hilti CFS-S SIL GG or CFS-S SIL SL (floors only)
   e. Up to 3 Hour Construction (2 hour F, 1 hour T) (Caulk): UL System C-AJ-7051; Hilti FS-ONE Sealant, FS-ONE MAX Intumescent Sealant, or CP606 Flexible firestop sealant.
   f. Up to 2 hour Construction (2 hour F, 3/4 hour T) (Caulk): UL System C-AJ-7143; Specified Technologies, Inc.; Spec Seal LCI Sealant.

g. Up to 2 hour Construction (3 hour F, 0 and 1/4 hour T) (Caulk): UL System C-AJ-7023; Specified Technologies, Inc.; Spec Seal LCI Sealant.

C. Penetrations Through Walls or Floors greater than 5 inches thick by:
1. Multiple metal or cable Penetrations in Large Openings:
a. Up to 2 Hour Construction (2 hour F, 1/2 hour T rating)(Caulk): UL System C-BJ-8024; Hilti FS-ONE MAX Intumescent Firestop Sealant or FS-ONE Sealant
b. Up to 2 Hour Construction (2 hour F, 0 hour T rating)(Mortar): UL System C-BJ-1049; Hilti CP 637
c. Up to 4 Hour Construction (4 Hour F, 1/2 hour T rating) (Composite Sheet): UL System C-BJ-3034; Specified Technologies; Spec Seal LCI Sealant and Spec Seal Composite Sheet
2. Uninsulated Metallic Pipe, Conduit, and Tubing:
a. Up to 3 Hour Construction (3 hour F, 3 hour T)(Caulk): UL System C-BJ-1059; Hilti FS-ONE MAX Intumescent Firestop Sealant. or FS-ONE Sealant.
b. Up to 2 Hour Construction (2 Hour F, 2 Hour T) (Caulk): UL System C-BJ-1047; Hilti CP 620 Fire Foam
c. Up to 2 Hour Construction (2 Hour F, 2 Hour T) (Caulk): UL System C-BJ-1055; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant
d. Up to 2 Hour Construction (2 hour F, 0 hour T) (Caulk): UL System C-BJ-1058; Specified Technologies, Inc.; Spec Seal SIL Silicone Firestop Sealant
3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
a. Up to 3 hour Construction refer to UL design for pipe sizes as they vary by material (4 hour F , 4 hour T)(Caulk and wrap strip): UL System C-BJ-2017; Hilti CP 648 and FS-ONE MAX Intumescent Firestop Sealant
b. Up to 2 Hour Construction refer to UL design for pipe sizes as they vary by material (2 hour F, 2 hour T) (Caulk): UL System C-BJ-2014; Hilti FS-ONE MAX Intumescent Firestop Sealant or FS-ONE Sealant
c. Up to 2 Hour Construction, refer to UL design for pipe sizes as they vary by material (2 hour F, 0 hour T) (Caulk): UL System C-BJ- 2046; Specified Technologies, Inc.; SpecSeal LCI Sealant
4. Electrical Cables Not In Conduit:
a. Up to 2 Hour Construction (2 hour F, 1/2 hour T)(Caulk) : UL System C-BJ-3024; Hilti FS-ONE Sealant
5. Cable Trays with Electrical Cables:
a. Up to 2 Hour Construction (2 hour F , 0, 1 and 1-1/2 hour T) (Blocks, putty and caulk): UL System C-BJ-4025; Hilti CFS-BL Firestop Block and CP 618 Firestop Putty with FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.
b. Up to 2 Hour Construction (2 hour F , 0 and 1-1/2 hour T) (Blocks, putty and caulk): UL System C-BJ-4026; Hilti CFS-BL Firestop Block, CP 618 Firestop Putty and FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.
6. Insulated Pipes:
a. Up to 2 Hour Construction 4 inch pipes or smaller (2 hour F, 1 hour T) (Caulk): UL System C-BJ-5013; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.
b. Up to 2 Hour Construction 2 inch pipes or smaller (2 hour F, 1-1/2 hour T)(Caulk): UL System C-BJ-5015; Hilti FS-One Sealant or FS-One MAX Intumescent Sealant.
c. Up to 3 Hour Construction 2 inch pipes or smaller (3 hour F, 1/2 hour T)(Caulk): UL System C-BJ-5018; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant
d. Up to 2 Hour Construction (2 hour F, 2 hour T) (Caulk): UL System C-BJ-1065; Specified Technologies, Inc.; Spec Seal LCI Sealant or Spec Seal SIL Silicone Sealant.
7. HVAC Ducts, Uninsulated and Insulated:
a. Up to 2 Hour Construction (3 hour F, 1/2 hour T) (Caulk): UL System C-BJ-7005; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.

D. Penetrations through Walls less than or equal to 8 inches thick by:
   1. Multiple metal or cable Penetrations in Large Openings:
      a. Up to 2 Hour Construction (2 hour F and 0 hour T) (Caulk): UL System C-AJ-8138; Rectorseal; MC 150+ or Metacaulk 1000
      b. Up to 2 Hour Construction (2 hour F, 1 hour T) (device and caulk): UL System C-AJ-8149; Rectorseal; Metacaulk Wrap Strip and either Metacaulk 1000 or Metacaulk 150+
      c. Up to 2 Hour Construction (2 hour F, 1 hour T) (device and caulk): UL System C-AJ-8151; Rectorseal; Metacaulk Wrap Strip and either Metacaulk 1000 or Metacaulk 150+
      d. Up to 3 Hour Construction (3 hour F and 0 hour T) (Caulk): UL System C-AJ-8110; Hilti CFS-BL Firestop Block with FS ONE Sealant, FS-ONE MAX Intumescent Sealant, CP618 Firestop Putty Stick, or CP 620 Firefoam
      e. Up to 2 Hour Construction (2 hour F, 0 hour T rating)(Caulk): UL System C-AJ-8143; Hilti FS-ONE MAX Intumescent Firestop Sealant. or FS-ONE Sealant
      f. Up to 2 hour Construction (2 Hour F, 0 hour T)(Device): UL System C-AJ-8148; Hilti FS-ONE MAX Intumescent Firestop Sealant. or FS-ONE Sealant
   2. Uninsulated Metallic Pipe, Conduit, and Tubing:
      a. Up to 2 hour Construction (2 hour F, 3/4 hour T) (Caulk): UL System W-J-1170; Rectorseal; Metacaulk MC 150+
      b. Up to 3 Hour Construction (3 hour F, 0 hour T) (caulk): UL System C-AJ-1263; Rectorseal; Metacaulk 1000
      c. Up to 3 Hour Construction (3 hour F, 2 and 3 hour T dependent on assembly) (caulk): UL System C-AJ-1601; Rectorseal; Metacaulk 1000
      d. Up to 3 Hour Construction (3 hour F, 1/4 hour T dependent on assembly) (caulk): UL System C-AJ-1038; Rectorseal; Metacaulk 950
      e. Up to 3 Hour Construction (3 hour F, 0 hour T)(Caulk): UL System C-AJ-1226; Hilti FS-ONE MAX Intumescent Firestop Sealant. or FS-ONE Sealant
      f. Up to 3 Hour Construction (3 Hour F, 2-3/4 hour T) (Caulk): UL System C-AJ-1597; Hilti FS-ONE MAX Intumescent Firestop Sealant, FS-ONE Sealant, or CFS-S-SIL-GG
      g. Up to 2 hour Construction (2 hour F, 0 hour T) (Caulk): UL System W-J-1168; Hilti CFS-S SIL GG
      h. Up to 2 hour Construction penetrant 3/4 inch or smaller (2 hour F, 2 hour T) (Device): UL System W-J-1248; Hilti CFS-D
   3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
      a. Up to 2 hour Construction (2 hour F, 1/2 hour T) (Caulk): UL System C-AJ-2490; Rectorseal; Metacaulk 1000 or Metacaulk 350i
      b. Up to 3 hour Construction (3 hour F, 1 & 1-1/2 hour T dependent on assembly) (Caulk): UL System C-AJ-2112; Rectorseal; Metacaulk 1000
      c. Up to 3 Hour Construction for pipes 6 inches or smaller. 2 hour for PVC & CPVC pipes larger than 6 inches (2 or 3 hour F and 0,2 or 3 hour T - dependent on materials) Refer to UL Design (Device and Caulk): UL System C-AJ-2109; Hilti CP 643N/644 Firestop Collar and FS-ONE MAX Intumescent Firestop Sealant, FS-ONE Sealant, or CFS-S-SIL-GG.
      d. Up to 2 Hour Construction for 2 inch or smaller pipes (2 hour F, 2 hour T) (Caulk): UL System W-J-2072; Hilti FS-ONE MAX Intumescent Firestop Sealant or FS-ONE Sealant
      e. Up to 2 Hour Construction for 2 inch or smaller pipes (2 hour F, 0, 1.25 and 2 hour T dependent on materials) Refer to UL Design (Caulk): UL System C-AJ-2567; Hilti FS-ONE MAX Intumescent Firestop Sealant, FS-ONE Sealant, or CFS-S-SIL-GG
   4. Electrical Cables Not In Conduit:
      a. Up to 3 hour construction (3 hour F, 1 hour T) (Caulk): UL System C-AJ-3101; Rectorseal; Metacaulk Fire Rated Putty

b. Up to 3 hour construction (3 hour F, 1/2 hour T) (Caulk): UL System C-AJ-3286; Rectorseal; Metacaulk MC 150+, Flamesafe FS900+, Metacaulk 350i or Metacaulk 1000
c. Up to 2 hour construction (2 hour F, 1-1/2 hour T) (Caulk): UL System C-AJ-3026; Rectorseal; Metacaulk 950
d. Up to 2 hour construction (2 hour F, 0 hour T) (Caulk): UL System C-AJ-3234; Rectorseal; Metacaulk MC 150+ or Flamesafe FS900+
e. Up to 3 hour construction (3 hour F, 0 hour T) (Caulk): UL System C-AJ-3208; Hilti CP618 Firestop Putty Stick
f. Up to 2 Hour Construction (2 hour F, 1/2 hour and 2 hour T) (Device): UL System W-J-3215; Hilti CFS D
g. Up to 2 hour construction (2 hour F, 1/2 hour T) (caulk): UL System C-AJ-3216; Hilti CP 618
h. Up to 2 hour construction (2 hour F, 0 hour T) (Caulk): UL System W-J-3060; Hilti CP601S Sealant, CP606 Sealant, CFS-S SIL GG Sealant, FS ONE Sealant, FS-ONE MAX Intumescent Sealant, or CP618 Putty
i. Up to 2 hour construction (3 hour F, 0, 1, 1-1/2, and 3 hour T depending on materials) Refer to UL Design: UL System C-AJ-3285; Hilti; CP601S Sealant, CP606 Sealant, CFS-S SIL GG Sealant, FS ONE Sealant, or FS-ONE MAX Intumescent Sealant

5. Cable Trays with Electrical Cables:
   a. Up to 3 Hour Construction 3 hour F, 0 hour T) (Blocks and caulk): UL System C-AJ-4093; Hilti CFS-BL Firestop Block with FS-ONE Sealant, FS-ONE MAX Intumescent Sealant, or CP 618 Firestop Putty.
   b. Up to 2 Hour Construction (2 hour F , 0 hour T) (Blocks and caulk): UL System C-AJ-4094; Hilti CFS-BL Firestop Block with FS-ONE Sealant, FS-ONE MAX Intumescent Sealant, CP 618 Firestop Putty, CP 620 Fire Foam, or CP 660 Firestop Foam.
   c. Up to 2 hour Construction (2 hour F, 0 hour T) (Caulk): UL System C-AJ-4071; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant
   d. Up to 2 Hour Construction (2 hour F, 3/4 hour T) (Device): UL System W-J-3098; Specified Technologies Inc. EZ-Path Series 33 Fire-Rated Pathway.
6. Insulated Pipes:
   a. Up to 1-1/2 Hour Construction (1-1/2 hour F, 3/4 hour T refer to UL Design): UL System C-AJ-5251; Rectorseal; Metacaulk Wrap Strip and one of the following: Metacaulk 1000, FlameSafe 900+, Metacaulk 350i, or Metacaulk MC150+
   b. Up to 2 Hour Construction (2 hour F, 0 and 3/4 hour T refer to UL Design): UL System C-AJ-5222; Rectorseal; Metacaulk 1000, FlameSafe 900+, Metacaulk 350i, or Metacaulk MC150+
   c. Up to 3 Hour Construction (3 hour F, 1 hour T refer to UL Design): UL System C-AJ-5283; Rectorseal; Metacaulk 1000, FlameSafe 900+, Metacaulk 350i, or Metacaulk MC150+
   d. Up to 3 hour construction (3 hour F, 1/2 hour T): UL System C-AJ-5061; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant
   e. Up to 2 Hour Construction (2 hour F, 0 and 1 hour T refer to UL Design): UL System C-AJ-5091; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.
   f. Up to 2 Hour Construction (2 hour F, 2 hour T)(Caulk and wrap strip): UL System C-AJ-5320; Hilti FS-One Sealant or FS-One MAX Intumescent Sealant and CP-648E Wrap Strip.
7. Electrical Busways:
   a. Up to 3 Hour Construction (3 hour F, 0 hour T) (Caulk): UL System C-AJ-6027; Rectorseal; Metacaulk MC150+
   b. Up to 3 Hour Construction (3 hour F, 0 hour T) (Caulk): UL System C-AJ-6017; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.
   c. Up to 2 Hour Construction (2 hour F, 0 hour T) (Caulk): UL System C-AJ-6042; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.

8. HVAC Ducts, Uninsulated and Insulated:
    a. Up to 3 Hour Construction (3 hour F, 0 hour T) (Caulk): UL System C-AJ-7088; Rectorseal; Metacaulk MC 150+ .
    b. Up to 3 Hour Construction (3 hour F, 1 hour T) (Caulk): UL System C-AJ-7051; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.
    c. Up to 2 hour Construction (2 hour F, 0 hour T) (Caulk): UL System C-AJ-7084; Hilti FS-ONE Sealant, FS-ONE MAX Intumescent Sealant, CP606 Flexible firestop sealant, CP 601S Elastomeric Firestop sealant, CFS-S SIL GG Sealant, or CFS-S-SIL SL Sealant (Floors Only)
    d. Up to 2 Hour Construction (2 hour F, 1-3/4 hour T) (Caulk): UL System C-AJ-7145; Hilti FS-ONE Sealant or FS-ONE MAX Intumescent Sealant
    e. Up to 2 Hour Construction (2 hour F, 0 hour T) (Caulk): UL System C-AJ-7154; Hilti CFS-S SIL GG
    f. Up to 2 Hour Construction (2 hour F, 0 hour T) (Caulk): UL System W-J-7109; Hilti FS-ONE Sealant, FS-ONE MAX Intumescent Sealant, or CP606 Flexible firestop sealant.

2.05 ACCESSORIES

A. Fill, Void, or Cavity Materials: Materials listed in UL (FRD) under Category XHHW.

B. Forming Materials: Materials listed in UL (FRD) under Category XHKU.

C. Safing Insulation: Mineral fibers formed into blankets, complying with ASTM C665, rated non-combustible by NFPA in accordance with ASTM E84, density not less than 4.0 lbs. per. cu. ft., fire resistant in accordance with ASTM E119, formulated for fire containment at floor perimeters.
    1. Safing Clips: Galvanized steel safing clips approved by safing insulation manufacturer for holding insulation in place.
    2. Caulking Compound: Material approved by safing insulation manufacturer for sealing joint between foil backing of safing insulation and edge of adjacent construction against penetration of smoke.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 CONDITIONS REQUIRING FIRESTOPPING

A. Provide firestopping for conditions specified whether or not firestopping is indicated, and if indicated, whether such material is designated as insulation, safing, or otherwise.
    1. Insulation types specified in other Sections shall not be installed in lieu of firestopping material specified herein.

B. Exterior Building Perimeters: Where exterior face construction is continuous past a structural floor, and a space remains open between the inner face of the wall construction and the outer perimeter edge of the structural floor, provide firestopping to equal the fire resistance of the floor assembly.
    1. Safing insulation by itself is not an acceptable firestop, nor is safing insulation with beads of caulk applied along the length of the curtainwall and/or floor slab junctures. If the safing insulation is part of the firestop system, the safing insulation must be completely covered by the appropriate thickness of Firestop Sealant Material for the listed Firestop System.

C. Provide firestopping to fill miscellaneous voids and openings in fire-rated construction in manner essentially the same as specified herein before.

3.03 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Surface Cleaning: Clean out penetrations, openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:
   1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of Air and Smoke seal.
   2. Clean opening and joint substrates and penetrating items to produce clean, sound, and dry surfaces capable of developing optimum bond with Air and Smoke seal. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form release agents from concrete.
   4. Remove incompatible materials that could adversely affect bond.

C. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

D. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing the firestoppings seal with substrates.

E. Install backing materials to prevent liquid material from leakage.

3.04 INSTALLATION, GENERAL

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Install labeling required by code.

3.05 INSTALLATION - FORMING, PACKING, OR BACKING MATERIALS

A. Install forming, packing, or backing materials in accordance with manufacturer's instructions to come in contact with and adhere to penetrating item and substrate, to support fill materials during their application and in position required to produce cross-sectional shapes and depths required to maintain fire assemblies per firestop system.

B. Remove or leave in place in accordance with firestop system.

3.06 INSTALLATION - FILL, VOID OR CAVITY MATERIALS

A. Install fill, void, or cavity materials in accordance with manufacturer's instructions, to come in contact with, and adhere to substrates to maintain fire separations per firestop listing.

B. For fill materials exposed to view, finish to a smooth, uniform surface flush with adjacent construction.

3.07 INSTALLATION - OTHER COMPONENTS

A. Install other components, like cover plates, retainers, fitting, etc., in accordance with manufacturer's instructions, to maintain fire separations, per fires listing.

3.08 RESPONSIBILITY

A. Contractor is responsible to select a system, or combination of systems which, when installed, will maintain required fire separation between building elements.

B. System must provide the fire (F) rating, temperature (T) rating and/or air leakage rating (L) as required by applicable codes.

C. Perform patching and repair of firestopping systems damaged by other trades.

3.09 FIELD QUALITY CONTROL

A. Keep areas of firestopping work accessible and notify authorities having jurisdiction, or other designated inspectors, of work completion and ready for final inspection.
   1. If deficiencies are found, repair, or replace fire resistive joint to comply with system requirements and authorities having jurisdiction.

3.10 CODE REQUIRED TESTING AND INSPECTION

A. Inspect through penetrations, membrane penetration firestops, and fire resistant joint systems by and approved testing agency in accordance with ASTM E2174 and ASTM E2393.

B. By code an approve agency must be objective, competent and independent from the contractor responsible for the work being inspected.

3.11 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.12 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 9200 - JOINT SEALANTS

JOINT SEALANTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Joint backings and accessories.

1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).

B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018.

C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, with indication where each product is being used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Substrates for which use of primer is required.
   6. Backing material recommended by sealant manufacturer.

C. Samples: Manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section and with at least five years of documented experience and approved by manufacturer.

B. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Stain Testing: In accordance with ASTM C1248.
   4. Allow sufficient time for testing to avoid delaying the work.
   5. Deliver sufficient samples to manufacturer for testing.
   6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

1.06 PROJECT CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

B. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40 degF.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Joint Width Conditions: Do not proceed with installation of joint sealant when joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealant until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints:
      a. Seal open joints, whether or not the joint is indicated on Drawings, unless specifically indicated as not sealed.
      b. Exterior joints to be sealed include, but are not limited to, the following items:
         1) Expansion and control joints.
         2) Joints between doors, windows, and other frames or adjacent construction.
         3) Joints between different exposed materials.
   2. Interior Joints:
      a. Do not seal interior joints indicated on drawings as not sealed.
      b. Do not seal gaps and openings in suspended ceilings
      c. Interior joints to be sealed include, but are not limited to, the following
         1) Joints between door frames, window frames, and other frames and adjacent construction.
         2) In sound rated wall and ceiling assemblies:
            (a) Seal gaps at electrical outlets, wiring devices, piping penetrations, and other openings.
            (b) Seal joints between wall assemblies and ceiling assemblies; between wall assemblies and other construction; between ceiling assemblies and other construction.
         3) Control and expansion joints.
         4) Plumbing fixtures.
         5) Countertops.
         6) Equipment.
         7) Joints in flooring materials, as indicated and required.
         8) Isolation joints between structure and other elements.
         9) Acoustic and other types of separation joints.
   3. Do Not Seal:
      a. Intentional weep holes in masonry.
      b. Joints indicated to be covered with expansion joint cover assemblies.
      c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      d. Joints where installation of sealant is specified in another section.

e. Joints between suspended panel ceilings/grid and walls.
f. Weep holes in window, storefront or curtainwall systems.
g. Vents in soffits, masonry, and other locations indicated to allow water to escape building envelope.
h. Joints in rainscreen facades.
i. Weep holes in metal panel systems.

B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
1. Control and Expansion Joints in Concrete Paving: Non-sag polyurethane "traffic-grade" sealant.

C. Interior Joints: Use paintable non-sag polyurethane sealant, unless otherwise indicated.
1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant.
3. Floor Joints in Wet Areas: Non-sag polyurethane "traffic-grade" sealant suitable for continuous liquid immersion.
4. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant (Not for use at aluminum); Where substrate is tile, refer to 09 3000 - Tiling for sealant to match grout.

D. Interior Wet Areas are defined as: restrooms and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.02 JOINT SEALANTS - GENERAL

A. Colors: As selected by Architect from manufacturer's full range, including special order and CUSTOM colors.

B. Architect may select multiple colors to match adjacent building components.

2.03 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
5. Cure Type: Single or multi- component neutral curing.
6. Products:
a. Dow; DOWSIL 756 SMS Building Sealant: www.dow.com/#sle.
b. Pecora Corporation; Pecora 864 NST (Non-Staining Technology) or ; Pecora 895 NST (Non-Staining Technology) as appropriate for substrates: www.pecora.com/#sle.
c. Tremco Commercial Sealants & Waterproofing; Spectrem 4-TS: www.tremcosealants.com/#sle.
d. Momentive; Silpruf SCS 9000

B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, acid-curing, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Products:
a. Dow Corning Corporation; 786 Silicone Mildew Resistant Sealant: www.dowcorning.com.
b. Tremco Global Sealants; Tremsil 200: www.tremcosealants.com.
c. Franklin International; Titebond 100% Silicone Sealant: www.titebond.com
d. Pecora Corporation; Pecora 898 NST (Non-Staining Technology): www.pecora.com/#sle.
e. Sika Corporation; Sikasil N Plus US: usa.sika.com/#sle.

f. Momentive; SCS 1700 Sanitary

C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
2. Products:
a. Pecora Corporation DynaTrol II General Purpose Two Part Polyurethane Sealant: www.pecora.com.
b. Sika Corporation; Sikaflex-2c NS EZ Mix+: www.usa.sika.com/#sle.
c. Tremco Commercial Sealants & Waterproofing; Dymonic 100: www.tremcosealants.com/#sle.

D. Non-Sag "Traffic-Grade" Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.
1. Hardness Range: 40 to 50, Shore A, when tested in accordance with ASTM C661.
2. Products:
a. Sika Corporation; Sikaflex-1A: usa.sika.com/#sle.
b. Pecora Corporation; Dynatred
c. Tremco; Dymonic 100

E. Acrylic Emulsion Latex: Water-based; ASTM C920, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Products:
a. Franklin International, Inc; Titebond Acoustical Smoke & Sound Sealant: www.titebond.com/#sle.
b. Pecora Corporation; AVW-920 Acrylic Latex: www.pecora.com.
c. Sherwin-Williams Company; 950A Siliconized Acrylic Latex Caulk: Clear only www.sherwin-williams.com.

2.04 ACCESSORIES

A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

B. Bond Breaker Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials and release tapes are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturers and the following requirements:

1. Remove all foreign material from joint substrates which could interfere with adhesion of joint sealant, including dust; paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; oil; grease; water; and surface dirt.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous surfaces include, but are not limited to, the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed ceramic tile.
3. Clean nonporous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealants. Non-porous surfaces include, but are not limited to, the following:
   a. Metal.
   b. Glass.
   c. Glazed surfaces of ceramic tile.
4. Remove laitance and form-release agents from concrete.

B. Joint Priming: Prime joint substrates where indicated or recommended by joint sealant manufacturer and based on preconstruction testing. Confine primers to areas of joint sealant bond; do not allow spillage or migration to other surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be stained or damaged by such contact or by cleaning methods to remove smears. Remove tape immediately after tooling joint sealant.

D. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

E. Protect elements surrounding the work of this section from damage or disfigurement.

F. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in an inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

D. Support sealant from back with backer rod, bond breaker tape, or as recommended by manufacturer.
1. Install joint backing of type indicated to support sealants during application and at position to allow optimum sealant joint geometry and optimum sealant movement capability.
   a. Do not stretch, twist, puncture, or tear joint backing. Do not leave gaps between ends of joint backing pieces.

E. Install bond breaker backing tape where backer rod cannot be used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
1. Place sealants in manner to directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Place uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Immediately after sealant application and prior to the time skinning or curing begins, tool surface concave, unless otherwise indicated, to form smooth, uniform beads, eliminating air pockets and ensuring contact and adhesion of sealant with sides of joint; remove masking tape immediately after tooling sealant surface.

3.04 FIELD QUALITY CONTROL

A. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.05 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealant and of products in which joints occur.

3.06 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so they are without deterioration or damage at time of substantial completion.
   1. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealant immediately and reseal joints with new materials so repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Thermally insulated hollow metal doors with frames.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames; 2022.

C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2018.

D. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.

E. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

F. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2025.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

H. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.

I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

J. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.

K. ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus; 2019.

L. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

M. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

N. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.

O. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.

P. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

Q. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

R. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2024.

S. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.

T. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.

U. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

V. NFRC 400 - Procedure for Determining Fenestration Product Air Leakage; 2017.

W. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Provide manufacturer's specifications for fabrication and installation, including data substantiating products comply with requirements. Include materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

C. Shop Drawings: For fabrication and installation of steel door and frame work. Indicate details of each frame type, elevation of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

D. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Contract Drawings.
   1. Indicate coordination of glazing frames and stops with glass and glazing requirements.

E. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

D. Maintain at project site copies of reference standards relating to installation of products specified.

E. Pre-Installation Conference: Conduct conference in compliance with requirements in Division 01 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.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

C. Inspect steel door and frame work upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Architect; otherwise remove and replace damaged item as directed.

D. Store doors and frames at the building site under cover. Place units on minimum 4-inch high wood blocking. Avoid use of non-vented plastic or canvas shelters, which could create a humidity chamber. If cardboard wrappers on doors become wet, remove carton immediately. Provide 1/4-inch spaces between stacked doors to promote air circulation.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.08 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
   3. Mesker MBM, LP: www.meskerdoor.com.
   4. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
   5. Steelcraft, an Allegion brand: www.allegion.com/#sle.
   6. Substitutions: Refer to Section 01 2500 - Substitution Procedures.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. 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.
   4. Door Edge Profile: Manufacturers standard for application indicated.
   5. Typical Door Face Sheets: Flush.
   6. Thermal performance:
      a. At doors and frames located on the exterior of the building and elsewhere as indicated, provide doors fabricated as thermal-insulating door and frame assemblies, tested per ASTM C1363.
         1) Minimum U-factor: 0.370
      b. Air Leakage of door and frame assembly: Not to exceed 0.4 cfm/square foot when tested at a minimum test pressure of 1/57 psf, determined in accordance with NFRC 400 or ASTM E283/E283M methods and model sizes.
   7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 and ANSI/SDI A250.6 in accordance with specified requirements.
      a. Reinforce hollow metal units to receive surface-applied hardware in conformance with ANSI/SDI A250.6. Drilling and tapping for surface-applied hardware may be done at Project site.
      b. Locate finish hardware as shown on final shop drawings, or if not shown, in accordance with the DHI (LOCS).
      c. Astragals: Provide overlapping astragals as noted in door hardware sets in Section 08 7100 - 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.
      d. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Section 08 7100 - Door Hardware.
      e. 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.
      f. Conduit: Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.

B. Hollow Metal Panels: Same construction, performance, and finish as doors.

C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 3 - Extra Heavy-duty.
   b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 2 - Seamless.
   d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.
   e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inches, nominal.
4. Top Closures: Flush with top of faces and edges. Minimum thickness 16 gage (0.053 inches) thick.

C. Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 2 - Heavy-duty.
   b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 2 - Seamless.
   d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
2. Door Thickness: 1-3/4 inches, nominal.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Exterior Door Frames: Full profile/continuously welded type.
1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
2. Frame Metal Thickness:
   a. Openings up to and including 4'-0": 14 gage, 0.067 inch, minimum.
   b. Openings greater than 4'-0": 14 gage, 0.067 inch, minimum.
3. Thermal Break: Provide frames constructed with thermal break along stop, to enable door and frame assembly to comply with specified U value.
4. Weatherstripping: Separate, see Section 08 7100 - Door Hardware.
5. Thermal Insulation: Fill frame with unfaced fiberglass or mineral wool batt insulation complying with ASTM C665.

D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
1. Frame Metal Thickness:
   a. Openings up to and including 4'-0": 16 gage, 0.053 inch
   b. Openings greater than 4'-0": 14 gage, 0.067 inch

E. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

A. 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.

B. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions. Install plastic plugs to keep holes clean during construction.
   1. Provide supply of manufacturer's standard rubber silencers in quantity not less than twice required for project.
   2. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".

C. Temporary Frame Spreaders: Provide removable spreader bar across bottom of frames, tack welded to jambs and mullions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which steel door and frame work is to be installed. Notify Contractor in writing of conditions detrimental to proper and timely completion of work.

B. Verify existing conditions before starting work.

C. Verify that opening sizes and tolerances are acceptable.

D. Verify that finished walls are in plane to ensure proper door alignment.

E. Do not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner.

3.02 PREPARATION

3.03 INSTALLATION

A. Install doors and frames in accordance with shop drawings, manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Placing Frames: Comply with ANSI/SDI A250.11, BHMA A156.115 and BHMA A156.115W, unless otherwise indicated. Set frames accurately in position, plumbed, aligned and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
   1. In masonry construction, install minimum 3 anchors per jamb adjacent to hinge location on hinge jamb and at corresponding locations on strike jamb. Anchors include masonry wire anchors and masonry T-shape strap anchors.

C. Door Installation: Fit steel doors accurately in frames, within clearances specified in ANSI/SDI A250.8.
   1. Non-Fire-Rated Doors: Fit non-fire-rated steel doors accurately in their respective frames with the following clearances:
      a. Jambs and Head: 3/32 inch.
      b. Meeting Edges, Pairs of Doors: 1/8 inch.
      c. Bottom: 5/8 inch where no threshold or carpet; 1/8 inch at threshold or carpet.

D. Coordinate frame anchor placement with wall construction.

E. Install door hardware as specified in Section 08 7100 - Door Hardware.
   1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 and NAAMM HMMA 861.

F. Coordinate installation of electrical connections to electrical hardware items.

3.04 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 and NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. Final Adjustments: Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames warped, bowed or otherwise unacceptable.

C. Prime Coat Touch-Up: Immediately after erection, sand smoothly any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

END OF SECTION

SECTION 08 4113 - ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Exterior entrance systems.

B. Exterior storefront framing systems.

1.03 REFERENCES

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

B. AAMA 701/702 - Voluntary Specification for Pile Weatherstripping and Replaceable Fenestration Weatherseals; 2011.

C. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.

F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

I. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

K. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.

L. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

M. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018.

N. ASTM D2287 - Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds; 2012.

O. ASTM D429 - Standard Test Methods for Rubber Property--Adhesion to Rigid Substrates; 2014 (Reapproved 2023).

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 E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

R. 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).

S. AWS A5.10/A5.10M - Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods; 2023.

T. BHMA A156.16 - Standard for Auxiliary Hardware; 2023.

U. GANA (GM) - GANA Glazing Manual; 2008.

V. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

1.04 SYSTEM DESCRIPTION

A. Provide aluminum entrances and storefront systems capable of withstanding loads, and thermal and structural movements indicated without failure, based on testing manufacturer's standard units in assemblies similar to this Project. Failure includes the following:
   1. Air infiltration and water penetration exceeding specified limits.
   2. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units

B. Thermally Broken Construction: Provide systems that isolate exposed to exterior aluminum components from exposed to interior aluminum components with a low thermal conductance material.

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: For each entrance and storefront system product specified.
   1. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.

C. Shop Drawings: For fabrication and installation of aluminum entrances and storefront systems. Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
   1. Include elevations, detail sections of typical composite members, hardware mounting heights, anchorages and attachment to other work, reinforcement, expansion provisions, and glazing.
   2. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   3. Delegated Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
      a. Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
         1) Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
         2) Show design assumptions, basis of sizing members, connections and other information as necessary, and as may be required including load calculations at points of attachment to building structure, deflection and movement.
         3) Clearly show basis of compliance with performance criteria.
         4) Include required product data and shop drawings.
         5) Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
         6) Include signature and seal of design professional responsible for allocated design services on calculations and drawings.

D. Samples: Submit samples of each type and color of aluminum finish, on 12 inch long sections of extrusions or formed shapes and on 6 inch square sheets.
   1. Where normal color and texture variations are to be expected, include 2 or more units in each set of samples showing limits of such variations.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of entrance and storefront system through one source from a single manufacturer.

B. Designer Qualifications: Design entrances and storefront systems and their structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

C. Modifications of Details: Maintain design concept as indicated (member sizes, basic profiles, and component alignment).

D. Preconstruction Sealant Testing: Perform sealant manufacturer's standard test for compatibility and adhesion of sealants with each material that will come in contact with sealants and each condition required by system.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond to aluminum when exposed to sunlight or weather.

1.08 WARRANTY

A. Provide written warranty signed by Manufacturer and Installer, agreeing to repair or replace aluminum entrances and storefront systems which fail in materials or work quality within specified warranty period indicated below.
   1. Failure of materials or work quality includes:
      a. Excessive water leakage or air infiltration.
      b. Structural failures, including excessive deflection.
      c. Faulty operation of entrances.
      d. Deterioration of metals, metal finishes, sealants and other materials in excess of normal weathering.
      e. Defects in hardware, weatherstripping, and other components of the work.
      f. Glazing and glazing gaskets.
   2. Duration of warranty is 5 years from date of substantial completion.

B. Finish Warranty: Correct defective work within a 20 year period after Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design products:
   1. Exterior Storefront Framing System: Tubelite, a brand of Architectural Framing Systems; T24650 Therml=Block.
   2. Exterior Entrance Systems: Tubelite; Medium Stile

B. Other Manufacturers: Subject to compliance with requirements, provide Basis of Design products or comparable products by the following:
   1. EFCO, a brand of Architectural Framing Systems
   2. Kawneer Company, Inc.

2.02 PERFORMANCE REQUIREMENTS

A. Performance Requirements: Fabricate aluminum entrance and storefront system components from manufacturer's stock systems with the following tested performance capabilities:
   1. Thermal Performance: Built-in provisions for expansion and contraction resulting from ambient temperature range of 120 degF (49 degC).

2. Wind Loading: Capable of withstanding uniform pressure indicated on structural drawings, as tested per ASTM E330/E330M.
3. Air and Water Leakage of Fixed Framing: Air infiltration of not more than 0.06 cfm per sq. ft. tested per ASTM E283 and no uncontrolled water penetration per ASTM E331 at pressure differential of 6.24 psf.
4. Air Leakage of Entrances: Air infiltration per linear foot of perimeter crack of not more than 1.0 cfm for doors per ASTM E283 at pressure differential of not less than 1.57 psf.
5. Heat Transfer Coefficient of fixed units using glass being provided for this project: Maximum U-value of 0.35 BTU/h*sqft*DegF. Coordinate with glass being provided
6. Heat Transfer Coefficient of operable units (doors) using glass being provided for this project: Maximum U-value of _____ BTU/h*sqft*DegF. Coordinate with glass being provided.

B. Wind Loads: Provide aluminum entrance and storefront systems, including anchorage, capable of withstanding wind-load design pressures calculated in conformance with requirements of authorities having jurisdiction or the American Society of Civil Engineers' ASCE 7, "Minimum Design Loads for Buildings and Other Structures", 6.4.2, "Analytical Procedure", whichever is more stringent.

2.03 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.
1. Sheet and Plate: ASTM B209.
2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B221.
3. Extruded Structural Pipe and Tubes: ASTM D429.
4. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Reinforcement: As follows:
1. Steel:
a. ASTM A36/A36M for structural shapes, plates, and bars.
b. ASTM A1008/A1008M for cold-rolled sheet and strip.
c. ASTM A1011/A1011M for hot-rolled sheet and strip.
2. Structural Aluminum: ASTM B308/B308M.

C. Glazing as specified in Section 08 8000 - Glazing.

D. Bituminous Coatings: Cold-applied asphalt mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

2.04 COMPONENTS

A. Aluminum Entrance Doors: Provide extruded aluminum tubular frame members, assembled with mechanical joints using heavy inserted reinforcing plates and concealed tie rods or j-bolts, or fabricate with structurally welded joints, at manufacturer's option.
1. Thickness: Provide doors nominally, 2 inches thick.
2. Stile Width: Medium

B. Glazing System: Manufacturer's standard pressure-glazing system of black, resilient glazing gaskets, setting blocks, and shims or spacers; type and hardness recommended by system and gasket manufacturer.
1. Provide gasket assemblies with corners sealed with sealant recommended by gasket manufacturer.

C. Brackets and Reinforcements: Manufacturer's standard brackets and reinforcement compatible with adjacent materials. Provide nonstaining, nonferrous shims for aligning system components.

D. Miscellaneous Closure Pieces and Extended Sills: Provide minimum 0.125 inch thick aluminum plate for miscellaneous closure pieces, of size, shape and width indicated on drawings. Furnish same color and finish as framing system.

E. Anchors, Clips and Accessories: Aluminum, nonmagnetic stainless steel or hot-dip zinc-coated steel or iron per ASTM B633. Provide sufficient strength to withstand design pressure indicated.

F. Fasteners: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners compatible with adjacent materials.
   1. Use concealed fasteners whenever possible.
   2. Do not use exposed fasteners except where unavoidable for application of hardware. Countersink exposed fasteners with heads finished to match adjoining metal.
   3. Provide Phillips flat-head machine screws for exposed fasteners.

G. Concealed Flashing: Dead-soft stainless steel, ASTM A666, 26 gage minimum, of type selected by manufacturer for compatibility with other components.

H. Sealant: Within entrance and storefront systems, type recommended by entrance and storefront manufacturer. Comply with Section 07 9200 - Joint Sealants.

I. Bituminous Paint: Asphalt emulsion or other high-build, water-resistant, resilient coating.

J. Compression Weatherstripping: Manufacturer's standard replaceable stripping of either molded neoprene gaskets per ASTM D2000 or molded PVC gaskets per ASTM D2287.

K. Sliding Weatherstripping: Manufacturer's standard replaceable stripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing, per AAMA 701/702

2.05 HARDWARE

A. Refer to Section 08 71 00 - Door Hardware.

B. Door Sweeps: Manufacturer’s standard door sweep for application to exterior door bottoms with concealed fasteners on mounting strips.

2.06 FABRICATION

A. Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify location in Project according to Shop Drawings.

B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.

C. Prepare components to receive concealed fasteners and anchor and connection devices.

D. Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.

E. Welding: Weld components to comply with referenced AWS standard.
   1. Weld before finishing components to greatest extent possible.
   2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish.
   3. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

F. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to GANA (GM) "Glazing Manual".

G. Glazing: Fabricate doors to facilitate replacement of glass without disassembly of door stiles and rails. Provide flush, square snap-on extruded aluminum glazing stops, with exterior stops anchored for non-removal.

H. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
   1. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Fabricate tubular and channel frame assemblies, as indicated, with either welded or mechanical joints in accordance with manufacturer's standards, reinforced as necessary to support required loads.

J. Storefront: Fabricate framing system using thermal break construction in profiles indicated.
   1. Fabricate framing system with an integral concealed low-conductance thermal barrier.
   2. Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system.
   3. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.

K. Entrances: Fabricate door framing in profiles indicated.
   1. Reinforce as required to support imposed loads.
   2. Factory assemble door and frame units and factory install hardware to greatest extent possible. Reinforce door and frame units as required for installing hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.
   3. Exterior Doors: Provide compression weather stripping at fixed stops. At other locations, provide sliding weather stripping retained in adjustable strip mortised into door edge.
   4. Interior Doors: Provide BHMA A156.16 silencers at stops to prevent metal to metal contact. Provide 3 silencers on strike jamb of single-door frames and 2 silencers on head of double-door frames.

2.07 FACTORY FINISHING

A. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

B. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42/A44 (Mechanical Finish: As fabricated nonspecular; Chemical Finish: etched, medium matte) Integrally colored anodic coating not less than 0.7 mils thick.
   1. Color: Dark Bronze.

C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.08 STEEL PRIMING

A. Comply with NAAMM AMP 500-06 "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying primer.

B. Surface Preparation: Perform manufacturer's standard cleaning operations to remove dirt, oil, grease, or other contaminants that could impair bond. Remove mill scale and rust, if present, for uncoated steel.

C. Priming: Apply manufacturer's standard corrosion-resistant primer immediately after surface preparation and pretreatment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's written instructions for protecting, handling, and installation of aluminum entrance and storefront systems.
   1. Set units plumb, level and true to line without warp or rack of frames.
   2. Fit joints to produce hairline joints free of burrs and distortion.
   3. Anchor components securely in-place with provisions for thermal and structural movement.
   4. Do not bridge thermal breaks.
   5. Do not install damaged components.
   6. Rigidly secure nonmovement joints.
   7. Install slip joint linings wherever possible to ensure movement as intended or necessary.

8. Install components to drain water passing joints, condensation occurring in glazing channels, condensation occurring within framing members, and moisture migrating within the system to the exterior.

B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
   1. Where aluminum contacts concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in a full bed of sealant to provide weathertight construction, unless otherwise indicated.

D. Lubricate operating hardware or other moving parts per manufacturer's written instructions.
   1. Install surface-mounted hardware per manufacturer's written instructions using concealed fasteners to greatest extent possible.

E. Install glass and glazing per Section 08 8000 - Glazing.

F. Install perimeter sealant per Section 07 9200 - Joint Sealants, unless otherwise indicated.

3.02 ERECTION TOLERANCES

A. Erection Tolerances: Install entrances and storefront systems to comply with the following maximum tolerances:
   1. Variation from Plane: Limit variation from plane or location shown to 1/8-inch in 12-feet; 1/4-inch over total length.
   2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16-inch. Where surfaces meet at corners, limit offset from true alignment to 1/32-inch.
   3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8-inch.

3.03 ADJUSTING

A. Adjust doors and operating hardware to function properly, without binding and to provide tight fit at contact points and weatherstripping. Adjust for smooth operation.

3.04 CLEANING AND PROTECTION

A. Clean completed aluminum entrances and storefront systems, inside and outside, promptly after installation, exercising care to avoid damage to finish coatings.

B. Clean glass surfaces after installation, per Section 08 8000 - Glazing. Remove excess glazing and sealant compounds, dirt, and other substances from aluminum surfaces.

C. Provide final protection and maintain conditions in manner acceptable to manufacturer and Installer, to ensure aluminum entrances and storefront systems are without damage or deterioration at time of substantial completion.

END OF SECTION

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SECTION 08 5619 - PASS-THRU WINDOWS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Sliding pass-thru windows, manually operated, bi-parting.

1.03 REFERENCES

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

E. ASTM C1036 - Standard Specification for Flat Glass; 2021.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data and Samples, for submittal procedures.

B. Product Data: Provide manufacturers product data, standard details, and descriptions of hardware and accessories.
   1. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.

C. Shop Drawings: Indicate elevations, opening dimensions, framed opening tolerances, anchorage locations, weep hole locations, glazing details, operable hardware, and installation requirements.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of experience.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Comply with requirements of AAMA CW-10 .

B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Basis of Design: Ready Access, Inc.; 600 Single Panel Sliding Window with Transom

B. Other Acceptable Manufacturers: Subject to compliance with requirements provide Basis of Design product or comparable product by one of the following:
   1. C. R. Laurence Co.
   2. Quikserv Inc.

C. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.02 MATERIALS

A. Stainless Steel Cladding: AISI Type 304, No. 8 polished mirror finish, minimum 0.030 inch thick (22 ga.).

B. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements indicated below.
   1. Sheet and Plate: ASTM B209/B209M .
   2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B221 .

C. Reinforcement: As follows:
   1. Galvanized Sheet Steel: ASTM A653/A653M , G90.

D. Glass: Clear, Insulated glass.
   1. Insulated Glass Characteristics: Float glass per ASTM C1036 , Type I, Quality Q3, fully tempered per ASTM C1048 , Kind FT, and as follows:
      a. Thickness: 3/4 inch.
      b. Color: Clear, Class 1.
      c. Temper glass materials horizontally; visible tong marks or tong mark distortions are not permitted.
      d. Coating: Low-E coating, on #2 surface.
         1) Basis of Design: Vitro; Solarban 70XL

2.03 FABRICATION

A. Panel Construction: Mortise and tenon type joints, neatly and mechanically secured. Sash consists of snap-in glass stops, snap-in glazing beads and vinyl gaskets.

B. Frame Construction: Butt joints, neatly and mechanically secured by means of screws and formed aluminum corner brackets.

C. Operator for Automatic Units: Electromechanical, modular type construction.

2.04 ACCESSORIES.

A. Fasteners: Manufacturer's standard fasteners and anchors.

B. Locking and Operating Hardware:
   1. Handle: Provide manufacturer's standard stainless steel fixed handle.
   2. Locking: Provide manufacturer's standard stainless steel, self-latching deadlock system.

C. Shelf: Provide manufacturer's standard stainless steel shelf to extend from sill, as indicated on Drawings.

2.05 FINISHES

A. Class I Color Anodized Finish: AA-M12C22A42/A44 (Mechanical Finish: As fabricated nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class I Architectural, film thicker than 0.7 mil with integral color or electrolytically deposited color) per AAMA 611 AAMA 61.
   1. Color: Dark Bronze to match storefront system.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of glazed aluminum window wall system.
   1. Notify Contractor in writing of conditions detrimental to the proper and timely completion of work.
   2. Do not proceed with installation until unsatisfactory conditions have been corrected in an acceptable manner.

3.02 INSTALLATION

A. General: Install window units plumb, level and true to line, without warp or rack of frames or sash with manufacturer's prescribed tolerances. Provide support and anchor in place.

1. Dissimilar Materials: Comply with AAMA 101, Appendix Dissimilar Materials by separating aluminum materials and other corrodible surfaces from sources of corrosion or electrolytic action contact points.

B. Install sill and other members in a bed of sealant or with joint filler or gaskets. Coordinate installation with wall flashings and other components of construction.

3.03 ADJUSTING

A. Adjust pass-thru window system operating hardware to function properly, without binding and to provide tight fit at contact points and weatherstripping. Adjust for smooth operation.

3.04 CLEANING AND PROTECTION

A. Clean completed pass-thru window systems, inside and outside, promptly after installation, exercising care to avoid damage to finish coatings.

B. Clean glass surfaces after installation, per Section 08 80 00 - Glazing. Remove excess glazing and sealant compounds, dirt, and other substances from aluminum surfaces.

C. Provide final protection and maintain conditions in manner acceptable to manufacturer and Installer, to ensure pass-thru window systems are without damage or deterioration at time of substantial completion.

END OF SECTION

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
   a. "Metal Doors and Frames"
   b. "Flush Wood Doors"
   c. "Stile and Rail Wood Doors"
   d. "Interior Aluminum Doors and Frames"
   e. "Aluminum-Framed Entrances and Storefronts"
   f. "Stainless Steel Doors and Frames"
   g. "Special Function Doors"
   h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
   a. Review drawings and Sections from related trades to verify compatibility with specified hardware.

b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   a. Wiring Diagrams: For power, signal, and control wiring and including:
      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
   a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule:
   a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
   b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
   c. Indicate complete designations of each item required for each opening, include:
      1) Door Index: door number, heading number, and Architect's hardware set number.
      2) Quantity, type, style, function, size, and finish of each hardware item.
      3) Name and manufacturer of each item.
      4) Fastenings and other pertinent information.
      5) Location of each hardware set cross-referenced to indications on Drawings.
      6) Explanation of all abbreviations, symbols, and codes contained in schedule.
      7) Mounting locations for hardware.
      8) Door and frame sizes and materials.
      9) Degree of door swing and handing.
      10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:
   a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.

b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
   b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Final approved hardware schedule edited to reflect conditions as installed.
   d. Final keying schedule
   e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
   f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
   a. Fire door assemblies, in compliance with NFPA 80.
   b. Required egress door assemblies, in compliance with NFPA 101.

1.03 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
   d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
   a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
   b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:
   a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
   b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware
   a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:
   a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
   a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
      1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
      2) Preliminary key system schematic diagram.
      3) Requirements for key control system.
      4) Requirements for access control.
      5) Address for delivery of keys.

2. Pre-installation Conference
   a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Inspect and discuss preparatory work performed by other trades.
   c. Inspect and discuss electrical roughing-in for electrified door hardware.
   d. Review sequence of operation for each type of electrified door hardware.
   e. Review required testing, inspecting, and certifying procedures.
   f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:
   a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.05 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.06 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.

1.07 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approval of alternate manufacturers and/or products other than those listed as ''Scheduled Manufacturer'' or ''Acceptable Manufacturers'' in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

B. Approval of products from manufacturers indicated in ''Acceptable Manufacturers'' is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Ives 5BB series

2. Acceptable Manufacturers and Products:
   a. McKinney TB series
   b. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high

b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.

2.04 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Select
   b. Best

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Von Duprin EPT-10

2. Acceptable Manufacturers and Products:
   a. Securitron CEPT-10
   b. Precision EPT-12C

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.

2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.06 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Any BHMA member adhering to listed criteria acceptable.

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.07 CYLINDRICAL LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage ND series

2. Acceptable Manufacturers and Products:
   a. Sargent 11-Line
   b. Best 9K series

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:
   a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.
   b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
   c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
   d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
   e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.

3. Cylinders: Refer to "KEYING" article, herein.

4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.
9. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
   a. Lever Design: TLR

2.08 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 78/75A series

2. Acceptable Manufacturers and Products:
   a. Precision 2100 Series
   b. Sargent 19-43-GL-80 series

B. Requirements

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware with manufacturer’s approved strikes.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements. No plastic inserts are allowed in touchpads.
4. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect. Touchpad must extend a minimum of one half of door width.
5. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
6. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
7. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
8. Provide electrified options as scheduled.
9. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
10. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.09 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. HES 1006 Series

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.10 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage/Von Duprin PS900 Series

2. Acceptable Manufacturers and Products:
   a. Precision ELR series
   b. Sargent 3500 series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
   a. 12/24 VDC Output, field selectable.
   b. Class 2 Rated power limited output.
   c. Universal 120-240 VAC input.
   d. Low voltage DC, regulated and filtered.
   e. Polarized connector for distribution boards.
   f. Fused primary input.
   g. AC input and DC output monitoring circuit w/LED indicators.
   h. Cover mounted AC Input indication.
   i. Tested and certified to meet UL294.
   j. NEMA 1 enclosure.
   k. Hinged cover w/lock down screws.
   l. High voltage protective cover.

2.11 CYLINDERS/CORES

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. (Match Existing BEST FSIC system as directed by owner)

B. Requirements:

1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.12 KEYING

A. Scheduled System:

1. Existing factory registered system:
   a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
   a. Temporary Construction Cylinder Keying.
      1) Provide construction cores that permit voiding construction keys without cylinder removal, furnished in accordance with the following requirements.
         a) Split Key or Lost Ball Construction Keying System.
         b) 3 construction control keys, and extractor tools or keys as required to void construction keying.
         c) 12 construction change (day) keys.
      2) Owner or Owner's Representative will void operation of temporary construction keys.
   b. Replaceable Construction Cores.
      1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
         a) 3 construction control keys
         b) 12 construction change (day) keys.
      2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2. Permanent Keying:
   a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      1) Master Keying system as directed by the Owner.
   b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   c. Provide keys with the following features:
      1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
      2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
      3) Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.
   d. Identification:
      1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
      2) Identification stamping provisions must be approved by the Architect and Owner.

3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

e. Quantity: Furnish in the following quantities.
1) Permanent Control Keys: 3.
2) Master Keys: 6.
3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
4) Key Blanks: Quantity as determined in the keying meeting.

2.13 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4050A series

2. Acceptable Manufacturers and Products:
   a. Norton 7500 series
   b. Sargent 351 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with cast aluminum cylinder.
3. Closer Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter heat-treated pinion journal and full complement bearings.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and all weather requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and back check.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide metal covers as specified.
9. Provide stick on templates, special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.14 ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4600 series

2. Acceptable Manufacturers and Products:
   a. Norton 6000 series
   b. Precision D4990 series

B. Requirements:

1. Provide low energy automatic operator units with hydraulic closer complying with ANSI/BHMA A156.19.
2. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
3. Provide units with conventional door closer opening and closing forces unless power operator motor is activated. Provide door closer assembly with adjustable spring size, back-check, and opening and closing speed adjustment valves to control door
4. Provide units with on/off switch for manual operation, motor start up delay, vestibule interface delay, electric lock delay, and door hold open delay.
5. Provide drop plates, brackets, and adapters for arms as required for details.
6. Provide actuator switches and receivers for operation as specified.
7. Provide weather-resistant actuators at exterior applications.
8. Provide key switches with LED's, recommended and approved by manufacturer of automatic operator as required for function described in operation description of hardware group below. Cylinders: Refer to "KEYING" article, herein.
9. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.
10. Provide units with vestibule inputs that allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.15 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Any BHMA member adhering to listed criteria acceptable.

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.16 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Any BHMA member adhering to listed criteria acceptable.

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.17 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
   a. Glynn-Johnson

2. Acceptable Manufacturers:
   a. Rixson
   b. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.18 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Any BHMA member adhering to listed criteria acceptable.

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.19 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Zero International

2. Acceptable Manufacturers:
   a. National Guard
   b. Pemko

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.
5.

2.20 KEYSWITCHES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage 650 series

2. Acceptable Manufacturers and Products:
   a. Security Door Control 700 series
   b. Securitron MK series

B. Requirements:

1. Provide key switches capable of being configured to momentary or maintained action.
2. Provide key switches that accept a mortise cylinder. Cylinders: Refer to "KEYING" article, herein.

2.21 FINISHES

A. Provide finishes as specified, unless noted otherwise by owner/architect.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.
3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.

L. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

M. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

P. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

S. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

Hardware Group No. 01

For use on Door #(s):
101

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	CONT. HINGE	224HD EPT			710	IVE
1	EA	POWER TRANSFER	EPT10			695	VON
1	EA	ELEC PANIC HARDWARE	LX-QEL-78-NL-OP-110MD			643E	VON
1	EA	FSIC MORTISE CYL.	80-110 (CAM/RING AS REQ'D)			626	SCH
1	EA	FSIC RIM CYLINDER	80-116			643E	SCH
1	EA	FSIC CORE	(COORDINATE WITH OWNER)			613	BES
1	EA	FSIC CORE	(COORDINATE WITH OWNER)			626	BES
1	EA	90 DEG OFFSET PULL	8190EZHD 12" O			643E/716	IVE
1	EA	OH STOP	100S			643E/716	GLY
1	EA	SURF. AUTO OPERATOR	4642			695	LCN
1	EA	WEATHER RING	8310-801				LCN
2	EA	TOUCH ACTUATOR	8310-853T			630	LCN
2	EA	ACTUATOR BOX	8310-867F				LCN
1	EA	GASKETING/WEATHERSTRIPPING	(BY DOOR/FRAME MANUFACTURER)				B/O
1	EA	DOOR SWEEP	39D			D	ZER
1	EA	THRESHOLD	655A-223			A	ZER
1	EA	KEY SWITCH	653-04 L2			630	SCE
1	EA	DOOR CONTACT	(SPECIFIED & FURNISHED UNDER DIV. 28)				B/O
1	EA	POWER SUPPLY	(SPECIFIED & FURNISHED UNDER DIV. 28)				B/O
1	EA	ACCESS CONTROL/CARD READER	(SPECIFIED & FURNISHED UNDER DIV. 28)				B/O

UNLOCKED HOURS:
PANIC DEVICE(S) ELECTRONICALLY DOGGED (I.E. IN PUSH/PULL MODE) AND BOTH ACTUATORS ACTIVE. PRESSING EITHER ACTUATOR BUTTON SIGNALS AUTOMATIC OPERATOR TO OPEN THE DOOR. FREE EGRESS AT ALL TIMES.

LOCKED HOURS:
DOOR NORMALLY CLOSED AND LOCKED AND EXTERIOR ACTUATOR BUTTON INACTIVE. PRESENTING CREDENTIAL TO READER RETRACTS LATCH AND ENABLES EXTERIOR ACTUATOR BUTTON. PRESSING ACTUATOR BUTTON SIGNALS AUTOMATIC OPERATOR TO MOMENTARILY OPEN DOOR. INTERIOR ACTUATOR ENABLED AT ALL TIMES. FREE EGRESS AT ALL TIMES.

LATCH BOLT MONITOR (LX) RELAYS LOCKED/UNLOCKED STATUS TO THE AUTO OPERATOR, ALLOWING ACTUATOR BUTTONS TO BE USED. KEY SWITCH ALLOWS FOR REMOTE LOCKING/UNLOCKING OF THE DOOR MAINTAINED WITH MECHANICAL KEY.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, ARCHITECT, AND ALL RELATED TRADES.

Hardware Group No. 02

For use on Door #(s):
107B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	224HD		710	IVE
1	EA	CONST LATCHING BOLT	FB51P/FB61P (AS REQ'D)		630	IVE
1	EA	DUST PROOF STRIKE	DP1		626	IVE
1	EA	STOREROOM LOCK	ND80BDC TLR		626	SCH
1	EA	FSIC CORE	(COORDINATE WITH OWNER)		626	BES
1	EA	OH STOP	100S - INACTIVE LEAF		630	GLY
1	EA	SURFACE CLOSER	4050A SCUSH MC ST-5207 - ACTIVE LEAF		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA		AA	ZER
1	EA	GASKETING	429AA		AA	ZER
1	EA	OVERLAPPING ASTRAGAL	(BY DOOR/FRAME MANUFACTURER)			B/O
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
2	EA	DOOR CONTACT	(SPECIFIED & FURNISHED UNDER DIV. 28)			B/O

Hardware Group No. 03

For use on Door #(s):
102 107A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP)		652	IVE
1	EA	ELECTRIC STRIKE	1006-XX		630	HES
1	EA	STOREROOM LOCK	ND80BDC TLR		626	SCH
1	EA	FSIC CORE	(COORDINATE WITH OWNER)		626	BES
1	EA	OH STOP	410S		652	GLY
1	EA	SURFACE CLOSER	4050A RW/PA (PULL SIDE MOUNT) MC ST-5203		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64/SR65		GRY	IVE
1	EA	POWER SUPPLY	(SPECIFIED & FURNISHED UNDER DIV. 28)			B/O
1	EA	ACCESS CONTROL/CARD READER	(SPECIFIED & FURNISHED UNDER DIV. 28)			B/O

DOOR NORMALLY CLOSED AND LOCKED. PRESENTING CREDENTIAL TO READER UNLOCKS ELECTRIC STRIKE ALLOWING ENTRY. FREE EGRESS AT ALL TIMES.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, ARCHITECT, AND ALL RELATED TRADES.

Hardware Group No. 04

For use on Door #(s):
103A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP)		652	IVE
1	EA	ELECTRIC STRIKE	1006-XX		630	HES
1	EA	STOREROOM LOCK	ND80BDC TLR		626	SCH
1	EA	FSIC CORE	(COORDINATE WITH OWNER)		626	BES
1	EA	SURFACE CLOSER	4050A HCUSH MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64/SR65		GRY	IVE
1	EA	POWER SUPPLY	(SPECIFIED & FURNISHED UNDER DIV. 28)			B/O
1	EA	ACCESS CONTROL/CARD READER	(SPECIFIED & FURNISHED UNDER DIV. 28)			

DOOR NORMALLY CLOSED AND LOCKED. PRESENTING CREDENTIAL TO READER UNLOCKS ELECTRIC STRIKE ALLOWING ENTRY. FREE EGRESS AT ALL TIMES.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, ARCHITECT, AND ALL RELATED TRADES.

Hardware Group No. 05

For use on Door #(s):
104

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP)		652	IVE
1	EA	ELECTRIC STRIKE	1006-XX		630	HES
1	EA	STOREROOM LOCK	ND80BDC TLR		626	SCH
1	EA	FSIC CORE	(COORDINATE WITH OWNER)		626	BES
1	EA	SURFACE CLOSER	4050A SCUSH MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	POWER SUPPLY	(SPECIFIED & FURNISHED UNDER DIV. 28)			B/O
1	EA	ACCESS CONTROL/CARD READER	(SPECIFIED & FURNISHED UNDER DIV. 28)			B/O

DOOR NORMALLY CLOSED AND LOCKED. PRESENTING CREDENTIAL TO READER UNLOCKS ELECTRIC STRIKE ALLOWING ENTRY. FREE EGRESS AT ALL TIMES.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, ARCHITECT, AND ALL RELATED TRADES.

Hardware Group No. 06

For use on Door #(s):
109

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP)		652	IVE
1	EA	STOREROOM LOCK	ND80BDC TLR		626	SCH
1	EA	FSIC CORE	(COORDINATE WITH OWNER)		626	BES
1	EA	SURFACE CLOSER	4050A RW/PA (PULL SIDE MOUNT) MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR64/SR65		GRY	IVE

Hardware Group No. 07

For use on Door #(s):
105

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP)		652	IVE
1	EA	PUSH PLATE	8200 6" X 16"		630	IVE
1	EA	PULL PLATE	8302 10" 4" X 16"		630	IVE
1	EA	OH STOP	410S		652	GLY
1	EA	SURFACE CLOSER	4050A RW/PA (PULL SIDE MOUNT) MC ST-5203		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FOOT PULL	FP100		630	IVE
3	EA	SILENCER	SR64/SR65		GRY	IVE

Hardware Group No. 08

For use on Door #(s):
106

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP)		652	IVE
1	EA	PUSH PLATE	8200 6" X 16"		630	IVE
1	EA	PULL PLATE	8302 10" 4" X 16"		630	IVE
1	EA	SURFACE CLOSER	4050A RW/PA (PULL SIDE MOUNT) MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		626	IVE
1	EA	FOOT PULL	FP100		630	IVE
3	EA	SILENCER	SR64/SR65		GRY	IVE

Hardware Group No. 09

For use on Door #(s):
110

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP)		652	IVE
1	EA	CORRIDOR LOCK W/ OUTSIDE INDICATOR	ND73BDC TLR OS-LOC		626	SCH
1	EA	FSIC CORE	(COORDINATE WITH OWNER)		626	BES
1	EA	SURFACE CLOSER	4050A RW/PA (PULL SIDE MOUNT) MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		626	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. 10

For use on Door #(s):
108

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP)		652	IVE
1	EA	ELECTRIC STRIKE	1006-XX		630	HES
1	EA	STOREROOM LOCK	ND80BDC TLR		626	SCH
1	EA	FSIC CORE	(COORDINATE WITH OWNER)		626	BES
1	EA	SURFACE CLOSER	4050A RW/PA (PULL SIDE MOUNT) MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	POWER SUPPLY	(SPECIFIED & FURNISHED UNDER DIV. 28)			B/O
1	EA	ACCESS CONTROL/CARD READER	(SPECIFIED & FURNISHED UNDER DIV. 28)			B/O

DOOR NORMALLY CLOSED AND LOCKED. PRESENTING CREDENTIAL TO READER UNLOCKS ELECTRIC STRIKE ALLOWING ENTRY. FREE EGRESS AT ALL TIMES.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, ARCHITECT, AND ALL RELATED TRADES.

Hardware Group No. 11

For use on Door #(s):
103B.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224HD		628	IVE
1	EA	STOREROOM LOCK	ND80BDC TLR		626	SCH
1	EA	FSIC CORE	(COORDINATE WITH OWNER)		626	BES
1	EA	SURFACE CLOSER	4050A SHCUSH MC ST-5207		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA		AA	ZER
1	EA	GASKETING	429AA		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	8726A		A	ZER

SIZE THRESHOLD TO ACCOMMODATE NECESSARY JAMB DEPTH.

Hardware Group No. 12

For use on Door #(s):
103B.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224HD		628	IVE
1	EA	EXIT X BLANK OUTSIDE	ND25D TLR		626	SCH
1	EA	FLOOR STOP/HOLDER	FS446/FS450		626	IVE
1	EA	DOOR SWEEP	111AA		AA	ZER
1	EA	FINGER GUARD	51A (LENGTH AS REQ'D)		A	ZER

END OF SECTION

SECTION 08 8000 - GLAZING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Glazing compounds.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. AAMA 800 - Voluntary Specifications and Test Methods for Sealants; 2016.

C. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

E. ASTM C719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle); 2022.

F. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).

G. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

H. ASTM C1036 - Standard Specification for Flat Glass; 2021.

I. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

J. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

K. ASTM C1281 - Standard Specification for Preformed Tape Sealants for Glazing Applications; 2016.

L. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.

M. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

N. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

O. GANA (GM) - GANA Glazing Manual; 2008.

P. GANA (SM) - GANA Sealant Manual; 2008.

Q. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2020.

R. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

S. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting two weeks before starting work of this section; require attendance by each of the affected installers, including but not limited to the following. Owner and Architect, may decline to attend at their discretion.

1. Owner's Representative

2. Architect.
3. Contractor.
4. Aluminum Entrance System Manufacturer.
5. Aluminum Entrance System Installer.
6. Glazed Window Wall Manufacturer.
7. Glazed Window Wall Installer.
8. Glazing Contractor.
9. Sealant Manufacturer.
10. Other interested parties.

B. Review methods and procedures related to glazing in aluminum entrance systems and glazed window wall systems including, but not limited to, the following:
   1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
   2. Review structural loading limitations.
   3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions.
   5. Review preparation and other requirements for installing structural sealant.

C. Contractor shall record discussion, including agreement or disagreement on significant matters. Furnish copies of report to all parties present within 5 days after meeting date.
   1. If substantial disagreements exist at conclusion of meeting, determine how disagreements will be resolved, and set date and time to reconvene meeting.

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data on each type of glazing provided: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Samples: Submit two samples 12 by 12 inch in size of each type of glazing indicated except for clear single pane glass.

E. Samples: Submit 12 inch long bead of glazing sealant, of each color required (except black) for each type of sealant exposed to view. Install sealant samples between two strips of material representing adjoining framing in colors being supplied for project.

F. Certification: Submit written certification from respective manufacturers attesting glass and glazing materials furnished for project comply with requirements.
   1. Separate certification will not be required for glazing materials bearing manufacturer's permanent labels designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authorities having jurisdiction.
   2. Certify secondary seals of insulated glass units are compatible with all glazing materials it will come in contact with (including structural silicone sealant) and that insulating glass seals will withstand structural loading requirements.

G. Compatibility and Adhesion Test Report: Submit statement from sealant manufacturer indicating glass and glazing materials have been tested for compatibility and adhesion with glazing sealants and interpreting test results relative to material performance, including recommendations for primers and substrate preparation needed to obtain adhesion.
   1. Compatibility test report from manufacturer of insulated glass unit edge sealant indicating glass edge sealants were tested for compatibility with other glazing materials including sealants, glazing tape, gaskets, setting blocks, and edge blocks.

1.06 QUALITY ASSURANCE

A. Single Source Responsibility for Materials: Provide materials produced by a single manufacturer for each kind and condition of material indicated.

B. Single Source Responsibility for Fabrication and Installation: Engage a fabricator/installer who shall assume undivided responsibility for all components of structural glazing work, including structural design and weatherproof integrity of the system in place.

C. Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, comply with CPSC 16 CFR Part 1201, Category II.
   1. Provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other agency acceptable to authorities having jurisdiction.

D. Pre-Construction Compatibility and Adhesion Testing: Submit samples of all materials including glass, glazing material and accessories, and framing support members proposed for use in contact with or proximity of glazing including structural sealant, to sealant manufacturer for compatibility and adhesion testing in accordance with sealant manufacturer's standard testing methods and the following requirements:
   1. Submit not less than four pieces of each type and finish of glass framing member and of each type, glass, kind, condition and form (monolithic, laminated, insulating units) of glass for adhesion testing and one sample of glazing material substrates (gaskets, setting blocks, spacers, etc.) for compatibility testing.
   2. Testing is not required when glazing sealant manufacturer can submit required preparation data acceptable to Architect; based on previous testing of current sealant products for adhesion to and compatibility with submitted glazing materials.

E. Consistency of appearance:
   1. Insulating glass with low emissivity coatings: Fabricate insulating glazing units to have the same orientation of the low-e coating throughout all of the glass units.

F. Structural Sealant: Provide manufacturer's structural glazing system that has been tested to demonstrate tensile or shear stress in structural silicone joints is not in excess of 20 psi with modulus of elasticity to allow no more than 25 percent movement of joint width, or less if required by sealant manufacturer.
   1. Provide supports and setting blocks at each light to support weight of glass; structural sealant shall not carry dead load of glass panels.

G. Perform Work in accordance with GANA (GM), GANA (LGRM), GANA (SM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.

H. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      a. Insulating Glass Certification Council (IGCC).
      b. Safety Glazing Certification Council (SGCC).

I. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Protect glass and glazing materials during delivery, storage, and handling to comply with manufacturer's directions and as required to prevent edge damage to glass, and damages to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and other causes.

1.08 FIELD CONDITIONS

A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when joint substrates are wet due to rain, frost, condensation or other causes. Install glazing sealants only when temperatures are in middle third of manufacturer's recommended installation temperature range.

B. Do not install glazing when ambient temperature is less than 40 degrees F.

C. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.09 WARRANTY

A. Insulating Glass Warranty: Provide written warranty signed by Manufacturer and Installer agreeing to provide replacement insulating glass units that deteriorate, freight on board point of manufacturer, freight allowed Project site, within specified warranty period indicated below.
   1. Manufacturing defects are defined as the following; provided the manufacturer’s instruction of handling, installing, protecting and maintaining units have been complied with during warranty period.
      a. Failure of hermetic seal of air space (beyond that due to glass breakage) as evidenced by intrusion of dirt or moisture, internal condensation or fogging.
      b. Deterioration of protected internal glass coating and other visual indications of seal failure or performance.
   2. Warranty Period: Ten (10) years after date of Substantial Completion.

B. Coated Glass: Provide written warranty signed by coated glass manufacturer agreeing to remove and replace coated glass units that deteriorate or have manufacturing defects. Warranty covers deterioration and defects due to normal conditions of use and not handling, installing, and cleaning practices contrary to glass manufacturer's published instructions.
   1. Warranty Period: Ten (10) years after date of substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glass Fabricators:
   1. Glass and Mirror Craft: www.glassandmirrorcraft.com
   2. Midwest Glass Fabricators: www.mwgf.com
   3. Tecnoglass: www.tecnoglass.com/#sle.
   4. Thompson I.G., LLC: www.thompsonig.com/#sle.
   5. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
   6. Viracon, Inc: www.viracon.com/#sle.

B. Float Glass Manufacturers:
   1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
   2. Guardian Glass, LLC: www.guardianglass.com/#sle.
   3. Saint Gobain North America: www.saint-gobain.com/#sle.
   4. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.

C. Etched Glass Manufacturers:
   1. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
   2. Guardian Glass, LLC: www.guardianglass.com/#sle.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.

2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges as follows:
   a. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
   b. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.
4. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
1. In conjunction with weather barrier related materials described in other sections <>.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7 computer program.
3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
4. Fully Tempered Safety Glass: Complies with 16 CFR 1201 - Category II criteria for safety glazing used in hazardous locations.
5. Heat-Soak Testing (HST): Provide HST of fully tempered glass used on point-supported, high-risk, or other demanding applications of project, to reduce risks of spontaneous breakage due to nickel sulfide (NiS) induced fractures in accordance with industry established testing requirements.
6. Thicknesses: As indicated; provide greater thickness as required for spans and loading.

2.04 FABRICATION

A. Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer.

B. Temper or heat strengthen glass where indicated or required for compliance with safety glass regulations or recommended by manufacturer/fabricator for size or thermal stress.

C. Clean cut or flat grind vertical edges of butt-glazed monolithic lights in manner to produce square edges with slight kerfs.

2.05 INSULATING GLASS UNITS

A. Manufacturers:
1. Guardian Glass, LLC: www.guardianglass.com/#sle.
2. Viracon, Apogee Enterprises, Inc: www.viracon.com/#sle.
3. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.

B. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

C. Where Basis of Design coating is indicated: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturer's listed above.

D. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Warm-Edge Spacers: Non-metallic material, stainless steel or thermally broken aluminum spacer capable of withstanding required loading with warm-edge technology design.
      a. Spacer Width: As required for specified insulating glass unit.
      b. Spacer Height: Manufacturer's standard.
   4. Spacer Color: Black.
   5. Edge Seal:
      a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
      b. Color: Black.
   6. Purge interpane space with dry air, hermetically seal.
   7. Dessicant: Manufacturer's standard.
   8. Where annealed glass is indicated in IGU's temper or heat strengthen glass where indicated and as required for compliance with safety glass regulations or recommended by manufacturer/fabricator for size or thermal stress.

E. Type GL-01 - Insulating Glass Units: Vision glass, double glazed.
   1. Outboard Lite: Annealed float glass, 1/4 inch thick, nominal.
      a. Coating: Low-E coating, on #2 surface.
         1) Basis of Design: Vitro Architectural Glass; Solarban 70
   2. Air space size: 1/2 inch, nominal.
   3. Total Thickness: 1 inch.
   4. Thermal Transmittance (U-Value), Winter - Center of Glass: Not greater than 0.24.
   5. Visible Light Transmittance (VLT): 64 percent, nominal.
   6. Shading Coefficient: 0.31, nominal.
   7. Solar Heat Gain Coefficient (SHGC): 0.27, nominal.

F. Type GL-02 - Insulating Glass Units: Etched glass, double glazed.
   1. Applications: Where indicated on Drawings.
   2. Space between lites filled with argon.
   3. Outboard Lite: Annealed float glass, 1/4 inch thick, nominal.
      a. Coating: Low-E coating, on #2 surface.
         1) Basis of Design: Vitro Architectural Glass; Solarban 70
   4. Air space size: 1/2 inch, nominal.
   5. Inboard Lite: Annealed float glass, 1/4 inch thick, nominal.
      a. Coating: Acid Etch, on #3 surface.
         1) Basis of Design: Vitro Architectural Glass; 100 Percent Etch Frit
   6. Thermal Transmittance (U-Value), Winter - Center of Glass: Not greater than 0.24.
   7. Visible Light Transmittance (VLT): 61 percent, nominal.
   8. Shading Coefficient: 0.31, nominal.
   9. Solar Heat Gain Coefficient (SHGC): 0.27, nominal.

2.06 GLAZING UNITS

A. Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Annealed float glass.
      a. Temper glass where indicated or required for compliance with safety glass regulations or recommended by manufacturer/fabricator for size or thermal stress.
   3. Tint: Clear.
   4. Thickness: As indicated on Drawings

2.07 GLAZING SEALANTS AND TAPES

A. General: Provide products of type indicated and complying with the following requirements:
   1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates under conditions of installation and service, as demonstrated by testing and field experience.
   2. Suitability: Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and condition at time of installation.
   3. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C920 requirements, including those for Type, Grade, Class, and Uses.
   4. Colors: As selected by Architect from manufacturer's standard color range.

B. High Modulus One-Part Silicone Sealant: Silicone sealant specifically designed and tested for use as structural sealant.

C. Low Modulus One-Part Silicone Sealant: Silicone sealant compatible with structural silicone for use as secondary seal (weather-seal) and for butt glazing. Weather-seal shall accommodate a 50 percent increase or decrease of joint width as measured at time of application per ASTM C719. Provide manufacturer’s recommended backer rod.
   1. Secondary structural silicone seal stress shall be designed considering that each light in an insulating glass unit, when both lights are of equal thickness, carries 50 percent of total applied wind load.

D. Preformed Glazing Tape: Butyl-based formulation with solids content of 100 percent; in extruded tape form; non-staining and non-migrating in contact with nonporous surfaces; packaged in rolls with release paper on one side; with or without continuous spacer rod as recommended by manufacturers of tape and glass for application indicated, per ASTM C1281 and AAMA 800.

E. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.08 ACCESSORIES

A. Setting Blocks: Neoprene, EPDM or silicone as required for compatibility with glazing sealants, with 80 to 90 Shore A durometer hardness; ASTM C864. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, EPDM or silicone as required for compatibility with glazing sealants, 50 to 60 Shore A durometer hardness; ASTM C864. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Edge Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant and tape, of size and hardness required to limit lateral movement (side-walking) of glass.

D. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with or without integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
   1. Width: As required for application.
   2. Thickness: As required for application.
   3. Spacer Rod Diameter: As required for application.

E. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

F. Glazing Clips: Manufacturer's standard type.

G. Compressible Filler Rods: Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with 5-10 psi compression strength for 25 percent deflection.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry immediately before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

3.04 INSTALLATION METHODS

A. Provide any of the following installation methods as appropriate for installation location, sequncing, and conditions, at contractors option.

3.05 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.06 INSTALLATION - DRY GLAZING METHOD (TAPE AND GASKET SPLINE GLAZING)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

B. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with butyl sealant.

C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

D. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.

E. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.

F. Carefully trim protruding tape with knife.

3.07 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

A. Application - Interior Glazed: Set glazing infills from the interior of the building.

B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.

C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.

E. Place glazing tape on free perimeter of glazing in same manner described above.

F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

G. Carefully trim protruding tape with knife.

3.08 INSTALLATION - WET GLAZING METHOD (SEALANT AND SEALANT)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

B. Place setting blocks at 1/4 points and install glazing pane or unit.

C. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch intervals, 1/4 inch below sight line.

D. Fill gaps between glazing and stops with sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.

E. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.09 INSTALLATION - WET GLAZING METHOD (COMPOUND AND COMPOUND)

A. Application - Interior Glazed: Set glazing infills from the interior of the building.

B. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch centers, kept 1/4 inch below sight line.

C. Locate and secure glazing pane using glazers' clips.

D. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

3.10 INSTALLATION - WET/DRY GLAZING METHOD (PREFORMED TAPE AND SEALANT)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

B. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with butyl sealant.

C. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.

D. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

E. 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.

F. Install removable stops, with spacer strips inserted between glazing and applied stops 1/4 inch below sight lines.
   1. Place glazing tape on glazing pane of unit with tape flush with sight line.

G. Fill gap between glazing and stop with _____ type sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch below sight line.

H. Apply cap bead of _____ type sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.11 INSTALLATION - WET/DRY GLAZING METHOD (TAPE AND SEALANT)

A. Application - Interior Glazed: Set glazing infills from the interior of the building.

B. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.

C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

D. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.

E. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.

F. Fill gaps between pane and applied stop with _____ type sealant to depth equal to bite on glazing, to uniform and level line.

G. Carefully trim protruding tape with knife.

3.12 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.13 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste. Do not apply markers to surfaces of glass. Remove non-permanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.

C. Remove and replace glass which is broken, chipped, cracked, abraded, or damaged in other ways during construction period, including natural causes, accidents, and vandalism.

D. Exercise extreme care in handling, installation and protection of spandrel glass and glass products with shatter resistant film. Repair or replace any damaged coatings or surfaces as acceptable to and determined solely by Architect.

END OF SECTION

SECTION 09 0561 - COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Carpet tile.
   2. Fluid Applied / Resinous Flooring

B. Preparation of new concrete floor slabs for installation of floor coverings.

C. Testing of concrete floor slabs for moisture and alkalinity (pH).

D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

E. Patching compound.

F. Remedial floor coatings.

1.03 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

F. CRI 104 - Standard for Installation of Commercial Carpet; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples for submittal procedures.

B. Visual Observation Report: For existing floor coverings to be removed.

C. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

D. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
   1. Manufacturer's qualification statement.

2. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.

E. Testing Agency's Report:
1. Description of areas tested; include floor plans and photographs if helpful.
2. Summary of conditions encountered.
3. Moisture and alkalinity (pH) test reports.
4. Copies of specified test methods.
5. Recommendations for remediation of unsatisfactory surfaces.
6. Submit report to Architect.
7. Submit report not more than two business days after conclusion of testing.

F. Adhesive Bond and Compatibility Test Report.

1.06 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.

B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

C. Contractor's Responsibility Relating to Independent Agency Testing:
1. Provide access for and cooperate with testing agency.
2. Confirm date of start of testing at least 10 days prior to actual start.
3. Allow at least 4 business days on site for testing agency activities.
4. Achieve and maintain specified ambient conditions.
5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer’s instructions and recommendations.

B. Deliver materials in manufacturer’s packaging; include installation instructions.

C. Keep materials from freezing.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.

B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment, compatible with adhesive and acceptable to flooring manufacturer.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:
1. Preliminary cleaning.
2. Moisture vapor emission tests; Per CRI 104; 1 per every 1,000 sq. ft., but not less than 3 tests total for a given area.
3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
5. Specified remediation, if required.
6. Patching, smoothing, and leveling, as required.
7. Other preparation specified.
8. Adhesive bond and compatibility test.
9. Protection.

B. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

3.03 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F1869 and as follows.

D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.

F. Report: Report the information required by the test method.

3.04 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F2170 Procedure A and as follows.

D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

F. Report: Report the information required by the test method.

3.05 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.

1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.

C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with requirements and recommendations of floor covering manufacturer.

C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 APPLICATION OF REMEDIAL FLOOR COATING

A. Comply with requirements and recommendations of coating manufacturer.

3.09 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 2116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Metal channel ceiling framing.

B. Gypsum wallboard.

C. Joint treatment and accessories.

1.03 REFERENCE STANDARDS

A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

C. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

D. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.

E. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

F. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.

G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.

I. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

J. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2020.

K. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

L. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

M. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

N. GA-214 - Levels of Finish for Gypsum Panel Products; 2021.

O. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Shop Drawings: Provide Shop Drawings indicating the following:
   1. Movement joint layout for all gypsum board surfaces.

C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system. Provide manufacturer's specifications and installation instructions for each gypsum wallboard component, including other data as required to show compliance construction documents.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of steel framing, and finishing materials through one source, from a single manufacturer. Each type of gypsum board and the finishing compound(s) used on that board must be obtained from a single source and a single manufacturer.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.

C. Handle board materials to prevent damage to edges, ends and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Environmental Conditions: Establish and maintain environmental conditions for application and finishing gypsum board per ASTM C840 and with gypsum board manufacturer's recommendations.

B. Minimum Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40 degF (4 degC). For adhesive attachment and finishing of gypsum board maintain not less than 50 degF (10 degC) for 48 hours prior to application and continuously thereafter until drying is complete.

C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216 complying with one of the following:
   1. ICC-ES Evaluation Report No. ESR-4358 (USG Interiors)
   2. ICC-ES Evaluation Report No. ESR-1308 and 1289 (Armstrong)
   3. ICC-ES Evaluation Report No. ESR--2631 (Chicago Metallic/Rockfon)
   4. ICC-ES Evaluation Report No. ESR-3336 (CertainTeed)

2.02 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

B. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. CEMCO: www.cemcosteel.com/#sle.
   2. ClarkDietrich: www.clarkdietrich.com.
   3. Jaimes Industries: www.jaimesind.com/#sle.
   4. MarinoWare: www.marinoware.com.
   5. MBA Metal Framing
   6. MRI Steel Framing, LLC
   7. State Building Products
   8. Telling Industries: www.tellingindustries.com/#sle.

C. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel ASTM A653/A653M, MinimumG40, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of framing of L/360 at 5 psf.
   1. Ceiling Channels: C-shaped.
      a. Minimum Thickness: 22 gage or 22 EQ

D. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

E. Non-structural Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

F. Grid Suspension Systems: ASTM C645 Steel grid system of main tees and support bars connected to structure using hanging wire.
   1. Products:
      a. Armstrong World Industries; FrameAll Drywall Grid
      b. Chicago Metallic Corp.; Drywall Grid
      c. CertainTeed Corporation; 1-1/2 inch Drywall Suspension System: www.certainteed.com/ceilings-and-walls/#sle.
      d. USG Corporation; Drywall Suspension System: www.usg.com/#sle.

2.03 BOARD MATERIALS

A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Thickness: Provide gypsum board in thickness indicated, or if not otherwise indicated, in 5/8 inch thickness.
   2. Application: Use for ceilings, unless otherwise indicated.
      a. Types:
         1) Regular, unless otherwise indicated.
         2) Mold Resistant where indicated.
      b. Edges: Tapered.
   3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
      a. Mold-resistant board is required at all exterior walls and gypsumboard walls/ceilings located in toilet and shower rooms.
   4. Paper-Faced Products:
      a. CertainTeed Corporation; Regular Gypsum Board / Type X & C
      b. Georgia-Pacific Gypsum; Tough Rock Gypsum Board / Tough Rock Type X & C
      c. National Gypsum Company; Gold Bond Brand Regular / Fireshield Type X & C
      d. USG Corporation; Sheetrock Brand Gypsum Panels / Sheetrock Brand Firecode X & C.
   5. Mold-Resistant, Paper-Faced Products:
      a. Certainteed Corporation; M2Tech and M2Tech Type X
      b. Georgia-Pacific Gypsum; ToughRock Mold-Guard and Fireguard X Mold-Guard.
      c. National Gypsum Company; Gold Bond XP Gypsum Board and XP Fireshield Gypsum Board.

2.04 GYPSUM BOARD ACCESSORIES

A. Interior Finishing Accessories: ASTM C1047, galvanized steel, rolled zinc, or rigid plastic, unless otherwise indicated. Provide with either knurled or perforated expanded flanges for nailing or stapling, and beaded for concealment of flanges, in joint compound. Provide tear away bead in profiles required to provide finished edges where gypsumboard abuts other materials.
   1. Shapes: As indicated below by reference to Figure 1 designations per ASTM C1047.
      a. Corner bead on outside corners, unless otherwise indicated.
         1) Horizontal Corners: Any corner bead meeting ASTM C1047, as specified above.
      b. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC beads for edge trim, unless otherwise indicated.
      c. L-bead with face flange only; face flange formed to receive joint compound.
      d. U-bead with face and back flanges; face flange formed to be left without application of joint compound. Use U-bead where indicated.
      e. One piece control joint formed with V-shaped slot and removable strip covering slot opening.

B. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Tape:
      a. Paper faced Gypsum Board: Paper reinforcing tape
      b. Mold Resistant Paper faced or Unfaced Gypsum Board: Glass mesh tape
   2. Joint Compound: Drying type, vinyl-based, ready-mixed.
      a. Manufacturer: Same as wall board being provided.
   3. Joint Compound: Setting type, field-mixed.
      a. Manufacturer: Same as wall board being provided.

C. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

D. Screws for Attachment to Steel Members From 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws for application of gypsum board to loadbearing steel studs; cadmium plated for exterior locations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates to which board attaches or abuts, installed hollow metal frames, cast in anchors and structural framing with installer(s) present for compliance with requirements for installation tolerances and other conditions affecting performance of gypsum board assemblies specified in this Section.

B. Verify that all electrical items in ceilings in contact with insulation are rated for insulation contact.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with AISI S220 and manufacturer's instructions.

B. Install supplementary framing, blocking and bracing at terminations in work and for support of fixtures, equipment services, heavy trim, toilet accessories, furnishings and similar construction to comply with details indicated and with recommendations of gypsum board manufacturer, or if none available, with "Gypsum Construction Handbook", published by United States Gypsum Co.

C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement, at locations indicated below to comply with details shown on drawings.
   1. Where suspended ceiling assemblies abut building structure horizontally at ceiling perimeters or penetrations of ceiling.

D. Do not bridge building expansion and control joints with steel framing or furring members, independently frame both sides of joints with framing or furring members or as indicated.

E. Suspended Ceilings: Space framing and furring members as indicated but not less than required by referenced steel framing standard.
   1. Level ceiling system to a tolerance of 1/1200 as measured both lengthwise in each member and transversely between parallel members.
   2. Laterally brace entire suspension system.
   3. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum not supporting structural or ceiling suspension system.
      a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying or other equally effective means.
   4. Where widths of ducts and other construction within ceiling plenum produce hanger spacings that interfere with the location of hangers at spacing required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

5. Secure wire hangers to structure, by looping or wire tying, directly to supporting structure, including intermediate framing members. Attach to inserts, eye screws, or other devices appropriate for structure to which hangers are attached as well as for type of hanger involved, in manner that will not cause deterioration or failure, due to age, corrosion or elevated temperatures.
6. Do not attach hangers to metal roof deck or metal deck tabs.
7. Do not connect or suspend steel framing from ducts, pipes or conduits.
8. Keep hangers and bracing 2 inches clear of ducts, pipes and conduits.
9. Sway-brace suspended steel framing with hangers used for support.
10. Installation Tolerances: Install steel framing components for suspended ceilings so cross furring members are level to within 1/8 inch in 12 ft. as measured both lengthwise in each member and transversely between parallel members.
11. Wire-tie or clip furring members to main runners and to other structural supports as indicated.
12. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension system abuts vertical surfaces. Mechanically join main beam and cross furring members to each other and butt cut to fit wall track.

F. Blocking: Install blocking for support of:
1. Framed openings.
2. Toilet partitions.
3. Other locations as indicated on Drawings.

3.03 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions.

B. Install gypsum board in manner to minimize end-butt joints or avoids them entirely where possible. At high walls, install boards horizontally with end joints staggered over studs.
1. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 24 inches in alternate courses of board.

C. Install ceiling boards across framing in manner to minimize end-butt joints, and avoids end joints in central area of each ceiling. Stagger end joints at least 24 inches.

D. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for light contact at edges and ends with not more than 1/16 inch open space between boards. Do not force into place.

E. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints.
1. Position boards so like edges abut, tapered edges against tapered edges and mill-cut or field-cut ends against mill-cut or field-cut ends.
2. Do not place tapered edges against cut edges or ends.
3. Stagger vertical joints over different studs on opposite sides of walls/partitions.

F. Attach gypsum board to steel studs so leading edge or end of each board is attached to open (unsupported) edge of stud flange first.

G. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.

H. Form control joints and expansion joints at locations indicated or as recommended, with space between edges of boards, prepared to receive trim accessories.

I. Cover both faces of steel stud wall/partition framing with gypsum board in concealed spaces (above ceiling, etc.), except in chase walls which are braced internally.

1. Except where concealed application is indicated or required for sound, fire, air or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. area, and may be limited to not less than 75 percent of full coverage.
2. Fit gypsum board around ducts, pipes and conduits.

J. Isolate perimeters of ceilings and non-load-bearing gypsum board walls/partitions at material abutments. Provide 1/4 to 1/2 inch space and trim edge with "U" bead edge trim. Seal joints with acoustical sealant unless fire resistant sealant is required.

K. Space fasteners in gypsum board in accordance with referenced gypsum board application and finishing standard and manufacturer's recommendations.

L. Space fasteners in panels that are tile substrates maximum 8 inches o.c.

3.04 METHODS OF GYPSUM BOARD APPLICATION

A. Single-Layer Application: Install gypsum board as follows:
1. On ceilings apply gypsum board prior to wall/partition board application to greatest extent possible.

B. Single-Layer Fastening Methods: Apply gypsum boards to metal supports with screws and to wood supports with nails.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. General: Where feasible, use same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports. Otherwise, fasten flanges to comply with manufacturer's recommendations.

B. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed. Provide type with face flange to receive joint compound except where "U" bead (semi-finishing type) is indicated.
1. Install "LC" bead where drywall construction is tightly butted to other construction and back flange can be attached to framing or supporting substrate.
2. Install "LK" bead where substrate is kerfed to receive long flange of trim.
3. Install "L" bead where edge trim can only be installed after gypsum board is installed.
4. Install U-type trim where edge is exposed, gasketed or sealant-filled (including expansion joints).

C. Install control joints at locations indicated, or if not indicated, at spacings and locations required by ASTM C840 and manufacturer's recommendations; and approved by Architect for visual effect.

D. Install reveals at locations indicated.

3.06 JOINT TREATMENT

A. General: Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim and control joints; penetrations; fastener heads, surface defects and elsewhere as required to prepare work for decoration.

B. Prefill open joints using setting-type joint compound.

C. Where patching and repair of holes in gypsum board is required, use setting-type compound to fill the void and finish with ready-mix drying type compound

D. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.

E. Finish interior gypsum wallboard by applying joint compound in three coats (not including prefill of openings in base), sand between coats, and after last coat. Provide setting or ready mix compounds as required to provide level of finish indicated without any shrinkage of joints.

F. Mold Resistant Gypsum Board: Finish using setting type joint compounds to prefill joints and embed tape, for first, fill (second), and finish (third) coats, with last coat being a sandable product. Smooth each coat before joint compound hardens to minimize sanding.

G. Finish gypsum board in accordance with levels defined in Gypsum Association GA-214 "Recommended Levels of Gypsum Board Finish", as follows:
   1. Level 1: Ceiling plenum areas and concealed areas, except provide higher level of finish as required to comply with fire resistance ratings and acoustical ratings.
      a. Embed tape in joint compound. Tool marks and ridges are acceptable.
   2. Level 2: Gypsum board substrate at tile, except remove tool marks and ridges.
      a. Embed tape in joint compound and apply first coat of compound. Cover fastener heads with joint compound.
   3. Level 3: Gypsum board substrate at areas of textured finishes and heavy duty wall coverings.
      a. Embed tape in joint compound and apply first and second coats of compound. Cover fastener heads with 2 coats of joint compound.
   4. Level 4: Gypsum board surfaces, except where another finish level is indicated.
      a. Embed tape in joint compound and apply first, second, and finish coats of compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat to produce a surface free of visual defects, ready for decoration.

H. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.
   2. Taping, filling, and sanding are not required at base layer of double-layer applications.

I. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 CLEANING AND PROTECTION

A. Promptly remove any residual joint compound from adjacent surfaces.

B. Provide final protection and maintain conditions, in manner suitable to Installer, to ensure gypsum board assemblies are without damage or deterioration at time of Substantial Completion.

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.09 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION

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SECTION 09 5100 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure interior acoustical ceilings are not installed until building is enclosed, dry, sufficient heat is provided, dust generating activities have terminated, and above ceiling work is completed, tested, and approved and humidity will be continuously maintained at values near those indicated for final occupancy.

B. Do not install acoustical units until after interior wet work is dry.

C. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with work of other trades that penetrate ceilings or is supported by them, including light fixtures, HVAC equipment and partition system.

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.

C. Product Data: Provide data on each suspension system components and acoustical units.

D. Samples: Submit two samples 6 by 6 inch in size illustrating material and finish of acoustical units. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

E. Samples: Submit two samples each, 12 inches long, of suspension system main runner, cross runner, and perimeter molding.

1.06 QUALITY ASSURANCE

A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Not less than three years of documented experience in installation of acoustical ceilings similar to this project and is acceptable to the manufacturer of acoustical units.

D. Single-Source Responsibility for Ceiling Units: Obtain each type of acoustical ceiling unit from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

E. Single-Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Deliver acoustical ceiling units to project site in original, unopened packages and store in a fully enclosed space, protected against damage from moisture, direct sunlight, surface contamination or other causes.

B. Before installing acoustical ceiling units, permit units to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264
   1. FireClass/Surface Burning Characteristics; ASTM E1264, Class A.
      a. Flame Spread, ASTM E84 : 25 or less.
      b. Smoke Developed, ASTM E84 : 50 or less.
   2. Light Reflectance: As indicated by product selection on Finish Key, determined in accordance with ASTM E1264.
   3. NRC Range: As indicated by product selection on Finish Key, determined in accordance with ASTM E1264.
   4. Articulation Class (AC): As indicated by product selection on Finish Key, determined in accordance with ASTM E1264.
   5. Ceiling Attenuation Class (CAC): As indicated by product selection on Finish Key, determined in accordance with ASTM E1264.

B. Acoustical Ceiling Panels: Provide products, colors and patterns as indicated on the Finish Key.

2.02 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, stabilizer bars, clips, and splices as required.
   1. Materials:
      a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

B. Exposed Suspension System: Hot-dip galvanized steel grid and steel or aluminum cap.
   1. Structural Classification: Heavy-duty, when tested in accordance with ASTM C635/C635M.
   2. Profile: Tee; 15/16 inch face width.
   3. Finish: Baked enamel.
   4. Products:
      a. Armstrong World Industries, Inc; Prelude XL Fire Guard 15/16 inch Exposed Tee: www.armstrongceilings.com/#sle.
      b. CertainTeed Corporation; 15/16 inch EZ Stab Classic System : www.certainteed.com/ceilings-and-walls/#sle.
      c. Rockfon; Chicago Metallic 1200 15/16 inch.
      d. USG Corporation; Donn Brand DX/DXL 15/16 inch Acoustical Suspension System: www.usg.com/ceilings/#sle.

2.03 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

B. Hanger Wire: Provide wire sized so that stress at 3 times hanger design load (ASTM C635/C635M, Table 1, Direct-Hung), will be less than yield stress of wire, but provide not less than 12 gauge, 0.08 inch galvanized steel wire.

C. Perimeter Moldings: Same metal and finish as grid.
   1. Size: As required for installation conditions and specified Seismic Design Category.
   2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
   3. Gaskets For Perimeter Moldings: Closed-cell foam, factory-applied to molding.
   4. Acoustical Sealant For Perimeter Moldings: Non-hardening, non-skinning, for use in conjunction with suspended ceiling system.
   5. At Curved walls: Provide prefabricated edge moldings to fit radius of curved walls.

D. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

C. Examine substrates and structural framing to which ceiling system attaches or abuts with installer present for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling system.

D. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders, and comply with reflected ceiling plans.

B. Install after major above-ceiling work is complete.

C. Coordinate the location of hangers with other work.

D. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C 636/C 636M and ASTM C 636/C 636M and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size. Comply with reflected ceiling plans. If there is a conflict notify Architect.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces, at junctions with other interruptions and where necessary to conceal edges of acoustical units.
   1. Sealant Bed: Apply continuous ribbon of acoustical sealant, concealed on back of vertical leg before installing moldings.
   2. Use longest practical lengths.
   3. Screw-attach moldings to substrate at intervals not over 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12'-0". Miter corners accurately and connect securely.

E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying or other equally effective means.

G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels and install supplemental suspension members and hangers in forms of trapezes or equivalent devices to span the extra distance.
   1. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

J. Do not eccentrically load system or induce rotation of runners.

K. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews or other devices that are secure and appropriate for substrate, and in manner that will not cause deterioration or failure due to age, corrosion or elevated temperatures.

L. Do not support ceilings directly from permanent metal forms; furnish cast-in-place hanger inserts that extend through forms.

M. Do not attach hangers to steel roof deck or deck tabs. Attach hangers to structural members.

N. Space hangers not more than 4’-0" o.c. along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than 8 inches from ends of each member.

O. Install suspension system runners square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

3.04 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Accurately fit acoustical units into suspension system runners and edge molding, free from damaged edges or other defects detrimental to appearance and function.

C. Where not possible to have full acoustical panel module, field cut edges to provide same appearance as factory reveal edge. Field apply matching paint to cut edges. Resulting appearance must be acceptable to Architect.

D. Fit border trim neatly against abutting surfaces.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.
   3. Double cut and field paint exposed reveal edges.
   4. Resulting appearance must be acceptable to Architect.

G. Lay acoustical insulation as indicated on Drawings extending over full area and butting joints tight, if extent not indicated install for a distance of 48 inches either side of acoustical partitions as indicated. Do not cover light fixtures.

3.05 CLEANING

A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings and suspension members. Comply with manufacturer’s instructions for cleaning and touch-up of minor finish damage.

B. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

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SECTION 09 6500 - RESILIENT FLOORING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Resilient base.

B. Installation accessories.

1.03 REFERENCE STANDARDS

A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Provide data on specified products and accessories, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

1. Submit manufacturers final cleaning instructions and maintenance cleaning instructions with the methods being used for this installation indicated by circling or highlighting. Final cleaning methods are for Architect's information only and are not for approval.

C. Test Reports: Indicating vapor emission rate and diagram showing vapor emission test locations and results of relative humidity test.

D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.05 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain each type, color and pattern of resilient base and accessory from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

B. Installer Qualifications: Company specializing in installing work of similar size and scope with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in manufacturer's original, unopened cartons and containers, each bearing names of products and manufacturer, project identification, and shipping and handling instructions. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

D. Protect roll materials from damage by storing on end.

E. Store tile on flat surfaces.

1.07 FIELD CONDITIONS

A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 65 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F but not greater than 95 degrees F..

C. Close spaces to traffic during base installation and for time period after installation recommended by manufacturer.

D. Install resilient base and accessories after other finishing operations, including painting, have been completed.

PART 2 PRODUCTS

2.01 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; as indicated on finish key and as follows:
   1. Manufacturers:
      a. As indicated on Finish Key
   2. Height: 4 inches.
   3. Thickness: 0.125 inch.
   4. Finish: Satin.
   5. Style: B - coved.
   6. Length: Minimum 100 foot rolls.
   7. Corners: Job Formed

2.02 ACCESSORIES

A. Rubber Edge and Reducer Strips: 1/8 inch thick, homogeneous rubber, profiles as scheduled.
   1. Color: As indicated on Finish Schedule.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by base manufacturer.

C. Adhesive (Cements): Water-resistant, stabilized type as recommended by base manufacturer to suit material and substrate conditions.

D. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based formulation provided or approved by base covering manufacturer for applications indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to base manufacturer, free of cracks that might telegraph through base , clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of base to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Prohibit traffic until filler is fully cured.

B. Remove coatings, including curing compounds, and other substances that are incompatible with base adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

C. Clean substrate. Broom and vacuum clean substrates to be covered immediately before installing base. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

D. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of substrate conditions.

B. Install in accordance with manufacturer's written instructions.

3.04 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall surfaces.

3.05 CLEANING

A. Perform the following operations immediately after installing base products:
   1. Remove adhesive and other surface blemishes using cleaner recommended in writing by base manufacturer.
   2. Sweep and vacuum thoroughly.
   3. Do not wash base until after time period recommended in writing by base manufacturer.
   4. Damp-mop floor to remove marks and soil using method and cleaner per base manufacturer's recommendations.

B. Protect base against mars, marks, indentations, and other 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 base manufacturer.

C. Clean in accordance with manufacturer's written instructions.
   1. Clean resilient materials not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean materials per manufacturer's written recommendations.

END OF SECTION

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SECTION 09 6700 - FLUID-APPLIED FLOORING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Resinous flooring.

1.03 REFERENCE STANDARDS

A. ANSI A326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials; 2021.

B. ANSI/NFSI B101.1 - Test Method for Measuring the Wet SCOF of Hard-Surface Walkways; 2022.

C. ANSI/NFSI B101.3 - Test Method for Measuring the Wet DCOF of Hard Surface Walkways; 2020.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples for submittal procedures.

B. Product Data: Provide data on specified systems and products, describing system components, application sequence, physical and performance characteristics; sizes, patterns and colors available.

C. Samples: Submit two samples, 3 by 3 inch in size illustrating color; texture, including level of slip resistance; and pattern for each floor material for each color specified.

D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports, including a diagram showing vapor emission test locations and results of relative humidity test.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, and sealing or finish coats, through one source from a single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

B. Applicator Qualifications: Engage an experienced installer (applicator) who has specialized in installing resinous flooring similar in material, design, and extent to this Project and who is acceptable to resinous flooring manufacturer.

1.06 PRE-INSTALLATION MEETING

A. Schedule a pre-installation meeting minimum two weeks prior to start of resinous flooring installation and associated work.
   1. Meet at the Project Site with the following parties in attendance. Owner and Architect, may decline to attend at their discretion.
      a. Owner’s Representative.
      b. Architect.
      c. Contractor.
      d. Resinous Flooring Contractor.
      e. Resinous Flooring Manufacturer’s Representative.
      f. Installers of associated work.
      g. Other parties concerned with performance of resinous flooring, including authorities having jurisdiction.
   2. Tour representative areas where resinous flooring is to be installed.
      a. Inspect and discuss conditions to be encountered.
      b. Discuss preparation work required to be performed by other trades.

3. Proceed with resinous flooring installation only where everyone concerned agrees that required ambient conditions can be maintained.

B. Contractor shall record discussion, including agreement or disagreement on significant matters. Furnish copies of report to all parties present within 5 days after meeting date.
   1. If substantial disagreements exist at conclusion of meeting, determine how disagreements will be resolved, and set date and time to reconvene meeting.

1.07 MOCK-UPS

A. Construct mock-up(s) of fluid applied flooring to serve as basis for evaluation of texture and workmanship.
   1. Number of Mock-Ups to be Prepared: One.
   2. Use same materials and methods for use in the work.
   3. Locate where directed.
   4. Minimum Size: 48 inches by 48 inches.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

C. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.09 FIELD CONDITIONS

A. Maintain minimum temperature in storage area in accordance with manufacturers recommendations

B. Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring installation.

PART 2 PRODUCTS

2.01 FLUID-APPLIED FLOORING SYSTEMS

A. Fluid-Applied Flooring: Epoxy base coat(s), with troweled aggregate.
   1. Aggregate: Quartz granules.
   2. First Broadcast: Two-component, epoxy.
   3. Second Broadcast: Two-component, epoxy.
   4. Grout Coat: Polyasparatic.
   5. Top Coat: Polyasparatic.
   6. System Thickness: 1/8 inch, nominal, dry film thickness (DFT).
   7. Base: Coved, height as indicated on Finish Key.
   8. Texture: Slip resistant.
   9. Slip Resistance of System:
      a. Wet Static Coefficient of Friction(SCOF):ANSI/NFSI B101.1 : Greater than 0.6
      b. Wet Dynamic Slip Resistance (DCOF), ANSI/NFSI B101.3 : Greater than 0.60.
   10. Color: As indicated on Finish Key.
   11. Basis of Design Product: Sherwin-Williams High-Performance Flooring; Resuflor Deco Quartz DB23
   12. Other Acceptable Manufacturers: Subject to compliance with requirements provide Basis of Design product or comparable product by one of the following:
      a. Protective Industrial Polymers: www.protectiveindustrialpolymers.com/
      b. Stonhard: www.stonhard.com/#sle.

2.02 ACCESSORIES

A. Preformed Cove Base Substrate: Preformed polyster cove base substrate for epoxy coating.
   1. Basis of Design: SpeedCove; Integral Cove Base
   2. Height: As indicated on Drawings.

B. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.

C. Primer: Type recommended by fluid-applied flooring manufacturer.

D. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resinous material.

C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for fluid-applied flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section09 0561 - Common Work Results for Flooring Preparation .
   2. Obtain instructions if test results are not within limits recommended by fluid-applied flooring manufacturer.

3.02 PREPARATION

A. General: Prepare and clean substrate according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminates incompatible with resinous flooring.
   1. Profile surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.

C. Vacuum clean substrate.

D. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

E. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

F. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

3.03 INSTALLATION - ACCESSORIES

3.04 INSTALLATION - FLOORING

A. Apply in accordance with manufacturer's instructions o produce a uniform, monolithic wearing surface of thickness indicated..
   1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate and optimum intercoat adhesion.
   2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
   3. At expansion and isolation joints, provide joints in resinous flooring to comply with resinous flooring manufacturer's written recommendations.

a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Apply troweled or screeded body coat(s) in thickness indicated. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.

C. Apply each coat to minimum thickness required by manufacturer.

D. Integral Cove Base: Apply cove base mix to wall surfaces at locations indicated. Round internal and external corners. Install cove base according to manufacturer's written instructions and details including taping, mixing, priming, troweling, sanding, and topcoating of cove base.

E. Apply top coat to resinous base floor as recommended by resinous flooring manufacturer to produce finish indicated. Apply in number of coats and at spreading rates recommended in writing by manufacturer.

F. Install flooring in recessed type floor access covers.

G. At movable partitions install flooring under partitions without interrupting floor pattern.

3.05 FIELD QUALITY CONTROL

A. Material Sampling: Owner may at any time and any number of times during flooring application require material samples for testing for compliance with requirements.
1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified and sealed, and certified in presence of Contractor.
2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's Product Data.
3. If test results show installed materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

B. Slip resistance testing: Perform wet static and dynamic slip coefficient of friction of completed floor installation. Demonstrate compliance with performance values indicated in Part 2 of this Section..

3.06 CLEANING AND PROTECTION

A. Barricade area to protect flooring until fully cured.

B. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

C. Clean resinous flooring not more than 4 days before date of Substantial Completion in each Project area. Use cleaning materials and procedures recommended in writing by resinous flooring manufacturer.

END OF SECTION

SECTION 09 6813 - TILE CARPETING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Extent, location and details for carpet tile are shown on the drawings and in schedules. Work of this section includes carpet and all accessories.

1.03 REFERENCE STANDARDS

A. 16 CFR 1630 - Standard for the surface Flammability of Carpets and Rugs (FF 1-70); Current Edition.

B. CRI 104 - Standard for Installation of Commercial Carpet; 2015.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Shop Drawings: Indicate layout and placement of cut tiles. Indicate pile or pattern direction, start points, and locations and types of edge strips. Indicate columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tile. Show installation details at special conditions.

C. Product Data: Provide data for each type of carpet tile material and installation accessory required. Submit written data on physical characteristics, durability, fade resistance, and fire test response. Submit methods of installation for each type of substrate.
   1. Provide written limits for moisture, alkalinity and internal relative humidity by flooring material manufacturers and adhesive manufacturers being provided for the project.

D. Samples of verification purposes in manufacturer's standard size, showing full range of colors, texture, and pattern variations expected. Prepare samples from same material to be used for the Work. Submit the following:
   1. Full-size carpet tile of each type required.
   2. 12-inch-long samples of each type exposed edge stripping and accessory item.

E. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

F. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience.

B. Single Source Responsibility: Provide material produced by a single manufacturer for each carpet tile type.

C. Comply with standards, requirements and recommendations of CRI 104.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Deliver materials to project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number.

B. Comply with CRI 104, Section 7: “Site Conditions” and the following. Where the requirements differ comply with the most restrictive of the requirements.
   1. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Lay flat, blocked off ground.
   2. Store materials in area of installation for minimum period of 72 hours prior to installation.

3. Maintain minimum 70 degrees F ambient temperature 48 hours prior to, during and 24 hours after installation.
4. Ventilate installation area during installation and for 72 hours after installation.

1.07 WARRANTY

A. Submit a written warranty executed by Contractor, Installer and Manufacturer, agreeing to repair or replace carpet tile which fails in materials or work quality within the specified warranty period. Failures include excessive surface wear, edge ravel, zippering, backing delamination, watermarking, change in physical properties or deterioration of materials and construction beyond normal wear.
   1. Warranty period is five years after the date of Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

A. Carpet Tile: As indicated on the Finish Key.

B. Carpet Tile Surface Burning Characteristics: Provide carpet tile identical to that tested for the following fire performance characteristics, per test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify carpet tile with appropriate markings of applicable testing and inspecting organization.
   1. Provide only carpet which has been tested and passes the Federal Flammability Standard 16 CFR 1630 (the pill test).
   2. Rating: Pass.

2.02 ACCESSORIES

A. Carpet Edge Guard: Extruded or molded heavy-duty vinyl or rubber of size and profile indicated; minimum 2-inch-wide anchorage flange; colors as selected by Architect from manufacturer's standard color range.

B. Trowelable Underlayments and Patching Compounds: As recommended by carpet manufacturer.

C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.
   2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
   3. Follow moisture and alkalinity remediation procedures in Section 09 0561 - Common Work Results for Flooring Preparation.

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Level subfloor within 1/4 inch in 10 feet, noncumulative, in all directions. Sand or grind protrusions, bumps, and ridges. Patch and repair rough areas. Fill depressions.
   1. Use leveling and patching compounds to fill cracks, holes, depressions in subfloor as recommended by manufacturer.

2. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
3. When substrates require vapor emission floor treatment, apply leveling and patching compounds after floor treatment.

C. Clear away debris and scrape up cementitious deposits, existing adhesive, and other detrimental materials, from concrete surfaces to receive carpet tile.

D. Broom, vacuum, and otherwise clean subfloors to be covered with carpet tile in manner recommended by carpet tile manufacturer.

E. Apply primer/sealer to concrete floor slab substrate as recommended by manufacturer. Primer/sealer shall be compatible with adhesive applied to carpet tile.

3.03 INSTALLATION

A. Do not allow carpet tile work to proceed until subfloor surfaces are satisfactory.

B. Starting installation constitutes acceptance of subfloor conditions.

C. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).

D. Maintain uniformity of carpet direction and lay of pile, unless otherwise indicated.

E. Blend carpet from different cartons to ensure minimal variation in color match.

F. Dry-fit sections of carpet tile prior to application of releasable adhesive.

G. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps. Extend carpet tile under removable flanges and furnishings and into alcoves and closets of each space.

H. Lay carpet tile in pattern indicated on Drawings.

I. Apply releasable adhesive uniformly to substrate per manufacturer's instructions. Butt edges tight to form seams without gaps.

J. Install carpet edge guard where edge of carpet tile is exposed; anchor guards to substrate.

K. Trim carpet tile neatly at walls and around interruptions.

L. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces, using manufacturers recommended cleaning practices.

B. Remove and dispose of debris and unusable scraps.

C. Clean and vacuum carpet surfaces. Using commercial machine having face-beater element. Remove soil. Replace carpet tiles where soil cannot be removed. Remove protruding face yarn.

D. Provide final protection and maintain conditions, in manner acceptable to manufacturer and installer, to ensure carpet tile is not damaged or deteriorated at time of Substantial Completion. Do not use plastic coverings as they may retard the proper curing of adhesives. Comply with recommendations of CRI 104.

END OF SECTION

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SECTION 09 9100 - PAINTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Extent of painting work is shown on Drawings and Schedules and by provisions of this Section.

B. Work includes surface preparation, painting and finishing of interior and exterior items and surfaces throughout project, except as otherwise indicated.
   1. Surface preparation, priming and finish coats of paint specified in this Section are in addition to shop-priming and surface treatment specified under other Sections.

C. "Paint" includes coating systems materials, primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

D. Paint exposed surfaces whether or not colors or finishes are designated in "schedules", except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces.
   1. Painting includes field painting exposed bare and covered (insulated) pipes and ducts, hangers, exposed steel and iron equipment, including sprinkler piping except as otherwise indicated. Do not paint pipe markers, color coded banding tape, pipe/duct tags, stenciled identification. Where piping and ductwork are to be painted to meet facilities color coding standard, paint surfaces according to color guidelines in Division 22 and 23, using paint systems and preparation designated in this Section.
   2. If color of finish is not designated, the Architect will select from colors or finishes specified.

E. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts and labels.
   1. Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
   2. Concealed surfaces include wall surfaces behind lockers, wood paneling, and other applied panels.

1.03 REFERENCES

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.

C. ASTM D523 - Standard Test Method for Specular Gloss; 2014 (Reapproved 2018).

D. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.04 DEFINITIONS

A. General: Standard coating terms defined in ASTM D16 apply to this Section.

B. Sheen: As defined by the Master Painters Institute (MPI).
   1. Wherever reference is made to sheen finish or gloss, provide reflectivity, when measured with a gloss meter per ASTM D523, as follows for each designation:

	Designation	**60 degree units**	**85 degree units**
Level 1	Flat	5 maximum	10 maximum
Level 2	Velvet	10 maximum	10 to 35
Level 3	Eggshell	10 to 25	10 to 35

Level 4	Satin	20 to 35	35 minimum
Level 5	Semi-gloss	35 to 70	N/A
Level 6	Gloss	70 to 85	N/A
Level 7	High Gloss	greater than 85	N/A

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Submit product data for each paint system specified including block fillers and primers.
   1. Provide manufacturer's technical information including label analysis and instructions for handling, storage and application of each material proposed for use.
   2. List each material and cross-reference the specific coating, finish system and application. Identify each material by the manufacturer's catalog number and general classification.
   3. Provide certification by manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's).

C. Samples for Initial Verification Purposes: Provide samples of each color, sheen and material to be applied, with texture to simulate actual conditions, on 12 inch by 12 inch card stock.
   1. Samples submitted must be dry.
   2. Resubmit until required color, sheen and texture is achieved.
   3. Do not order paint materials until Architect has reviewed and accepted samples for initial verification.

1.06 QUALITY ASSURANCE

A. Single Source Responsibility: Provide primers and undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

1.07 FIELD SAMPLES

A. Field Samples: On wall surfaces and other exterior and interior components, duplicate finishes of prepared samples.
   1. Provide full-coat finish samples on minimum 100 sq. ft. of surface until required sheen, color, and texture are obtained; simulate finished lighting conditions for review of in-place work.
   2. Final acceptance of colors will be from field samples.
   3. Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
      a. Apply coatings in room or surface in accordance with schedule or as specified.
      b. After finishes are accepted, room or surface will be used for evaluation of coating systems of a similar nature.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Deliver materials to job site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Federal Specification number, if applicable.
   4. Manufacturer's stock number and date of manufacture.
   5. Contents by volume, for pigment and vehicle constituents.
   6. Thinning instructions.
   7. Application instructions.
   8. Color name and number.

B. Store materials not in use in tightly covered containers in well ventilated area at minimum ambient temperature of 45 degF. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage areas neat and orderly. Remove oily rags and water daily. Take necessary measures to ensure workers and work areas are protected from fire and health hazards resulting from handling, mixing and application.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Apply water-based paints only when temperature of surfaces to be painted and surrounding air temperature are between 50 degF and 90 degF.

B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperature are between 45 degF and 95 degF.

C. Do not apply paint in snow, rain, fog or mist, when relative humidity exceeds 85 percent, at temperatures less than 5 degF above the dew point, or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

D. Do not apply paint where conditions of airborne debris or contamination exist or could exist.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements including color selection, provide products as indicated in paint schedules in Part 3.

B. Manufacturer Abbreviations:
   1. Moore - Benjamin Moore and Co.
   2. PPG - PPG Paints
   3. PRO - Prosoco
   4. SW - The Sherwin-Williams Co.

2.02 MATERIALS

A. Material Compatibility: Provide block fillers, primers, finish coat materials and related materials compatible with one another and the substrates indicated under conditions of service and application as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

C. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

D. Colors: Acceptability of any manufacturer is contingent upon availability of colors, sheens and textures matching those indicated on Room Finish Schedule as acceptable to Architect.

E. Volatile Organic Compound (VOC) Content:
   1. Provide coatings that comply with the most stringent requirements specified in the following:
      a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
      b. Architectural coatings VOC limits of State in which the project is located.
   2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with paint application requirements. Surfaces receiving paint must be thoroughly dry before paint is applied.
   1. Do not begin to apply paint until unsatisfactory conditions have been corrected.
   2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
   1. Notify Architect about anticipated problems using materials specified over substrates primed by others.

3.02 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures and similar items already installed that are not to be painted. Where removal is not practical, provide surface-applied protection prior to surface preparation and painting.
   1. Do not remove Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment names, identification, performance rating or nomenclature plates.
   2. Protect adjacent surfaces with suitable covering or other method during work progress. Mask, or protect with suitable coverings, sealing and glazing compound, glass, gauges, moving parts of machinery and other mechanical equipment such as valve stems, sprinkler heads and similar items.
   3. After completion of painting operations, reinstall items removed using workers skilled in trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean new and previously painted (existing) substrates of substances that could impair the bond of the various coatings. Remove oil and grease prior to cleaning.
   1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted in conformance with manufacturer's instructions for each particular substrate condition and specified.
   1. Provide barrier coats over incompatible primers or remove and reprime. Notify Architect in writing about anticipated problems using specified finish-coat material with substrates primed by others.
   2. Cementitious Materials: Prepare concrete and concrete masonry surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils and release agents. Roughen as required to remove glaze. If hardeners and sealers have been used to improve curing, use mechanical methods of surface preparation.
      a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
      b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish to blister and burn, correct this condition before application.
         1) Do not paint surfaces where moisture content exceeds that permitted in manufacturer’s written instructions.
      c. Clean concrete floors to be painted with a 5 percent muriatic acid solution or other etching cleaner. Flush floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum.
   3. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods in compliance with the Society for Protective Coatings recommendations.

a. Clean steel surfaces as recommended by paint system manufacturer and the requirements of SSPC-SP 6.
b. Touch up bare areas and damaged shop-applied prime coats. Wire brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as shop coat.

D. Materials Preparation: Carefully mix and prepare paint materials per manufacturer's directions.
1. Maintain containers used in mixing and applying paint in clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density; stir as required during application.
a. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
3. Use only thinners approved by painting manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match color of finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.03 APPLICATION

A. Apply paint per manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces or conditions detrimental to formulation of a durable paint film.
1. Paint colors, surface treatments and finishes as indicated in schedules.
2. Provide finish coats compatible with primers used.
3. The number of coats and film thickness required is the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by the manufacturer.
a. Sand between applications where sanding is required to produce an even smooth surface per manufacturer's directions.
b. Give special attention to ensure surfaces, including edges, corners, crevices, welds and exposed fasteners receive a dry film thickness equivalent to flat surfaces.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles and similar components are in place. Extend coatings in these areas as required to maintain system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.
7. Paint backside of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms and side edges same as exterior faces.
9. Sand lightly between each succeeding coat.

C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
a. Sand between applications where sanding is required to produce an even smooth surface per manufacturer's directions.
2. Omit primer on metal surfaces that have been shop primed and touch up painted.

a. At existing, previously painted surfaces, apply finish coats only.

3. Apply additional coats if undercoats, stains, and other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance.
   a. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky or moderate thumb pressure and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

D. Application Procedures: Apply paints and coating by brush, roller, spray or other applicators per manufacturer's directions.

E. Minimum Coating Thickness: Apply materials no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of entire system as recommended by manufacturer.

F. Mechanical and Electrical Work: Painting mechanical and electrical work is limited to items without factory finish exposed in occupied spaces.

G. Block Fillers: Apply block fillers to concrete masonry block at rate to ensure complete coverage with pores filled.

H. Prime Coats: Before applying finish coats, apply a prime coat of material as recommended by manufacturer to material required to be painted or finished and not prime coated by others.
   1. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

I. Pigmented (Opaque) Finishes: Completely cover to provide a smooth opaque surface of uniform finish, color, appearance and coverage.
   1. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

J. Completed Work: Match approved samples for color, sheen texture and coverage. Remove, refinish or repaint work not complying with specified requirements.

3.04 CLEANING AND PROTECTION

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish and other discarded paint materials from the site.
   1. After completion of painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

B. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting as acceptable to Architect.

C. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
   1. At completion of construction activities of other trades, touchup and restore damaged or defaced painted surfaces.

3.05 INTERIOR PAINT SCHEDULE

A. General: Provide the following paint systems for the various substrates indicated.

B. Concrete Masonry Units:
   1. Eggshell Acrylic Epoxy Coating System: Provide 2 finish coats with total dry film thickness not less than that recommended by the manufacturer over concrete masonry block filler.
      a. Filler Coat: Concrete Masonry Block Filler.
         1) Moore: Ultra Spec High Build Masonry Block Filler 571
         2) PPG:6-15XI Speedhide Int/Ext Acrylic Masonry Latex Block Filler.
         3) SW: PrepRite Interior / Exterior Block Filler B25 Series

b. First and Second Finish Coats: High Performance Acrylic Epoxy Coating applied at a spreading rate recommended by manufacturer to achieve a total dry film thickness of not less than that recommended by the manufacturer.
   1) Moore: Corotech Precatalyzed Waterborne Epoxy Eggshell V342
   2) PPG: Pitt-Glaze WB1 Interior Eggshell Pre-Catalyzed Water-Borne Acrylic Epoxy 16-1310
   3) SW: Pro Industrial Pre Catalyzed Waterbased Epoxy Eg-Shel K45 Series

C. Gypsum Wall Board:
   1. Flat Acrylic Finish: 2 finish coats over a primer.
      a. Primer (New gypsumboard): Latex-based, interior primer applied at spreading rate recommended by manufacturer to achieve a total dry film thickness not less than that recommended by the manufacturer.
         1) Moore: Drywall Primer 380 or Ultra Spec 500 Primer N534
         2) PPG: Speedhide Primer 6-2
         3) SW: ProMar 200 0 VOC Primer B28 Series
      b. First and Second Coats: Flat acrylic-latex, interior enamel applied at spreading rate recommended by manufacturer to achieve a total dry film thickness not less than that recommended by the manufacturer.
         1) Moore:Super Hide Latex Flat 282 or Ultra Spec 500 Flat T535 (Deep Base) as required for color indicated on Finish Key.
         2) PPG: Speedhide zero VOC Latex Flat 6-70ZV Series
         3) SW: ProMar 200 Zero VOC Interior Flat B30 Series

D. Interior Hollow Metal Doors and Frames:
   1. Semi Gloss Waterbased Alkyd Urethane Enamel: Paint with 2 finish coats over a rust-inhibitive primer.
      a. Prime Coat: Rust inhibitive metal primer, as recommended by manufacturer, applied at spreading rate to achieve a total dry film thickness not less than that recommended by the manufacturer.
         1) S-W: Pro Industrial ProCryl Universal Primer B66
      b. First and Second Coat: Semi-gloss, waterbased alkyd urethane enamel applied at spreading recommended by manufacturer to achieve a total dry film thickness not less than that recommended by the manufacturer.
         1) S-W: Pro Industrial Waterbased Alkyd Urethane Enamel B53

END OF SECTION

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SECTION 09 9600 - HIGH PERFORMANCE COATINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Extent of high performance coating work is shown on Drawings and schedules and by provisions of this Section.

B. Work includes surface preparation and application of high performance coatings to designated exterior and interior steel surfaces.
   1. Surface preparation, priming and finish coats of high performance coating systems specified in this Section are in addition to shop-priming and surface treatment specified under other Sections.

1.03 REFERENCES

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.

B. ASTM D523 - Standard Test Method for Specular Gloss; 2014 (Reapproved 2018).

C. SSPC-SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals; current version.

1.04 DEFINITIONS

A. General: Standard coating terms defined in ASTM D16 apply to this Section.

B. Sheen: As defined by the Master Painters Institute (MPI).
   1. Wherever reference is made to sheen finish or gloss, provide reflectivity, when measured with a gloss meter per ASTM D523, as follows for each designation:

	Designation	60 degree units	85 degree units
Level 1	Flat	5 maximum	10 maximum
Level 2	Velvet	10 maximum	10 to 35
Level 3	Eggshell	10 to 25	10 to 35
Level 4	Satin	20 to 35	35 minimum
Level 5	Semi-gloss	35 to 70	N/A
Level 6	Gloss	70 to 85	N/A
Level 7	High Gloss	greater than 85	N/A

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Submit product data for each high performance coating system specified including primers and undercoat material.
   1. Provide manufacturer's technical information including label analysis and instructions for handling, storage and application of each material proposed for use.
   2. List each material and cross-reference the specific coating, finish system and application. Identify each material by the manufacturer's catalog number and general classification.

C. Samples for Initial Verification Purposes: Provide samples of each color, sheen and material to be applied, with texture to simulate actual conditions, on 12 inch by 12 inch card stock. Resubmit until required color, sheen and texture is achieved. Do not order paint materials until Architect has reviewed and accepted samples for initial verification.

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

1.06 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed coating system applications similar to this Project and with a record of successful in-service performance.

B. Source Limitations: Obtain high performance coating materials from one source and by a single manufacturer.

1.07 FIELD SAMPLES

A. Field Samples: On wall surfaces and other exterior and interior components, duplicate finishes of prepared samples. Provide full-coat finish samples on minimum 100 sq. ft. of surface until required sheen, color, texture, and quality of work quality are obtained; simulate finished lighting conditions for review of in-place work.
   1. Final acceptance of colors and work quality will be from field samples.
   2. Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted. Apply coatings in room or surface in accordance with schedule or as specified. After finishes are accepted, room or surface will be used for evaluation of coating systems of a similar nature.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Deliver materials to job site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Manufacturer's stock number and date of manufacture.
   4. Contents by volume, for pigment and vehicle constituents.
   5. Thinning instructions.
   6. Application instructions.
   7. Color name and number.

B. Store materials not in use in tightly covered containers in a well ventilated area at a minimum ambient temperature of 45 degF (7 degC). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage areas neat and orderly. Remove oily rags and water daily. Take necessary measures to ensure workers and work areas are protected from fire and health hazards resulting from handling, mixing and application.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Do not install materials when temperature is below 55 degF or above 90 degF.

B. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.

C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

D. Restrict traffic from area where coating is being applied or is curing.

E. Apply high performance coatings only when temperature of surfaces to be painted and surrounding air temperature are between 50 degF and 90 degF.

F. Do not apply high performance coatings in snow, rain, fog or mist, when the relative humidity exceeds 85 percent, at temperatures less than 5 degF above the dew point, or to damp or wet surfaces.

1. High performance coating work may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements including color selection, provide products of one of the following except as otherwise indicated:
   1. Carboline(Carboline)
   2. PPG Industries, Pittsburgh Paints(PPG)
   3. Tnemec Company, Inc.(TCI)
   4. Sherwin Williams (SW)

2.02 MATERIALS

A. Material Compatibility: Provide primers, finish coat materials and related materials compatible with one another and the substrates indicated under conditions of service and application as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best quality high performance coating materials of types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

C. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

D. Colors: Provide color selection made by Architect from manufacturer’s full range of standard colors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, under which high performance coating application will be performed for compliance with paint application requirements. Surfaces receiving paint must be thoroughly dry before paint is applied.
   1. Notify Architect in writing about anticipated problems using coating systems specified.
   2. Proceed with coating application only after unsatisfactory conditions have been corrected.
   3. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. General Procedures: Protect adjacent surfaces with suitable covering or other method during work progress. Mask, or protect with suitable coverings.

B. Cleaning: Before applying paint or other surface treatments, clean substrate of substances that could impair bond of high performance coatings. Remove oil and grease prior to cleaning.

C. Surface Preparation: Clean and prepare surfaces to be coated per manufacturer's instructions for each particular substrate condition and specified.
   1. Provide barrier coats over incompatible primers or remove and reprime. Notify Architect in writing about anticipated problems using specified finish-coat material with substrates primed by others.
   2. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods. Abrasive blast clean substrate to comply with requirements of SSPC-SP 16.

D. Materials Preparation: Carefully mix and prepare high performance coating materials according to manufacturer's instructions to achieve a smooth, uniform color and consistency.
   1. Maintain containers used in mixing and applying high performance coating in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
3. Use only thinners approved by high performance coating manufacturer and only within recommended limits.

E. Application Procedures: Apply high performance coatings by brush, roller, spray or other applicators according to manufacturer's directions.

F. Minimum Coating Thickness: Apply materials no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by the manufacturer.

G. Prime Coats: Before applying finish coats, apply a prime coat of material as recommended by manufacturer to material required to be coated or finished and not prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

H. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not complying with specified requirements.

3.03 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke quality control test procedures at any time and as often as the Owner deems necessary during the period when coating operations are being conducted:
1. The Owner will engage the services of a qualified independent testing agency to sample coatings used. Samples of material delivered to the Project site will be taken, identified and sealed, and certified in presence of the Contractor.
2. If results show materials do not comply with requirements, the Contractor may be directed to stop work, remove noncomplying materials, pay for testing, recoat surfaces coated with rejected materials, or remove rejected materials from previously coated surfaces if, on recoating with specified materials, the two coatings are not compatible.

3.04 CLEANING

A. Cleanup: Clean spilled or spattered materials from adjacent surfaces not to be coated, immediately before coating has achieved an initial set. Do not scratch or damage adjacent finished surfaces.
1. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from the Project site.
2. Clean tools, brushes, and containers at the end of each workday.

3.05 EXTERIOR COATING SCHEDULE

A. General: Provide the following high performance coating systems for the various exterior substrates indicated.

B. Zinc-Coated Metal: Provide the following finish systems over zinc-coated (galvanized) metal primer. Test for passivators. Prepare surface properly, if present.
1. Semi-Gloss Urethane Enamel Finish: Urethane finish coat over polyamide epoxy undercoat. Touch-up galvanized coating with zinc rich urethane primer.
a. Undercoat: Polyamide epoxy undercoat, as recommended by manufacturer, applied at spreading rate to achieve a total dry film thickness of not less than that recommended by manufacturer.
1) Carboline: Carboguard 890 VOC
2) TCI: Hi-Build Epoxoline II Series L69
3) SW: Macropoxy 646 FC B58 Series
b. Finish Coat: Semi-gloss, aliphatic acrylic urethane enamel or polysiloxane applied at spreading recommended by manufacturer to achieve a total dry film thickness not less than that recommended by manufacturer.

1) Carboline: Carbothane 133 MC
2) TCI: Endura-Shield Series 1095
3) SW: Hi-solids Polyurethane 250 B65 Series

END OF SECTION

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SECTION 09 9713.13 - THERMAL BARRIER COATING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Extent of thermal barrier coating for steel is shown on Drawings by provisions of this Section.

B. Work includes surface preparation, priming and application of coatings to designated steel surfaces.

1.03 RELATED SECTIONS

A. Section 05 1200 - Structural Steel Framing; for structural steel.

1.04 REFERENCES

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

D. SSPC-SP 2 - Hand Tool Cleaning; 2024.

E. SSPC-SP 3 - Power Tool Cleaning; 2024.

F. SSPC-SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals; current version.

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Submit product data for thermal barrier coating system specified including primers, intermediate and finish material.

1. Provide manufacturer's technical information including label analysis and instructions for handling, storage and application of each material proposed for use.
2. List each material and cross-reference the specific coating, finish system and application. Identify each material by the manufacturer's catalog number and general classification.

1.06 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed coating system applications similar to this Project and with a record of successful in-service performance.

B. Source Limitations: Obtain coating materials from one source and by a single manufacturer.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Deliver materials to job site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.

B. Store materials not in use in tightly covered containers in a well ventilated area at a minimum ambient temperature of 45 degF. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage areas neat and orderly. Remove oily rags and water daily. Take necessary measures to ensure workers and work areas are protected from fire and health hazards resulting from handling, mixing and application.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not install materials when temperature is outside of manufacturers recommended application range for surface or air temperature.

B. Maintain recommended temperature range, 24 hours before, during, and 72 hours after installation of coating.

C. Do not apply coatings in snow, rain, fog or mist, when the relative humidity exceeds 85 percent, at temperatures less than 5 degF above the dew point, or to damp or wet surfaces.
   1. Coating work may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide the following:
   1. Prime Coat:
      a. Tnemec Company, Inc.;Series 1224 Epoxoline WB at 4.0-8.0 mils DFT
   2. Intermediate Coat:
      a. Tnemec Company, Inc.; Series 971 Aerolon at 50 - 60 mils DFT
   3. Finish Coat:
      a. Tnemec Company, Inc.; Series 971 Aerolon at 50 - 60 mils DFT
   4. Top Coat: Use where exterior steel coated with Aerolon will be exposed to view.
      a. Tnemec Company, Inc.; Series 1095 Endurashield at 2-3 mils DFT
   5. Top Coat: Use where interior steel coated with Aerolon will be exposed to view.
      a. Tnemec Company, Inc.; Series 1028 Enduratone at 2-3 mils DFT

B. Performance:
   1. Thermal Conductivity, ASTM C518: 0.2468 BTU-in/sq.ft.-hr-degF
   2. Flame Spread, ASTM E84: Not greater than 25
   3. Smoke developed, ASTM E84: Not greater than 450

2.02 MATERIALS

A. Material Compatibility: Provide primers, finish coat materials and related materials compatible with one another and the substrates indicated under conditions of service and application as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best quality coating materials of types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

2.03 ACCESSORIES

A. Thermally insulative tape: Self adhesive tape with insulative particles for low thermal conductivity to control condensation.
   1. Thermal Conductivity, ASTM C177: 0.3446 BTU-in/sq.ft.-hr-degF
   2. Tape thickness: 1.5 mm
   3. Basis of Design: Tnemec; Series 945 Aerolon Tape
      a. Primer: Manufacturers recommended primer for substrate conditions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, under which coating application will be performed for compliance with paint application requirements. Surfaces receiving paint must be thoroughly dry before paint is applied.
   1. Notify Architect in writing about anticipated problems using coating systems specified.
   2. Proceed with coating application only after unsatisfactory conditions have been corrected.
   3. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. General Procedures: Protect adjacent surfaces with suitable covering or other method during work progress. Mask, or protect with suitable coverings.

B. Cleaning: Before applying paint or other surface treatments, clean substrate of substances that could impair bond of coatings. Remove oil and grease prior to cleaning.

C. Surface Preparation: Clean and prepare surfaces to be coated per manufacturer's instructions for each particular substrate condition and specified.
   1. Provide barrier coats over incompatible primers or remove and reprime. Notify Architect in writing about anticipated problems using specified finish-coat material with substrates primed by others.
   2. Ferrous Metals: Clean ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
      a. Clean steel surfaces as recommended by paint system manufacturer and the requirements of SSPC-SP 2 or SSPC-SP 3.
      b. Touch up bare areas and damaged shop-applied prime coats. Wire brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as shop coat.
   3. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods. Abrasive blast clean substrate to comply with requirements of SSPC-SP 16.

D. Materials Preparation: Carefully mix and prepare coating materials according to manufacturer's instructions to achieve a smooth, uniform color and consistency.
   1. Maintain containers used in mixing and applying coating in a clean condition, free of foreign materials and residue.
   2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
   3. Use only thinners approved by coating manufacturer and only within recommended limits.

3.03 APPLICATION

A. Application Procedures: Apply coatings by brush, roller, spray or other applicators according to manufacturer's directions.

B. Minimum Coating Thickness: Apply materials no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by the manufacturer.

C. Prime Coats: Before applying finish coats, apply a prime coat of material as recommended by manufacturer to material required to be coated or finished and not prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

D. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not complying with specified requirements.

E. Tape application:
   1. Direct to Metal: Apply tape to surface and heat activate and back roll in accordance with manufacturers written instructions.
   2. Primed surfaces: Apply manufacturers recommended primers, according to primer application instructions. Allow primer to fully cure prior to application of tape. heat activate and back roll in accordance with manufacturers written instructions.
   3. Tape to tape: Apply tape to surface and heat activate and back roll in accordance with manufacturers written instructions.

3.04 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke quality control test procedures at any time and as often as the Owner deems necessary during the period when coating operations are being conducted:
   1. The Owner will engage the services of a qualified independent testing agency to sample coatings used. Samples of material delivered to the Project site will be taken, identified and sealed, and certified in presence of the Contractor.
   2. If results show materials do not comply with requirements, the Contractor may be directed to stop work, remove noncomplying materials, pay for testing, recoat surfaces coated with rejected materials, or remove rejected materials from previously coated surfaces if, on recoating with specified materials, the two coatings are not compatible.

3.05 CLEANING

A. Cleanup: Clean spilled or spattered materials from adjacent surfaces not to be coated, immediately before coating has achieved an initial set. Do not scratch or damage adjacent finished surfaces.
   1. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from the Project site.
   2. Clean tools, brushes, and containers at the end of each workday.

END OF SECTION

SECTION 09 9723.16 - CONCRETE FLOOR SEALER

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Application of concrete sealer to horizontal surfaces indicated on drawings and schedules and by provisions of this Section.

B. Surface preparation and application of concrete sealers to designated surfaces.

1.03 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Submit concrete sealer product data and manufacturer's technical information including label analysis and instructions for handling, storage and application of each material proposed for use.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed coating system applications similar in material and extent to this Project and with a record of successful in-service performance.

B. Source Limitations: Obtain concrete sealer materials from one source and by a single manufacturer.

1.05 DELIVERY, STORAGE, AND PROTECTION

A. Deliver materials to job site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Contents by volume, for pigment and vehicle constituents.
   4. Thinning instructions.
   5. Application instructions.

B. Sealer material containers not displaying manufacturer's product identification will not be acceptable.

C. Store materials not in use in tightly covered containers in a well ventilated area at a minimum ambient temperature of 45 degF or temperature recommended by manufacturer, whichever is greater. Maintain containers used in storage in clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage areas neat and orderly. Take necessary measures to ensure workers and work areas are protected from fire and health hazards resulting from handling, mixing and application.

1.06 PROJECT CONDITIONS

A. Apply concrete sealer only when the temperature of surfaces to be sealed and surrounding air temperature are between 50 degF and 90 degF.

B. Do not apply concrete sealer in snow, rain, fog or mist, when the relative humidity exceeds 85 percent, at temperatures less than 5 degF above the dew point, or to damp or wet surfaces.
   1. Concrete sealer work may continue during inclement weather if surfaces and areas to be sealed are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide the following:
   1. Curecrete Chemicals; Ashford Formula.
   2. Dayton Superior; Day Chem Sure Hard (J-17).
   3. L & M Construction Chemicals, Inc.; Seal Hard.
   4. ChemMasters, Inc.; Chemisil
   5. H&C Concrete; Endurapolish Clear Liquid Hardener and Densifier
   6. Prosoco; Blended Densifier-1
   7. Sika USA; Sikafloor-957 SSD

B. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.02 MATERIALS

A. Material Compatibility: Provide prime coat and related materials compatible with one another and substrates indicated under conditions of service and application as demonstrated by manufacturer based on testing and field experience.

B. Sealer Compound: Water-based penetrating chemical hardener and dustproofer that seals, hardens, and densifies concrete floors. Develops a polished look with age.

C. Color: Clear.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, under which concrete sealer application will be performed for compliance with application requirements. Surfaces receiving sealer must be thoroughly dry before sealer is applied.
   1. Notify Contractor in writing about anticipated problems using sealer systems specified.
   2. Proceed with sealer application only after unsatisfactory conditions have been corrected.
   3. Application of sealer indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. General Procedures: Protect adjacent surfaces with suitable covering or other method during work progress. Mask, or protect with suitable coverings.

B. Cleaning: Before applying sealer, clean substrate of substances detrimental to concrete sealers. Remove oil and grease prior to cleaning.

C. Surface Preparation: Clean and prepare surfaces to be sealed according to manufacturer's instructions for each particular substrate condition and specified.

D. Materials Preparation: Carefully mix and prepare concrete sealer materials according to manufacturer's instructions to achieve a uniform coating.
   1. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
   2. Use only thinners approved by concrete sealer manufacturer and only within recommended limits.

3.03 APPLICATION

A. Apply concrete sealer in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Do not apply concrete sealers over dirt, grease, moisture, or conditions detrimental to sealer.
   1. The number of coats and film thickness required is the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by the manufacturer.

2. Apply additional coats until film is of uniform finish, color and appearance. Give special attention to ensure that surfaces, including edges, corners, and crevices receive a dry film thickness equivalent to that of flat surfaces.

C. Application Procedures: Apply concrete sealers by brush, roller, spray or other applicators according to manufacturer's directions and as follows:

D. Minimum Coating Thickness: Apply materials no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.

3.04 CLEANING AND PROTECTION

A. Cleanup: Clean spilled or spattered materials from adjacent surfaces not to be coated, immediately before sealer has achieved an initial set. Do not scratch or damage adjacent finished surfaces.

B. Protect work of other trades from damage by concrete sealer work. Correct damage by cleaning, repairing, or replacing as acceptable to Architect. Leave work in an undamaged condition.

END OF SECTION

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SECTION 10 1419 - DIMENSIONAL LETTER SIGNAGE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Dimensional letter signage.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Manufacturer's product literature for each type of dimensional letter sign, indicating style, font, colors, locations, and overall dimensions of each sign.

C. Shop Drawings:
   1. Include dimensions, locations, elevations, materials, text and graphic layout, and attachment details.

D. Samples: Submit one sample of each type of dimensional letter sign of size similar to that required for project, indicating sign style, font, and method of attachment.

E. Selection Samples: Where materials, colors, and finishes are not specified, submit two sets of selection charts or chips.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.

B. Single-Source Responsibility: For each separate type of sign, required, obtain signs from one source from a single manufacturer.

C. Design Criteria: The drawings indicate size, profiles, and dimensional requirements of signs .

1.06 PROJECT CONDITIONS

A. Coordinate electrical work for electrical service and final connections to illuminated signage with Contractor and Electrical Contractor.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package dimensional letter signs as required to prevent damage before installation.

1.08 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain minimum ambient temperature during and after installation.

1.09 WARRANTY

A. Provide a written warranty signed by the Manufacturer and Installer agreeing to repair or replace all illuminated exterior dimensional letter signage which fails in materials and work quality including, but not limited to, fading, peeling, delamination, warping (“oil canning”) or installation defects.

B. Duration of Warranty is five years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Non-Illuminated Dimensional Letter Signs:
   1. APCO Graphics
   2. A.R.K. Ramos Signage Systems, Inc.Gemini, Inc.
   3. ASI Sign Systems
   4. Best Sign Systems
   5. Impact Architectural Signs
   6. Steelart

2.02 PERFORMANCE REQUIREMENTS

A. Design exterior dimensional letter signs and mounting devices to withstand a 30 psf wind load normal to the sign in addition to the weight of the sign. Sign Contractor shall determine appropriate method of anchoring signs to locations specified to meet these requirements and all local code requirements.

2.03 DIMENSIONAL LETTERS

A. Applications: As indicated on Drawings. Verify placement and specific signage lettering with owner
   1. Use individual metal letters.
   2. Mounting Location: Exterior as indicated on drawings.

B. Metal Letters:
   1. Material: Aluminum sheet, fabricated reverse channel.
   2. Thickness: 0.25 inch minimum.
   3. Letter Height: 10 inches.
   4. Text and Typeface:
      a. Character Font: Gill Sans MT, Bold.
      b. Character Case: Upper and lower case (title case).
   5. Finish: Color Anodized, Dark Bronze.
   6. Mounting: 10 inch standoffs with concealed fasteners.

2.04 FABRICATION

A. Design, fabricate, and install dimensional letter signage to prevent buckling and overstressing fasteners.

B. Conceal fasteners.

2.05 ACCESSORIES

A. Concealed Screws: Noncorroding metal; stainless steel.

B. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosive resistance. Furnish inserts, as required, to be set into concrete or masonry work.

C. Bituminous Coatings: Cold-applied asphalt mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Locate signage and accessories where indicated, using mounting methods recommended by manufacturer for substrate and wind conditions.

C. Install signage level, plumb, true, and at height indicated.

D. Install signage products such that there are no misalignments between visible components. Correct any installation misalignments to satisfaction of Architect.

E. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

F. At completion of the installation, clean soiled sign surfaces per manufacturer's instructions. Protect from damage until Substantial Completion; repair or replace damaged items. Replace all damaged or defective signs with new units.

END OF SECTION

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SECTION 10 1423 - PANEL SIGNAGE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Panel signage.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.

C. Shop Drawings:
   1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
   2. Schedule: Provide information sufficient to completely define each panel sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
      a. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
      b. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
      c. Submit for approval by Owner through Architect prior to fabrication.

D. Samples: Submit two samples of each type of sign, of size similar to that required for project, indicating sign style, font, and method of attachment.

E. Selection Samples: Where colors, materials, and finishes are not specified, submit two sets of color selection charts or chips.

F. Manufacturer's qualification statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.

B. Single-Source Responsibility: For each separate type of sign, required, obtain signs from one source from a single manufacturer.

C. Design Criteria: The drawings indicate size, profiles, and dimensional requirements of signs .

D. Code Compliance: All signs must meet the requirements of the current State of Michigan Barrier Free Design Law.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Store tape adhesive at normal room temperature of 68 to 72 degrees F..

1.07 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Inpro Corporation; Santa Cruz Collection: www.inprocorp.com/#sle.

B. Other Acceptable Manufacturers: Subject to compliance with requirements provide Basis of Design product or comparable product by one of the following:
   1. 2/90 Sign Systems
   2. APCO Graphics
   3. ASI Sign Systems
   4. Best Sign Systems, Inc: www.bestsigns.com/#sle.
   5. Takeform: www.takeform.net/#sle.
   6. Vista System LLC: www.vistasystem.com/#sle.

2.02 REGULATORY REQUIREMENTS

A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.03 PANEL SIGNAGE

A. Panel Signage:
   1. Application: Restroom, Operations, and Concessions signs.
   2. Description: Flat signs UV direct digital printed media, tactile characters.
   3. Sign Size: 6 inches by 8 inches.
   4. Sign Edges: Squared.
   5. Corners: Squared.
   6. Color and Font, unless otherwise indicated:
      a. Character Font: ADA Gills Sans.
      b. Character Case: Upper case only.
      c. Background Color: Black.
      d. Back Plate Color: To match Inpro Corporation: Amber Cherry 0547
      e. Character Color: Contrasting color.
   7. Non-text graphics
      a. Obtain Art Copy from Owner prior to completing shop Drawings. Submit shop Drawing indicating Art work to Owner for final approval.
   8. Material:UV direct digital printed letters and braille on rigid vinyl.
   9. Profile: Flat panel without frame.
   10. Tactile Letters: Raised 1/32 inch minimum.
   11. Braille: Grade II, ADA-compliant.
   12. One-Sided Wall Mounting: Tape adhesive.

2.04 ACCESSORIES

A. Tape Adhesive: Double-sided tape, permanent adhesive.

B. Backplates: Provide backplates matching signage background color and material for all signs mounted to glass surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install level, plumb and at height in compliance with ADA requirements. Signage surfaces shall be free from distortion or other defects in appearance.

C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1. Align edge of signage 2 inches from edge of door jamb, unless otherwise indicated or required for compliance with ADA Standards and ICC A117.1. Use mounting method indicated.

D. At completion of the installation, clean soiled sign surfaces per manufacturer's instructions. Protect from damage until Substantial Completion; repair or replace damaged items. Replace all damaged defective signs with new units.

END OF SECTION

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SECTION 10 2113.19 - PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Solid plastic toilet compartments.

B. Urinal screens.

1.03 REFERENCE STANDARDS

A. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Field Measurements: Verify dimensions by field measurements before fabrication and show recorded measurements on Shop Drawings.
   1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication without field measurements. Coordinate construction to ensure actual dimensions correspond to guaranteed dimensions.

B. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: For each type and style of compartment provide data on panel construction, hardware, and accessories.

C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall, floor, and ceiling supports, door swings. Show locations of cutouts for compartment-mounted toilet accessories.

D. Samples: Submit two sets of samples of partition panel material, 3 by 3 inch in size illustrating full range of panel finish, color, and sheen available.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Solid Plastic Toilet Compartments:
   1. All American Metal Corp - AAMCO: www.allamericanmetal.com/#sle.
   2. ASI Accurate Partitions: www.asi-accuratepartitions.com/#sle.
   3. ASI Global Partitions: www.asi-globalpartitions.com/#sle.
   4. Hadrian: www.hadrian-inc.com/#sle.
   5. Metpar Corp: www.metpar.com.
   6. Partition Systems International of South Carolina: www.psisc.com/#sle.
   7. Scranton Products: www.scrantonproducts.com/#sle.

2.02 PLASTIC TOILET COMPARTMENTS

A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-to-ceiling anchored.
   1. Color: Metallic Bronze 9513, Pebble Grained Finish.

B. Doors:
   1. Thickness: 1 inch.
   2. Width: 24 inch.
   3. Width for Handicapped Use: 36 inch with minimum 32 inch clear opening, out-swinging.

4. Height: 55 inch.

C. Panels:
1. Thickness: 1 inch.
2. Height: 55 inch.

D. Pilasters:
1. Thickness: 1 inch.
2. Width: As required to fit space; minimum 3 inch.

2.03 FABRICATION

A. General: Provide standard doors, panels, screens, and pilasters fabricated for compartment system. Provide units with cutouts and drilled holes to receive compartment-mounted hardware, accessories, and grab bars, as indicated.
1. Provide aluminum heat-sink strips at exposed bottom edges of HDPE units to prevent burning.

B. Furnish units with cut-outs, drilled holes, and internal reinforcement to receive partition mounted hardware, accessories, and grab bars, as indicated.

C. Floor-to-Ceiling-Anchored Compartments: Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

2.04 ACCESSORIES

A. Pilaster Shoes: Formed plastic to match, 3 inch high, concealing floor fastenings.
1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Brackets: Anodized aluminum; continuous type.

C. Attachments, Screws, and Bolts: Stainless steel.
1. For attaching panels and pilasters to brackets: Through-bolts and nuts.

D. Hinges: Anodized aluminum, manufacturer's standard finish.
1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.

E. Door Hardware: Anodized aluminum; satin finish.
1. Door Latch: Thumb turn or sliding door latch with exterior emergency access feature.
2. Door Strike and Keeper with Rubber Bumper: Mount on pilaster in alignment with door latch.
3. Provide door pull for outswinging doors.
4. Provide door pulls on both sides of all barrier free and ambulatory stall doors.

F. Coat Hook with Rubber Bumper: One per compartment, mounted on door.
1. Provide two hooks at barrier free compartments. Mount one hook at barrier free height, one hook at standard height.

G. Provide door pull for outswinging doors.

H. Provide door pulls on both sides of all barrier free and ambulatory stall doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that field measurements are as indicated on shop drawings.

C. Verify correct spacing of and between plumbing fixtures.

D. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.
   1. Locate brackets so anchors occur in masonry joints.

D. Attach panels and pilasters to brackets.

E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

F. Floor-to-Ceiling-Anchored Compartments: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

B. Adjust hinges to position doors in full closed position when unlatched. Return out-swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

3.05 CLEANING AND PROTECTION

A. Clean exposed surfaces using materials and methods recommended by partition manufacturer.

B. Field touch-up of scratches or damaged enamel finish will not be permitted. Replace damaged or scratched materials with new materials.

C. Provide final protection and maintain conditions to ensure toilet compartments and screens are without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 10 2800 - TOILET ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. The following toilet accessories shall be furnished by the Owner, installed by the Contractor (OFCI).
   1. Toilet tissue dispenser.
   2. Soap dispenser.

B. Commercial toilet accessories.

C. Commercial shower and bath accessories.

D. Diaper changing stations.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Submit manufacturer's technical data for each toilet accessory item specified including details of construction relative to materials, dimensions, gages, profiles, method of mounting, specified options and finishes.

C. Setting Drawings: Provide setting drawings where cutouts are required in other work including templates, substrate preparation instructions and directions for preparing cutouts and installing anchorage devices.

1.06 QUALITY ASSURANCE

A. Single Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Architect.

1.07 COORDINATION

A. Inserts and Anchorages: Furnish accessory manufacturer's standard inserts and anchoring devices that must be set in concrete or built into masonry. Coordinate delivery with other work to avoid delay.

B. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

PART 2 PRODUCTS

2.01 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Keys: Provide 6 keys for each accessory to Owner; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

2.02 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

B. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.

2.03 COMMERCIAL TOILET ACCESSORIES

A. Mirrors
   1. Stainless Steel Mirrors
      a. Frameless stainless steel with bright polished finish, minimum 22 gage. Provide 1/4 inch return on all edges and tempered hardboard backing.
      b. Mounting: Provide exposed screw mounting. Provide mounting screws with finish washers.
         1) Use heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring special tool to remove.
      c. Size:
         1) 24 inches x 36 inches.
      d. Basis of Design: Bobrick No. B-1556 x 2436.

B. Grab Bars
   1. Stainless Steel Type: Provide grab bars with minimum 18 gage (0.050 inch) wall thickness and as follows:
   2. Grab Bars: Stainless steel, peened surface.
      a. Standard Duty Grab Bars:
         1) Push/Pull Point Load: 250 pound-force, minimum.
         2) Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
         3) Length and Configuration: As indicated on drawings.
         4) Products:
            (a) Bobrick; B6806.99 Series
            (b) Bradley Corporation; 812-7 Series

C. Sanitary Napkin Disposal
   1. Surface Mounted Unit: Stainless steel unit equipped removable plastic receptacle. Provide self closing door in front panel. Equip front panel with piano hinge and tumbler lock.
      a. Basis of Design: Bobrick No. B-254.
      b. Other acceptable products: Subject to compliance with requirements provide Basis of Design or one of the following comparable products:
         1) American Specialties, Inc.; 0473-1A

2.04 SHOWER ACCESSORIES

A. Folding Bench Seat: Wall-mounted folding bench with retractable folding legs. 0.5 inch thick phenolic seat mechanically fastened to type 304 satinless steel framing, wall mounting brackets, and fold-down support legs.
   1. Finish: Teak Phenolic
   2. Basis of Design: Seachrome Corparation; Model No. SSB2-420200-PTS
      a. Other Acceptable Manufacturers: Subject to compliance with requirements provide Basis of Design product or comparable product as approved by Architect.

2.05 ELECTRIC HAND/HAIR DRYERS

A. Warm Air Hand Dryer: Surface mounted, rapid drying, infrared sensor activation, satin stainless steel, air outlet nozzle, UL labeled, not less than 0.67 hp, minimum 16,000 rpm motor, 1250w air heater, 60 second maximum timed power cutoff if hands are not removed.
   1. Basis of Design: American Specialties, Inc.; 0196-93

2.06 DIAPER CHANGING STATIONS

A. Diaper Changing Stations
   1. Surface Mounted Plastic and Stainless Steel Unit: Horizontal design, plastic unit with stainless steel veneer with hinged changing surface, polyethylene interior embedded with microban antimicrobial, child safety strap, and built-in sanitary liner dispenser. Equip with pneumatic cylinder for controlled opening and closing of bed. Withstands loads up to 50 pounds.
      a. Basis of Design: Koala Care Products; KB300-01SS
      b. Other Acceptable Manufacturers: Subject to compliance with requirements provide Basis of Design product or comparable product by one of the following:
         1) American Specialties, Inc.
         2) Bradley Corporation
   2. Recessed Stainless Steel Unit: Horizontal design, stainless steel unit with hinged changing surface, polyethylene interior embedded with microban antimicrobial, child safety strap, and built-in sanitary liner dispenser. Equip with pneumatic cylinder for controlled opening and closing of bed. Withstands loads up to 350 pounds.
      a. Products:
         1) Koala Care Products; KB310-SSRE
         2) American Specialties, Inc.; 9013
         3) Bradley Corporation; 962

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

D. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Mounting Heights: Refer to Drawings and as required by accessibility regulations, unless otherwise indicated.

3.03 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

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SECTION 10 4116 - EMERGENCY KEY CABINETS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. High security key box for storage of building keys and other small items required for emergency access to building.

1.03 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Provide manufacturer's product data and installation details of high security key box.

C. Shop Drawings: Indicate location in wall and anchorage devices required.

D. Certificates: Certify products of this section meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of experience.

1.05 PROJECT CONDITIONS

A. Coordinate installation of key box with other trades.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. At the time of the writing of this specification the following products were approved by the Authorities Having Jurisdiction (AHJ). Prior to provision of key lock box and padlock confirm that model indicated is still approved by AHJ.

B. Knox Company; Knox Box 3200

C. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.02 HIGH SECURITY KEY BOX

A. Key Box Construction:
   1. Steel plate, 1/4 inch thick, all welded construction.
   2. Hinged door, 1/2 inch thick steel plate, with weather resistant gasket.
   3. Lock: UL listed high security lock with double action rotating tumblers and hardened steel pins accessed by a biased cut key with 1/8 inch stainless steel dust cover and provision for tamper proof seal.
   4. Box Size: Capacity for up to 10 keys or access cards
   5. Mounting: Surface mount.
   6. Provide with UL listed alarm tamper switches.

B. Finish: Polyester powder coat finish, aluminum color.

PART 3 EXECUTION

3.01 COORDINATION

A. Coordinate installation and anchorage of recessed mounting box with masonry trades.

3.02 EXAMINATION

A. Verify recessed mounting is installed level and plumb, ready to accept high security key box. Recessed mounting box shall be installed such that high security key box cover is flush with finished wall.

3.03 INSTALLATION

A. Install mounting box level and plumb, ready to receive high security key box.

B. Anchor mounting box and high security key box in manner recommended by manufacturer.

C. Coordinate connection to building alarm systems with electrical trades.

END OF SECTION

SECTION 10 4400 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Fire extinguishers.

B. Accessories.

1.03 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, for submittal procedures.

B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, and color and finish.

C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

D. Samples: Submit two samples 2 by 2 inch in size illustrating materials and finish, color and texture of each cabinet finish.

1.05 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
1. Activar Construction Products Group, Inc. - JL Industries; Cosmic Extinguisher - Multipurpose Chemical: www.activarcpg.com/#sle.
2. Ansul, a Tyco Business: www.ansul.com/#sle.
3. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
4. Nystrom, Inc[<>]: www.nystrom.com/#sle.
5. Oval Brand Fire Products: www.ovalfireproducts.com/#sle.
6. Potter-Roemer: www.potterroemer.com/#sle.

B. Substitutions: Refer to Section 01 2500 - Substitution Procedures.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
1. Class: A:B:C type.
2. Size: 10 pound.
3. Finish: Baked polyester powder coat, color as selected.
4. Temperature range: Minus 40 degrees F to 120 degrees F.

2.03 FABRICATION

A. Names or labels are not permitted on exposed faces of fire extinguisher cabinets. Provide identification on either the inside face of the door or on the back of the cabinet concealed by the wall indicating manufacturer's name and product model number.

2.04 ACCESSORIES

A. Lettering: “FIRE EXTINGUISHER” decal, or vinyl self-adhering, prespaced black lettering in accordance with authorities having jurisdiction (AHJ).
   1. Lettering color: black

B. Provide manufacturer's standard bracket designed to prevent accidental dislodgement of extinguisher, of proper size for type and capacity of extinguisher indicated, in manufacturer's standard plated finish.
   1. Provide brackets for extinguishers not located in cabinets.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install items included in this Section at locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.
   1. Prepare recess in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim to comply with manufacturer's instructions.
   2. Securely fasten fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.

C. Secure rigidly in place.

D. Place extinguishers on wall brackets.

END OF SECTION

SECTION 12 2400 - ROLLER WINDOW SHADES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Division 00 - Procurement and Contracting Requirements, and Division 01 - General Requirements, are hereby made part of this Section.

1.02 SECTION INCLUDES

A. Interior manual roller shades.

1.03 REFERENCE STANDARDS

A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

C. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.04 SUBMITTALS

A. See Section 01 3323 - Shop Drawings, Product Data, and Samples, submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, operation direction, room schedule using same room designations indicated on Drawings, field verified dimensions of each opening receiving window shades, and indicate fabric selection and mounting type.

D. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum 5 years of documented experience with shading systems of similar size and type.
   1. Manufacturer's authorized representative.
   2. Factory training and demonstrated experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.07 FIELD CONDITIONS

A. Field Measurements: Check actual window shades dimensions by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Space Enclosure and Environmental Limitations: Do not install window shades until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

1.08 WARRANTY

A. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: 25 years.
   2. Fabric: 25 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Manually Operated Roller Shades:
   1. Draper, Inc: www.draperinc.com/#sle.
   2. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com/#sle.
   3. SWFcontract, a division of Springs Window Fashions, LLC.: www.swfcontract.com/#sle.

B. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Roller Shades:
   1. Basis of Design: Hunter Douglas Architectural; RB Basics Manual Roller Shades.
   2. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
      a. Drop Position: Regular roll.
      b. Roll Direction: Roll down, closed position is at window sill.
      c. Mounting: Ceiling mounted.
      d. Size: As indicated on drawings.
      e. Fabric: Selected from roller shade system manufacturer's standard line of fabrics.
   3. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
   4. Roller Tubes: As required for type of shade operation.
   5. Hembars: Designed to maintain bottom of shade straight and flat.
   6. Manual Operation for Interior Shades:
      a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
      b. Drive Chain: Continuous loop, beaded ball chain with restraining device, 95 lb minimum breaking strength; comply with WCMA A100.1. Provide upper and lower limit stops.
   7. Accessories:
      a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; baked enamel finish.
         1) Color: Architect to select from manufacturer's standard line of colors.
         2) Profile: Square.

2.03 SHADE FABRIC

A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Performance Requirements:

a. Flammability: Pass NFPA 701 large and small tests.
b. Fungal Resistance: No growth when tested in accordance with ASTM G21.

2. Openness Factor: Three percent.
3. Roll Width: Width as required to meet window sizes as indicated on Drawings.
4. Color: As selected by Architect from manufacturer's full range of colors.

2.04 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window sill.
2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.

C. Dimensional Tolerances: As recommended in writing by manufacturer.

D. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.05 PROTECTION

A. Protect installed products from subsequent construction operations.

END OF SECTION

SECTION 20 0500 - MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 01 Specification Sections.

1.03 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
3. ABMA - American Boiler Manufacturers Association; www.abma.com.
4. AGA - American Gas Association; www.aga.org.
5. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
6. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
7. ANSI - American National Standards Institute; www.ansi.org.
8. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
9. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
10. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
11. ASTM - ASTM International; www.astm.org.

12. AWS - American Welding Society; www.aws.org.
13. AWWA - American Water Works Association; www.awwa.org.
14. CDA - Copper Development Association; www.copper.org.
15. CGA - Compressed Gas Association; www.cganet.com.
16. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
17. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
18. CSI - Construction Specifications Institute (The); www.csiresources.org.
19. FM Approvals - FM Approvals LLC; www.fmglobal.com.
20. HI - Hydraulic Institute; www.pumps.org.
21. ICC - International Code Council; www.iccsafe.org.
22. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
23. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
24. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org
25. NADCA - National Air Duct Cleaners Association; www.nadca.com.
26. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
27. NEBB - National Environmental Balancing Bureau; www.nebb.org.
28. NECA - National Electrical Contractors Association; www.necanet.org.
29. NEMA - National Electrical Manufacturers Association; www.nema.org.
30. NETA - InterNational Electrical Testing Association; www.netaworld.org.
31. NFPA - National Fire Protection Association; www.nfpa.org.
32. NSF - NSF International; www.nsf.org.
33. NSPE - National Society of Professional Engineers; www.nspe.org.
34. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
35. STI - Steel Tank Institute; www.steeltank.com.
36. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
37. UL - Underwriters Laboratories Inc.; www.ul.com.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
   1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.04 PERFORMANCE REQUIREMENTS

A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

1.05 QUALITY ASSURANCE

A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified and as indicated on Drawings.
   1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.

B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.

1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.
2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.

C. Source Limitations: Obtain equipment and other components of the same or similar systems through one source from a single manufacturer.

D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

F. Sequence and Schedule: Perform work to avoid interference with the work of other trades. Remove and relocate work which in the opinion of the Owner's Representatives causes interference.

G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (Intertek, CSA, etc.).

1.06 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.

B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.

C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

D. Refer to Division 22 Section "Domestic Water Piping" for purchase and installation of potable water meters.

1.07 DRAWINGS

A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly. Provide fittings, valves, and accessories as required to meet actual conditions.

C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.08 MATERIAL AND EQUIPMENT MANUFACTURERS

A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid.

C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.

D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

1.09 INSPECTION OF SITE

A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

B. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonably foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.

1.10 ITEMS REQUIRING PRIOR APPROVAL

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 01 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.

1.11 ACTION SUBMITTALS

A. Submit for review in compliance with Division 01.

B. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 01 for submittal quantities.

C. Submittals shall be in groupings of similar or related items. Plumbing fixture submittals shall be in one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned “Rejected”. Submit product data with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.

D. Submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned “Rejected”.

E. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be included with the submittal for approval.

1.12 INFORMATIONAL SUBMITTALS

A. Shop Drawings:
   1. Prepare shop drawings to scale for the Architect/Engineer for review.
   2. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.
   3. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. Review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action indicated is subject to the requirement of the plans and specifications.
      a. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.
      b. Contractor is responsible for:
         1) Dimensions, which shall be confirmed and correlated at the job site.
         2) Fabrication processes and techniques of construction.
         3) Quantities.
         4) Coordination of Contractor’s work with all other trades.
         5) Satisfactory performance of Contractor’s work.
         6) Temporary aspects of the construction process.

B. Coordination Drawings:
   1. Submit project specified coordination drawings for review in compliance with Division 01 Specification Sections.

1.13 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Instructional Manuals:
   1. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
   2. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. One copy of all manuals shall be furnished for Owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75 percent complete.

3. Format: Submit operation and maintenance manuals in the following format:
   a. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
      1) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
      2) Enable inserted reviewer comments on draft submittals.
4. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:
   a. Routine maintenance procedures.
   b. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
   c. Trouble-shooting procedures.
   d. Contractor's telephone numbers for warranty repair service.
   e. Submittals.
   f. Recommended spare parts list.
   g. Names and telephone numbers of major material suppliers and subcontractors.
   h. System schematic drawings.

B. Record Drawings:
1. Submit record drawings in compliance with Division 01.
2. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or vellum which have been neatly marked to represent as-built conditions for all new mechanical work.
3. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

C. Warranties:
1. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner’s satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
2. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.14 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 24 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.

C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.

E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

1.15 WARRANTY

A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 MECHANICAL DEMOLITION WORK

A. Demolition of existing mechanical equipment and materials shall be done by the Contractor unless otherwise indicated. Include items such as, but not limited to, existing piping, pumps, ductwork, supports, and equipment where such items are not required for the proper operation of the modified system.

B. Include draining of piping systems where required for demolition, modification of, or connection to existing systems.

C. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this Work.

D. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse.
   1. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived.
   2. Remove items from the systems and turn over to the Owner in their condition prior to removal. The Owner will move and store these materials.
   3. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.

E. Work that has been cut or partially removed shall be protected against damage until covered by permanent construction.

F. Clean and flush the interior and exterior of existing relocated equipment and its related piping, valves, and accessories that are to be reused of mud, debris, pipe dope, oils, welding slag, loose mill scale, rust, and other extraneous material so that the existing equipment and accessories can be repainted and repaired as required for the proper operation and performance of the relocated equipment.

G. Where existing equipment is to be removed, cap piping under floor, behind face of wall, above ceiling, or at mains.

H. Cap ductwork and cap piping immediately adjacent to demolition as soon as demolition commences in order to allow existing systems to remain in operation.
   1. Cap or plug piping with same or compatible piping material.
   2. Cap or plug ducts with same or compatible ductwork material.

3.02 REFRIGERANT HANDLING

A. Refrigerant Installation and Disposal: Perform all work related to refrigerant contained in chillers, cooling coils, air conditioners, and similar equipment, including related piping, in strict accordance with the following requirements:
   1. ASHRAE Standard 15 and Related Revisions: Safety Code for Mechanical Refrigeration.

2. ASHRAE Standard 34 and Related Revisions: Number Designation and Safety Classification of Refrigerants.
3. United States Environmental Protection Agency (US EPA) requirements of Section 8 08 (Prohibition of Venting and Regulation of CFC) and applicable State and Local regulations of authorities having jurisdiction.

B. Recovered refrigerant is the property of the Contractor. Dispose of refrigerant legally, in accordance with applicable rules and regulations.

3.03 WORK IN EXISTING BUILDINGS

A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.

B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.

C. Consult with the Owner’s Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.

D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement, if necessary, of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.04 TEMPORARY SERVICES

A. Provide temporary service as described in Division 01.

3.05 WORK INVOLVING OTHER TRADES

A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

3.06 ACCEPTANCE PROCEDURE

A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.

B. The Contractor shall demonstrate operation of equipment and control systems, including each individual component, to the Owner and Architect/Engineer.

C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.

D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

E. Operation of the following systems shall be demonstrated:
1. Air Handling Systems.
2. Domestic Hot Water Heaters.
3. Temperature Controls.
4. Exhaust Systems.

F. For systems requiring seasonal operation, demonstrate system performance within six months when weather conditions are suitable.

END OF SECTION

SECTION 20 0510 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 22 Section “Domestic Water Piping” for flushing and cleaning of potable water piping.

1.02 SUMMARY

A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheet metal systems and equipment. This section supplements all other Division 20, 21, 22, and 23 Mechanical Sections, and Division 01 Specification Sections.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

D. Comply with NSF 372, “Drinking Water System Components – Lead Content” for potable domestic water piping and components.

E. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

F. Duct Joint and Seam Welding: Qualify procedures and personnel according to the following:
   1. AWS D9.1, "Sheet Metal Welding Code."

G. Soldering: Qualify processes and operators according to AWS B2.3/2.3M, "Specification for Soldering Procedure and Performance Qualification."

H. Installer Qualifications:

1. Installers of Grooved Components: Installers shall be certified by the grooved component manufacturer as having been trained and qualified to join piping with grooved couplings, fittings, and specialties.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Provide adequate weather protected storage space for all mechanical equipment and materials deliveries to the job site. Storage locations will be designated by the Owner's Representative. Equipment stored in unprotected areas must be provided with temporary protection.
   1. Protect equipment and materials from theft, injury, or damage.
   2. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.
   3. Materials with enamel or glaze surface shall be protected from damage by covering and/or coating as recommended in bulletin "Handling and Care of Enameled Cast Iron Plumbing Fixtures", issued by the Plumbing Fixtures Manufacturer Association, and as approved.
   4. Electrical equipment furnished by Mechanical Trades and installed by the Electrical Trades: Turn over to Electrical Trades in good condition, receive written confirmation of same.
   5. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
   6. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations. Coordinate with other trades to ensure accurate locations and sizes of mechanical spaces, chases, slots, shafts, recesses, and openings.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Install Work to avoid interference with work of other trades including, but not limited to, Architectural and Electrical Trades. Remove and relocate any work that causes an interference at Contractor's expense.

D. Coordinate requirements for and provide access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

E. The mechanical trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.
   1. All patching and repair of any such damaged work shall be performed by the trades which installed the work. The cost shall be paid by the Mechanical Trades.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21, 22, and 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 21, 22, and 23 piping Sections for special joining materials not listed below.

B. Unions: Pipe Size 2 Inches and Smaller:

1. Ferrous pipe: Malleable iron ground joint type unions.
2. Unions in galvanized piping system shall be galvanized.
3. Copper tube and pipe: Bronze unions with soldered joints.

C. Flanges: Pipe Sizes 2-1/2 Inch and Larger:
1. Ferrous pipe: Standard weight, forged steel weld neck flanges.
2. Copper tube and pipe: Slip-on bronze flanges.

D. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Square head bolts and nuts are not acceptable.

F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

G. Solder Filler Metals: ASTM B 32, lead-free, antimony-free, silver-bearing alloys. Include water-flushable flux according to ASTM B 813.

H. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.04 PIPE THREAD COMPOUNDS

A. General: Pipe thread compounds for the fluid service compatible with piping materials provided.

B. Potable Water Service and Similar Applications: Compounds acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.

C. Natural Gas System: Use either of the following:
1. Tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for threaded joints.
a. Manufacturers:
1) Cadillac Plastic.
2) Permacel.
3) Other approved.
2. Lead-free pipe thread compounds suitable for service.
a. Manufacturers:
1) HCC Holdings, Inc.; Hercules Pro Dope.
2) Mill-Rose Company (The); Clean-Fit Products; Blue Monster Thread Sealant.
3) Oatey; Great Blue Pipe Joint Compound.
4) RectorSeal LLC: A CSW Industrials Company; No. 5, No.5 Special, and No. 5 Sub-Zero Pipe Thread Sealants.

2.05 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
1. Manufacturers:
a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Manufacturers:
a. IPEX Inc. (formerly Eslon Thermoplastics).

C. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
1. Manufacturers:
a. Cascade Waterworks Mfg. Co.
b. Fernco, Inc.
c. Mission Rubber Company.
d. Plastic Oddities, Inc.
e. Can-Tex Industries Division of Harsco Corp. “CT-Adaptors”.
f. Joint Inc., “Caulder”.

2.06 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Brass Unions, Brass Nipples, Brass Couplings: For systems up to 286 deg F.

D. Dielectric-Flange Kits: Include full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
1. Manufacturers:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Capitol Manufacturing Co.
d. GF Piping Systems; George Fischer Central Plastics.
e. Epco Sales, Inc.
f. Pipeline Seal and Insulator, Inc.
g. Watts Water Technologies, Inc.; Watts Regulator Co.
h. Zurn Industries, Inc.; Wilkins Div.
2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

E. Dielectric Nipple/Waterway Fittings: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, male NPT threaded, or grooved ends; and 300-psig minimum working pressure at 230 deg F.
1. Manufacturers:
a. ASC Engineered Solutions; Gruvlok Manufacturing; DI-LOK Nipples.
b. Elster Group; Perfection Corp.; ClearFlow.
c. Precision Plumbing Products, Inc.; ClearFlow.
d. Sioux Chief Manufacturing Co., Inc.
e. Tyco Fire & Building Products; Grinnell Mechanical Products; Figure 407 ClearFlow.
f. Victaulic Co. of America; Style 47 ClearFlow.

2.07 MODULAR MECHANICAL SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve or pipe and core drilled hole.
1. Manufacturers:

a. Advance Products & Systems, Inc.; Innerlynx.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.; Thunderline Link Seal.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.08 SLEEVES

A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall black.

B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall galvanized, plain ends.

C. Water Stop: Cast or ductile-iron; fabricated steel; PVC; or rotationally molded HDPE pipe; with plain ends and integral water stop, unless otherwise indicated.
1. Manufacturers:
a. Advance Products & Systems, Inc.; Infinity and Gal-Vo-Plast Sleeves.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with set screws.

2.09 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
1. New Piping:
a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping or Piping in High Humidity Areas: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
e. Bare Piping in Unfinished Service Spaces or Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.

2.10 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.11 EPOXY BONDING COMPOUND

A. Two-component system suitable for bonding wet or dry concrete to each other and to other materials.

B. Manufacturers:
1. Euco 452 #450; Euclid Chemical Co.
2. Epobond; L & M Construction Chemicals.
3. Sikadur 87; Sika Corp.

2.12 LEAK DETECTOR SOLUTION

A. Commercial leak detector solution for pipe system testing.

B. Manufacturers:
   1. American Gas and Chemicals Inc.; Leak Tec.
   2. Cole-Parmer Inst. Co.; Leak Detector.
   3. Guy Speaker Co. Inc.; Squirt 'n Bubbles.

2.13 PIPE PENETRATION ASSEMBLIES

A. Contractor may choose from one of the following:

B. Pipe Roof Penetration Enclosures
   1. Manufacturers:
      a. Pate Company (The); pca Series.
      b. Portal Plus, Inc.
      c. Thybar Corporation; Thycurb.
   2. Prefabricated roof curb with:
      a. Minimum 18 gage welded galvanized steel construction.
      b. Integral base plate.
      c. Factory installed insect and decay resistant wood nailer.
      d. EPDM compression molded rubber cap for single or multiple pipes as required. Quantity of molder rubber caps shall be sufficient for no more than one pipe or conduit per cap.
      e. Stainless steel draw-band clamps.

C. Pipe Roof Penetration Hood Assembly
   1. Manufacturers:
      a. Pate Company (The); pha Series.
   2. Heavy gage aluminum construction.
   3. Removable top cover.
   4. Fully insulated aluminum mounting base to isolate hood from galvanized curb.
   5. Includes prefabricated roof curb with:
      a. Minimum 18 gage welded galvanized steel construction.
      b. Integral base plate.
      c. Factory installed insect and decay resistant wood nailer.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Refer to piping application schedules on the Drawings.

B. Install piping according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems, and in accordance with manufacturer’s instructions.

C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. The Drawings shall be followed as closely as elements of construction will permit.

D. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.

E. Prior to and during laying of pipe, maintain excavations dry and clear of water and extraneous materials. Provide minimum 4 inches of clearance in all directions for pipe passing under or through building grade beams.

F. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells in steel pipe. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

G. Brazolets can be used for annular flow measuring devices, temperature control components, and thermal wells in copper tube. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

H. Clean and lubricate elastomer joints prior to assembly.

I. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.

J. Install piping to conserve building space and not interfere with use of space.

K. Group piping whenever practical at common elevations.

L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
   1. Install piping to allow for expansion and contraction at locations where piping crosses building or structure expansion joints.

M. Slope piping and arrange systems to drain at low points.

N. Slope horizontal piping containing non-condensable gases 1 inch per 100 feet, upward in the direction of the flow.

O. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

P. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

Q. In concealed locations where piping, other than black steel, cast-iron, or galvanized steel, is installed through holes or notches in studs, joists, rafters, or similar members less than 1-1/2 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16 inch thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.

R. Do not penetrate building structural members unless specifically indicated on drawings.

S. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.

T. Install valves with stems upright or horizontal, not inverted.

U. Provide clearance for installation of insulation and access to valves and fittings.

V. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.

W. Install piping at indicated slopes. Provide drain valves with hose end connections and caps at all piping low points, where piping is trapped and at all equipment.

X. Install piping free of sags and bends.

Y. Install fittings for changes in direction and branch connections.

Z. Unless otherwise indicated or specified, install branch connections to mains using tee fittings in main pipe:
   1. Branch connected to bottom of main pipe for HVAC systems. Side connection is acceptable. Connection above centerline of main is unacceptable. For up-feed risers, connect branch to top of main pipe.
   2. Branch connected to top of main for steam and condensate, plumbing systems, compressible gasses, and vacuum.

AA. Install piping to allow application of insulation.

BB. Select system components with pressure rating equal to or greater than system operating pressure.

CC. Install escutcheons for penetrations of walls below ceiling, and ceilings.

DD. Sleeves are not required for core-drilled holes in poured concrete walls.

EE. Permanent sleeves are not required for holes formed by removable PE sleeves in poured concrete walls.

FF. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces of walls.
   a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
   b. 0.375 Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.
   c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.
   d. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
   e. For pipes penetrating floors with membrane water proofing provide cast iron sleeve with clamping flanges. Secure/seal membrane to sleeves with clamping flanges.
4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
5. Seal sleeves in plaster/gypsum-board partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

GG. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.
1. Install Schedule 40 galvanized steel pipe for sleeves smaller than 12 inches in diameter.
2. Install 0.375 galvanized steel pipe for sleeves 12 inches and larger in diameter.
3. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

HH. Existing Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Seal core drilled pipe penetrations using modular mechanical seals. Allow for 1-inch annular clear space between pipe and cored opening for installing modular mechanical seals.
1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of cored hole. Assemble modular mechanical seals and install in annular space between pipe and cored opening. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

II. Pipe Roof Penetration Enclosures:
1. Coordinate delivery of roof penetration enclosures to jobsite.
2. Locate and set curbs on roof.
3. Framing, flashing, and attachment to roof structure are specified under Division 07.
4. Attach cap to curbs, cut pipe boots to fit pipe, and clamp boots to pipe or conduit.

JJ. Verify final equipment locations for roughing-in.

KK. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.

B. Cut piping square.

C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.

E. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.

F. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.

G. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.

H. Use eccentric reducers for drainage and venting of pipe lines; bushings are not permitted.

I. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.

J. Provide temperature sensing device thermal wells and similar piping specialty connections.

K. Provide instrument connections except thermal wells with specified isolating valves at point of connection to system.

L. Locate instrument connections in accordance with manufacturer’s instructions for accurate read-out of function sensed. Locate instrument connections for easy reading and service of devices.

M. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

N. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

O. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
   1. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

P. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.
   1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.
   2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face;

machine the raised face down to a smooth matching surface and use a full face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.

Q. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Galvanized piping shall be cut grooved to prevent damage to galvanizing on internal pipe surfaces. The grooved coupling manufacturer’s factory trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer’s representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

R. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Application Schedules on the Drawings.

S. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
3. PVC Nonpressure Piping: Join according to ASTM D 2855.
4. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

T. Remake joints which fail pressure tests with new materials including pipe, fittings, gaskets and/or a filler.

3.03 ACCESS DOORS

A. Provide access doors for installation by architectural trades. Provide access doors in the walls, as required to make all valves, controls, coils, motors, air vents, filters, electrical boxes, and other equipment installed by the Contractor accessible. Minimum size 12 inches x 12 inches. Provide access doors in the ceiling, for accessibility as mentioned above, 24 inches x 24 inches minimum size. Areas with accessible ceilings (ceilings where lay-in panels are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors. Refer to Division 08 Section “Access Doors and Frames” for manufacturers and model numbers and additional information.

B. When access doors are in fire resistant walls or ceilings, they shall bear the Underwriters' Laboratories, Inc., Label, with time design rating equal to or greater than the wall or ceiling unless they were a part of the tested assembly.

3.04 EQUIPMENT CONNECTIONS

A. Make connections to equipment, fixtures, and other items included in the work in accordance with the submittals and rough-in measurements furnished by the manufacturers of the particular equipment furnished.
1. Any and all additional connections not shown on the drawings but shown on the equipment manufacturer’s submittal or required for the successful operation of the equipment shall be installed as part of this Contract at no additional charge to the Owner.

B. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.

3.05 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

2. Install flanges, in piping NPS 2-1/2 and larger, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

3.06 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated. Housekeeping pad locations and sizes shall be coordinated by mechanical contractor prior to the placement of concrete slabs.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

E. For suspended equipment, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect for same including loads, locations, and methods of attachment.

F. Equipment Rigging Over Roof Areas: Protect building structure against damage during equipment rigging. Make provisions to distribute load of equipment to main roof structure, and to prevent damage to roof decking, roofing, or purlins.

G. The Contract Documents indicate items to be purchased and installed. The items are noted by a manufacturer’s name, catalog number and/or brief description. The catalog number may not designate all the accessory parts for a particular application. Arrange with the manufacturer for the purchase of all items required for a complete installation.

3.07 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 09.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.08 CONCRETE BASES

A. Concrete housekeeping pads for floor mounted mechanical equipment shall be provided by Architectural Trades.

B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
   1. Construct concrete bases as shown on Drawings or specified, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.

3.09 EPOXY BONDING TO EXISTING MATERIALS

A. Use epoxy bonding compound to set sleeves or pipes in existing concrete to bond new concrete and/or grout to existing materials or to bond dissimilar materials.

B. The compound, when applied in accordance with the manufacturer's instructions, shall be capable of initial curing within 48 hours at temperatures as low as 40 deg F and shall be capable of bonding any combination of the following properly prepared materials: Wet or dry, cured, or uncured concrete or mortar; vitrified clay; cast iron and carbon steel.

3.10 JACKING OF PIPE

A. Do not jack pipe in place except upon prior approval of proposed materials and complete details of methods.

3.11 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.12 CUTTING, CORING AND PATCHING

A. Refer to Division 01 Specification Sections for requirements for cutting, coring, patching and refinishing work necessary for the installation of mechanical work.

B. All cutting, coring, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.13 EXCAVATION AND BACKFILLING

A. Refer to Division 31 Specification Sections.

B. Provide all excavation, trenching, tunneling, and backfilling required for the mechanical work.

C. Provide all pumping and/or well pointing required for the mechanical work.

D. Provide foundations if required to support underground piping.

E. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

3.14 FLASHING

A. Provide all flashing required for mechanical work. Refer to Division 07 Specification Sections.

3.15 LUBRICATION

A. Provide all lubrication for the operation of the equipment until acceptance by the Owner. Contractor is responsible for all damage to bearings up to the date of acceptance of the equipment. Protect all bearings and shafts during installation. Thoroughly grease steel shafts to prevent corrosion. Provide covers as required for proper protection of all motors and other equipment during construction.

3.16 FILTERS

A. Provide and maintain filters in air handling systems throughout the construction period and prior to final acceptance of the building. Do not run air handling equipment, without all prefilters and final filters as specified.

B. Immediately prior to final building acceptance by the Owner, Contractor shall:
1. Replace all disposable type air filters with new units.

3.17 CLEANING

A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.

B. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 22 Section "Domestic Water Piping."

C. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.

D. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

END OF SECTION

SECTION 20 0513 - MOTORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section "Mechanical Vibration Controls" for mounting motors and vibration isolation devices.
3. Division 20 Section “Variable Frequency Controllers”.
4. Division 21, 22, and 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.02 SUMMARY

A. This Section includes basic requirements for factory-installed motors.

1.03 DEFINITIONS

A. ABMA: American Bearing Manufacturers Association. (Formerly AFBMA: Anti-Friction Bearing Manufacturers Association.)

B. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

C. Packaged Self Contained Equipment: Equipment which includes component mechanical and electrical equipment mounted on common bases, skids or frames or in common enclosures with internal control and power wiring factory installed and ready to accept a single electrical service connection. Provide the equipment complete with enclosed controllers, main disconnect switches, control transformers, control devices, wiring and accessories as required.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL), acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.05 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

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:
   1. Dayton.
   2. Toshiba Intl.
   3. Baldor Electric/Reliance.
   4. Rockwell Automation/Allen-Bradley.
   5. Nidec Motor Corporation; U.S. Electrical Motors.
   6. Regal Beloit/GE Commercial Motors.
   7. Regal Beloit/Leeson.
   8. Regal Beloit/Marathon.
   9. Siemens.

2.02 MOTOR REQUIREMENTS

A. Motor requirements apply to factory-installed motors except as follows:
   1. Different ratings, performance, or characteristics for a motor are specified in another Section.
   2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.
   3. Submersible motors integral to pumps and excluded from NEMA and EISA standards.

B. Electrical Power Supply Characteristics: Coordinate electrical system requirements with Division 26.

C. Electrical Power System Characteristics: As scheduled on the Drawings.

D. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

2.03 MOTOR CHARACTERISTICS

A. Motors 1/2 HP and Larger: Three phase, unless otherwise indicated.

B. Motors Smaller Than 1/2 HP: Single phase, unless otherwise indicated.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.

F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Brake Horsepower Input: Shall not exceed 90 percent of the rated motor horsepower.

I. Enclosure: Open dripproof (ODP) for motors installed indoors and out of the airstream. Totally-enclosed fan-cooled (TEFC) for motors installed outdoors or within the airstream.

2.04 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Fire pump motors, C-face motors, JP and JM frame motors, and motors over 200 horsepower shall be energy efficient motors. Efficiency of the motor shall be determined based

on the NEMA MG1. The minimum efficiencies, nominal efficiencies and shall meet or exceed Table 12-11.

	1800 RPM OPEN DRIP-PROOF MOTORS 4 POLE		1800 RPM ENCLOSED MOTORS 4 POLE	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM EFF
1	82.5	81.5	82.5	81.5
1.5	84	82.5	84	82.5
2	84	82.5	84	82.5
3	86.5	85.5	87.5	86.5
5	87.5	86.5	87.5	86.5
7.5	88.5	87.5	89.5	88.5
10	89.5	88.5	89.5	88.5
15	91	90.2	91	90.2
20	91	90.2	91	90.2
25	91.7	91	92.4	91.7
30	92.4	91.7	92.4	91.7
40	93	92.4	93	92.4
50	93	92.4	93	93
60	93.6	93	93.6	93
75	94.1	93.6	94.1	93.6
100	94.1	93.6	94.5	94.1
125	94.5	94.1	94.5	94.1
150	95	94.5	95	94.5
200	95	94.5	95	94.5

	1200 RPM OPEN DRIP-PROOF MOTORS 6 POLE		3600 RPM OPEN DRIPPROOF MOTORS 2 POLE	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM EFF
1	80	78.5	--	--
1.5	84	82.5	82.5	81.5
2	85.5	84	84	82.5
3	86.5	85.5	84	82.5
5	87.5	86.5	85.5	84
7.5	88.5	87.5	85.5	86.5
10	90.2	89.5	88.5	87.5
15	90.2	89.5	89.5	88.5
20	91	90.2	90.2	89.5
25	91.7	91	91	90.2
30	92.4	91.7	91	90.2
40	93	92.4	91.7	91
50	93	93	92.4	91.7
60	93.6	93	93	92.4
75	93.6	93	93	92.4
100	94.1	93.6	93	92.4
125	94.1	93.6	93.6	93

	1200 RPM OPEN DRIP-PROOF MOTORS 6 POLE		3600 RPM OPEN DRIPPROOF MOTORS 2 POLE	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM EFF
150	94.5	94.1	93.6	93
200	94.5	94.1	94.5	94.1

C. Efficiency: Motors 1 horsepower to 200 horsepower shall be premium efficient motors meeting requirements of NEMA Premium Efficiency Motor Program. Efficiency of the motor shall be determined based on the NEMA MG1. The nominal efficiencies shall meet or exceed Table 12-12.

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated 600 Volts or Less (Random Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated Medium Volts for 5kV or Less (Form Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
250	95.0	95.0	94.5	95.0	95.0	95.0
300	95.0	95.0	94.5	95.0	95.0	95.0
350	95.0	95.0	94.5	95.0	95.0	95.0
400	95.0	95.0	94.5	95.0	95.0	95.0
450	95.0	95.0	94.5	95.0	95.0	95.0
500	95.0	95.0	94.5	95.0	95.0	95.0

D. Stator: Copper windings, unless otherwise indicated.

E. Rotor: Squirrel cage, unless otherwise indicated.

F. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 120,000 hours. Calculate bearing load with NEMA minimum V- belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

G. Temperature Rise: Match insulation rating, unless otherwise indicated.

H. Insulation: Class F, unless otherwise indicated.

I. Code Letter Designation:
1. Motors 10 HP and Larger: NEMA starting Code (KVA Code) F or G.
2. Motors Smaller Than 10 HP: Manufacturer's standard starting characteristic.
3. Fire Pump Motors: NEMA starting Code (KVA Code) B.

J. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
1. Finish: Gray enamel.

K. Sound Level: Not to exceed NEMA MG-1 12.54.

2.05 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.

B. Shaft Grounding: Provide a means to protect motor from common mode currents.
1. Required for:
a. Motors used with variable frequency controllers.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Electro Static Technology, Inc.; Aegis SGR Conductive Microfiber.

C. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

2.06 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. Furnish for equipment where specified or scheduled with ECM.
1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
6. Integrated motor protection verified by UL to protect equipment against over-/undervoltage, overtemperature of motor, electronics, or both, overcurrent, locked rotor, and dry run (no-load condition).

PART 3 - EXECUTION

3.01 ADJUSTING

A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.02 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 20 0519 - METERS AND GAGES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 21 Section “Fire-Suppression Piping” for listed or approved pressure gages.
4. Division 21 fire pump sections for fire-pump flowmeter systems.
5. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
6. Division 23 Section "Fuel Gas Piping" for gas utility meters.

1.02 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Schedule for the following indicating manufacturer's number, scale range, and location for each:
1. Thermometers.
2. Gages.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:
   1. AMETEK, Inc.; U.S. Gauge Div.
   2. Miljoco Corporation.
   3. REOTEMP Instrument Corporation.
   4. Trerice, H. O. Co.
   5. Weiss Instruments, Inc.
   6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Die-cast aluminum or Chrome-plated brass, 9 inches long.

C. Tube: Red, blue, or green reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanent scale markings.

E. Window: Glass or plastic.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.03 THERMOWELLS

A. Manufacturers: Same as manufacturer of thermometer being used.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Brass for compatible services less than 353 degrees F; ANSI 18-8 stainless steel for all others to suit service. Furnish extension neck to accommodate insulation where applicable.

2.04 PRESSURE GAGES

A. Manufacturers:
   1. AMETEK, Inc.; U.S. Gauge Div.
   2. Cambridge.
   3. Dwyer Instruments, Inc.
   4. Marsh Bellofram.
   5. Miljoco Corporation.
   6. Trerice, H. O. Co.
   7. Weiss Instruments, Inc.
   8. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
   1. Case: Stainless steel, aluminum, or FRP, 6-inch diameter.
   2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
   3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
   4. Movement: Mechanical, with link to pressure element and connection to pointer.
   5. Dial: Satin-faced, nonreflective aluminum with permanent scale markings.
   6. Pointer: Red or other dark-color metal.

7. Window: Glass or plastic.
8. Ring: Stainless steel or chrome plated metal.

C. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
1. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
2. Water: 0-100 PSIG (1 psi divisions to 50 psi; 5 psi divisions above 50 psi), liquid filled.
3. Range for Fluids under Pressure: 1-1/2 times expected working pressure. If not a standard scale, select next largest scale.

D. Pressure-Gage Fittings:
1. Valves: NPS 1/4 brass ball type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.01 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:
1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each thermal storage tank.
3. Outside-air, return-air, and mixed-air ducts.

B. Provide the following temperature ranges for thermometers:
1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
2. Domestic Cold Water: 30 to 130 deg F, with 2-degree scale.
3. Air Ducts: Minus 40 to plus 110 deg F, with 2-degree scale divisions.

3.02 GAGE APPLICATIONS

A. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.03 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.

C. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

E. Install ball valve and snubber fitting in piping for each pressure gage for fluids (except steam).

F. Install ball valve and syphon fitting in piping for each pressure gage for steam.

G. Install test plugs in tees in piping.

3.04 CONNECTIONS

A. Install gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

3.05 ADJUSTING

A. Adjust faces of gages to proper angle for best visibility.

END OF SECTION

SECTION 20 0529 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
4. Division 21 Section "Fire-Suppression System" for pipe hangers for fire-protection piping.
5. Division 23 Section(s) "Metal Ducts for duct hangers and support.

1.02 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

B. MFMA: Metal Framing Manufacturers Association.

1.03 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:
1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.

1.05 QUALITY ASSURANCE

A. MSS Standards: Pipe hangers, supports, and accessories shall comply with the following:
   1. MSS SP-58, Pipe Hangers and Supports – Materials, Design and Manufacture, Selection, Application, and Installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 HANGER ROD MATERIAL

A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.
   1. Rod continuously threaded.
   2. Use of rod couplings is prohibited.

2.03 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article, and schedules and details on the Drawings for where to use specific hanger and support types.
   1. Hangers and Supports for Fire Protection Piping: UL listed or FMG approved.

B. Manufacturers:
   1. Anvil; ASC Engineered Solutions.
   2. B-Line by Eaton.
   3. Carpenter & Paterson, Inc.
   4. Hilti USA.
   5. nVent Electric plc; CADDY.
   6. PHD Manufacturing, Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.04 METAL INSULATION SHIELDS

A. Manufacturers:
   1. Anvil; ASC Engineered Solutions.
   2. B-Line by Eaton.
   3. Carpenter & Paterson, Inc.
   4. nVent Electric plc; CADDY.
   5. PHD Manufacturing, Inc.

B. Description: MSS SP-58, Type 40, protective shields. Shields shall span an arc of 180 degrees.

C. Shield Dimensions for Pipe: Not less than the following:
   1. NPS 1/4 to NPS 2: 12 inches long and 0.048 inch thick.

2.05 PIPE COVERING PROTECTION SADDLES

A. Manufacturers:
   1. Anvil; ASC Engineered Solutions.
   2. B-Line by Eaton.
   3. Carpenter & Paterson, Inc.
   4. nVent Electric plc; CADDY.
   5. PHD Manufacturing, Inc.

B. Description: MSS SP-58, Type 39A and Type 39B, for suspension of insulated hot pipe where heat losses are to be kept to a minimum.
   1. Saddles shall match insulation thickness.
   2. Saddle length: 12 inches.
   3. Furnish with center rib for pipe sized NPS 12 and larger.

2.06 PLASTIC INSULATION SHIELDS

A. Manufacturers:
   1. Anvil; ASC Engineered Solutions.
   2. Armacell LLC; Insuguard.
   3. B-Line by Eaton; Snap'N Shield.
   4. Hydra-Zorb Company; Bronco.

B. Description: Polypropylene copolymer protective shields with modular elements designed to snap directly onto strut channel, clevis hangers, or structural members. Shields shall span an arc of 180 degrees.
   1. Operating Temperature Range: Minus 40 deg F to plus 178 deg F.

C. Certifications:
   1. UL Classified for USA: UL-723 (ASTM E 84).
   2. UL listed for Canada: ULC-S102.2.
   3. Meets UL94 HB flammability standards.

D. Shield Dimensions for Pipe: Not less than the following:
   1. NPS 1/4 to NPS 4: 12 inches long.

2.07 THERMAL-HANGER SHIELDS

A. Manufacturers:
   1. American Mechanical Insulation Sales Inc. (AMIS).
   2. B-Line by Eaton.
   3. nVent Electric plc; CADDY.
   4. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
   5. Rilco Manufacturing Company, Inc.
   6. Value Engineered Products, Inc.

B. Description: Manufactured assembly consisting of insulation insert encased in 360 degree sheet metal shield.
   1. Minimum Compressive Strength of Insert Material:
      a. 100-psig- for sizes smaller than NPS 6.
      b. 600-psig- for sizes NPS 6 and larger.

C. Insulation-Insert Material for Cold Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

F. Include carbon steel ASTM A36 load distribution plates as required by load, pipe movement, hanger style, and hanger spacing.

G. Thermal-Hanger Shields for Flexible Foamed Elastomeric Insulated Piping:
   1. Manufacturer:
      a. B-Line by Eaton/Armacell; Armafix IPH.
      b. Aeroflex USA, Inc,; Aerofix-U.
      c. ZSi-Foster, Inc.; Cush-A-Therm.
   2. Insulation-Insert Material for Copper Piping with Flexible Foamed Elastomeric Insulation: Use the following:

a. Flexible foamed elastomeric, ASTM 534, Type I-Tubular Grade 1 with PUR/PIP support inserts.

H. Thermal-Hanger Shields for Small Diameter Piping:
1. Manufacturer:
a. Hydra-Zorb Company; Klo-Shure Insulation Couplings.
2. Insulation-Insert Material for Small Diameter Piping with Flexible Foamed Elastomeric or Glass Fiber Insulation: Use the following:
a. Rigid Hytrel thermoplastic insulation coupling designed for use with pipe or tube NPS 4 and smaller, and insulation from 3/8 inch to 1-1/2 inch thick.

2.08 FASTENER SYSTEMS

A. Post-Installed Anchors:
1. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
a. Manufacturers:
1) B-Line by Eaton.
2) DeWalt Engineered by Powers.
3) Hilti, Inc.
4) ITW Ramset/Red Head.
5) MKT Fastening, LLC.
2. Internally Threaded Screw Anchors: Internally threaded, self-tapping screw anchor designed for performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete, sand-lightweight concrete and concrete over steel deck.
a. UL Listed or FMG approved for fire sprinkler piping.
b. Available Sizes: For1/4-inch, 3/8-inch, and 1/2-inch diameter rod sizes
c. Manufacturers:
1) B-Line by Eaton; Rapid Rod Hangers.
2) DeWalt Engineered by Powers; Snake+.
3. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application. Exception: Do not use chemical fasteners to support hanger systems for fire protection piping.
a. Manufacturers:
1) DeWalt Engineered by Powers.
2) Hilti, Inc.
3) ITW Ramset/Red Head.
4) MKT Fastening, LLC.
b. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
c. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
d. Washer and Nut: Zinc-coated steel.

2.09 ROOF MOUNTED PIPING SUPPORTS

A. Low, Fixed-Height, Single-Base Stand: Assembly of base and horizontal member, and pipe support, for roof installation without membrane penetration.
1. Manufacturers:
a. B-Line by Eaton; Dura-Blok.
b. Eco Support Products.
c. MIFAB, Inc.; C-Port.
d. MIRO Industries; Conduit and Condensate Supports, and Rooftop Sleeper Support.
e. nVent Electric plc; CADDY.

f. Portable Pipe Hangers.
2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.

B. Low, Adjustable-Height, Single-Base Stand: Assembly of base, horizontal member, and adjustable vertical members, and pipe support, for roof installation without membrane penetration.
1. Manufacturers:
a. B-Line by Eaton; Dura-Blok.
b. Eco Support Products.
c. MIFAB, Inc.; C-Port.
d. MIRO Industries; Conduit and Condensate Supports.
e. nVent Electric plc; CADDY.
f. Portable Pipe Hangers.
2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.

2.10 ROOF MOUNTED EQUIPMENT SUPPORTS

A. Non-Penetrating Equipment Supports: Assembly of two or more bases and horizontal members, for roof installation without membrane penetration.
1. Manufacturers:
a. B-Line by Eaton; Dura-Blok.
b. Eco Support Products.
c. MIFAB, Inc.; C-Port.
d. MIRO Industries; HD and LD Mechanical Unit Supports.
e. nVent Electric plc; CADDY.
f. Portable Pipe Hangers.
2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel, galvanized-steel, or stainless steel strut, and planking; designed for use with standard strut clamps, all-thread rood, and accessories.

B. Roof Rail-Type Equipment Stands: Welded 18 gage galvanized steel shell, base plate and counter flashing. Factory installed chemically treated wood nailer. Fully mitered end sections. Internal bulkhead reinforcement.
1. Roof Rail Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.
a. Manufacturers:
1) Pate.
2) Thybar; TEMS Series.
3) Roof Products and Systems.
4) Greenheck.
5) Creative Metals.

2.11 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

A. Refer to application schedules on the Drawings.

B. For insulated pipe, oversize hanger elements to accommodate insulation thickness.

C. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

D. Comply with MSS SP-58 for pipe hanger selections and applications that are not specified in piping system Sections.

E. Use hangers and supports with galvanized, metallic coatings for outdoor applications or where exposed to outdoor conditions.

F. Use hangers and supports with plastic coating, or galvanized metallic coatings for applications in corrosive atmospheres.

G. Use metal framing, with plastic coating, or galvanized metallic coatings for metal framing in corrosive atmospheres.

H. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

I. Use padded hangers for piping that is subject to scratching.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. MSS Type 8 or spring type to meet system requirements.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
   2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
   3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
   4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
   5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Concrete Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Inserts, Concrete: TYPE 18 or 19. When applied to loads equivalent to piping in sizes NPS 2 and larger, and where otherwise required by imposed loads, a one foot length of 1/2 inch reinforcing rod shall be inserted and wired through wing slots. Proprietary type continuous inserts may be proposed and shall be submitted for approval.
   2. Use mechanical-expansion anchors where required in concrete construction.
   3. Use chemical fasteners where required in concrete construction.

M. Steel Frame Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Beam Clamps:
      a. Center Loading: TYPE 21, 28, 29 and 30, unless otherwise indicated. Type 27 shall be allowed to support single pipes NPS 6 size or smaller only.
      b. "C" Clamps: Type 19, 20 or 23, for supporting single pipes NPS 2-1/2 size or smaller only. Use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting multiple pipes or pipes larger than NPS 2-1/2.

N. Comply with MSS SP-58 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.02 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structural frame.

B. Provide necessary piping and equipment supporting elements including: building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, other pipe, duct or equipment.

C. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohm meter to ensure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative and/or Architect.

D. Use copper plated or plastic coated supporting element in contact with copper tubing or glass piping.

E. File and paint cut ends and shop or field prime paint supporting element components.

F. Secure Type 40 shields to support elements in a manner that prevents movement and damage to insulation and jacket materials.

G. Hang piping parallel with the lines of the building, unless otherwise indicated. Route piping in an orderly manner and maintain gradient. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.

H. Flange loads on connected equipment shall not exceed 75 percent of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.

I. Spring supports, within specified limitations: Constant support type, where necessary to avoid transfer of load from support to support or onto connected equipment; otherwise, variable support type located at points subject to vertical movement.

J. Where necessary, brace piping and supports against reaction, sway and vibration.

K. Do not hang piping from concrete joist pans, floor decks, roof decks, equipment, ductwork, or other piping.

L. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.

M. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of each runout, not more than 3 feet from connections to equipment, and not over 25 percent of specified interval from each change in direction of piping and for concentrated loads such as valves, etc.

N. Base the load rating for pipe support elements on loads imposed by insulated weight of pipe filled with water. The span deflection shall not exceed slope gradient of pipe.

O. If structural steel, roofs, or tunnels will allow support spacing greater than that shown above, Contractor shall submit proposed support system along with structural calculations documenting the allowance of such spacing, in accordance with ANSI, B31.1, and MSS Guidelines.

P. Support vertical risers independently of connected horizontal piping whenever practical, with supports at the base and at intervals to accommodate system range of load with thermal conditions. Support vertical risers at each floor penetration for piping in shafts or chases. Guide for lateral stability. Fit horizontal piping connected to moving risers with two spring supports connected adjacent to riser, spaced according to required hanger spacing.

Q. For risers at temperatures of 100 deg F or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.

R. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.

S. Attach pipe anchors and pipe alignment guides to the building structure where indicated. If not indicated, the method used is optional to the Contractor, subject to approval by the Architect. In the case of structural steel, make attachment by clamping in accordance with the American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Building.

T. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure.

U. Attach pipe hangers and other supporting elements to roof purlins and trusses at panel points.

V. Where eccentric loading beam clamps are approved and where other work is supported by similar eccentric loading support element from the same structural member, locate eccentric loading support elements to minimize structural member torsion load.

W. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.

X. Building structure shall not be reinforced except as approved by the Architect in writing.

Y. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.

Z. Attach piping supports to the side of concrete beams and concrete joist. Provide supplementary support steel as required. Cast-in-place or drilled anchors will not be permitted in the bottom of concrete beams and concrete joist.

AA. Attach piping supports to the side of concrete beams or concrete joist. Where intermediate hangers are required to meet the hanger spacing schedule, the Contractor may propose attachment of intermediate pipe supports to the bottom of the concrete slab pending submittal of a satisfactory pull out test. The Contractor shall submit pull out test criteria, pull out test results, proposed hanger detail and hanger point loads to the Architect for written approval.

BB. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

CC. Roof-Mounting Pipe and Equipment Stand Installation:
1. Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb or Rail Mounting Type Stands: Assemble components or fabricate stand and mount on permanent, stationary roof curb or rail. Refer to Division 07 Section "Roof Accessories" for curb and rail installation.
3. Maintain support manufacturer’s recommended spacing.

DD. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

EE. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

FF. Install lateral bracing with pipe hangers and supports to prevent swaying.

GG. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

HH. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

II. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

JJ. Refer to individual piping sections for hanger spacing and hanger rod sizes.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 20 0547 - MECHANICAL VIBRATION CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 ACTION SUBMITTALS

A. Product Data: Include load deflection curves for each vibration isolation device.

1.03 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Installation of these items is specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATION EQUIPMENT BASES

A. **Type A**: Direct Isolator Attachment
1. Unit to be isolated is so constructed that vibration isolators of the type specified may be directly attached, provided that the edge deflection of the isolated unit base over unsupported span between mountings does not exceed specified or manufacturer's limits. If units to be isolated will not meet required deflection provisions, Type B bases shall be provided.

2.02 VIBRATION ISOLATORS

A. **Type 1a** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, arranged in single or multiple layers (maximum 3 layers separated by steel shims) to achieve 90 percent efficiency, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type W, Super W, WSW, and WSWSW or comparable products by one of the following:
a. Amber/Booth; a VMC Group Company.
b. Kinetics Noise Control, Inc.

c. Korfund Dynamics; a VMC Group Company.
d. Vibration Eliminator Co., Inc.
e. Vibration Mountings & Controls; a VMC Group Company.
f. Vibro-Acoustics.

2. Material: Standard neoprene for indoor applications.
3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.

B. **Type 1b** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, single layer, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and 1/4 inch steel load bearing plate. Factory cut to sizes that match requirements of supported equipment.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type Super WMSW and MBSW or a comparable product by one of the following:
   a. Amber/Booth; a VMC Group Company.
   b. Kinetics Noise Control, Inc.
   c. Korfund Dynamics; a VMC Group Company.
   d. Vibration Eliminator Co., Inc.
   e. Vibration Mountings & Controls; a VMC Group Company.
   f. Vibro-Acoustics.
2. Material: Standard neoprene for indoor applications.
3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install roof curbs, equipment supports, and roof penetrations as specified in Division 07 Section "Roof Accessories."

B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.

3.03 APPLICATION

A. Refer to Vibration Isolator Application Schedule on the drawings for isolator application and minimum deflection.

3.04 CONNECTIONS

A. Vibration isolate piping connected to vibration isolated equipment using Type 8a or 8b spring hangers, and with distance to be isolated as scheduled on the Drawings. Maximum spacing between isolators same as maximum distance between pipe hangers and supports.

B. Vibration isolate ductwork connected to air handling units, return air fans, and vibration isolated equipment using Type 8a or 8b spring hangers, and in accordance with isolation distances scheduled on the Drawings.

3.05 EQUIPMENT BASES

A. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.06 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:
   1. Isolator deflection.

3.07 CLEANING

A. After completing equipment installation, inspect vibration isolation devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION

SECTION 20 0553 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

A. Samples: For color, letter style, and graphic representation required for each identification material and device.

B. Valve numbering scheme.

1.04 CLOSEOUT SUBMITTALS

A. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.

1.05 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME (ANSI) A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.06 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
1. Seton.
2. Brady.
3. EMED.
4. Craftmark.
5. Brimar Industries, Inc.
6. Marking Services Inc. (MSI).
7. Kolbi Pipe Marker Co.

2.02 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
1. Data:
a. Manufacturer, product name, model number, and serial number.
b. Capacity, operating and power characteristics, and essential data.
c. Labels of tested compliances.
2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

2.03 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
3. Legends: Spelled out in full or commonly used and accepted abbreviations.
4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

C. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4mil thick, manufactured for direct burial service.

2.04 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Vinyl, 2-inch minimum character height, with permanent pressure sensitive adhesive. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust).

2.05 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Engineer. Provide 5/32-inch hole for fastener.
1. Material: 0.032-inch- thick brass.
2. Valve-Tag Fasteners: Brass wire-link chain or beaded chain.

2.06 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space),

normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Finished hardwood or extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

PART 3 - EXECUTION

3.01 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 20, 21, 22, and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
2. Pumps, compressors, condensers, and similar motor-driven units.
3. Heat exchangers, coils, evaporators, and similar equipment.
4. Fans, blowers, primary balancing dampers, and mixing boxes.
5. Packaged HVAC central-station and zone-type units.

B. Area Served: Equipment serving different areas of a building other than where the equipment is installed shall be permanently marked in a manner that, in addition to identifying the equipment as specified in this Section, also identifies the area it serves.

3.03 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

B. 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 non-concealed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

C. Underground Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

3.04 DUCT IDENTIFICATION

A. Identify ductwork with vinyl markers and flow direction arrows.

B. Locate markers at air handling units, each side of floor and wall penetrations, near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.05 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
   1. Valve-Tag Size and Shape:
      a. Cold Water: Minimum 1-1/2 inches, round or square.
      b. Hot Water: Minimum 1-1/2 inches, round or square.
      c. Fire Protection: Minimum 1-1/2 inches, round or square.
      d. Gas: Minimum 1-1/2 inches, round or square.

3.06 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

3.07 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.08 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.09 SCHEDULES

A. Paint colors are listed here for reference only. Painting is specified under Division 9.

PIPE LABELING AND COLOR CODING

Pipe System Label	Drawing Abbrev.	Labels
Sanitary Sewer	SAN	White on Green
Sanitary Vent	V	White on Green
Rain Conductor	RC	White on Green
Domestic Cold Water	CW	White on Green
Domestic Hot Water	HW	Black on Yellow
Domestic Hot Water Return	HWR	Black on Yellow
Natural Gas	G	Black on Yellow
Refrigerant Liquid	RL	Black on Yellow
Refrigerant Suction	RS	Black on Yellow
Fire Protection	FP	White on Red

SHEET METAL WORK

Service	Abbrev.	Labels	Ductwork
Air Conditioning Supply	Supply Air	White on Green	White
Air Conditioning Return	Return Air	White on Green	White
Exhaust Systems	Exhaust Air	Black on Yellow	Green
Outside Air Intake	Outside Air	White on Green	White

END OF SECTION

SECTION 20 0700 - MECHANICAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section “Hanger and Supports” for thermal hanger shield inserts.
4. Division 22 Section “Plumbing Fixtures: for protective shielding guards.
5. Division 23 Section "Metal Ducts" for duct liners.

1.02 SUMMARY

A. This Section includes mechanical insulation for pipe, duct, and equipment.

1.03 DEFINITIONS

A. ASJ: All-service jacket.

B. FSK: Foil, scrim, kraft paper.

C. PSK: Polypropylene, scrim, kraft paper.

D. PVC: Polyvinyl Chloride.

E. SSL: Self-sealing lap.

1.04 INDOOR PIPING INSULATION SYSTEMS DESCRIPTION

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

1.05 OUTDOOR, ABOVEGROUND PIPING INSULATION SYSTEMS DESCRIPTION

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

1.06 INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.07 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
   1. ESR Report: For fire-rated grease duct insulation.

1.08 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

B. Ductwork Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Prior to installation, protect insulation from exposure to water and from physical damage. Prior to installation, store insulation in manufacturer’s original packaging.

1.10 COORDINATION

A. Coordinate size and location of supports, hangers, and pre-insulated pipe shields/supports specified in Division 20 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.11 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS, GENERAL REQUIREMENTS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Adhesives used shall be fire resistant in their dry states and UL listed.

2.02 PIPE INSULATION MATERIALS

A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
   1. Products: Subject to compliance with requirements, provide one of the products specified.
      a. Aeroflex USA, Inc.; Aerocel Tube and Sheet.
      b. Armacell LLC; AP Armaflex.
      c. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.

B. Glass-Fiber, Preformed Pipe Insulation, Type I:
   1. Products: Subject to compliance with requirements, provide one of the products specified.
      a. Johns Manville; Micro-Lok.
      b. Knauf Insulation; 1000 Pipe Insulation.
      c. Manson Insulation Inc.; Alley-K.
      d. Owens Corning; Fiberglas Pipe Insulation.
   2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.03 DUCTWORK INSULATION MATERIALS

A. Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket.. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the products specified.
      a. CertainTeed Corp.; Duct Wrap.
      b. Johns Manville; Microlite EQ.
      c. Knauf Insulation; Duct Wrap.
      d. Manson Insulation Inc.; Alley Wrap B.
      e. Owens Corning; All-Service Duct Wrap.

2.04 FIRE-RATED INSULATION SYSTEMS

A. Grease Duct Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested according to ASTM E2336.
   1. Products: Subject to compliance with requirements, provide one of the products specified.
      a. Morgan Advanced Materials; Thermal Ceramics; FireMaster FastWrap XL and Pyroscat XL.
      b. 3M Fire Protection Products; Fire Barrier Duct Wrap 615+.
      c. Unifrax Corporation; FyreWrap Max 2.0.

2.05 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Insulco, Division of MFS, Inc.; SmoothKote.
   b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
   c. Rock Wool Manufacturing Company; Delta One Shot.

2.06 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Aeroflex USA, Inc.; Aeroseal and Aeroseal LVOC.
   b. Armacell LCC; 520 Adhesive.
   c. Foster Products Corporation, H. B. Fuller Company; 85-75.

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Childers Products, H.B. Fuller Company; CP-82.
   b. Foster Products Corporation, H. B. Fuller Company; 85-20.
   c. Johns Manville Industrial Insulation; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.

D. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Dow Chemical Company (The); 739, Dow Silicone.
   b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
   c. P.I.C. Plastics, Inc.; Welding Adhesive.
   d. Red Devil, Inc.; Celulon Ultra Clear.
   e. Speedline Corporation; Speedline Vinyl Adhesive.

2.07 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Childers Products, H.B. Fuller Company; CP-76-8.
   b. Foster Products Corporation, H. B. Fuller Company; 95-44.
   c. Marathon Industries, Inc.; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Childers Products, H.B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.08 FACTORY-APPLIED JACKETS

A. Insulation systems indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.09 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

C. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

D. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as specified; roll stock ready for shop or field cutting and forming.
1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Airex Manufacturing, Inc.; E-Flex Guard.
   b. Johns Manville; Zeston and Ceel-Co.
   c. P.I.C. Plastics, Inc.; FG Series.
   d. Proto PVC Corporation; LoSmoke.
   e. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated tank heads and tank side panels.

E. PVC Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C, and including flexible glass fiber insulation inserts.
1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Airex Manufacturing, Inc.
   b. Johns Manville; Zeston and Ceel-Co.
   c. P.I.C. Plastics, Inc.; FG Series.
   d. Proto PVC Corporation; LoSmoke.
   e. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers:
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.

F. Self-Adhesive Outdoor Jacket for Piping: Laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a fabric reinforced insulation cladding with natural aluminum stucco embossed facing.
1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. 3M VentureClad; 1579GCW-E.
   b. Polyguard; Alumaguard.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 728 Cold Seal ASJ or comparable products by one of the following:
   a. Avery Dennison Corporation, Specialty Tapes Division.
   b. 3M Venture Tape.
2. Width: 3 inches.

3. Thickness: 9 mils.
4. Adhesion: 70 ounces force/inch in width.
5. Elongation: 3 percent.
6. Tensile Strength: 45 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with rubber or acrylic adhesive; complying with ASTM C 1136 and UL listed.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 491 FSK or 791 Cold Seal Acrylic FSK, or comparable products by one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division.
b. 3M Venture Tape.
2. Width: 3 inches.
3. Thickness: 6 mils.
4. Adhesion (Rubber Adhesive): 100 ounces force/inch in width.
5. Adhesion (Acrylic Adhesive): 90 ounces force/inch in width.
6. Elongation: 3 percent.
7. Tensile Strength: 35 lbf/inch in width.
8. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 370 White PVC tape, or comparable products by one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division.
b. 3M Venture Tape.
2. Width: 2 inches.
3. Thickness: 5 mils.
4. Adhesion: 20 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 15 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 488 AWF rubber adhesive or 788 Cold Seal acrylic adhesive, or comparable products by one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division.
b. 3M Venture Tape.
2. Width: 3 inches.
3. Thickness: 3.0 to 4.0 mils.
4. Adhesion (Rubber Adhesive): 90 ounces force/inch in width.
5. Adhesion (Acrylic Adhesive): 50 ounces force/inch in width.
6. Elongation: 3 percent.
7. Tensile Strength: 14 to 20 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:
1. Products: Subject to compliance with requirements, provide one of the products specified.
a. PABCO-Childers Metals; Johns Manville Industrial Insulation; Pab-Bands and Fabstraps.
b. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.

3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
   a. Products: Subject to compliance with requirements, provide one of the products specified.
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   a. Products: Subject to compliance with requirements, provide one of the products specified.
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the products specified.
      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.
   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the products specified.
      1) GEMCO; Nylon Hangers.
      2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
   b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
   c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the products specified.
      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
      2) GEMCO; Press and Peel.
      3) Midwest Fasteners, Inc.; Self Stick.
   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Products: Subject to compliance with requirements, provide one of the products specified.
      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Manufacturers:
      1) GEMCO.
      2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.
   1. Manufacturers:
      a. ACS Industries, Inc.
      b. C & F Wire.
      c. PABCO-Childers Metals; Johns Manville Industrial Insulation.
      d. RPR Products, Inc.

2.12 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that applies to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at the 4 o’clock or 8 o’clock position on horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive as recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. For services with surface temperatures below ambient, install a continuous unbroken vapor barrier. Seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install thermal hanger insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover thermal hanger inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at the 4 o’clock or 8 o’clock position on the pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness. Where compression of insulation is possible, fabricate/install insulation per manufacturer's recommendations.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations that Are Not Fire Rated: Install insulation through walls and partitions as detailed.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations:
1. Terminate ductwork insulation at angle closure of fire damper sleeves.
2. Install pipe insulation continuously through penetrations of fire-rated walls and partitions.
a. Firestopping is specified in Division 07 Section "Through-Penetration Firestop Systems."

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at angle closure of fire damper sleeves.
2. Pipe: Install insulation continuously through floor penetrations.
   a. Seal penetrations through fire-rated assemblies according to Division 07 Section "Through-Penetration Firestop Systems."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible Elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.06 FLEXIBLE ELASTOMERIC PIPE INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.07 GLASS-FIBER AND MINERAL WOOL PIPE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install preformed pipe insulation to outer diameter of pipe flange:
   a. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   b. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with fiberglass or mineral wool blanket insulation as specified for system.
3. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.08 DUCT AND PLENUM INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.
1. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not over compress insulation during installation.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
2. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
3. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Flexible Elastomeric Thermal Insulation Installation for Ducts and Plenums: Install insulation over entire surface of ducts and plenums.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.
3. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with strips of same material used to insulate duct and following manufacturer’s installation instructions.

3.09 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, install two layers in strict accordance with manufacturer’s instructions, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors in strict accordance with insulation manufacturer’s to achieve same fire rating as duct.

C. Maintain a copy of insulation manufacturer’s installation instructions on site for Code Official.

D. Where fire-rated plenum wrap system is indicated, secure to system piping to maintain a continuous UL-listed fire rating.

E. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Through-Penetration Firestop Systems."

3.10 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system specified in Division 09 painting Sections.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

END OF SECTION

SECTION 22 0523 - GENERAL-DUTY VALVES FOR PLUMBING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section "Mechanical Identification" for valve tags and charts.
2. Division 21 Fire-Suppression Piping and Fire Pump Sections for fire-protection valves.
3. Division 22 Piping Sections for specialty valves applicable to those Sections only.
4. Division 23 Section “General-Duty Valves for HVAC” for HVAC.
5. Division 23 Section "Temperature Controls" for control valves and actuators.

1.02 SUMMARY

A. This Section includes valves for general plumbing applications. Refer to piping Sections for specialty valve applications.

1.03 DEFINITIONS

A. The following are standard abbreviations for valves:
1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. NRS: Nonrising stem.
5. OS&Y: Outside screw and yoke.
6. PTFE: Polytetrafluoroethylene plastic.
7. RPTFE: Reinforced polytetrafluoroethylene plastic.
8. SWP: Steam working pressure.

9. TFE: Tetrafluoroethylene plastic.
10. WOG: Water, oil, and gas.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
1. Certification that products for use in potable water systems comply with NSF 61 and NSF 372.

1.05 QUALITY ASSURANCE

A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 VALVES, GENERAL

A. Isolation valves are scheduled on the Drawings. For other general plumbing valve applications, use the following:
1. Shutoff Service: Ball, butterfly valves.
2. Throttling Service: Angle, ball, butterfly, or globe valves.
3. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

D. For valves not indicated in the Application Schedules, select valves with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water, steam, and steam condensate services.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.

5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Systems: Valve ends may be grooved.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted unless otherwise noted.

F. Wetted surfaces of valves contacted by consumable water shall contain not more than 0.25 percent weighted average lead content.
1. Exceptions:
   a. Valves in pumped sanitary systems.
   b. Valves in pumped storm systems.
   c. Drain valves.
   d. Valves in general air or vacuum systems.
   e. Valves in irrigation systems.
   f. Valves in non-potable water systems.
   g. Valves in other plumbing systems not intended for human consumption.

G. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

H. Valve Actuators:
1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller.

I. Extended Valve Stems: On insulated valves.

J. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

K. Valve Grooved Ends: AWWA C606.

L. Solder Joint: With sockets according to ASME B16.18.
1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.

M. Threaded: With threads according to ASME B1.20.1.

N. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.

B. Two-Piece, Regular Port Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; and 150 psig SWP and 600-psig CWP ratings.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.; Series 70LF-140/240.
   b. Hammond Valve.
   c. Kitz Corporation; Kitz Valves.
   d. Milwaukee Valve Company; Model UPBA100S/150S.
   e. NIBCO INC.; Models S-580-70-66-LF/T-580-70-66-LF.
   f. Watts Water Technologies, Inc.

C. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; 150 psig SWP and 600-psig CWP ratings.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Valves; by Conbraco Industries, Inc.; Series 77CLF-A Series.
      b. Hammond Valve.
      c. Kitz Corporation; Kitz Valves.
      d. Milwaukee Valve Company; UPBA400S/450S.
      e. NIBCO INC.; Models S-585-70-66-LF/T-585-70-66-LF.
      f. Watts Water Technologies, Inc.; Series LFB6080G2/LFB6081G2.

2.03 GENERAL SERVICE BUTTERFLY VALVES

A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:
   1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.
   2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.

B. Lug-Style (Single-Flange) Size NPS 2-1/2 through NPS 12, 200-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat (liner).
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD145.
      b. Bray International, Inc.
      c. DeZurik.
      d. Emerson Automation Solutions; Keystone.
      e. Forum Energy Technologies; ABZ Valve.
      f. Hammond Valve.
      g. Milwaukee Valve Company.
      h. NIBCO INC.; LD-2000-3/5.
      i. Tyco Flow Control; Grinnell Flow Control.
      j. Watts Water Technologies.

C. Lug-Style (Single-Flange) Size NPS 14 and Larger, 150-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, one- or two-piece Type 416 stainless-steel stem, bronze bushing, and phenolic-backed EPDM seat (liner) attached to the body.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD145.
      b. Bray International, Inc.
      c. DeZurik.
      d. Emerson Automation Solutions; Keystone.
      e. Forum Energy Technologies; ABZ Valve.
      f. Milwaukee Valve Company.
      g. NIBCO INC.; LD-1000-5.
      h. Tyco Flow Control; Grinnell Flow Control.
      i. Watts Water Technologies.

D. Grooved-End Butterfly Valves with EPDM-Encapsulated Ductile-Iron Disc: Ductile-iron body with grooved or shouldered ends and polyamide coating inside and outside; Type 416 stainless-steel

stem, PTFE bronze sintered on steel bushing, and 300-psig CWP Rating for Valves NPS 2 through NPS 8, 200 psig CWP Rating for Valves NPS 10 through NPS 12.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ASC Engineered Products.
   b. NIBCO INC.; Model GD-4765-3/5.
   c. Victaulic Co. of America.

2.04 BRONZE CHECK VALVES

A. Bronze Check Valves, General: MSS SP-80.

B. Class 125, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze disc, Y-pattern design, soldered or threaded end connections, and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.; Model 162T-LF and 163T-LF (61YLF Series).
   b. Milwaukee Valve Company; Model UP509/UP1509.
   c. NIBCO INC.; Models S-413-B-LF or T-413-B-LF.
   d. Watts Water Technologies; LFCVY/LFCVYS.

2.05 IRON SWING CHECK VALVES

A. Iron Swing Check Valves, General: MSS SP-71.

B. Class 125, Gray-Iron, Standard Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; bronze disc and seat; and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.; Model 910F.
   b. Crane Co.; Crane Valves.
   c. Crane Co.; Stockham Div.
   d. Hammond Valve; IR1124-HI.
   e. Milwaukee Valve Company; Model F-2974.
   f. NIBCO INC.; Model F-918-B.
   g. Watts Water Technologies.

C. Class 250, Gray-Iron, Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; and bronze disc and seat; and having 500 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.; Model 920F.
   b. Crane Co.; Crane Valves.
   c. Crane Co.; Stockham Div.
   d. Hammond Valve; IR322.
   e. Milwaukee Valve Company; Model F-2970.
   f. NIBCO INC.; Model F-968-B.
   g. Watts Water Technologies.

D. Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends; nonasbestos, synthetic-fiber gaskets; rubber seats; and having 250-psig CWP Rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Mueller Co.
   b. NIBCO, INC.; Model G-917-W.

c. Victaulic Co. of America.

2.06 LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; by Conbraco Industries, Inc.; Model CBV-LF (61LF Series).
b. Bonomi USA, Inc.; Series 100002 and 100003.
c. Hammond Valve; UP943 and UP947.
d. Milwaukee Valve Company; UP548T and UP1548T.
e. NIBCO INC.; Model S-480-Y-LF and T-480-Y-LF.
f. Watts Water Technologies; LF600.
2. Description:
a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 250 psig.
c. Body Design: Vertical flow.
d. Body Material: Lead free brass or bronze.
e. Ends: Threaded or Solder.
f. Disc: PTFE, TFE, or Polyethermide.

2.07 SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES

A. Lift-Disc Check Valves, General: FCI 74-1 and MIL-V-18436F, with spring-loaded, center-guided bronze disc and seat.

B. Class 125, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 200 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. NIBCO INC.; Model W-910-B-LF.
b. Mueller Steam Specialty.
c. Milwaukee Valve Company.
d. Hammond Valve.

C. Class 250, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 400 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. NIBCO INC.; Model W-960-B-LF.
b. Mueller Steam Specialty.
c. Milwaukee Valve Company.
d. Hammond Valve.

D. Class 125, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends and having 200 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. NIBCO INC.; Model F-910-B-LF.
b. Mueller Steam Specialty.
c. Milwaukee Valve Company.
d. Hammond Valve.

E. Class 250, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends and having 400 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. NIBCO INC.; Model F-960-B-LF.
b. Mueller Steam Specialty.

c. Milwaukee Valve Company.
d. Hammond Valve.

2.08 BRONZE GLOBE VALVES

A. Bronze Globe Valves, General: MSS SP-80, with malleable-iron handwheel.

B. Class 125, TFE Disc, Bronze Globe Valves: ASTM B-62 bronze body, bonnet, and seat, TFE disc, copper-silicone bronze stem, union-ring bonnet, soldered or threaded end connections; and having 200 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
a. Apollo Valves; by Conbraco Industries, Inc.; Model 121T-LF.
b. Hammond Valve; UP418 and UP440.
c. Milwaukee Valve Company; Model UP502 and UP1502.
d. Watts Water Technologies, Inc.; LFGLV.

2.09 CAST-IRON GLOBE VALVES

A. Cast-Iron Globe Valves, General: MSS SP-85 with bolted bonnet, flanged end connections, and non-asbestos packing and gasket.

B. Class 125, Metal Seat, Cast-Iron Globe Valves: ASTM A-126, Class B cast-iron body and bonnet with bronze trim and having 200 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
a. Apollo Valves; by Conbraco Industries, Inc.; Model 711F.
b. Crane Co.; Crane Valves.
c. Crane Co.; Stockham Valves.
d. Hammond Valve.
e. Milwaukee Valve Company; Model F-2981.
f. NIBCO INC.; Model F-718-B.
g. Watts Water Technologies, Inc.

2.10 CAST-IRON ANGLE VALVES

A. Cast-Iron Angle Valves, General: MSS SP-85, Type II; having ASTM A 126, Class B cast-iron body and bolted bonnet; bronze mounted, non-asbestos packing and gaskets; and flanged-end connections.

B. Class 125, Cast-Iron, Standard Angle Valves: 200-psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. NIBCO INC.; Model F-818-B.
b. Crane Co.; Stockham Valves.
c. Crane Co.; Crane Valves.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Bronze ball valve as specified in this Section. Lead free construction is not required.
2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:
   1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
   2. Pressure Rating: 200-psig minimum CWP or Class 125.
   3. Size: NPS 3/4.
   4. Body: Copper alloy or ASTM B 62 bronze.
   5. Drain: NPS 1/8 side outlet with cap.

2.12 SOURCE QUALITY CONTROL

A. Identification: Factory label or color coding to identify lead free valves.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, butterfly valves.
   2. Throttling Service: Angle, ball, butterfly, or globe valves.
   3. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

3.03 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.

E. Install valves in position to allow full stem movement.

F. Install chainwheel operators on valves NPS 4 and larger and more than 84 inches above floor. Extend chains to 60 inches above finished floor elevation.

G. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Lift Check Valves: With stem upright and plumb.

3.04 JOINT CONSTRUCTION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.05 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION

SECTION 22 1116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods” for materials and methods common to mechanical piping systems.
3. Division 20 Section “Hangers and Supports.”
4. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
5. Division 22 Section “General-Duty Valves for Plumbing.”
6. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.02 SUMMARY

A. This Section includes domestic water piping inside the building.

B. Water meters will be furnished and installed by utility company.

1.03 PERFORMANCE REQUIREMENTS

A. Where not indicated on the Drawings, provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.
1. Exception: PEX plastic piping insert fittings specified are limited to 100 psig.

1.04 SYSTEMS DESCRIPTION

A. Potable and non-potable domestic water piping system materials are scheduled on the Drawing.

B. Refer to Application Schedules on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 and smaller. Use general service butterfly valves or cast-iron globe valves with flanged ends for piping NPS 2-1/2 and larger.
   2. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
   3. Drain Duty: Hose-end drain valves.
   4. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2 and Smaller: Class 150, bronze.
   5. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2-1/2 and Larger: Class 125, OS&Y, bronze-mounted cast iron.

C. Transition and special fittings with pressure ratings at least equal to piping rating may be used unless otherwise indicated.

1.05 ACTION SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Fire-suppression-water piping.
   2. Domestic water piping.
   3. Compressed air piping.
   4. HVAC hydronic piping.

1.07 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Water Samples: Specified in Part 3 "Cleaning" Article.

1.08 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

E. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

1.09 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

A. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.03 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.
   1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
   2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
   3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
   1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
   2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
   3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Grooved-Joint Systems:
   1. Manufacturers:
      a. ASC Engineered Solutions; Gruvlok; Fig. 64 CTS SlideLOK.
      b. Victaulic Company; Style 606 and Style 607.
   2. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
   3. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.

D. Copper or Bronze Pressure-Seal Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Viega North America; ProPress System.
      b. NIBCO Inc.; Press System.
      c. Mueller Industries, Inc.; Streamline PRS.
      d. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.
      e. Apollo Valves; by Conbraco Industries; ApolloXpress.
      f. ASC Engineered Solutions; Anvil Press.
   2. Housing: Copper.
   3. O-Rings and Pipe Stops: EPDM.
   4. Tools: Manufacturer's special tools.
   5. Maximum 200-psig working-pressure rating at 250 deg F.

E. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube. Mechanically formed tee fittings may be used up to half size of main.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. T-DRILL Industries Inc.

2.04 VALVES

A. General-duty plumbing valves; and drain valves are specified in Division 22 Section "Plumbing Valves."

B. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

2.05 SPECIALTY VALVES

A. Cast-Iron Gate Valves: MSS SP-70, with bolted bonnet, flanged end connections, and non-asbestos packing and gasket.
   1. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: ASTM A-126, Class B cast-iron body and bonnet with bronze trim, and solid-wedge disc; and having 200 psig CWP rating.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Crane Valve Group; Crane Valves.
         2) Hammond Valve.
         3) Milwaukee Valve Company; Model F-2885.
         4) NIBCO INC.; Model F-617-O.
         5) Watts Water Technologies.

2.06 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

2.07 PIPING SYSTEM INSTALLATION

A. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Install sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."

C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 20 Section "Meters and Gages," and strainers are specified in Division 22 Section "Domestic Water Piping Specialties."

D. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.

E. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
   1. Install hose-end drain valves at low points in water mains, risers, and branches.
   2. Install stop-and-waste drain valves where indicated.

F. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

G. Install domestic water piping level without pitch and plumb.

2.08 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

2.09 WATER METER INSTALLATION

A. Water meters will be furnished and installed by utility company.

B. Rough-in domestic water piping for water meter installation and install water meters according to utility company's requirements.

2.10 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support devices are specified in Division 20 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

F. Install supports for vertical steel piping every 15 feet.

G. Install hangers for drawn-temper copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 and Smaller: 60-inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Soft copper tube: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.

J. Alternate support for copper tubing NPS 3/4 and smaller: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

2.11 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect domestic water piping to distribution side of water meter with shutoff valve.

C. Connect domestic water piping to existing domestic water distribution piping. Use dielectric fitting if connection dissimilar metals. Refer to Application Schedule on the Drawings and Division 20 Section “Basic Mechanical Materials and Methods” for dielectric fittings.

D. Install piping adjacent to equipment and machines to allow service and maintenance.

E. Connect domestic water piping to the following:
1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."

2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.
3. Booster Pumps: Cold-water suction and discharge piping.
4. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

2.12 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:
1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
   a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:
1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 150 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

2.13 ADJUSTING

A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

2.14 CLEANING AND DISINFECTION

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

B. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
4. Division 22 Section "Domestic Water Piping " for water meters.
5. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
6. Division 22 Section "Drinking Fountains, Water Coolers and Cuspidors" for water filters for water coolers.

1.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Flow Reports and Settings: For calibrated balancing valves.

C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. NSF Compliance:
1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
3. Comply with NSF 372, “Drinking Water System Components – Lead Content” for components with wetted surfaces in contact with potable water.

PART 2 - PRODUCTS

2.01 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; Conbraco Industries, Inc.
b. FEBCO; a Division of Watts Water Technologies, Inc.
c. Watts Water Technologies, Inc.; Watts Regulator Co.
d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; Conbraco Industries, Inc.
b. MIFAB, Inc.
c. Watts Water Technologies, Inc.; Watts Regulator Co.
d. Woodford Manufacturing Company.
2. Standard: ASSE 1011.
3. Body: Bronze or brass, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; Conbraco Industries, Inc.
b. FEBCO; a Division of Watts Water Technologies, Inc.
c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
d. Watts Water Technologies, Inc.; Watts Regulator Co.
e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.

4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size and Capacity: As indicated on the drawings.
6. Accessories:
    a. Valves: Ball type, on inlet and outlet.

2.02 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Apollo Valves; Conbraco Industries, Inc.
    b. FEBCO; a Division of Watts Water Technologies, Inc.
    c. Watts Water Technologies, Inc.; Watts Regulator Co.
    d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Apollo Valves; Conbraco Industries, Inc.
    b. FEBCO; a Division of Watts Water Technologies, Inc.
    c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
    d. Watts Water Technologies, Inc.; Watts Regulator Co.
    e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.
6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:
    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
    c. Y-Pattern strainer and soft-seated check valve.

C. Hose-Connection Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Apollo Valves; Conbraco Industries, Inc.
    b. Watts Water Technologies, Inc.; Watts Regulator Co.
    c. Woodford Manufacturing Company.
2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

D. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; Conbraco Industries, Inc.
   b. FEBCO; a Division of Watts Water Technologies, Inc.
   c. Watts Water Technologies, Inc.; Watts Regulator Co.
   d. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.03 BALANCING VALVES

A. Calibrated Balancing Valves NPS 1/2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong International, Inc.
   b. Armstrong Pumps, Inc.
   c. Apollo Valves; by Conbraco Industries, Inc.
   d. Bell & Gossett; Xylem Inc.
   e. Flo Fab Inc.
   f. Flow Design Inc.
   g. Griswold Controls.
   h. NIBCO INC.
   i. IMI Indoor Climate; Tour & Andersson.
   j. Taco, Inc.
   k. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Dezincification resistant brass, or bronze.
4. Minimum Flow Rate: 0.3 gpm.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.04 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Acorn Controls; Morris Group International; ST70.
   b. Apollo Valves; Conbraco Industries, Inc.; Model MVD (34D Series).
   c. Bradley Corporation.
   d. Lawler Manufacturing Company, Inc.
   e. Leonard Valve Company; Series 170-LF and 270-LF.
   f. Watts Water Technologies, Inc.; Powers Division; Hydroguard Series LFe480, LFG480, and LFLM495.
   g. Watts Water Technologies, Inc.; Watts Regulator Co.
   h. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: 1/2-inch union or 3/8-inch compression; with integral check valves.
7. Accessories: Adjustable temperature-control knob.
8. Outlet Temperature Range: Adjustable from 85 deg F to 120 deg F. Set at 105 deg F.
9. Minimum Flow Rate: 0.5 gpm.
10. Valve Finish: Chrome plated where exposed. Chrome plated or rough bronze where concealed.

2.05 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
1. Manufacturers:
   a. Apollo Valves; Conbraco Industries, Inc.
   b. Keckley Company.
   c. Metraflex Company.
   d. Mueller Steam Specialty; a Watts Brand.
   e. NIBCO, Inc.
   f. Titan Flow Control, Inc.
   g. Watts.
   h. Yarway; Emerson Automation Solutions.
2. CWP: 200 psig minimum, unless otherwise indicated.
3. SWP: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
5. End Connections: Threaded or soldered for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Screen: Stainless steel with round perforations, unless otherwise indicated.
7. Perforation Size:
   a. Strainers NPS 2 and Smaller: 0.033 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
8. Drain: Pipe plug.

2.06 HOSE BIBBS

A. Hose Bibbs:
1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.07 WALL HYDRANTS

A. Nonfreeze Wall Hydrants, WH-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Water Technologies, Inc.; Watts Regulator co.
   f. Woodford Manufacturing Company.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M for self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze or chrome plated.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

2.08 WATER HAMMER ARRESTERS

A. Water Hammer Arresters (Copper Tube Type):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. MIFAB, Inc.
   b. PPP Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   e. Tyler Pipe; Wade Div.
   f. Watts Drainage Products Inc.
   g. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

B. Water Hammer Arresters (Metal Bellows Type):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   e. Tyler Pipe; Wade Div.
   f. Watts Drainage Products Inc.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Precharged stainless steel bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

C. Water Hammer Arresters (Custom Type):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMTROL, Inc.
   b. Josam Company.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Type: Factory precharged stainless steel pressure chamber with stainless steel bellows and non-toxic hydraulic fluid having pressure gage and air valve with cap.
3. Size: Custom sized for application by manufacturer.

2.09 AIR VENTS

A. Bolted-Construction Automatic Air Vents:
   1. Body: Bronze.
   2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
   3. Float: Replaceable, corrosion-resistant metal.
   4. Mechanism and Seat: Stainless steel.
   5. Size: NPS 3/8 minimum inlet.
   6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:
   1. Body: Stainless steel.
   2. Pressure Rating: 150-psig minimum pressure rating.
   3. Float: Replaceable, corrosion-resistant metal.
   4. Mechanism and Seat: Stainless steel.
   5. Size: NPS 3/8 minimum inlet.
   6. Inlet and Vent Outlet End Connections: Threaded.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
   3. Do not install bypass piping around backflow preventers.
   4. Install strainer and soft-seated check valve upstream of backflow preventer. Exception: Fire protection backflow preventers.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install temperature-actuated water mixing valves with strainers, and check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install thermometers and water regulators if specified.
   2. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Install Y-pattern strainers for water on supply side of each solenoid valve, and pump.

F. Install roof hydrants in accordance with manufacturer’s instructions. Pipe drain hole to acceptable discharge point.

G. Install water hammer arresters in water piping according to PDI-WH 201.

H. Install air vents at high points of water piping.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

C. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Calibrated balancing valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
1. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.05 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves as follows:
1. Set calibrated balancing valves at calculated presettings.
2. Measure flow each station and adjust where necessary.
3. Record settings and mark balancing devices.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 22 1123 - DOMESTIC WATER CIRCULATION PUMPS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section "Domestic Water Packaged Booster Pumps" for booster systems.
4. Division 20 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”

1.02 DEFINITIONS

A. PEI: Pump Energy Index as defined by the Department of Energy.

B. PEI_{CL}: Pump Energy Index – Constant Load, as defined by the Department of Energy.

C. PEI_{VL}: Pump Energy Index – Variable Load, as defined by the Department of Energy.

1.03 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Department of Energy Requirements: Pumps supplied that are regulated by the Department of Energy pump standards shall bear the acceptable PEI index.
   1. Constant load pumps supplied shall bear the acceptable PEICL index.
   2. Variable load pumps supplied with variable speed controls shall bear the acceptable $PEIv_L$ index.
   3. Submittals for approval shall clearly identify the applicable PEI index and affirm that that index meets the DOE pump standards.

D. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

F. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.08 COORDINATION

A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS (SMALL)

A. Manufacturers:
   1. Armstrong Pumps Inc.
   2. Bell & Gossett; Xylem Inc.; Series PL.
   3. Grundfos Pumps Corp.
   4. Taco, Inc.; Series 1400.

B. Description: Factory-assembled and –tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; and designed for installation with pump and motor shafts mounted horizontally.
   1. Pump Construction: All bronze.
      a. Casing: Radially split, bronze, with threaded companion-flange connections.
      b. Impeller: Glass-reinforced corrosion-resistant material; keyed to shaft.
      c. Shaft: High-strength alloy steel.
      d. Seal: Mechanical, carbon/silicon carbide seal.

e. Bearings: Permanently oil-lubricated type.

2. Motor-Single speed, with oil-lubricated bearings, unless otherwise indicated; and directly mounted to pump casing. Comply with requirements in Division 20 Section “Motors.”

C. Capacities and Characteristics: Refer to Schedule on Drawings.

2.03 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Manufacturers:
   a. Honeywell International, Inc.; Aquastat.
   b. Johnson Controls, Inc.
   c. Schneider Electric USA, Inc.
   d. Siemens Industry, Inc.; Building Technologies Division.
   e. White-Rodgers Div.; Emerson Electric Co.
2. Type: Strap-on sensor, with suitable removable spring clip attaching thermostat to hot-water circulation piping.
3. Range: 65 to 200 deg F.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 24 V, ac or 120 V, ac.
7. Settings: Start pump at 122 deg F and stop pump at 130 deg F.

2.04 FLEXIBLE CONNECTORS

A. Refer to Division 20 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”

2.05 BUILDING-AUTOMATION-SYSTEM INTERFACE

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:

1. On-off status of each pump.
2. Alarm status.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.02 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping. Do not use pump motors as a support point.

D. Install centrifugal pumps with motor and pump shafts horizontal.

E. Install continuous-thread hanger rods and elastomeric hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 20 Section "Mechanical Vibration Controls." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 20 Section "Hangers and Supports."

F. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and elastomeric hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 20 Section "Mechanical Vibration Controls." Hanger and support materials are specified in Division 20 Section "Hangers and Supports."

G. Install vertical in-line pumps on concrete bases. Install pumps with motor and pump shafts vertical.

3.03 CONTROL INSTALLATION

A. Install thermostats in hot-water return piping.

B. Install timers where indicated on Drawings.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 22 Section "Domestic Water Piping."
   1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
      a. Separately coupled, in-line centrifugal pumps.
      b. Separately coupled, horizontally mounted, in-line centrifugal pumps.
      c. Close-coupled, horizontally mounted, in-line centrifugal pumps.
      d. Close-coupled, vertically mounted, in-line centrifugal pumps.
   2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 20 Section "Valves" for general-duty valves for domestic water piping and Division 22 Section "Domestic Water Piping Specialties" for strainers.
   3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 20 Section "Meters and Gages" for pressure gages and gage connectors.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

F. Connect thermostats to pumps that they control.

G. Interlock pump with water heater burner and time delay relay.

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Set thermostats for automatic starting and stopping operation of pumps.
   5. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.
   6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
   7. Start motor.
   8. Open discharge valve slowly.
   9. Adjust temperature settings on thermostats.
   10. Adjust timer settings.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION

SECTION 22 1316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements”.
2. Division 20 Section “Basic Mechanical Materials and Methods”.
3. Division 22 Section “Drainage Piping Specialties”.
4. Division 22 Section "Chemical-Waste Piping" for chemical-waste and vent piping systems.
5. Division 22 Section "Sewage Pumps."
6. Division 22 Section “Sanitary Waste and Vent Piping” for piping outside building.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. LLDPE: Linear, low-density polyethylene plastic.

D. NBR: Acrylonitrile-butadiene rubber.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. TPE: Thermoplastic elastomer.

1.03 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 10-foot head of water.
   2. Sanitary Sewer, Force-Main Piping: 125 psig.

1.04 SYSTEMS DESCRIPTIONS

A. Sanitary waste and vent piping system materials are scheduled on the Drawing.

1.05 ACTION SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.06 INFORMATIONAL SUBMITTALS

A. Shop Drawings:
   1. Sovent Drainage System: Include plans, elevations, sections, and details.

1.07 CLOSEOUT SUBMITTALS

A. Field quality-control inspection and test reports.

1.08 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).

C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:
   1. Manufacturers:
      a. ANACO-Husky; McWane Plumbing Group.
      b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
      c. IDEAL-TRIDON.
      d. MIFAB, Inc.
      e. Mission Rubber Company; a division of MCP Industries, Inc.
      f. Tyler Pipe; McWane Plumbing Group.
      g. Fernco Inc.
   2. Standards: CISPI 310.
   3. Description: NSF certified for compliance with CISPI 310. Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
   1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

2.04 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: Schedule 40, ASTM D 2665, drain, waste, and vent.
   1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

2.05 SPECIALTY PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Manufacturers:
      a. Dallas Specialty & Mfg. Co.
      b. Fernco, Inc.
      c. Logan Clay Products Company (The).
      d. Mission Rubber Co.
      e. NDS, Inc.
      f. Plastic Oddities, Inc.
   2. Sleeve Materials:
      a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
      b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Mission Rubber Co.

C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Manufacturers:
      a. ANACO.

D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Dresser, Inc.; DMD Div.
      c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
      d. JCM Industries, Inc.
      e. Smith-Blair, Inc.
      f. Viking Johnson.
      g. EBAA Iron Sales, Inc.
      h. Romac Industries, Inc.
   2. Center-Sleeve Material: Manufacturer's standard.
   3. Gasket Material: Natural or synthetic rubber.
   4. Metal Component Finish: Corrosion-resistant coating or material.

E. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
   1. Manufacturers:
      a. SIGMA Corp.

F. Tubular Fittings: ASTM F 409, PVC drainage-pattern tube and tubular fittings with ends as required for application.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Comply with requirements in Division 31 Section “Earth Moving” for excavating, trenching, and backfilling.

3.02 PIPING SYSTEM INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Sanitary sewer piping outside the building is specified in Division 22 Section "Sanitary Sewerage."

C. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

F. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."

G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Building Sanitary Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
   2. Horizontal Sanitary Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
   3. Vent Piping: 1/8-inch per foot down toward vertical fixture vent or toward vent stack.

K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

L. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

M. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.03 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

F. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.04 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in OD's.
   2. In Drainage Piping: Shielded, nonpressure transition couplings.

3.05 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 20 Section "Hangers and Supports." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Install individual, straight, horizontal piping runs according to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 2-1/2: 11 feet with 1/2-inch rod.
   5. NPS 3: 12 feet with 1/2-inch rod.
   6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
   7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.
   8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   3. NPS 2-1/2: 108 inches with 1/2-inch rod.
   4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
   5. NPS 6: 10 feet with 5/8-inch rod.
   6. NPS 8: 10 feet with 3/4-inch rod.

J. Install supports for vertical copper tubing every 10 feet.

K. Install hangers for and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
   2. NPS 3: 48 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

L. Alternate support for plastic piping: Continuous support 18 gauge v-shaped galvanized steel channel, maximum hanger spacing 8 feet.

M. Install supports for vertical PVC piping every 48 inches.

N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:
   1. Sanitary Sewer: To exterior force main or sanitary manhole.
   2. Sewage Pumps: To sewage pump discharge.

3.07 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 Section "Mechanical Identification."

3.08 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   2. Cap and subject piping to static-water pressure of 150 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   4. Prepare reports for tests and required corrective action.

3.09 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PROTECTION

A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION

SECTION 22 1319 - DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section "Plumbing Fixtures" for hair interceptors.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PUR: Polyurethane plastic.

H. PVC: Polyvinyl chloride plastic.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings:
   1. Show fabrication and installation details for frost-resistant vent terminals.
   2. Wiring Diagrams: Power, signal, and control wiring.

B. Delegated-Design Submittal: For siphonic roof drainage system indicated to comply with performance requirements and design criteria, including analysis data.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For drainage piping specialties to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary and storm piping specialty components.

D. Comply with ASPE/ANSI 45-2013 “Siphonic Roof Drainage” for siphonic roof drainage systems.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.01 CAST-IRON CLEANOUTS

A. Size: Cleanouts shall be same nominal size as the pipe they serve up to 4 inches. For pipes larger than 4 inches nominal size, minimum size of cleanout shall be 4 inches.

B. Exposed Cast-Iron Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.; Series 58910.
      b. MIFAB, Inc.; C1460.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; 4510 Series.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.
      f. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
   3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
   4. Closure: Countersunk or raised-head, brass or bronze plug with tapered threads.

C. Cast-Iron Floor Cleanouts (On-Grade Interior Floor Areas):
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. MIFAB, Inc.; C1220-R.
      c. Sioux Chief Manufacturing Company, Inc.
      d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4023S-F.
      e. Tyler Pipe; Wade Div.
      f. Watts Drainage Products Inc.

g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Not required.
6. Outlet Connection: Spigot.
7. Closure: Brass, bronze, or plastic plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Medium Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

D. Cast-Iron Wall Cleanouts (Finished Wall Areas):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company; Josam Div.; Model 58790-20.
b. MIFAB,Inc.; C1460-RD.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, drilled-and-threaded bronze or brass plug with tapered threads.
5. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
6. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

E. Exterior Surface Area (Outdoor) Cast-Iron Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M.
3. Type: Cast-iron soil pipe with cast-iron ferrule.
4. Body or Ferrule: Cast iron.
5. Outlet Connection: Spigot.
6. Closure: Brass, bronze, or plastic plug with tapered threads.
7. Access Frame and Cover Material and Finish: Non-skid nickel-bronze, copper alloy.
8. Frame and Cover Shape: Round.
9. Top Loading Classification: Heavy Duty.
10. Riser: ASTM A 74, Extra-Heavy Service class, cast-iron drainage pipe fitting and riser to cleanout.

2.02 FLOOR DRAINS

A. Cast-Iron Floor Drains (Toilet Rooms, Labs, and Janitor’s Closet) FD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Sioux Chief Manufacturing Company, Inc.; Finish Line Adjustable Drainage System.
   d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2005Y-A.
   e. Tyler Pipe; Wade Div.
   f. Watts Drainage Products Inc.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom unless otherwise noted.
8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Nickel bronze.
11. Top Shape: Round, with vandal proof screws.
12. Dimensions of Top or Strainer: 7 inch diameter.
13. Top Loading Classification: Light Duty.
14. Inlet Fitting: Gray iron, with spigot outlet.
15. Trap-Seal Protection Device: Barrier type.

2.03 FLOOR SINKS

A. Stainless-Steel Floor Sink Drains FS-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 3004-10.
      d. Tyler Pipe; Wade Div.
      e. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Standard: ASME A112.6.7.
   3. Outlet: Bottom unless otherwise noted.
   4. Top or Strainer Material: Stainless steel.
   5. Top Shape: Square.
   6. Dimensions of Top or Strainer: 10 1/2 inch by 10 1/2 inch, 14 gage, Type 304 stainless steel ribbed, non-tilt loose set half grate with 1/2 inch square holes and perforated stainless steel sediment bucket.
   7. Seepage Flange: Required.
   8. Clamping Device: Required.
   9. Trap-Seal Protection Device: Barrier type.

2.04 GREASE INTERCEPTORS

A. Grease Interceptors, GI-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. Lowe Engineering; a div. of Highland Tank & Manufacturing Co., Inc.
      c. MIFAB, Inc.
      d. Schier Products Company; Model GB-2
      e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      f. Tyler Pipe; Wade Div.

g. Watts Drainage Products Inc.
h. Zurn Plumbing Products Group.

2. Standard: ASME A112.14.3, for intercepting and retaining fats, oils, and greases from food-preparation or -processing wastewater.
3. Body Material: Cast iron, steel, or polyethylene.
4. Interior Lining: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polyethylene bodies.
5. Exterior Coating: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polyethylene bodies.
6. Riser Extension: As required.
7. Size and Capacities: 35” x 23” x 13-3/4”. 130 lb. grease @ 35 gpm.
8. Cleanout: Integral.
9. Mounting: Above floor.
10. Flow-Control Fitting: Integral.
11. Operation: Manual cleaning.

2.05 TRAP SEAL PROTECTION DEVICES

A. Barrier Type Trap Seal Protection Devices:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Smith, Jay R. Mfg. Co.; Quad Close Trap Seal Device Fig. 2692.
b. Rectorseal; a CSW Industrials Company; SureSeal Plus Inline Floor Drain Trap Sealer.
2. Standard: ASSE 1072-2007.
3. Sealing Element: Neoprene rubber or chemically resistant elastomer.
4. Size: 2 inch, 3 inch, 3-1/2 inch, or 4 inch.
5. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

2.06 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Engineering Company; Elmdor/Stoneman Div.
b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly consisting of metal flashing collar and skirt extending at least 6 inches from pipe, with boot reinforcement and counterflashing fitting.
1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.07 TRAP SEAL PROTECTION DEVICES

A. Barrier Type Trap Seal Protection Devices:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Smith, Jay R. Mfg. Co.; Quad Close Trap Seal Device Fig. 2692.
b. Rectorseal; a CSW Industrials Company; SureSeal Plus Inline Floor Drain Trap Sealer.
2. Standard: ASSE 1072-2007.
3. Sealing Element: Neoprene rubber or chemically resistant elastomer.
4. Size: 2 inch, 3 inch, 3-1/2 inch, or 4 inch.
5. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

2.08 ROOF DRAINS

A. Metal Roof Drains RD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 1015/1074.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4
3. Pattern: Roof drain.
4. Body Material: Cast iron.
5. Dimensions of Body: Minimum 10 inch diameter body.
6. Combination Flashing Ring and Gravel Stop: Required.
7. Flow-Control Weirs: Not required.
8. Outlet: Bottom unless otherwise noted.
9. Dome Material: Cast iron, or ductile iron.
10. Extension Collars: Required.
11. Underdeck Clamp: Required.
12. Sump Receiver: Required.

B. Metal Secondary Roof Drains RD-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 1015/1074.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4
3. Pattern: Roof drain.
4. Body Material: Cast iron.
5. Dimensions of Body: Minimum 10 inch diameter body.
6. Combination Flashing Ring and Gravel Stop: Required.
7. Flow-Control Weirs: Not required.
8. Outlet: Bottom unless otherwise noted.
9. Dome Material: Cast iron, or ductile iron.
10. Extension Collars: Required.
11. Underdeck Clamp: Required.
12. Sump Receiver: Required.
13. Standpipe: Cast iron. 2 inches high where overflow drains are indicated.

2.09 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

A. Hub Outlets:
1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.

5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Expansion Joints:
1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

G. Downspout Boots, DSB-1:
1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout.
3. Description: ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.
4. Size: Same as or larger than connected downspout.

H. Downspout Covers DNZ-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Fig. No. 1775.
b. Zurn Plumbing Products Group; Specification Drainage Operation; Z199-DC.
2. Description: Round fabricated stainless steel frame with mounting holes, and with fabricated secured perforated stainless steel hinged strainer.
3. Size: Same as connected conductor.

2.10 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
      b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
      c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install fixture air-admittance valves on fixture drain piping.

G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

I. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.
   1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
   2. Position roof drains for easy access and maintenance.

J. Assemble open drain fittings and install with top of hub 2 inches above floor.

K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

M. Install vent caps on each vent pipe passing through roof.

N. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

O. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

P. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

Q. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

R. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

S. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

T. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
1. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

3.03 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.04 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Grease interceptors.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."

3.05 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 1413 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section “Drainage Piping Specialties.”
4. Division 22 Section "Sump Pumps."
5. Division 33 Section “Storm Utility Drainage Piping” for piping outside building.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. TPE: Thermoplastic elastomer.

1.03 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
1. Storm Drainage Piping: 10-foot head of water.
2. Storm Drainage, Force-Main Piping: 125 psig.

1.04 SYSTEMS DESCRIPTIONS

A. Storm drainage piping system materials are scheduled on the Drawing.

1.05 ACTION SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.06 CLOSEOUT SUBMITTALS

A. Field quality-control inspection and test reports.

1.07 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).

C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with “NSF-dwv” for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: Schedule 40, ASTM D 2665, drain, waste, and vent.
   1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.02 PIPING SYSTEM INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Drainage."

B. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Drainage Piping Specialties."

D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

E. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
   1. Install encasement on piping according to ASTM A 674 or AWWA C105.

F. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
   1. Install encasement on piping according to ASTM A 674 or AWWA C105.

G. Install underground, copper, force-main tubing according to Copper Development Association’s "Copper Tube Handbook."

H. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."

I. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

J. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
   1. Building Storm Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
   2. Horizontal Storm-Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.

M. Install force mains at elevations indicated.

N. Install engineered controlled-flow storm drainage piping in locations indicated.

O. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

P. Install PVC storm drainage piping according to ASTM D 2665.

Q. Install underground PVC storm drainage piping according to ASTM D 2321.

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.03 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.04 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 20 Section "Hangers and Supports." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6: 60 inches with 3/4-inch rod.
   5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
   6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 2-1/2: 11 feet with 1/2-inch rod.
   5. NPS 3: 12 feet with 1/2-inch rod.
   6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
   7. NPS 6: 12 feet with 3/4-inch rod.
   8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   3. NPS 2-1/2: 108 inches with 1/2-inch rod.
   4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
   5. NPS 6: 10 feet with 5/8-inch rod.
   6. NPS 8: 10 feet with 3/4-inch rod.

J. Install supports for vertical copper tubing every 10 feet.

K. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
   2. NPS 3: 48 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
   4. NPS 6: 48 inches with 3/4-inch rod.
   5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.

L. Alternate support for plastic piping: Continuous support 18 gauge v-shaped galvanized steel channel, maximum hanger spacing 8 feet.

M. Install supports for vertical PVC piping every 48 inches.

N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.05 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

D. Connect force-main piping to the following:
   1. Storm Sewer: To exterior force main or storm manhole.
   2. Sump Pumps: To sump pump discharge.

3.06 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   2. Cap and subject piping to static-water pressure of 150 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   4. Prepare reports for tests and required corrective action.

3.07 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 22 3300 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
   1. Division 20 Section “Mechanical General Requirements.”
   2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 ACTION SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

B. Product Certificates: For each type of electric water heater, signed by product manufacturer.

C. Source quality-control test reports.

1.04 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For electric water heaters to include in operation and maintenance manuals.

C. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
   1. ASHRAE 90.1, “Energy Efficient Design of New Buildings except Low-Rise Residential Buildings,” for commercial water heaters.

F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.06 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 COMMERCIAL ELECTRIC WATER HEATERS

A. Commercial Electric Booster Heaters: Comply with UL 1453 requirements for booster-type water heaters.
   1. Manufacturers:
      a. Bock Water Heaters, Inc.; ElectriTherm Heavy Duty.
      b. Bradford White Corporation.
      c. Lochinvar Corporation.
      d. Smith, A. O. Water Products Company; Gold Xi Series and Dura-Power CMC and SU Series.
   2. Storage-Tank Construction: Corrosion-resistant metal or steel.
      a. Tappings: ASME B1.20.1 pipe thread.
      b. Pressure Rating: 150 psig.
      c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
   3. Factory-Installed Storage-Tank Appurtenances:
      a. Anode Rod: Replaceable magnesium.
      b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
      c. Insulation: Comply with ASHRAE/IESNA 90.1.
      d. Jacket: Rectangular shaped, with stainless-steel front panel, unless otherwise indicated.
      e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
         1) Option: Booster heaters with 9 kW or less total may have 2 or 3 elements.
         2) Staging: Input not exceeding 18 kW per step.
      f. Temperature Control: Adjustable thermostat, to setting of at least 180 deg F.
      g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
      h. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3, combination temperature and pressure relief valve. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater

working-pressure rating. Select relief valve with sensing element that extends into storage tank.

i. Gages: Combination temperature and pressure type or separate thermometer and pressure gage.

4. Special Requirements: NSF 5 construction with legs for floor installation.
5. Capacity and Characteristics:
   a. Refer to Schedule on Drawings.

2.03 EXPANSION TANKS

A. Description: Steel, pressure-rated tank, ASME-code constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

1. Manufacturers:
   a. AMTROL Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett; Xylem Inc.
   d. Taco, Inc.
   e. Wessels Co.
2. Construction:
   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.
3. Capacity and Characteristics: Refer to Schedule on Drawings.

2.04 WATER HEATER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working-pressure rating.

C. Water Heater Stand and Drain-Pan Units: High-density-polyethylene-plastic, 18-inch- high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 drain outlet with ASME B1.20.1 pipe thread.

D. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.

E. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

F. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

G. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25-psig- maximum outlet pressure, unless otherwise indicated.

H. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

2.05 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.
   1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
   2. Concrete base construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 20 Section "Valves" for hose-end drain valves.

F. Install thermometer on outlet piping of water heaters. Refer to Division 20 Section "Meters and Gages" for thermometers.

G. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 20 Section "Valves" for general-duty valves and to Division 20 Section "Meters and Gages" for thermometers.

H. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

I. Fill water heaters with water.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove water heaters that do not pass tests and inspections. Replace with water heaters meeting Contract requirements and retest as specified above.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial electric water heaters.

END OF SECTION

SECTION 22 4200 - PLUMBING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 10 Section "Toilet and Bath Accessories."
2. Division 20 Section “Mechanical General Requirements.”
3. Division 20 Section “Basic Mechanical Materials and Methods.”
4. Division 22 Section "Emergency Plumbing Fixtures."
5. Division 22 Section "Drinking Fountains and Water Coolers."
6. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers; individual-fixture, water tempering valves; and specialty fixtures not included in this Section.
7. Division 22 Section “Drainage Piping Specialties” for floor drains, and specialty fixtures not included in this Section.
8. Division 22 Section "Water Distribution" for exterior plumbing fixtures and hydrants.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

B. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For plumbing fixtures and trim to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
   1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

H. Comply with applicable ANSI, ASME, ASSE, ASTM, ICC, NSF, and UL standards and other requirements specified for plumbing fixtures, trim, fittings, components, and features.

1.07 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures of unit shell.
      b. Faulty operation of controls, blowers, pumps, heaters, and timers.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period for Commercial Applications: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 URINALS

A. Urinals, UR-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard Companies, Inc.; Washbrook Urinal System.
      b. Kohler Co.; Bardon K 4991-ETSS.
      c. Sloan Valve Company.
      d. Zurn Industries, Inc.; EcoVantage.
   2. Description: Wall-mounting, back-outlet, ultra-low water consumption, vitreous-china fixture designed for flushometer valve operation.
      a. Type: High efficiency.
      b. Strainer or Trapway: Open trapway with integral trap.
      c. Design Consumption: Operates in the range of 1/8 gal./flush.
      d. Color: White.
      e. Supply Spud Size: NPS 3/4.
      f. Supply Spud Location: Top.
      g. Outlet Size: NPS 2.
      h. Flushometer: FV-1-1.
      i. Fixture Support: Urinal chair carrier.

2.02 HARD WIRED SENSOR URINAL FLUSHOMETERS

A. Flushometers, FV-1-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard Companies, Inc.
      b. Delany Products.
      c. Delta Faucet Company.
      d. Moen Commercial.
      e. Sloan Valve Company; Model Sloan 186 ESS-0.125-TMO-HW.
      f. Zurn Plumbing Products Group.
   2. Description: Flushometer for urinal -type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, courtesy flush feature, true mechanical overrise, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
      a. Internal Design: Diaphragm or piston operation.
      b. Style: Concealed.
      c. Inlet Size: NPS 3/4.
      d. Trip Mechanism: Hard-wired, electric-sensor actuator.
      e. Consumption: 0.125 gal./flush.

f. Tailpiece Size: NPS 3/4 and standard length to top of fixture.
g. Transformer: 1 required for up to 8 flushometers.

2.03 WATER CLOSETS

A. Water Closets, WC-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard Companies, Inc.; Madera FloWise 16-1/2" Elongated Toilet.
b. Kohler Co.; Highcliff Ultra K-96057.
c. Sloan Valve Company.
d. Zurn Plumbing Products Group.
2. Description: Accessible, floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.
a. Style: Flushometer valve.
1) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
2) Supply Spud Location: Top.
3) Height: 16-1/2 to 16-3/4 inches, universal/accessible.
4) Design Consumption: 1.28 gal./flush or 1.6 gal./flush.
5) Color: White.
b. Flushometer: FV-2-1.
c. Toilet Seat: TS-1.

2.04 HARD-WIRED SENSOR WATER CLOSET FLUSHOMETERS

A. Flushometers, FV-2-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard Companies, Inc.
b. Delany Products.
c. Delta Faucet Company.
d. Moen Commercial.
e. Sloan Valve Company; Model Sloan 111 ESS-1.6-TMO-HW.
f. Zurn Plumbing Products Group.
2. Description: Flushometer for water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, courtesy flush feature, true mechanical override, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
a. Internal Design: Diaphragm or piston operation.
b. Style: Concealed.
c. Inlet Size: NPS 1.
d. Trip Mechanism: Hard-wired, electric-sensor actuator.
e. Consumption: 1.6 gal./flush.
f. Tailpiece Size: NPS 1-1/2 and standard length to top of bowl.
g. Transformer: 1 required for up to 8 flushometers.

2.05 TOILET SEATS

A. Toilet Seats, TS-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bemis Manufacturing Company; 1955SSC/1955SSCT.
b. Centoco Manufacturing Corp.
c. Church Seats; 295SSC/295SSCT.
d. Comfort Seats; a Jones Stephens Brand; Model Number C106SSC.
e. Ferguson Enterprises, Inc.; ProFlo PFTSCOF2000WH.

f. Olsonite Seat Company; Model 10SSC/10SSCT.
g. Plumbtech; Plumbing Technologies, LLC.
h. Sanderson Plumbing Products, Inc.; Beneke Div.
i. Zurn Plumbing Products Group; 5955STS-WH.

2. Description: Toilet seat for water-closet-type fixture.
   a. Material: Molded, solid plastic.
   b. Configuration: Open front without cover.
   c. Size: Elongated.
   d. Hinge Type: SC, self-sustaining, check.
   e. Class: Standard commercial.
   f. Color: White.

2.06 LAVATORIES

A. Lavatories, LAV-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.; Lucerne Model 0355.012.
   b. Ferguson Enterprises, Inc.; ProFlo PF5504.
   c. Kohler Co.; K 2005 Kingston.
   d. Sloan Valve Company.
   e. Zurn Plumbing Products Group; Z5344.
2. Description: Accessible, wall-mounting, vitreous-china fixture.
   a. Type: With contoured back and side shields.
   b. Size: 17 1/4 by 18 1/4 inches rectangular.
   c. Faucet Hole Punching: Three holes, 2-inch centers.
   d. Color: White.
   e. Faucet: LF-1.
   f. Water Temperature Limiting Device: Required.
   g. Drain: Grid.
   h. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, 17 gage tubular brass waste to wall; and wall escutcheon.
   i. Fixture Support: Lavatory with concealed arms.

2.07 LAVATORY FAUCETS

A. Lavatory Faucets, LF-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.
   b. Chicago Faucets.
   c. Delta Faucet Company
   d. Geberit Manufacturing, Inc.
   e. Kohler Co.; K13463 (with K13478-A escutcheon), K13480 power supply.
   f. Moen Commercial.
   g. Sloan Valve Company; Model ETF-880 SMT.
   h. Speakman Company.
   i. Zurn Plumbing Products Group; Z6917-CWB.
2. Description: Faucet suitable for 4 inch centers, grid strainer, and no lift rod hole.
   a. Body Material: Commercial, solid brass.
   b. Finish: Polished chrome plate.
   c. Mounting: Deck, concealed.
   d. Inlet(s): NPS 1/2.
   e. Spout Outlet: Vandal proof spray, 0.5 gpm.
   f. Operation: Sensor/Hard-wired.
   g. Step-Down Transformers: Required.

2.08 SINKS

A. Hand Sink, SK-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elkay Manufacturing Co.; Model SEHS-17X
      b. Franke Consumer Products, Inc., Commercial Div.
      c. Just Manufacturing Company.
   2. Description: Wall-mounting, Type 300 stainless-steel, 20 gage, commercial hand sink fixture.
      a. Type: Basin with radius corners, back for faucet, and support brackets.
      b. Size: 17 inches by 15 inches by 11 inches deep.
      c. Basin: 14 inches by 10 inches by 5-1/2 inches deep.
      d. Faucet: Gooseneck included with sink.
      e. Drain: Grid.
      f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon.
      g. Fixture Support: For wall-mounting installation.

B. Three Compartment Sink, SK-2:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elkay Manufacturing Co.
      b. Franke Consumer Products, Inc., Commercial Div.
      c. Just Manufacturing Company.
   2. Description: Three-compartment, freestanding, Type 304 stainless-steel commercial sink with backsplash and right drainboard.
      a. Overall Dimensions: 25-13/16 inches by 72-1/2 inches.
      b. Metal Thickness: 16 gage.
      c. Compartment:
         1) Dimensions: 16 inches by 20 inches by 14 inches deep.
         2) Drain: Grid with NPS 1-1/2 tailpiece.
            a) Location: Centered in compartment.
      d. Drainboard(s): right side. 18” wide.
      e. Supports: Tubular stainless steel legs with adjustable bullet shaped feet.
      f. Faucet(s): Sink SF-2.
         1) Mounting: In backsplash.
      g. Wash Compartment Drain Piping: chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon(s).
      h. Rinse and Sanitize Compartment Drain Piping: chrome-plated, cast-brass indirect waste.

2.09 SERVICE SINKS

A. Service Sinks, SS-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard Companies, Inc.; Florwell Cast Iron Service Sink.
      b. Kohler Co.; Whitby K 6710.
      c. Zurn Plumbing Products Group; Z5850.
   2. Description: Floor-mounting, enameled, cast-iron fixture with front apron, raised back, and coated, wire rim guard.
      a. Size: 28 by 28 inches.
      b. Color: White.
      c. Faucet: Sink SF-1.
      d. Drain: Grid with NPS 3 outlet.

2.10 SINK FAUCETS

A. Sink Faucets, SF-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.
   b. Chicago Faucets; Model 897.
   c. Delta Faucet Company; Model 28C2383.
   d. Ferguson Enterprises, Inc.; ProFlo PF1118.
   e. Kohler Co.
   f. Moen Commercial.
   g. Speakman Company; SC5811-RCP-LEV-5H-WHK.
   h. Symmons Industries, Inc.
   i. T & S Brass and Bronze Works, Inc.
   j. Zurn Plumbing Products Group.
2. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor. Include 5 foot rubber hose and wall mounted hose clamp.
   a. Body Material: Commercial, solid brass.
   b. Finish: Polished chrome plate.
   c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
   d. Mixing Valve: Two handle.
   e. Centers: 8 inches.
   f. Mounting: Back/wall.
   g. Handle(s): Lever.
   h. Inlet(s): NPS 1/2.
   i. Spout Type: Rigid, solid brass with wall brace and pail hook.
   j. Spout Outlet: Hose thread.
   k. Vacuum Breaker: Required.
   l. Operation: Noncompression, manual.

B. Sink Faucets, SF-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Chicago Faucets
   b. Elkay Manufacturing Co.; Model LK940AT12T4S
   c. Just Manufacturing Co.
   d. T & S Brass and Bronze Works, Inc.
2. Description: Food service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
   a. Body Material: Commercial, solid brass.
   b. Finish: Polished chrome plate.
   c. Maximum Flow Rate: 1.5 gpm, unless otherwise indicated.
   d. Mixing Valve: Two handle.
   e. Centers: 8 inches.
   f. Mounting: Back/wall.
   g. Handle(s): 4” wrist blade.
   h. Inlet(s): NPS 1/2.
   i. Spout Type: Swivel, solid brass.
   j. Spout Outlet: Aerator.
   k. Operation: Noncompression, manual.

2.11 FIXTURE SUPPLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. BrassCraft; a Masco Company.
   2. McGuire Mfg. Co., Inc.
   3. Any of the approved plumbing fixture manufacturers.

B. Description: Chrome-plated brass, loose-key or screwdriver angle stops with brass stems; rigid, chrome-plated copper risers; and chrome-plated wall flanges.

2.12 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers (PSG-1):
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Engineered Brass Co.
      b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
      c. McGuire Manufacturing Co., Inc.
      d. Oatey; Dearborn Safety Series.
      e. Plumberex Specialty Products Inc.
      f. TCI Products; SG-200BV.
      g. TRUEBRO, Inc.
      h. Zurn Plumbing Products Group; Z8946-3-NT.
   2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures (PSG-2):
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Sloan Valve Co.
      b. TRUEBRO, Inc.
      c. Zurn Plumbing Products Group; Z6900-VG
   2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.13 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Josam Company.
   2. MIFAB Manufacturing Inc.
   3. Smith, Jay R. Mfg. Co.
   4. Tyler Pipe; Wade Div.
   5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
   6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Water-Closet Supports:
   1. Description: Combination carrier designed for wall-mounting, water-closet-type fixture. Include:
      a. Single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement.
      b. Faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture.
      c. Cast iron nipple and coupling kit.
      d. Additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Urinal Supports:
   1. Description: For wall-mounting, urinal-type fixture. Include steel uprights with feet.

2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Lavatory Supports:
1. Description: Lavatory carrier with concealed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Sink Supports:
1. Description: For wall-mounting sink-type fixture. Include steel uprights with feet.
a. Type I, sink carrier with exposed arms and tie rods.
b. Type II, sink carrier with hanger plate, bear studs, and tie rod.
c. Type III, sink carrier with hanger plate and exposed arms.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

D. Install wall-mounting fixtures with tubular waste piping attached to supports.

E. Install counter-mounting fixtures in and attached to casework.

F. Install fixtures level and plumb according to roughing-in drawings. Install accessible fixtures at heights required by local codes.

G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
1. Exception: Fixtures with flushometer valves, and faucets or valves with integral stops.

H. Install ASSE 1070 water-temperature limiting devices on supplies for lavatories and sinks that will be used for handwashing, and where specified. Refer to Division 20 Section “Domestic Water Piping Specialties.”

I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

K. Install protective shielding guards PSG-1 on exposed traps and supplies of lavatories, and sinks used for hand washing.

L. Install toilet seats on water closets.

M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

P. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

Q. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

R. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."

S. Set service basins in leveling bed of cement grout. Grout is specified in Division 20 Section "Basic Mechanical Materials and Methods."

T. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Individual water line branches, waste lines, vents, and traps for connection to individual fixtures, fixture fittings and specialties shall be in accordance with the schedule on the Drawings.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.05 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Adjust flow at laboratory faucets having serrated nozzles to prevent splashing.

D. Replace washers and seals, or cartridges of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

3.06 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 4500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers and water filters.
4. Division 22 Section "Drainage Piping Specialties" for floor drains and cleanouts.

1.02 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Tepid: Moderately warm.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For emergency plumbing fixtures to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

C. ASSE Standard: Comply with ASSE 1071 “Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment” for emergency mixing valves.

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

PART 2 - PRODUCTS

2.01 EYEWASH EQUIPMENT

A. Eyewash Equipment, EEW-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bradley Corporation; Halo S19214 Series.
   b. Chicago Faucets.
   c. Encon Safety Products.
   d. Guardian Equipment Co.
   e. Haws Corporation.
   f. Sellstrom Manufacturing Co.
   g. Speakman Company.
   h. Stingray Systems.
2. Description: Plumbed, freestanding eyewash equipment.
   a. Capacity: Deliver potable water at rate not less than 0.4 gpm for at least 15 minutes.
   b. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
   c. Control-Valve Actuator: Paddle.
   d. Receptor: Stainless-steel bowl.
   e. Drain Piping: NPS 1-1/4. Include galvanized-steel indirect connection to drainage system.

2.02 WATER-TEMPERING EQUIPMENT

A. Water-Tempering Equipment, MV-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Acorn Controls; Morris Group International; ET71 Series.
   b. Armstrong International, Inc. (RADA)
   c. Bradley Corporation.
   d. Guardian Equipment Co.
   e. Haws Corporation.
   f. Lawler Manufacturing Co., Inc.; Model 911 E/F.
   g. Leonard Valve Company.
   h. Powers, a Watts Industries Co.; Model ES 150.
   i. Speakman Company.
   j. Stingray Systems; SV107.
2. Description: Factory-fabricated, hot- and cold-water-tempering equipment with thermostatic mixing valve.
   a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at a single emergency eyewash or eye/face wash fixture, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.

2.03 SOURCE QUALITY CONTROL

A. Certify performance of emergency plumbing fixtures by independent testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 22 Section "General Duty Valves for Plumbing."
   1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency plumbing fixture.
   2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 20 Section "Basic Mechanical Materials and Methods."

F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Thermometers are specified in Division 20 Section "Meters and Gages."

G. Install trap and waste to wall on drain outlet of fixture receptors that are indicated to be directly connected to drainage system.

H. Install indirect waste piping to wall on drain outlet of fixture receptors that are indicated to be indirectly connected to drainage system. Drainage piping is specified in Division 22 Section "Sanitary Waste and Vent Piping."

I. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."

J. Install equipment nameplates or equipment markers on fixtures and equipment signs on water-tempering equipment. Identification materials are specified in Division 20 Section "Mechanical Identification."

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.

C. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary drainage and vent piping.

D. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary or storm drainage piping.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.

B. Electrical-Component Testing: After electrical circuitry has been energized, test for compliance with requirements.
   1. Test and adjust controls and safeties.

C. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

D. Report test results in writing.

3.05 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION

SECTION 22 4700 - DRINKING FOUNTAINS, WATER COOLERS, AND CUSPIDORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
   1. Division 20 Section “Mechanical General Requirements.”
   2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 DEFINITIONS

A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.

B. Cast Polymer: Dense, cast-filled-polymer plastic.

C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.

D. Fitting: Device that controls flow of water into or out of fixture.

E. Fixture: Drinking fountain or water cooler.

F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.

G. TDS: Total dissolved solids.

H. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.03 ACTION SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in the U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about fixtures for people with disabilities.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

E. AHRI Standard: Comply with AHRI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with AHRI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 - PRODUCTS

2.01 PRESSURE (ELECTRIC) WATER COOLERS

A. Water Coolers (EWC-1):
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elkay Manufacturing Co.; LZSTL8WSSP-W1.
      b. Halsey Taylor; SCWT Series.
      c. Haws Corporation; HF Series.
      d. Murdock Manufacturing;
      e. Oasis Corporation; PLF Series.
      f. Sunroc Corp.; NSF Series.
   2. Description: AHRI 1010, Type PB, pressure with bubbler, accessible, Style W, architectural-style wall-mounting, water cooler with bottle filling station.
      a. Material: Stainless steel.
      b. Receptor Shape: Round.
      c. Back Panel: Stainless-steel behind receptor with ventilation grille located below receptor.
      d. Bubblers: One, flexible or elastomeric over molded, with adjustable stream regulator, located on receptor
      e. Control: Push button.
      f. Supply: NPS 3/8 with isolation valve.
      g. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.
      h. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
         1) Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.
         2) Electrical Characteristics: 1/5 hp; 120-V ac; single phase; 60 Hz.
      i. Bottle Filling Station: Recessed design constructed of 18 gage Type 300 series stainless steel and ABS plastic. Include:
         1) Electronic sensor for no-touch activation.
         2) Automatic 20-second shut-off timer.
         3) 1.1 gpm flow rate
         4) Anti-microbial protected plastic components.

j. Support: Refer to "Fixture Supports" Article.

2.02 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.; A Member of Morris Group International.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use mounting frames for recessed water coolers, unless otherwise indicated.

C. Set freestanding and pedestal drinking fountains on floor.

D. Set remote water coolers on floor, unless otherwise indicated.

E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.03 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."

G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
   1. Remove and replace malfunctioning units and retest as specified above.
   2. Report test results in writing.

3.06 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

3.07 CLEANING

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Testing, Adjusting, and Balancing.”

1.02 SUMMARY

A. This Section includes common requirements for fans and air moving equipment.

1.03 ACTION SUBMITTALS

A. Product Data: For the following:
1. Fan bearings.
2. V-belt fan drives.
3. Direct drive couplings.

1.04 QUALITY ASSURANCE

A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

B. Fan Performance Data: AMCA Standard 210.

C. Sound Power Level Ratings:
1. Ducted Fans - Rated per AMCA 301, when tested per AMCA 300.

2. Nonducted Fans - Rated in Zones at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 FAN SHAFTS

A. Fan Shafts: Ground from solid cold rolled steel, and proportioned to run at least 25 percent below the first critical speed.

2.03 FAN POWER TRANSMISSION

A. V-Belt Type Fan Drives: In accordance with Engineering Standard Specification for Drives Using Multiple V-Belts, sponsored by the Mechanical Power Transmission Association and the Rubber Manufacturer's Association.

B. A given manufacturer's V-belt drive, as applied to specific equipment provided under the Contract, shall conform to the equipment manufacturer's published recommendations, except as otherwise specified.

C. Base horsepower rating of drive on minimum pitch diameter of small sheave.

D. Locate belt drives outboard of bearings. Align drive and driven shafts by the four-point method.

E. Adjust belt tension in accordance with the manufacturer's recommendations.

F. Perform alignment and final belt tensioning in the presence of the Architect.

2.04 SHEAVES

A. Furnish sheaves of machined cast iron or carbon steel, bushing type of fixed bore, secured to the shaft by key and keyway.

B. For all constant speed fans at or above 2 inches of total static pressure, Contractor shall provide and install two sets of fixed sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after system balance is complete and shall be based on actual field conditions.

C. For all constant speed fans below 2 inches total static pressure, Contractor shall provide and install two sets of adjustable sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after the balance is complete and shall be based on actual field conditions, and selected at mid-range of the sheave.

D. Set pitch diameters of fixed pitch and adjustable or variable pitch sheaves when adjusted as specified, at not less than that recommended by NEMA Standard MG1-14.42.

E. For companion sheaves for adjustable or variable pitch drives, furnish wide groove spacing to match driving sheaves.

F. For all variable frequency controller (VFC) operated fans, contractor shall provide and install one set of fixed sheaves sized to allow full utilization of fan motor horsepower provided, with VFC at 100 percent of fan motor RPM.

2.05 V-BELT FAN DRIVES

A. Fan Drives: Multiple V-belt style with adjustable pitch driver sheaves for fans up to 2 inches of total static pressure and fixed pitch driver sheaves for fans at or above 2 inches of total static

pressure and up. Sheaves shall have split, taper style bushings. Drives shall be selected for a 150 percent service factor and shall provide for adjustment of both belt tension and alignment.

B. Manufacturers:
   1. Emerson Power Transmission; Browning.
   2. Rockwell Automation; Dodge.
   3. T.B. Wood's Incorporated.

2.06 FAN DRIVE, SHAFT, AND COUPLING GUARDS

A. Safety Provisions: Include guards and screens for power transmission equipment, but do not negate vibration isolation provision.

B. Furnish ANSI and OSHA compliant mechanical power transmission apparatus guards except where superseded by other governing codes, and except as modified and supplemented. Requirements specified apply to all types of fans.

C. Fabricate mechanical power transmission device guards such that the completed structure is capable of withstanding a load of at least 200 pounds applied in any direction.

D. Furnish a guard enclosure for each V-belt drive, coupling, shaft, and rotating component. Secure guards in place, easily removable for maintenance. Guard fasteners used for maintenance access shall be "captive type." Locate holes on each guard for tachometer readings on both the motor and fan shafts. Fabricate guard of minimum 16 gage sheet metal with hemmed edges at openings for shafts. Weld four mounting lugs or feet of 10 gage material to the guard. Fabricate guards for couplings five inches in diameter and larger of 12 gage sheet metal. Furnish holes in mounting feet sized for suitable machine screws.

E. Centrifugal exhaust fans shall be provided with shaft seals.

2.07 BELT DRIVE GUARDS

A. Belt Guards: ANSI and OSHA compliant with provision for readily viewing belt tension and measuring shaft speeds. Guards shall be installed with quick release pins, so that removal of three to five clip pins, will allow the guard to be removed from fan housing.

B. Fabricate guards which completely enclose moving parts of the particular drive. Design and construct guards of such rigidity as to contain a belt which breaks during operation. Minimum material thickness, 16 gage sheet metal. Where ventilation is required, perforated metal shall be used for the sides. Fabricate top of solid sheet metal.

2.08 V-BELTS

A. Notched or cogged style, endless type, of Dacron reinforced elastomer construction, with cross-section to suit sheave grooves. Determine the number of V-belts from the motor horsepower to which apply the service factor to obtain the design horsepower. Determine the corrected horsepower per belt by multiplying the nominal horsepower per belt by an arc of contact factor not greater than 0.85. Divide the design horsepower by the corrected horsepower per belt to obtain the number of belts required. In any case, furnish not less than two belts for each drive.

B. Furnish belts that have been factory or factory-authorized distributor matched and measured on a belt-matching machine. Selection by "code numbers," "sag numbers" or "match numbers" is not acceptable. Bind each belt set with wire and tag with equipment identification.

C. Manufacturers:
   1. Emerson Power Transmission; Browning; AX, BX, and CX Series and 3VX and 5VX Series.
   2. Rockwell Automation; Dodge; Classic Cog and Narrow Cog V-Belts.
   3. T.B. Wood's Incorporated; Classical Cog and Narrow Cog V-Belts.

2.09 V-BELT DRIVE MOTOR BASES

A. Furnish fan motors with slide or adjustable pivoted bases wherever equipment configuration permits proper installation.

B. Provide for adjustment of both belt tension and alignment.

2.10 AIR HANDLING SYSTEM BALANCING PROVISIONS

A. Provide extra sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each air handling system during air quantity balancing operations. Furnish sheaves as specified in this Section.

2.11 FLEXIBLE COUPLINGS (DIRECT DRIVE)

A. Fan shaft shall be connected to the motor shaft through a flexible coupling. The flexible member shall be a tire shape, in shear, or a solid mass serrated edge disc shape, made of chloroprene materials and retained by fixed flanges. Flexible coupling shall act as a dielectric connector and shall not transmit sound, vibration or end thrust.

B. Manufacturer:
   1. Falk Corporation (The).

2.12 MOTOR REQUIREMENTS

A. Furnish motors in accordance with Division 20 Section “Motors.”

2.13 FAN BEARINGS

A. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with ABMA L_{10} minimum life of 200,000 hours. Use cast iron housings and dust-tight seals suitable for lubricant pressures.
   1. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe maintenance while equipment is operating. Provide manual or automatic pressure relief fittings to prevent overheating or seal blow-out due to excess lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.
   2. Bearings on Equipment with less than 1/2 horsepower rating or on shafts smaller than 1-3/4 inch in diameter: Permanently sealed, pre-lubricated anti-friction bearings per specified materials and ABMA L_{10} life requirements.

2.14 IDENTIFICATION

A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.

2.15 ACCESSORIES

A. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each nonducted fan.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.

B. Install sheaves where recommended by Testing, Adjusting, and Balancing agency.

C. Refer to individual Division 23 HVAC equipment Sections for additional requirements.

END OF SECTION

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
   1. Division 20 Section “Mechanical General Requirements.”
   2. Division 20 Section “Basic Mechanical Materials and Methods.”
   3. Division 23 Section “Common Work Results for HVAC.”

1.02 SUMMARY

A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:
   1. Air Systems:
      a. Constant-volume air systems.
      b. Variable-air-volume systems.
   2. HVAC equipment quantitative-performance settings.
   3. Kitchen hood airflow balancing.
   4. Verifying that automatic control devices are functioning properly.
   5. Reporting results of activities and procedures specified in this Section.

B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

1.03 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. AHJ: Authority having jurisdiction.

C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

F. NC: Noise criteria.

G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

H. RC: Room criteria.

I. Report Forms: Test data sheets for recording test data in logical order.

J. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

K. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

L. TAB: Testing, adjusting, and balancing.

M. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

N. Test: A procedure to determine quantitative performance of systems or equipment.

O. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 2 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 15 days from Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

D. Sample Report Forms: Submit two sets of sample TAB report forms.

1.05 CLOSEOUT SUBMITTALS

A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

B. Warranties specified in this Section.

1.06 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

B. Approved Balancing Agencies.
   1. The TAB firm selected shall be from the following list:

a. Airflow Testing Inc.; Lincoln Park, MI.
b. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.
c. Ener-Tech Testing; Holly, MI.
d. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.
e. International Test & Balance Inc.; Southfield, MI.

C. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
1. Agenda Items: Include at least the following:
a. Submittal distribution requirements.
b. The Contract Documents examination report.
c. TAB plan.
d. Work schedule and Project-site access requirements.
e. Coordination and cooperation of trades and subcontractors.
f. Coordination of documentation and communication flow.

D. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

E. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." TAB firm's forms approved by Architect.

F. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

G. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.07 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.08 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.09 WARRANTY

A. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract

Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

B. Examine system and equipment test reports.

C. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

D. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

E. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

F. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

G. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

H. Examine equipment for installation and for properly operating safety interlocks and controls.

I. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

J. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
   1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
   2. Maximum Allowable Leakage: Leakage rates are scheduled on the Drawings.

C. Complete system readiness checks and prepare system readiness reports. Verify the following:
   1. Permanent electrical power wiring is complete.
   2. Automatic temperature-control systems are operational.
   3. Equipment and duct access doors are securely closed.
   4. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   5. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts, or use reduced scale contract documents with notations.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

F. Check air flow within intake plenums and mixing boxes of air handling units for uneven flow and temperature stratification and prepare a report with profile elevations (temperature and velocity) on each coil or filter face for Architect.

G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

H. Verify that motor starters are equipped with properly sized thermal protection.

I. Check dampers for proper position to achieve desired airflow path.

J. Check for airflow blockages.

K. Check condensate drains for proper connections and functioning.

L. Check for proper sealing of air-handling unit components.

M. Check for proper sealing of air duct system.

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure fan static pressures to determine actual static pressure as follows:
      a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
   3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
   4. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.
   5. Do not recommend fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure airflow at a point downstream from the balancing damper and adjust volume dampers until the proper airflow is achieved.
      a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
   1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
   2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow.
    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record the final fan performance data.

3.07 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Power factor.
6. Nameplate and measured voltage, each phase.
7. Nameplate and measured amperage, each phase.
8. Starter size.
9. Starter thermal-protection-element rating.
10. Fuse number and size.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.08 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.09 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:
1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

7. Air pressure drop.

B. Electric-Heating Coils: Measure the following data for each coil:
1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Refrigerant Coils: Measure the following data for each coil:
1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.10 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.11 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.

B. After balancing is complete, do the following:
1. Measure and record the static pressure at the hood exhaust-duct connection.
2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.

C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
1. Check duct slopes as required.
2. Verify that duct access is installed as required.
3. Verify that point of termination is as required.
4. Verify that duct air velocity is within the range required.
5. Verify that duct is within a fire-rated enclosure.

D. Report deficiencies.

3.12 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
1. Air handling equipment and outlets: Plus or minus 5 percent.

a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow rates if overall room supply is within plus or minus 5 percent.

2. Heating-Water Flow Rate: 0 to minus 10 percent.
3. Cooling-Water Flow Rate: 0 to plus 5 percent.

3.13 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.14 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:
1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
a. Indicated versus final performance.
b. Notable characteristics of systems.
c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports varies from indicated values.
14. Test conditions for fans and pump performance forms including the following:
a. Settings for outside-, return-, and exhaust-air dampers.
b. Conditions of filters.
c. Cooling coil, wet- and dry-bulb conditions.
d. Face and bypass damper settings at coils.

e. Fan drive settings including settings and percentage of maximum pitch diameter.
f. Inlet vane settings for variable-air-volume systems.
g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water flow rates.
3. Terminal units.
4. Balancing stations.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
j. Number of belts, make, and size.
k. Number of filters, type, and size.
2. Motor Data:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Power factor efficiency.
3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat coil static-pressure differential in inches wg.
g. Cooling coil static-pressure differential in inches wg.
h. Heating coil static-pressure differential in inches wg.
i. Outside airflow in cfm.
j. Return airflow in cfm.
k. Outside-air damper position.
l. Return-air damper position.
m. Vortex damper position.

G. Gas- Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.

e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btuh.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btuh.
i. High-fire fuel input in Btuh.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btuh.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btuh.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Number of belts, make, and size.

3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
    a. System and air-handling unit number.
    b. Location and zone.
    c. Traverse air temperature in deg F.
    d. Duct static pressure in inches wg.
    e. Duct size in inches.
    f. Duct area in sq. ft.
    g. Indicated airflow rate in cfm.
    h. Indicated velocity in fpm.
    i. Actual airflow rate in cfm.
    j. Actual average velocity in fpm.
    k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:
1. Unit Data:
    a. System and air-handling unit identification.
    b. Location and zone.
    c. Test apparatus used.
    d. Area served.
    e. Air-terminal-device make.
    f. Air-terminal-device number from system diagram.
    g. Air-terminal-device type and model number.
    h. Air-terminal-device size.
    i. Air-terminal-device effective area in sq. ft.
2. Test Data (Indicated and Actual Values):
    a. Airflow rate in cfm.
    b. Air velocity in fpm.
    c. Preliminary airflow rate as needed in cfm.
    d. Preliminary velocity as needed in fpm.
    e. Final airflow rate in cfm.
    f. Final velocity in fpm.
    g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils of terminal units, include the following:
1. Unit Data:
    a. System and air-handling unit identification.
    b. Location and zone.
    c. Room or riser served.
    d. Coil make and size.
    e. Flowmeter type.
2. Test Data (Indicated and Actual Values):
    a. Airflow rate in cfm.
    b. Entering-air temperature in deg F.
    c. Leaving-air temperature in deg F.

L. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
1. Unit Data:
    a. Unit identification.
    b. Location.
    c. Unit make and model number.
    d. Compressor make.
    e. Compressor model and serial numbers.
2. Test Data (Indicated and Actual Values):

a. Inlet-duct static pressure in inches wg.
b. Outlet-duct static pressure in inches wg.
c. Entering-air, dry-bulb temperature in deg F.
d. Leaving-air, dry-bulb temperature in deg F.
e. Condenser entering-water temperature in deg F.
f. Condenser leaving-water temperature in deg F.
g. Condenser-water temperature differential in deg F.
h. Condenser entering-water pressure in feet of head or psig.
i. Condenser leaving-water pressure in feet of head or psig.
j. Condenser-water pressure differential in feet of head or psig.
k. Control settings.
l. Voltage at each connection.
m. Amperage for each phase.
n. Kilowatt input.
o. Crankcase heater kilowatt.
p. Number of fans.
q. Condenser fan rpm.
r. Condenser fan airflow rate in cfm.
s. Condenser fan motor make, frame size, rpm, and horsepower.
t. Condenser fan motor voltage at each connection.
u. Condenser fan motor amperage for each phase.

M. Air-to-Air Heat-Recovery Unit Reports:
1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and type.
e. Model and serial numbers.
2. Motor Data:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
3. If fans are an integral part of the unit, include the following for each fan:
a. Make and type.
b. Arrangement and size.
c. Sheave make, size in inches, and bore.
d. Sheave dimensions, center-to-center, and amount of adjustments in inches.
4. Test Data (Indicated and Actual Values):
a. Total exhaust airflow rate in cfm.
b. Purge exhaust airflow rate in cfm.
c. Outside airflow rate in cfm.
d. Total exhaust fan static pressure in inches wg.
e. Total outside-air fan static pressure in inches wg.
f. Pressure drop on each side of recovery wheel in inches wg.
g. Exhaust air temperature entering in deg F.
h. Exhaust air temperature leaving in deg F.
i. Outside-air temperature entering in deg F.
j. Outside-air temperature leaving in deg F.
k. Calculate sensible and total heat capacity of each airstream in MBh.

N. Instrument Calibration Reports:
   1. Report Data:
      a. Instrument type and make.
      b. Serial number.
      c. Application.
      d. Dates of use.
      e. Dates of calibration.

3.15 INSPECTIONS

A. Initial Inspection:
   1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
   2. Randomly check the following for each system:
      a. Measure airflow of at least 10 percent of air outlets.
      b. Measure water flow of at least 5 percent of terminals.
      c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
      d. Measure sound levels at two locations.
      e. Measure space pressure of at least 10 percent of locations.
      f. Verify that balancing devices are marked with final balance position.
      g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:
   1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.
   2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.
   3. Owner shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
   4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
   5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
   6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
   7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.16 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 0933 - TEMPERATURE CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”

2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Testing, Adjusting, and Balancing.”
4. Division 26 Section “Electrical General Requirements.”
5. Division 26 Section “Control-voltage Electrical Power Cables.”
6. Division 26 Section “Hangers and Supports for Electrical Systems.”
7. Division 26 Section “Raceways and Boxes.”

1.02 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.03 DEFINITIONS

A. BACnet: Communications open protocol for building automation system networks and control (developed by ASHRAE and documented per ANSI/ASHRAE Standard 135-2012.

B. BAS: Building Automation System

C. CAD: Computer Aided Design.

D. DDC: Direct-digital controls.

E. LonWorks (aka LonTalk): Communications open protocol as developed by Echelon Corporation that is utilized with building automation system networks and control.

F. TC: Temperature Control.

1.04 SYSTEM DESCRIPTION

A. Temperature control building automation system consisting of direct digital control system controllers, sensors, transducers, relays, switches, data communication network, etc. and all associated control wiring and raceway systems.

B. BAS/DDC system programming, database generation. Graphic display generation accessible through Building Network Supervisory Controller or at the remote operator workstation (when applicable for project).

C. Electric thermostats, control valves, dampers, operators, control wiring, etc.

D. Gauges, indicating devices, electric and electronic control accessories, and other control system devices.

1.05 SEQUENCE OF OPERATION

A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.

1.06 SUBMITTALS

A. Submit under Division 20 and 23 provisions of respective project and as supplemented in this section.

B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valves and automated dampers shall be incorporated with the complete temperature controls submittal.

C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
   1. Each control device labeled with setting or adjustable range of control

D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

E. Shop Drawings:
   1. Shop drawings shall be done on CAD. Minimum size 11” x 17”.

2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
4. Details of control enclosure including panel faces and interior, including controls, instruments, terminations blocks and component labeling.
5. Written sequence of operation for each controlled system.
6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).
7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).
8. Complete bill of materials to identify and quantify all control components.
9. Overall system schematic showing communication trunk cabling from Building Network Supervisory Controller(s) to BAS field level controllers including component locations and wire termination details.
10. DDC controller layouts showing connected data points and LAN connections. DDC controller terminations including power supply and remote control component termination details shall be provided.
11. Point list for each DDC controller including point descriptions and addresses. This information may be incorporated with DDC controller layouts.

F. Graphic Displays: One month after TC Shop Drawing submittal, TC Contractor shall submit graphical display backgrounds for preliminary Engineer review. Concept for each floor plan, each system, each terminal unit template. Engineer understands that final representation of graphics may not be available until BAS database is established during course of construction. Thorough graphics review will be conducted by Engineer as part of the TC/BAS acceptance procedure.

G. Design Data: Provide indicated component selection and sizing criteria for the following component categories:
1. Dampers:
   a. Component tag.
   b. Equipment served/function.
   c. Overall damper size (inch width x inch height).
   d. Quantity of damper sections with respective size(s):
   e. Material and gauge of thickness.
   f. Mounting orientation (horizontal or vertical).
   g. Blade configuration (parallel or opposed)
   h. Pressure drop (in. WG).
   i. Shut-off rating/differential pressure rating (in. wg).
   j. Leakage rating (CFM/sq. ft. at 4 in. wg).
   k. Normal position (normally open, normally closed, floating).
   l. Actuator spring range (where applicable).
   m. Actuator power requirement.
   n. Actuator torque requirement.
   o. Actuator quantity.
   p. Damper manufacturer/model number.
   q. Actuator manufacturer/model number.
2. Flow measuring probes - Air:
   a. Component tag.
   b. Equipment served/function.
   c. Duct dimension (inch width x inch height) if applicable.
   d. Fan inlet diameter (inch) if applicable)
   e. Probe quantity.
   f. Probe length (inch).
   g. Flow rate (CFM).
   h. Flow velocity (FPM).

i. Probe manufacturer/model number.
j. Transmitter manufacturer/model number.

3. Flow measuring stations - Air:
   a. Component tag.
   b. Equipment served/function.
   c. Duct dimension (inch width x inch height).
   d. Station dimension (inch width x inch height).
   e. Flow rate (CFM).
   f. Flow velocity (FPM).
   g. Pressure drop (in. wg).
   h. Station manufacturer/model number.
   i. Transmitter manufacturer/model number.
4. Gauges:
   a. Component tag.
   b. Equipment served/function.
   c. Units/range of scale

H. Wall mounted temperature sensor, thermostat and/or other temperature control device cover color shall be coordinated to match color of wall mounted electrical device components and cover plates – coordinate with electrical contractor. Provide samples of available temperature control device cover colors to Architect upon request or if available temperature control device colors do not match electrical device colors so a desired color selection may be determined. Provide sample of temperature sensor / thermostat guard upon request of Architect, Engineer or Owner.

I. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

J. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.

K. Project Record Documents: Include the following:
1. Revise Shop Drawings to reflect actual installation and operating sequences.
2. Record actual locations of control components, including control units, thermostats, and sensors.
3. Submit the electronic files for all as-built shop drawings in pdf format on USB Flash Drives (3 Total).

L. Software and Firmware Operational Documentation: Include the following:
1. DDC controller keypad operating instructions and DDC controller override features, where applicable.
2. Device address list.
3. Program Software Backup: On a magnetic media or compact disc, complete with data files.

M. Maintenance Manuals: Include the following:
1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.
2. Keypad illustrations and step-by-step procedures indexed for each operator function, where applicable.
3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
4. Calibration records and list of set points.

1.07 REFERENCES

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.

C. ANSI/ASTM B32 - Solder Metal.

D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

F. ASTM B75 - Seamless Copper Tube for General Engineering Purposes.

G. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.

H. ASTM E1 - Specification for ASTM Thermometers.

I. MMC – Michigan Mechanical Code, version applicable for project.

J. NEMA DC 3 - Low-Voltage Room Thermostats.

K. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.

B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with all applicable code requirements for project.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 COORDINATION

A. Coordinate work under Division 20 and 23 provisions and as supplemented in this section.

B. Coordinate location of space temperature sensors, space humidity sensor, thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.

D. Ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.

F. Coordinate equipment with Division 28 Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.

G. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout.

H. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 23 Section "Testing, Adjusting and Balancing."

1.11 WARRANTY

A. Provide warranty per Division 20 Section "Mechanical General Requirements" and as supplemented in this section.

B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.

C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Make a minimum of one eight hour service call every three months. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.

D. Provide any software or firmware revisions which are released by the DDC system manufacturer during the warranty period, at no additional cost to the Owner.

1.12 POSTED OPERATING INSTRUCTIONS

A. Provide DDC controller related as-built documents in protective binder or clear plastic display envelope for each control enclosure panel. These instructions shall include such items as as-built control diagrams and sequence of operation, simplified narrative instructions and materials necessary to aid in the operation of the equipment at the local control panels.

1.13 SPECIAL TOOLS

A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance, excluding PC laptop.

1.14 PROTECTION OF PROPRIETARY INFORMATION

A. Non-disclosure agreement(s) that may be subject to proprietary manuals and software shall be submitted by the proprietary equipment manufacturer to the Owner for approval and signature during the warranty period.

PART 2 - PRODUCTS

2.01 DESCRIPTION OF THE BUILDING AUTOMATION SYSTEM (BAS)

A. The building automation system (BAS) shall be fully integrated, distributed data processing system incorporating direct digital control (DDC) for the control and monitoring of heating, ventilating and air conditioning (HVAC) equipment and other related systems. Microprocessor based BAS field level DDC controllers shall be directly connected to HVAC equipment sensors and actuators. A data communication network shall allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller. The Building Network Supervisory Controller shall be the primary operator BAS interface point for the building either through web-browser direct or through server application software (when applicable) or through local or remote Operator Workstation (when applicable to project).

B. Approved Manufacturer – System / Approved Installer (Locations) as listed:
   1. Honeywell – WEBS with BACnet Spyder ILC Controllers / by:
      a. Knight Watch (Kalamazoo, Grand Rapids, Lansing & Troy, MI).
   2. Johnson Controls – Facility Explorer with FX Controllers / by:
      a. Knight Watch (Kalamazoo, Grand Rapids, Lansing & Troy, MI).

2.02 BAS BUILDING NETWORK SUPERVISORY CONTROLLER (TRIDIUM N4 PLATFORM)

A. The Building Network Supervisory Controller, utilizing the HTML5 platform, shall provide the interface between the Owner's Ethernet and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:
   1. Calendar functions
   2. Scheduling.
   3. Trending.
   4. Alarm monitoring and routing.
   5. Time synchronization.
   6. Integration of BACnet controller data.
   7. Network Management functions for all BACnet based devices.

B. The Network Area Controller shall provide the following hardware and driver features as a minimum:
   1. One RS-232 port
   2. One RS-485 port with BACnet MS/TP Driver.
   3. Battery Backup

4. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity).
5. Where the option for expanded memory is available, it must be supplied.

C. Provide LonWorks or MODBUS driver(s) as required for system or equipment integration requirements for project.

D. The network supervisory controller shall be sized appropriately per building to handle the required quantity of connected controllers and devices.

E. Provide 5 year service agreement per network supervisory controller for updating firmware/software as available by manufacturer. Labor for updating the controllers shall be included.

F. For Tridium based systems, provide Niagara 4 JACE-8000 series network supervisory controllers.

G. Manufacturer:
1. Manufacturers as listed for Building Automation System (based on N4 JACE-8000 platform).
2. Vykon N4 JACE-8000 series is to be used in lieu of listed manufacturer's standard product per requirements of Owner's existing network or as indicated on the construction drawings.

2.03 DIRECT DIGITAL CONTROL (DDC) FIELD LEVEL CONTROLLERS

A. Modular in design and consisting of stand-alone microprocessor board with ROM and fully custom programmable RAM, EPROM, and/or EEPROM memory, integral interface equipment and power surge protection. DDC controllers shall be connected directly to sensors, controlled devices and the communication network.

B. Powerfail Restart and Battery Backup: Minimum of 72 battery backup hours for complete system RAM memory and clock, with automatic battery charger or 48 hour low voltage alarm warning. Upon full system power recovery, all clocks shall be automatically synchronized, and all controlled equipment shall be automatically re-started based on correct clock time and sequence of operation.

C. Provide fully functional communication interface ports for communication between processor, other processors, portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.

D. Panel enclosure for controller, associated power supply and other ancillary control components shall be finished steel or rigid plastic with hinged door and keyed lock. Electronics shall be removable for protection during mounting of panel.

2.04 DDC CONTROLLER SOFTWARE

A. Operating system shall work in real time, provide prioritized task scheduling, control time programs, monitor DDC controller communications, scan inputs and outputs, and contain built-in diagnostics.

B. Input/output point processing shall include the following:
1. Continuous update of input and output values and/or conditions. All connected points are to be updated at least once per second.
2. Assignment of proper engineering units and status condition identifiers to all points.
3. In addition to physical or "hardware" points required, "software" points shall be provided where required for command access and meaningful displays, where required by the "execution" portion of this section or where required on the DDC input/output points lists. "Software" points shall appear identical to physical points in output displays and shall be assignable to text descriptors, logical groups, reports, etc. in the same manner as physical points. "Software" points shall be assigned alarm limits in the same manner as physical points.

C. Command control software shall manage the receipt of commands from control panels, portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.

1. Command delay, programmable from 0 to 2 minutes, shall be provided to prevent simultaneous energizing of large loads. Command delays shall be honored throughout the BAS DDC network, not just within the DDC controller. Delays shall be assignable on an individual per point basis.
2. Each command shall be assigned a command and residual priority to manage contentions created by multiple programs having access to the same command point. Only commands with a higher command priority than the existing residual priority shall be permitted to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.
3. A "fixed mode" option shall be supported to allow inputs to, and outputs from DDC control programs to be set to a fixed state or value. When in the "fixed mode," inputs and outputs shall be so noted in all reports.
4. A "last user" record is to be maintained to positively identify which program or manual command is in control of a given point. The last user information shall be displayed and printed along with other point data of logical groups.

D. Provide self-test procedure. Notify remote Operator Workstation (when applicable for project) for maintenance, performance, software, cable break, or data transmission problems. Identify variables as reliable or unreliable. Variables identified as unreliable shall use default in calculation.

E. Alarm Processing
1. High/Low Alarm: Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and actual alarm) to an input. Each alarm shall be assigned a unique differential to prevent a point from oscillating into and out of alarm. Alarm comparisons are to be made each scan cycle.
2. Floating Alarm: Where analog controlled values are automatically varied by software (such as hot water temperature reset), a single set of alarm limits shall be provided for those varying values. These alarm limits shall then "float" a user definable differential above and below the varying setpoint value.
3. Abnormal Alarm: When a digital input is not in agreement with the commanded state of its associated output point, or when a digital input is not in its normal state, an abnormal alarm shall be generated. Abnormal "on" shall cause an alarm, as well as abnormal "off." Alarm time delay for digital inputs to prevent nuisance alarms shall be provided. Each digital input alarm time delay shall be adjustable from zero to two minutes in one-second increments.
4. Alarm lockout shall be provided to positively lock out alarms when equipment is turned off or when a true alarm is dependent on the condition of an associated point. Lockout points and lockout initiators shall be operator programmable. On initial startup of air handler and other mechanical equipment, a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating alarm comparison logic. Timed lockout period shall be programmable on a per point basis from 0 to 90 minutes in one-minute increments.
5. The capability of automatically initiating commands upon the occurrence of an alarm.

F. Totalization
1. Run time shall be accumulated based on the status of digital input points. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Run time counts shall be resident in memory and have DDC controller resident run time limits assignable through portable programmer’s terminal, portable operator’s unit or the remote Operator Workstation when applicable for project.
2. A transition counter shall be provided to accumulate the number of times a device has been cycled on or off. Counter shall be capable of accumulating 600,000 switching cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.
3. Analog totalization capability shall be provided to allow the totalization of electricity, air, water and steam flow, etc. These flows shall be totalized with respect to time and converted to the appropriate energy unit. It shall be possible to automatically set time intervals for

totalization, adjustable from one second to 365 days. The totalization program shall keep track of the maximum and minimum instantaneous analog value measured during the period, including the date and time at which each occurred.

G. DDC Controller Programming / Configuration
   1. All DDC controllers shall be fully programmable or configurable per required controller application type. DDC controllers which require remote or factory programming or configuration are not acceptable. DDC controllers with custom programs which may not be modified by the user are not acceptable. "Custom" programming shall mean allowing the alteration of actual control logic, and shall not be limited to allowing only the alteration of setpoints, gains, parameters, time constants, etc.
   2. DDC controllers shall be provided to meet the control strategies as called for in the sequences of operation on the drawings. If a configurable application specific DDC controller cannot meet this requirement, a DDC fully programmable controller shall be provided.
   3. All DDC controller setpoints, gains, parameters, time constants, etc., associated with DDC controller programs shall be available to the operator for display and modification via portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
   4. Each DDC controller shall have resident in its memory and available to the programs a full library of DDC algorithms, intrinsic control operators, and arithmetic, logic and relational operators for implementation of control sequences. Functions to be provided shall include, but not be limited to, the following:
      a. Mathematical: Absolute value, calculate, square root, power, sign, average, totalize.
      b. Logic: OR, AND, compare, negate.
      c. Fixed Formula: High and low select, span, rate, ramp, enthalpy, wet bulb, dew point, relative humidity, humidity ratio, and filter.
      d. Data Manipulation: Store, file and set.
      e. Control Routines: Real-time based functions, proportional control, proportional-integral control, proportional-integral-derivative control, adaptive control (self-tuning), direct-acting, reverse acting, feedforward, fixed setpoint, calculated setpoint, adjustable setpoint, lead lag, hysteresis correction, event initiation/ software interlock.

H. Building Automation System program applications (as required for controllers)
   1. Time of day scheduling: Allow the creation and maintenance of operating schedules for selected points based on time of day and holiday scheduling. At least two independent start and stop times per day for each system shall be allowed. Each point shall be allowed to have a unique time program, or points shall be able to be grouped and assigned to a common time program. Both digital and analog output points shall be able to be assigned to a time program. This software shall work in conjunction with the time of day scheduler software at the remote Operator Workstation (when applicable for project). This program shall also work in conjunction with the optimum start and optimum stop application software.
   2. Optimum Start: Start equipment based on outdoor temperature, space temperature, and system response to minimize energy usage and to assure that comfort conditions are reached exactly at scheduled occupancy time (occupancy schedules are defined under "Time Of Day Scheduling"). This program shall operate in both the heating and cooling cycles. An adaptive algorithm shall be employed which automatically adjusts the start time according to previous performance and shall automatically assign longer lead times for weekend and holiday shutdowns.
   3. Enthalpy Optimization: Using standard psychrometric calculations, automatically determine which air source, outdoor air or return air, presents the least total heat load, and automatically adjust mixed air damper position. When outside enthalpy exceeds return air enthalpy, the outside air damper shall go to its minimum position. Typically, the outside air damper must be in its minimum position before the cooling coil valve is allowed to open.

4. Duty Cycle: Periodically cycle electrical equipment to reduce energy consumption and/or energy demand. Each load shall be assigned a cycle interval and an off period. A load leveling algorithm shall be utilized to assure that cycle periods do not coincide.
5. Demand Limiting: Distributed power demand program shall be based on a sliding window instantaneous demand algorithm. The DDC controller(s) connected to the demand meter shall calculate the demand, forecast the demand trend, compare it to established demand limits, and initiate load shedding action or reestablishment of loads as required. Shedding shall be on a sequential basis with least important loads shed first and restored last. Restoration cycle shall add the most important loads first. DDC controllers on the network shall each have a four-tier shed table for assignment of sheddable loads. When a request is issued to the network to shed a specific number of kilowatts, each DDC controller shall shed Tier 1 loads, Tier 2 loads, etc. until the shed requirement is met. The program shall have the capability to sum the readings from multiple meters connected to multiple DDC controllers on the network, and to shed various loads from multiple DDC controllers on the network.
6. Warm-Up: Position the outside air dampers in an adjustable (minimum) position, and trigger a digital output(s) normally used to signal air terminal units to move to their maximum flow settings. When the desired space temperature is reached, as determined by feedback from space temperature sensor(s), the digital output shall return the air terminal units to their normal operation. When occupancy time is reached, the outside air dampers shall be controlled by the normal occupied mode control sequence. During the warm-up cycle, the outside air damper shall be set at the position which minimizes outside air intake while preventing over/under pressurizing of ductwork. This program shall work in conjunction with the time scheduling program and/or the optimum start program as required.
7. Night Cycle: Cycle HVAC equipment on and off as required to maintain an operator selectable unoccupied space temperature. During the equipment "on" time, the outside air damper shall be maintained in an adjustable position which minimizes outside air intake while preventing over/under pressurization of ductwork. The equipment shall be cycled such that energy reduction during unoccupied periods is uniform.
8. Night Purge: Night Purge program shall apply to cooling cycle only. Night Purge shall introduce 100% outdoor air any time the outdoor air is above 50 degrees F, the space temperature is above 75 degrees F, the outdoor air temperature is below space temperature and the outdoor air dew point is less than 60 deg F. Purging shall stop when outdoor air is below 50 deg F, or space temperature is below 75 deg F, or outdoor temperature is less than 5 deg F cooler than space temperature, or outdoor air dew point is greater than 60 deg F.
9. Reset Optimization: Adjust equipment discharge setpoints based on one of the following criteria:
    a. By sensing the worst case requirements (e.g., the zone requiring the most heating or cooling and providing only the minimum energy required to meet the load.
    b. Adjusting the setpoint in direct proportion to another sensed variable (e.g., reset supply water temperature based on outside temperature).

2.05 DDC AIR TERMINAL UNIT CONTROLLERS

A. Microprocessor based controllers capable of stand-alone operation for control of pressure independent air terminal units. Controllers shall be networked together and connected to the building's BAS/DDC network.

B. Controllers shall have separate adjustable minimum and maximum airflow setpoints. Controllers shall work in conjunction with the air handling unit's DDC panel to provide the sequence of operation as indicated on the drawings. Setpoints shall be adjustable through the portable programmer terminal.

C. Provide electronic type air terminal unit damper operators compatible with the controller and the air terminal units provided.

D. Each controller shall have an internal differential pressure transducer capable of utilizing the total and static pressure signals from the air terminal unit's velocity sensor. Velocity sensor shall be furnished by air terminal unit manufacturer.

E. Each controller shall have electronic outputs compatible with the electronically operated air terminal unit tempering coil control valve and perimeter radiation control valve where applicable

F. TC contractor shall provide 24 VAC power requirements including transformers.

G. If coordinated with mechanical contractor. Controllers and damper operators shall be furnished to the air terminal unit manufacturer for factory mounting by the air terminal unit manufacturer; otherwise, controls shall be field installed.

H. Room temperature sensors for the DDC air terminal unit controllers:
1. Sensing Element: Thermistor or resistance temperature detector (RTD) type. Accuracy shall be+/- 0.5 degrees F over the range of 55 degrees F to 95 degrees F, including calibration error, repeatability, hysteresis, and yearly drift.
2. Cover: with tamper-proof fasteners.
3. Provide with exposed setpoint adjustment dial and exposed temperature reading.
4. Provide with exposed override switch to allow an occupant to reset the space to occupied control during the unoccupied cycle for a predetermined time period.
5. Provide with portable operator unit plug-in port.

2.06 DDC INPUT/OUTPUT SENSORS

A. Air Static/Differential Pressure Transmitters:
1. Variable capacitance type with ranges not exceeding 150 percent of maximum expected input. Transmitter shall have zero and span adjustments.
2. Safe overpressure rating shall be minimum 5 times the range.
3. Temperature compensated with thermal error of not greater than 0.04 percent of full scale in temperature range of 40 to 100 deg F.
4. Accuracy: +/- 0.5% of full scale including calibration error, repeatability, hysteresis, and yearly drift.
5. Manufacturers:
   a. Air Monitor.
   b. Belimo.
   c. Dwyer.
   d. Modus
   e. Setra.

B. Current Sensors:
1. Split-core or donut type transformer for monitoring AC current, with analog output signal as indicated. Current sensors used on motor side of variable frequency drives shall have low frequency detection capability.
2. Analog sensors shall have accuracy of ±1% full scale.
3. Manufacturers:
   a. ACI.
   b. Johnson Controls.
   c. Senva.
   d. Veris Industries.

C. Current Switches:
1. Split-core or donut type transformer for monitoring AC current, with digital output signal. Current switches used on motor side of variable frequency drives shall have low frequency detection capability.
2. For Electronically Commutated Motor (ECM) applications: Current switch shall be rated for ECM operation with amperage trip setting higher than trickle/idle/standby amperage with ECM off and amperage trip setting lower than minimum speed setting. Verify minimum amperage expectation for equipment with equipment suppliers to select appropriate

current switch from list of approved manufacturers as their minimum trip settings vary from 0.15A to 0.5A.

3. For induction motor applications (as applicable): Current switch shall have adjustable trip setting to accommodate VFC minimum speed settings, to detect fan belt loss, or to detect pump coupling detachment. Set trip setting at approximately 90% of normal motor operating amperage.
4. Manufacturers:
   a. ACI.
   b. Johnson Controls.
   c. Senva.
   d. Veris Industries.

D. Differential Pressure Transmitters (Commercial Version):
1. Transmitters used for measuring differential pressure only:
   a. Each differential pressure transmitter shall be selected and calibrated for operations between 0 and 200% of the normal differential pressure. The calibration point shall be rounded upward to the nearest 10 inches of water column (for spans less than 200" W.C.) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transmitter.
   b. The accuracy, including linearity, hysteresis and repeatability, of the transmitter for measuring differential pressure shall be better than 2% of the span stated above throughout a 4:1 turndown.
   c. The transmitter shall not be damaged by pressures of up to 500 psig on either side of the transmitter and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene or propylene glycol in water.
   d. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
   e. Span and zero shall be individually adjustable.
   f. With LCD Display.
   g. Manufacturers:
      1) Belimo.
      2) Dwyer.
      3) Setra.
      4) Veris Industries.

E. Digital to Pneumatic Transducers: Convert pulse width modulation outputs or continuous proportional current or voltage to proportional 0 to 20 psi pneumatic output.

F. Temperature Sensors:
1. Resistance temperature detectors (RTD) with 1000 ohm, thin-filmed platinum, nickel or balco element having 0.000385 temperature coefficient meeting the input requirements of the DDC controller.
2. Thermally sensitive resistors (thermistor) shall be 10k-type, epoxy or glass coated, having NTC characteristic, meeting the input requirements of the DDC controller.
3. Initial calibration accuracy shall be +/- 0.5 deg F over the entire range. Range shall be as indicated below, or as appropriate to the application.
4. Additional error such as repeatability, stability, tolerance, linearity and hysteresis shall not exceed an additional +/- 0.5 deg F additive (using RMS method) throughout the selected operating range for the application.
5. Temperature sensors shall be resistant to chlorine and other cleaning agents
6. Single point duct mounted sensors shall have 18" rigid probe and calibrated span of 20 - 120°F.
7. Averaging duct mounted sensors shall have 25' long averaging element and calibrated span of 20 - 120°F.
8. Liquid immersion sensors shall have welded stainless steel thermowells for ferrous pipe and brass thermowells for copper pipe. Length of sensor and thermowell shall be selected

based on the diameter of the pipe to provide accurate, reliable and homogeneous sensing of the liquid temperature. Thermowell pressure rating shall meet or exceed the system minimum pressure rating. Sensors for chilled water application shall have calibrated span of 20 - 120°F. Sensors for hot water applications shall have calibrated span of 40 - 240°F.

9. Room sensors shall have locking cover and a minimum span of 40 - 90°F.
10. Outside air temperature (only) sensors shall have watertight inlet fitting and shall be shielded from direct rays of sun and wind.
11. Manufacturers:
    a. Specified BAS product where available that meets the requirements herein.
    b. ACI – except PT1000 averaging sensor.
    c. BAPI – Basys Series.
    d. Belimo.
    e. MAMAC
    f. Minco.
    g. TCS.

2.07 DDC DATA COMMUNICATIONS NETWORK

A. Data communication network shall be provided to allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller.

B. The BAS/DDC system-wide communication network shall consist of a primary peer-to-peer network, and at the Contractor's option, secondary sub-networks linked to the primary network. The primary network shall support peer-to-peer communications between primary network BAS field level DDC controllers. The Building Network Supervisory Controller shall be connected to the primary network. Secondary sub-networks when used shall interface with the primary network though the primary network BAS field level DDC controllers. At least one DDC controller connected to the primary peer-to-peer network shall be provided in each mechanical room, or as indicated on the drawings.

C. Data communications media shall be twisted pair wires.

D. The communications network shall allow shared point and control information between BAS field level DDC controllers. All required repeaters, hubs, active links, gateways, etc. and associated power supplies shall be provided as required to provide shared point and control information between BAS field level DDC controllers.

E. Failure of any individual BAS field level DDC controller shall not cause the loss of communications between peer BAS field level DDC controllers.

F. All data transmitted must be positively acknowledged as received or negatively acknowledged as not received. Negative acknowledgments shall cause a retransmission of the data. Network connected devices must send a "functioning" message each network cycle. Lack of a "functioning" message after successive retries shall constitute a device failure and shall be recognized as such by the network.

G. Error recovery and communication initialization routines shall be resident in each network connected device.

2.08 AIRFLOW MEASURING PROBES – OUTSIDE AIRFLOW

A. Duct airflow measuring probes shall be Thermal Dispersion type.

B. Probes shall be constructed of extruded aluminum. Probes shall be provided with mounting plate, and gasket. Probe and mounting hardware shall facilitate easy removal and reinstallation of the probes.

C. The number of sensors on each probe, and the quantity of probes provided at each location, shall comply with ASHRAE standards for duct traversing. Multiple probes provided at a single location shall be interconnected external to the duct to produce an average signal.

D. For each airflow measurement location, the measured velocity pressure shall have accuracy within ± 2% of the full scale throughout the velocity range of 0-4000 fpm.

E. Associated transmitter at each airflow measurement location shall be provided with LCD readout to indicate airflow (in CFM) of the connected airflow measuring station.

F. Manufacturers / Model:
   1. Ebtron.
   2. Air Monitor Corporation / ELECTRA-flo.

2.09 CONTROL AND INSTRUMENTATION TUBING

A. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.
   1. Fittings: ANSI/ASME B16.22, wrought copper.
   2. Joints: ANSI/ASTM B32, 95-5 tin antimony.

B. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.
   1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
   2. Joints: Ball Sleeve compression type.

C. Polyethylene Tubing: Black, UL 1820 flame and smoke retardant where exposed in an air plenum, virgin polyethylene, conforming to modified ASTM D1693 test. All non-metallic tubing shall be minimum 1/4" O.D.; micro-sleeve is not acceptable.
   1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
   2. Joints: Compression or barbed type.

2.10 DAMPERS - AUTOMATED

A. Performance: Test in accordance with AMCA 500.

B. Frames: Galvanized steel, minimum 16 gauge, minimum 2 inches in width, welded or riveted with corner reinforcement for 12 gage structural equivalence.

C. Blades: Galvanized steel, minimum 14 gauge, maximum blade size 8 inches wide, 60 inches long, attached to minimum 1/2 inch shafts. Dampers which are required to have a static pressure rating over 4 inch W.G. shall have minimum 3/4 inch solid shafts.

D. Blade Seals: Synthetic elastomeric or Neoprene, mechanically attached, field replaceable.

E. Jackshafts (where required): Minimum 1/2 inch galvanized steel.

F. Jamb Seals: Stainless steel.

G. Bearings: Oil impregnated sintered bronze or lubricant free, solid stainless steel. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.

H. Linkages: Accessible for maintenance. Linkages may be located in airstream. Linkages located in damper frame shall be external to the duct, accessible for maintenance. Linkages located in the airstream shall be zinc-plated.

I. Leakage: Less than 8 CFM per square foot based on 4 inches W.G. pressure differential.

J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4" W.G.

K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.

L. Temperature Limits: -40 to 200 deg F.

M. Manufacturers:
   1. American Warming & Ventilating.
   2. Arrow United Industries.
   3. Greenheck.
   4. Honeywell.
   5. Johnson Controls.
   6. Louvers & Dampers, Inc.
   7. Ruskin.
   8. Tamco.
   9. Vent Products.

2.11 DAMPER OPERATORS - ELECTRIC

A. Electric damper motor shall be 24 or 120 volt two-position or modulating as required with spring return type and sized to operate the damper with sufficient reserve power for smooth operation from full close to full open and tight shut-off. Damper motor shall have "O ring" gaskets for weatherproof operation.

B. Number: Sufficient to achieve unrestricted movement throughout damper range. Provide sufficient number of operators such that one operator does not operate more than the maximum square footage of damper area as recommended in standard catalog of manufacturer.

C. Manufacturers:
1. Belimo.
2. Delta Control Products.
3. Honeywell.
4. Schneider Electric Controls.
5. Johnson Controls.
6. Siemens.

2.12 DIFFERENTIAL PRESSURE SWITCHES

A. Shall provide electrical switching action upon a sensed pressure differential increase between two sensed points. Sensitivity shall be suitable for the application. Setpoint shall be adjustable over the full range of the device. Switching action shall open or close two independent single-pole, double-throw (SPDT) switches. Electrical switch rating shall be based on the application and circuit voltage

B. Pressure rating of switch/connecting tubing and reset type:
1. Filter pressure drop - Rated for 2 inches w.g. Provide automatic reset type.
2. Duct static pressure - Rated for 10 inches w.g. Provide manual reset type when used for high limit cutout safety.

2.13 ELECTRICAL REQUIREMENTS FOR CONTROLS WORK

A. Electrical accessories such as relays, switches, contactors and control transformers shall meet the requirements of the Division 26 Specifications of respective project.

B. Electrical wiring and conduit shall meet the requirements of the Division 26 Specifications.

C. All control wiring in mechanical rooms and any other exposed areas shall be run in conduit. Low voltage temperature control wiring in concealed accessible locations (i.e. above lay-in ceilings), as well as low voltage temperature control wiring within partitions, may be run using plenum rated cable, neatly tie-wrapped and fastened to the building structure (not to ceiling or ceiling support wires).

D. Conduits carrying control wiring shall be sized for a maximum fill of 40% of capacity.

E. Where raceway is required, two separate raceway systems shall be provided; one for A.C. wiring and the other for D.C. wiring.

F. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.

G. All control wiring sizes and types shall meet or exceed the equipment manufacturer's recommendations.

H. TC Contractor shall provide 24V power supply transformers for TC Contractor provided controllers. Maximum Transformer circuit for controls shall be 100VA serving controllers within mechanical room control panels or for remote terminal unit controllers served from common 24V power supply circuit. Transformers shall be located within enclosures provided by TC Contractor.

2.14 INDICATING GAUGES - DUCT STATIC PRESSURE

A. 4" diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, scale as indicated on drawings or as appropriate for application, suitable for surface or flush mounting. Accuracy ± 2 % of full scale.

B. Where indicated on drawings, gauge shall incorporate high and low pressure switches. Switches shall be front adjustable over the full range of the gauge with pointers and with adjustable deadband to 1% of full scale. Separate electrical contacts shall close upon reaching the high or low pressure setpoints.

C. Manufacturer:
1. Dwyer "Magnehelic" or "Photohelic."

2.15 LIMIT SWITCHES

A. Oil tight type with operator as required providing required function. Limit switches used on dampers should be set at approximately 75% of full stroke.

B. Manufacturers:
1. Allen-Bradley.
2. General Electric.
3. Square D.
4. Westinghouse.
5. Micro-switch.

2.16 LOCAL AND AUXILIARY CONTROL COMPONENT ENCLOSURE PANELS

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.

B. ANSI/NEMA 250, general purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.

C. Panels shall be sized for a maximum fill of 50% capacity, and shall not be smaller than 24" X 24".

2.17 REFERENCE PROBE - DUCT STATIC PRESSURE

A. Duct static pressure probe shall be capable of static pressure measurement with bi-directional flow in a duct, plenum or air handling unit. Probe shall have minimum 4" insertion depth, shall compensate for total pressure error, and shall provide an accurate, repeatable and stable static pressure value with a maximum flow of 4000 fpm.

B. Probe shall be constructed of aluminum, with mounting flange suitable for round or flat duct surfaces. Probe shall have static pressure signal fitting.

C. Manufacturers:
1. MAMAC # A-520.
2. Dwyer # A-305.
3. Tek-Air # T-SPP 7100/7200.

2.18 REFERENCE PROBE - INDOOR STATIC PRESSURE

A. Indoor pressure reference probe shall be a shielded static pressure sensor suitable for flush mounting in the ceiling, complete with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, control tubing take-off fitting, and brush finish on exposed surface. Probe shall be capable of sensing the static pressure in the proximity of the sensor to within 1% of the actual pressure value while being subjected to a maximum airflow of 1000 fpm from a radial source.

B. Manufacturers:
1. Air Monitor Corporation.
2. Tek-Air.

2.19 REFERENCE PROBE - OUTDOOR STATIC PRESSURE

A. Outdoor pressure reference probe shall be constructed of anodized aluminum, with control tubing take-off fitting, which shall be capable of sensing the outside ambient air pressure to within 2% of the actual value when subjected to radial wind velocities up to 80 miles per hour with approach angles up to 30 degrees to the horizontal.

B. Manufacturers:
1. Air Monitor Corporation.
2. Tek-Air.

2.20 THERMOMETERS - AIRSTREAM

A. ASTM E1, 4 inch diameter dial in stainless steel or drawn steel with enamel finish case, vapor or liquid actuated with brass or copper bulb, copper or bronze braided capillary of sufficient length and with necessary bulb supports within airstream, white with black markings and black pointer, unbreakable lens, 1 percent scale accuracy. Maximum scale divisions shall be 2 deg F. Select scale ranges such that all expected temperatures are within the range but such that the range does not extend beyond the extremes more than 25 degrees.

B. Manufacturers:
1. Trerice.
2. Weksler.
3. Marsh.
4. Honeywell.
5. Schneider Electric Controls.
6. Johnson Controls.
7. Siemens.

2.21 THERMOSTATS – ELECTRONIC & ELECTRIC

A. Electronic Floating Control Room Thermostats: Microprocessor based tri-state (floating)proportional thermostat providing individual room control with setpoint adjustment, locking cover and range stops, output status LED’s, night setback/setup feature with local override switch. Manufacturer: Honeywell, Model T6984 or similar.

B. Electronic Modulating Control Room Thermostats: Microprocessor based modulating 2-10V DC thermostat providing individual room control with setpoint adjustment, locking cover and range stops, output status LED’s, night setback/setup feature with local override switch. Capable of single and dual modulating outputs to meet required control application. Manufacturer: Honeywell, Model T7984 or similar.

C. Line Voltage Room Thermostats: Adjustable single setpoint with exposed setpoint indicator and exposed thermometer for a range of 55 deg F to 85 deg F with maximum dead band of 1-1/2 degrees F, and locking cover. Contacts shall be rated for load, single-pole or two-pole as required. Provide with integral manual On/Off/Auto selector switch where indicated on control details. Power Requirement: 24 V, ac or 120 V, ac as required.

D. Room Thermostat Accessories:
1. Thermostat Covers: Manufacturers standard with finish as selected by Architect.
2. Insulating Bases: Provide one inch insulating base for thermostats located on exterior walls.
3. Adjusting Key: As required for device.

E. Electric Low Limit Duct Thermostat (freezestat): Snap acting which trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint, fixed 5 deg F differential, range 30 deg F to 60 deg F, requiring minimum 20 feet length of bulb. Manual-reset unless indicated on drawings to be auto-reset type. Provide one thermostat for every 20 sq ft of coil surface. Switch shall be UL listed and rated for 10 amps at 120 VAC. Provide additional switch or contacts for connection to monitoring system.

F. Electric High Limit Duct Thermostat: Snap acting, manual reset switch.

G. Electric; water-immersion type thermostat, for installation in hot-water circulation piping adjustable for control of water circulation pump. Operation of pump to be On or Off upon setpoint as required per control details. Contacts shall be rated for load. Provide transformer for 24 V, ac or 120 V, ac duty as required.

H. Electric; strap-on piping type thermostat for control of fans with hot water heating coils. Operation of fan to be Off when temperature is below setpoint as required per control details. Contacts shall be rated for load. Provide transformer for 24 V, ac or 120 V, ac duty as required

I. Manufacturers for listed Thermostat Types:
   1. Honeywell International, Inc.
   2. Johnson Controls, Inc.
   3. Schneider Electric USA, Inc.
   4. Siemens Industry, Inc.; Building Technologies Division.
   5. White-Rodgers Div.; Emerson Electric Co.

PART 3 - EXECUTION

3.01 INSTALLATION - CONTROL SYSTEMS

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of temperature sensors, thermostats and other exposed control sensors with plans and room details before installation. Locate room temperature sensors and thermostats 48 inches above floor unless noted otherwise.

C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.

D. Caulk both sides of damper frames to duct walls to prevent leakage between damper frame and duct.

E. Mount control panels adjacent to associated equipment on vibration free walls or free-standing angle iron supports. Sensors used for closed loop control must be connected to the same DDC controller as the associated output signal.

F. Provide conduit and electrical wiring where required.

G. All wiring in altered and unaltered areas shall be run concealed. "Wiremold" in finished areas shall be allowed when wiring cannot be run concealed in walls or partitions. Minimize “wiremold” routing.

H. Splicing of DDC sensor cabling at junction boxes shall not be acceptable.

I. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.

J. Coil and conceal excess capillary on remote element instruments.

K. Install thermometers in air duct systems on flanges.

L. Install all gauges and thermometers in locations where they are easily read from normal floor level. Provide tubing or wiring as required.

M. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.

N. Locate, size and support sensing elements in airstreams so that they properly sense the representative condition. Controlling, transmitting and indicating elements shall be located to sense the average condition. Safety elements shall be located to sense the extreme condition.

O. Locate and size sensing elements in liquid lines so that they are in moving liquid and not in stagnant or turbulent locations. Wells shall not obstruct the flow of the liquid being measured. Pipes one inch and smaller shall be increased at least one pipe size at the point of insertion.

P. Locate pressure sensing taps in liquid lines in straight runs of pipe with at least 10 pipe diameters of straight pipe both upstream and downstream of pressure tap. Provide a shut-off cock in sensing line at each pressure tap.

Q. Install pressure sensing elements in ducts and casings with clean, sharp taps to accurately read true static pressure, avoiding velocity influence and turbulence.

R. Locate, support and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture or other harmful conditions beyond their rated limitations.

S. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.

T. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.

U. All electric valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 120 seconds.

3.02 TC CONTRACTOR DESIGN & INSTALLATION COORDINATION MEETINGS

A. Temperature Controls Shop Drawing Pre-submittal Meeting: TC Contractor's option to schedule a meeting at the Engineer's Office to review project design documentation for clarification purposes to aide in the TC Contractor development of TC/BAS shop drawings. For simple clarification items, TC Contractor may contact Engineer via telephone to discuss. For project scope questioning items, TC Contractor shall utilize the formal Request of Information (RFI) process.

B. Temperature Controls Shop Drawing Submittal Meeting: Project Design Engineer's option to schedule a meeting at the Engineer's Office to review the TC Contractor's formally submitted drawings to address Engineer's comments and concerns that indicate TC Contractor's shop drawings vary from project design intent. This meeting can be avoided if TC Contractor's shop drawing submittal is complete and Engineer is confident that documents are going to lead to an installation that meets project design intent.

C. Temperature Controls Installation Technician Meeting: Project Design Engineer's option to schedule a meeting at the project site to meet and discuss project expectations with the TC Contractor's field installation technician and/or project manager. Discussion may include
   1. Shop drawing review comments to ensure installation technician has the most up-to-date TC submittal.
   2. Graphics generation requirements including special Owner requirements and schedule for completion.
   3. Owner training agenda and scheduling.
   4. TC/BAS system acceptance procedures.

3.03 IDENTIFICATION AND MARKING

A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.

B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.

C. Identify each wire as to ID number at each controller termination, field device termination or on the field device.

D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate permanently attached on the front exterior with panel identification to match details of temperature control submittals and include system(s) served and area(s) served on the labeling. Include labeling near 120VAC terminations within panel identifying power source panel ID and specific circuit breaker used.

E. Temperature control conduit and junction box covers shall be painted green to signify that it is used for temperature controls. All junction box covers shall be painted green and the conduit shall be painted with a green mark (approximately 6 inches long) every 36" to 48", and on both sides of all penetrations.

3.04 GRAPHIC DISPLAY GENERATION

A. Provide the following graphic displays as a minimum at the operator interface, arranged in logical penetration paths:
   1. Overall campus layout which shows all of the buildings on the Owner's campus.
   2. Individual building layout or isometric for each building connected to the system.
   3. Floor plans for each floor within each building, with display of present values of space conditions sensed by connected space sensors, display of the name of the air handler associated with each space sensor, display of the room number in which the sensor is located and color coding to indicate whether the sensed space condition is within the acceptable range, is too high, or is too low. TC Contractor shall confirm Owner desired room names prior to graphics generation which may differ from the room names indicated on construction documents.
   4. Schematic diagram for each HVAC system. Each system schematic display shall include at least the following:
      a. Schematic arrangement of ductwork, fans, dampers, coils, valves, piping, pumps, equipment etc.
      b. System name.
      c. Area served.
      d. Present value or status of all inputs, along with present setpoint.
      e. Present percent open for each damper, valve, etc. based on commanded position.
      f. Reset schedule parameters for all points, where applicable.
      g. Present occupancy mode.
      h. Present economizer mode, where applicable.
      i. Present outside air temperature.
      j. Associated space conditions and setpoints, where applicable.
      k. Status of application programs (e.g., warm-up, night cycle, duty cycle, etc.).
      l. Color coding to indicate normal and abnormal values, alarms, etc.
   5. Manual override capability for each on/off or open/closed controlled digital output (for fans, pumps, 2-position dampers and valves, etc.) and each modulating analog output (for dampers, valves, VFD speed modulation type points, etc.) shall be provided. Graphic display of output point auto or manual override status shall be provided.
   6. Sequence of operation in written (text) format for each HVAC system.
   7. Overall BAS system schematic.
   8. System management graphic for each network device and/or DDC controller.

3.05 OWNER INSTRUCTION AND TRAINING

A. Provide a minimum of forty (40) hours of combined on-site and classroom instruction and training to the Owner on the operation of the control systems for the initial installation.

B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance and calibration.

C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.

D. Provide computer training & tutorial material on USB Flash Drives 5 total describing operator’s BAS graphical interface capabilities and functions.

E. Provide 5 sets of literature pertaining to the operation and maintenance of the DDC system components provided.

3.06 CALIBRATION AND START-UP

A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.

B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required, or shall be replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.

3.07 ACCEPTANCE PROCEDURE

A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.

B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.

C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.

D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

END OF SECTION

SECTION 23 2300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 07 Section "Roof Accessories" for roof curbs, piping supports, and roof penetration boots.
2. Division 07 Section "Penetration Firestopping" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
3. Division 07 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
4. Division 20 Section “Mechanical General Requirements.
5. Division 20 Section “Basic Mechanical Materials and Methods.”
6. Division 20 Section "Hangers and Supports" for pipe supports and installation requirements.
7. Division 20 Section "Mechanical Identification" for labeling and identifying refrigerant piping.
8. Division 20 Section "Meters and Gages" for thermometers and pressure gages.
9. Division 23 Section "Temperature Controls" for thermostats, controllers, automatic-control valves, and sensors.

1.02 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerants: 535 psig.

1.03 SYSTEMS DESCRIPTIONS

A. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
1. Thermostatic expansion valves.
2. Solenoid valves.

3. Hot-gas bypass valves.
4. Filter dryers.
5. Strainers.
6. Pressure-regulating valves.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

C. UL Standard: Provide products complying with UL 207, “Refrigerant-Containing Components and Accessories, Nonelectrical”; or UL 429, “Electrically Operated Valves.”

1.07 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.08 COORDINATION

A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

D. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 07 Section "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.

E. Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

PART 3 - EXECUTION

3.01 PIPING SYSTEM INSTALLATION

A. Install refrigerant piping according to ASHRAE 15.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping adjacent to machines to allow service and maintenance.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Refer to Division 23 Section "Temperature Controls" and Sequence of Operation on the Drawings for solenoid valve controllers, control wiring, and sequence of operation.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

M. Slope refrigerant piping as follows:
1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

N. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

O. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

P. Seal penetrations through fire and smoke barriers according to Division 07 Section "Through-Penetration Firestop Systems."

Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

S. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

T. Identify refrigerant piping and valves according to Division 20 Section "Mechanical Identification."

3.02 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube." Brazing filler metals are specified in Division 20 Section “Basic Mechanical Materials and Methods.”

D. Purge pipe and fittings with nitrogen, during brazing to prevent scale formation.

E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.03 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 20 Section "Hangers and Supports."

B. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.

5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 and smaller, and soft copper tubing: Continuous support v-shaped plastic pipe channel, maximum hanger spacing 8 feet.
2. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
3. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
   a. Fill system with nitrogen to the required test pressure.
   b. System shall maintain test pressure at the manifold gage throughout duration of test.
   c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
   d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

END OF SECTION

SECTION 23 3113 - METAL DUCTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section "Mechanical General Requirements."
2. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
3. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 SUMMARY

A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems.

1.03 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. Low Pressure: Up to and including 2 inch WG and velocities less than 1,500 fpm.

1.04 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.05 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Application Schedule" Article.

1.06 ACTION SUBMITTALS

A. Shop Drawings: Drawn to scale. Show fabrication and installation details for metal ducts. Shop drawings shall be reviewed and approved by the Architect prior to any fabrication.
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Duct layout indicating sizes and pressure classes.
   3. Elevations of top and bottom of ducts.
   4. Dimensions of main duct runs from building grid lines.
   5. Fittings.
   6. Reinforcement and spacing.
   7. Seam and joint construction.
   8. Penetrations through fire-rated and other partitions.
   9. Equipment installation based on equipment being used on Project.
   10. Duct accessories, including access doors and panels.
   11. Hangers and supports, including methods for duct and building attachment, vibration isolation.

1.07 INFORMATIONAL SUBMITTALS

A. 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.
   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.

1.08 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

1.09 QUALITY ASSURANCE

A. NFPA Compliance:
   1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
   2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

C. Duct Liner Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.10 COORDINATION

A. Sheet metal trades shall cooperate fully with the Test and Balance Contractor and provide all miscellaneous caps and any other materials required for structural integrity and leakage testing

of the complete duct system in whole or in part. Refer to Division 23 Section "Testing, Adjusting and Balancing."

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

B. Sheet metal trades shall participate in the above ceiling coordination program. Refer to Division 01 requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.

C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

D. Reinforcement Shapes and Plates:

1. Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
2. Compatible materials for aluminum and stainless-steel ducts.

E. Tie Rods:

1. Galvanized Steel Duct: Galvanized steel, 3/8-inch minimum diameter.
2. Ducts in Humid or Corrosive Atmospheres: Stainless steel, 1/4-inch diameter for lengths 36 inches or less; 3/8-inch diameter for lengths longer than 36 inches.

2.03 ZERO-CLEARANCE PREFABRICATED RANGE HOOD EXHAUST DUCT

A. Manufacturers:

1. AMPCO; American Metal Products; Model IVSI-4ZC.
2. Metal-Fab Inc.; Model IPIC-3G/4G.
3. Schebler Chimney Systems; FyreGuard.
4. Selkirk Inc.; Selkirk Metalbestos; ZeroClear Z3.

B. Description: Factory-fabricated, -listed, and -labeled, double-wall ducts tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211, and suitable for zero-clearance installations.

C. Construction: Inner shell and outer jacket separated by a 3-inch to 4-inch annular space filled with high-temperature, ceramic-fiber insulation.

1. Inner Shell: ASTM A 666, Type 304 stainless steel.
2. Outer Jacket: Aluminized steel indoors and Type 304 stainless steel outdoors. Seams shall be fully welded.

D. Gaskets and Flanges: Ensure that gaskets and sealing materials are rated at 1500 deg F minimum.

E. Hood Connectors: Constructed from same material as grease duct with internal or external continuously welded or brazed joints.

F. Accessories: Tees, elbows, increasers, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials

and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters, and drain fittings.

G. Grease Duct Supports: Construct duct bracing and supports from non-combustible material.
1. Design bracing and supports to carry static and seismic loads within stress limitations of the International Building Code.
2. Ensure that bolts, screws, rivets and other mechanical fasteners do not penetrate duct walls.

2.04 DUCT LINER

A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
1. Manufacturers:
a. CertainTeed Corp.; Insulation Group.
b. Johns Manville International, Inc.
c. Knauf Fiber Glass GmbH.
2. Materials: ASTM C 1071, Type I, flexible; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
a. Thickness: 1 inch.
b. Density: 1-1/2 pounds per cubic foot.
c. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
d. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
e. Maximum Operating Temperature: 250 deg F when tested according to ASTM C 411.
f. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
g. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
1) Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
3. Noise reduction coefficient (NRC): Sound absorption coefficients shall not be less than those in the table below as tested by ASTM C423 using an ASTM E795 Type A mounting.

	Sound absorption coefficients at octave band center frequencies, Hz						
Thickness Inches	125	250	500	1000	2000	4000	NRC
1	.08	.31	.59	.84	.91	.90	.70

2.05 SEALANTS AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Elastomeric Sealant Tape: 3 inches wide; modified butyl adhesive backed.
1. Manufacturers:
a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.

C. Water-Based Joint and Seam Sealant:
1. Manufacturers:
a. Design Polymerics; DP1010 Water Based Duct Sealant.
b. Hardcast; Flex-Grip 550 and Versa-Grip 181.
c. Polymer Adhesives; No. 11.

d. United McGill.
2. Application Method: Brush on.
3. Solids Content: Minimum 63 percent.
4. Shore A Hardness: Minimum 20.
5. Water resistant.
6. Mold and mildew resistant.
7. VOC: Maximum 75 g/L (less water).
8. Maximum Static-Pressure Class: 0-inch wg, positive and negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.

F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.06 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Attachments for stainless steel and PVC-coated duct shall be stainless steel.

D. Load Rated Cable Suspension System for Noncorrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
1. Cable: Aircraft quality 7 x 7 and 7 x 19 wire rope.
a. Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
b. Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
2. Fastener: One-piece, die-cast zinc housing with Type 302 S26 stainless steel hardened and tempered springs, and oil impregnated, sintered, hardened and tempered steel locking wedges.
3. End Fixings: Loop, stud or toggle; or plain end suitable for wire rope beam clamp.
4. Manufacturers:
a. B-Line by Eaton; KwikWire.
b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
c. Duro Dyne Corp.; Dyna-Tite System.
d. Gripple Inc.; Hang-Fast System.

2.07 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" unless otherwise indicated. For metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", unless otherwise indicated.
   1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
   2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
   3. Internal Tie Rods: As allowed by SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's and SMACNA guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
   1. Manufacturers:
      a. Ductmate Industries, Inc.
      b. Nexus Inc.

C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.08 APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

F. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

G. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   1. Fan discharges.
   2. Intervals of lined duct preceding unlined duct.
   3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

2.09 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA “Industrial Duct Construction Standards” as required based on pressure class.
   1. Round fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.

C. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA “Industrial Duct Construction Standards” as required based on pressure class.
   1. Flat-oval fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.

D. Duct Joints:
   1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
   2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
   3. Bolts and fasteners for galvanized steel duct shall be carbon steel, zinc coated per ASTM A153. Bolts and fasteners for stainless steel and polyvinyl chloride coated steel duct shall be stainless steel.
   4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
   5. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

E. Low Pressure Ductwork (plus or minus 2 inches W.G. Static Pressure Class)
   1. Fabricate according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" unless otherwise indicated.

F. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

G. Diverging-Branch Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

H. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Unless elbow construction type is indicated, fabricate elbows as follows:
   1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
   2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
      a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
      b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
      c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
      d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
   3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
      a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
      b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
      c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
      d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
   4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
   5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
   6. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
8. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
12. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

PART 3 - EXECUTION

3.01 DUCTWORK APPLICATION SCHEDULE

A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.02 DUCT INSTALLATION

A. Install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

N. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

O. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
1. Intermediate level.

3.03 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.04 RANGE HOOD EXHAUST DUCTS, SPECIAL INSTALLATION REQUIREMENTS

A. Install ducts to allow for thermal expansion through 2000 deg F temperature range.

B. Install ducts without dips or traps that may collect residues unless traps have continuous or automatic residue removal.

C. Install access openings at each change in direction and at intervals defined by NFPA 96; locate on sides of duct a minimum of 1-1/2 inches from bottom; and fit with grease-tight covers of same material as duct.

D. Install welded test ports or prefabricated test port section in the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.

E. Do not penetrate fire-rated assemblies except as permitted by applicable building codes.

F. Field Quality Control:
   1. Prior to use or concealment of any portion of grease duct system, perform leakage test in presence of Code Official.
   2. Light test or approved equivalent test method shall be performed to determine that welded and brazed joints are liquid tight.
   3. Lamp shall be not less than 100 watts and shall be open to emit light equally in all directions perpendicular to duct walls.

3.05 DUCT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. Ducts must be properly cleaned and sealed in strict accordance with sealant manufacturer’s instructions.
   1. Seal Class: Refer to Application Schedule on the Drawings.
   2. Seal ducts before external insulation is applied.
   3. After pressure testing, remake leaking joints until leakage is equal to or less than maximum allowable. Refer to Application Schedule on the Drawings for allowable leakage rates.

3.06 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

C. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

D. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.

E. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

F. Install roof mounted duct supports in accordance with manufacturer's instructions. Provide additional membrane layer or walkpads under support bases as required.

G. Use load rated cable suspension system for round duct in exposed locations.

3.07 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.08 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.09 FIELD QUALITY CONTROL

A. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.

B. Duct system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 3300 - DUCT ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 23 Section “Testing, Adjusting, and Balancing” for duct test holes.
3. Division 23 Section “Temperature Controls” for motorized control dampers.
4. Division 28 Section "Fire Alarm" for duct-mounting fire and smoke detectors.

1.02 DEFINITIONS

A. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
1. For turning vanes, include data for pressure loss generated sound power levels.
2. For duct silencers, include pressure drop and dynamic insertion loss data.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
   a. Special fittings.
   b. Manual volume damper installations.
   c. Control damper installations.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.

C. Stainless Steel: ASTM A 480/A 480M, Types 304 and 316 as indicated.

D. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.

E. Bird Screens: No. 2 mesh, 0.063 inch diameter galvanized wire screen with open area of not less than 72 percent. Conceal sharp edges by adding metal edging consisting of rod, flat or angle iron, or 16 gage galvanized sheet steel turned over at least 3/4 inch on both sides.

2.03 LOW PRESSURE MANUAL VOLUME DAMPERS

A. Manufacturers:
   1. American Warming and Ventilating; Mestek, Inc.
   2. Arrow United Industries; Mestek, Inc.
   3. Greenheck Fan Corporation.
   4. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
   5. Louvers and Dampers, Inc.; Mestek, Inc.
   6. Nailor Industries Inc.
   7. Ruskin Company.
   8. Vent Products Co., Inc.
   9. Young Regulator Co.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
   1. Except for dampers in round ductwork sized 12 inches and smaller, provide end bearings.

C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

F. Damper Materials:
1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
3. Blade Axles: Galvanized steel.
4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
5. Tie Bars and Brackets: Galvanized steel.

G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

H. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.04 MANUAL VOLUME DAMPERS (IRIS STYLE)

A. Manufacturers:
1. Continental Fan Manufacturing Inc.; IRIS Series.
2. Fantech; a Systemair Company; IR Series.
3. Ruskin Company; VFBD35.

B. Description: Round manual volume damper complete with pressure ports, constructed of galvanized steel, fitted with a neoprene gasket, and using interlocking steel plates and calibrated control lever to form an adjustable aperture.

2.05 MOTORIZED CONTROL DAMPERS

A. Refer to Division 23 Section “Temperature Controls.”

2.06 DUCT SILENCERS (FIBERGLASS FILL)

A. Manufacturers:
1. IAC Acoustics; a Division of Sound Seal.
2. Price Industries.
3. Ruskin Company.
4. VAW Systems Ltd.
5. Vibro-Acoustics; A Swegon Group Company.

B. General Requirements:
1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.

C. Rectangular Units: Unless otherwise scheduled on the Drawings, fabricate casings with a minimum of 20 gage, solid galvanized sheet metal for outer casing and 22 gage, ASTM A 653/A 653M, G90, perforated galvanized sheet metal for inner casing.

D. Sheet Metal Perforations: 1/8-inch diameter for inner casing and baffle sheet metal.

E. Fill Material: Inert and vermin-proof fibrous glass material, packed under not less than 5 percent compression.
   1. Erosion Barrier: Fiberglass cloth.
      a. Return fan inlet and outlet silencer fill do not require an erosion barrier.

F. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.
   1. Do not use nuts, bolts, or sheet metal screws for unit assemblies.
   2. Lock form and seal or continuously weld joints.
   3. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
   4. Reinforcement: Cross or trapeze angles for rigid suspension.

G. Source Quality Control:
   1. Acoustic Performance: Test according to ASTM E 477.
      a. Tests performed in NVLAP accredited laboratory.
      b. Include accreditation certificate with submittals.
      c. Submittals from non-NVLAP accredited facilities will not be accepted.
   2. Record acoustic ratings, including dynamic insertion loss and self-noise power levels with an airflow of at least 2000-fpm face velocity.
   3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.07 TURNING VANES

A. Manufactured Turning Vanes:
   1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
   2. Double-vane or airfoil-shaped, curved blades of galvanized sheet steel set into vane runners suitable for duct mounting.
   3. Generated sound power level shall not exceed 54 decibels in octave band 4 at 2000 fpm in a 24-inch by 24-inch duct.
   4. Manufacturers:
      a. Aero-Dyne Sound Control; H-E-P Turning Vanes & Rail.
      b. Ductmate Industries, Inc.
      c. Duro Dyne Corporation.
      d. Ward Industries, Inc.; a JCI Company.

B. Manufactured Acoustic Turning Vanes:
   1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
   2. Double-vane curved blades of galvanized sheet steel with perforated faces and fibrous-glass fill set into vane runners suitable for duct mounting.
   3. Manufacturers:
      a. Ductmate Industries, Inc.
      b. Ward Industries, Inc.; a JCI Company.

2.08 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Pottorff.
   2. Ventfabrics, Inc.
   3. Young Regulator Co.-DCD

B. Description: Digitally controlled remote damper adjustment.

C. Cable: 22/6 non-shielded plenum rated wire.

D. Wall-Box Mounting: Recessed gang box.

E. Wall-Box Cover-Plate Material: 12 port cover plate, white, plastic.

2.09 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class. Doors may be field fabricated in accordance with SMACNA Standards, or commercially produced.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
   1. Manufacturers:
      a. Air Balance, Inc.; Mestek, Inc.
      b. Greenheck Gan Corporation.
      c. Nailor Industries Inc.
      d. Ruskin Company.
   2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
   3. Provide number of hinges and locks as follows:
      a. Less Than 12 Inches Square: Secure with two sash locks.
      b. Up to 18 Inches Square: Two hinges and two compression locks.
      c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
      d. Sizes 24 by 48 Inches and Larger: One additional hinge.

C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

D. Insulation: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.10 GREASE DUCT ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Flame Gard Inc.
   3. 3M.

B. Description: Factory-fabricated, -listed, and -labeled, double-wall personnel and maintenance access doors tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.
   1. Construction: 0.0625 inch ASTM A 666, Type 304 stainless-steel inner shell; and aluminized-steel indoor or stainless-steel outdoor outer cover with two handles.
   2. Fasteners: Stainless-steel bolts and wing nuts.
      a. Ensure that bolts do not penetrate interior of duct space.
   3. Maintenance Access Door Dimensions: Minimum 7 x 7 inches.
   4. Personnel Access Door Dimensions: Minimum 24 x 24 inches.
   5. Door Label: Mark door with uppercase lettering as follows: "ACCESS PANEL. DO NOT OBSTRUCT."

C. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

D. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.11 FLEXIBLE CONNECTORS

A. Manufacturers:
   1. ADSCO Manufacturing LLC.
   2. Duro Dyne Corp.
   3. Senior Flexonics Pathway.
   4. Ventfabrics, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip minimum 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Select metal compatible with ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 20 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

2.12 FLEXIBLE DUCTS, LOW AND MEDIUM PRESSURE

A. Manufacturers:
1. Flexmaster U.S.A.; a Masterduct Company; Type 1M Acoustical.
2. Hart & Cooley.
3. Thermaflex; part of the Flexible Technologies Group.

B. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 6 inches WG positive and 4 inches WG negative for low and medium pressure ducts.

C. Insulated Flexible Ducts: UL 181, Class 1, flexible duct wrapped with flexible glass fiber insulation, enclosed by a fire retardant polyethylene vapor barrier jacket; maximum 0.23 K value at 75 deg F .

D. Acoustical performance tested in accordance with the Air Diffusion Council's *Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties* shall be as follows:
The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	8	32	38	35	39	25
8" diameter	13	32	36	35	36	21
12" diameter	15	29	28	33	26	14

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	6	8	7	8	9	13
8" diameter	9	6	6	7	8	10
12" diameter	9	7	6	6	8	11

The self-generated sound power levels (LW) dB are 10-12 Watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	42	31	23	18	17	21
8" diameter	41	34	27	19	18	21
12" diameter	53	44	36	27	21	22

E. Flexible Duct Fittings: Galvanized steel, twist-in design with damper. Size as indicated.

F. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.13 FLEXIBLE DUCT ELBOW SUPPORTS

A. Manufacturer:
   1. Titus; Air Distribution Technologies, Inc.; a JCI Company; FlexRight.
   2. Thermaflex; part of the Flexible Technologies Group; FlexFlow Elbow.
   3. Hart and Cooley, Inc.; Smart Flow Elbow.

B. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6 inches through 16 inches.

C. Elbow supports shall be UL listed for use in return air plenum spaces.

2.14 DUCT ACCESSORY HARDWARE

A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.15 FINISHES

A. Chemical Resistant Coating: P-403 manufactured by Heresite Chemical Company.

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts and PVC coated ducts; and aluminum accessories in aluminum ducts.

C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install duct silencers rigidly to ducts.

G. Install duct access doors on ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. Downstream from control dampers, backdraft dampers, and duct mounted equipment.
   2. Control devices requiring inspection, including airflow measuring devices. Size access doors appropriately to facilitate service of each device.
   3. Elsewhere as indicated.

H. Install access doors with swing against duct static pressure.

I. Install duct-mounting, rectangular access doors with long dimension at right angles to direction of airflow and of largest standard size which can be accommodated in duct. Maximum size: 21 by 14 inches.

J. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

K. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

L. Connect diffusers to low pressure ducts flexible duct clamped or strapped in place.

M. Connect flexible ducts to metal ducts with plenum-rated draw bands.

N. Install flexible duct elbow supports at each diffuser, grille, or register, and elsewhere as indicated.

O. Install turning vanes in rectangular duct elbows in excess of 45 degrees, and where indicated:
   1. Use manufactured double-vane turning vanes unless otherwise specified.
   2. Seat outboard-most vane in heal of duct elbow.
   3. Provide vanes for all runner punchings. Practice of eliminating every other vane is prohibited.
   4. Use single-vane turning vanes in low pressure square elbows.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operate dampers to verify full range of movement.
   2. Inspect locations of access doors and verify that purpose of access door can be performed.
   3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
   4. Inspect turning vanes for proper and secure installation.
   5. Operate remote damper operators to verify full range of movement of operator and damper.

3.03 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 3433 - AIR CURTAINS AND DOOR HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings:
1. Design Calculations: Calculate requirements for selecting vibration isolators.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Plans and details drawn to scale and coordinating penetrations of exterior walls.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air curtains to include in operation and maintenance manuals.

B. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air curtains and are based on the specific product indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with AMCA 210, “Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.”

D. Comply with AMCA 220, "Test Methods for Air Curtain Units," for airflow, outlet velocity, and power consumption.

E. Comply with AMCA 300, “Reverberant Room Method for Sound Testing of Fans.”

F. Comply with AHRI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils," for components, construction, and rating.
   1. Certify coils according to AHRI 410.

G. Comply with NSF 37, "Air Curtains for Entranceways in Food and Food Service Establishments."

1.06 COORDINATION

A. Coordinate layout and installation of air curtains and suspension system components with other construction, including light fixtures, fire-suppression-system components, and partition assemblies.

PART 2 - PRODUCTS

2.01 AIR CURTAINS (UNHEATED)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Berner International Corp.

B. Housing Materials: Minimum 14-gage, electroplated-zinc steel with welded construction and polyester-coated finish.

C. Mounting Brackets: Steel, for wall mounting.

D. Intake Louvers: Integral part of the housing, mechanically field adjustable and capable of reducing air-outlet velocity by 60 percent with louver in totally closed position.

E. Discharge Nozzle: Integral part of the housing, containing adjustable air-directional vanes with 20 -degree sweep front to back.

F. Fans: Painted steel, centrifugal, forward curved, double width, double inlet; statically and dynamically balanced.

G. Fan Drives: Belt, equipped with belt guards and adjustable sheaves and pulleys for adjusting air-outlet velocity.

H. Motor Type: Resiliently mounted, continuous duty, totally enclosed, air over, with integral thermal-overload protection.
   1. Bearings: Permanently sealed, lifetime, prelubricated, ball bearings.
   2. Disconnect: Internal power cord with plug and receptacle.

2.02 FILTERS

A. Disposable Panel Filters: Factory-fabricated, viscous-coated, flat-panel-type, disposable air filters with glass-fiber media sprayed with nonflammable adhesive in cardboard frame.

2.03 ACCESSORIES

A. Thermostat: Line voltage, factory installed and wired to the junction box on air curtain.

B. Automatic Door Switch: Plunger type installed in door area to activate air curtain when door opens and to deactivate air curtain when door closes.

C. Start-Stop, Push-Button Switch: Manually activates and deactivates air curtain.

D. Time-Delay Relay: Factory installed and adjustable to allow air curtain to operate from 0.5 seconds to 10 hours.

E. Motor-Control Panel: Complete with motor starter, 115-V ac transformer with primary and secondary fuses, terminal strip, and NEMA 250, Type 1 enclosure.

F. Mounting Brackets: Adjustable mounting brackets for drum-type roll-up doors.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions where air curtains will be installed for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install air curtains with clearance for equipment service and maintenance.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

C. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing air curtains completely, perform visual and mechanical check of individual components.
2. After electrical circuitry has been energized, start unit to confirm motor rotation and unit operation. Certify compliance with test parameters.
3. Test gas train and verify that there are no gas leaks.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Repair or replace malfunctioning units and retest as specified above.

3.05 ADJUSTING

A. Adjust belt tension.

B. Adjust motor and fan speed to achieve specified airflow.

C. Adjust discharge louver and dampers to regulate airflow.

D. Adjust air-directional vanes.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air curtains.

END OF SECTION

SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 20 Section “Mechanical General Requirements.”
3. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.02 ACTION SUBMITTALS

A. Product Data: For each product indicated, include the following:
1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

1.03 INFORMATIONAL SUBMITTALS

A. 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. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

PART 2 - PRODUCTS

2.01 AIR DIFFUSION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Nailor Industries, Inc.
2. Price Industries.
3. Titus; Air Distribution Technologies, Inc.; a JCI Company.
4. Tuttle & Bailey; Air Distribution Technologies, Inc.; a JCI Company.

B. Terminal air diffusion devices have been chosen in terms of specific air distribution requirements, spacing, and sound characteristics.

C. Provide plaster frames for units installed in plaster ceilings.

D. Provide gaskets for supply terminal air devices mounted in finished surfaces.

E. Finish:
   1. Device Face and Visible Trim: Standard off white baked enamel finish unless noted otherwise.
   2. Device Interior Surfaces, Including Blank-Offs and Boots: Black matte finish.

F. Air pattern adjustments shall be made from the face of the device.

G. Refer to drawings and schedules for quantities, types, and finishes.

H. Coordinate frame types with Architectural Reflected Ceiling Plan.

2.02 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

B. Acoustical Applications and Sound Evaluation: Based on ARI Standard 885-98, “Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.”

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Wall-Mounted Supply Registers: Install 6 inches below finished ceiling unless otherwise indicated.

D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 7210 - LIGHT COMMERCIAL AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 23 Section "Temperature Controls" for control wiring and control devices connected to energy recovery units.

1.02 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings:
1. Include plans, elevations, sections, details, and attachments to other Work. For installed products indicated to comply with design loads, include structural analysis data.
2. Wiring Diagrams: Power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain air-to-air energy recovery units through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of air-to-air energy recovery units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

D. AHRI Compliance: Ratings for energy recovery devices shall comply with AHRI 1060, “Rating Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment.”

E. ASHRAE Compliance:

1. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

F. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.

G. UL Compliance:
1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."
2. Electric coils shall comply with requirements in UL 1995, "Heating and Cooling Equipment."

1.06 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 ENERGY RECOVERY VENTILATORS

A. Manufacturers:
1. Venmar CES; an affiliate of CES Group.
2. Thermal Corporation; a Division of Nailor International, Inc.
3. Ruskin Company.
4. RenewAire LLC; member of the Soler & Palau Ventilation Group.
5. Loren Cook Company.
6. Greenheck.
7. Dunham-Bush, Inc.
8. American ALDES Ventilation Corporation.

B. Description: Factory assembled and tested; designed for exterior installation; consisting of fixed-plate or enthalpy wheel heat exchanger, supply-air fan, exhaust-air fan, filters, dampers, basic unit controls and interface to BAS.

C. Casing: Manufacturer's double-wall galvanized sheet metal construction with exterior enamel paint finish. Units having single-wall casing construction are not acceptable.
1. Finish able to withstand minimum 500-hour salt spray test in accordance with ASTM B117.
2. Hinged access doors with neoprene gaskets for inspection and access to internal parts.
3. Minimum 1-inch-thick thermal insulation.
4. Perforated-metal liner on supply-air fan discharge section.
5. Knockouts for electrical and piping connections.
6. Exterior condensate drain connection.
7. Lifting lugs.

D. Supply-Air Fan: Airfoil, or backward inclined as scheduled, centrifugal, direct-driven or V-belt driven with fixed motor sheaves, grease-lubricated ball bearings, and motor. Mount fan and motor assembly on base with elastomeric isolator pads.

E. Exhaust Fan: Forward curved or airfoil, centrifugal, belt driven with adjustable motor sheaves, grease-lubricated ball bearings, and motor. Mount fan and motor assembly on base with elastomeric isolator pads.

F. Filters: Size, type, and rating as scheduled on the Drawings, in filter racks or galvanized-steel frames as required by filter type.

1. Air Filter and Filter-Holding System Manufacturers:
   a. AAF International.
   b. ECO Air.
   c. Farr Co.
   d. Flanders Filters, Inc.

G. Electrical:
1. Factory installed and wired, and functionally tested at factory before shipment.
2. Single-point, field-power connection to nonfused disconnect switch. Minimum SCCR according to UL 508 shall be as indicated on the Drawings or 5,000 A, whichever is greater.
   a. Branch power circuit to each motor, dedicated electrical load, and controls with disconnect switch or circuit breaker.
      1) NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
      2) NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit-trip set point.
   b. NEMA ICS 2, Class A, full-voltage, nonreversing motor controller, hand-off-auto switch, and overcurrent protection for each motor.
   c. Control-circuit transformer with primary and secondary side fuses.
3. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.

H. Unit Controls: Solid-state control board and components contain at least the following features:
1. Supply-air fan control relay.
2. Exhaust air fan control relay.
3. Default control to ensure proper operation after power interruption.
4. Service relay output.
5. Unit diagnostics and diagnostic code storage.
6. Field-adjustable control parameters.

I. BAS Communication Link (with or without unit manufacturer provided Programmable DDC): Stand-alone control module providing link between unit controls and DDC temperature-control system. Control module shall be compatible with temperature-control system specified in Division 23 Section "HVAC Instrumentation and Controls."

J. Accessories:
1. Dirty-filter switch.

2.03 MOTORS

A. Comply with requirements in Division 20 Section "Motors."

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install units level and plumb, maintaining manufacturer's recommended clearances. Install according to AHRI - SMACNA Guideline B.

B. Install units with clearances for service and maintenance.

C. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions. Refer to Division 20 Section “Basic Mechanical Materials and Methods” for base requirements. Coordinate wall penetrations and flashing with wall construction.

D. Install heat wheels so supply and exhaust airstreams flow in opposite directions and rotation is from exhaust side to purge section to supply side.
1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.
2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.

3. Access doors and panels are specified in Division 23 Section "Duct Accessories."
4. For outdoor units: Provide waterproof roof with standing seam construction and positive slope to ensure water drainage.

E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

F. Pipe condensate drains from heat exchanger units and drain pans to nearest floor drain or roof drain. Use same size piping as condensate drain connection. For equipment located outdoors, insulate and provide electrical heat trace for condensate drains.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Units shall be provided complete for single point connection to hydronic piping system.

B. Install piping adjacent to machine to allow service and maintenance.

C. Duct and fan installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts, fittings, and specialties.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Adjust seals and purge.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Set initial temperature and humidity set points.
5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

B. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.

C. Remove malfunctioning units, replace with new units, and retest as specified above.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 23 8126 - SPLIT-SYSTEM AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 SUMMARY

A. This Section includes ductless split-system air-conditioning units consisting of separate evaporator-fan and compressor-condenser components.

B. Products supplied but not installed under this Section:
1. Roof curbs and equipment rails.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For split-system air-conditioning units to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. ASHRAE Compliance:
   1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

E. Seasonal Energy-Efficiency Ratio (SEER): Minimum 13.

1.07 COORDINATION

A. Coordinate delivery and placement of roof curbs, and equipment supports. Installation of roof curbs, equipment supports, and roof penetrations is specified in Division 07 Section “Roof Accessories.” Pipe Roof Penetration Enclosures are specified in Division 20 Section “Basic Mechanical Materials and Methods.”

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One set of filters for each unit.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Single-Zone Split-System Air-Conditioning Units:
      a. Airedale North America, Inc.
      b. Carrier Corp.; United Technologies Corporation.
      c. Johnson Controls-Hitachi.
      d. LG Electronics, HVAC Division.
      e. Mitsubishi Electric & Electronics America, Inc.; HVAC Advanced Products Division.
      f. Samsung Electronics.
   2. Roof Curbs and Equipment Rails:
      a. Pate Company (The).
      b. Roof Products and Systems Corp.
      c. ThyCurb; a division of THYBAR Corporation.

2.02 SINGLE-ZONE DUCTLESS SPLIT SYSTEM AIR CONDITIONER

A. Complete packaged air conditioning unit factory fabricated and tested.

B. Indoor Evaporator Section: Complete with fan section, motor, washable filter, condensate drain pan and direct expansion evaporator section. Include factory-installed float switch to detect high condensate water level and disable fan operation.

C. Air Cooled Condensing Section: Completely factory piped for single point connection of refrigerant lines. Condensing unit with propeller fan shall be matched to evaporator section to provide cooling capacity as scheduled on drawings.

D. Controls: Unit furnished with factory installed microprocessor controls. Provide wireless remote or unit mounted control or wall thermostat, which shall provide selection of all functions and control of room temperature set points. Furnish and install one mounting bracket for each wireless remote control.

E. Provide complete refrigerant piping circuit (including all piping specialties) sized in accordance with manufacturer's requirements to interconnect evaporator and condenser sections.

F. Ceiling-Mounting, Evaporator-Fan Components:

1. Cabinet: Enameled steel chassis with removable panels on front and ends, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
3. Fan: Direct drive, centrifugal fan, with outside air intake, and integral factory or field installed condensate pump.
4. Fan Motors: Comply with requirements in Division 20 Section "Motors."
   a. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
5. Filters: Permanent, cleanable.

G. Air-Cooled, Compressor-Condenser Components:
1. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
   a. Compressor Type: Reciprocating or Scroll.
   b. Include refrigerant charge.
   c. Refrigerant: R-454B.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 0 deg F.

H. Control equipment is specified in Division 23 Section "Temperature Controls," and sequence of operation is indicated on the Drawings.

I. Thermostat: Wall-mounted low voltage type to control compressor and evaporator fan.

J. Automatic-reset timer to prevent rapid/short cycling of compressor.

2.03 ACCESSORIES

A. Roof Curbs and Equipment Rails:
1. Minimum 18 gage welded galvanized steel construction.
2. Integral base flange or plate.
3. Built-in fully mitered raised cant with step matching insulation thickness.
4. Factory installed insect and decay resistant wood nailer.
5. Top of curb or equipment support shall be level and extend a minimum of 8 inches above the top of the roof insulation.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Deliver roof curbs and equipment support to site for installation under Division 07. Install roof-mounting compressor-condenser components on equipment supports specified. Anchor units to supports with removable, cadmium-plated fasteners. Install wind baffle according to manufacturer’s installation instructions.

D. Install and connect refrigerant tubing to components. Install tubing to allow access to unit. Evacuate and charge with refrigerant in accordance with manufacturers instructions.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 23 Sections.

B. Install piping adjacent to unit to allow service and maintenance.

C. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 23 8219 - FAN-COIL UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 DEFINITIONS

A. IAQ: Indoor air quality.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Wiring Diagrams: Power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For fan-coil units to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.07 COORDINATION

A. Coordinate layout and installation of fan-coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate size and location of wall sleeves for outdoor-air intake.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Compressor failure.
      b. Condenser coil leak.
   2. Warranty Period: Five years from date of Substantial Completion.
   3. Warranty Period (Compressor Only): Five years from date of Substantial Completion.
   4. Warranty Period (Condenser Coil Only): Five years from date of Substantial Completion.

1.09 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fan-Coil-Unit Filters: Furnish spare filter for each filter installed.
   2. Fan Belts: Furnish one set of spare fan belts for each unit installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 FAN-COIL UNITS

A. Manufacturers:
   1. Airtherm.
   2. Carrier.
   3. Daikin Applied.
   4. Engineered Comfort.
   5. Enviro-Tec.
   6. International Environmental Corporation.
   7. Price.
   8. Trane.

B. Description: Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

C. Coil Section Insulation: Minimum 1/2-inch thick, dual-density coated glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
   1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.

D. Main and Auxiliary Drain Pans: Stainless steel. Drain pans shall be removable. Include factory-installed float switch to detect high condensate water level and disable fan operation.

E. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.

F. Cabinet: Steel, minimum 18 gage, with baked-enamel finish in manufacturers standard paint color as selected by Architect.
   1. Vertical Unit Front Panels: Removable, steel, with integral stamped discharge grille and channel-formed edges, cam fasteners, and insulation on back of panel.
   2. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge and attached with safety chain; with integral stamped discharge grilles.
   3. Steel recessing flanges for recessing fan-coil units into ceiling or wall.

G. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Washable Foam: 70 percent arrestance and 3 MERV.
   2. Glass Fiber Treated with Adhesive: 80 percent arrestance and 5 MERV.
   3. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.

Indoor Refrigerant Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and brazed joints at fittings. Comply with AHRI 210/240, and leak test to minimum 450 psig for a minimum 300-psig working pressure. Include thermal expansion valve.

H. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

I. Fan and Motor Board: Removable.
   1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
   2. Motor: Permanently lubricated, electronically commutated motor.
      a. Speed control: Infinitely adjustable by DC voltage or milliamp signal from control system.

J. Remote Condensing Units: Factory assembled and tested, consisting of compressors, condenser coils, fans, motors, refrigerant receiver, and operating controls. Construct, test, and rate condensing units according to AHRI 210/240 and ASHRAE 15.
   1. Casing: Steel with baked-enamel finish, removable panels for access to controls, weep holes for water drainage, and mounting holes in base.
   2. Compressor: Hermetic, scroll or reciprocating type; internally isolated for vibration with factory-installed safety devices as follows:
      a. Antirecycle timer.
      b. High-pressure cutout.
      c. Low-pressure cutout or loss-of-charge switch.
      d. Internal thermal-overload protection.
      e. Current and voltage sensitive safety devices.
   3. Compressor Motor: Start capacitor, relay, and contactor. Comply with requirements in Division 20 Section Motors.
   4. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, Energy Standard for Buildings except Low-Rise Residential Buildings.
   5. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.
   6. Refrigerant: R-454B.
   7. Low ambient controls to permit operation down to 45 deg F.
   8. Crankcase heater.
   9. Charging and service fittings on exterior of casing.
   10. Filter dryer.

11. Air-to-Air Heat Pump: Pilot-operated, sliding-type reversing valve with replaceable magnetic coil, and controls for air-to-air heat pump operation with supplemental heat operation.
12. Condenser: Copper-tube, aluminum-fin coil, with liquid subcooler.
13. Condenser Fan: Direct-drive, aluminum propeller fan.
    a. Motor: Comply with requirements in Division 20 Section Motors.

K. Controls and indicated on Sequence of Operation on the Drawings.

L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

M. Capacities and Characteristics: Refer to schedule on Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install fan-coil units level and plumb.

B. Install fan-coil units to comply with NFPA 90A.

C. Suspend fan-coil units from structure with elastomeric hangers. Vibration isolators are specified in Division 20 Section "Mechanical Vibration Controls."

D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above finished floor.

E. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
1. Install piping adjacent to machine to allow service and maintenance.
2. Connect condensate drain to indirect waste.
    a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

B. Connect refrigerant tubing to components. Install tubing to allow access to unit. Evacuate and charge with refrigerant in accordance with manufacturer’s instructions.

C. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Division 23 Section "Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.

3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.05 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units.

END OF SECTION

SECTION 23 8239 - ELECTRIC WALL AND CEILING HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 SUMMARY

A. This Section includes wall and ceiling heaters with propeller fans and electric heating elements.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Wiring Diagrams: Power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For wall and ceiling heaters to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Berko Electric Heating; a division of Marley Engineered Products.
   2. Brasch Manufacturing Company, Inc.
   3. Chromalox Advanced Thermal Technologies; Spirax-Sarco Engineering plc.
   4. Indeeco Heating Solutions; ASPEQ Heating Group.
   5. Markel Products; a division of TPI Corporation.
   6. QMark Electric Heating; a division of Marley Engineered Products.

B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

C. Cabinet:
   1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
   2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

D. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.

E. Fan: Aluminum propeller directly connected to motor.
   1. Motor: Permanently lubricated. Comply with requirements in Division 20 Section "Motors."

F. Controls: Unit-mounted thermostat.

G. Electrical Connection: Factory wired motors and controls for a single field connection including factory wired disconnect switch and starter.

H. Capacities and Characteristics: Refer to schedule on Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive wall and ceiling heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before wall and ceiling heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install wall boxes in finished wall assembly.

B. Install wall and ceiling heaters to comply with NFPA 90A.

C. Suspend wall and ceiling heaters from structure with threaded rod.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Operate electric heating elements to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.05 ADJUSTING

A. Adjust initial temperature set points.

END OF SECTION

SECTION 23 8241 - PROPELLER FAN UNIT HEATERS – STEAM, HOT WATER, ELECTRIC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 SUMMARY

A. This Section includes propeller fan unit heaters with electric-resistance coils.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit type and configuration.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Submit the following for each unit type and configuration:
1. Plans, elevations, sections, and details.
2. Details of anchorages and attachments to structure and to supported equipment.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Coordination Drawings: Plan(s) and other details, 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. Suspended ceiling components.
2. Structural members to which unit heaters will be attached.
3. Other items, including the following:
a. Lighting fixtures.
b. Sprinklers.

c. Ductwork.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Electric Unit Heaters:
   a. Berko Electric Heating; a division of Marley Engineered Products.
   b. Brasch Manufacturing Company, Inc.
   c. Chromalox Advanced Thermal Technologies; Spirax-Sarco Engineering plc.
   d. Indeeco Heating Solutions; ASPEQ Heating Group.
   e. Markel Products; a division of TPI Corporation.
   f. Sterling Radiator; a Mestek Company.
   g. Trane Inc.; a Trane Technologies Brand.

2.02 UNIT HEATERS

A. Description: An assembly including casing, coil, fan, and motor in vertical and horizontal discharge configuration with adjustable discharge louvers.

B. Comply with UL 2021.

2.03 CASING

A. Cabinet: Removable panels for maintenance access to controls.

B. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.

C. Discharge Louver: Four-way adjustable louvers for horizontal units and adjustable pattern diffuser for projection units.

2.04 ELECTRIC-RESISTANCE HEATING ELEMENTS

A. Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.
1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

2.05 FAN

A. Propeller type, aluminum wheel directly mounted on motor shaft in the fan venturi.

2.06 FAN MOTORS

A. Comply with requirements in Division 20 Section "Motors."

B. Motor Type: Permanently lubricated, multispeed.

2.07 CONTROLS

A. Control Devices:
1. Wall-mounting, variable fan-speed switch.
2. Wall-mounting thermostat.

2.08 CAPACITIES AND CHARACTERISTICS

A. Refer to Schedule on Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before propeller unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install propeller unit heaters level and plumb.

B. Install propeller unit heaters to comply with NFPA 90A.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers.
1. Hanger rods and attachments to structure are specified in Division 20 Section "Hangers and Supports."
2. Vibration hangers are specified in Division 20 Section "Mechanical Vibration Controls."

D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing and report results in writing:
1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safeties.

B. Remove and replace malfunctioning units and retest as specified above.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain propeller fan unit heaters. Refer to Division 20 Section "Mechanical General Requirements."

END OF SECTION

SECTION 26 0010 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.02 SUMMARY

A. This Section includes electrical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.03 REFERENCES

A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:
   1. ANSI - American National Standards Institute; www.ansi.org.
   2. ASTM - ASTM International; www.astm.org.
   3. CSI - Construction Specifications Institute (The); www.csiresources.org.

4. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
5. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
6. NEC - National Electrical Code
7. NECA - National Electrical Contractors Association; www.necanet.org.
   a. NECA 1-2000, “Practices for Good Workmanship in Electrical Contracting (ANSI).”
8. NEMA - National Electrical Manufacturers Association; www.nema.org.
9. NETA - InterNational Electrical Testing Association; www.netaworld.org.
10. UL - Underwriters Laboratories Inc.; www.ul.com.

1.04 QUALITY ASSURANCE

A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test, and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.
   1. Contract Documents are complementary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
   2. The Contractor understands that the work herein described shall be complete in every detail.

B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State, and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.
   1. Notify the Architect/Engineer if revisions to the Drawings or Specifications are required to conform to applicable ordinances, codes, or regulations. Identify the cost associated with these revisions in the bid.

C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.

D. Tests and Inspections: Perform all tests required by state, city, county, and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

F. Sequence and Schedule: Avoid interference with the work of other trades. Remove and relocate any work which in the opinion of the Owner’s Representatives causes interference.

1.05 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals, and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules, and regulations.

B. Comply with rules of local utility companies. Coordinate with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets, and meters which will be required and include the cost of all such items and all utilities costs in proposal.

C. All work shall be executed in accordance with the rules and regulations outlined in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction that exceed code requirements, the Drawings and/or Specifications shall govern.

1.06 DRAWINGS

A. The Drawings show the location and general arrangement of equipment, electrical systems, and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes, and accessories as may be required to meet such conditions.

C. Deviations from the Drawings, apart from minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades, and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.07 MATERIAL AND EQUIPMENT MANUFACTURERS

A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new, be standard products of manufacturers regularly engaged in the production of electrical equipment and be of the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.

C. Where existing equipment is modified to include new switches, circuit breakers, metering, or other components, the new components shall be by the original equipment manufacturer and shall be listed for installation in the existing equipment. Where original equipment manufacturer components are not available, third-party aftermarket components shall be listed for the application and submitted to the engineer for approval. Reconditioned or salvaged components shall not be used unless specifically indicated on the drawings.

1.08 INSPECTION OF SITE

A. Visit the site, examine, and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.09 ITEMS REQUIRING PRIOR APPROVAL

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information, and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.

2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

1.10 SHOP DRAWINGS/SUBMITTALS

A. Submit project-specific submittals for review in compliance with Division 1.

B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.

C. If deviations (not substitutions) from the Contract Documents are deemed necessary by the Contractor, the details of such deviations, the reason for the deviation, and the resulting changes shall be included with the submittal for approval.

D. Submit for approval shop drawings for electrical systems or equipment indicated in other sections of electrical specs. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation (light fixtures).

1.11 COORDINATION DRAWINGS

A. Submit project specific coordination drawings for review in compliance with Division 1 Specification Sections.

1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.

B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Manual shall be provided on electronic media. All literature shall be combined in one document and shall be properly bookmarked with all applicable sections. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.

C. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:
1. Routine maintenance procedures.
2. Trouble-shooting procedures.
3. Contractor's telephone numbers for warranty repair service.
4. Submittals.
5. Recommended spare parts list.
6. Names and telephone numbers of major material suppliers and subcontractors.
7. System schematic drawings on 8-1/2" x 11" sheets.

1.13 RECORD DRAWINGS

A. Submit record drawings in compliance with Division 01.

B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media which have been neatly marked to represent as-built conditions for all new electrical work. Modifications to original drawings shall be marked with a contrasting color so the marks are readily apparent.

C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer, and Owner at their request during construction.

1.14 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours

of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.

D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

1.15 WARRANTY

A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner’s satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 26 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship, or failure to follow the contract documents.

B. Contractor shall be responsible for any temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.

C. File with the Owner all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.16 USE OF EQUIPMENT

A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.

B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

1.17 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.
   4. To ensure that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions; and to maintain the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange, and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.02 DEMOLITION WORK

A. All demolition of existing electrical equipment and materials will be done by this Contractor unless otherwise indicated. Include all items related to the existing systems that are being removed such as, but not limited to, electrical equipment, cabinets, devices, lighting fixtures, conduit, fittings, boxes, wiring, and supports. No abandoned components of the electrical systems indicated to be removed shall remain.
   1. Where electrically powered equipment is included in the demolition scope of other trades, disconnect electrical wiring connections and remove circuit wiring complete.

B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this work.

C. Unless specifically noted otherwise, removed materials shall not be reused in the work.
   1. Materials indicated to be salvaged shall be carefully removed, stored, and protected from damage.
   2. Salvaged materials intended to be re-used shall be thoroughly cleaned, refurbished if necessary, and determined to be fully functional prior to placing back into service.
   3. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items that the Owner has waived ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.

D. Where equipment or fixtures are removed, outlet boxes that remain recessed in walls shall be properly blanked off, and conduits capped. After alterations are complete, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present electrical systems remaining in service shall not be changed unless specifically indicated as part of the project scope.

E. Reroute signal wires, lighting, and power wiring as required to maintain services that are to remain and/or unaffected by the renovations. Where walls and ceilings are to be removed as shown on the Drawings, the conduit is to be cut off by the Electrical Trades so that the abandoned conduit in these walls and ceilings may be removed with the walls and ceilings by the Architectural Trades. All dead-end conduit runs shall be plugged at the remaining line outlet boxes or the panels.

F. Where new walls and/or floors are installed which interfere with existing outlets, devices, etc., the Electrical Trades shall adjust, extend and reconnect such items as required to maintain continuity of same.

G. All electrical work in altered and unaltered areas shall be run concealed wherever possible. Use of surface raceway or exposed conduits will be permitted only where specifically indicated on the drawings or approved by the Architect/Engineer.

H. Existing lighting shall be reused where indicated on plans. Reused fixtures shall be detergent cleaned, re-lamped, and reconditioned suitable for satisfactory operation and appearance.

3.03 INSTALLATION OF EQUIPMENT

A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.

B. Device Location:
   1. Allow for wiring devices, control devices, and fire alarm devices to be relocated within a 10’ radius to accommodate final coordination with furnishings and other finish elements. Devices relocated prior to installation shall be done without additional cost to the project.

3.04 WORK IN EXISTING BUILDINGS

A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption to return work areas as soon as possible to Owner.

B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.

C. Consult with the Owner’s Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.

D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal, or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.05 TEMPORARY SERVICES

A. Provide and remove upon completion of the project, following the general conditions and as described in Division 01, a complete temporary electrical and telephone service during construction.

3.06 DISPOSAL

A. Fluorescent Lamps
   1. Fluorescent lamps are known to contain mercury and are classified as hazardous material. All fluorescent lamps shall be assumed to contain mercury unless tested and confirmed otherwise with a toxicity characteristic leaching procedure (TCLP).
   2. Hazardous materials (fluorescent lamps), shall be sent to a lamp recycling facility. The materials shall be properly packaged with labels that meet the Department of Transportation Regulations and stored in a secure location before transportation.
   3. The Contractor shall identify the costs of the lamp disposal process including, but not limited to, the lamp packaging, storage, transportation, disposal, and any profile fees.
   4. Upon completion of the project, provide documentation to verify that the lamps have been properly disposed of in accordance with all local, state, and federal guidelines.

B. Ballasts
   1. Lighting ballasts manufactured prior to 1979 have been known to contain polychlorinated biphenyls (PCBs). Unless specifically noted on the ballast as containing "No PCBs," the ballast shall be assumed to contain components with PCB materials.
   2. Hazardous materials (ballasts with PCBs), shall be disposed of at a hazardous waste incineration facility, or at a recycling facility in accordance with the Code of Federal Regulations as administered by the EPA in regards to this issue. The ballasts shall be packaged/stored in fifty-five gallon steel drums with labels that meet the Department of Transportation Regulations.
   3. The Contractor shall identify the costs of the ballast disposal process including, but not limited to, the packaging, storage, transportation, disposal, and any profile fees.
   4. Provide at completion of the project documentation (manifests) to verify that the ballasts have properly been disposed of in accordance with all local, state, and federal guidelines.

3.07 CHASES AND RECESSES

A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.

3.08 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

A. Refer to General Conditions for requirements.

B. All cutting, patching, and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.09 EXCAVATION AND BACKFILLING

A. Provide all excavation, trenching, tunneling, dewatering, and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.

B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical Drawings.

C. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

D. Backfill all excavations inside building, under drives, and parking areas with well-tamped granular material. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

E. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction as specified above. Backfill remainder of excavation with unfrozen excavated material in such a way as to prevent settling.

3.10 EQUIPMENT CONNECTIONS

A. Make connections to equipment and other items included in the work in accordance with the approved shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the Drawings, but called out by the equipment manufacturer's shop Drawings shall be provided.

3.11 CLEANING

A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.

B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

3.12 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

A. Equipment and materials shall be protected from theft, injury, or damage.

B. Protect conduit openings with temporary plugs or caps.

C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.

3.13 EXTRA WORK

A. For additional electrical work which may be proposed or requested, furnish an itemized cost breakdown of material and labor required to complete the work. Proceed only after receiving a written authorization.

B. Before providing an itemized break-down for additional electrical work, submit unit prices for the following items: 1/2", 3/4", 1", 1-1/2" EMT conduit; #12, #10, #8, #6, #2 building wire; duplex receptacles, GFCI receptacles, data box and raceway, fire alarm audible/visual notification appliance and visual notification appliance, clocks and speakers, and other common electrical work which may be anticipated for any future revisions. These unit costs, once agreed to, shall be applied to additions and deducts for all project change orders.

3.14 DRAWINGS AND MEASUREMENTS

A. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor's responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.

END OF SECTION

SECTION 26 0519 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes:
1. Building wires and cables rated 600V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:
1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.
2. Division 26 Section “Control-Voltage Electrical Power Cables” for multi-conductor cables for electrical control and communications systems operating at 70V and less.
3. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.03 ACTION SUBMITTALS

A. Submit letter of compliance (intent) for copper and aluminum building wire.

B. Provide product data for the following:
1. Metal-Clad Cable, Type MC
2. Power Cable for Variable Frequency Controlled Motors

1.04 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Test Reports.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

D. Conductor Insulation:
1. Type THHN/THWN-2: Comply with UL 83.
2. Type THW/THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
3. Type XHHW-2: Comply with UL 44.

2.02 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
1. Allowed only for conductors used in feeders 100A and larger.

B. Manufacturers:
1. General Cable
2. Southwire

C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Aluminum, complying with ASTM B 800 and ASTM B 801.

E. Conductor Insulation:
1. Type XHHW-2: Comply with UL 44.

2.03 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers:
1. AFC Cable Systems
2. Alpha Wire Company
3. American Bare Conductor
4. Belden
5. Encore
6. General Cable
7. Okonite
8. Service Wire Co.
9. Southwire Company

C. Standards:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
   2. Comply with UL 1569.
   3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:
   1. Single circuit and multi-circuit with color-coded conductors for branch circuit distribution.
   2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors:
   1. Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
   2. Aluminum, complying with ASTM B 800 and ASTM B 801 for conductors #1 AWG and larger.

F. Ground Conductor: Insulated. Ground conductor sized as indicated on drawings (reduced ground conductor is not acceptable).

G. Conductor Insulation:
   1. Type TFN/THHN/THWN-2: Comply with UL 83.
   2. Type XHHW-2: Comply with UL 44.

H. Armor: Aluminum, interlocked.

I. Jacket: PVC applied over armor.

2.04 TRAY CABLE, TYPE TC

A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in a nonmetallic jacket.

B. Manufacturers:
   1. Alpha Wire Company
   2. Belden
   3. Encore
   4. General Cable
   5. Okonite
   6. Service Wire Co.
   7. Southwire Company

C. Standards:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
   2. Comply with UL 1277.
   3. Comply with ICEA S-73-532/NEMA WC 57 for Type TC cables used for control, thermocouple extension, and instrumentation.
   4. Comply with ICEA S-95-658/NEMA WC 70 for Type TC cables used for power distribution.
   5. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Ground Conductor: Insulated.

F. Conductor Insulation: Type XHHW-2. Comply with UL 44.

G. Shield: Metallic.

2.05 POWER CABLE FOR VARIABLE FREQUENCY CONTROLLED MOTORS

A. Description: A factory assembly of three conductor cable with three symmetrical ground conductors, a continuous shield, an overall PVC jacket and a product specific connector and termination kit.

B. Manufacturers:
   1. Service Wire Co.

C. Standards:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
   2. Comply with UL 1277
   3. Comply with ICEA S-95-658/NEMA WC 70 for Type TC-ER Power Cable (for VFD application)
   4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:
   1. Single circuit feeder.

E. Phase Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

F. Ground Conductor: Bare copper.

G. Phase Conductor Insulation: Moisture resistant, flame retardant, cross linked polyethylene (2KV RHW-2) suitable for 90degC conductor temperature operation inf dry, damp and wet locations

H. Shield: Helically applied minimum 5 mils thick bare copper with minimum 50% overlap.

I. Armor: Steel or Aluminum, interlocked.

J. Jacket: Oil resistant PVC

K. Connector: Water-tight and UL listed for installation on supplied TC cable (tray cable) assembly.
   1. Body material: nickel clad aluminum
   2. Connector shall provide a 360-degree electrical bonding of the copper tape shield to the connector body.
   3. Connection of the copper tape shield to the connector body shall be accomplished by an integral and self-retaining grounding collar that automatically provides a 360-degree connection as the connector is tightened.
   4. The connector assembly shall be designed to ensure against loosening of threads due to vibration.
   5. A UL listed chrome plated grounding and bonding locknut with a 360-degree knurled teeth connection shall be provided with each connector to secure and bond the connector to the inverter cabinet / motor termination box.
   6. Tinned copper braids (minimum ¾ inches wide) with installation hardware to connect the copper tape shield to the inverter enclosure / back-panel and to the motor frame shall be provided as part of the cable system.

L. Termination Kit: Tinned copper braids (minimum ¾ inches wide) with installation hardware to connect the copper tape shield to cable core, to the inverter enclosure/back-panel, and to the motor frame shall be provided as part of the cable system.
   1. Braid width shall be determined by cable core diameter size and shall be placed at a separation of 180 degrees.

2.06 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Refer to application schedule on the drawings

B. If providing aluminum feeders, contractor is responsible for providing correct feeder, equipment ground and conduit size based on voltage drop and any de-rating required.

C. Feeders and Branch Circuits: Solid or stranded for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

D. Each feeder shall be of the same conductor and insulation material (phase, neutral, and parallel).

E. Use conductor not smaller than 14 AWG for 120V control circuits.

F. Where equipment is listed for use with copper conductors only, use copper conductors for the entire length of feeder.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Refer to application schedule on the drawings

B. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel wire-mesh strain relief device at terminations to suit application.

C. Connection between Variable Frequency Controllers and Motors: Use power cable for variable frequency- controlled motors. Install and terminate according to cable manufacturer’s recommendations.

D. Isolated Power System Circuits: Use Type XLP in raceway.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 26 0533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 26 0536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

H. Neatly train and lace wiring inside boxes, equipment, and panelboards.

I. Provide a separate neutral conductor for each circuit unless multi-wire branch circuits are specifically indicated on the drawings.

J. Electrical Contractor shall be responsible for de-rating of conductors as required by N.E.C. when more than three current carrying conductors are installed in a single raceway or cable. Neutral conductors shall be considered current carrying conductors.

K. Type MC cable shall be supported and secured at intervals not exceeding 4'-0" in new construction.

L. AC/MC cable shall not be used for home runs to receptacle or distribution panels.

M. Where AC/MC cable is permitted by the specifications, AC/MC cable shall not be bundled.

N. Between support, hangers and termination no more than 3" deflection from the bottom of the cable to a horizontal line between the support/hanger or termination.

O. Do not route conductors across roof without prior approval from engineer.

P. Install and terminate power cable for variable frequency- controlled motors according to cable manufacturer’s recommendations.

Q. Install fire resistive cable assemblies (Type MI cable and/or fire rated MC cable) in accordance with the manufacturer’s instructions and the product UL listing.
   1. Do not paint fire resistive cable assemblies.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
   1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
   2. Use compression type terminations for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

D. Clean conductor surfaces before installing lugs and connectors.

E. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

F. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.

G. Use Sta-Kon connectors to terminate stranded conductors #10 AWG and smaller to screw terminals.

H. Use insulated spring wire connectors with plastic caps (wire nuts) for copper conductor splices and taps, 10 AWG and smaller. Push-in style connectors are not permitted.

I. Provide lugs suitable for bussing and conductor material used.

J. Use appropriately sized compression pin adapters to make terminations at equipment where equipment lugs cannot accommodate conductors that are oversized for voltage drop or similar conditions.

3.05 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 0553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 0533 "Raceways and Boxes."

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping”.

3.08 FIELD QUALITY CONTROL

A. Perform the following field quality control tests in accordance with Division 26 Section “Electrical Testing”.
   1. Description: Test all feeders rated 100 A and above.

2. Visual and Mechanical Inspection
   a. Inspect cables for physical damage and proper connection in accordance with the one line diagram.
   b. Test cable mechanical connections with an infrared survey.
   c. Check cable color-coding against project Specifications and N.E.C. requirements.
3. Electrical Tests
   a. Perform insulation resistance test on each conductor with respect to ground and adjacent conductors. Applied potential to be 1000 volts dc for 1 minute.
   b. Perform continuity test to insure proper cable connection.
4. Test Values
   a. Minimum insulation resistance values shall be not less than fifty mega-ohms.

B. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 0526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Related Sections include the following:
1. Division 26 Section "Underground Ducts and Utility Structures" for ground test wells.
2. Division 26 Section "Lightning Protection" for additional grounding and bonding materials.
3. Division 26 Section “Electrical General Requirements”.
4. Division 26 Section “Conductors and Cables”.

1.03 REFERENCES

A. ASTM B 3: Specification for Soft or Annealed Copper Wire.

B. ASTM B 8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.

C. ASTM B 33: Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

D. ASTM B 187: Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.

E. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

F. IEEE 142: Grounding of Industrial and Commercial Power Systems.

G. IEEE 837: Qualifying Permanent Connections Used in Substation Grounding.

H. IEEE 1100 – 1992: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.

I. IEEE C2: National Electrical Safety Code.

J. NETA MTS – 2001: Maintenance Testing Specifications.

K. NFPA 70: National Electrical Code.

L. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.

M. NFPA 99: Health Care Facilities.

N. NFPA 780: Lightning Protection Code.

O. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.

P. UL 96: Lightning Protection Components.

Q. UL 467: Grounding and Bonding Equipment.

R. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

S. UL 486B: Wire Connectors for Use with Aluminum Conductors.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Ground rods.
   2. Exothermic Connectors
   3. Compression-type connectors.

1.05 INFORMATIONAL SUBMITTALS

A. Field Quality Control Test Reports: Submit written test reports to include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
   4. Indicate overall system resistance to ground.
   5. Indicate overall Telecommunications system resistance to ground.

1.06 CLOSEOUT SUBMITTALS

A. Project Record Documents
   1. Submit under provisions of Division 26 “Electrical General Requirements”.
   2. Accurately record actual locations of grounding electrodes and connections to building steel.

1.07 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   1. Comply with UL 467.

B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

C. Comply with ANSI/TIA/EIA-607 “Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications”.

D. Comply with ANSI/IEEE 1100 -1992 “Powering and Grounding Sensitive Electronic Equipment”.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Grounding Conductors and Cables:
      a. Refer to Division 26 Section “Conductors and Cables”.
   2. Grounding Rods:

a. American Electric-Blackburn.
b. Apache Grounding/Erico Inc.
c. Chance/Hubbell.

3. Mechanical Connectors:
   a. American Electric-Blackburn.
   b. Burndy.
   c. Chance/Hubbell.
4. Exothermic Connections:
   a. Cadweld.
5. Compression-type Connectors:
   a. Burndy HyGround
   b. Blackburn EZ Ground.
   c. Panduit.

2.02 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."

B. Material: Aluminum, copper-clad aluminum, and copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, stranded, copper unless otherwise indicated.

G. Bare Copper Conductors: Comply with the following:
   1. Solid Conductors: ASTM B 3.
   2. Assembly of Stranded Conductors: ASTM B 8.
   3. Tinned Conductors: ASTM B 33.

H. Copper Bonding Conductors: As follows:
   1. Bonding Conductor: Stranded copper conductor; size per the NEC.
   2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; size per the NEC.
   3. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; size per the NEC.

I. Electrical Grounding Busbar
   1. 24” (min) x 2” x ¼” tin plated, copper busbar with two rows of ¼” x 20 tapped holes 1” on center.

J. Telecommunications Main Grounding Busbar (TMGB)
   1. 48” (min) x 4” x ¼” tin plated, copper busbar with three rows of ¼ x 20 tapped holes 1” on center.

K. Telecommunications Grounding Busbar (TGB)
   1. 12” (min) x 2” x ¼” tin plated, copper busbar with two rows of ¼ x 20 tapped holes 3” on center.

L. Telecommunications Bonding Backbone (TBB)
   1. Minimum No. 2 AWG insulated stranded copper.

M. Telecommunications Bonding Conductors
   1. Minimum No. 6 AWG insulated stranded copper.

2.03 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected for the specific application per manufacturer's written instructions.

D. Compression-Type Connectors: Pure, wrought copper, per ASTM B187.

2.04 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.
   1. Size: 5/8 in diameter.
   2. Length: 120 inches.

B. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Provide handholes as specified in Division 2 Section "Underground Ducts and Utility Structures."

PART 3 - EXECUTION

3.01 EQUIPMENT GROUNDING

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. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

C. Underground Grounding Conductors: No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

D. In raceways, use insulated equipment grounding conductors. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.
   1. Where existing branch circuits are using conduit as equipment grounding conductor and are extended, provide grounding bushing on existing conduit and provide new equipment grounding conductor with new branch circuit.

E. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.

F. 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.

G. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.

H. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

I. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

J. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and anti-frost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

K. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a separate equipment grounding conductor with supply branch-circuit conductors. Bond pole and foundation reinforcing steel to equipment ground conductor.

L. Verify specific equipment grounding requirements with the manufacturer’s recommendations.

3.02 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: Use for connections to structural steel and for underground connections, except those at test wells. 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
1. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
2. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

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 or UL 486B as applicable.

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Connections shall be non-reversible. 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.

3.03 INSTALLATION

A. Equipotential Ground: Interconnect grounding electrodes to form one, electrically continuous, equipotential grounding electrode system. Grounding electrodes to be interconnected include:
1. Metal Underground Water Service Pipe.
2. Metal In-Ground Support Structure.
3. Concrete Encased Electrode.
4. Ground Rods.

B. Metal Underground Water Service Pipes in direct contact with the earth for 10 feet or more: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to all metal water service entrances to building including fire protection water service entrance. Connect grounding conductors to 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.

C. Metal in-ground support structure in direct contact with the earth vertically for 10 feet (3.0 m) or more, with or without concrete encasement: Provide insulated copper grounding conductors, in

conduit, from building's main service equipment, or grounding bus, to at least one metal in-ground support structure, or as otherwise indicated. Connect grounding conductors to metal in-ground support structure by exothermic welds. Bond metal grounding conductor conduit or sleeve to conductor at each end.

D. Concrete Encased Electrode: Fabricate in accordance with NFPA 70:
   1. Provide a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation.
   2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.
   3. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

E. 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.
   1. Verify that final backfill and compaction has been complete before driving ground rods.
   2. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
   3. Interconnect ground rods with grounding electrode conductors. Use exothermic welds or non-reversing compression-type connectors, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

F. 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. Install in conduit where routed above grade.
   1. Aluminum and copper-clad aluminum conductors shall not be used in direct contact with masonry, within 18 inches of the earth, or where subject to corrosive conditions.

G. 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 or non-reversing compression-type 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.

H. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

I. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

J. Separately Derived AC Power Systems: Ground separately-derived ac power system neutrals including distribution transformers and uninterruptible power supplies to grounding electrodes per NFPA 70.

K. 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.

L. Grounding Bus:
   1. Install grounding bus in the locations listed below and elsewhere as indicated:
      a. Electrical equipment rooms.
      b. Telephone equipment rooms.
      c. Rooms housing service equipment.
   2. Use insulated spacer; space 2 inch from wall and support from wall 12 inches above finished floor, unless otherwise indicated.

M. Equipment Grounding: Provide a permanent and continuous bonding of conductor enclosures, equipment frames, power distribution equipment ground busses, cable trays, metallic raceways, and other non-current carrying metallic parts of the electrical system.

N. Bond together metal building elements not attached to grounded structure; bond to ground.

3.04 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Manholes and Handholes: Install a driven ground rod close to wall, inside manhole, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

B. Connections to Manhole Components: Connect all exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

C. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with transformers/substations by connecting them to underground cable and grounding electrodes. Use not less than a No. 2 AWG conductor for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

D. Other underground systems to be bonded to the grounding electrode system:

3.05 TELECOMMUNICATIONS GROUNDING

A. Telecommunications Grounding System: The telecommunications grounding system shall consist of:
   1. Telecommunications Main Grounding Busbar (TMGB) located in the main telecommunications room near the telecommunications service entrance. Bond to the main building electrical grounding electrode system via a No. 3/0 AWG copper ground conductor.
   2. A Telecommunications Grounding Busbar (TGB) in each telecommunications room, cabinets, etc.
   3. A Telecommunications Bonding Backbone (TBB) tying together the TMGB and each TGB.
   4. Bonding of all equipment racks, raceways, non-current carrying metallic equipment and surge protection devices within the telecommunications room to the TGB's or TMGB using approved bonding conductors. Each piece of equipment shall be bonded individually directly to the ground bus.

B. All bonding connections shall be installed at an accessible location for inspection and maintenance.

C. All telecommunications bonding connections shall be of an approved mechanical type connection. Do not use exothermic welds unless specifically indicated on the Drawings.

D. The physical routing shall, in general, follow the same path as the backbone cable system.

E. Bond each TGB directly to the building steel with a No. 6 AWG conductor.

F. Do not use TGB's as a power system ground connection unless specifically noted on the Drawings.

G. All bonding connectors and conductors shall be UL listed for the purpose intended.

H. TMGB and TGB installation: Use insulated spacer; space 2 inch from wall and support from wall 12 inches above finished floor, unless otherwise indicated.

I. Individually bond each piece of non-current carrying metallic equipment in the Telecommunications Room to the TGB.

J. Install continuous cable from the TMGB to the furthest TGB. Bond all TGB's to TBB with bare No. 3/0 AWG copper ground conductor and T-tap grounding hardware.

3.06 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”

1. Inspect grounding and bonding system conductors and connections for tightness and proper installation and for compliance with the Drawings and Specifications.
2. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
    a. 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.
    b. 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.
    c. Perform tests, by the fall-of-potential method according to IEEE 81. Instrumentation utilized shall be as defined in Section 12 of IEEE 81 and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that curves flatten in the 62% area of the distance between the item under test and the current electrode.
    d. Equipment Grounds: Utilize two-point method of IEEE 81. Measure between equipment ground being testing and known low-impedance grounding electrode or system.
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.
    b. Equipment Rated 500 to 1000 kVA: 5 ohms.
    c. Equipment Rated More Than 1000 kVA: 3 ohms.
    d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
    e. Manhole Grounds: 10 ohms.
    f. The telecommunications grounding system shall have a maximum resistance of 1 ohm as measured from the TMGB ground to earth ground.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.07 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 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.

B. Related Sections include the following:

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.05 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Nonmetallic slotted support systems.
   3. Roof mounted supports

1.06 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube & Conduit; a part of Atkore International..
      b. B-Line, by Eaton..
      c. GS Metals Corp.
      d. Pentair Electrical & Fastening Solutions.
      e. Thomas & Betts Corporation.
      f. Unistrut; a part of Atkore International.
      g. Wesanco, Inc.
   2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   4. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube & Conduit; a part of Atkore International..
      b. B-Line by Eaton.
      c. Fabco Plastics Wholesale Limited.
      d. Seasafe, Inc.
   2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
   3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
   4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1) Hilti Inc.
   2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
   3) MKT Fastening, LLC.
   4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) B-Line by Eaton.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

2.03 ROOF MOUNTED CONDUIT AND EQUIPMENT SUPPORTS

A. General: Shop- or field- fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted conduit and equipment.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-Line by Eaton; Dura-Blok.
   2. MIRO Industries.
   3. Pentair Electrical & Fastening Solutions; Caddy Pyramid.
   4. Pipe Pier Support Systems; Pipe Piers.

C. Adjustable Compact Stand: Recycled rubber base unit with integral threaded coupling capable of accepting 3/8-16 threaded rod, or 1-5/8 inch by 1-5/8 inch metal strut and various supporting elements.

D. Multiple-Conduit and Equipment Stand: Assembly of bases, vertical and horizontal members, and conduit supports, for roof installation without membrane penetration.
   1. Bases: One or more adjustable compact stand bases.
   2. Vertical Members: Two or more protective-coated-steel channels.
   3. Horizontal Member: Protective-coated-steel channel.
   4. Supports: Standard strut clamps, hangers, and accessories.

2.04 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 6 Section "Rough Carpentry." Plywood sheets shall be free of all voids. Plywood shall have a minimum of two coats of fire-resistant, non-

conducting paint applied to all sides of all sheets. Provide flush hardware and supports to mount plywood to wall. The provided hardware shall have sufficient strength to carry all anticipated loads including, but not limited to cabling, cable management and equipment racks.

PART 3 - EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70 or as scheduled in NECA 1. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with:
      a. Two-bolt conduit clamps
      b. Single-bolt conduit clamps
      c. Single-bolt conduit clamps using spring friction action for retention in support channel.

D. Support single runs of MC cable using spring-steel clamps from suspended ceiling hangers, hanger wire or building structure at intervals not to exceed three feet. Do not support MC cable from ceiling grid.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. To Steel:
      a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
      b. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
      c. Spring-tension clamps.
   6. To Light Steel: Sheet metal screws.
   7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel support systems attached to substrate.

E. Slotted support systems applications:
   1. Indoor dry and damp Locations: Painted Steel

2. Outdoors and interior wet locations: Galvanized Steel
3. Corrosive Environments, including pool equipment rooms: Nonmetallic

F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

G. Do not fasten supports to floor decks, roof decks, pipes, ducts, mechanical equipment, or conduit.

H. Obtain permission from Architect/Engineer before using powder-actuated anchors.

I. Obtain permission from Architect/Engineer before drilling or cutting structural members.

J. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

K. Install surface-mounted cabinets and panelboards with minimum of four anchors.

L. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.

M. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

N. The Contractor shall replace all supports and channels that sag, twist, and/or show signs of not providing proper structural support, to the equipment, it is intended for, as determined by the Owner and Architect/Engineer. All costs associated with replacing supports and steel channels shall be incurred by the Contractor.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 INSTALLATION OF ROOF MOUNTED SUPPORTS

A. Install in accordance with manufacturer’s instructions.

B. If gravel top roof, gravel must be removed around and under support.

C. Consult roofing manufacturer for roof membrane compression capacities. If required, a compatible sheet of roofing material (rubber pad) may be required under rooftop support to disperse concentrated loads and add further membrane protection.

D. Utilize properly sized clamps and accessories to suit conduit sizes.

E. Provide vertical steel channel members as required for elevated conduit supports where required for clearances, coordination with other roof mounted systems or derating.

3.05 CONCRETE BASES

A. Provide concrete bases for all floor mounted electrical equipment.

B. Provide concrete bases for all exterior, grade level electrical equipment, and where indicated.

C. Base/Pad Construction:
1. Construct per manufacturer’s recommendations for particular equipment, including suggested piers and dowel rods.
2. Interior concrete bases shall have a minimum depth of 4” unless other indicated or recommended by the manufacturer.
3. Exterior concrete bases shall have a minimum depth of 8” unless other indicated or recommended by the manufacturer.
4. Construct concrete bases for primary and secondary power distribution equipment per requirements of the electrical utility, where submitted for its review.

D. Anchor equipment to base per both supports and equipment manufacturer's instructions.

E. Coordinate conduit openings and sleeve locations in base with requirements of equipment to be supported.
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of the base.
   2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

3.06 BACKBOARDS

A. A minimum of two walls (or as indicated on drawings) shall be covered with plywood backboards to a minimum 8'-6" above finished floor in all Telecommunication Rooms and similar spaces and as indicated on Drawings.

B. Securely fasten backboard to wall using appropriate hardware and mount at all four corners, minimum. Securely fasten backboard to wall-framing members (studs).

C. Provide adequate backboard space to allow a clean and workable arrangement for telephone and data connections.

3.07 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 0533 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section, “Underground Ducts and Raceways for Electrical Systems” for exterior duct banks, manholes and underground utility construction.
2. Division 07 Section, “Penetration Firestopping” for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
3. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings, and for access floor boxes and service poles.
4. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. LFNC: Liquidtight flexible nonmetallic conduit.

G. RNC: Rigid nonmetallic conduit.

H. PVC: Polyvinyl Chloride.

I. HDPE: High Density Polyethylene.

J. RTRC: Reinforced Thermosetting Resin Conduit

1.04 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.06 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.01 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube Triangle Century.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. International Metal Hose.
6. Electri-Flex Co
7. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
8. LTV Steel Tubular Products Company – Manhattan/CDT/Cole-Flex.
9. Maverick.
10. O-Z Gedney; unit of General Signal.
11. Wheatland.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. IMC: ANSI C80.6.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

F. EMT: ANSI C80.3.

G. FMC: Zinc-coated steel or Aluminum.

H. LFMC: Flexible steel conduit with PVC jacket.

I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel, set-screw type.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

2.02 FIRE ALARM EMT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Allied Tube Triangle Century.

B. EMT conduit with bright red topcoat; Fire Alarm EMT.

C. EMT and Fittings: ANSI C80.3.

2.03 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American International.
   2. Anamet Electrical, Inc.; Anaconda Metal Hose.
   3. Arnco Corp.
   4. Cantex Inc.
   5. Certainteed Corp.; Pipe and Plastics Group.
   6. Condux International.
   7. ElecSys, Inc.
   8. Electri-Flex Co.
   9. Integral.
   10. Kor-Kap.
   11. Lamson and Sessions: Carlon Electrical Products.
   12. Manhattan/CDT/Cole-Flex.
   13. RACO; Division of Hubbell, Inc.
   14. Scepter.
   15. Spiralduct, Inc./AFC Cable Systems, Inc.
   16. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

E. LFNC: UL 1660.

F. HDPE: UL 651, ASTM D 3350, ASTM D 1248 Schedule 40.

G. RTRC: Comply with UL 2515A and NEMA TC 14.

2.04 METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hoffman.
   2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Hinged type

F. Finish: Manufacturer's standard enamel finish.

2.05 NONMETALLIC WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hoffman.
   2. Lamson & Sessions; Carlon Electrical Products.

B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.

C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

2.06 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Airey-Thompson Sentinel Lighting: Wiremold Company (The).
      b. Thomas & Betts Corporation.
      c. Walker Systems, Inc.; Wiremold Company (The).
      d. Wiremold Company (The); Electrical Sales Division.
      e. Mono-Systems, Inc.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hubbell, Inc.; Wiring Device Division.
      b. Carlon Electric Products.
      c. Panduit Corporation.
      d. Walker Systems, Inc.; Wiremold Company (The).
      e. Wiremold Company (The); Electrical Sales Division.
      f. Mono-Systems, Inc.

C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.07 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Shall be used within walls or ceiling.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover. Shall be used in all exposed, non-recessed, locations.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2. Shall be used in corrosive areas.

D. Floor Boxes: Cast metal, fully adjustable, rectangular.

E. Floor Boxes: Nonmetallic, nonadjustable, round.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover. Shall be used in areas exposed to water.

H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2.08 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with ANSI/SCTE 77.
   1. Color of Frame and Cover: Green.
   2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
   3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
   4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   5. Cover Legend: Molded lettering, "ELECTRIC", “COMMUNICATIONS” or as indicated for each system service.
   6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
   7. Handholes 12 inches wide by 24 inches longand larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hubbell: Quazite
      b. Armorcast Products Company.
      c. Carson Industries LLC.
      d. CDR Systems Corporation.
      e. NewBasis.
      f. Christy Concrete Products.

2.09 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.10 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advance Products & Systems, Inc.
   2. Calpico, Inc.
   3. Metraflex Co.
   4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
   1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.11 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.12 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

A. Provide raceways in interior and exterior locations in accordance with the “Raceway Application Matrix” included on the drawings.

B. Boxes and Enclosures, Exterior Aboveground: NEMA 250, Type 3R.

C. Boxes, Enclosures, and Handholes:
1. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Non-deliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
2. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Non-deliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.

D. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.

E. Minimum Raceway Size: 3/4-inch trade size.

F. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

G. Do not install aluminum conduits in contact with concrete.

H. Install surface raceways only where indicated on Drawings.

I. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F

3.02 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Install temporary closures to prevent foreign matter from entering raceways.

F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
   1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

J. Support conduit within 12 inches of enclosures to which attached.

K. Raceways Embedded in Slabs:
   1. Raceways embedded in slabs shall be limited to above grade concrete decks. Embedded conduit shall be limited to servicing floor boxes and equipment located in open spaces away from accessible walls.
   2. Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.
   3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
   4. Space raceways laterally to prevent voids in concrete.
   5. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
   6. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   7. Conduits shall run flat. Do not allow conduits to cross.
   8. Change from non-metallic raceway to rigid steel before turning up out of the concrete and rising above the floor.

L. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
   1. Run parallel or banked raceways together on common supports.
   2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

S. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

U. Communications and Signal Cabling Systems Raceways: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
   1. Electrical condulet (LB's) are not permitted.
   2. Conduits shall have no more than two 90 degree bends between pull points or pull boxes.
   3. Conduits shall contain no continuous sections longer than 150 ft. without a pull point/box.
   4. Conduit for fiber cabling shall have a bend radius of at least 10 times the internal diameter.
   5. Conduit for copper cabling less than 2" shall have a bend radius of at least 6 times the internal diameter. Conduit for copper cabling 2" and larger shall have a bend radius of at least 10 times the internal diameter.
   6. All conduit ends shall have an insulated bushing.

V. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where conduits route through, to, or from a hazardous classified space (Class I or II), provide proper seal offs when exiting or entering the hazardous classified space.
   3. Where conduits pass between spaces that are maintained at two different vapor pressures.
   4. Where otherwise required by NFPA 70.

W. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

X. Expansion-Joint Fittings:
   1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
   2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
      b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
      c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
      d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Y. Flexible Conduit Connections: Comply with NEMA RV3. Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

Z. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals. Provide cover clips to cover space between connecting pieces.

AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

CC. Locate boxes so that cover or plate will not span different building finishes.

DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

FF. Set floor boxes level and flush with finished floor surface. Trim non-metallic boxes after installation to fit flush with finished floor surface.

GG. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

HH. Do not route feeders across roof.

II. Provide a pull box (a handhole for outdoor applications) for each conduit run that exceeds 250 feet. Provide two pull boxes (handholes for outdoor applications) for runs that exceed 500 feet.

JJ. Route conduits in finished areas with exposed ceilings at underside of structural deck or as high as possible.

KK. Outlet boxes within hazardous locations shall be of the proper class and division as noted in the N.E.C.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 2 Section "Earthwork" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 2 Section "Earthwork."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

5. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes and boxes with bottom below the frost line, 42” below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE INSTALLATION FOR ELECTRICAL AND COMMUNICATIONS PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Through-Penetration Firestop Systems."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:
1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches above finished floor level.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.06 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Through-Penetration Firestop Systems."

3.08 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.09 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 26 0553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

1.04 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with 29 CFR 1910.145.

1.05 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:
1. Power Circuits: Black letters on an orange field.
2. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.02 CONDUCTOR, COMMUNICATION AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.03 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.04 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.05 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background. Minimum letter height shall be 3/8 inch.

B. Outdoor Equipment Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.06 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb, minimum.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 APPLICATION

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service and Feeders More Than 400 A: Identify with orange self-adhesive vinyl label.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
   1. Fire Alarm System: Red.
   2. Security System: Blue and yellow.
   3. Telecommunication System: Green and yellow.
   4. Control Wiring: Green and red.

C. Power-Circuit Conductor Identification: For conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and marker tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number as indicated on Drawings. Identify control circuits by control wire number as indicated on shop drawings.

E. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.

F. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
   3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
   1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.
   2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

J. Instruction Signs:
   1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
   2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Indoor Equipment: Engraved, laminated acrylic or melamine label mechanically secured.
      b. Outdoor Equipment: Stenciled.
      c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   2. Equipment to Be Labeled: If included on project. All items may not be on project.
      a. Panelboards, electrical cabinets, and enclosures.
      b. Access doors and panels for concealed electrical items.
      c. Transformers.
      d. Emergency system boxes and enclosures.
      e. Motor-control centers.
      f. Disconnect switches.
      g. Enclosed circuit breakers.
      h. Motor starters.
      i. Push-button stations.
      j. Power transfer equipment.
      k. Contactors.
      l. Remote-controlled switches, dimmer modules, and control devices.
      m. Power-generating units.
      n. Fire-alarm control panel and annunciators.
      o. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
      p. Monitoring and control equipment.
      q. Uninterruptible power supply equipment.
      r. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
      s. Breakers or switches at distribution panels.

3.02 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location:
   1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
   2. Conduit Markers: Provide identification for each power conduit containing conductors rated 400A or greater.

C. Apply identification devices to surfaces after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
   1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
   2. Colors for 208/120-V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
      d. Grounded Conductor (Neutral): White.
   3. Colors for 480/277-V Circuits:
      a. Phase A: Brown.
      b. Phase B: Orange.
      c. Phase C: Yellow.
      d. Ground Conductor (Neutral): Grey.
   4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

I. Label information arrangement for 3 lines of text.
   1. Line one shall describe the panel or equipment. Line one example: “DP-XX,” RP-XX,” “T-XX,” “EF-XX,” etc.
   2. Line two shall describe the first disconnecting means feeding this panel or equipment. Line two example: “Fed from DP-XX,” “Fed from RP-XX,” etc.
   3. Line three indicates that location of the disconnecting means as identified in line two. Line three example: “First Floor Elect. Rm #XXX.”
   4. Line four shall include “Via T-XX” when panel or equipment is fed from a transformer.

J. Examples:

RP-1A FED FROM DP-1A ELECTRICAL ROOM A100 VIA T-1A	EF-1 FED FROM MCC-1A MECHANICAL ROOM F101	LP-1A LOCATED IN ELECTRICAL ROOM A100

K. Fusible Enclosed Switches and Distribution Equipment: Install self-adhesive vinyl label indicating fuse rating and type on the outside of door on each fused switch.

L. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

M. Degrease and clean surface to receive nameplates.

N. Install nameplate and labels parallel to equipment lines.

O. Secure nameplate to equipment front using screws.

P. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

Q. Identify conduit using field painting where required.

R. Paint red colored band on each fire alarm conduit and junction box.

S. Paint bands 10 feet on center, and 4 inches minimum in width.

END OF SECTION

SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following lighting control devices:
   1. Time controllers.
   2. Outdoor photoelectric control.
   3. Occupancy sensors.

B. Related Sections include the following:
   1. Division 26 Section “Electrical General Requirements”.
   2. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.
   3. Division 26 Section "Lighting Control Systems" for programmable lighting systems.

1.03 REFERENCES

A. IEEE C62.41: Guide for Surge Voltages in Low-Voltage AC Power Circuits.

B. IEEE C136.10: Standard for Roadway Lighting Equipment Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.

C. NEMA ICS 2: Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC Part 8: Disconnect Devices for Use in Industrial Control Equipment.

D. NFPA 70: National Electrical Code.

E. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

F. UL 486B: Wire Connectors for Use with Aluminum Conductors.

G. UL 773: Plug-in, Locking Photocontrols for Use with Area Lighting.

H. UL 773A: Nonindustrial Photoelectric Switches for Lighting Control.

I. UL 917: Clock Operated Switches.

J. UL 1449: Surge Protective Devices.

K. UL 1598: Luminaires.

L. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.04 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

C. ULTRASONIC: Active emission of at least 35 kHz sound waves, using Doppler reflectance to detect motion.

D. MICROPHONIC: Passive reception to listen for continued occupancy, with circuitry to filter out white noise.

E. MULTI-Tech: Using PIR and ultrasonic or microphonic technologies in one sensor.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated including physical data and electrical performance.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.
1. Lighting plan showing location, orientation, and coverage area of each sensor.
2. Interconnection diagrams showing field-installed wiring.

1.06 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:
1. Description of operation and servicing procedures.
2. List of major components.
3. Recommended spare parts.
4. Programming instructions and system operation procedures.

1.08 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.09 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate interface of lighting control devices with temperature controls specified in Division 23.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under provisions of Division 26 Section “Electrical General Requirements”.

B. Store and protect products under provisions of Division 26 Section “Electrical General Requirements”.

PART 2 - PRODUCTS

2.01 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.02 OUTDOOR PHOTOELECTRIC CONTROL

A. Manufacturers:
   1. Intermatic, Inc.
   2. Square D.
   3. TORK.

B. General
   1. Provide fully-gasketed, weathertight enclosure constructed of die cast zinc, with one-half inch conduit nipple for mounting purposes, and with positioning lug to permit full 360-degree adjustable orientation of photocell.
   2. Provide hermetically-sealed, one-inch-diameter, cadmium sulphide photoelectric cell with manual, light level selector.
   3. Provide photoelectric control suitable for an operating temperature range of minus 40 degrees F to plus 140 degrees F.

C. Description: Solid state, with SPST dry contacts rated for 2000 W tungsten or 1800 VA ballasted load, to operate connected load, relay, contactor coils, or microprocessor input, and complying with UL 773A.
   1. Light-Level Monitoring Range: Adjustable turn-on range of 1 to 5 footcandle (11 to 54 lux) and adjustable turn-off range of 3 to 15 footcandle (32 to 1662 lux), and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
   2. Time Delay: Adjustable delay up to two minutes to prevent false operation.
   3. Contacts: Normally closed, fail on.
   4. Electrical: Provide photocell with operating voltage rated to switch the load directly unless otherwise indicated.
   5. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.
   6. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.
   7. Provide hermatically-sealed, one inch diameter, cadmium sulphide photoelectric cell with manual, 2 to 50 footcandle, light level selector.

2.03 OCCUPANCY SENSORS

A. General
   1. Coordinate occupancy sensor locations, coverages and required quantities with manufacturer’s recommendations. Coverage areas indicated on the Drawings are for minor motion (6 to 8 inches of hand movement). Provide additional occupancy sensors and control units as required to achieve complete minor motion coverage of the space indicated.
   2. Adjust occupancy sensors and test that complete minor motion coverage is obtained in accordance with Part 3. Provide written confirmation of testing to owner, architect and engineer.
   3. Provide occupancy sensors with a bypass switch to override the “ON” function in the event of sensor failure.
   4. Provide occupancy sensors with an LED indicator indicating when motion is being detected during testing and normal operation of the sensor.
   5. Provide occupancy sensors and occupancy sensor control units from single manufacturer.

B. Wall Switch Passive Infrared Occupancy Sensor
   1. Manufacturers:
      a. Perfect Sense – PS-PWS
      b. Wattstopper PW-100.
      c. Hubbell Building Automation SOM 101.
      d. Greengate OSW-P-0451-W.
      e. Sensorswitch WSD.
      f. Philips LRS2210.
      g. Leviton ODS10-IDW.
   2. Description: Wall mounted, 180° coverage, passive infrared sensing occupancy sensor.
      a. Electrical Characteristics: Capable of switching up to 800W fluorescent or incandescent lighting loads at 120V and 1200 watts fluorescent loads at 277V.
      b. Functions: Automatic ON/Automatic OFF, or Manual ON/Automatic OFF operation, field selectable. Integral manual override pushbutton switch.
      c. Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 30 minutes. Ambient light sensing shall be adjustable from 20 footcandle to 300 footcandle, with override.
      d. Ambient Light Sensor: Integral ambient light sensor to switch off lights when sufficient daylight is present.
      e. Device Body: White plastic with momentary on/off override pushbutton designed to mount in a standard switch box with “decora” style switch plate.
   3. Dual Level Switching: Provide occupancy sensor capable of controlling two switch legs independently where dual level switching is indicated.
      a. Manufacturers:
         1) Perfect Sense PWD.
         2) Wattstopper PW-200.
         3) Hubbell Building Automation SOM-102.
         4) Greengate OSW-P-0451-DMV.
         5) Sensorswitch WSD-2P.
         6) Philips LRS2215.
         7) Leviton ODSOD-IDW.

C. 360° Ceiling Mounted Dual Technology Occupancy Sensor
   1. Manufacturers:
      a. Perfect Sense CDS.
      b. Wattstopper DT 300
      c. Hubbell Building Automation “OMNI-DT” Series.
      d. Greengate OMC-DT-2000-R.
      e. Sensorswitch CM-PDT-R.
      f. Philips LRM2255.
      g. Leviton OSC10-M0W.
   2. Description: Ceiling mounted, 360° coverage, multi-tech sensing occupancy sensor.
      a. Housing: White, thermoplastic, tamper resistant ceiling mount.
      b. Functions: Automatic ON must sense motion from both ultrasonic and infrared sensing elements. Either technology shall maintain ON, with adjustable time delays.
      c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.
      d. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
      e. Manual override function.

D. 110° Wall Mounted Dual Technology Occupancy Sensor

1. Manufacturers:
   a. Perfect Sense DTC.
   a. Wattstopper DT-200
   b. Hubbell Building Automation “LO-DT” Series.
   c. Sensorswitch WV-PDT-R/WV-BR.
   d. Philips LRM2265.
   e. Leviton OSW12-M0W.
2. Description: Wall mounted, 110° coverage, multi-tech occupancy sensor.
   a. Housing: White, thermoplastic, tamper resistant with swivel bracket for wall or ceiling mounting.
   b. Functions: Automatic ON must sense motion from both sensing elements. Either technology shall maintain ON, with adjustable time delays.
   c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 15 minutes.
   d. Sensor Orientation: Orient sensor in room such that sensor will not detect motion through open door which could cause false activation.
   e. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
   f. Manual override function.

E. 360° Ceiling Mounted Ultrasonic Occupancy Sensors
1. Manufacturers:
   a. Perfect Sense WDS.
   b. Wattstopper “WT” Series.
   c. Hubbell Building Automation “OMNI-US” Series.
   d. Greengate OPC-U-2000.
   e. Sensorswitch CM MPT-10.
   f. Philips LRM2255.
   g. Leviton OSC20-U0W.
2. Description: Ceiling mounted, 360° coverage, ultrasonic or microphonics sensing occupancy sensor.
   a. Housing: White, thermoplastic, tamper resistant.
   b. Adjustments: Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 15 minutes.
   c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
   d. Manual override function.

F. 360° Ceiling Mounted Passive Infrared Occupancy Sensor.
1. Manufacturers:
   a. Perfect Sense CPS.
   a. Wattstopper CI-200.
   b. Hubbell Building Automation OMNI-IR.
   c. Greengate OMC-P-04500-R.
   d. Sensorswitch CM-9.
   e. Philips LRM2250.
   f. Leviton OSC04-I0W.
2. Description: Ceiling mounted, 360° coverage, infrared sensing occupancy sensor.
   a. Housing: White, thermoplastic, tamper resistant ceiling mount.
   b. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.

c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
d. Manual override function.

G. Occupancy Sensor Control Units:
1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.
a. Control units shall be provided as required to power ceiling mounted occupancy sensors, control lighting loads and provide a minimum of one auxiliary contact.
b. Occupancy sensor control units shall mount external to 4" sq junction box in the ceiling space. Wiring between control unit and occupancy sensor shall be plenum rated.
c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.
d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.
e. It is acceptable to provide controls and auxiliary contacts as required integral to the ceiling sensor, provided all required contacts are provided.
f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

PART 3 - EXECUTION

3.01 LIGHTING CONTACTOR INSTALLATION

A. Install lighting contactors as indicated on plan. Install at accessible locations. Switch controls where provided shall be no higher than 54" or lower than 48".

B. Demonstrate proper operation of all lighting control functions to the Owner and Engineer.

3.02 OUTDOOR PHOTOELECTRIC CONTROL INSTALLATION

A. Mount photocell on roof or parapet to ½" GRS conduit, supported to building structure below. Coordinate roof penetration with roofing contractor.

B. Install photoelectric control oriented in the northeast direction and not within any potential shadows.

C. Adjust photocell sensitivity and delay to meet owner's requirements. Multiple adjustments may be required, as needed.

3.03 TIME CONTROLLER INSTALLATION

A. Install time controller, near contactor control equipment or as indicated on plan. Install at accessible location.

B. Program time controller as directed by the owner. Train owner in time clock programming.

3.04 OCCUPANCY SENSOR INSTALLATION

A. Install wall mounted occupancy sensors as noted on plan. Arrange occupancy sensors with adjacent switch devices so that device plates line-up and are equally spaced.

B. Install ceiling mounted sensors at approximate locations as indicated on plan. Sensor manufacturer shall provide quantity of sensors as required to provide complete coverage for rooms.

C. Locate sensors such that motion through open doors will not falsely activate sensors.

D. Do not locate ultrasonic sensors within six feet of supply air diffusers.

E. Locate infrared sensors to avoid obstructions.

F. Provide the services of a manufacturer's representative for commissioning of occupancy sensor installation. This shall include consultation on layout and location prior to installing sensors, testing of each sensor for compliance with Contract Documents and field adjustment and fine tuning after installation is complete. Provide written confirmation of testing to the Owner, Architect and Engineer.

G. Field adjustments shall take place in the presence of the owner and the engineer. This shall include owner training on adjustment techniques for the occupancy sensors.

3.05 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Conductors and Cables".

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.06 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."

B. Label time switches and contactors with a unique designation.

3.07 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
   2. Operational Test: Verify actuation of each sensor and adjust time delays.

B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.08 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION

SECTION 26 0943 - LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the design and installation programmable automatic lighting controls with all input and control devices necessary to meet the performance indicated on the contract drawings and this specification.

B. Related Sections include the following:
1. Division 26 Section "Lighting Control Devices" for time switches, photoelectric switches, occupancy sensors, and multi-pole contactors.
2. Division 26 Section “LED Interior Lighting” for luminaire specifications and accessories.

1.03 DEFINITIONS

A. BACnet: A networking communication protocol that complies with ASHRAE 135.

B. Lon Works: A control network technology platform for designing and implementing interoperable control devices and networks.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.

D. RS-485: A serial network protocol, like RS-232, complying with TIA/EIA-485-A.

1.04 ACTION SUBMITTALS

A. Product Data: Indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature for all sensors, relays, dimming modules, control stations and other devices necessary for complete operation of the system

B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.
   1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements for all system components requiring field installation.
   2. Riser Diagram: Show interconnection between all system components.
      a. Identify complete data communication backbone and interconnection between sensors, relays, dimming modules control stations and other components.
      b. Identify typical room/area type configurations.
      c. Indicate interconnections with emergency egress lighting relays and transfer devices required.
   3. Information Technology (IT) connection: Provide information pertaining to interconnection with facility IT networking equipment and third-party systems.
   4. Other Diagrams and Operational Descriptions – as needed to indicate system operation or interaction with other system(s).
   5. Contractor startup and commissioning worksheet.

C. Submit qualifications of commissioning agent and draft functional test plans for review and approval.

1.05 INFORMATIONAL SUBMITTALS

A. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

B. Field quality-control test reports and commissioning reports at project closeout.

1.06 CLOSEOUT SUBMITTALS

A. Software licenses and upgrades required by and installed for operation and programming of digital devices.

B. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals. Include the following:
   1. Software manuals.
   2. Operation of adjustable zone controls.
   3. Description of operation and servicing procedures.
   4. List of major components and recommended parts.
   5. System operation and integration instructions.

C. Warranty: Special warranty specified in this Section.

1.07 QUALITY ASSURANCE

A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer with total responsibility for compatibility of lighting control system components specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with NFPA 70.

E. Listed as qualified under Design Lights Consortium (DLC) Networked Lighting Control System Specification V2.0.

F. System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.

G. Comply with ASHRAE 90.1 – 2013.

1.08 COORDINATION

A. Coordinate lighting control components specified in this Section and with systems and components specified in other Sections to form an integrated interconnection of compatible components.

B. Match components and interconnections for optimum performance of lighting control functions.

C. Coordinate lighting controls with devices specified in Division 26 Section “Lighting Control Devices”.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.11 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for five years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revise licenses for use of the software.
   1. Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment, if necessary.

1.12 SYSTEM COMMISSIONING

A. Provide the services of a third party, independent agent to perform functional testing and verification of the lighting control system to comply with the requirements of ASHRAE 90.1 – 2013.

B. Perform functional testing of all lighting control system operations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Acuity nLight Air
   2. Lutron Vive
   3. WaveLinx – Cooper Lighting

2.02 SYSTEM PERFORMANCE REQUIREMENTS

A. System Architecture
   1. System shall have an architecture that is based upon three main concepts: (a) networkable intelligent lighting control devices, (b) standalone lighting control zones using distributed

intelligence, (c) system backbone for remote, time based and global operation between control zones.

a. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible to minimize overall device count of system.

b. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wall stations without requiring connection to a higher-level system backbone; this capability is referred to as “distributed intelligence.”

c. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone.

2. The system shall provide individually addressable switching and dimming control of the following: networked luminaires, control zones to include multiple switch legs or circuits, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required in each project area or typical space type. A single platform shall be used for both indoor and outdoor lighting controls.

3. Lighting control zones shall be networked with a higher-level system backbone to provide time-based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software.

4. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality later.

5. System shall be capable of “out of box” sequence of operation for each control zone. Standard sequence is:

a. All switches control all fixtures in a zone.

b. All occupancy sensors automatically control all fixtures in the control zone with a default timeout.

6. System shall be capable of automatic receptacle control using occupancy sensors.

7. System shall be capable of time-of-day automatic receptacle control with manual override control during unoccupied hours.

B. Wired Networked Control Zone Characteristics

1. All networked devices connected with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The “out of box” default sequence of operation is intended to provide typical sequence of operation to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.

2. System shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.

3. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:

a. Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.

b. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss of power sensed via line voltage connections.

c. Emergency egress devices shall be provided, and UL labeled by the lighting control manufacturer.

C. System Integration Capabilities
1. The system shall be capable of interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols.
a. Systems utilizing a third-party converter or systems that require a dedicated server to achieve integration are not acceptable.

2.03 SYSTEM SOFTWARE INTERFACES

A. Management Interface
1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
3. All system software updates must be available for automatic download and installation via the internet.

B. Historical Database and Analytics Interface
1. System shall provide a browser-based trending and monitoring interface that stores historical data for all occupancy/daylight sensors and lighting loads. Additionally, the system shall optionally upload that data to a cloud-based server.

C. Visualization Interfaces
1. System shall provide an optional web-based visualization interface that displays a graphical floorplan. System data, to include status of occupancy sensors, daylight sensors and light output shall be overlaid to the floorplan to provide a graphical status page.

D. Portable Programming Interface for Standalone Control Zones
1. Portable handheld application interface for standalone control zones shall be provided for systems that allows configuration of lighting control settings.
2. Programming capabilities through the application shall include, but not be limited to, the following:
a. Switch, occupancy and photo sensor group configuration
b. Manual/automatic on modes
c. Turn-on dim level
d. Occupancy sensor time delays
e. Dual technology occupancy sensors sensitivity
f. Photo-sensor calibration adjustment and auto-setpoint
g. Trim level settings

2.04 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

A. System Controller
1. System Controller shall be a multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
2. System Controller shall perform the following functions:
a. Facilitation of global network communication between different areas and control zones.
b. Time-based control of downstream wired and wireless network devices.
c. Linking into an Ethernet network.
d. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.

e. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.

3. System Controller shall not require a dedicated PC or a dedicated cloud connection.
4. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.
5. Device shall have a standard and astronomical internal time clock.
6. Shall be capable of connecting to the customers Local Area Network (LAN) via IEEE 802.11.x Wireless and IEEE 802.3 Wired connection.
7. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
   a. BACnet/MSTP shall support a minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.
   b. BACnet/MSTP shall support 9600 to 115200 baud.
   c. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
   d. System controller must support BACnet/IP Broadcast Management Device (BBMD) and Foreign Device Registration (FDR).

2.05 WIRED NETWORKED DEVICES

A. Wired Networked Wall Switches, Dimmers, Scene Controllers
   1. Wall switches & dimmers shall support the following device options:
      a. Number of control zones: 1, 2 or 4. Gang multiple switches where more than 4 control zones are required in a single location under a single faceplate.
      b. Control Types Supported: On/Off or On/Off/Dimming
   2. Scene controllers shall support the following device options:
      a. Number of scenes: 1, 2 or 4
      b. Control Types Supported:
         1) On/Off or On/Off/Dimming
         2) Preset Level Scene Type
         3) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene
         4) Selecting a lighting profile to be run by the system’s upstream controller to implement a selected lighting profile across multiple zones
   3. Match color specified in Division 26 Section "Wiring Devices."
   4. Integral green LED pilot light to indicate when circuit is on.
   5. Internal white LED locator light to illuminate when circuit is off.
   6. Networked switch stations shall have backlit buttons.
   7. Wall Plates:
      a. Single and multi-gang plates as specified in Division 26 Section "Wiring Devices."
      b. Where multiple switches and/or dimmers are adjacent to each other, install a single cover plate. Provide separate boxes or barriers as required for the application.
      c. Provide cover plates that are identical in material and dimension to standard single and double gang switch plates.
      d. Verify back box requirements for multiple control points with manufacturer.
   8. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

B. Wired Networked Graphic Wall Stations
   1. Device shall have a full color touch screen.
   2. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
   3. Graphic wall stations shall support the following device options:
      a. Number of control zones: Minimum of 16

b. Number of scenes: Minimum of 16
c. Optional password protection for setup screens.

C. Wired Networked Auxiliary Input / Output (I/O) Devices
1. Auxiliary Input/output Devices shall be specified as an input or output device with the following options:
a. Contact closure input: Programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.
b. 0-10V analog input: Programmable to function as a daylight sensor.
c. RS-232/RS-485 digital input: Supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
d. 0-10V dimming control output, capable of sinking a minimum of 20mA of current programmable to support all standard sequence of operations supported by system.

D. Wired Networked Occupancy and Photosensors
1. Sensors shall utilize passive infrared (PIR) or passive dual technology (PDT) to detect both major and minor motion as defined by NEMA WD-7 standard.
2. Sensing technologies that are acoustically passive, meaning they do not transmit sounds waves of any frequency do not require additional commissioning. Ultrasonic or Microwave based sensing technologies may require commissioning due to the active nature of their technology, if factory required.
3. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.
4. Sensor mounting type shall match project design requirements as shown on plans.
a. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.
5. The system shall support the following types of photocell-based control:
a. On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.
b. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

E. Wired Networked Wall Switch Sensors
1. Wall switches sensors shall support the following device options:
a. User Input Control Types Supported: On/Off or On/Off/Dimming
b. Occupancy Sensing Technology: PIR only or Dual Tech
c. Daylight Sensing Option: Inhibit Photosensor

F. Wired Networked Embedded Sensors
1. Embedded sensors shall support the following device options:
a. Occupancy Sensing technology: PIR only or Dual Tech
b. Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor

G. Distributed System Power, Switching and Dimming Controls
1. Devices shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
2. Device programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
3. Device shall be plenum rated.
4. Devices shall be UL Listed for load and load type as specified on the plans.

H. Wired Networked Luminaires

1. Networked luminaire shall have a factory installed mechanically integrated control device and carry a UL Listing as required.
2. Networked LED luminaire shall provide low voltage power to other networked control devices.
3. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation.
4. System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.
5. Controls manufacturer is responsible for primary troubleshooting and tech support of complete fixture.

I. Wired Networked Power Pack for Receptacle Control
1. Relay capable of full 20-Amp switching of general-purpose receptacle for automatic receptacle control.

2.06 WIRELESS NETWORKED DEVICES

A. Wireless Networked Sensor Interface
1. The device shall be capable of broadcasting the following manual wall control commands: on, off, and adjust dim level.

B. Wireless Networked Light Controllers (No Sensor)
1. The wireless light controller shall be capable of providing continuous dimming and on/off control of one commercial light fixture including fluorescent, HID, induction and LEDs.
2. An external antenna attached to the luminaire shall not be allowed.
   a. Each wireless light controller shall provide measurement capability of the amperage, voltage, wattage, and watt-hours of its controlled lighting.

C. Wireless Networked Power Pack for Receptacle Control
1. The wireless controller shall be capable of providing full 20-Amp switching of general-purpose receptacle circuits.

D. Wireless Networked Digital Sensors
1. In addition to providing Wireless Networked Light Controllers functionality, also provides:
   a. Integrated digital occupancy sensing and digital photocell sensor.
   b. Sensor shall connect directly to the wireless light controller and shall be suitable for embedding into the enclosure of a luminaire.
   c. Sensor shall have software-adjustable settings
   d. Photocell shall be suitable for closed and open loop applications.

E. Wireless Network Communication Bridge
1. A communication bridge device shall be provided that interfaces with the System Controller via Owner’s LAN connection and interfaces with wireless network.
2. Device shall be capable of communicating with a group of a minimum of 250 wireless networked devices and luminaires, to reduce the amount of communication bridges required in the system.

2.07 CONDUCTORS AND CABLES

A. General: All conductors and cables shall comply with the requirements of Division 26 Section "Conductors and Cables." Where cable is permitted to be installed exposed in ceiling space, provide plenum rated cable.

B. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG.

C. Classes 2 and 3 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 22 AWG.

D. Class 1 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 18 AWG.

E. Digital and Multiplexed Signal Cables: As required by system manufacturer. Provide plenum rated cables where installed exposed in ceiling space.

PART 3 - EXECUTION

3.01 WIRING INSTALLATION

A. The lighting control system shall be installed and connected as shown on the plans and as directed by the manufacturer.

B. Comply with NECA 1.

C. Wiring Method: Install wiring in raceways except where installed in accessible ceilings. Comply with Division 26 Sections "Conductors and Cables" and “Raceways and Boxes”.

D. Where cables are installed in finished areas with exposed construction, conceal cables from view. Route at top of structural systems and conceal on top of structural members where possible. Where cable is exposed to view, provide raceway. As an alternative to raceway, provide cable that is factory colored to match exposed ceiling. Submit sample to Architect for approval.

E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

F. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

G. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

H. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes as per manufacturers’ recommendations.

I. Identify components and power and control wiring according to Division26 Section "Electrical Identification."

J. Label each relay with a unique designation.

3.02 INSTALLATION REQUIREMENTS

A. Review all required installation and pre-startup procedures with the manufacturer’s representative through pre-construction meetings.

B. Install and connect the networked lighting control system components according to the manufacturer’s installation instructions, wiring diagrams, the project submittals, plans and specifications.

C. Coordination with Owner’s IT Network Infrastructure to secure all required network connections to the owner’s IT network infrastructure. Provide the owner’s representative with all network infrastructure requirements of the networked lighting control system. Provide the manufacturer’s representative with all necessary contacts pertaining to the owner’s IT infrastructure, to ensure that the system is properly connected and started up.

D. Verify integration and interoperability scope with the Mechanical Contractor prior to submittal phase and provide all necessary schedules to the Lighting Control manufacturer.

3.03 SYSTEM STARTUP

A. Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.
   1. Low voltage network cable testing shall be performed prior to system startup at the discretion of the manufacturer.

B. System start-up and programming shall include:
   1. Verifying operational communication to all system devices.

2. Programming the network devices into functional control zones to meet the required sequence of operation.
3. Programming and verifying all sequence of operations.
4. Customization of owner's software interfaces and applications.

C. Initial start-up and programming are to occur on-site. Additional programming may occur on-site or remotely over the Internet as necessary.

3.04 DOCUMENTATION

A. Submit software database file with desired device labels and notes completed.

B. Document the installed location of all networked devices, including networked luminaires. Provide as-built plan drawing showing device addresses corresponding to locations of installed equipment.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components and equipment installation, including connections and assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
1. Test for circuit continuity.
2. Verify that the control module features are operational.
3. Check operation of local override controls.
4. Test system diagnostics by simulating improper operation of several components selected by Architect.

3.06 SYSTEM COMMISSIONING

A. Facilitate the functional testing and verification of the lighting control system by an independent, third party commissioning agent.

B. Perform commissioning in the presence of the Owner's representative.

C. Submit functional test plan checklist signed by the commissioning agent.

3.07 SOFTWARE INSTALLATION

A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.08 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting programming functions and other system parameters and to assist Owner's personnel in making program changes to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to program, adjust, operate, and maintain lighting controls.

B. Demonstration shall be done only after initial system start-up setup has occurred and system is functioning properly.

C. Demonstration shall consist of a four-hour minimum session.

3.10 MANUFACTURER SUPPORT

A. Manufacturer telephone support shall be available at no cost to the Owner during the warranty period and shall include the following:
1. Assistance in solving programming or other application issues pertaining to the control equipment.

2. The manufacturer shall provide a toll-free number for direct technical support available 7 days a week, 24 hours a day.
3. A factory authorized technician shall be located within a 100-mile radius of the project site.

END OF SECTION

SECTION 26 2200 - DRY-TYPE TRANSFORMERS (600 V AND LESS)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 750 kVA:
   1. Distribution transformers.

B. Related Section includes the following:
   1. Division 26 Section “Electrical General Requirements.”
   2. Division 26 Section “Grounding and Bonding.”
   3. Division 26 Section “Conductors and Cables.”
   4. Division 26 Section “Raceways and Boxes.”
   5. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 REFERENCES

A. ANSI/IEEE C57.12.9: Test Code for Dry-Type Distribution and Power Transformers

B. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum)

C. NEMA ST 1: Specialty Transformers

D. NEMA ST 20: Dry Type Transformers for General Applications

E. NEMA TP 1: Guide for Determining Energy Efficiency for Distribution Transformers

F. NEMA TP 2: Standard Test Method for Measuring the Energy Consumption of Distribution Transformers

G. NETA ATS: Acceptable Testing Specifications for Electrical Power Distribution Equipment and Systems

H. NFPA 70: National Electrical Code

I. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors

J. UL 486B: Wire Connectors for Use with Aluminum Conductors

K. UL 506: Specialty Transformers

L. UL 1561: Dry-Type General Purpose and Power Transformers

1.04 ACTION SUBMITTALS

A. Product Data Include rated nameplate data, capacities, weights, dimensions, utility or manufacturer's anchorage and base recommendations, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

1. Transformer Inrush: Provide time-current coordination curves demonstrating transformer inrush and ANSI damage curves with primary overcurrent device selections to clear inrush yet still protecting damage curve.

B. Shop Drawings: Wiring and connection diagrams.

1.05 INFORMATIONAL SUBMITTALS

A. Source quality-control test reports. Include loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

B. Field quality control test reports

C. Output Settings Reports: Record of tap adjustments specified in Part 3.

1.06 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 IEEE C 57.12.91.

C. Comply with NFPA 70.

D. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting doe 2016 efficiency levels when tested according to NEMA TP2.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

B. Store, protect, and handle products to site under provisions of Division 26 section "Electrical General Requirements."

C. Deliver transformers individually wrapped for protection and mounted on shipping skids.

D. Accept transformers on site. Inspect for damage.

E. 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.

F. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.08 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 26 "Hangers and Supports for Electrical Systems."

B. Coordinate installation of wall-mounting and structure-hanging supports.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Acme.
   2. Eaton
   3. ABB
   4. Siemens Industries, Inc.
   5. Square D/Groupe Schneider NA.

2.02 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and tested, air-cooled units for 60 Hz service.

B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

C. Transformers Rated 15 kVA and Larger:
   1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
   2. Marked as compliant with DOE 2016 efficiency levels by qualified electrical testing laboratory recognized by authorities having jurisdiction.

D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside transformer enclosure.

2.03 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
   1. One leg per phase.
   2. Grounded to enclosure.

C. Coils: Continuous windings without splices, except for taps.
   1. Coil Material: Aluminum.
   2. Internal Coil Connections: Brazed or pressure type.

D. Encapsulation: Transformers smaller than 30 kVA must have core and coils completely resin encapsulated.

E. Enclosures: Ventilated
   1. Core and coil must be encapsulated within resin compound to seal out moisture and air.
   2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
   3. Vibration Isolation: Isolate core and coil from enclosure using vibration-absorbing mounts.
   4. Wiring Compartment: Sized for conduit entry and wiring installation.
   5. Environmental Protection:
      a. Indoor: UL 50E, Type 2.
      b. Outdoor: UL 50E, Type 3R.
   6. Finish Color: Gray weather-resistant enamel.

F. Taps for Transformers 3 kVA and Smaller: None.

G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

I. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with maximum of 115 deg C rise above 40 deg C ambient temperature.

J. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with maximum of 150 deg C rise above 40 deg C ambient temperature.

K. Basic Impulse Level: 10 kV.

L. Mounting: Suitable for mounting as indicated.

M. Wall Brackets: Manufacturer's standard brackets.

N. Grounding: Provide ground-bar kit or ground bar installed on inside of transformer enclosure.

O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

P. K-Factor Rating: Transformers indicated to be K-factor rated must comply with UL 1561 requirements for non-sinusoidal load current-handling capability to degree defined by designated K-factor.
1. Unit may not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor, without exceeding indicated insulation class in 40 deg C maximum ambient and 24-hour average ambient of 30 deg C.
2. Indicate value of K-factor on transformer nameplate.
3. Unit must comply with requirements of DOE 2016 efficiency levels when tested in accordance with NEMA TP 2 with K-factor equal to one.

2.04 CONTROL AND SIGNAL TRANSFORMERS

A. Description: Factory-assembled and tested, self-cooled, two-winding dry type, rated for continuous duty, and 60 Hz operation, complying with NEMA ST 1, and listed and labeled as complying with UL 506.

B. Ratings: Continuous duty. If rating is not indicated, provide at least 50 percent spare capacity above connected peak load.

2.05 SOURCE QUALITY CONTROL

A. Factory Tests and Inspections: Provide the factory tests on the actual transformers provided or on similar units identical to those provided. Test and inspect assembled system, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, in accordance with IEEE C57.12.01 and IEEE C57.12.91 before delivering to site. Affix label with name and date of certification of system compliance on control units.
1. Resistance measurements of windings at rated voltage connections and at tap connections.
2. Ratio tests at rated voltage connections and at tap connections.
3. Phase relation and polarity tests at rated voltage connections.
4. No load losses, and excitation current and rated voltage at rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation-Resistance Tests:
    a. Line-side to ground.
    b. Load-side to ground.
    c. Line-side to load-side.
9. Temperature tests.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls and floors for suitable mounting conditions where transformers will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
   1. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

C. Install floor mounted transformers on and anchor to concrete bases according to manufacturer's recommendations.
   1. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

D. Identification: Engraved metal or laminated-plastic nameplate mounted with corrosion resistant screws. Provide nameplate according to Division 26 Section "Electrical Identification" indicating the following:
   1. Transformer designation (e.g. "T-1").
   2. Primary power characteristics (e.g. "480V, 3PH, 3W").
   3. Secondary power characteristics (e.g. "208Y/120V, 3PH, 4W").
   4. Power rating (e.g. "75 kVA").
   5. Power source (e.g. "Fed from DP-1).

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

C. Provide conduit according to Division 26 Section "Raceways and Boxes" for connections to transformer case. Make conduit connections to side panel of enclosure.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

E. Check for damage and tighten connections prior to energizing transformer.

3.04 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing" for transformers 75KVA and above:
   1. Visual and Mechanical Inspection
      a. Inspect for physical damage, cracked insulators, tightness of connections, defective wiring and general mechanical and electrical conditions.
      b. Verify proper core grounding.
      c. Verify proper equipment grounding.
      d. Compare equipment nameplate with single line diagram and report discrepancies.
   2. Electrical Tests
      a. Perform insulation resistance tests, winding-to-winding and windings-to-ground, utilizing a meg-ohmmeter with test voltage output in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Test duration shall be for 10 minutes with resistance values tabulated at 30 seconds, 1 minute, and 10 minutes. Calculate Polarization index.
      b. Perform a turns ratio test between windings at every tap position. The final tap setting is to be set at the secondary system rated voltage at full load or as directed by the Architect/Engineer.
      c. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3. Test Values
   a. Perform insulation resistance tests in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Results to be temperature corrected in accordance with Table 10.14.
   b. The polarization index should be above 1.2 unless an extremely high value is obtained initially, such that when doubled will not yield a meaningful value.
   c. Turns ratio test results shall not deviate more than one half percent (0.5%) from either the adjacent coils or the calculated ratio.

3.05 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 5 percent. Submit recording and tap settings as test results.

B. Adjust buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report that records output voltages and tap settings.

END OF SECTION

SECTION 26 2416 - PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Distribution panelboards.
   2. Lighting and appliance branch-circuit panelboards.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. AFCI: Arc-fault circuit interrupter.

E. RFI: Radio-frequency interference.

F. RMS: Root mean square.

G. SPDT: Single pole, double throw.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Related Submittals:

1. Provide overcurrent device coordination study to demonstrate proper overcurrent device ratings, adjustments, and settings.

C. Shop Drawings: For each panelboard and related equipment.
1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.
c. Short-circuit current rating of panelboards and overcurrent protective devices.
d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring Diagrams: Power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports including the following:
1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.06 CLOSEOUT SUBMITTALS

A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

B. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.07 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
1. Ambient Temperature: Not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Owner’s representative no fewer than seven days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without written permission from Owner's representative.

1.09 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
a. Eaton.
b. ABB.
c. Siemens Industries, Inc.
d. Square D by Schneider Electric

2.02 MANUFACTURED UNITS

A. Enclosures: Mounting as noted on panel schedules. NEMA PB 1, Type 1.
1. Cabinet Front: Flush or surface cabinet as noted on the Drawings.
a. Eaton LTDD (Piano hinge trim)
b. ABB – FGB (front hinge to box).
c. Square D – Continuous piano hinge trim.
d. Siemens – Figure 4 hinge to box w/piano hinge.
2. Finishes:
a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Same finish as panels and trim.
3. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.

B. Phase and Ground Buses:
1. Material: Aluminum.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

C. Conductor Connectors: Suitable for use with conductor material.
1. Main and Neutral Lugs: Mechanical type.
2. Ground Lugs and Bus Configured Terminators: Compression type.

D. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

E. Surge Protective Devices: Where indicated, provide manufactured units with direct bus connected type as specified in Division 26 Section "Surge Protective Devices."
1. Provide Surge Protective Device for all Distribution and Branch Circuit Panelboards that are part of the Emergency Distribution System.
2. Provide Surge Protective Devices elsewhere where indicated on the drawings.

2.03 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.04 DISTRIBUTION PANELBOARDS

A. Main bus bars, neutral and ground, shall be aluminum and sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.

C. Main Overcurrent Protective Devices: Circuit breaker.

D. Branch Overcurrent Protective Devices:
   1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
   2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
   3. Fused switches.

2.05 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Main bus bars, neutral and ground, shall be sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.

B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.06 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
      a. Circuit Breakers 250A and Larger: Magnetic trip element with front-mounted, field-adjustable trip setting with restricted access cover.
   2. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings with restricted access cover:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response.
   3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
   5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
   6. AFCI Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   4. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
   5. Shunt Trip: 120-V trip coil energized from separate circuit.

6. Do not use tandem circuit breakers.
7. Provide lock on devices for circuit breakers when called out on panel schedules with “LOD” designation.
8. Provide type GFEP circuit breakers for all self- regulating heating (snow melting and heat trace) cables branch circuits and where noted on panel schedules with “GFEP” designation
9. Provide GFCI circuit breaker when called out on panel schedules with “GFCI” designation.
10. Provide Arc-Fault Circuit Interrupters where indicated on panel schedule with “AFCI” designation.
11. Provide shunt trip breakers when called out on panel schedules with “STB” designation.
12. Provide smart controllable circuit breakers when called out on panel schedules with “SMT” designation.
13. Provide permanent padlockable handle for circuit breakers when called out on panel schedules with “PL” designation.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

D. Fuses are specified in Division 26 Section "Fuses."

E. Circuit Breaker Selection for Transformer Primary Protection:
1. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.

2.07 ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Provide permanent provisions for padlocking all overcurrent devices in Distribution Panelboards. Provisions shall remain in place whether or not lock is installed.

C. Provide permanent provisions for padlocking overcurrent devices in Branch Circuit Panelboards that serve equipment not provided with a local, lockable disconnecting means. Provisions shall remain in place whether or not lock is installed

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Division 26 Section “Hangers and Supports for Electrical Systems.”

C. Mount top of trim 74 inches above finished floor, unless otherwise indicated.

D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

E. Install overcurrent protective devices and controllers.
1. Set field-adjustable switches and circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch empty conduits from recessed panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.02 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads or created by retrofitting. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Coordinate final directory room names and numbers with facility engineer.

C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”
   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters. Perform electrical tests on all breakers and switches 200A and above or that constitute a component of an emergency distribution system. Main circuit breakers in branch circuit panelboards 225A and below are not required to be tested.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
   1. Measure as directed during period of normal system loading.
   2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
   3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
   4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
   1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   2. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
1. Single and duplex receptacles
2. Ground-fault circuit interrupter receptacles
3. Controlled receptacles.
4. Single- and double-pole snap switches.
5. Device wall plates.
6. Pin and sleeve connectors and receptacles.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. AFCI: Arc-fault circuit interrupter.

D. PVC: Polyvinyl chloride.

E. RFI: Radio-frequency interference.

F. SPD: Surge protective devices.

G. UTP: Unshielded twisted pair.

H. USB: Universal serial bus.

1.04 REFERENCES

A. DSCC W-C-596G: Federal Specification Connector, Electrical, Power, General Specification.

B. DSCC W-C-896F: Federal Specification Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).

C. IEC 309-1, Part 1: General Requirements: Plugs, Socket-Outlets and Couplers for Industrial Purposes

D. NEMA FB 11: Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.

E. NEMA WD 1: General Requirements for Wiring Devices.

F. NEMA WD 6: Wiring Device – Dimensional Requirements.

G. UL 20: General-Use Snap Switches.

H. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

I. UL 486B: Wire Connectors for Use with Aluminum Conductors.

J. UL 498: Electrical Attachment Plugs and Receptacles.

K. UL 943: Ground Fault Circuit Interrupters.

L. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.05 ACTION SUBMITTALS

A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations for each type of product indicated.

1.06 INFORMATIONAL SUBMITTALS

A. Field quality control test reports

1.07 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.01 GENERAL WIRING DEVICE REQUIREMENTS

A. Comply with NFPA 70, NEMA WD 1, NEMA WD 6, and UL498.

B. Device Color:
   1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
   2. Wall Switches: As selected by Architect, unless otherwise indicated.

2.02 STANDARD GRADE RECEPTACLES

A. Duplex Receptacle, NEMA 5-20R:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hubbell Wiring Device-Kellems: BR20
      b. Eaton/Arrow Hart Wiring Devices: BR20

c. Leviton: BR 20
d. Legrand, Pass & Seymour: CRB5362

B. Tamper-Resistant Duplex Receptacle, NEMA 5-20R:
1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell Wiring Device-Kellems: BR20TR
b. Eaton/Arrow Hart Wiring Devices: TRBR20
c. Leviton: TBR20
d. Legrand, Pass & Seymour: TR5352

C. Weather-Resistant Duplex Receptacle, NEMA 5-20R:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell Wire Device-Kellems: BR20WR
b. Eaton/Arrow Hart Wiring Devices: WRBR20
c. Leviton: WBR20
d. Legrand, Pass & Seymour: WR20TR

D. Weather- and Tamper-Resistant Duplex Receptacle, NEMA 5-20R:
1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell Wire Device-Kellems: BR20WRTR
b. Eaton/Arrow Hart Wiring Devices: TWRBR20
c. Leviton: TWR20
d. Legrand, Pass & Seymour: WR5352TR

2.03 INDUSTRIAL-GRADE RECEPTACLES

A. Duplex Receptacle, NEMA 5-20R:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell Wiring Device-Kellems: HBL 5362
b. Eaton/Arrow Hart Wiring Devices: AH5362
c. Leviton: 5362
d. Legrand, Pass & Seymour: 5362A

2.04 GFCI RECEPTACLES

A. General:
1. Comply with UL 943

B. Duplex GFCI Receptacle, NEMA 5-20R:
1. Manufacturers: Subject to compliance with requirements, provide one of the following:
a. Hubbell Wiring Device-Kellems: GFRST20
b. Eaton/Arrow Hart Wiring Devices: SGF20
c. Leviton: GFNT2
d. Legrand, Pass & Seymour: 2097

C. Tamper-Resistant Duplex GFCI Receptacle, NEMA 5-20R:
1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide one of the following:
a. Hubbell Wiring Device-Kellems: GFTRST20
b. Eaton/Arrow Hart Wiring Devices: TRSGF20

c. Leviton: GFTR2
d. Legrand, Pass & Seymour: 2097TR

D. Tamper- and Weather-Resistant Duplex GFCI Receptacle, NEMA 5-20R:
1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide one of the following:
a. Hubbell Wiring Device-Kellems: GFTWRST20
b. Eaton/Arrow Hart Wiring Devices: TWRSGF20
c. Leviton: GFWT2
d. Legrand, Pass & Seymour: 2097TRWR

E. Weather-Resistant Duplex GFCI Receptacle, NEMA 5-20R:
1. Manufacturers: Subject to compliance with requirements, provide one of the following:
a. Hubbell Wiring Device-Kellems: GFWRST20
b. Eaton/Arrow Hart Wiring Devices WRSGF20
c. Leviton: GFWR2
d. Legrand, Pass & Seymour: 2097TRWR

F. Dead Front GFCI, 20A:
1. Manufacturers: Subject to compliance with requirements, provide one of the following:
a. Hubbell Wiring Device-Kellems: GFBFST20
b. Eaton/Arrow Hart Wiring Devices: SGF20
c. Leviton: GFRBF
d. Legrand, Pass & Seymour: 2087

2.05 CONTROLLED RECEPTACLES

A. General:
1. Comply with NEC Article 406.3(E). Provide permanent markings of controlled symbol and the word “controlled”.

B. Half-Controlled Duplex Receptacle, NEMA 5-20R:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell Wiring Device-Kellems: BR20C1
b. Eaton/Arrow Hart Wiring Devices: 5262CH
c. Bryant: CBRS20C1
d. Leviton: CR020-1P
e. Legrand, Pass & Seymour: 5362CHW

C. Dual-Controlled Duplex Receptacle, NEMA 5-20R:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell Wiring Device-Kellems: BR20C2
b. Eaton/Arrow Hart Wiring Devices: 5362CD
c. Bryant: CBRS20C2
d. Leviton: CR020-2P
e. Legrand, Pass & Seymour: 5362CD

D. Half-Controlled Tamper-Resistant Duplex Receptacle, NEMA 5-20R:
1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell Wiring Device-Kellems: BR20C1TR
b. Eaton/Arrow Hart Wiring Devices: TR5362CH
c. Leviton: TBR15-S1
d. Legrand, Pass & Seymour: TR5362CH

E. Controlled Tamper-Resistant Duplex Receptacle, NEMA 5-20R:
   1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hubbell Wiring Device-Kellems: BR20C2TR
      b. Eaton/Arrow Hart Wiring Devices: TR5362CD
      c. Leviton: TBR15-S2
      d. Legrand, Pass & Seymour: TR5362CD

F. Controlled Tamper-Resistant Duplex GFCI Receptacle, NEMA 5-20R:
   1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Leviton: G5362-2T
      b. Legrand, Pass & Seymour: 2091TRCD

2.06 LOCK RECEPTACLES, OTHER THAN NEMA 5-20R

A. Provide commercial specification grade straight blade and twist-lock receptacles with standard NEMA configurations in accordance with the “Special Receptacles” schedule included on the drawings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell Wiring Device-Kellems
   2. Eaton/Arrow Hart Wiring Devices
   3. Leviton
   4. Legrand, Pass & Seymour

2.07 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking type plug and receptacle body connector, NEMA WD 6, device configurations as indicated on drawings, heavy-duty grade.

B. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.

C. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.08 CORD AND PLUG SETS

A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.09 WALL SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell Wiring Device-Kellems: 1220 Series
   2. Eaton/Arrow Hart Wiring Devices: AH1220 Series
   3. Leviton: 1220 Series
   4. Legrand, Pass & Seymour: PS20AC Series

B. Device body: Plastic handle.

C. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.

D. Snap Switches: Heavy Duty specification grade, quiet type; rated 20A., 120-277 V AC.

E. Provide single-pole, two-pole, three-way and four-way switches as indicated.

F. Provide pilot light where indicated. Switch shall be illuminated when the switch is on.

G. Provide key type where indicated. Furnish four keys to Owner.

H. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
   1. Switch: 20 A, 120/277-V ac.
   2. Receptacle: NEMA WD 6, Configuration 5-20R.

2.10 WALL PLATES

A. Manufacturers:
   1. Provide wall plates and corresponding wiring devices from same manufacturer.

B. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces:
      a. 0.035-inch- thick, satin-finished stainless steel
      b. Steel with white baked enamel, suitable for field painting
      c. Smooth, high-impact thermoplastic
      d. 0.04-inch- thick, brushed brass with factory polymer finish
      e. 0.05-inch- thick anodized aluminum
      f. 0.04-inch- thick steel with chrome-plated finish
   3. Material for Unfinished Spaces:
      a. Galvanized steel
      b. Smooth, high-impact thermoplastic.
   4. Material for Wet Locations: Gasketed Non-Metallic with hinged cover and listed and labeled as Extra Duty Weatherproof While-In-Use.
      a. Manufacturers:
         1) Hubbell: MM420
         2) Legrand, Pass & Seymour: WIUC10FRED
         3) Eaton/Arrow Hart: WIU-1VX
         4) Red Dot: CKPS
         5) Intermatic: WP5000
   5. Material for Damp Locations: Gasketed Cast aluminum with hinged cover and listed and labeled as Weatherproof.
      a. Manufacturers:
         1) Red Dot Model CCGV, ABB Installation Products
         2) Eaton/Arrow Hart WLRD1
         3) Legrand, Pass & Seymour
         4) Intermatic: WP3110MXD

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Prior to installation of devices, verify wall openings are neatly cut and will be completely covered by wall plates, clean debris from outlet boxes and provide extension rings to bring outlet boxes flush with finished surface.

C. Install devices and assemblies level, plumb, and square with building lines.

D. Arrangement of Devices:
   1. Coordinate locations of outlet boxes provided under Division 26 Section “Raceways and Boxes” to obtain mounting heights indicated on Drawings.

2. Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top.
3. Where multiple switches, dimmers, and/or occupancy sensors are adjacent to each other, provide a single cover plate. Custom fabricate, if required, for all combinations. Provide separate boxes or barriers as required for the application.
4. Install horizontally mounted receptacles with grounding pole on the left.
5. Install GFCI receptacles so that the “Push To Test” and “Reset” designations can be read correctly. If printed in both directions, install with ground pole on top.
6. Install switches with OFF position down.

E. Install cover plates on switch, receptacle, and blank outlets in finished areas.

F. Install weather-resistant type receptacles in all damp and wet locations, including pool environments.

G. Install weatherproof cover plates on receptacles in damp locations.

H. Install weatherproof While-In-Use cover plates on receptacles in wet locations.

I. Install tamper-resistant type receptacles in all locations as required by the NEC (406.12) and as indicated on plan.

J. Use oversized plates for outlets installed in masonry walls.

K. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

L. Remove wall plates and protect devices and assemblies during painting.

M. Adjust devices and wall plates to be flush and level. Three corners of wall plates must be in contact with wall surfaces. Devices shall be solidly mounted against the box.

3.02 IDENTIFICATION

A. Comply with Division 26 Section "Electrical Identification."
1. Receptacles: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section “Electrical Identification” with black filled lettering on back side of wall plate, and durable wire markers or tags inside outlet boxes.
2. Wall Switches: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section “Electrical Identification” with black filled lettering on back side of wall plate, and durable wire markers or tags inside outlet boxes.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding." Connect wiring device grounding terminal to outlet box with bonding jumper. Use of quick ground strap or screw is not acceptable.

B. Connect wiring according to Division 26 Section "Conductors and Cables." Connect wiring devices by wrapping conductor around screw terminal or by using back wiring and tightening the screw securely.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
1. Inspect each wiring device for defects.
2. Operate each wall switch with circuit energized and verify proper operation.
3. After installing wiring devices and after electrical circuitry has been energized, test each receptacle for proper polarity, ground continuity, and compliance with requirements.
4. Test each GFCI receptacle for proper operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION

SECTION 26 2813 - FUSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Cartridge fuses rated 600 V and less for use in switches and controllers.
   2. Spare-fuse cabinets.

1.03 ACTION SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:
   1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
   1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Division 1 Section "Closeout Procedures include the following:
      a. Let-through current curves for fuses with current-limiting characteristics.
      b. Time-current curves, coordination charts and tables, and related data.
      c. Ambient temperature adjustment information.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with:
1. NEMA FU 1 – Low Voltage Cartridge Fuses.
2. NFPA 70 – National Electrical Code.
3. UL 198C – High-Interrupting-Capacity Fuses, Current-Limiting Types.
4. UL 198E – Class R Fuses.
5. UL 512 – Fuseholders.

1.06 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.07 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Quantity equal to 10% percent of each fuse type and size, but no fewer than 3 of each type and size.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussmann, Inc.
2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
3. Ferraz Shawmut, Inc.
4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.
1. Motor Branch Circuits: Class RK5, time delay.
2. Other Branch Circuits: Class RK1, time delay

2.03 SPARE-FUSE CABINET

A. Cabinet: Wall-mounted, 0.05-inch- thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
1. Size: 30 inches high by 24 inches wide by 12 inches deep.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
4. Fuse Pullers: For each size of fuse.

2.04 FLUORESCENT AND H.I.D. LIGHTING BALLAST FUSES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussmann, Inc. – GLR fuses with HLR holder.
2. Tracor, Inc.; Littelfuse, Inc. Subsidiary – LGR fuses with LHR-000 holder.
3. Ferraz Shawmut, Inc. – SLR fuses.

B. Provide each fluorescent and HID lighting ballast with individual protection on the line side.

C. Provide fuse and holder mounted within or as part of the fixture.

D. Provide fuse size and type recommended by the fixture manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by the Electrical Contractor with new fuses as specified above prior to energization at no additional expense to Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energization of the circuit in which it is applied.

B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

C. Install spare-fuse cabinet(s).

3.03 IDENTIFICATION

A. Install labels indicating fuse rating and type on outside of the door on each fused switch.

END OF SECTION

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 26 Section “Fuses”.
2. Division 26 Section “Hangers and Supports for Electrical Systems”.

1.02 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
1. Fusible switches.
2. Non-fusible switches.
3. Molded-case circuit breakers.
4. Molded-case switches.
5. Enclosures.

1.03 DEFINITIONS

A. GD: General duty.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault circuit-interrupter for equipment protection.

D. GFLS: Ground-fault circuit-interrupter for life safety.

E. HD: Heavy duty.

F. RMS: Root mean square.

G. SPDT: Single pole, double throw.

1.04 REFERENCES

A. NECA 1: Practices for Good Workmanship in Electrical Contracting.

B. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.

E. NEMA FU 1: Low Voltage Cartridge Fuses.

F. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

G. NEMA PB1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

H. NEMA PB2.1: General Instructions for Proper Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.

I. NFPA 70: National Electrical Code.

J. UL 50: Enclosures for Electrical Equipment, Non-Environmental Considerations.

K. UL 50E: Enclosures for Electrical Equipment, Environmental Considerations

L. UL 98: Enclosed and Dead-Front Switches

M. UL 489: Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

N. UL 1053: Standard For Ground-Fault Sensing and Relaying Equipment.

O. UL 1077: Supplementary Protectors for Use in Electrical Equipment

P. UL 508: Industrial Control Equipment

1.05 ACTION SUBMITTALS

A. Product Data:
   1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
   2. Enclosure types and details for types other than UL 50E, Type 1.
   3. Current and voltage ratings.
   4. Short-circuit current rating.
   5. Include evidence of qualified electrical testing laboratory listing for series rating of installed devices.
   6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include wiring diagrams for power, signal, and control wiring.

1.06 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports including the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.08 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish to Owner spare parts, for repairing enclosed switches and circuit breakers, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Source Limitations: Obtain products from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.

2.02 FUSIBLE SWITCHES

A. Manufacturers:
   1. Eaton.
   2. ABB.
   3. Siemens Industries, Inc.
   4. Square D by Schneider Electric.

B. Type GD, General Duty, Three Pole, Single Throw, 240 V(ac), 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Three Pole, Single Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   4. Service-Rated Switches: Labeled for use as service equipment.
   5. Hook stick Handle: Allows use of hook stick to operate handle.
   6. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.03 NONFUSIBLE SWITCHES

A. Manufacturers:
   1. Eaton.
   2. ABB.
   3. Siemens Industries, Inc.
   4. Square D by Schneider Electric.

B. Type GD, General Duty, Three Pole, Single Throw, 240 V(ac), 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Three Pole, Single Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Three Pole, Double Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating – 120VAC.
      a. Provide auxiliary contacts for motor disconnects served by variable frequency controllers.
   4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.04 SHUNT TRIP SWITCHES

A. Manufacturers:
   1. Eaton.
   2. Mersen

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200 kA interrupting and short-circuit current rating.

C. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 600 V(ac); UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120 V(ac); obtained from integral control power transformer, with primary and secondary fuses, with control power transformer of enough capacity to operate shunt trip, pilot, indicating and control devices.

E. Accessories:
   1. Oiltight key switch for key-to-test function.
   2. Oiltight green ON pilot light.
   3. Isolated neutral lug; 100 percent rating.
   4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
   5. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   6. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   7. Form C alarm contacts that change state when switch is tripped.
   8. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120 V(ac).
   9. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.05 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers:
   1. Eaton.
   2. ABB.
   3. Siemens Industries, Inc.

4. Square D by Schneider Electric.

B. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.

C. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.

D. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker.

E. MCCBs must be equipped with device for locking in isolated position.

F. Lugs must be suitable for 90 deg C rated wire, sized in accordance with 75 deg C temperature rating in NFPA 70.

G. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits.
   1. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, RMS sensing, with the following field-adjustable settings:
   1. Instantaneous trip.
   2. Long- and short-time pickup levels.
   3. Long- and short-time time adjustments.
   4. Ground-fault pickup level, time delay, and I-squared t response.

K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

L. GFLS Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6 mA trip).

M. GFEP Circuit Breakers: With Class B ground-fault protection (30 mA trip).

N. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Application Listing: Appropriate for application.
   3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
   4. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
   5. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
   6. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
   7. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
   8. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
   9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key must be removable only when circuit breaker is in off position.
   10. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
   11. Electrical Operator: Provide remote control for on, off, and reset operations.

2.06 MOLDED-CASE SWITCHES

A. Manufacturers:
   1. Eaton.
   2. ABB.
   3. Siemens Industries, Inc.
   4. Square D by Schneider Electric.

B. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

D. Features and Accessories:
   1. Standard frame sizes and number of poles.
   2. Lugs:
      a. Mechanical type, suitable for number, size, trip ratings, and conductor material.
      b. Lugs must be suitable for 90 deg C rated wire, sized in accordance with 75 deg C temperature rating in NFPA 70.
   3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
   4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
   5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
   6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
   7. Alarm Switch: One NO contact that operates only when switch has tripped.
   8. Key Interlock Kit: Externally mounted to prohibit switch operation; key must be removable only when switch is in off position.

2.07 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish:
   1. Gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (Type 1)
   2. Gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (Types 3R, 12)
   3. A brush finish on Type 304 stainless steel (Type 4-4X stainless steel)
   4. Copper-free cast aluminum alloy.

C. Conduit Entry: Types 4, 4X, and 12 enclosures may not contain knockouts. enclosures must be provided with threaded conduit openings in both end walls.

D. Operating Mechanism:
   1. Directly operable through front cover of enclosure (Type 1).
   2. Directly operable through dead front trim of enclosure (Type 3R).
   3. Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.

E. Enclosures designated as Type 4, 4X stainless steel, 12, or 12K must have dual cover interlock mechanism to prevent unintentional opening of enclosure cover when circuit breaker is ON and to prevent turning circuit breaker ON when enclosure cover is open.

2.08 TOGGLE DISCONNECT SWITCH

A. Manufacturers:

1. Double Pole:
   a. Hubbell 1372.
   b. Leviton 3032-2W.
   c. Pass & Seymour 7812.
   d. Bryant 30102.
2. Three Pole:
   a. Hubbell 1379.
   b. Leviton MS303-DSW.
   c. Pass & Seymour 7813.
   d. Bryant 30103.

B. Description: Heavy duty, 30A, 600 volts, double or three pole as required, single throw, motor rated switch without overload protection. Provide NEMA 1 enclosure and padlock attachment.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SELECTION OF ENCLOSURES

A. Indoor, Dry and Clean Locations: Type 1.

B. Outdoor Locations: Type 3R.

C. Kitchen and Wash-Down Areas: Type 4X, stainless steel.

D. Other Wet or Damp, Indoor Locations: Type 4.

E. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.

3.03 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Special Techniques:
   1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
   2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
   3. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
   4. Install fuses in fusible devices.

C. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

D. Anchor floor-mounted switches to concrete base.

E. Install NEMA KS 1 enclosed switch for motor loads ½ HP and larger and equipment loads greater than 30A.

F. Install toggle disconnect switch, surface mounted, for motor loads less than ½ HP and equipment loads 30A. and less.

G. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.

H. Install equipment on exterior foundation walls at least one inch from wall to permit vertical flow of air behind breaker and switch enclosures.

I. Support enclosures independent of connecting conduit or raceway system.

J. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.04 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Electrical Identification."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.
   3. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

3.05 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:
   1. Inspect mechanical and electrical connections.
   2. Verify switch and relay type and labeling verification.
   3. Verify rating of installed fuses.
   4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.

B. Perform field quality control tests in accordance with Division 26 section “Electrical Testing”:

C. Tests and Inspections for Switches:
   1. Visual and Mechanical Inspection:
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, grounding, and clearances.
      c. Verify that unit is clean.
      d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
      e. Verify that fuse sizes and types match the Specifications and Drawings.
      f. Verify that each fuse has adequate mechanical support and contact integrity.
      g. Inspect bolted electrical connections for high resistance using one of the following methods:
         1) Use low-resistance ohmmeter.
            a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
            a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
      h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on Drawings.
      i. Verify correct phase barrier installation.
      j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
   2. Electrical Tests:
      a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
      b. Measure contact resistance across each switchblade fuse holder. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
      c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage

in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

e. Perform ground fault test in accordance with NETA ATS Section 7.14 "Ground Fault Protection Systems, Low-Voltage."

D. Tests and Inspections for Molded-Case Circuit Breakers:

1. Visual and Mechanical Inspection:
   a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.
   b. Inspect physical and mechanical condition.
   c. Inspect anchorage, alignment, grounding, and clearances.
   d. Verify that unit is clean.
   e. Operate circuit breaker to ensure smooth operation.
   f. Inspect bolted electrical connections for high resistance using one of the following methods:
      1) Use low-resistance ohmmeter.
         a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
      2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
         a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
   g. Inspect operating mechanism, contacts, and chutes in unsealed units.
2. Electrical Tests:
   a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
   b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
   c. Perform contact/pole resistance test. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
   d. Perform insulation resistance tests on control wiring with respect to ground. Applied potential must be 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable. Test duration must be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values may be no less than 2 M Ω.
   e. Determine the following by primary current injection:
      1) Long-time pickup and delay. Pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

2) Short-time pickup and delay. Short-time pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
3) Ground-fault pickup and time delay. Ground-fault pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) Instantaneous pickup. Instantaneous pickup values must be as specified and within manufacturer's published tolerances.

f. Test functionality of trip unit by means of primary current injection. Pickup values and trip characteristics must be as specified and within manufacturer's published tolerances.
g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of shunt trip and close coils must be as indicated by manufacturer.
h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset trip logs and indicators. Investigate units that do not function as designed.
i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Test and adjust controls, remote monitoring, and safeties.

E. Nonconforming Work:
1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

F. Collect, assemble, and submit test and inspection reports.
1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

G. Manufacturer Services:
1. Engage factory-authorized service representative to support field tests and inspections.

3.06 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges in accordance with study report specified in Division 26 Section “Overcurrent Device Coordination Study/Arc Flash Hazard Analysis”.

3.07 PROTECTION

A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.08 MAINTENANCE

A. Infrared Scanning of Enclosed Switches and Breakers: Two months after Substantial Completion, perform infrared scan of joints and connections. Remove covers so joints and connections are accessible to portable scanner. Take visible light photographs at same locations and orientations as infrared scans for documentation to ensure follow-on scans match same conditions for valid comparison.
1. Instruments and Equipment: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

2. Follow-up Infrared Scanning: Perform two follow-up infrared scans of enclosed switches and breakers, one at four months and another at 11 months after Substantial Completion.
3. Instrument: Use infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide documentation of device calibration.
4. Report: Prepare certified report that identifies units checked and that describes scanning results. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

3.09 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip and time delay settings to values as determined by the protective device coordination study.

3.10 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION

SECTION 26 5119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:
1. Division 26 "Lighting Control Devices."
2. Division 26 “Lighting Control Systems”

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lamp: LED and substrate as a replaceable assembly.

F. LED: Light-emitting diode.

G. Lumen: Measured output of lamp and luminaire, or both.

H. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project per IES LM-79 and IES LM-80.
a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products or certified by a qualified independent testing agency.

B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.

D. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
1. Include Samples of luminaires and accessories involving color and finish selection.

E. Samples for Verification: For each type of luminaire.
1. Include Samples of luminaires and accessories to verify finish selection.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Lighting luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:
a. Other luminaires.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Ceiling-mounted projectors.
7. Moldings.

B. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency

C. Sample warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps: 5% attic stock of each type and rating installed. Furnish at least one of each type.
   2. LED Drivers 5% attic stock of each type and rating installed. Furnish at least one of each type.
   3. Diffusers and Lenses: 1% attic stock of each type and rating installed. Furnish at least one of each type.
   4. Globes and Guards: 5% attic stock of each type and rating installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with:
   1. NFPA 70 - National Electrical Code.
   2. NECA/IESNA 500-1998 – Recommended Practice for Installing Indoor Commercial Lighting Systems.
   3. NECA/IESNA 502-1999 – Recommended Practice for Installing Industrial Lighting Systems.
   4. Code of Federal Regulations (47 CFR 37342).
   5. Michigan Department of State Police, Fire Marshall Division Policy Number 11-06 “Plastic Materials as Interior Finishes” pertaining to the use of plastic lenses in lighting fixtures for health care facilities.
   6. Michigan Department of Community Industry Services requirements that all lamps shall be protected from breakage. Exposed lamps are not acceptable.

F. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

G. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) or manufacturer's standard warranty length (whichever is longer) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 LUMINAIRES (LIGHTING FIXTURES)

A. Provide Luminaires as included in specification 26 5700 "Luminaire Product Data." This section contains product data sheets from the basis of design manufacturer with annotations.

B. Acceptable alternate manufacturers are indicated on the product data sheets. Alternate manufacturer products shall be equal in all respects including materials, finishes, photometric performance and energy performance and shall include all options, features, and accessories identified.

C. The Luminaire schedule shown on the drawings is supplemental provided for convenience and reference only. The requirements of this section and 26 5700 shall govern.

2.02 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Unless otherwise specified in Luminaire product data, provide products with a minimum CRI of 80.

E. Unless otherwise specified in Luminaire product data, provide products with a CCT of 3500K.

F. Unless otherwise specified in Luminaire product data, provide products with an IES LM-80 rated lamp life of 50,000 hours.

G. Driver
1. Provided as an integrated component of the luminaire or as an external component of an assembly of luminaries.
2. Nominal Input Voltage: All drivers shall be rated for use on either 120V or 277V systems.

2.03 EMERGENCY AUTOMATIC LOAD CONTROL RELAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bodine BLCD Series.
2. Nine-24, Inc.: ELCR Series.
3. LVS, EPC Series
4. IOTA, ETS-20 Series
5. Functional Devices, Inc., ESR Series
6. ETC, ALCR Series
7. Wattstopper, ELCU series

B. Description:
1. The Automatic Load Control Relay (ALCR) shall provide required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area of the building.
2. The ALCR shall allow control of emergency lighting fixtures in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device.
3. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.
4. Self-contained with integral ½" nipple mount with snap in locking feature for mounting into a standard junction box knock out.

5. Normally closed dry contacts capable of switching 20 amp emergency ballast loads @ 120-277 VAC, 60 Hz, or 10 amp tungsten loads @ 120 VAC, 60 Hz.
6. Universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
7. Integral momentary test switch. Pressing and holding this switch shall instantly force the unit into emergency mode and turn on emergency lighting. Releasing the test switch shall immediately return the unit to normal operation.
8. Dedicated leads and 24 VDC source for connection to remote test switch, fire alarm system, or other external system capable of providing a normally closed dry contact closure. Breaking contact between the terminals shall force and hold the emergency lighting on until the terminals are again closed. An integral LED indicator shall indicate the unit's current remote activation status.
9. Separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency).
10. Normal power input leads shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
11. Automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
12. Utilize zero crossing circuitry to protect relay contacts from inrush current.
13. Plenum rated housing equipped with compression flying leads.
14. The unit shall be UL listed to the UL924 standard and labeled for connection to both normal and emergency lighting power sources.

C. Provide device with proper rating for total load and load type being transferred

D. Provide for devices suitable for line voltage and low voltage dimming control where required such that device bypasses dimming control signal to luminaire to provide full output upon loss of normal power.

E. Coordinate with luminaire product data, lighting control schedules and details and diagrams included on the drawings for dimming characteristics.

2.04 BRANCH CIRCUIT EMERGENCY LIGHTING TRANSFER SWITCH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. LVS EPC-D-F-ATS Series
2. Bodine.

B. Description: Localized load transfer switch to allow emergency fixture to be powered and controlled by the normal lighting circuit, sense presence of normal power ahead of control circuit and switch luminaire (both line and neutral) over to emergency source upon loss of normal source.

C. Universal dimming capability to allow the lighting to be controlled and dimmed by the normal lighting circuit during normal times. In the event of a loss of the normal branch circuit, and transfer the designated emergency fixtures form normal dimming control to the emergency power source and bring them to full brightness, regardless of the current state of the dimming system.

D. Device shall be mounted remotely for each control circuit as application requires.

E. Listed and labeled by an NRTL to the UL1008 for emergency operation and listed for field installation.

F. Integral test switch and indicating lamps to indicate status.

G. Provide device with proper rating for total load and load type being transferred

H. Coordinate with luminaire product data, lighting control schedules and details and diagrams included on the drawings.

2.05 MATERIALS

A. Metal Parts:
1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:
1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Factory-Applied Labels: Comply with UL 1598 Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI for all luminaires.

2.06 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.07 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: Unless otherwise specified in Luminaire product data, provide products with a minimum ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

A. Do not use permanent luminaires for temporary lighting.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and N.E.C.A./I.E.S.N.A. 500-2006 and 502-2006.

B. Locate ceiling luminaires as indicated on reflected ceiling plan.

C. Support luminaires independent of ceiling framing. Support recessed grid luminaries from two opposite corners directly to structure. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

D. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure

E. Install recessed luminaires to permit removal from below.

F. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

G. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

H. Install fixture with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Trims of fixtures shall be properly and uniformly aligned.

I. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Provide support for luminaire without causing deflection of ceiling or wall.
   4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

J. Flush-Mounted Luminaire Support:
   1. Secured to outlet box.
   2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
   3. Trim ring flush with finished surface.

K. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.
   2. Do not attach luminaires directly to gypsum board.

L. Ceiling-Mounted Luminaire Support:
   1. Ceiling mount with two 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
   2. Ceiling mount with pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
   3. Ceiling mount with hook mount.

M. Suspended Luminaire Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
   3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
   4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

N. Comply with requirements in Section 26 0519 "Conductors and Cables" for wiring connections.

O. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned.

P. Locate the remote test/monitor modules identically so that they are visible and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

C. Bond products and metal accessories to branch circuit equipment grounding conductor.

D. Connect luminaires to branch circuit outlet boxes provided under Division 26 Section "Raceways and Boxes" using 1/2" flexible conduit.

3.05 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.06 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

D. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures, misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.

3.07 STARTUP SERVICE

A. Comply with requirements for startup specified in Division 26 Section "Lighting Control Systems."

3.08 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
   1. During adjustment visits, inspect all luminaires. Replace lamps, drivers, or luminaires that are defective.
   2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   3. Adjust the aim of luminaires in the presence of the Architect.

B. Adjust and calibrate all dimming system controls until the system works as designed. Contact the Architect/Engineer when dimming is complete and demonstrate operation to owner’s representative and Architect/Engineer.

3.09 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.

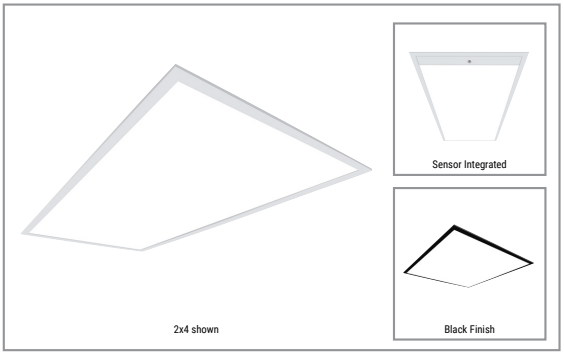
B. Remove dirt and debris from enclosures and lenses.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

END OF SECTION

Project		Catalog #		Type	TYPE - L1
Prepared by		Notes		Date	



Metalux

CGTX Panel

Configurable LED Backlit Panel, Recessed, Surface, Suspended

Typical Applications

• Commercial Office Spaces • Schools • Healthcare
• Retail Merchandising Areas

Interactive Menu

Product Certification

Product Features

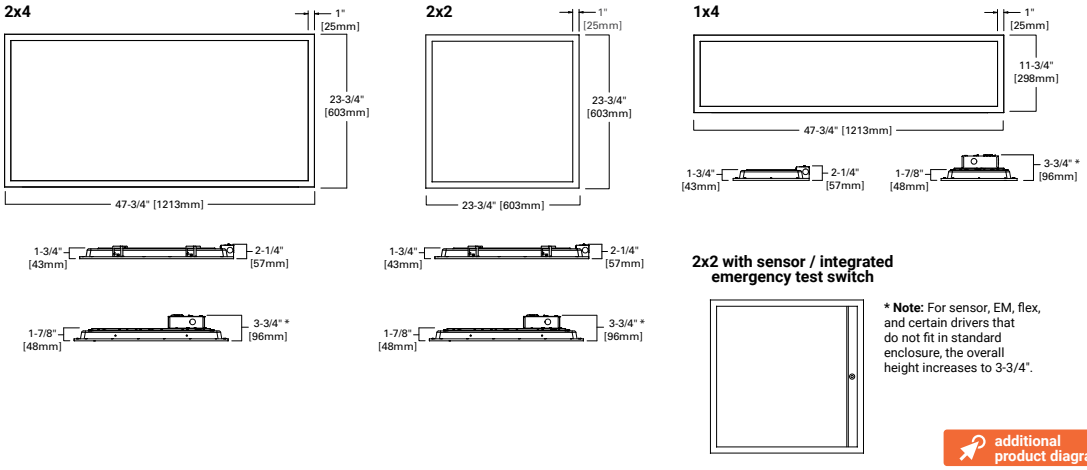
damp location

MWS MODULAR WIRING SYSTEM CLICK HERE

Top Product Features

- Highly configurable backlit panel fits a variety of applications
- Integrated control and emergency options in all sizes
- Standard and high efficiency available for further energy savings
- Available in 3000K, 3500K, 4000K, and 5000K CCT, 80 and 90 CRI
- Options to meet Buy American and other domestic preference requirements

Dimensional and Mounting Details



2x2 with sensor / integrated emergency test switch

*** Note:** For sensor, EM, flex, and certain drivers that do not fit in standard enclosure, the overall height increases to 3-3/4".

additional product diagrams

COOPER Lighting Solutions
a ◎ignify business

Metalux — CGTX

TYPE - L1

Order Information

SAMPLE ORDER NUMBER: **24CGTX-40-EL14W-L840-WLS**

Domestic Preferences	Rating	Width/Length	Series	1x4 Lumen Output	2x2 Lumen Output	2x4 Lumen Output
[Blank]=Standard **BAA**=Buy American Act **TAA**=Trade Agreements Act	**[Blank]**=Standard **ATW-SW4**=Chicago Rated [2]	**14**=1' x 4' **22**=2' x 2' **24**=2' x 4'	**CGTX**=Configurable LED Backlit Panel	**Standard** **20**=2000 **30**=3000 **42**=4200 **High Efficiency** **20HE**=2000 **30HE**=3000 **42HE**=4200 **70HE**=7000 **80HE**=8000	**Standard** **20**=2000 **25**=2500 **35**=3500 **45**=4500 **High Efficiency** **20HE**=2000 **25HE**=2500 **35HE**=3500 **45HE**=4500 **50HE**=5000 **60HE**=6000	**Standard** **20**=2000 **30**=3000 **35**=3500 **40**=4000 **45**=4500 **55**=5500 **65**=6500 **72**=7200 **High Efficiency** **20HE**=2000 **30HE**=3000 **35HE**=3500 **40HE**=4000 **45HE**=4500 **55HE**=5500 **65HE**=6500 **72HE**=7200 **80HE**=8000 **90HE**=9000 **100HE**=10000 [4, 5]
Notes (1) Only product configurations with these designated prefixes are built to be compliant with the Buy American Act of 1933 (BAA) or Trade Agreements Act of 1979 (TAA), respectively. Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analyzed under domestic preference requirements.	**Notes** (2) Installed Flex not available with ATW-SW4 option.			**Notes** (3) Lumens are approximate. Refer to performance tables and IES files for actual delivered lumens and wattage. (4) 2x4 100E lumen output requires two drivers. (5) 2x4 100 lumen output requires two drivers.		

Lens Options	Voltage	Emergency	CCT / CRI	Flex/MWS
[Blank]=Smooth White Frosted	**[Blank]**=Universal Voltage 120-277 **347V**=347 Volt [6]	**[Blank]**=None **EL7W**=7-watt, 120V-277V emergency battery pack installed [8] **EL14W**=14-watt 120V-277V emergency battery pack installed [8] **EL10W**=10-watt 120V-277V emergency battery pack installed [8] **EL10WSD**=10-watt 120V-277V emergency battery pack installed, with self-diagnostics [8] **GTRD**=Bodine Emergency Transfer Relay with dimming control [9] **ETRD**=Iota Emergency Transfer Relay with dimming control [10]	**L830**=3000K, 80 CRI **L835**=3500K, 80 CRI **L840**=4000K, 80 CRI **L850**=5000K, 80 CRI **L930**=3000K, 90 CRI [11] **L935**=3500K, 90 CRI [11] **L940**=4000K, 90 CRI [11] **90 CRI only available with HE**	**[Blank]**=None **Dimming Flex** [12] **A3/8-4/18GDIM**=Flex, hot, neutral, ground, 2 dimming leads **A3/8-5/18GDIM**=Flex, 2 hots, neutral, ground, 2 dimming leads **Non-Dimming Flex** [12] **A3/8-2/18G**=Flex, hot, neutral, ground **A3/8-3/18G**=Flex, 2 hots, neutral, ground **A3/8-4/18G**=Flex, 3 hots, neutral, ground **MWS - Modular Wiring Systems -** Fixture Fitting [15] **MW12FF12/3G**=120V Fixture Feed, #12, 3 Conductors + Ground [14] **MW27FF12/3G**=277V Fixture Feed, #12, 3 Conductors + Ground [14] **MW12FF12/2G-010V**=120V Fixture Feed, #12, 2 Conductors, Ground, 0-10V Dimming [14] **MW27FF12/2G-010V**=277V Fixture Feed, #12, 2 Conductors, Ground, 0-10V Dimming [14]
	(6) 347V with sensor and/or emergencies only available with HCD.	**Notes** (7) Fixture height increases to 3-3/4". (8) With integral test switch/indicator. For approximate delivered lumens multiply the lumens per watt of the desired fixture by the wattage of the emergency battery pack (100 lm/W x 7=700 lumens). IES-format photometry for luminaire under emergency operation available. (9) Used to bypass local control during outage. Device is dual listed to UL 1008 (transfer switch) and UL 924 (switch bypass), 347V not available. (10) Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others). 347V not available.	**Notes** (11) 90 CRI only available in HE lumen packages.	**Notes** (12) Fixture height increases to 3-3/4". (13) Multiple options available in online configurator. See additional notes on Flex below. (14) To be used with Modular Wiring System. Refer to MWS Fixture Fitting specification for additional details.(15) MWS Fixture Fitting increases overall fixture height to 4-7/8". **Flexible Metal Conduit Options** Flex options available for 0-10V dimming control, DALI dimming control, emergency and night light functions. 72-inch factory-installed and pre-wired to driver, fitted to luminaire housing access plate with 90° enclosed FMC connector. Not all options may be combined and installation ratings vary by type.

PROVIDE FOR FIXTURES LABELED EM

Driver Type	Number of Drivers	Integrated Sensing Systems	Options	Packaging
[Blank]=CD 0-10V Driver (10%-100% Dimming) **HCD**=0-10V Driver (1%-100% Dimming) [16] **5LTD**=DALI Driver (1%-100% Dimming) [16] **SD**=Step Dimming Driver (50%,100% Dimming) [16] **LH**=Lutron HiLume (LDE1 series) 1%-100% EcoSystem Driver with Soft-on Fade to Black dimming [16], [F]	**[Blank]**=1 Driver **2**=2 Drivers [17]	**[Blank]**=No Sensor **WLS (formerly WAB)**=WaveLinx LITE Wireless Sensor, Occupancy w/ photocell, Independent & Networked [19], [B] **WPS (formerly WAA)**=WaveLinx PRO Wireless Sensor, Occupancy w/ photocell, Networked [19], [A] **WLN**=WaveLinx LITE Wireless Control Node, without sensor [19], [B] **WPN**=WaveLinx PRO Wireless Control Node, without sensor [19], [A]	**[Blank]**=None **BLKF**=Black Frame, Matte Finish	**[Blank]**=Unit Pack **PAL**=Job Pack, out of carton
Notes (16) Fixture height increases to 3-3/4". Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories. Please refer to the following: (F) Consult Marketplace Options - Lutron system pages for additional details and compatibility. Compatible only with driver series shown, and may require two or more drivers. Requires field commissioning to operate or dim. Contact Lutron at www.lutron.com.	**Notes** (17) Fixture height increases to 3-3/4".	**Notes** (18) Fixture height increases to 3-3/4". (19) Must be used with CD or HCD driver. Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories. Please refer to the following: (A) Consult WaveLinx PRO system pages for additional details and compatibility. (B) Consult WaveLinx LITE system pages for additional details and compatibility.		

Metalux CGTX

TYPE - L1

Product Specifications

Construction
- Robust die-formed steel back plate to ensure durability
- Housing is absent of holes to resist debris/bug intrusion
- Aluminum frame weld and ground for a seamless appearance

Mounting
- Integral grid/EQ clips provided and include suspension / wire retention features
- Grid clip includes fold up hang points. Use FPSUS24-ML or other desired suspension methods for direct suspension
- Large junction box constructed of code gauge galvanized steel with access plate
- Multiple 7/8" KO's provided, suitable for up to 12AWG wiring
- Surface kits available for use in grid or hard surfaces
- Factory installed MWS fixture fitting or flexible conduit available to reduce installation time
- FPSUS2-ML is a 2-point suspension kit includes aircraft cable, carabiner, ceiling connection, SO cord, cord connectors, round 4" J-box cover and #8 sheet metal screws

Controls
- 0-10V dimming to 10% standard, 1% dimming available
- Integrated WaveLinx options provide wireless individual fixture control and enable code compliance, increased energy savings, grouping of fixtures, and connection to WaveLinx control systems
- DALI 2.0, Lutron, and step-dimming available

Electrical
- TM21 life at 60,000 hours up to L86 and calculated L70 exceeds 120,000 hrs
- Driver rated for FCC part 15 Class B for use in residential or commercial applications
- LED's available in 3000K, 3500K, 4000K, or 5000K at 80 CRI or 90 CRI minimum
- Color accuracy ≤3-Step MacAdam ellipse (SDCM)
- Integral emergency battery pack options available in 7W, 10W, and 14W. Test switch located on fixture lens band. Self-diagnostic options available
- Emergency/generator transfer options available
- Drivers available in 120-277V; 0-10V drivers also available in 347V

Optical Shielding
- Micro-optics enable uniform distribution of the LEDs for uniform lens illumination
- Frosted smooth lens provides uniform illumination across the entire lens
- Durable lens with surface texture to minimize scratch and impact damage

Compliance
- cULus listed for 25°C ambient environments, indoor applications
- IC rated for direct insulation contact
- UL Damp Location listed
- IP5X rated from the room side with no modification needed
- Tested to IESNA LM-79 and LM-80
- Stated life per TM21 standards
- DesignLights Consortium® Qualified and classified for DLC Standard and DLC Premium, refer to www.designlights.org for details.
- Suitable for State of California Title 24 high efficacy luminaire
- FCC part 15 class A compliant
- Fixture is rated for NSF/ANSI standard 2 - Light fixture for Splash Zone and Non-Food Zone

Warranty
- Five year warranty
- Extended warranty to 10 years available

Surface Mounting Options

Catalog No.	Description	UPC	Kit Height
CGTSURF24	2x4 CGT Surface Mount Kit	080083083107	3-7/8"
CGTSURF22	2x2 CGT Surface Mount Kit	080083083121	3-7/8"
CGTSURF14	1x4 CGT Surface Mount Kit	080083083145	3-7/8"
SK-24-WS	2x4 SK Surface Mount Kit, Shallow	080083719389	5-1/16"
SK-22-WS	2x2 SK Surface Mount Kit, Shallow	080083719402	5-1/16"
SK-14-WT	1x4 SK Surface Mount Kit, Tall	080083906703	6-1/4"
Note: Cannot be used with EL10W, EL10WSD, GTRD, 100HE lumen output, MWS, or 347V with alternative driver. Metalux Universal Surface Mount kits are compatible with these configurations – see #SK-24, #SK-22, and #SK-14). Metalux Universal Surface Mount			

Shipping Data

	1x4	2x2	2x4
Packaged Weight (lb.)	10	10	16
Pallet Qty - Standard (Tall)	17 (11)	34 (22)	16 (11)
Pallet Size	30x53		
Note: Base configurations; options may add weight.			

Drywall Frame Kit

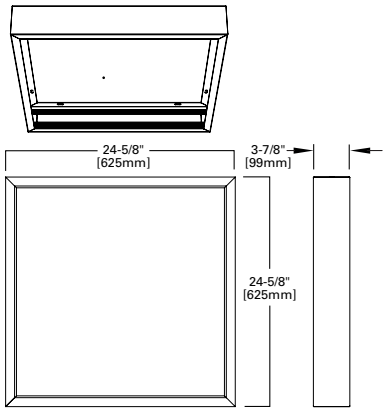
Catalog No.	Description	UPC
DF-24W-U	2x4 dry wall frame kit	662401232970
DF-22W-U	2x2 dry wall frame kit	662401232963
DF-14W-U	1x4 dry wall frame kit	662401232949

Surface Mount Kit

Size	Width	Length
1x4	12-5/8"	48-5/8"
2x2	24-5/8"	24-5/8"
2x4	24-5/8"	48-5/8"

Suspension Kit

Catalog	UPC	Description
FPSUS2-ML	080083802784	ML / Max Load Kit for CGTX with options. 2 point Y-hanger suspension kit includes aircraft cable, carabiner, ceiling connection, SO cord, cord connectors, round 4" J-box cover plate, and #8 sheet metal screws.
Mounting height from ceiling **Min.**=7-1/4" [184mm] **Max**.=27" [286mm] **Note**: Suspension kit is intended to be used without surface mount box.		



CGTSURF22 Shown

Metalux — CGTX

TYPE - L1

Energy and Performance Data

Electrical & Optical Performance - CGTX (3500K, 80 CRI)

Size	Lumen Pkg	Delivered Lumens	Input Watts	Efficacy lm/W	Current (A)		Glare Performance	
					120V	277V	UGR (1)	Max Luminance (1)
1x4	2000	1815	16.4	120	0.14	0.06	18.3	1590
	3000	2679	23.9	122	0.20	0.09	19.7	2347
	4200	3911	31.7	134	0.26	0.11	21	3427
1x4 HE	2000 HE	1877	14.8	138	0.12	0.05	18.4	1645
	3000 HE	2820	22.4	137	0.19	0.08	19.9	2471
	4200 HE	3984	31.9	136	0.27	0.12	21.1	3491
	7000 HE	6372	52.5	132	0.44	0.19	22.7	5583
	8000 HE	7346	61.9	129	0.52	0.22	23.2	6437
2x2	2000	2041	15.1	135	0.13	0.05	18.8	1786
	2500	2536	18.9	134	0.16	0.07	19.5	2219
	3500	3606	27.9	129	0.23	0.10	20.8	3155
	4500	4424	36.1	123	0.30	0.13	21.5	3870
2x2 HE	2000 HE	2024	14.8	137	0.12	0.05	18.8	1771
	2500 HE	2598	19.2	135	0.16	0.07	19.6	2272
	3500 HE	3633	27.2	134	0.23	0.10	20.8	3178
	4500 HE	4650	36.2	128	0.30	0.13	21.7	4068
	5000 HE	5121	40.0	128	0.33	0.14	22	4480
	6000 HE	6004	47.4	127	0.40	0.17	22.5	5253
2x4	2000	2232	16.7	134	0.14	0.06	16.8	982
	3000	3135	23.7	132	0.20	0.09	18	1378
	3500	3742	28.4	132	0.24	0.10	18.6	1646
	4000	4008	30.3	132	0.25	0.11	18.8	1763
	4500	4649	35.6	131	0.30	0.13	19.4	2044
	5500	5546	44.1	126	0.37	0.16	20	2439
	6500	6606	53.4	124	0.45	0.19	20.6	2905
	7200	7416	60.9	122	0.51	0.22	21	3261
2x4 HE	2000 HE	2031	14.9	136	0.12	0.05	16.5	893
	3000 HE	2988	21.9	136	0.18	0.08	17.8	1314
	3500 HE	3480	25.6	136	0.21	0.09	18.3	1530
	4000 HE	4052	29.9	136	0.25	0.11	18.9	1782
	4500 HE	4662	34.7	134	0.29	0.13	19.4	2050
	5500 HE	5509	41.3	133	0.34	0.15	19.9	2422
	6500 HE	6610	49.9	132	0.42	0.18	20.6	2907
	7200 HE	6969	53.6	130	0.45	0.19	20.8	3064
	8000 HE	8176	63.5	129	0.53	0.23	21.3	3595
	9000 HE	9001	70.3	128	0.59	0.25	21.6	3957
	10000 HE	10451	82.6	127	0.69	0.30	22.2	4596

Notes:
(1) UGR values per CIE 190:2010 with 4H, 8H, Reflectance: 70% Ceiling, 50% Wall, 20% Ref. Plane.
Luminance measured at 45-90 degrees from nadir.
UGR and Luminance values that meet WELL v2 L04 requirements for Managing Glare are shown with green highlighted cell (UGR < 16, Luminance < 6,000).
UGR and Luminance values that meet LEED v4.1 requirements for Glare Control are shown with green text (UGR < 19, Luminance < 7,000).

Key

	Meets WELL v2
TEXT	Meets LEED v4.1

Lumen Adjustment Factors

CCT Multiplier	80 CRI	90 CRI (2)
3000K	0.99	0.83
3500K	1.00	0.85
4000K	1.03	n/a
5000K	1.05	0.89

Notes: (2) 90 CRI only available in HE lumen outputs.

Example of Lumen Adjustment Calculation

24CGTX-45-L850
at 5000K

Lumen Adjustment Factor = 1.05

Total Light Output =
4,537 lm x 1.05 = 4,764 lm

$$\textit{Efficacy} = \frac{4{,}764\ lm}{35.6\ W} = 133\ lm/W$$

Lumen Maintenance

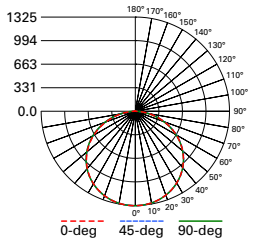
TM-21 Lumen Maintenance (60,000 hours) (3)	Theoretical L70 (Hours) (4)
> 86%	> 120,000

Notes: (3) Supported by IES TM-21 standards. (4) Theoretical values represent estimations commonly used; however, refer to the IES position on LED Product Lifetime Prediction, IES PS-10-18, that explains proper use of IES TM-21 and LM-80.

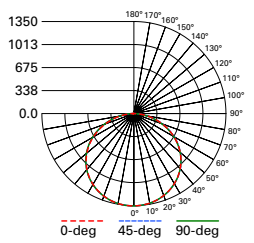
Metalux CGTX

TYPE - L1

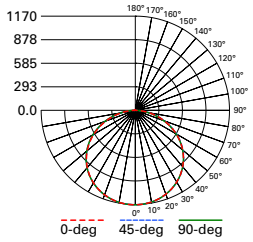
Photometric Data



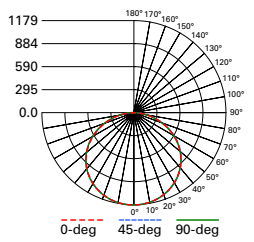
14CGTX-42-L835
Electronic Driver
LED 3500K
Spacing criterion: (II) 1.26 x mounting height, (⊥) 1.27 x mounting height
Lumens: 3911
Input Watts: 31.7W
Efficacy: 134 LPW
Test Report: 14CGTX-42-L835.IES



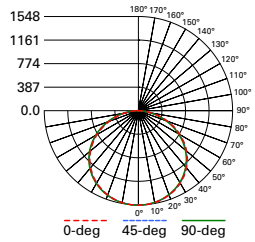
14CGTX-42HE-L835
Electronic Driver
LED 3500K
Spacing criterion: (II) 1.26 x mounting height, (⊥) 1.27 x mounting height
Lumens: 3984
Input Watts: 31.9W
Efficacy: 136 LPW
Test Report: 14CGTX-42HE-L835.IES



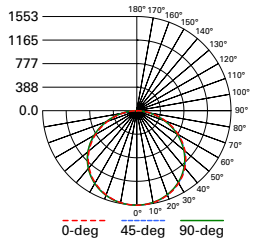
22CGTX-35-L835
Electronic Driver
LED 3500K
Spacing criterion: (II) 1.26 x mounting height, (⊥) 1.26 x mounting height
Lumens: 3606
Input Watts: 27.9W
Efficacy: 129 LPW
Test Report: 22CGTX-35-L835.IES



22CGTX-35HE-L835
Electronic Driver
LED 3500K
Spacing criterion: (II) 1.26 x mounting height, (⊥) 1.26 x mounting height
Lumens: 3633
Input Watts: 27.2W
Efficacy: 134 LPW
Test Report: 22CGTX-35HE-L835.IES



24CGTX-45-L835
Electronic Driver
LED 4000K
Spacing criterion: (II) 1.27 x mounting height, (⊥) 1.26 x mounting height
Lumens: 4649
Input Watts: 35.6W
Efficacy: 131 LPW
Test Report: 24CGTX-45-L835.IES



24CGTX-45HE-L835
Electronic Driver
LED 4000K
Spacing criterion: (II) 1.27 x mounting height, (⊥) 1.26 x mounting height
Lumens: 4662
Input Watts: 34.7W
Efficacy: 134 LPW
Test Report: 24CGTX-45HE-L835.IES

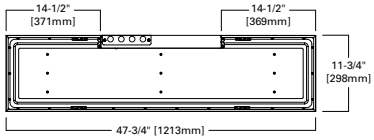
Metalux CGTX

TYPE - L1

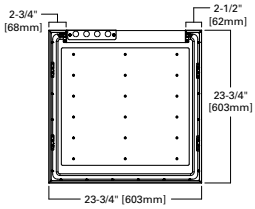
Dimensional and Mounting Details

Standard driver - no controls, EM, or flex

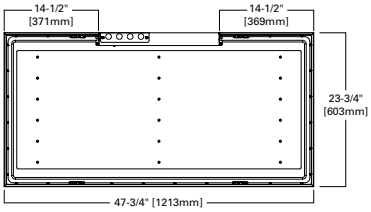
1x4



2x2

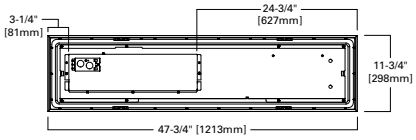


2x4

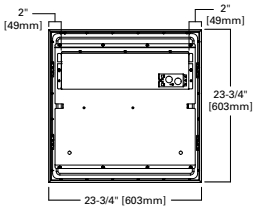


Alternative driver, with controls, EM and/or flex

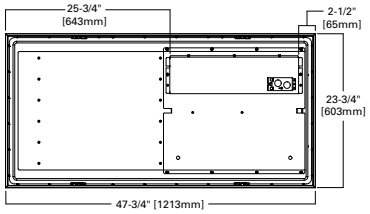
1x4



2x2



2x4



Metalux

CGTX

TYPE - L1

Control Solutions

- WaveLinx LITE wireless
- WaveLinx PRO wireless
- WaveLinx CAT wired
- WaveLinx Wired

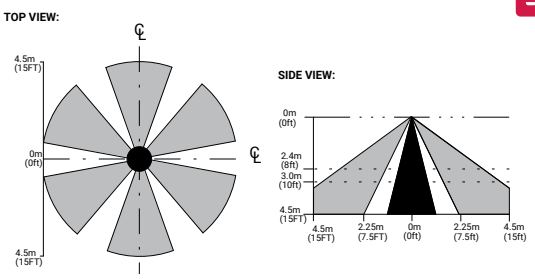
WaveLinx Digital Lighting Control Solutions

The CGTX with WaveLinx offers no-hassle lighting control with
solutions.

WaveLinx PRO is a wireless lighting control solution, for connected spaces, that significantly reduces a building's energy consumption. From a single floor to an entire campus, WaveLinx PRO connects more than lighting assets; it shares aggregated sensor data with the WaveLinx CORE platform and other building systems, so building owners can improve operations, spaces environment, and tenants' experience. WaveLinx PRO offers a rich portfolio of wireless devices, WaveLinx PRO-enabled luminaires, and an intuitive WaveLinx mobile app for office, education, warehouse, and parking garage applications.

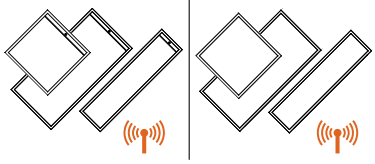
WaveLinx LITE is a cost effective, wireless digital lighting control solution, with out-of-the-box functionality, that saves energy and meets code. It's designed for applications that require occupancy-based, daylighting, or manual light control. Customize installations for office, education, warehouse and parking garages using the secure, simple mobile app.

Integrated Sensor Coverage Pattern



***Note**: Installation of integrated sensors within 3-ft (1m) of HVAC air vents is not recommended. The pattern shown is intended solely as a general guide and is not to scale.*

With Integrated WaveLinx Sensor | **With Integrated WaveLinx Node**



Add a hidden WaveLinx sensor node (WPN, WLN) to your space lighting design!

Allows to:

- Keeps luminaire aesthetics
- Connect fixtures without the realestate to include sensor option such as downlights
- Connect sealed fixtures without a standard sensor option such as products for clinical space.

Integrated Controls Options

Option	Out of the Box Functionality	Luminaire Level Lighting Control (LLLC)	Automatic Dimming Photocell	Occupancy Sensing	CCT Control
WLS	X	X	X	X	
WLN		X			
WPS		X	X	X	X
WPN		X			X

Note: WaveLinx utilizes scenes to allow users to change an area's fixtures Correlated Color Temperature (CCT) and intensity using commissioned manual wireless wallstation scene control. To enable CCT adjustments through WaveLinx, include WPS or WPN devices in addition to VividTune or BioUp technologies for integrated fixture control.

Systems comparison chart

Cooper Lighting Solutions provides many lighting system solutions designed to satisfy code requirements and meet the unique needs of any project.

	Luminaire with standalone sensor	Standalone Spaces WaveLinx LITE	Standalone Spaces WaveLinx CAT	Networked Spaces WaveLinx PRO	Enterprise WaveLinx CORE
Occupancy	Yes	Yes	Yes	Yes	Yes
Daylighting	Yes	Yes	Yes	Yes	Yes
Wallstations	–	Yes	Yes	Yes	Yes
Gateways	–	–	–	1 WAC	300 WACs
Devices (MAX)	–	40 per Area (1120 per space)	40 per Area	200 per WAC2	32,500 per CORE Enterprise
Software	–	WaveLinx LITE Mobile App	WaveLinx CAT Mobile App	WaveLinx Mobile App	CORE
Areas	–	28 per Space	Unlimited	50 per WAC2	up to 3,000
Zones	–	16 per Area	16 per Area	16 per Area	up to 9,000
Scheduling	–	–	–	Local	Global
VividTune™	–	–	–	Yes	Yes
Plug-Load Control	–	Yes	Yes	Yes	Yes
Low-Voltage Power	–	–	Yes	Yes	Yes
Integration	–	–	–	–	BACnet, API
Dashboards	–	–	–	–	Energy, Occupancy
Configuration	–	Installer	Installer	Technician	Technician / IT

COOPER Lighting Solutions
a ◎ignify business

Cooper Lighting Solutions
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

Project		Catalog #		Type	TYPE - L2A
Prepared by		Notes		Date	

Portfolio

LDSSQ4C | EU4C | 4LBSSQ

4" Shallow Square, new construction downlight
250-3000 Lumens

Typical Applications

Office • Education • Healthcare • Hospitality • Retail • Code-Compliance Areas • Sports Venues

Interactive Menu

Product Certification

ENERGY STAR · Efficiency Standards T24 · RoHS COMPLIANT · UL CERTIFIED · wet location

Product Features

powered by fifthlight · Showerlight · Recessed

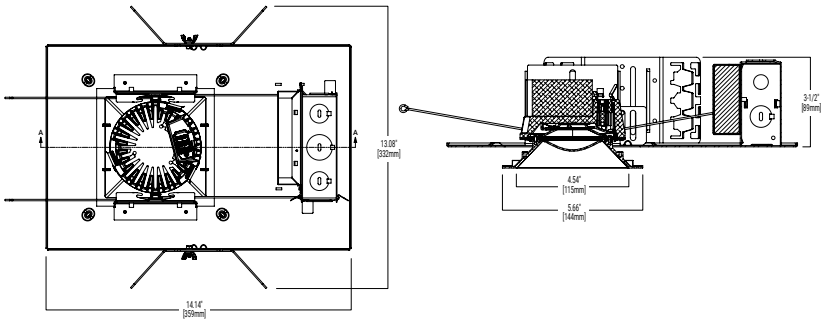
Control Compatibility

WaveLinx LITE · WaveLinx PRO

Top Product Features

- 250-4000 lumens; Offered in 90 and 97 CRI; ENERGY STAR® qualified
- Easy disconnect for LED engine replacement and installation
- Optional snap in driver for ease of replacement
- Standard 0-10V driver dims to 1%
- 2400K, 2700K, 3000K, 3500K, 4000K, 5000K; D2W™ option from 3000K to 1850K
- Available W2N tunable white CCT range 2700K to 6500K or 2000K to 5000K

Dimensional and Mounting Details



CLICK HERE dimension information

COOPER Lighting Solutions
a ⓘignify business

Portfolio

LDSSQ4 | EU4B | 4LBCSSQ

TYPE - L2A

Single Line Order Information

SAMPLE ORDER NUMBER: **LDSSQ4C109030D010CSSQ1MW= LDSSQ4C10D010 + EU4C10209030 + 4LBCSSQ1MW**
(all components in multiple packages in same shipment)

Invoice will indicate separate fixture components (housing, trim, module) which will ship complete from a single CLS facility in separate cartons.
To receive separate components (housing, trim, module) shipment, click on the "Multi-Line Ordering Information Option" button to the right.

Housing	Lumen [1]	Color Control	CCT [11]
LDSSQ4C=LED Shallow Square Downlight 4" Nominal Aperture **LDSSQ4CCP**=LED Shallow Square Downlight 4" Nominal Aperture, Chicago Plenum	**02** = 250 lumens, IC rated **05** = 500 lumens, IC rated **08** = 800 lumens, IC rated **10** = 1000 Lumens **10IC** = 1000 Lumens, IC rated **15** = 1500 Lumens **15IC** = 1500 Lumens, IC rated **20** = 2000 Lumens **25** = 2500 lumens **30** = 3000 Lumens **35** = 3500 lumens **40** = 4000 lumens	**90**=90 CRI Minimum **97**=97 CRI Minimum	**90 CRI** **24**=2400K **27**=2700K **30**=3000K **35**=3500K **40**=4000K **50**=5000K **97 CRI** **27**=2700K **30**=3000K

Voltage	Driver	Driver Options	Hanger Bars
Blank = 120-277V **3** = 347V (D010 driver 800-4000 lumens) 250 & 500 include step down transformer	**D010** = 0-10V 1% dimming 500-4000 lumens **D010TR**=0-10V or (120V) phase cut 1% dimming 250-4000 lumens **DE010** = 0-10V linear 0.1% dimming 500-4000 lumens **D5LT** = DALI T6 Logarithmic 0.1% Dimming 500-4000 lumens **DMX** = DMX/RDM Logarithmic 0.1% Dimming 800-4000 lumens [14] **DMXC5** = DMX/RDM Logarithmic 0.1% Dimming with RJ45 connection 800-4000 lumens [14] **DLE** = Lutron Ecosystem dimming 1-100% 800-4000 lumens **DLV** = Low voltage dimming 1-100% for use with DLVP system, 800-3000 lumens (not offered with plug in driver) [3]	**Blank** = Standard mount driver **PD** = Magnetic Plug in Driver [22]	**Blank** = Without hanger bars **B26** = C-channel Bar Hanger, 26" Long, Pair

INTERIOR FIXTURES TO HAVE MATTE WHITE FINISH

Trim Distribution [5]	Trim Flange	Trim Finish	Options [3] [8]
CSSQ=Cast Shallow Square, Die Cast Aluminum	**1**=Self-flanged [5] **2**=White Painted Self-flanged **3** = Flangeless for use with plaster lathing ring **4**=Knife edge rimless use with die cast only [13]	**MW**=Matte White (Antimicrobial) **MB**=Matte Black **MMS**=Matte Metallic Silver	**EMBOD6ST**=Bodine® 6W Self Test Emergency Module with Remote Test Switch **WPN** = WaveLinx PRO Wireless Node without sensor [11] [20] **WLN** = WaveLinx LITE Wireless Node without sensor [19] [20]
PSSQMW1=Non-Conductive Shallow (dead front), Self Flanged, White [15]			

Accessories (*Sold separately*) [18]

LGSKT4SQIP66=IP66 Gasket Kit

PRSQ4 = Rimless Plaster Ring [2]
RKPSQ4= Knife Edge plaster Ring [14]

RPMSQ4MW=Rimless Millwork Ring, Matte White [2]
RPMSQ4MB=Rimless Millwork Ring, Matte Black [2]
RKMSQ4MW=Knife Edge Millwork Ring, Matte White [14]
RKMSW4MB=Knife Edge Millwork Ring, Matte Black [14]

Bar Hangers
HB50=C-channel Bar Hanger, 50" Long, Pair
RMB22=Wood Joist Bar Hanger, 22" Long, Pair

Connected Lighting Systems [3] [7]
WPST = Field installed WaveLinx PRO Sensor Kit [9]
WLST = Field installed WaveLinx LITE Sensor Kit [10]

Notes:

1. Nominal Lumens will vary depending on selected color, CRI, driver and reflector finish. Reference Multiplier tables.
2. Order trim with flange type 3.
3. Not available with Chicago Plenum.
4. ULus listed only
5. Flange is the same finish as the reflector
6. DMX fixtures default to full on upon loss of DMX signal
7. Refer to system specifications for additional information,features, and benefits. Use with 0-10V driver.
8. Non-IC
9. WLST = WaveLinx LITE tilemount sensor kit for daylight dimming, PIR motion sensing, use with D010 only (Refer to WaveLinx LITE system specifications)
10. WPST = WaveLinx PRO wireless sensor kit for daylight dimming, PIR motion sensing, and optional RLTS - Real Time Location Services, use with 0-10V only.
11. WPN = WaveLinx PRO wireless node provides luminairelevel control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with D010 or DE010 drivers only.
13. Accessory (Requires knife edge accessory ring)
14. Order die cast trim with flange type 4
16. Limited to 2000 lumens
17. Not available with DLVP
18. Accessories sold separately will be separately analyzed under domestic preference.
19. WLN = WaveLinx LITE wireless node provides luminaire level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with D010 or DE010 drivers only.
20. Not compatible with 347V or Chicago plenum.

Portfolio

LDSSQ4 | EU4C | 4LBCSSQ

TYPE - L2A

Product Specifications

Lower Shielding Reflector
- Painted die cast aluminum with a lensed upper optical chamber providing superior lumen output with minimal source brightness
- Plaster lathing ring, knife edge and millwork ring accessory for flush reflector transition

Trim Retention
- Two torsion springs hold reflector flange tightly to the finished ceiling surface

Plaster Frame/Collar
- Galvanized steel plaster frame with adjustable collar adjusts for up to 2" thick ceilings and rotates+/- 7.5°.

Universal Mounting Bracket
- Accepts 1/2" Electric Metallic Tube (EMT), C-channel and bar hangers
- Adjusts 5" vertically from above and below the ceiling

Junction box
- Four 1/2" and two 3/4" trade size pry outs positioned to allow straight conduit runs
- Lever connectors for simple push in wiring
- Listed for (4) #12 AWG (two in, two out) 90°C conductors and feed thru branch wiring for type IC and Plug in drivers for 120/277V only. For all other cases (8) #12 AWG (four in, four out) 90°C conductors and feed thru branch wiring for 120/277V only

Thermal
- Aluminum heat sink conducts heat away from the LED module for improved performance and longer life

LED System
- Contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution without pixilation
- Auto resetting, thermally protected, LED's are turned off when safe operating temperatures are exceeded
- Quick disconnect allows for tool-less replacement of LED engine from below ceiling
- 90 and 97 CRI
- 90 & 97CRI: L78 55,000 hours for 1000-2000 lumens, L90 55,000 for all other lumen output
- Color variation within 2-step MacAdam ellipses
- Available in 2400K, 2700K, 3000K, 3500K, 4000K and 5000K correlated color temperature (CCT)

Vividtune and High CRI
- 98 CRI and W2N: L70 55,000 hours
- D2W™ – dim-to-warm shifts CCT from 3000K to 1850K as fixture dims mimicking halogen sources.
- W2N - Tunable white CCT range 2700K to 6500K or 2000K to 5000K, 90 CRI. Standard
- **98 CRI** With a full-spectrum approach using broad-blue chip technology and special phosphor blends, Thrive is able to closely match the spectrum of the sun across all color temperatures. Benefits of the natural spectrum of the sun using Thrive include superior accurate color rendering, reduced eye strain, and a higher sense of emotional well-being.
- See dedicated specification sheet for more details.

Driver
- Standard 120-277V 0-10V dimming driver provides flicker free dimming from 100% to 1%
- Optional 120V leading edge/0-10V, <1% 0-10V, Fifth Light, DMX or Lutron® Ecosystem
- Driver can be serviced from above or through the aperture
- Distributed low voltage power system combines power, lighting, and controls with ease of installation.
- Optional magnetically guided snap in driver for ease of maintenance.

Emergency Option
- Self test 6W battery provides 90 minutes of standby lighting, meeting most life safety codes for egress lighting
- UL 924 listed

Connected Lighting System
Two WaveLinx connected solutions to choose from. Refer to WaveLinx system specifications and application guides for details.

WaveLinx PRO Tilemount Sensor Kit
- WaveLinx PRO WPST tilemount sensor kit offers daylight dimming, PIR motion sensing, scene and zone configuration, automatic commissioning; and optional RLTS - Real Time Location Services available.

WaveLinx PRO Wireless Node
- WaveLinx PRO WPN wireless node provides luminaire-level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with 0-10V driver only. **Note:** Not compatible with 347V or Chicago plenum.

WaveLinx LITE Tilemount Sensor Kit
- WaveLinx LITE WLST tilemount sensor kit offers daylight dimming and PIR motion sensing, scene and grouping configuration.

WaveLinx LITE Wireless Node
- WaveLinx LITE WLN wireless node provides luminaire level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with 0-10V driver only. **Note:** Not compatible with 347V or Chicago plenum.

WaveLinx Tilemount
- The WPST and WLST tilemount kits include a control module mounted on the luminaire junction box via 1/2" knock-out, and a tilemount sensor on 54-inch whip; for ceiling installation by direct-mount spring clips or via mounting bracket in octagon ceiling boxes.
- The WPST and WLST tilemount kits may be ordered as factory installed on the luminaire, or ordered separately as a field installed accessory kit.
- **Note: WaveLinx PRO devices are only compatible with the WaveLinx PRO system.**
- **Note: WaveLinx LITE devices are only compatible with the WaveLinx LITE system.**

Code Compliance
- Thermally protected
- cULus Certified to UL 1598 / C22.2 No. 250.0 suitable for wet locations with covered ceiling
- IP66 rated when used with IP66 gasket kit accessory
- Use IP66 gasket with non conductive reflector for steam room applications up to 2000 lumens and 40°C.
- Optional City of Chicago environmental air (CCEA) marking for plenum applications
- FCC CFR Title 47 Part 15 Class B at 120VAC and Class A at 277VAC
- Insulated ceiling (IC) rated up to 1,500 lumens (90 and 97CRI). All others are non-IC rated (insulation must be kept 3" from top and sides of housing).
- Can be used for State of California Title 24 high efficacy LED compliance under JA8, reference Modernized Appliance Efficiency Database System (MAEDBS) for 2016 JA8 High Efficacy Lighting
- RoHS compliant
- Photometric testing completed in accordance with IES LM-79
- LED life testing completed in accordance with IES LM-80-08 and TM-21-11 standards

Warranty
- Five year warranty www.cooperlighting.com/legal

Marked Spacing

4-inch Marked spacing for 90 and 97 CRI			
Lumens	**Center to Center of Adjacent Luminaire (inches)**	**Center Luminaire to Building Side Member (inches)**	**Minimum Overhead Height (inches)**
4000	36	18	6
4000-7500 (Lutron)	36	18	8
4500-7500	36	18	8

Portfolio

LDSSQ4 | EU4C | 4LBCSSQ

Energy and Performance Data

TYPE - L2A

D010 DRIVER ENERGY DATA

Series	250 lumen		500 lumen		800 lumen		1000 lumen		1500 lumen		2000 lumen	
Input Voltage 120-277VAC	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V
Input Current (A)	0.029	0.017	0.061	0.032	0.085	0.041	0.084	0.042	0.135	0.063	0.189	0.084
Input Power (W)	3.45	3.87	7.33	7.78	10.15	10.52	10.04	10.43	16.17	16.56	22.58	22.63
In-rush (A)	2.1	8.5	3.7	8.5	3.6	8.3	3.6	8.4	2.3	9.5	2.1	9.7
Inrush duration (µs)	250	131	190	136	220	135	226	136	230	125	243	132
THDi (%)	7.21	16.92	7.82	10.78	5.57	9.63	7.78	9.24	4.75	9.93	8.03	7.44
PF	≥ 0.98	≥ 0.9	≥ 0.99	≥ 0.93	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.94	≥ 0.99	≥ 0.96

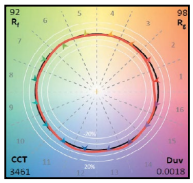
Series	2500 lumen		3000 lumen	
Input Voltage 120-277VAC	120V	277V	120V	277V
Input Current (A)	0.276	0.121	0.276	0.121
Input Power (W)	32.98	32.57	32	32.57
In-rush (A)	2.5	11.8	3.6	11.8
Inrush duration (µs)	215	111	220	111
THDi (%)	9.86	6.57	5.57	6.57
PF	≥ 0.99	≥ 0.97	≥ 0.99	≥ 0.99

Minimum starting temperature -30°C (-22°F)* (Nominal input 120-277VAC & 100% of rated output power)
Sound Rating: Class A standards

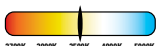
Notes:
Emergency Battery packs are rated for a minimum starting temperature of 0°C.

COLOR METRICS - TM-30-15 & CRI/CIE

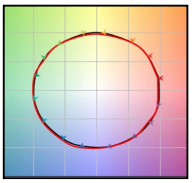
90 CRI Color Metric Summary - 3500K*



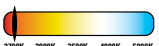
TM-30-15	Rf = 92
	Rg = 98
CRI/CIE	Ra = 92.2
	R9 = 51.4



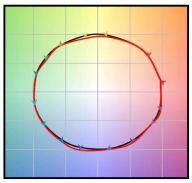
97 CRI Color Metric Summary - 2700K*



TM-30-15	Rf = 95
	Rg = 99.8
CRI/CIE	Ra = 97.2
	R9 = 98.5



97 CRI Color Metric Summary - 3000K*



TM-30-15	Rf = 93.9
	Rg = 100.2
CRI/CIE	Ra = 98.7
	R9 = 97.2

* Color values are based on haze reflector, other finishes and field results may vary.

Portfolio

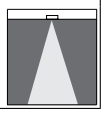
LDSSQ4 | EU4C | 4LBCSSQ

TYPE - L2A

Photometric Data

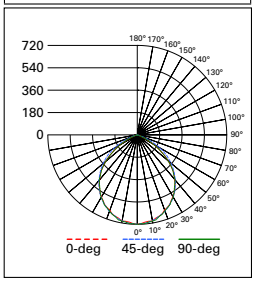
NON CONDUCTIVE

Test Number	P571650
Housing	LDSSQ4C15D010
Module	EU4C10209035
Trim	4LBPSSQMW
Lumens	1537
Efficacy	97.3 Lm/W
SC	1.2
UGR	24.8

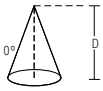


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	45.4	4.6	4.6
7'	14.8	8.2	8.2
9'	9	10.6	10.6
13'	4.3	15.4	15.4
16'	2.8	18.8	19

CANDELA TABLE

Degrees Vertical	Candela
0	720
5	705
15	678
25	618
35	526
45	410
55	237
65	78
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	545	35.5
0-40	876	57
0-60	1425	92.7
0-90	1537	100
90-180	0	0
0-180	1537	100

LUMINANCE

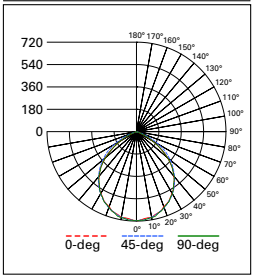
Average Candela Degrees	Average 0° Luminance
37	61218
45	55920
55	39886
65	17740
75	746
85	0

SHALLOW SQUARE MATTE WHITE

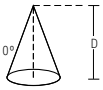
Test Number	P563395
Housing	LDSSQ4C15D010
Module	EU4C10209035
Trim	4LBCSSQMW
Lumens	1537
Efficacy	97.3 Lm/W
SC	1.2
UGR	24

CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	45.4	4.6	4.6
7'	14.8	8.2	8.2
9'	9	10.6	10.6
13'	4.3	15.4	15.4
16'	2.8	18.8	19

CANDELA TABLE

Degrees Vertical	Candela
0	720
5	705
15	678
25	618
35	526
45	410
55	237
65	78
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	545	35.5
0-40	876	57
0-60	1425	92.7
0-90	1537	100
90-180	0	0
0-180	1537	100

LUMINANCE

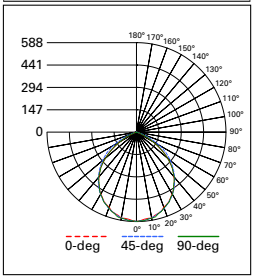
Average Candela Degrees	Average 0° Luminance
37	61218
45	55920
55	39886
65	17740
75	746
85	0

SHALLOW SQUARE MATTE METALLIC SILVER

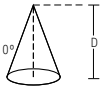
Test Number	P563394
Housing	LDSSQ4C15D010
Module	EU4C10209035
Trim	4LBCSSQMMS
Lumens	1257
Efficacy	79.6 Lm/W
SC	1.2
UGR	24

CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	37.1	4.6	4.6
7'	12.1	8.2	8.2
9'	7.3	10.6	10.6
13'	3.5	15.4	15.4
16'	2.3	18.8	19

CANDELA TABLE

Degrees Vertical	Candela
0	588
5	577
15	554
25	506
35	430
45	335
55	194
65	64
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	446	35.5
0-40	716	57
0-60	1166	92.7
0-90	1257	100
90-180	0	0
0-180	1257	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	50067
45	45740
55	32618
65	14498
75	634
85	0

Photometric Multipliers (Nominal Lumen Values)

250 Lumen	500 Lumen	800 Lumen	1000 Lumen	1500 Lumen	2000 Lumen	2500 Lumen	3000 Lumen
0.224	0.423	0.569	0.653	1.00	1.29	1.62	1.902

Multipliers for relative lumen values with other series models.

CCT Multipliers – 90CRI

2400K	2700K	3000K	3500K	4000K	5000K
0.912	0.949	0.986	1	1.001	1.022

Multipliers for relative lumen values with other series color temperatures.

CCT Multipliers – 97CRI

2700K	3000K	3500K	4000K	5000K
0.889	0.955	1	1.016	1.07

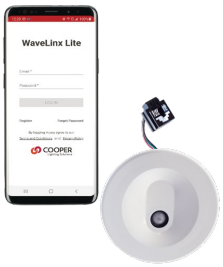
Multipliers for relative lumen values with other series color temperatures.

Portfolio

LDSSQ4 | EU4B | 4LBCSSQ

Connected Systems

TYPE - L2A



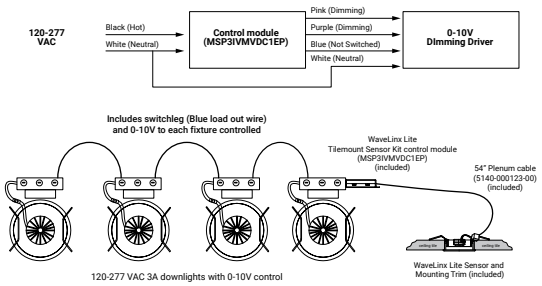
WaveLinx LITE - WLST Tilemount Sensor

WaveLinx LITE devices only compatible with the WaveLinx LITE system.

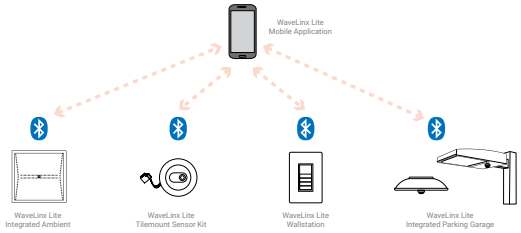
- Intuitive Android™ or Apple® iOS® app for basic system code compliant set up and configuration via Bluetooth
- Up to 28 unique areas per project site (WaveLinx LITE Bluetooth network)
- Up to 50 devices for an area, any one of 16 control zones, up to 6 occupancy sets, and custom lighting scenes
- Automatic occupancy or vacancy, sensor sensitivity, daylight dimming, etc. configurable through the app
- Refer to the WaveLinx system specifications for details

Device Security | Manual Dimmer | Occupancy Sensor | Daylighting Control | Manually Switched ON/OFF | Tuning Control | Lumen Maintenance Control | Scenes

WaveLinx LITE WLST Tilemount Wiring Diagram



WaveLinx LITE Bluetooth Enabled System



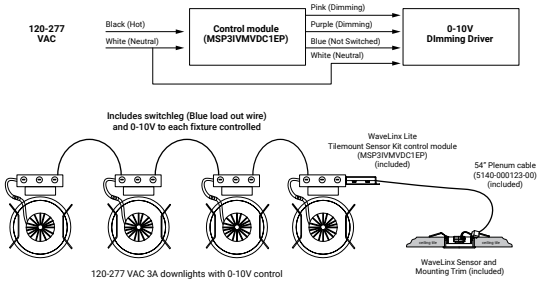
WaveLinx PRO Wireless – WPST Tilemount Sensor

WaveLinx PRO devices only compatible with the WaveLinx PRO system.

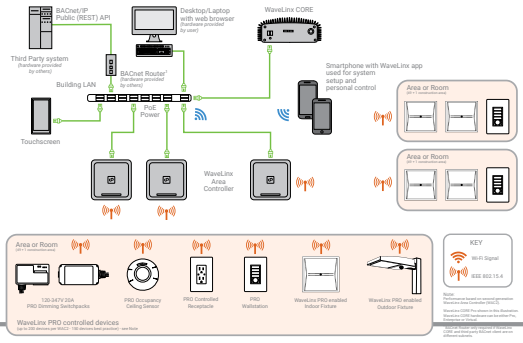
- WaveLinx PRO Wireless functionality configures zones and customizes settings from one secure mobile app
- Automatic code commissioning that meets the strictest codes
- Fixtures and sensors integrate with Wireless Area Controller, Wall Stations, and Control Devices
- Stand-Alone Offices or Entire Building Network Installations

WaveLinx mobile app settings

WaveLinx PRO WPST Tilemount Wiring Diagram



WaveLinx CORE Building Management Integration



COOPER Lighting Solutions
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Portfolio

LDSSQ4 | EU4B | 4LBCSSQ

TYPE - L2A

Connected Solutions

WaveLinx LITE Wireless Node - WLN

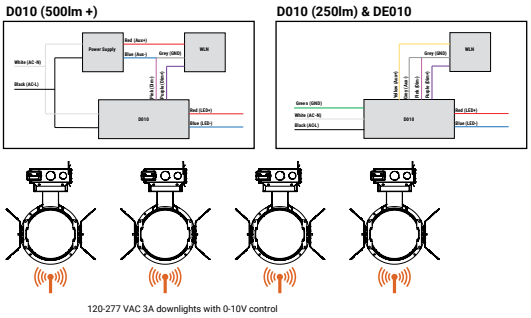
WaveLinx LITE devices only compatible with the WaveLinx LITE system.

- Intuitive Android™ or Apple® iOS® app for basic system code compliant set up and configuration via Bluetooth
- Up to 28 unique areas per project site (WaveLinx LITE Bluetooth network)
- Up to 50 devices for an area, any one of 16 control zones, up to 6 occupancy sets, and custom lighting scenes
- Refer to the WaveLinx system specifications for details
- Not available with BioUp or Tunable White

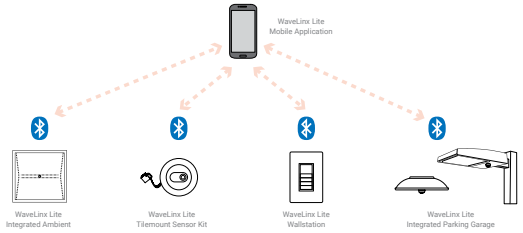
WaveLinx mobile app settings

Device Security · Manual Dimmer · Occupancy Sensor · Daylighting Control · Manually Switched ON/OFF · Tuning Control · Lumen Maintenance Control · Scenes

WaveLinx LITE Wireless Node (WLN) Wiring Diagram



WaveLinx LITE Bluetooth Enabled System



WaveLinx PRO Wireless Node - WPN

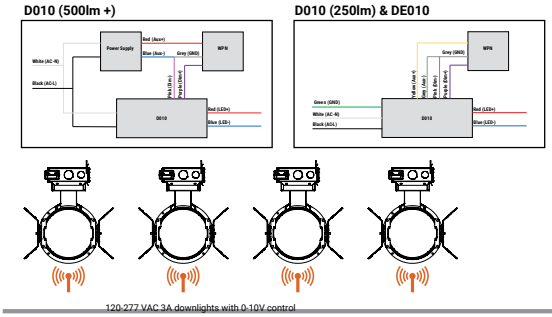
WaveLinx PRO devices only compatible with the WaveLinx PRO system.

- WaveLinx Wireless functionality configures zones and customizes settings from one secure mobile app
- Automatic code commissioning that meets the strictest codes
- Fixtures and sensors integrate with WaveLinx Area Controller, Wall Stations, and Control Devices
- Stand-Alone Offices or Entire Building Network Installations

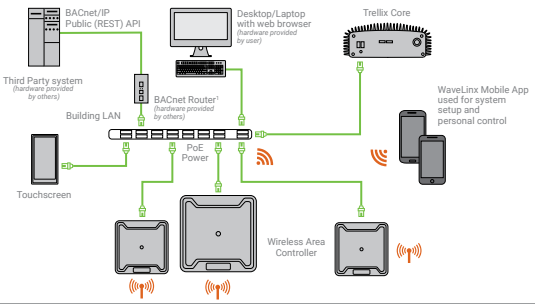
WaveLinx mobile app settings

Manual Dimmer · Occupancy Sensor · Lumen Maintenance Control · Daylighting Control · Receptacle Control · Tuning Control · Scheduling · Manually Switched ON/OFF · Demand Response

WaveLinx PRO Wireless Node (WPN) Wiring Diagram



WaveLinx CORE Building Management Integration



COOPER Lighting Solutions
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Portfolio LDSSQ4 | EU4C | 4LBCSSQ

TYPE - L2A

Multi-line Order Information

SAMPLE ORDER NUMBER: **LDSSQ4C10D010TRIEM14**

Invoice will indicate separate fixture components (housing, trim, module) and may ship from multiple CLS facilities in separate cartons.

Housing	Lumens [2]	
LDSSQ4C=LED Square Downlight 4" Nominal Aperture **LDSSQ4CCP**=LED Square Downlight 4" Nominal Aperture, Chicago Plenum	**02**=250 lumens **05**=500 lumens **08**=800 lumens **10**=1000 lumens **15**=1500 lumens	**20**=2000 lumens **25**=2500 lumens **30**=3000 lumens **35** = 3500 lumens **40** = 4000 lumens

Driver	Driver Options	Options [6] [19] [20] [21]
D010 = 0-10V Dimming, 1% to 100%, 120V-277V 500-4000 lumens **3D010**=0-10V Dimming, 1% to 100%, 347V dedicated drivers for 800 to 4000 lumens; and 500 use step down transformers	**Blank**=Integral driver **R**=Remote driver (order remote driver separately) (not available with CP) **PD**=Magnetic Plug in Driver [8]	**EMBOD6ST**=Bodine® 6W Self Test Emergency Module with Remote Test Switch **WPN** = WaveLinx PRO Wireless Node without sensor [23] [20] **WLN** = WaveLinx LITE Wireless Node without sensor [25] [20]
D010TR = 0-10V Dimming, 1% to 100%, 120V-277V 250- 4000 lumens **3D010TR**=0-10V Dimming, 1% to 100%, 347V step down transformer 250-4000 lumens		
DE010 = 0-10V Dimming, 0.1% to 100%, 120V-277V 500-4000 lumens **3DE010**=0-10V Dimming, 0.1% to 100%, 347V step down transformer 500-4000 lumens		
D5LT = Fifth Light® (DALI T6) Logarithmic Dimming, 0.1% to 100%, 120V-277V, 500-4000 lumens **3D5LT**=Fifth Light® (DALI T6) Logarithmic Dimming, 0.1% to 100% 347V step down transformer, 500-4000 lumens		
DMX = DMX/RDM Logarithmic Dimming, 0.1% to 100%, 120V-277V 800-4000 lumens [5] **3DMX**=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 347V step down transformer, 800-4000 [5]		
DMXC5 = DMX/RDM Logarithmic Dimming, 0.1% to 100%, 120V-277V, 800-4000 lumens, RJ45 Connection [5] **3DMXC5**=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 347V step down transformer, 800-4000, RJ45 Connection [5]		
DLE = Lutron Ecosystem dimming 1% to 100%, 120V-277V, 800-3500 lumens **3DLE**=Lutron Ecosystem dimming 1% to 100%, 347, step down transformer, 800-3500 lumens		
DLV = Low voltage dimming driver (1-100%) for use with DLVP system 800-3000 lumens (Not offered with plug in driver) [6]		

SAMPLE ORDER NUMBER: **EU4C10209035**

Power Module	Lumen Levels [2]	CRI [2]	Color	
EU4C=4-inch Universal LED Module	**0208IC**=250, 500, 800 lumens, IC Rated (For use with all drivers, min 500 lumen with DE010 and D5LT, min 800 lumens with DLVP, Lutron and DMX) **1020**=1000, 1500, 2000 lumens **1015IC**=1000, 1500 lumens IC Rated **2540**=2500, 3000, 3500, 4000 lumens (For use with Lutron 3000-3500, DLVP 3000 lumens, DMX, D010, D010TR, D5LT and DE010 3000-4000)	**90**=90 CRI Minimum **97**=97 CRI Minimum	**90 CRI** **24**=2400K **27**=2700K **30**=3000K **35**=3500K **40**=4000K **50**=5000K	**97 CRI** **27**=2700K **30**=3000K

SAMPLE ORDER NUMBER: **4LBM2H**

Trim	Reflector	Flange	Finish
4LB=4" LED	**CSSQ**=Cast Shallow Square, Die Cast Aluminum	**1**=Self flanged [14] **2**=White painted self flanged **4**=Knife edge rimless use with die cast only [15]	**MW**=Matte White **MB**=Matte Black **MMS**=Matte Metallic Silver
	PSSQMW1=Non-Conductive Shallow (dead front), Self Flanged, White [24]		

Continued on next page.

Portfolio

LDSSQ4 | EU4C | 4LBCSSQ

TYPE - L2A

Multi-line Order Information

REQUIRED if Remote Driver (R) is specified

SAMPLE ORDER NUMBER: **RC10010D010TREM7**

Remote Drivers [6]		Lumens [2] [4]	
RC100=Remote 100ft	**RC15**=Remote 15ft	**02**=250 lumens	**20**=2000 lumens
RC75=Remote 75ft	**RC5**=Remote 5ft	**05**=500 lumens	**25**=2500 lumens
RC50=Remote 50ft	**RC2**=Remote 2ft	**08**=800 lumens	**30**=3000 lumens
RC25=Remote 25ft		**10**=1000 lumens	**35**=3500 lumens
		15=1500 lumens	**40**=4000 lumens

Driver

D010 = 0-10V Dimming, 1% to 100%, 120V-277V, 500-3000 lumens
1D010 = 0-10V Dimming, 1% to 100%, 120V, 3500-4000 lumens
2D010 = 0-10V Dimming, 1% to 100%, 277V, 3500-4000 lumens
3D010 = 0-10V Dimming, 1% to 100%, 347V dedicated drivers for 800 to 4000 lumens; and 500 lumens use step down transformer

D010TR = 0-10V Dimming, 1% to 100%, 120V-277V, 250- 3000 lumens
1D010TR = 0-10V Dimming, 1% to 100%, 120V, 3500-4000 lumens
2D010TR = 0-10V Dimming, 1% to 100%, 277V, 3500-4000 lumens
3D010TR = 0-10V Dimming, 1% to 100% 347V step down transformer, 250-4000 lumens

DE010 = 0-10V Dimming, 0.1% to 100%, 120V-277V, 500-3000 lumens
1DE010 = 0-10V Dimming, 0.1% to 100%, 120V, 3500-4000 lumens
2DE010 = 0-10V Dimming, 0.1% to 100%, 277V, 3500-4000 lumens
3DE010 = 0-10V Dimming, 0.1% to 100%0-10V Dimming 347V step down transformer, 500-4000 lumens

D5LT = Fifth Light® (DALI T6) Logarithmic Dimming, 0.1% to 100%, 120V-277V, 500-3000 lumens
1D5LT = Fifth Light® (DALI T6) Logarithmic Dimming, 0.1% to 100%, 120V, 3500-4000 lumens
2D5LT =Fifth Light® (DALI T6) Logarithmic Dimming, 0.1% to 100%, 277V, 3500-4000 lumens
3D5LT =Fifth Light® (DALI T6) Logarithmic Dimming, 0.1% to 100% 347V step down transformer, 500-4000 lumens

DMX = DMX/RDM Logarithmic Dimming, 0.1% to 100%, 120V-277V, 800-3000 lumens [5]
1DMX=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 120V, 3,500-4000 [5]
2DMX=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 277V, 3,500-4000 [5]
3DMX=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 347V step down transformer, 800-4000 [5]

DMXC5 = DMX/RDM Logarithmic Dimming, 0.1% to 100%, 120V-277V up to 800-3000 lumens, RJ45 Connection [5]
1DMXC5=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 120V, 3,500-4000 lumens, RJ45 Connection [5]
2DMXC5=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 277V, 3,500-4000 lumens, RJ45 Connection [5]
3DMXCF=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 347V step down transformer, 800-4000 lumens, RJ45 Connection [5]

DLE = Lutron Ecosystem dimming 1% to 100%, 120V-277V, 25' Max remote length, 800-3000 lumens
1DLE=Lutron Ecosystem dimming 1% to 100%, 120V, 25' Max remote length, 3500 lumens
2DLE=Lutron Ecosystem dimming 1% to 100%, 277V, 25' Max remote length, 3500 lumens
3DLE=Lutron Ecosystem dimming 1% to 100%, 347V, step down transformer, 25' Max remote length, 800-3500 lumens

DLV = Low voltage dimming driver (1-100%) for use with DLVP system, 800-3000 lumens [6]

Options [6] [19] [20] [21]

EMBOD=Bodine® Emergency Module with Remote Test Switch
EMBOD6ST=Bodine® 6W Self Test Emergency Module with Remote Test Switch
EM7=7W Emergency Module with Remote Test Switch
EM14=14W Emergency Module with Remote Test Switch
EMBOD7ST=Bodine® Self Test Emergency Module
EMV7=7W Low Voltage Emergency Module with Remote Test Switch [7]
EMV14=14W Low Voltage Emergency Module with Remote Test Switch [7]
ETRD=Emergency transfer device [22]

PROVIDE FOR FIXTURES LABELED EM

Controls

WPST=Factory installed WaveLinx PRO Sensor Kit [11] [13]
WLST=Factory installed WaveLinx LITE Sensor Kit [11] [12]
WPN = WaveLinx PRO Wireless Node without sensor [23] [26]
WLN = WaveLinx LITE Wireless Node without sensor [25] [26]

Accessories

LGSKT4SQIP66=IP66 Gasket Kit

PRSQ4 = Rimless Plaster Ring [17]
RKPSQ4 = Knife Edge plaster Ring [18]

RPMSQ4MW=Rimless Millwork Ring, Matte White [17]
RPMSQ4MB=Rimless Millwork Ring, Matte Black [17]
RKMSQ4MW=Knife Edge Millwork Ring, Matte White [18]
RKMSW4MB=Knife Edge Millwork Ring, Matte Black [18]

Bar Hangers
HB26=C-channel Bar Hanger, 26" Long, Pair
HB50=C-channel Bar Hanger, 50" Long, Pair
RMB22=Wood Joist Bar Hanger, 22" Long, Pair

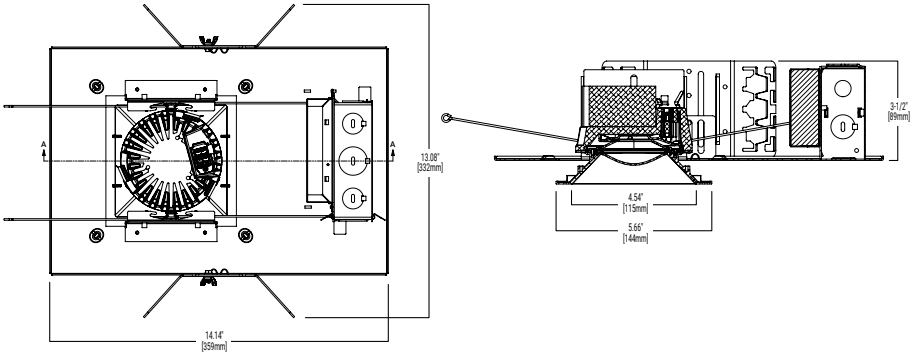
Connected Lighting Systems [6] [11]
WPST = Field installed WaveLinx PRO Sensor Kit [13]
WLST = Field installed WaveLinx LITE Sensor Kit [12]

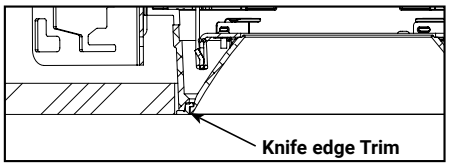
Notes:
2. Nominal Lumens will vary depending on selected color, CRI, driver and reflector finish. Reference Multiplier tables.
4. IC rated up to 3000 lumens for 90 & 97 CRI
5. DMX fixtures default to full on upon loss of DMX signal.
6. Not available with Chicago Plenum.
7. ULus listed only
8. Not available with DLVP
11. Refer to system specifications for additional information,features, and benefits. Order either factory installed option or accessory. Use with 0-10V driver.
12. WLST = WaveLinx LITE tilemount sensor kit for daylight dimming, PIR motion sensing, use with D010 only (Refer to WaveLinx LITE system specifications)
13. WPST = WaveLinx PRO wireless sensor kit for daylight dimming, PIR motion sensing, and optional RLTS - RealTime Location Services, use with 0-10V only.
14. Flange is the same finish as the reflector
15. Requires knife edge ring
16. Accessories sold separately will be separately analyzed under domestic preference.
17. Order trim with flange type 3.
18. Order die cast trim with flange type 4
19. For remote driver order emergency module with the remote driver.
20. 120V-277V
21. Non-IC
22. Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others)
23. WPN = WaveLinx PRO wireless node provides luminairelevel control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with D010 or DE010 drivers only.
24. Limited to 2000 lumens
25. WLN = WaveLinx LITE wireless node provides luminaire level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with D010 or DE010 drivers only.
26. Not compatible with 347V or Chicago plenum.

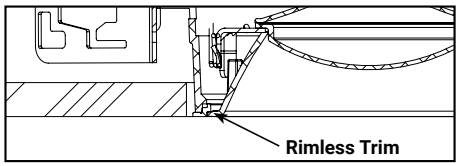
Portfolio LDSSQ4 | EU4B | 4LBCSSQ

Dimensional and Mounting Details

TYPE - L2A







Project		Catalog #		Type	TYPE - L2B
Prepared by		Notes		Date	

Portfolio

LDSSQ4C | EU4C | 4LBSSQ

4” Shallow Square, new construction downlight
250-3000 Lumens

Typical Applications

Office • Education • Healthcare • Hospitality • Retail • Code-Compliance Areas • Sports Venues

Interactive Menu

Product Certification

ENERGY STAR · Efficiency Standards T24 · RoHS Compliant · UL Certified · wet location

Product Features

powered by fifthlight · Showerlight · Recessed

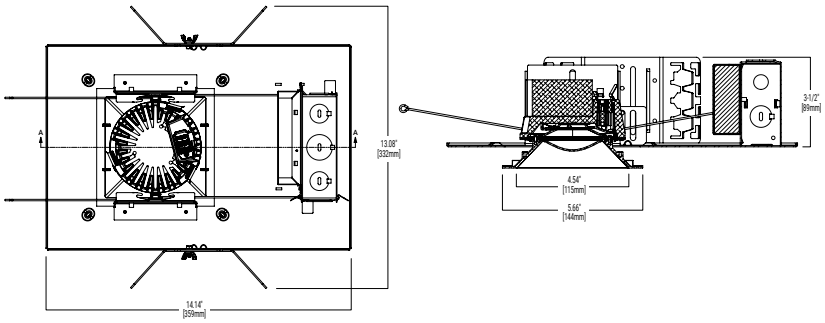
Control Compatibility

WaveLinx LITE · WaveLinx PRO

Top Product Features

- 250-4000 lumens; Offered in 90 and 97 CRI; ENERGY STAR® qualified
- Easy disconnect for LED engine replacement and installation
- Optional snap in driver for ease of replacement
- Standard 0-10V driver dims to 1%
- 2400K, 2700K, 3000K, 3500K, 4000K, 5000K; D2W™ option from 3000K to 1850K
- Available W2N tunable white CCT range 2700K to 6500K or 2000K to 5000K

Dimensional and Mounting Details



CLICK HERE dimension information

COOPER Lighting Solutions
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Portfolio

LDSSQ4 | EU4B | 4LBCSSQ

TYPE - L2B

Single Line Order Information

SAMPLE ORDER NUMBER: **LDSSQ4C109030D010CSSQ1MW= LDSSQ4C10D010 + EU4C10209030 + 4LBCSSQ1MW**
(all components in multiple packages in same shipment)

Invoice will indicate separate fixture components (housing, trim, module) which will ship complete from a single CLS facility in separate cartons.
To receive separate components (housing, trim, module) shipment, click on the "Multi-Line Ordering Information Option" button to the right.

Housing	Lumen [1]	Color Control	CCT [11]
LDSSQ4C=LED Shallow Square Downlight 4" Nominal Aperture **LDSSQ4CCP**=LED Shallow Square Downlight 4" Nominal Aperture, Chicago Plenum	**02** = 250 lumens, IC rated **05** = 500 lumens, IC rated **08** = 800 lumens, IC rated **10** = 1000 Lumens **10IC** = 1000 Lumens, IC rated **15** = 1500 Lumens **15IC** = 1500 Lumens, IC rated **20** = 2000 Lumens **25** = 2500 lumens **30** = 3000 Lumens **35** = 3500 lumens **40** = 4000 lumens	**90**=90 CRI Minimum **97**=97 CRI Minimum	**90 CRI** **24**=2400K **27**=2700K **30**=3000K **35**=3500K **40**=4000K **50**=5000K **97 CRI** **27**=2700K **30**=3000K

Voltage	Driver	Driver Options	Hanger Bars
Blank = 120-277V **3** = 347V (D010 driver 800-4000 lumens) 250 & 500 include step down transformer	**D010** = 0-10V 1% dimming 500-4000 lumens **D010TR**=0-10V or (120V) phase cut 1% dimming 250-4000 lumens **DE010** = 0-10V linear 0.1% dimming 500-4000 lumens **D5LT** = DALI T6 Logarithmic 0.1% Dimming 500-4000 lumens **DMX** = DMX/RDM Logarithmic 0.1% Dimming 800-4000 lumens [14] **DMXC5** = DMX/RDM Logarithmic 0.1% Dimming with RJ45 connection 800-4000 lumens [14] **DLE** = Lutron Ecosystem dimming 1-100% 800-4000 lumens **DLV** = Low voltage dimming 1-100% for use with DLVP system, 800-3000 lumens (not offered with plug in driver) [3]	**Blank** = Standard mount driver **PD** = Magnetic Plug in Driver [22]	**Blank** = Without hanger bars **B26** = C-channel Bar Hanger, 26" Long, Pair

EXTERIOR FIXTURES TO HAVE MATTE BLACK FINISH

Trim Distribution [5]	Trim Flange	Trim Finish	Options [4] [6]
CSSQ=Cast Shallow Square, Die Cast Aluminum	**1**=Self-flanged [5] **2**=White Painted Self-flanged **3** = Flangeless for use with plaster lathing ring **4**=Knife edge rimless use with die cast only [13]	**MW**=Matte White (Antimicrobial) **MB**=Matte Black **MMS**=Matte Metallic Silver	**EMBOD6ST**=Bodine® 6W Self Test Emergency Module with Remote Test Switch **WPN** = WaveLinx PRO Wireless Node without sensor [11] [20] **WLN** = WaveLinx LITE Wireless Node without sensor [19] [20]
PSSQMW1=Non-Conductive Shallow (dead front), Self Flanged, White [15]			

Accessories (*Sold separately*) [18]			
LGSKT4SQIP66=IP66 Gasket Kit **PRSQ4** = Rimless Plaster Ring [2] **RKPSQ4**= Knife Edge plaster Ring [14]	**RPMSQ4MW**=Rimless Millwork Ring, Matte White [2] **RPMSQ4MB**=Rimless Millwork Ring, Matte Black [2] **RKMSQ4MW**=Knife Edge Millwork Ring, Matte White [14] **RKMSW4MB**=Knife Edge Millwork Ring, Matte Black [14]	**Bar Hangers** **HB50**=C-channel Bar Hanger, 50" Long, Pair **RMB22**=Wood Joist Bar Hanger, 22" Long, Pair	**Connected Lighting Systems** [8] [7] **WPST** = Field installed WaveLinx PRO Sensor Kit [9] **WLST** = Field installed WaveLinx LITE Sensor Kit [10]

Notes:

1. Nominal Lumens will vary depending on selected color, CRI, driver and reflector finish. Reference Multiplier tables.
2. Order trim with flange type 3.
3. Not available with Chicago Plenum.
4. ULus listed only
5. Flange is the same finish as the reflector
6. DMX fixtures default to full on upon loss of DMX signal
7. Refer to system specifications for additional information,features, and benefits. Use with 0-10V driver.
8. Non-IC
9. WLST = WaveLinx LITE tilemount sensor kit for daylight dimming, PIR motion sensing, use with D010 only (Refer to WaveLinx LITE system specifications)
10. WPST = WaveLinx PRO wireless sensor kit for daylight dimming, PIR motion sensing, and optional RLTS - Real Time Location Services, use with 0-10V only.
11. WPN = WaveLinx PRO wireless node provides luminairelevel control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with D010 or DE010 drivers only.
13. Accessory (Requires knife edge accessory ring)
14. Order die cast trim with flange type 4
16. Limited to 2000 lumens
17. Not available with DLVP
18. Accessories sold separately will be separately analyzed under domestic preference.
19. WLN = WaveLinx LITE wireless node provides luminaire level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with D010 or DE010 drivers only.
20. Not compatible with 347V or Chicago plenum.

Portfolio

LDSSQ4 | EU4C | 4LBCSSQ

TYPE - L2B

Product Specifications

Lower Shielding Reflector
- Painted die cast aluminum with a lensed upper optical chamber providing superior lumen output with minimal source brightness
- Plaster lathing ring, knife edge and millwork ring accessory for flush reflector transition

Trim Retention
- Two torsion springs hold reflector flange tightly to the finished ceiling surface

Plaster Frame/Collar
- Galvanized steel plaster frame with adjustable collar adjusts for up to 2" thick ceilings and rotates+/- 7.5°.

Universal Mounting Bracket
- Accepts 1/2" Electric Metallic Tube (EMT), C-channel and bar hangers
- Adjusts 5" vertically from above and below the ceiling

Junction box
- Four 1/2" and two 3/4" trade size pry outs positioned to allow straight conduit runs
- Lever connectors for simple push in wiring
- Listed for (4) #12 AWG (two in, two out) 90°C conductors and feed thru branch wiring for type IC and Plug in drivers for 120/277V only. For all other cases (8) #12 AWG (four in, four out) 90°C conductors and feed thru branch wiring for 120/277V only

Thermal
- Aluminum heat sink conducts heat away from the LED module for improved performance and longer life

LED System
- Contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution without pixilation
- Auto resetting, thermally protected, LED's are turned off when safe operating temperatures are exceeded
- Quick disconnect allows for tool-less replacement of LED engine from below ceiling
- 90 and 97 CRI
- 90 & 97CRI: L78 55,000 hours for 1000-2000 lumens, L90 55,000 for all other lumen output
- Color variation within 2-step MacAdam ellipses
- Available in 2400K, 2700K, 3000K, 3500K, 4000K and 5000K correlated color temperature (CCT)

Vividtune and High CRI
- 98 CRI and W2N: L70 55,000 hours
- D2W™ – dim-to-warm shifts CCT from 3000K to 1850K as fixture dims mimicking halogen sources.
- W2N - Tunable white CCT range 2700K to 6500K or 2000K to 5000K, 90 CRI. Standard
- **98 CRI** With a full-spectrum approach using broad-blue chip technology and special phosphor blends, Thrive is able to closely match the spectrum of the sun across all color temperatures. Benefits of the natural spectrum of the sun using Thrive include superior accurate color rendering, reduced eye strain, and a higher sense of emotional well-being.
- See dedicated specification sheet for more details.

Driver
- Standard 120-277V 0-10V dimming driver provides flicker free dimming from 100% to 1%
- Optional 120V leading edge/0-10V, <1% 0-10V, Fifth Light, DMX or Lutron® Ecosystem
- Driver can be serviced from above or through the aperture
- Distributed low voltage power system combines power, lighting, and controls with ease of installation.
- Optional magnetically guided snap in driver for ease of maintenance.

Emergency Option
- Self test 6W battery provides 90 minutes of standby lighting, meeting most life safety codes for egress lighting
- UL 924 listed

Connected Lighting System
Two WaveLinx connected solutions to choose from. Refer to WaveLinx system specifications and application guides for details.

WaveLinx PRO Tilemount Sensor Kit
- WaveLinx PRO WPST tilemount sensor kit offers daylight dimming, PIR motion sensing, scene and zone configuration, automatic commissioning; and optional RLTS - Real Time Location Services available.

WaveLinx PRO Wireless Node
- WaveLinx PRO WPN wireless node provides luminaire-level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with 0-10V driver only. **Note:** Not compatible with 347V or Chicago plenum.

WaveLinx LITE Tilemount Sensor Kit
- WaveLinx LITE WLST tilemount sensor kit offers daylight dimming and PIR motion sensing, scene and grouping configuration.

WaveLinx LITE Wireless Node
- WaveLinx LITE WLN wireless node provides luminaire level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with 0-10V driver only. **Note:** Not compatible with 347V or Chicago plenum.

WaveLinx Tilemount Kits Application
- The WPST and WLST tilemount kits include a control module mounted on the luminaire junction box via 1/2" knock-out, and a tilemount sensor on 54-inch whip; for ceiling installation by direct-mount spring clips or via mounting bracket in octagon ceiling boxes.
- The WPST and WLST tilemount kits may be ordered as factory installed on the luminaire, or ordered separately as a field installed accessory kit.
- **Note: WaveLinx PRO devices are only compatible with the WaveLinx PRO system.**
- **Note: WaveLinx LITE devices are only compatible with the WaveLinx LITE system.**

Code Compliance
- Thermally protected
- cULus Certified to UL 1598 / C22.2 No. 250.0 suitable for wet locations with covered ceiling
- IP66 rated when used with IP66 gasket kit accessory
- Use IP66 gasket with non conductive reflector for steam room applications up to 2000 lumens and 40°C.
- Optional City of Chicago environmental air (CCEA) marking for plenum applications
- FCC CFR Title 47 Part 15 Class B at 120VAC and Class A at 277VAC
- Insulated ceiling (IC) rated up to 1,500 lumens (90 and 97CRI). All others are non-IC rated (insulation must be kept 3" from top and sides of housing).
- Can be used for State of California Title 24 high efficacy LED compliance under JA8, reference Modernized Appliance Efficiency Database System (MAEDBS) for 2016 JA8 High Efficacy Lighting
- RoHS compliant
- Photometric testing completed in accordance with IES LM-79
- LED life testing completed in accordance with IES LM-80-08 and TM-21-11 standards

Warranty
- Five year warranty www.cooperlighting.com/legal

Marked Spacing

4-inch Marked spacing for 90 and 97 CRI			
Lumens	**Center to Center of Adjacent Luminaire (inches)**	**Center Luminaire to Building Side Member (inches)**	**Minimum Overhead Height (inches)**
4000	36	18	6
4000-7500 (Lutron)	36	18	8
4500-7500	36	18	8

Portfolio LDSSQ4 | EU4C | 4LBCSSQ

TYPE - L2B

Energy and Performance Data

D010 DRIVER ENERGY DATA

Series	250 lumen		500 lumen		800 lumen		1000 lumen		1500 lumen		2000 lumen	
Input Voltage 120-277VAC	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V	120V	277V
Input Current (A)	0.029	0.017	0.061	0.032	0.085	0.041	0.084	0.042	0.135	0.063	0.189	0.084
Input Power (W)	3.45	3.87	7.33	7.78	10.15	10.52	10.04	10.43	16.17	16.56	22.58	22.63
In-rush (A)	2.1	8.5	3.7	8.5	3.6	8.3	3.6	8.4	2.3	9.5	2.1	9.7
Inrush duration (µs)	250	131	190	136	220	135	226	136	230	125	243	132
THDi (%)	7.21	16.92	7.82	10.78	5.57	9.63	7.78	9.24	4.75	9.93	8.03	7.44
PF	≥ 0.98	≥ 0.9	≥ 0.99	≥ 0.93	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.95	≥ 0.99	≥ 0.94	≥ 0.99	≥ 0.96

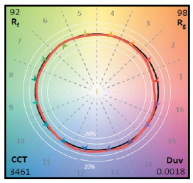
Series	2500 lumen		3000 lumen	
Input Voltage 120-277VAC	120V	277V	120V	277V
Input Current (A)	0.276	0.121	0.276	0.121
Input Power (W)	32.98	32.57	32	32.57
In-rush (A)	2.5	11.8	3.6	11.8
Inrush duration (µs)	215	111	220	111
THDi (%)	9.86	6.57	5.57	6.57
PF	≥ 0.99	≥ 0.97	≥ 0.99	≥ 0.99

Minimum starting temperature -30°C (-22°F)* (Nominal input 120-277VAC & 100% of rated output power)
Sound Rating: Class A standards

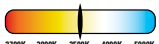
Notes:
Emergency Battery packs are rated for a minimum starting temperature of 0°C.

COLOR METRICS - TM-30-15 & CRI/CIE

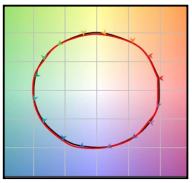
90 CRI Color Metric Summary - 3500K*



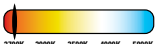
TM-30-15	Rf = 92
	Rg = 98
CRI/CIE	Ra = 92.2
	R9 = 51.4



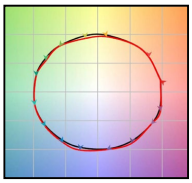
97 CRI Color Metric Summary - 2700K*



TM-30-15	Rf = 95
	Rg = 99.8
CRI/CIE	Ra = 97.2
	R9 = 98.5



97 CRI Color Metric Summary - 3000K*



TM-30-15	Rf = 93.9
	Rg = 100.2
CRI/CIE	Ra = 98.7
	R9 = 97.2

* Color values are based on haze reflector, other finishes and field results may vary.

Portfolio

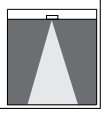
LDSSQ4 | EU4C | 4LBCSSQ

TYPE - L2B

Photometric Data

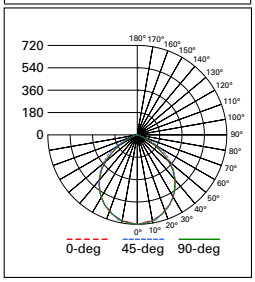
NON CONDUCTIVE

Test Number	P571650
Housing	LDSSQ4C15D010
Module	EU4C10209035
Trim	4LBPSSQMW
Lumens	1537
Efficacy	97.3 Lm/W
SC	1.2
UGR	24.8

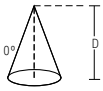


CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	45.4	4.6	4.6
7'	14.8	8.2	8.2
9'	9	10.6	10.6
13'	4.3	15.4	15.4
16'	2.8	18.8	19

CANDELA TABLE

Degrees Vertical	Candela
0	720
5	705
15	678
25	618
35	526
45	410
55	237
65	78
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	545	35.5
0-40	876	57
0-60	1425	92.7
0-90	1537	100
90-180	0	0
0-180	1537	100

LUMINANCE

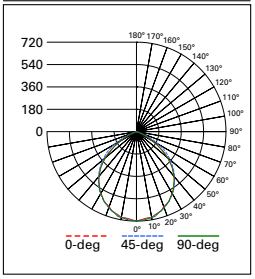
Average Candela Degrees	Average 0° Luminance
37	61218
45	55920
55	39886
65	17740
75	746
85	0

SHALLOW SQUARE MATTE WHITE

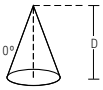
Test Number	P563395
Housing	LDSSQ4C15D010
Module	EU4C10209035
Trim	4LBCSSQMW
Lumens	1537
Efficacy	97.3 Lm/W
SC	1.2
UGR	24

CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	45.4	4.6	4.6
7'	14.8	8.2	8.2
9'	9	10.6	10.6
13'	4.3	15.4	15.4
16'	2.8	18.8	19

CANDELA TABLE

Degrees Vertical	Candela
0	720
5	705
15	678
25	618
35	526
45	410
55	237
65	78
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	545	35.5
0-40	876	57
0-60	1425	92.7
0-90	1537	100
90-180	0	0
0-180	1537	100

LUMINANCE

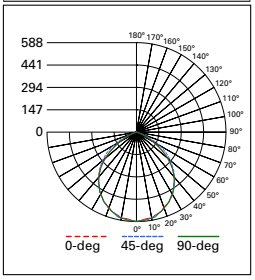
Average Candela Degrees	Average 0° Luminance
37	61218
45	55920
55	39886
65	17740
75	746
85	0

SHALLOW SQUARE MATTE METALLIC SILVER

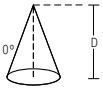
Test Number	P563394
Housing	LDSSQ4C15D010
Module	EU4C10209035
Trim	4LBCSSQMMS
Lumens	1257
Efficacy	79.6 Lm/W
SC	1.2
UGR	24

CANDLEPOWER DISTRIBUTION

Downlight



CONE OF LIGHT



D	FC	L	W
4'	37.1	4.6	4.6
7'	12.1	8.2	8.2
9'	7.3	10.6	10.6
13'	3.5	15.4	15.4
16'	2.3	18.8	19

CANDELA TABLE

Degrees Vertical	Candela
0	588
5	577
15	554
25	506
35	430
45	335
55	194
65	64
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0-30	446	35.5
0-40	716	57
0-60	1166	92.7
0-90	1257	100
90-180	0	0
0-180	1257	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
37	50067
45	45740
55	32618
65	14498
75	634
85	0

Photometric Multipliers (Nominal Lumen Values)

250 Lumen	500 Lumen	800 Lumen	1000 Lumen	1500 Lumen	2000 Lumen	2500 Lumen	3000 Lumen
0.224	0.423	0.569	0.653	1.00	1.29	1.62	1.902

Multipliers for relative lumen values with other series models.

CCT Multipliers – 90CRI

2400K	2700K	3000K	3500K	4000K	5000K
0.912	0.949	0.986	1	1.001	1.022

Multipliers for relative lumen values with other series color temperatures.

CCT Multipliers – 97CRI

2700K	3000K	3500K	4000K	5000K
0.889	0.955	1	1.016	1.07

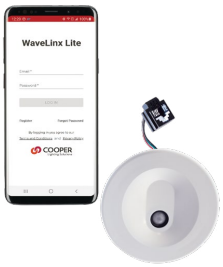
Multipliers for relative lumen values with other series color temperatures.

Portfolio

LDSSQ4 | EU4B | 4LBCSSQ

Connected Systems

TYPE - L2B



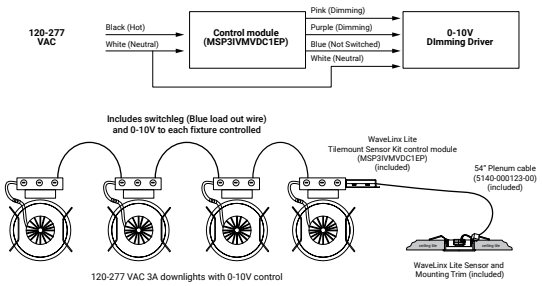
WaveLinx LITE - WLST Tilemount Sensor

WaveLinx LITE devices only compatible with the WaveLinx LITE system.

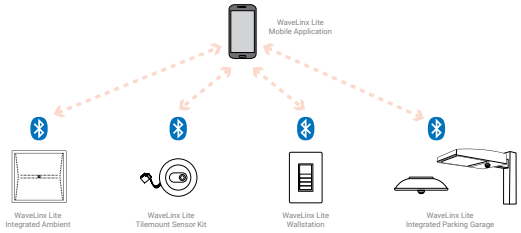
- Intuitive Android™ or Apple® iOS® app for basic system code compliant set up and configuration via Bluetooth
- Up to 28 unique areas per project site (WaveLinx LITE Bluetooth network)
- Up to 50 devices for an area, any one of 16 control zones, up to 6 occupancy sets, and custom lighting scenes
- Automatic occupancy or vacancy, sensor sensitivity, daylight dimming, etc. configurable through the app
- Refer to the WaveLinx system specifications for details

Device Security | Manual Dimmer | Occupancy Sensor | Daylighting Control | Manually Switched ON/OFF | Tuning Control | Lumen Maintenance Control | Scenes

WaveLinx LITE WLST Tilemount Wiring Diagram



WaveLinx LITE Bluetooth Enabled System



WaveLinx PRO Wireless – WPST Tilemount Sensor

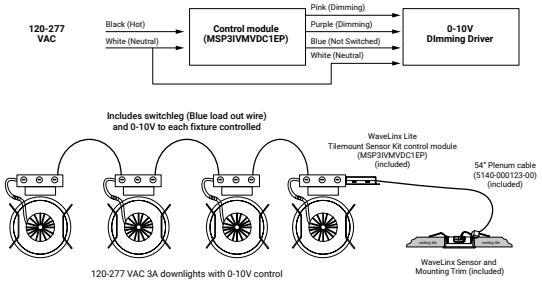
WaveLinx PRO devices only compatible with the WaveLinx PRO system.

- WaveLinx PRO Wireless functionality configures zones and customizes settings from one secure mobile app
- Automatic code commissioning that meets the strictest codes
- Fixtures and sensors integrate with Wireless Area Controller, Wall Stations, and Control Devices
- Stand-Alone Offices or Entire Building Network Installations

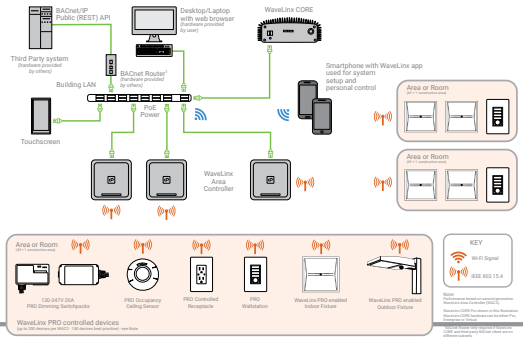
WaveLinx mobile app settings

Manual Dimmer | Occupancy Sensor | Lumen Maintenance Control | Daylighting Control | Receptacle Control | Tuning Control | Scheduling | Manually Switched ON/OFF | Demand Response

WaveLinx PRO WPST Tilemount Wiring Diagram



WaveLinx CORE Building Management Integration



COOPER Lighting Solutions
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Portfolio

LDSSQ4 | EU4B | 4LBCSSQ

TYPE - L2B

Connected Solutions

WaveLinx LITE Wireless Node - WLN

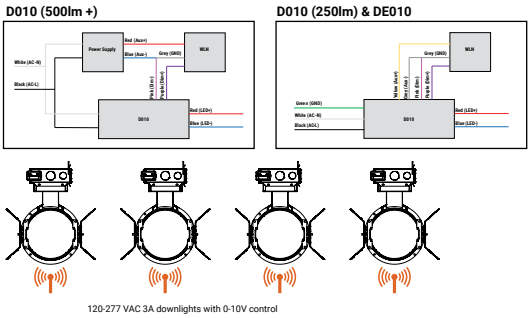
WaveLinx LITE devices only compatible with the WaveLinx LITE system.

- Intuitive Android™ or Apple® iOS® app for basic system code compliant set up and configuration via Bluetooth
- Up to 28 unique areas per project site (WaveLinx LITE Bluetooth network)
- Up to 50 devices for an area, any one of 16 control zones, up to 6 occupancy sets, and custom lighting scenes
- Refer to the WaveLinx system specifications for details
- Not available with BioUp or Tunable White

WaveLinx mobile app settings

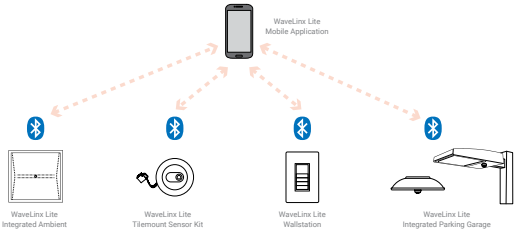
Device Security · Manual Dimmer · Occupancy Sensor · Daylighting Control · Manually Switched ON/OFF · Tuning Control · Lumen Maintenance Control · Scenes

WaveLinx LITE Wireless Node (WLN) Wiring Diagram



120-277 VAC 3A downlights with 0-10V control

WaveLinx LITE Bluetooth Enabled System



WaveLinx PRO Wireless Node - WPN

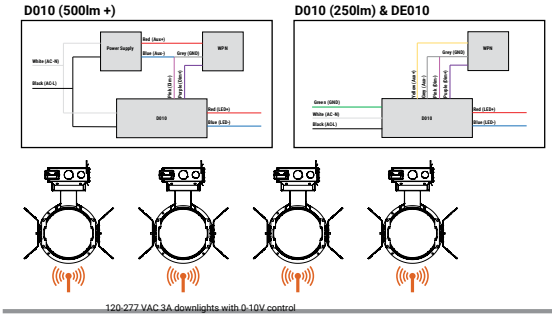
WaveLinx PRO devices only compatible with the WaveLinx PRO system.

- WaveLinx Wireless functionality configures zones and customizes settings from one secure mobile app
- Automatic code commissioning that meets the strictest codes
- Fixtures and sensors integrate with WaveLinx Area Controller, Wall Stations, and Control Devices
- Stand-Alone Offices or Entire Building Network Installations

WaveLinx mobile app settings

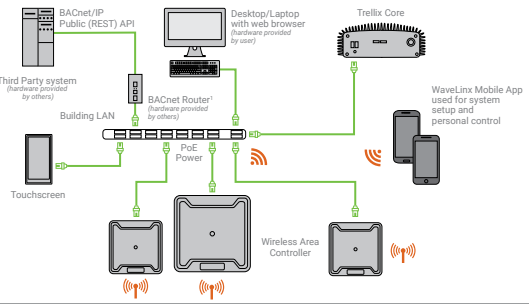
Manual Dimmer · Occupancy Sensor · Lumen Maintenance Control · Daylighting Control · Receptacle Control · Tuning Control · Scheduling · Manually Switched ON/OFF · Demand Response

WaveLinx PRO Wireless Node (WPN) Wiring Diagram



120-277 VAC 3A downlights with 0-10V control

WaveLinx CORE Building Management Integration



Portfolio LDSSQ4 | EU4C | 4LBCSSQ

TYPE - L2B

Multi-line Order Information

SAMPLE ORDER NUMBER: **LDSSQ4C10D010TRIEM14**

Invoice will indicate separate fixture components (housing, trim, module) and may ship from multiple CLS facilities in separate cartons.

Housing	Lumens [2]	
LDSSQ4C=LED Square Downlight 4" Nominal Aperture **LDSSQ4CCP**=LED Square Downlight 4" Nominal Aperture, Chicago Plenum	**02**=250 lumens **05**=500 lumens **08**=800 lumens **10**=1000 lumens **15**=1500 lumens	**20**=2000 lumens **25**=2500 lumens **30**=3000 lumens **35** = 3500 lumens **40** = 4000 lumens

Driver	Driver Options	Options [6] [19] [20] [21]
D010 = 0-10V Dimming, 1% to 100%, 120V-277V 500-4000 lumens **3D010**=0-10V Dimming, 1% to 100%, 347V dedicated drivers for 800 to 4000 lumens; and 500 use step down transformers	**Blank**=Integral driver **R**=Remote driver (order remote driver separately) (not available with CP) **PD**=Magnetic Plug in Driver [8]	**EMBOD6ST**=Bodine® 6W Self Test Emergency Module with Remote Test Switch **WPN** = WaveLinx PRO Wireless Node without sensor [23] [20] **WLN** = WaveLinx LITE Wireless Node without sensor [25] [20]
D010TR = 0-10V Dimming, 1% to 100%, 120V-277V 250- 4000 lumens **3D010TR**=0-10V Dimming, 1% to 100%, 347V step down transformer 250-4000 lumens		
DE010 = 0-10V Dimming, 0.1% to 100%, 120V-277V 500-4000 lumens **3DE010**=0-10V Dimming, 0.1% to 100%, 347V step down transformer 500-4000 lumens		
D5LT = Fifth Light® (DALI T6) Logarithmic Dimming, 0.1% to 100%, 120V-277V, 500-4000 lumens **3D5LT**=Fifth Light® (DALI T6) Logarithmic Dimming, 0.1% to 100% 347V step down transformer, 500-4000 lumens		
DMX = DMX/RDM Logarithmic Dimming, 0.1% to 100%, 120V-277V 800-4000 lumens [5] **3DMX**=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 347V step down transformer, 800-4000 [5]		
DMXC5 = DMX/RDM Logarithmic Dimming, 0.1% to 100%, 120V-277V, 800-4000 lumens, RJ45 Connection [5] **3DMXC5**=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 347V step down transformer, 800-4000, RJ45 Connection [5]		
DLE = Lutron Ecosystem dimming 1% to 100%, 120V-277V, 800-3500 lumens **3DLE**=Lutron Ecosystem dimming 1% to 100%, 347, step down transformer, 800-3500 lumens		
DLV = Low voltage dimming driver (1-100%) for use with DLVP system 800-3000 lumens (Not offered with plug in driver) [6]		

SAMPLE ORDER NUMBER: **EU4C10209035**

Power Module	Lumen Levels [2]	CRI [3]	Color	
EU4C=4-inch Universal LED Module	**0208IC**=250, 500, 800 lumens, IC Rated (For use with all drivers, min 500 lumen with DE010 and D5LT, min 800 lumens with DLVP, Lutron and DMX) **1020**=1000, 1500, 2000 lumens **1015IC**=1000, 1500 lumens IC Rated **2540**=2500, 3000, 3500, 4000 lumens (For use with Lutron 3000-3500, DLVP 3000 lumens, DMX, D010, D010TR, D5LT and DE010 3000-4000)	**90**=90 CRI Minimum **97**=97 CRI Minimum	**90 CRI** **24**=2400K **27**=2700K **30**=3000K **35**=3500K **40**=4000K **50**=5000K	**97 CRI** **27**=2700K **30**=3000K

SAMPLE ORDER NUMBER: **4LBM2H**

Trim	Reflector	Flange	Finish
4LB=4" LED	**CSSQ**=Cast Shallow Square, Die Cast Aluminum	**1**=Self flanged [14] **2**=White painted self flanged **4**=Knife edge rimless use with die cast only [15]	**MW**=Matte White **MB**=Matte Black **MMS**=Matte Metallic Silver
	PSSQMW1=Non-Conductive Shallow (dead front), Self Flanged, White [24]		

Continued on next page.

Portfolio

LDSSQ4 | EU4C | 4LBCSSQ

TYPE - L2B

Multi-line Order Information

REQUIRED if Remote Driver (R) is specified

SAMPLE ORDER NUMBER: **RC10010D010TREM7**

Remote Drivers [6]		Lumens [2] [4]	
RC100=Remote 100ft	**RC15**=Remote 15ft	**02**=250 lumens	**20**=2000 lumens
RC75=Remote 75ft	**RC5**=Remote 5ft	**05**=500 lumens	**25**=2500 lumens
RC50=Remote 50ft	**RC2**=Remote 2ft	**08**=800 lumens	**30**=3000 lumens
RC25=Remote 25ft		**10**=1000 lumens	**35**=3500 lumens
		15=1500 lumens	**40**=4000 lumens

Driver
D010 = 0-10V Dimming, 1% to 100%, 120V-277V, 500-3000 lumens **1D010** = 0-10V Dimming, 1% to 100%, 120V, 3500-4000 lumens **2D010** = 0-10V Dimming, 1% to 100%, 277V, 3500-4000 lumens **3D010** = 0-10V Dimming, 1% to 100%, 347V dedicated drivers for 800 to 4000 lumens; and 500 lumens use step down transformer
D010TR = 0-10V Dimming, 1% to 100%, 120V-277V, 250- 3000 lumens **1D010TR** = 0-10V Dimming, 1% to 100%, 120V, 3500-4000 lumens **2D010TR** = 0-10V Dimming, 1% to 100%, 277V, 3500-4000 lumens **3D010TR** = 0-10V Dimming, 1% to 100% 347V step down transformer, 250-4000 lumens
DE010 = 0-10V Dimming, 0.1% to 100%, 120V-277V, 500-3000 lumens **1DE010** = 0-10V Dimming, 0.1% to 100%, 120V, 3500-4000 lumens **2DE010** = 0-10V Dimming, 0.1% to 100%, 277V, 3500-4000 lumens **3DE010** = 0-10V Dimming, 0.1% to 100%0-10V Dimming 347V step down transformer, 500-4000 lumens
D5LT = Fifth Light® (DALI T6) Logarithmic Dimming, 0.1% to 100%, 120V-277V, 500-3000 lumens **1D5LT** = Fifth Light® (DALI T6) Logarithmic Dimming, 0.1% to 100%, 120V, 3500-4000 lumens **2D5LT** =Fifth Light® (DALI T6) Logarithmic Dimming, 0.1% to 100%, 277V, 3500-4000 lumens **3D5LT** =Fifth Light® (DALI T6) Logarithmic Dimming, 0.1% to 100% 347V step down transformer, 500-4000 lumens
DMX = DMX/RDM Logarithmic Dimming, 0.1% to 100%, 120V-277V, 800-3000 lumens [5] **1DMX**=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 120V, 3,500-4000 [5] **2DMX**=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 277V, 3,500-4000 [5] **3DMX**=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 347V step down transformer, 800-4000 [5]
DMXC5 = DMX/RDM Logarithmic Dimming, 0.1% to 100%, 120V-277V up to 800-3000 lumens, RJ45 Connection [5] **1DMXC5**=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 120V, 3,500-4000 lumens, RJ45 Connection [5] **2DMXC5**=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 277V, 3,500-4000 lumens, RJ45 Connection [5] **3DMXCF**=DMX/RDM Logarithmic Dimming, 0.1% to 100%, 347V step down transformer, 800-4000 lumens, RJ45 Connection [5]
DLE = Lutron Ecosystem dimming 1% to 100%, 120V-277V, 25' Max remote length, 800-3000 lumens **1DLE**=Lutron Ecosystem dimming 1% to 100%, 120V, 25' Max remote length, 3500 lumens **2DLE**=Lutron Ecosystem dimming 1% to 100%, 277V, 25' Max remote length, 3500 lumens **3DLE**=Lutron Ecosystem dimming 1% to 100%, 347V, step down transformer, 25' Max remote length, 800-3500 lumens
DLV = Low voltage dimming driver (1-100%) for use with DLVP system, 800-3000 lumens [6]

Options [6] [19] [20] [21]		Controls
EMBOD=Bodine® Emergency Module with Remote Test Switch	**EMBOD7ST**=Bodine® Self Test Emergency Module	**WPST**=Factory installed WaveLinx PRO Sensor Kit [11] [13]
EMBOD6ST=Bodine® 6W Self Test Emergency Module with Remote Test Switch	**EMV7**=7W Low Voltage Emergency Module with Remote Test Switch [7]	**WLST**=Factory installed WaveLinx LITE Sensor Kit [11] [12]
EM7=7W Emergency Module with Remote Test Switch	**EMV14**=14W Low Voltage Emergency Module with Remote Test Switch [7]	**WPN** = WaveLinx PRO Wireless Node without sensor [23] [26]
EM14=14W Emergency Module with Remote Test Switch	**ETRD**=Emergency transfer device [22]	**WLN** = WaveLinx LITE Wireless Node without sensor [25] [26]

PROVIDE FOR FIXTURES LABELED EM

Accesso

LGSKT4SQIP66=IP66 Gasket Kit	**RPMSQ4MW**=Rimless Millwork Ring, Matte White [17]	**Bar Hangers**	**Connected Lighting Systems** [6] [11]
	RPMSQ4MB=Rimless Millwork Ring, Matte Black [17]	**HB26**=C-channel Bar Hanger, 26" Long, Pair	**WPST** = Field installed WaveLinx PRO Sensor Kit [13]
PRSQ4 = Rimless Plaster Ring [17]	**RKMSQ4MW**=Knife Edge Millwork Ring, Matte White [18]	**HB50**=C-channel Bar Hanger, 50" Long, Pair	**WLST** = Field installed WaveLinx LITE Sensor Kit [12]
RKPSQ4 = Knife Edge plaster Ring [18]	**RKMSW4MB**=Knife Edge Millwork Ring, Matte Black [18]	**RMB22**=Wood Joist Bar Hanger, 22" Long, Pair	

Notes:

2. Nominal Lumens will vary depending on selected color, CRI, driver and reflector finish. Reference Multiplier tables.

4. IC rated up to 3000 lumens for 90 & 97 CRI

5. DMX fixtures default to full on upon loss of DMX signal.

6. Not available with Chicago Plenum.

7. ULus listed only

8. Not available with DLVP

11. Refer to system specifications for additional information,features, and benefits. Order either factory installed option or accessory. Use with 0-10V driver.

12. WLST = WaveLinx LITE tilemount sensor kit for daylight dimming, PIR motion sensing, use with D010 only (Refer to WaveLinx LITE system specifications)

13. WPST = WaveLinx PRO wireless sensor kit for daylight dimming, PIR motion sensing, and optional RLTS - Real Time Location Services, use with 0-10V only.

14. Flange is the same finish as the reflector

15. Requires knife edge ring

16. Accessories sold separately will be separately analyzed under domestic preference.

17. Order trim with flange type 3.

18. Order die cast trim with flange type 4

19. For remote driver order emergency module with the remote driver.

20. 120V-277V

21. Non-IC

22. Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others)

23. WPN = WaveLinx PRO wireless node provides luminairelevel control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with D010 or DE010 drivers only.

24. Limited to 2000 lumens

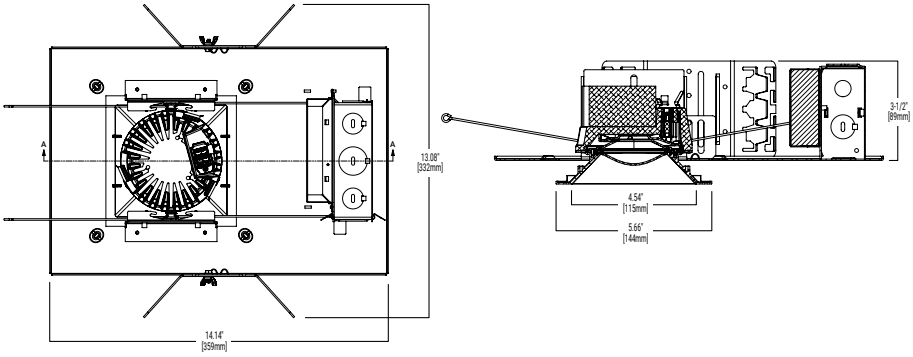
25. WLN = WaveLinx LITE wireless node provides luminaire level control with scene and zone configuration without an integrated sensor; Connects wirelessly with daylight dimming sensor and PIR motion sensor if desired. Use with D010 or DE010 drivers only.

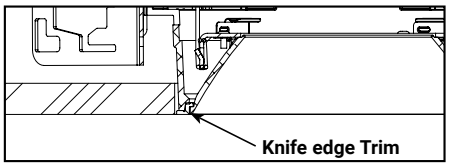
26. Not compatible with 347V or Chicago plenum.

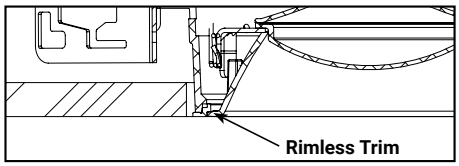
Portfolio LDSSQ4 | EU4B | 4LBCSSQ

Dimensional and Mounting Details

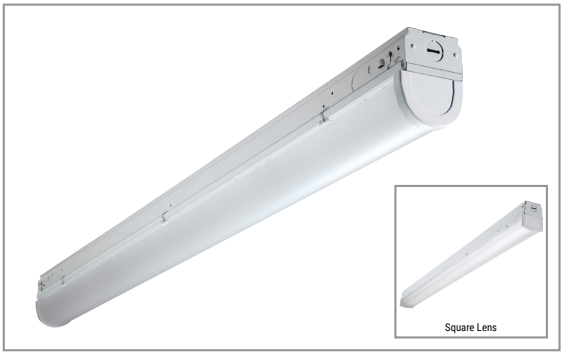
TYPE - L2B







Project		Catalog #		Type	TYPE - L3
Prepared by		Notes		Date	



Metalux

SNLED Lensed

Lensed LED Strip Round and Square Lens

Typical Applications

Storage / Utility • Coves • Display Cases • Task and General Area

Interactive Menu

Product Certification

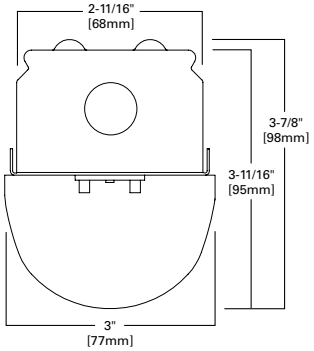
Product Features

Top Product Features

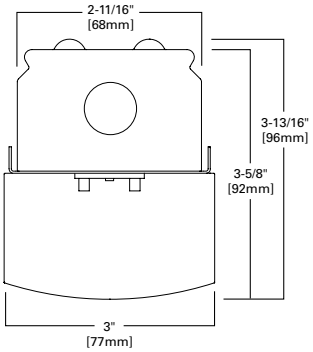
- Standard (SL) and High lumen/High Efficacy (HL) packages
- High efficiencies - up to 153 LPW
- Three different lens types for optical control
- Two different reflectors for precise distribution control
- Available CCT: 3000K, 3500K, 4000K and 5000K
- Minimum CRI of 80; 90 CRI available
- Options to meet Trade Agreements Act requirements

Dimensional Details

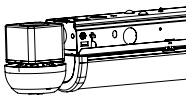
Round Lens



Square Lens



ZW-SWPD3 Sidecar



additional product diagrams

Metalux

SNLED Lensed

TYPE - L3

Order Information

SAMPLE ORDER NUMBER: **4SNLED-LD5-46SL-LN-UNV-L835-CD1-U**
8TSNLED-LD5-200HL-SLN-UNV-EL7W-L840-CD2-U

Domestic Preferences	Length	Series	Lamp Type
[Blank]=Standard **TAA**=Trade Agreements Act	**2**=2 ft. **4**=4 ft. **8T**=8 ft.	**SNLED**=Commercial LED Striplight [2]	**LD5**=LED 5.0
Notes (1) Only product configurations with this designated prefix are built to be compliant with the Trade Agreements Act of 1979 (TAA). Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analyzed under domestic preference requirements.		**Notes** (2) DesignLights Consortium® Qualified and classified for both DLC Standard and DLC Premium, refer to www.designlights.org for details.	

LED Lumen Packages

LED Lumen Packages [3]

2 ft. Round Lens

LC	LN	LW
18SL	18SL	16SL
22SL	22SL	20SL
26SL	26SL	23SL
34HL	32HL	30HL
Clear	Semi-frost narrow	Full frost wide

4 ft. Round Lens

LC	LN	LW
18SL	18SL	16SL
22SL	22SL	20SL
26SL	26SL	23SL
30SL	30SL	27SL
34SL	34SL	30SL
37SL	37SL	33SL
41SL	41SL	37SL
46SL	46SL	41SL
49SL	53SL	44SL
52SL	56SL	47SL
56SL	61SL	50SL
63SL	64SL	56SL
66SL	50HL	58SL
52HL	54HL	44HL
55HL	60HL	48HL
60HL	74HL	54HL
76HL		65HL
Clear	Semi-frost narrow	Full frost wide

8 ft. Round Lens

LC	LN	LW
60SL	60SL	54SL
68SL	68SL	61SL
75SL	75SL	67SL
83SL	83SL	74SL
90SL	91SL	81SL
98SL	98SL	88SL
105SL [4]	106SL	95SL
130HL [4]	130HL [4]	110HL
170HL [4]	170HL [4]	150HL
Clear	Semi-frost narrow	Full frost wide

SL denotes standard lumen output. HL denotes high lumen output. Additional LEDs to obtain lumen package.
For comparable lumen packages, HL efficacy is greater than SL efficacy.
26SL: 2600 delivered lumens, standard lumen output
170HL: 17000 delivered lumens, high output.

2 ft. Square Lens

SLC	SLN	SLW
19SL	19SL	16SL
24SL	24SL	20SL
27SL	27SL	22SL
37HL	37HL	30HL
48HL	48HL	41HL
Clear	Semi-frost narrow	Full frost wide

Same notes apply as round (column on left)

4 ft. Square Lens

SLC	SLN	SLW
19SL	19SL	15SL
23SL	23SL	19SL
27SL	27SL	22SL
30SL	30SL	25SL
35SL	35SL	29SL
39SL	39SL	32SL
42SL	42SL	35SL
47SL	46SL	39SL
50SL	50SL	41SL
54SL	54SL	45SL
58SL	58SL	48SL
63SL	63SL	52SL
65SL	65SL	54SL
77SL	78SL	64SL
85SL	85SL	70SL
54HL	54HL	46HL
57HL	57HL	48HL
62HL	62HL	52HL
68HL	68HL	57HL
82HL	82HL	69HL
97HL	97HL	81HL
Clear	Semi-frost narrow	Full frost wide

8 ft. Square Lens

SLC	SLN	SLW
60SL	64SL	50SL
70SL	70SL	58SL
78SL	77SL	64SL
84SL	84SL	70SL
93SL	93SL	77SL
100SL	100SL	83SL
108SL	108SL	90SL
116SL	116SL	96SL
125SL	125SL	104SL
131SL	130SL	108SL
130HL	130HL	130HL
170HL [4]	170HL [4]	170HL [4]
200HL	200HL	200HL
Clear	Semi-frost narrow	Full frost wide

Notes
(3) Nominal lumen values. See table for value and fixture length. (4) DALI and Step-dim versions require two drivers.

Metalux — SNLED Lensed

Order Information

SAMPLE ORDER NUMBER: **4SNLED-LD5-46SL-LN-UNV-L835-CD1-U**
8TSNLED-LD5-200HL-SLN-UNV-EL7W-L840-CD2-U

TYPE - L3

Lens | Voltage | Options | Color Temp / CCT

Lens	Voltage	Options	Color Temp / CCT
~~**Round**~~ **LC**=Clear Lens **LN**=Semi-Frost Lens - Narrow **LW**=Full Frost Lens - Wide **Square** **SLC**=Square / Flat Clear Lens **SLN**=Square / Flat Semi - Frost Lens - Narrow **SLW**=Square / Flat Full Frost Lens - Wide	**UNV**=Universal Voltage 120-277 **347**=347V (6), (7), (8) **480**=480V (5)	**Emergency** **EL7W**=7-watt, 120V-277V emergency battery pack installed (9), (10), (15) **EL14W**=14-watt 120V-277V emergency battery pack installed (9), (10), (15) **GTR2**=Bodine Generator Transfer Relay (11) **ETRD**=Iota Emergency Transfer Relay with dimming control (11), (15) **Wiring** **PI/CPI**=Plug in and cross over plug in options (13) **PC6/515P**=(NEMA 5-15P) 6 ft. Cord with NEMA Straight Plug (12), (13) **PC6/L715**=(NEMA L7-15P) 6 ft. Cord with NEMA Twist Plug (12), (13) **Motion Sensors** (14) **LB-ERMS360**=360° Low Bay Motion Sensor - End of Row, 8' Mounting **LB-MRMS360**=360° Low Bay Motion Sensor - Middle of Row, 8' Mounting **HB-ERMS360**=360° High Bay Motion Sensor - End of Row, 15-40' Mounting (18) **HB-MRMS360**=360° High Bay Motion Sensor - Middle of Row, 15-40' Mounting (18) **WLS (formerly WAB)**=WaveLinx LITE Wireless Sensor, Occupancy w/ photocell, Independent & Networked (16), (17), (B) **WPS (formerly WAA)**=WaveLinx PRO Wireless Sensor, Occupancy w/ photocell, Networked (A) **WLS4**=WaveLinx LITE, Dimming Motion and Daylight, Bluetooth Programmable, 15' - 40' Mounting (16), (17), (B) **WPS4**=WaveLinx PRO, Dimming Motion and Daylight, WAC Programmable, 15' - 40' Mounting (A)	**CCT/CRI** ~~**L830**=3000K, 80 CRI~~ **L835**=3500K, 80 CRI ~~**L840**=4000K, 80 CRI~~ **L850**=5000K, 80 CRI **L930**=3000K, 90 CRI **L935**=3500K, 90 CRI **L940**=4000K, 90 CRI **L950**=5000K, 90 CRI
	Notes (5) 4 ft. and 8 ft. only. (6) 347V CD driver is limited to 50W max output before requiring 2 drivers (no 85W 347V solution). (7) 347 SD Driver require qty 2 transformers for Dual switch legs can not offer with EBP due to space requirements for 3 ed transformer for EBP charge circuit. (8) All other drivers at 347V requires single transformer for Driver. If EBP is included, would require second transformer THD an PF affected by transformer (no DLC).	**Notes** (9) 4 ft. and 8 ft. only. (10) With integral test switch/indicator/laser test. For approximate delivered lumens multiply the lumens per watt of the desired fixture by the wattage of the emergency battery pack (100 lm/W x 7=700 lumens). IES-format photometry for luminaire under emergency operation available. (11) Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others). GTR2 and ETR2 options include 2 relays on fixtures with dimming drivers. ETRD option only requires one relay when used on a dimming fixture. Must specify voltage as 120V or 277V when ordering these devices. (12) Most common C&P shown. Must specify location for cord. All "end" locations will be on the end with sensor installed. (13) Consult tech support on numerous options for this feature. (14) Sensors provided in separate externally mounted enclosure. See SRL spec sheet for fully integrated/connected sensors. (15) Emergency component is UL924 classified. (16) WLSx provided in separate enclosure. (17) Not available in Mid-Row Configuration. (18) Motion Sensor offers dimmability. Integrated options must be used in conjunction with the associated system and may not be compatible with other options and accessories. (A) Consult WaveLinx system pages for additional details and compatibility. (B) Consult WaveLinx LITE system pages for additional details and compatibility.	

FOR FIXTURES LABELED EM

Driver Type | No. of Drivers | Paint Finish | Packaging | Accessories

Drive Type	No.of Drivers	Paint Finish	Packaging	Accessories (Order Separately) (22)
CD=0-10V Dimming Driver (10%-100% Dimming) **HCD**=0-10V Dimming Driver (1%-100% Dimming) **SD**=Step-dim (Bi Level) (19) **5LTD**=Fifth Light (DALI) Driver (19), (20)	**1**=1 Driver **2**=2 Drivers	**[Blank]**=Standard White **BLK**=PAF Black (21)	**U**=Unit Pack	**AYC-Chain/Set**=36" Chain Hanger (Use 1 set per fixture) **SCF**=Fixed Stem Set (Specify Length) **SCS**=Swivel Stem Set (Specify Length) **SCA**=Adjustable 48" Stem Set **EYE-CHAIN/SET-B**=Eye Bolt Chain (Use 1 set per fixture) **WG-SNX/SN-2FT-B-PK**=2ft Wire Guard **WG-SNX/SN-4FT-B**=4ft Wire Guard **A1B/Spacer-U**=Spacer 1-1/2" to 2-1/2" from ceiling (Use 2 per fixture) **TOGGLE**=Single Toggle No. 2 (Specify Length) **Y-TOGGLE-__-2PK**=(2) Y-Toggle Cable Kits (Specify 10 or 30 for length in feet) **GRP-SNF-U**=Gripper Hanger **CLC-SNLED-EXT-B**=SNLED Long Row Aligner Extension **Round Replacement Lenses** **SNLED-LENS-LW-2FT-U**= Replacement Lens 2 ft, Full Frost **SNLED-LENS-LN-2FT-U**= Replacement Lens 2 ft, Semi Frost **SNLED-LENS-LC-2FT-U**= Replacement Lens 2 ft, Clear **SNLED-LENS-LW-4FT-U**= Replacement Lens 4 ft, Full Frost **SNLED-LENS-LN-4FT-U**= Replacement Lens 4 ft, Semi Frost **SNLED-LENS-LC-4FT-U**= Replacement Lens 4 ft, Clear **Square Replacement Lenses** **SNLED-SQLENS-SLW-2FT-U**= Replacement Lens 2 ft, Full Frost **SNLED-SQLENS-SLN-2FT-U**= Replacement Lens 2 ft, Semi Frost **SNLED-SQLENS-SLC-2FT-U**= Replacement Lens 2 ft, Clear **SNLED-SQLENS-SLW-4FT-U**= Replacement Lens 4 ft, Full Frost **SNLED-SQLENS-SLN-4FT-U**= Replacement Lens 4 ft, Semi Frost **SNLED-SQLENS-SLC-4FT-U**= Replacement Lens 4 ft, Clear
Notes (19) 4 ft. and 8 ft. only. (20) For a complete listing of Fifth Light products, visit www.cooperlighting.com		**Notes** (21) Black fixture and lens ends. Refer to Finish multiplier table for performance (page 3).		**Notes** (22) Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information.

Metalux — SNLED Lensed

TYPE - L3

Product Specifications

Construction
- Die-formed of cold rolled steel with numerous knockouts for easy installation
- Groove for Tong Hanger
- Convertible end plate for continuous row alignment
- Channel/wireway cover secured with sheet metal screws
- Surface, pendant or stem mounting

Controls
- Standard with 0-10V dimming driver (10% standard, 1% optional)
- Integrated WaveLinx sensor options provide wireless individual fixture control and enable code compliance, ncreased energy savings, grouping of fixtures, and connection to WaveLinx control systems
- DALI 2.0 and step-dimming available
- For motion control, reference sensor locations for both end and middle of the row applications

Electrical
- Long-life LED system with electrical driver for optimal performance
- LED's available in 3000K, 3500K, 4000K or 5000K with CRI of 80 standard or optional 90 CRI
- TM21 rating of L87>60,000 hours
- Electronic drivers available for 120-277V, 347V and 480 applications
- Operating temperatures of -20°C up to 50°C (refer to ambient temperature chart)

Emergency Battery Pack Option
- Optional 120V-277V integral emergency battery pack available in 7W or 14W
- 90-minute backup period for code compliance
- Generator transfer options available

Finish
- Multi-stage, iron phosphate pretreatment
- Highly reflective paint after fabrication
- Standard baked white enamel finish

Shielding
- Three round lensed optical distributions available: Clear with linear ribs (LC), semi-frost for narrow distribution (LN) and full frost for wide distribution (LW)
- Three square lensed optical distributions available: clear with linear ribs (SLC), semi-frost for narrow distribution (SLN) and full frost for wide distribution (SLW)

Compliance
- cULus Listed for damp locations
- State of California Title 24 high efficacy luminaire
- DesignLights Consortium® Qualified and classified for DLC Standard and DLC Premium (refer to www.designlights.org)
- Suitable for closet use when installed to NEC 410.16 spacings standards

Warranty
- Five year limited warranty

WaveLinx LITE devices are not currently compatible with the WaveLinx PRO Wireless Area Controller

Photometric Data

View IES files

Control Solutions

- WaveLinx LITE wireless
- WaveLinx PRO wireless
- WaveLinx CAT wired
- WaveLinx Wired

WaveLinx Digital Lighting Control Solutions

Energy and Performance Data

CCT Table

Approximate Color Temperature	Multiplier
2700K	.93
3000K	.98
3500K	1.0
4000K	1.02
5000K	1.02

CRI

Lumen multiplier (80CRI to 90CRI)			
3000K	3500K	4000K	5000K
0.805	0.840	0.846	0.901

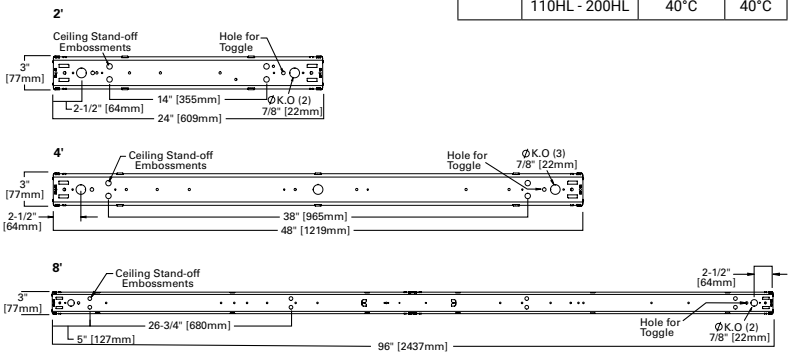
Shipping Data

Length	Wt.
2 ft.	4.3 lbs.
4 ft.	8.2 lbs.
8 ft.	15.1 lbs.

Ambient Temperature

Length	Lumen Package	Standard	EM
2FT	16SL - 27SL	50°C	40°C
	30HL - 48HL	40°C	40°C
4FT	15SL - 54SL	50°C	40°C
	56SL - 97HL	40°C	40°C
8FT	50SL - 108SL	50°C	40°C
	110HL - 200HL	40°C	40°C

Dimensional and Mounting Details



Metalux — SNLED Lensed

TYPE - L3

Energy and Performance Data

Wattage: Round Clear Lens

SNELD Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Clear Lens (LC)	Standard	2 ft.	2SNLED-LD5-18SL-LC-UNV-L8XX-CD1-U	1960	14	137.4
Clear Lens (LC)	Standard	2 ft.	2SNLED-LD5-22SL-LC-UNV-L8XX-CD1-U	2420	18	133.7
Clear Lens (LC)	Standard	2 ft.	2SNLED-LD5-26SL-LC-UNV-L8XX-CD1-U	2747	21	131.1
Clear Lens (LC)	High	2 ft.	2SNLED-LD5-34HL-LC-UNV-L8XX-CD1-U	3487	27	131.2
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-18SL-LC-UNV-L8XX-CD1-U	1890	13	145.0
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-22SL-LC-UNV-L8XX-CD1-U	2344	16	146.4
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-26SL-LC-UNV-L8XX-CD1-U	2699	18	146.3
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-30SL-LC-UNV-L8XX-CD1-U	3077	21	145.4
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-34SL-LC-UNV-L8XX-CD1-U	3567	25	143.3
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-37SL-LC-UNV-L8XX-CD1-U	3924	28	141.6
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-41SL-LC-UNV-L8XX-CD1-U	4269	31	139.6
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-46SL-LC-UNV-L8XX-CD1-U	4718	35	136.8
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-49SL-LC-UNV-L8XX-CD1-U	5051	38	134.4
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-52SL-LC-UNV-L8XX-CD1-U	5478	41	133.3
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-56SL-LC-UNV-L8XX-CD1-U	5880	46	127.4
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-63SL-LC-UNV-L8XX-CD1-U	6358	52	123.1
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-66SL-LC-UNV-L8XX-CD1-U	6628	55	120.2
Clear Lens (LC)	High	4 ft.	4SNLED-LD5-52HL-LC-UNV-L8XX-CD1-U	5171	37	139.5
Clear Lens (LC)	High	4 ft.	4SNLED-LD5-55HL-LC-UNV-L8XX-CD1-U	5409	39	138.5
Clear Lens (LC)	High	4 ft.	4SNLED-LD5-60HL-LC-UNV-L8XX-CD1-U	5893	43	136.7
Clear Lens (LC)	High	4 ft.	4SNLED-LD5-76HL-LC-UNV-L8XX-CD1-U	7774	62	125.1
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-60SL-LC-UNV-L8XX-CD1-U	6154	42	145.4
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-68SL-LC-UNV-L8XX-CD1-U	7134	50	143.3
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-75SL-LC-UNV-L8XX-CD1-U	7847	55	141.6
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-83SL-LC-UNV-L8XX-CD1-U	8537	61	139.6
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-90SL-LC-UNV-L8XX-CD1-U	9437	69	136.8
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-98SL-LC-UNV-L8XX-CD1-U	10101	75	134.4
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-105SL-LC-UNV-L8XX-CD1-U	10956	82	133.3
Clear Lens (LC)	High	8 ft.	8TSNLED-LD5-130HL-LC-UNV-L8XX-CD2-U	11786	86	136.7
Clear Lens (LC)	High	8 ft.	8TSNLED-LD5-170HL-LC-UNV-L8XX-CD2-U	15549	124	125.1

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.

Metalux — SNLED Lensed

TYPE - L3

Energy and Performance Data

Wattage: Round Semi-frost Lens, Narrow

SNELD Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Semi-Frost Lens (LN)	Standard	2 ft.	2SNLED-LD5-18SL-LN-UNV-L8XX-CD1-U	1903	14	133.4
Semi-Frost Lens (LN)	Standard	2 ft.	2SNLED-LD5-22SL-LN-UNV-L8XX-CD1-U	2350	18	129.8
Semi-Frost Lens (LN)	Standard	2 ft.	2SNLED-LD5-26SL-LN-UNV-L8XX-CD1-U	2667	21	127.3
Semi-Frost Lens (LN)	High	2 ft.	2SNLED-LD5-32HL-LN-UNV-L8XX-CD1-U	3385	27	127.4
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-18SL-LN-UNV-L8XX-CD1-U	1835	13	140.8
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-22SL-LN-UNV-L8XX-CD1-U	2276	16	142.2
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-26SL-LN-UNV-L8XX-CD1-U	2620	18	142.0
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-30SL-LN-UNV-L8XX-CD1-U	2987	21	141.2
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-34SL-LN-UNV-L8XX-CD1-U	3463	25	139.2
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-37SL-LN-UNV-L8XX-CD1-U	3809	28	137.5
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-41SL-LN-UNV-L8XX-CD1-U	4144	31	135.6
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-46SL-LN-UNV-L8XX-CD1-U	4581	35	132.8
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-49SL-LN-UNV-L8XX-CD1-U	4903	38	130.4
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-53SL-LN-UNV-L8XX-CD1-U	5318	41	129.4
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-56SL-LN-UNV-L8XX-CD1-U	5708	46	123.7
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-61SL-LN-UNV-L8XX-CD1-U	6172	52	119.5
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-64SL-LN-UNV-L8XX-CD1-U	6435	55	116.7
Semi-Frost Lens (LN)	High	4 ft.	4SNLED-LD5-50HL-LN-UNV-L8XX-CD1-U	5020	37	135.4
Semi-Frost Lens (LN)	High	4 ft.	4SNLED-LD5-54HL-LN-UNV-L8XX-CD1-U	5252	39	134.5
Semi-Frost Lens (LN)	High	4 ft.	4SNLED-LD5-60HL-LN-UNV-L8XX-CD1-U	5721	43	132.7
Semi-Frost Lens (LN)	High	4 ft.	4SNLED-LD5-74HL-LN-UNV-L8XX-CD1-U	7548	62	121.5
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-60SL-LN-UNV-L8XX-CD1-U	5975	42	141.2
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-68SL-LN-UNV-L8XX-CD1-U	6926	50	139.2
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-75SL-LN-UNV-L8XX-CD1-U	7619	55	137.5
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-83SL-LN-UNV-L8XX-CD1-U	8289	61	135.6
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-91SL-LN-UNV-L8XX-CD1-U	9162	69	132.8
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-98SL-LN-UNV-L8XX-CD1-U	9807	75	130.4
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-106SL-LN-UNV-L8XX-CD1-U	10636	82	129.4
Semi-Frost Lens (LN)	High	8 ft.	8TSNLED-LD5-130HL-LN-UNV-L8XX-CD2-U	11442	86	132.7
Semi-Frost Lens (LN)	High	8 ft.	8TSNLED-LD5-170HL-LN-UNV-L8XX-CD2-U	15095	124	121.5

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.

Metalux — SNLED Lensed

TYPE - L3

Energy and Performance Data

Wattage: Round Full-frost Lens, Wide

SNELD Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Full Frost Lens (LW)	Standard	2 ft.	2SNLED-LD5-16SL-LW-UNV-L8XX-CD1-U	1750	14	122.7
Full Frost Lens (LW)	Standard	2 ft.	2SNLED-LD5-20SL-LW-UNV-L8XX-CD1-U	2162	18	119.4
Full Frost Lens (LW)	Standard	2 ft.	2SNLED-LD5-23SL-LW-UNV-L8XX-CD1-U	2453	21	117.1
Full Frost Lens (LW)	High	2 ft.	2SNLED-LD5-30HL-LW-UNV-L8XX-CD1-U	2975	27	112.0
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-16SL-LW-UNV-L8XX-CD1-U	1688	13	129.5
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-20SL-LW-UNV-L8XX-CD1-U	2093	16	130.8
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-23SL-LW-UNV-L8XX-CD1-U	2410	18	130.7
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-27SL-LW-UNV-L8XX-CD1-U	2748	21	129.8
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-30SL-LW-UNV-L8XX-CD1-U	3186	25	128.0
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-33SL-LW-UNV-L8XX-CD1-U	3504	28	126.5
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-37SL-LW-UNV-L8XX-CD1-U	3812	31	124.7
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-41SL-LW-UNV-L8XX-CD1-U	4214	35	122.1
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-44SL-LW-UNV-L8XX-CD1-U	4511	38	120.0
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-47SL-LW-UNV-L8XX-CD1-U	4892	41	119.1
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-50SL-LW-UNV-L8XX-CD1-U	5251	46	113.8
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-56SL-LW-UNV-L8XX-CD1-U	5678	52	109.9
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-58SL-LW-UNV-L8XX-CD1-U	5920	55	107.3
Full Frost Lens (LW)	High	4 ft.	4SNLED-LD5-44HL-LW-UNV-L8XX-CD1-U	4412	37	119.0
Full Frost Lens (LW)	High	4 ft.	4SNLED-LD5-48HL-LW-UNV-L8XX-CD1-U	4615	39	118.2
Full Frost Lens (LW)	High	4 ft.	4SNLED-LD5-54HL-LW-UNV-L8XX-CD1-U	5028	43	116.6
Full Frost Lens (LW)	High	4 ft.	4SNLED-LD5-65HL-LW-UNV-L8XX-CD1-U	6633	62	106.7
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-54SL-LW-UNV-L8XX-CD1-U	5496	42	129.8
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-61SL-LW-UNV-L8XX-CD1-U	6371	50	128.0
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-67SL-LW-UNV-L8XX-CD1-U	6371	50	128.0
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-74SL-LW-UNV-L8XX-CD1-U	7625	61	124.7
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-81SL-LW-UNV-L8XX-CD1-U	8428	69	122.1
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-88SL-LW-UNV-L8XX-CD1-U	9022	75	120.0
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-95SL-LW-UNV-L8XX-CD1-U	9785	82	119.1
Full Frost Lens (LW)	High	8 ft.	8TSNLED-LD5-110HL-LW-UNV-L8XX-CD1-U	11356	103	109.9
Full Frost Lens (LW)	High	8 ft.	8TSNLED-LD5-150HL-LW-UNV-L8XX-CD2-U	15739	158	99.5

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.

Metalux

SNLED Lensed

TYPE - L3

Energy and Performance Data

Wattage: Square Flat Clear Lens

SNELD Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Flat Clear Lens (SLC)	Standard	2 ft.	2SNLED-LD5-19SL-SLC-UNV-L8XX-CD1-U	1936	14	135.7
Flat Clear Lens (SLC)	Standard	2 ft.	2SNLED-LD5-24SL-SLC-UNV-L8XX-CD1-U	2391	18	132.1
Flat Clear Lens (SLC)	Standard	2 ft.	2SNLED-LD5-27SL-SLC-UNV-L8XX-CD1-U	2714	21	129.5
Flat Clear Lens (SLC)	High	2 ft.	2SNLED-LD5-37HL-SLC-UNV-L8XX-CD1-U	3669	27	138.1
Flat Clear Lens (SLC)	High	2 ft.	2SNLED-LD5-48HL-SLC-UNV-L8XX-CD1-U	4830	36	134.5
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-19SL-SLC-UNV-L8XX-CD1-U	1868	13	143.3
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-23SL-SLC-UNV-L8XX-CD1-U	2316	16	144.7
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-27SL-SLC-UNV-L8XX-CD1-U	2666	18	144.5
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-30SL-SLC-UNV-L8XX-CD1-U	3040	21	143.6
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-35SL-SLC-UNV-L8XX-CD1-U	3524	25	141.6
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-39SL-SLC-UNV-L8XX-CD1-U	3876	28	139.9
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-42SL-SLC-UNV-L8XX-CD1-U	4217	31	138.0
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-47SL-SLC-UNV-L8XX-CD1-U	4662	35	135.1
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-50SL-SLC-UNV-L8XX-CD1-U	4990	38	132.7
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-54SL-SLC-UNV-L8XX-CD1-U	5412	41	131.7
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-58SL-SLC-UNV-L8XX-CD1-U	5809	46	125.9
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-63SL-SLC-UNV-L8XX-CD1-U	6281	52	121.6
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-65SL-SLC-UNV-L8XX-CD1-U	6549	55	118.7
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-77SL-SLC-UNV-L8XX-CD1-U	7697	70	110.0
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-85SL-SLC-UNV-L8XX-CD1-U	8490	85	100.4
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-54HL-SLC-UNV-L8XX-CD1-U	5441	37	146.8
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-57HL-SLC-UNV-L8XX-CD1-U	5692	39	145.7
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-62HL-SLC-UNV-L8XX-CD1-U	6201	43	143.8
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-68HL-SLC-UNV-L8XX-CD1-U	6795	48	140.8
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-82HL-SLC-UNV-L8XX-CD1-U	8181	62	131.7
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-97HL-SLC-UNV-L8XX-CD1-U	9705	79	122.7
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-60SL-SLC-UNV-L8XX-CD1-U	6080	42	143.6
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-70SL-SLC-UNV-L8XX-CD1-U	7048	50	141.6
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-78SL-SLC-UNV-L8XX-CD1-U	7753	50	139.9
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-84SL-SLC-UNV-L8XX-CD1-U	8435	61	138.0
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-93SL-SLC-UNV-L8XX-CD1-U	9323	69	135.1
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-100SL-SLC-UNV-L8XX-CD1-U	9980	75	132.7
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-108SL-SLC-UNV-L8XX-CD1-U	10824	82	131.7
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-116SL-SLC-UNV-L8XX-CD1-U	11618	61	125.9
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-125SL-SLC-UNV-L8XX-CD2-U	12562	69	121.6
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-131SL-SLC-UNV-L8XX-CD2-U	13097	75	118.7
Flat Clear Lens (SLC)	High	8 ft.	8TSNLED-LD5-130HL-SLC-UNV-L8XX-CD2-U	12402	82	143.8
Flat Clear Lens (SLC)	High	8 ft.	8TSNLED-LD5-170HL-SLC-UNV-L8XX-CD2-U	16361	103	131.7
Flat Clear Lens (SLC)	High	8 ft.	8TSNLED-LD5-200HL-SLC-UNV-L8XX-CD2-U	19411	158	122.7

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.

Metalux

SNLED Lensed

TYPE - L3

Energy and Performance Data

Wattage: Square Flat Semi-frost Lens, Narrow

SNELD Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Flat Semi-frost Lens (SLN)	Standard	2 ft.	2SNLED-LD5-19SL-SLN-UNV-L8XX-CD1-U	1931	14	135.3
Flat Semi-frost Lens (SLN)	Standard	2 ft.	2SNLED-LD5-24SL-SLN-UNV-L8XX-CD1-U	2385	18	131.7
Flat Semi-frost Lens (SLN)	Standard	2 ft.	2SNLED-LD5-27SL-SLN-UNV-L8XX-CD1-U	2706	21	129.1
Flat Semi-frost Lens (SLN)	High	2 ft.	2SNLED-LD5-37HL-SLN-UNV-L8XX-CD1-U	3659	27	137.7
Flat Semi-frost Lens (SLN)	High	2 ft.	2SNLED-LD5-48HL-SLN-UNV-L8XX-CD1-U	4816	36	134.2
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-19SL-SLN-UNV-L8XX-CD1-U	1863	13	142.9
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-23SL-SLN-UNV-L8XX-CD1-U	2309	16	144.3
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-27SL-SLN-UNV-L8XX-CD1-U	2659	18	144.1
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-30SL-SLN-UNV-L8XX-CD1-U	3032	21	143.2
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-35SL-SLN-UNV-L8XX-CD1-U	3514	25	141.2
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-39SL-SLN-UNV-L8XX-CD1-U	3866	28	139.5
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-42SL-SLN-UNV-L8XX-CD1-U	4206	31	137.6
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-46SL-SLN-UNV-L8XX-CD1-U	4649	35	134.7
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-50SL-SLN-UNV-L8XX-CD1-U	4976	38	132.4
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-54SL-SLN-UNV-L8XX-CD1-U	5397	41	131.4
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-58SL-SLN-UNV-L8XX-CD1-U	5793	46	125.6
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-63SL-SLN-UNV-L8XX-CD1-U	6264	52	121.3
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-65SL-SLN-UNV-L8XX-CD1-U	6530	55	118.4
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-78SL-SLN-UNV-L8XX-CD1-U	7676	70	109.7
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-85SL-SLN-UNV-L8XX-CD1-U	8466	85	100.1
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-54HL-SLN-UNV-L8XX-CD1-U	5426	37	146.4
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-57HL-SLN-UNV-L8XX-CD1-U	5676	39	145.3
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-62HL-SLN-UNV-L8XX-CD1-U	6184	43	143.4
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-68HL-SLN-UNV-L8XX-CD1-U	6776	48	140.5
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-82HL-SLN-UNV-L8XX-CD1-U	8158	62	131.3
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-97HL-SLN-UNV-L8XX-CD1-U	9679	79	122.4
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-64SL-SLN-UNV-L8XX-CD1-U	6063	42	143.2
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-70SL-SLN-UNV-L8XX-CD1-U	7028	50	141.2
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-77SL-SLN-UNV-L8XX-CD1-U	7731	55	139.5
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-84SL-SLN-UNV-L8XX-CD1-U	8411	61	137.6
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-93SL-SLN-UNV-L8XX-CD1-U	9297	69	134.7
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-100SL-SLN-UNV-L8XX-CD1-U	9952	75	132.4
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-108SL-SLN-UNV-L8XX-CD1-U	10794	82	131.4
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-116SL-SLN-UNV-L8XX-CD1-U	11586	92	125.6
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-125SL-SLN-UNV-L8XX-CD2-U	12527	103	121.3
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-130SL-SLN-UNV-L8XX-CD2-U	13061	110	118.4
Flat Semi-frost Lens (SLN)	High	8 ft.	8TSNLED-LD5-130HL-SLN-UNV-L8XX-CD2-U	12368	86	143.4
Flat Semi-frost Lens (SLN)	High	8 ft.	8TSNLED-LD5-170HL-SLN-UNV-L8XX-CD2-U	16316	124	131.3
Flat Semi-frost Lens (SLN)	High	8 ft.	8TSNLED-LD5-200HL-SLN-UNV-L8XX-CD2-U	19357	158	122.4

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.

Metalux — SNLED Lensed

TYPE - L3

Energy and Performance Data

Wattage: Square Flat Full-frost Lens, Wide

SNELD Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Flat Full-frost Lens (SLW)	Standard	2 ft.	2SNLED-LD5-16SL-SLW-UNV-L8XX-CD1-U	1604	14	112.4
Flat Full-frost Lens (SLW)	Standard	2 ft.	2SNLED-LD5-20SL-SLW-UNV-L8XX-CD1-U	1981	18	109.4
Flat Full-frost Lens (SLW)	Standard	2 ft.	2SNLED-LD5-22SL-SLW-UNV-L8XX-CD1-U	2248	21	107.3
Flat Full-frost Lens (SLW)	High	2 ft.	2SNLED-LD5-30HL-SLW-UNV-L8XX-CD1-U	3077	27	115.8
Flat Full-frost Lens (SLW)	High	2 ft.	2SNLED-LD5-41HL-SLW-UNV-L8XX-CD1-U	4051	36	
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-15SL-SLW-UNV-L8XX-CD1-U	1547	13	118.7
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-19SL-SLW-UNV-L8XX-CD1-U	1918	16	119.8
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-22SL-SLW-UNV-L8XX-CD1-U	2209	18	119.7
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-25SL-SLW-UNV-L8XX-CD1-U	2518	21	119.0
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-29SL-SLW-UNV-L8XX-CD1-U	2919	25	117.3
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-32SL-SLW-UNV-L8XX-CD1-U	3211	28	115.9
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-35SL-SLW-UNV-L8XX-CD1-U	3494	31	114.3
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-39SL-SLW-UNV-L8XX-CD1-U	3862	35	111.9
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-41SL-SLW-UNV-L8XX-CD1-U	4134	38	110.0
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-45SL-SLW-UNV-L8XX-CD1-U	4483	41	109.1
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-48SL-SLW-UNV-L8XX-CD1-U	4812	46	104.3
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-52SL-SLW-UNV-L8XX-CD1-U	5203	52	100.7
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-54SL-SLW-UNV-L8XX-CD1-U	5425	55	98.4
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-64SL-SLW-UNV-L8XX-CD1-U	6376	70	91.1
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-70SL-SLW-UNV-L8XX-CD1-U	7033	48	83.1
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-46HL-SLW-UNV-L8XX-CD1-U	4564	37	123.1
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-48HL-SLW-UNV-L8XX-CD1-U	4774	39	122.2
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-52HL-SLW-UNV-L8XX-CD1-U	5201	43	120.6
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-57HL-SLW-UNV-L8XX-CD1-U	5699	48	118.1
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-69HL-SLW-UNV-L8XX-CD1-U	6862	62	110.4
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-81HL-SLW-UNV-L8XX-CD1-U	8141	79	102.9
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-50SL-SLW-UNV-L8XX-CD1-U	5037	42	119.0
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-58SL-SLW-UNV-L8XX-CD1-U	5838	50	117.3
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-64SL-SLW-UNV-L8XX-CD1-U	6422	55	115.9
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-70SL-SLW-UNV-L8XX-CD1-U	6987	61	114.3
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-77SL-SLW-UNV-L8XX-CD1-U	7723	69	111.9
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-83SL-SLW-UNV-L8XX-CD1-U	8267	75	110.0
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-90SL-SLW-UNV-L8XX-CD1-U	8966	82	109.1
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-96SL-SLW-UNV-L8XX-CD1-U	9624	92	104.3
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-104SL-SLW-UNV-L8XX-CD1-U	10406	103	100.7
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-108SL-SLW-UNV-L8XX-CD1-U	10850	110	98.4
Flat Full-frost Lens (SLW)	High	8 ft.	8TSNLED-LD5-130HL-SLW-UNV-L8XX-CD2-U	10402	86	120.6
Flat Full-frost Lens (SLW)	High	8 ft.	8TSNLED-LD5-170HL-SLW-UNV-L8XX-CD2-U	13723	124	110.4
Flat Full-frost Lens (SLW)	High	8 ft.	8TSNLED-LD5-200HL-SLW-UNV-L8XX-CD2-U	16281	158	102.9

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.

Cooper Lighting Solutions
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

Project		Catalog #		Type	
Prepared by		Notes		Date	

Metalux

APVT Select

4' and 8' Industrial Vaportite
CCT and Lumen Select

Typical Applications

• Industrial • Manufacturing • Gymnasium • Warehouse • Parking • Retail

Interactive Menu

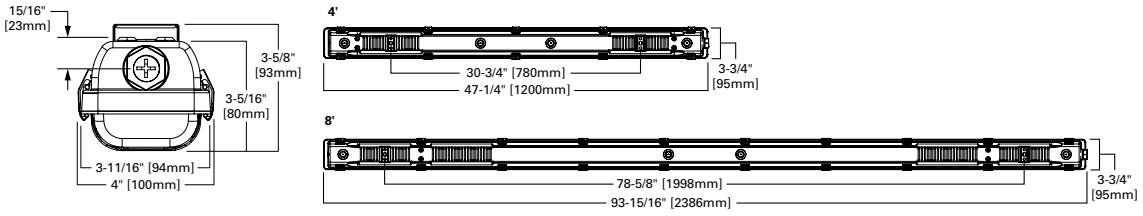
Product Certification

Product Features

Top Product Features

- Lumen and CCT select option provide application versatility
- 2-piece easy access design: captive lens, electrical and housing enclosures
- Impact protection rating IK07 Lens and IK10 Housing
- Available in 4FT & 8FT lengths
- Stainless steel latches, single conduit hub, and mounting included
- Standard 0-10V dimming to 10% for more energy savings
- Emergency and sensor options available for commercial applications

Dimensional Details



Metalux — APVT Select

Order Information by Catalog Number

Default CCT/Lumen Setting: 4000K / Med Power

Catalog Number	UPC	Lumen Setting	Nominal CCT (K)	120V Nominal Lumens	120V Watts	120V Efficacy (lm/W)	277V Nominal Lumens	277V Watts	277V Efficacy (lm/W)
4APVTLD-SL3C3	080083266371	Low Power	3500	3043	21	144	3036	22	140
			4000	3138	21	151	3128	21	147
			5000	2988	22	138	2977	22	134
		Mid Power	3500	4452	32	137	4443	33	137
			4000	4620	32	146	4614	32	145
			5000	4231	33	128	4242	33	127
		High Power	3500	5906	46	127	5911	46	129
			4000	6254	45	139	6241	45	140
			5000	5667	47	120	5531	46	120
8APVTLD-SL3C3	080083266333	Low Power	3500	8726	59	149	8835	60	147
			4000	8591	59	146	8658	60	144
			5000	8379	59	142	8427	60	140
		Mid Power	3500	10483	78	135	10461	78	134
			4000	10321	78	132	10251	78	131
			5000	10066	78	129	9977	78	128
		High Power	3500	11664	94	124	11480	92	125
			4000	11484	94	122	11249	92	122
			5000	11200	94	119	10949	92	119

Factory Installed Option

Catalog Number	Sensor and Emergency
4APVTLD-SL3C3-_____	**EL10W=**10-watt, 120-277V emergency battery pack installed (1), (4)
8APVTLD-SL3C3-_____	**MSWL20**=Wet Listed Motion Sensor 360° (3) **WPS4**=WaveLinx Pro Wireless Sensor, Sidecar mount, 1200 sq ft. coverage at 40ft MH (2), (3), (4) **WLS4**=WaveLinx Lite Wireless Sensor, Sidecar mount, 15' - 40' Mounting Height (2), (3), (4) **WLS2**=WaveLinx Lite, Wireless Sensor, Bluetooth Programmable, Sidecar mount, 7' - 15' Mounting (2), (3), (4)

FOR FIXTURE DESIGNATED EM

Example: 4APVTLD-SL3C3-EL10

Notes: (1) IP ratings require fixtures to be mounted horizontally. 40C max ambient for EL option.
(2) WaveLinx Lite devices are not currently compatible with the WaveLinx Pro Wireless Area Controller.
(3) All fixtures with sensor come with two (2) hubs as standard.
(4) Wavelinx with EL10W available on 8 ft only.

Energy Data - 120V

	4'	8'
PF	0.99	0.99
THD %	<15	< 15
Low Temp Start	-20° C	-20° C

Shipping Data

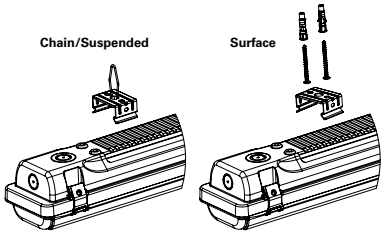
Catalog Base	Wt. (lbs)	Unit per Pallet	Case Pack Qty.
4APVTLD	4.8	100	4
8APVTLD	9.7	70	2

Accessories

Catalog Number	Description
VT2 WATER TIGHT HUB	(1) Water tight hub parts bag
AYC-Chain/Set-U	(2) 36" Chain Hanger (Use 1 set per fixture)
APVT-SS-CLIPS PK	(5) Stainless Steel APVTS replacement clips

Mounting Data

Mounting hardware included with luminaire



IK Rating

APVTS	IK Rating
Lens	IK07
Housing	IK10

Metalux — APVT Select

Product Specifications

Construction
- High-impact polycarbonate housing with integrated metal gear tray
- Standard housing available with one 1/2" entry point. One conduit hub included with fixture.
- Stainless steel latches secures diffuser tightly for a positive seal between housing and diffuser
- Captive lens and gear tray light engine enclosure drops for easy electrical access by contractor
- Marked KO entry points for continuous feed installation and multiple entry points
- Continuous feed requires additional conduit hub. Order hub separately
- Impact protection rating IK07 Lens and IK10 Housing

Emergency Battery Pack Option
- Factory installed 120V-277V integral emergency battery pack available via mod-shop
- 90-minute backup period for code compliance
- Factory installed integral test switch visible through lens
- Max ambient temp with EL battery pack is 40°C (104°F)

Electrical
- 0-10V dimming, 10% standard
- Driver meets FCC part 15 Class B for use in residential or commercial applications
- Long-Life LED system with an energy-efficient electronic driver comes in 120-277V
- LED's are 80 CRI and CCT Selectable option available for maximum color flexibility: choose from 3500K, 4000K or 5000K
- Lumen select switch provides three lumen package choices (Low, Medium and High) in selectable options
- L70 at >160,000 hours (TM-21)
- Default CCT/Lumen Setting is 4000K and Med Power

Lens
- UV stabilized high-impact polycarbonate lens
- Lens is IK08 rated for impact protection
- Diffuse lens provides medium distribution and general coverage

Controls
- Integral 360° motion sensor, 1200 sq. ft. coverage
- Wavelinx Pro Wireless Sensor provides 1200 sq. ft. coverage for occupancy sensing and daylight harvesting
- Wavelinx Lite Wireless sensor suitable for low or high bay applications up to 40ft (45ft major motion).
- All fixtures with sensor come with two (2) hubs as standard

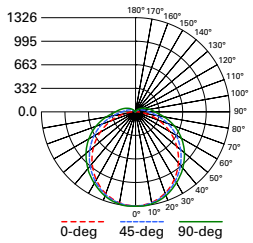
Mounting
- Includes surface mount clips and v-bracket
- Great for mounting heights between 9 and 12ft high

Warranty
- Five year limited warranty

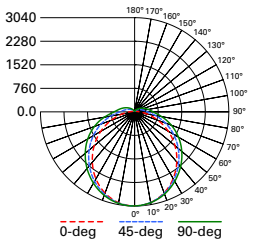
Compliance
- cULus listed for wet location rated
- Recommended operating ambient temp -20°C to 45°C (-4°F to 113°F)
- LED's comply with IESNA LM-79 and LM-80 standards
- DesignLights Consortium® Qualified and classified for DLC Standard, refer to www.designlights.org for details
- RoHS compliant
- FCC part 15 Class B (residential) compliant with standard 0-10V dimming driver, battery packs excluded
- Not for residential use if emergency battery pack is installed

Photometric Data

View IES files

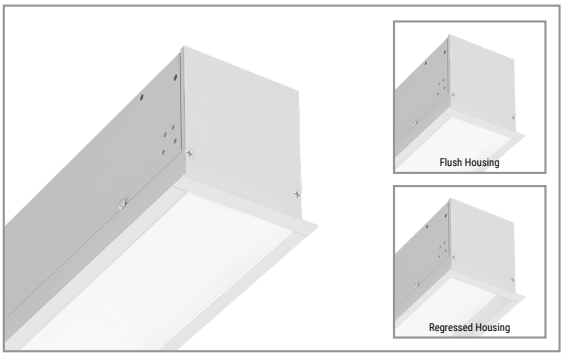


4APVTLD-SL3C3
Electronic Driver
Linear LED 4000K
Spacing criterion: (II) 1.23 x mounting height, (⊥) 1.3 x mounting height
Lumens: 4620
Input Watts: 31.6W
Efficacy: 146 lm/W
Test Report: 4APVTLD-SL3C3-MID-4000K-120V.IES



8APVTLD-SL3C3
Electronic Driver
Linear LED 4000K
Spacing criterion: (II) 1.22 x mounting height, (⊥) 1.28 x mounting height
Lumens: 10321
Input Watts: 78W
Efficacy: 132 lm/W
Test Report: 8APVTLD-SL3C3-MID-4000K-120V.IES

Project		Catalog #		Type	TYPE - L5
Prepared by		Notes		Date	



NeoRay

Define 4

LED
Recessed
Direct

Typical Applications

Office • Education • Healthcare • Hospitality • Retail

Interactive Menu

Product Certification

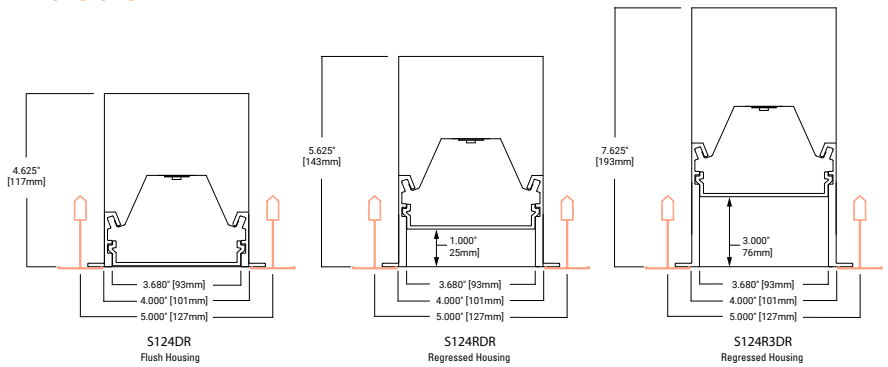
Product Features

VividTune

Top Product Features

- Flush, 1" regressed and 3" regressed housings available as standard
- Specifiable to the nearest 1" in length
- Satin Lens, Asymmetric Lens and Drop Lens available
- Customizable lumen packages
- Precision extended trims fit a variety of different architectural ceiling types
- Industry leading performance and efficacy
- Standard and custom corners / transitions available
- Options to meet Buy American Act requirements

Dimensions



additional product diagrams

COOPER Lighting Solutions

NeoRay — Define 4 LED Recessed

Order Information

Icon Key: Grey bar denotes a Ø Consult factory for

TYPE - L5

SAMPLE ORDER NUMBER: **S124DR-S795D840-ETG4F0-1B1-UDD-F-W-WPS**

Domestic Preference	Light Distribution	Light Engine	Lumen Package Down	CRI	LED CCT	Ceiling Type	Length	Circuiting
[Blank]=Standard **BAA**=Buy American Act	**S124DR**=Define 4 Direct Recessed **S124RDR**=Define 4 Regressed Direct Recessed **S124R3DR**=Define 4 Regressed 3" Direct Recessed **QS-S124DR**=Define 4 Direct Recessed Quick Spec	**-S**=Standard **-H**=High Performance **-V**=VividTune	**350D**=350 Lms/ft **575D**=575 Lms/ft **795D**=795 Lms/ft **1020D**=1020 Lms/ft **1195D**=1195 Lms/ft **____D**=Custom Lms/ft	**8**=80 **9**=90	**27**=2700K **30**=3000K **35**=3500K **40**=4000K **50**=5000K **2765**=2700K-6500K **3050**=3000K-5000K	**-ETG**=15/16" T-Grid **-FTG**=9/16" T-Grid **-STG**=9/16" Slot T-Grid **-FTT**=9/16" Tegular T-Grid **-ITG**=9/16" Interlude T-Grid **-ETT**=15/16" Tegular T-Grid **-GYP**=Gypsum board **-FSR**=Mud-in Gypsum Board **-FES**="Finished" Extruded Side	**2F0**=2' Individual **4F0**=4' Individual **8F0**=8' Individual **12F0**=12' Individual **__F0**=4' Incremental Run (e.g. 40F0 = 40' 0") **__F_**=1" Incremental Run (e.g. 21F3 = 21' 3")	**-1**=Single Circuit **-S**=Secondary Circuit
Notes Only product configurations with this designated prefix are built to be compliant with the Buy American Act of 1933 (BAA). Please refer to Domestic Preferences website for more information. Components shipped separately may be separately analyzed under domestic preference requirements.	**Notes** RDR regress of 1" will add an additional 1" to fixture depth. R3DR regress of 3" will add additional 3" to fixture depth. 3" regressed only available in GYP, ETG and FTG ceiling types.	**Notes** See performance table for add'l details. Light engine must be consistent across run length.	**Notes** 3500K/80CRI/DR housing/F Lens. Please refer to scaling data for other variables. For custom lumen output, please refer to additional information on page 4. VividTune available with 795D, 1020D, and 1195D.	**Notes** Additional lead-time and cost may apply for 927, 930, 935 and 940 configurations. 2700K not available in 80CRI. 2765 & 3050 VividTune configurations require V light engine, 90 CRI, and W2A driver.	**Notes** Please refer to ceiling interface diagrams for additional detail and dimensions. 3" regressed only available in GYP, ETG and FTG ceiling types.	**Notes**	**Notes** Secondary circuit similar to A/B switching. Price adder applies for "S" configuration. VividTune Secondary Circuit has shared CCT wiring.

Emergency	Voltage	Integral LED Driver	Shielding Down
E=Emergency circuit **B1**=7W UNV integral battery **B2**=14W UNV integral battery **B3**=6W UNV Integral **T**=UL924 EPC Emergency Bypass Relay	**-U**=UNV 120-277V **-1**=120V **-2**=277V **-3**=347V **-4**=48VDC Ø	**DD**=0-10 Volt Dimming, 1% **5L**=DALI Dimming, 1%-100% **LH**=Lutron LDE1 w/ecosys **LV1**=DLVP Ø **W2A**=White Tuning, 0-10V Dimming (VividTune only)	**-F**=Satin Flush Diffuser **-A**=Asym Flush Optic **-D**=Satin Drop Diffuser **-L**=Straight blade louver with diffuser Ø
Notes Internal battery standard for fixtures ≥ 4ft and lumen output ≤1195 Lms/ft. Fixture Non-IC-Rated for internal battery and lumen output ≥1020 Lms/ft. External battery standard with fixtures <4ft and all Chicago plenum fixtures.	**Notes** 48V for use with LV1 driver. 347V only available with DD driver.	**Notes** DD driver is standard. For non-dimming applications, the driver will default to full brightness if no connection is made to the capped dimming wires in the field.	**Notes** All lensing options are snap-in lenses. "L" option required RDR housing and may require additional lead-time, please consult factory for details. A option not available with VividTune.

Options	Color	Integrated Sensor
-CP=Chicago Plenum **-R**=GLR Fuse (Fast) **-F**=GMF Fuse (Slow)	**-W**=Matte White **-S**=Silver **-B**=Black **-C**=Custom Color Ø	**[Blank]**=None **WaveLinx Wireless** **-WPS** = WaveLinx Pro Integrated Sensor (formerly WAA) **-WLS** = WaveLinx Lite Integrated Sensor (formerly WAB) **-WPST** = WaveLinx Pro Tilemount Sensor (formerly WTA) **-WLST** = WaveLinx Lite Tilemount Sensor (formerly WTB) **Other** **-LWIPD1** = Enlighted Integrated Sensor **-LWTPD1** = Enlighted Tilemount Sensor
Notes	**Notes**	**Notes** WaveLinx Wireless Sensors are available with (DD) driver option only. Enlighted Sensor is available with (5L) driver option only. Refer to Sensor Placement section for additional details. Integrated Sensors are available with Single Circuit (1) option only. Integrated Sensors combined with Emergency Circuit (E) require one UL924 Bypass Relay (T) per emergency fixture. Integrated Sensor options with Regressed or Drop lenses available as ETO. Tilemount Sensor is recommended.

NeoRay — Define 4 LED Recessed

TYPE - L5

Product Specifications

Construction
- Available in Flush and Regressed Housing
- Precision cut housing trim extruded from 6063 aluminum with aluminum frame
- Extruded end-caps ensure a precise and uniform ceiling interface
- Nominal 2' -12' illuminated sections used in run configuration and/or individual fixtures

Finish
- Electrostatically applied polyester powder coat paint

LED Module
- Modular LED tray assembly comprising reflector, light engine, led driver and quick disconnect wire-harness for ease of installation and maintenance over the life of the luminaire

Light Engine
- Offered with three next generation Neo-Ray light engines delivering industry leading efficacy and long-life
- LED's are available in 2700K, 3000K, 3500K, 4000K or VividTune ranges of 2700K-6500K and 3000K-5000K
- CRI options of either ≥80CRI or ≥90CRI (Lumen output will be affected - please refer to the lumen adjustment factor table)

LED Drivers
- LED system coupled with electrical driver
- Traditional electronic drivers are available for 120-277V and 347V applications
- Cooper Lighting Solutions's DLVP Low voltage drivers are available for 48VDC applications

Controls and Integrated Sensors
- Equipped standard with a 0-10V continuous dimming driver. Compatible with most standard dimming devices
- Additional control types are available (DALI, Lutron, DLVP) at an additional cost
- WaveLinx and Enlighted wireless sensors as well as stand-alone sensors available

Mounting
- Recessed

Lengths
- Available in any length (23" min) with a resolution of 1 inch. Max section length of 12ft (8ft max option available)
- Additional fixture lengths are available please consult factory. All lengths are nominal
- VividTune available as standard product in 1ft resolution
- Actual sizes are one inch shorter than nominal to allow easy in-grid installation
- For Gypsum or Flangeless installations add 1 inch to overall fixture length (e.g. 4F1 for 48" length)
- Refer to ceiling type section of specification sheet and submittal drawings for actual sizes

Corners and Transition Pieces
- Corners and other transition pieces are fully luminous
- Constructed using precision mitered frame and lens components
- The frame is welded to ensure a precise and robust assembly
- Standard 90° horizontal and vertical corners as well as custom corners are available
- Consult corner and pattern addendum for additional information
- Alternative transition pieces such as T's, Y's, X's, etc. are also available Ø

Snap-In lensing Options
- Satin Flush - Flush, high diffusion glare-free lens
- Satin Drop - 1" Drop, high diffusion glare-free lens
- Asymmetric - Flush, low-glare Asymmetric lens
- Flush options ship with our patent-pending underlens solution, the proud lens ships with an injection molded end cap to eliminate light leak

Reflectors
- Precision formed cold-rolled steel reflectors with high reflectivity
- Ultra high reflectivity used with High Performance light engine

Lumen Maintenance
- 90% (L90) of initial light output at 100,000+ hrs
- 70% (L70) of initial light output at 400,000+ hrs
- Derived from TM-21 standard @25°C ambient and typical operating conditions

Custom Lumen Output
- Custom lumen output expressed option in Lumens per foot (e.g. -725D for 725 Lms/ft down). Refer to additional detail on page 4.

Electrical
- Dimming provided as standard
- Dimming wires capped with wire-nuts for non-dimming applications
- Optional battery backup options provided
- Default battery location is internal to fixture
- Default emergency section is 4ft in length and located at the beginning of the fixture unless designated elsewhere
- Estimated lumen output = battery wattage * min efficacy (see performance table)
- Estimate lumen output from the emergency section, multiply battery wattage x minimum fixture efficacy
- The EPC option will bypass local controls and dimming upon loss of normal power. This option is required when the fixture has both integrated sensors and emergency circuiting

Integrated Sensors
- Please reference page 6 for details

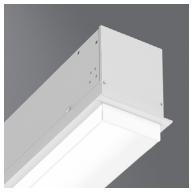
Weight
- 2.65 lbs per foot

Approvals
- cULus - listed for damp locations
- RoHS compliant
- Meets NYC requirements
- Meets CCEC requirements
- IC Rated for insulation contact (except where noted)
- Tested to IESNA LM-79 and LM-80
- Can be used for State of California Title 24 high efficacy luminaire
- DesignLights Consortium® Qualified and classified for both DLC Standard and DLC Premium, refer to www.designlights.org for details

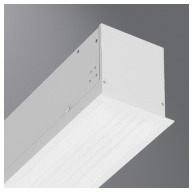
Warranty
- Five year warranty standard.

Shielding Options

S124DR with Flush Satin Lens (F)



S124DR with Drop Satin Lens (D)

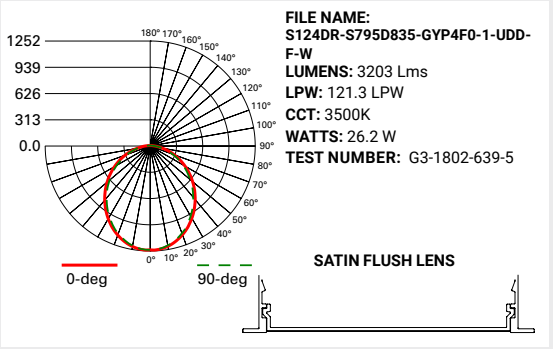


S124DR with Flush Asymmetric Lens (A)

NeoRay — Define 4 LED Recessed

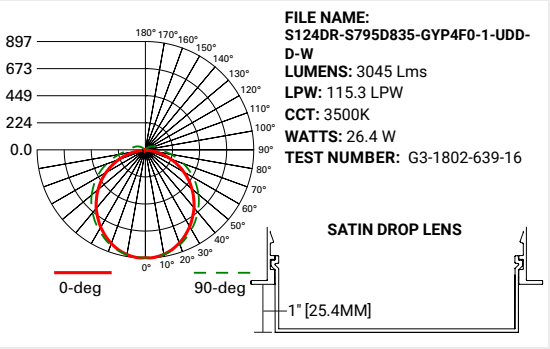
TYPE - L5

Photometric Data



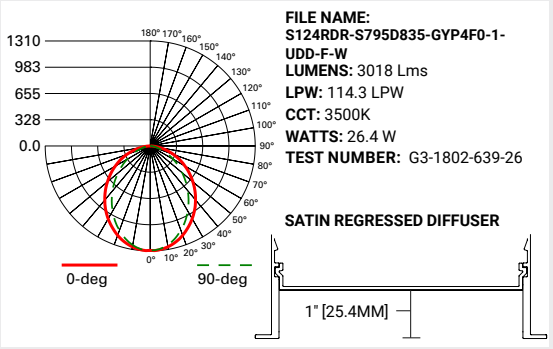
FILE NAME: S124DR-S795D835-GYP4F0-1-UDD-F-W
LUMENS: 3203 Lms
LPW: 121.3 LPW
CCT: 3500K
WATTS: 26.2 W
TEST NUMBER: G3-1802-639-5

SATIN FLUSH LENS



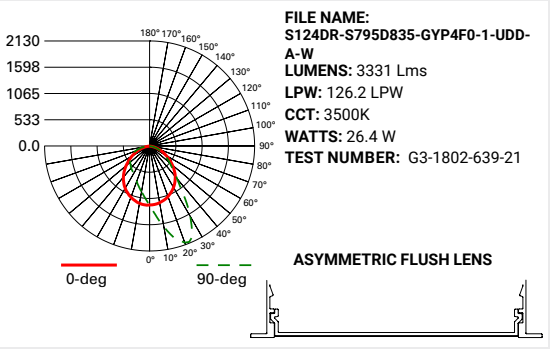
FILE NAME: S124DR-S795D835-GYP4F0-1-UDD-D-W
LUMENS: 3045 Lms
LPW: 115.3 LPW
CCT: 3500K
WATTS: 26.4 W
TEST NUMBER: G3-1802-639-16

SATIN DROP LENS



FILE NAME: S124RDR-S795D835-GYP4F0-1-UDD-F-W
LUMENS: 3018 Lms
LPW: 114.3 LPW
CCT: 3500K
WATTS: 26.4 W
TEST NUMBER: G3-1802-639-26

SATIN REGRESSED DIFFUSER



FILE NAME: S124DR-S795D835-GYP4F0-1-UDD-A-W
LUMENS: 3331 Lms
LPW: 126.2 LPW
CCT: 3500K
WATTS: 26.4 W
TEST NUMBER: G3-1802-639-21

ASYMMETRIC FLUSH LENS

Photometric Overview and Performance Data

Performance Per Linear Foot at 3500K/80CRI

Nominal Output	Standard and VividTune Light Engine		High Performance Light Engine	
lms/ft	W/ft	lm/W	W/ft	lm/W
350	3.0	121	2.9	126
575	4.8	123	4.4	133
795	6.8	121	6.1	133
1020	8.9	118	8.1	130
1195	10.6	115	9.7	126

Lumen Adjustment Factors

CCT	80CRI	90CRI
2700K	N/A	0.801
3000K	0.943	0.815
3500K	1.000	0.861
4000K	1.010	0.892

LUMEN ADJUSTMENT CALCULATIONS

Example 1 - Adjusted Lumen Output
Nominal Lumen Output selected = 1025 lms/ft (based on standard of 3500K/80CRI)
Lumen Adjustment Factor = 0.801 (2700K/90CRI desired)

Adjusted Lumen Output = Nominal Lumen Output x Lumen Adjustment Factor
Adjusted Lumen Output = 1025 lms/ft x 0.801 = 821 lms/ft

Example 2 - Custom Lumen Output based on Required Lumens Per Foot
Total light output (4ft) requirement of 2800 lms, desired CCT and CRI of 4000K/80CRI

Total required lumens per foot @ 4000K= 2800 lms / 4 ft = 700 lms/ft
Lumen Adjustment Factor = 1.018 (Requirement based on 4000K / 80CRI)

Total required lumens per foot @ 3500K / 80CRI = 700 lms/ft ÷ 1.018 = 688 lms/ft

Estimated efficacy = 121 lm/W (find nearest value using table above)
Estimated power consumption = 688 lms/ft ÷ 121 lm/W = 5.69 W/ft

Custom Lumen Output

Total Light Output Range (lms/ft)

CCT	80CRI	90CRI
2700K	N/A	189-1058
3000K	222-1246	192-1077
3500K	236-1321	203-1138
4000K	238-1335	210-1179

If your requirement is expressed in power consumption (W/ft) rather than light output, you can use the power to lumen output curves to convert power consumption to light output for specification.

Efficacy for custom lumen outputs can be estimated using lumen output curves or with the use of our online custom lumen output tool.

NeoRay — Define 4 LED Recessed

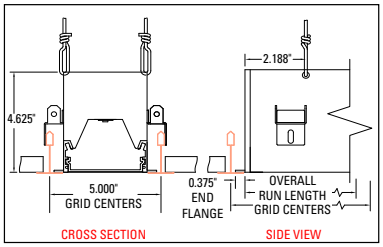
TYPE - L5

Ceiling Type

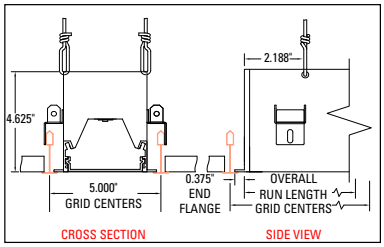
Extruded Trim Flange Details - Refer to submittal drawings for detailed flange information - for additional options consult factory.

Grid Ceiling Systems

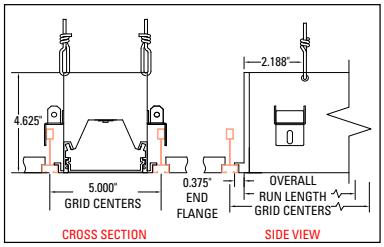
15/16 Tee (ETG)



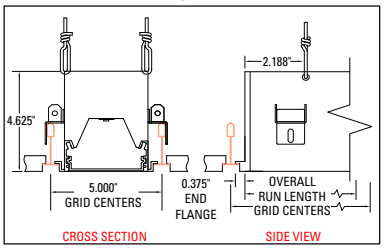
9/16 Tee (FTG)



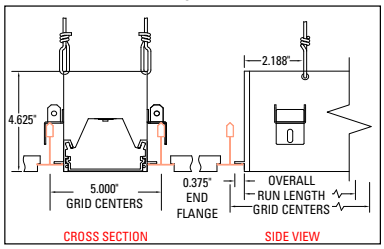
9/16 Slotted Tee (STG)



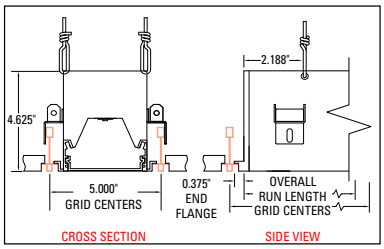
9/16 Tegular (FTT)



15/16 Tegular (ETT)

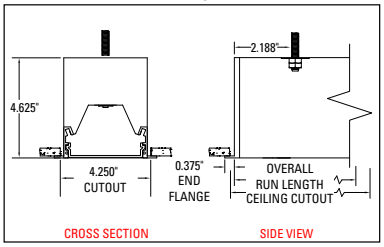


9/16 Interlude Tee (ITG)

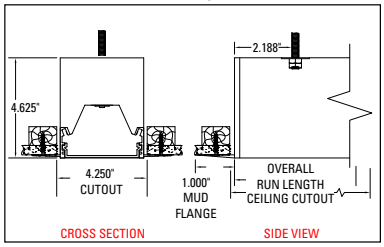


Drywall Ceiling

Visible Flange (GYP)



Mud-In Flange (FSR)



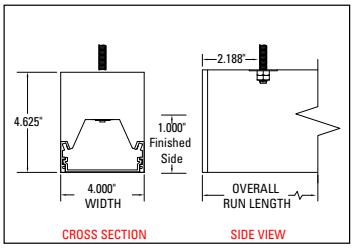
NOTE: ACTUAL LENGTH OF GYP/FSR FIXURES WILL BE 1" SHORTER IN LENGTH THAN TOTAL REQUESTED RUN LENGTH FOR ALL RECESSED / PERIMETER FIXTURES

OVERALL RUN LENGTH = 'FIXTURE ORDER LENGTH' - 1" E.G. - OVERALL RUN LENGTH OF 3' 11" WILL SHIP WHEN ORDERING A '4F0' FIXTURE

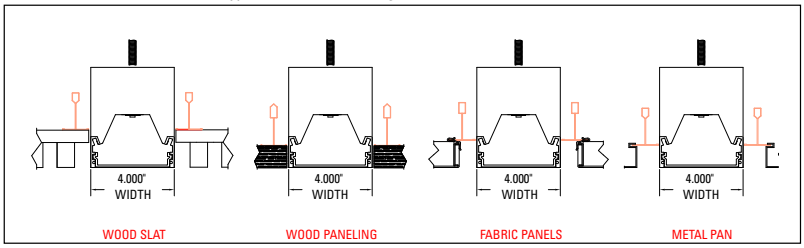
CEILING CUTOUT = 'OVERALL RUN LENGTH' + 0.250" OR CEILING CUTOUT = 'FIXTURE ORDER LENGTH' - 0.750" E.G. - CEILING CUTOUT WHEN ORDERING A '4F0' LENGTH FIXTURE WILL BE 3' 11.250"

Other Ceiling Systems (Wood, Fabric, Metal Pan, HD Box Style)

Finished Extruded Side (FES)



Typical Installations using Finished Extruded Side (FES)



NeoRay — Define 4 LED Recessed

TYPE - L5

Integrated Sensor Details and Placement

Sensor Type	Wireless	Sensor Integration	Sensor Mounting	Ordering Code
WaveLinx Pro	Yes	Integral to Fixture	Mounted in solid cover	WAA
		Pre-wired for tile-mount	Installation in ceiling tile or J-Box cover	WTA
WaveLinx Lite	Yes	Integral to Fixture	Mounted in solid cover	WAB
		Pre-wired for tile-mount	Installation in ceiling tile or J-Box cover	WTB
Enlighted	Yes	Integral to Fixture	Mounted in illuminated lens	LWIPD1
		Pre-wired for tile-mount	Installation in ceiling tile or J-Box cover	LWTPD1
Stand-Alone SVPD1	No	Integral to Fixture	Mounted in solid cover	SVPD1
		Pre-wired for tile-mount	Installation in ceiling tile or J-Box cover	SVTPD1

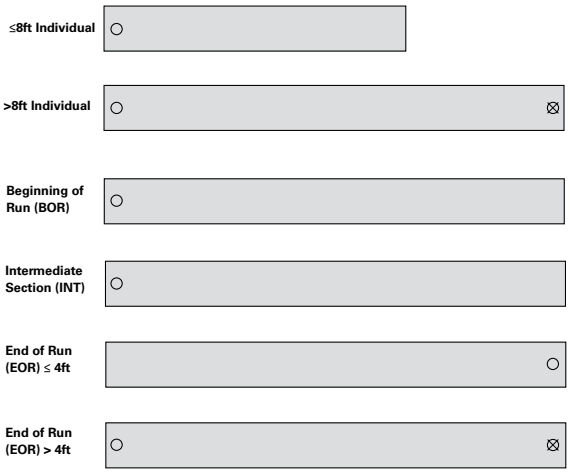
○ Standard Sensor with Luminaire Control
⊠ Auxiliary Sensor used for Sensor Coverage (wireless systems only)

Optional standalone and wireless connected integrated sensors require use of the DD (0-10V) driver. WaveLinx Pro and Enlighted sensors require additional system hardware (not provided) for full functionality. Tilemount sensor recommended for optimal sensor coverage on perimeter applications. Tilemount sensor not available with Chicago plenum option.

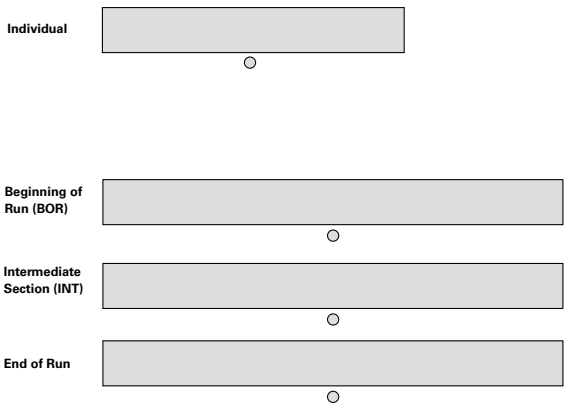
Standard sensor layout is shown below. Please refer to sensor coverage pattern diagrams to ensure proper coverage for the application. Standard configurations are available in both individual fixtures and in continuous runs. For optimal coverage, continuous runs will default to 8ft max section length.

For additional information integrated sensors and connected lighting, please visit Cooper Lighting Solutions's Connected Lighting Website.

INTEGRAL SENSOR



TILEMOUNT SENSOR (OPTIMAL LOCATION)



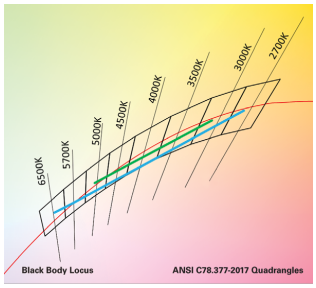
NeoRay — Define 4 LED Recessed

TYPE - L5

VividTune
color tuning solutions

Define 4 LED Recessed with VividTune Tunable White

VividTune tunable white luminaires deliver high-quality light in a broad range of continuously variable color temperatures and intensities. Create a dynamic environment by adjusting the ambient light warmer or cooler to influence mood, support the task at hand, or create a dramatic ambience. The ability to control correlated color temperature and intensity separately using simple controls is the next evolution of LED lighting for the commercial, educational, healthcare and hospitality space. The unparalleled flexibility and number of available lighting environments enable users to find the right light with tunable white.



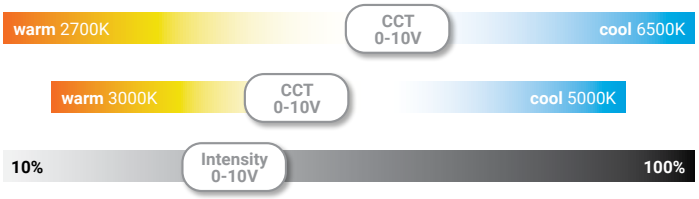
Performance Data*

Tunable White - Lumen Adjustment Factors				
CCT	3000K-5000K		2700K-6500K	
	80 CRI	90 CRI	80 CRI	90 CRI
2700K	-	-	0.868	0.741
3000K	0.894	0.736	0.893	0.771
3500K	0.946	0.804	0.924	0.809
4000K	0.993	0.868	0.944	0.835
4500K	1.002	0.883	0.961	0.857
5000K	1.002	0.883	0.974	0.874
6500K	-	-	0.988	0.897

Example of Approximate Lumen Calculation			
	Standard Catalog #	VividTune 80 CRI Catalog #	VividTune 90 CRI Catalog #
CCT Setting	S124DR-C1020D835-X-UDD-F-W	S124DR-V1020D83050-X-UW2A-F-W	S124DR-V1020D93050-X-UW2A-F-W
3000K	-	3648	3003
3500K	4080	3860	3280
4000K	-	4051	3541
4500K	-	4088	3603
5000K	-	4088	3603

Controlling VividTune Tunable White

VividTune luminaires make tunable white more accessible by using simple and familiar controls. From wall dimmers to wireless controls, VividTune tunable white luminaires are compatible with industry standard 0-10V dimming controls. A single 0-10V dimming input is used to control intensity (brightness) while a second 0-10V dimming input is used to adjust CCT. For suggested control configurations, go to www.cooperlightingsolutions.com for tunable white application guides.



Example of Lumen Adjustment Calculation

S124DR-V1020D83050-X-UW2A-F-W
at 80 CRI tuned to 3500K

Adjusted Lumen =
published lm x adjusted lm factor

Adjusted Lumen = 4080 x 0.946

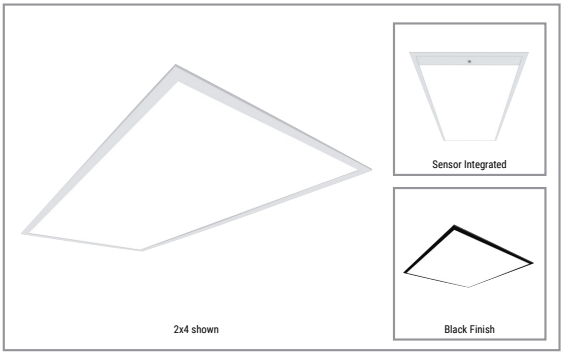
Adjusted Lumen = 3860 lm

* Lumen adjustment factors are for reference and may be different for each product selected. Refer to IES files for actual performance data on each.

COOPER Lighting Solutions

Cooper Lighting Solutions
18001 East Colfax Avenue
Aurora, CO 80011
P: 303-393-1522
www.cooperlighting.com

Project		Catalog #		Type	TYPE - L6
Prepared by		Notes		Date	



Metalux

CGTX Panel

Configurable LED Backlit Panel, Recessed, Surface, Suspended

Typical Applications

• Commercial Office Spaces • Schools • Healthcare
• Retail Merchandising Areas

Interactive Menu

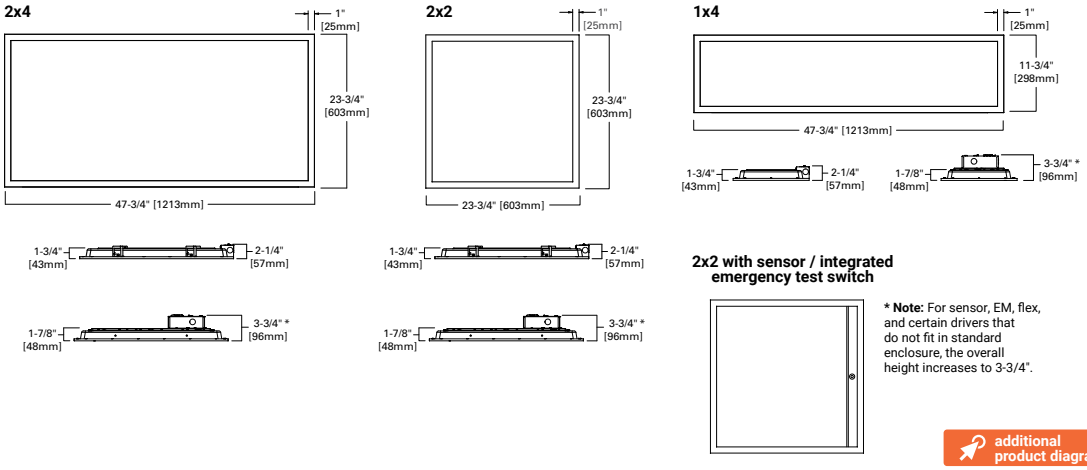
Product Certification

Product Features

Top Product Features

- Highly configurable backlit panel fits a variety of applications
- Integrated control and emergency options in all sizes
- Standard and high efficiency available for further energy savings
- Available in 3000K, 3500K, 4000K, and 5000K CCT, 80 and 90 CRI
- Options to meet Build America, Buy America, Buy American and other domestic preference requirements

Dimensional and Mounting Details



2x2 with sensor / integrated emergency test switch

*** Note:** For sensor, EM, flex, and certain drivers that do not fit in standard enclosure, the overall height increases to 3-3/4".

additional product diagrams

Metalux

CGTX

TYPE - L6

Order Information

SAMPLE ORDER NUMBER: **24CGTX-40-EL14W-L840-WLS**

Domestic Preferences	Rating	Width/Length	Series	1x4 Lumen Output		2x2 Lumen Output		2x4 Lumen Output	
[Blank]=Standard **BAA**=Buy American Act **TAA**=Trade Agreements Act **BABA**=Build America Buy America Act	**[Blank]**=Standard **ATW-SW4**=Chicago Rated [2]	**14**=1' x 4' **22**=2' x 2' **24**=2' x 4'	**CGTX**=Configurable LED Backlit Panel	**Standard** **20**=2000 **30**=3000 **42**=4200	**High Efficiency** **20HE**=2000 **30HE**=3000 **42HE**=4200 **70HE**=7000 **80HE**=8000	**Standard** **20**=2000 **25**=2500 **35**=3500 **45**=4500	**High Efficiency** **20HE**=2000 **25HE**=2500 **35HE**=3500 **45HE**=4500 **50HE**=5000 **60HE**=6000	**Standard** **20**=2000 **30**=3000 **35**=3500 **40**=4000 **45**=4500 **55**=5500 **65**=6500 **72**=7200	**High Efficiency** **20HE**=2000 **30HE**=3000 **35HE**=3500 **40HE**=4000 **45HE**=4500 **55HE**=5500 **65HE**=6500 **72HE**=7200 **80HE**=8000 **90HE**=9000 **100HE**=10000 [4], [5]
Notes (1) Only product configurations with these prefixes are built to be compliant with the Buy American Act of 1933 (BAA), Trade Agreements Act of 1979 (TAA), or the Build America Buy America Act (BABA). BABA is the minimum Government compliance requirement for the Build America Buy America standards which is part of the Infrastructure and Investment Jobs Act (IIJA). Individual Government Agencies may have more stringent compliance standards. Please refer to DOMESTIC PREFERENCES website or consult the CLS Domestic Preferences team for more information. Components shipped separately may be separately analyzed under domestic preference requirements.	**Notes** (2) Installed Flex not available with ATW-SW4 option.			**Notes** (3) Lumens are approximate. Refer to performance tables and IES files for actual delivered lumens and wattage. (4) 2x4 100E lumen output requires two drivers. (5) 2x4 100 lumen output requires two drivers.					

Lens Options	Voltage	Emergency	CCT / CRI	Flex/MWS
[Blank]=Smooth White Frosted	**[Blank]**=Universal Voltage 120-277 **347V**=347 Volt [6]	**[Blank]**=None **EL7W**=7-watt, 120V-277V emergency battery pack installed [8] **EL14W**=14-watt 120V-277V emergency battery pack installed [8] **EL10W**=10-watt 120V-277V emergency battery pack installed [8] **EL10WSD**=10-watt 120V-277V emergency battery pack installed, with self-diagnostics [8] **GTRD**=Bodine Emergency Transfer Relay with dimming control [9] **ETRD**=Iota Emergency Transfer Relay with dimming control [10]	**L830**=3000K, 80 CRI **L835**=3500K, 80 CRI **L840**=4000K, 80 CRI **L850**=5000K, 80 CRI **L930**=3000K, 90 CRI [11] **L935**=3500K, 90 CRI [11] **L940**=4000K, 90 CRI [11] **90 CRI only available with HE**	**[Blank]**=None **Dimming Flex** [12] **A3/8-4/18GDIM**=Flex, hot, neutral, ground, 2 dimming leads **A3/8-5/18GDIM**=Flex, 2 hots, neutral, ground, 2 dimming leads **Non-Dimming Flex** [12] **A3/8-2/18G**=Flex, hot, neutral, ground **A3/8-3/18G**=Flex, 2 hots, neutral, ground **A3/8-4/18G**=Flex, 3 hots, neutral, ground **MWS - Modular Wiring Systems -** Fixture Fitting [15] **MW12FF12/3G**=120V Fixture Feed, #12, 3 Conductors + Ground [14] **MW27FF12/3G**=277V Fixture Feed, #12, 3 Conductors + Ground [14] **MW12FF12/2G-010V**=120V Fixture Feed, #12, 2 Conductors, Ground, 0-10V Dimming [14] **MW27FF12/2G-010V**=277V Fixture Feed, #12, 2 Conductors, Ground, 0-10V Dimming [14]
	Notes (6) 347V with sensor and/or emergencies only available with HCD.	**Notes** (7) Fixture height increases to 3-3/4". (8) With integral test switch/indicator. For approximate delivered lumens multiply the lumens per watt of the desired fixture by the wattage of the emergency battery pack (100 lm/W x 7=700 lumens). IES-format photometry for luminaire under emergency operation available. (9) Used to bypass local control during outage. Device is dual listed to UL 1008 (transfer switch) and UL 924 (switch bypass), 347V not available. (10) Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others). 347V not available.	**Notes** (11) 90 CRI only available in HE lumen packages.	**Notes** (12) Fixture height increases to 3-3/4". (13) Multiple options available in online configurator. See additional notes on Flex below. (14) To be used with Modular Wiring System. Refer to MWS Fixture Fitting specification for additional details.(15) MWS Fixture Fitting increases overall fixture height to 4-7/8". **Flexible Metal Conduit Options** Flex options available for 0-10V dimming control, DALI dimming control, emergency and night light functions. 72-inch factory-installed and pre-wired to driver, fitted to luminaire housing access plate with 90° enclosed FMC connector. Not all options may be combined and installation ratings vary by type.

Driver Type	Number of Drivers	Integrated Sensing Systems	Options	Packaging
[Blank]=CD 0-10V Driver (10%-100% Dimming) **HCD**=0-10V Driver (1%-100% Dimming) [16] **5LTD**=DALI Driver (1%-100% Dimming) [16] **SD**=Step Dimming Driver (50%,100% Dimming) [16] **LH**=Lutron HiLume (LDE1 series) 1%-100% EcoSystem Driver with Soft-on Fade to Black dimming [16], [F] **CDW**=0-10V Dimming (10%-100%) [20]	**[Blank]**=1 Driver **2**=2 Drivers [17]	**[Blank]**=No Sensor **WLS (formerly WAB)**=WaveLinx LITE Wireless Sensor, Occupancy w/ photocell, Independent & Networked [19], [B] **WPS (formerly WAA)**=WaveLinx PRO Wireless Sensor, Occupancy w/ photocell, Networked [19], [A] **WLN**=WaveLinx LITE Wireless Control Node, without sensor [19], [B] **WPN**=WaveLinx PRO Wireless Control Node, without sensor [19], [A]	**[Blank]**=None **BLKF**=Black Frame, Matte Finish	**[Blank]**=Unit Pack **PAL**=Job Pack, out of carton
Notes (16) Fixture height increases to 3-3/4". (20) Not available with 20, or 65 and higher lumen packages. Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories. Please refer to the following: (F) Consult Marketplace Options - Lutron system pages for additional details and compatibility. Compatible only with driver series shown, and may require two or more drivers. Requires field commissioning to operate or dim. Contact Lutron at www.lutron.com.	**Notes** (17) Fixture height increases to 3-3/4".	**Notes** (18) Fixture height increases to 3-3/4". (19) Must be used with CD or HCD driver. Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories. Please refer to the following: (A) Consult WaveLinx PRO system pages for additional details and compatibility. (B) Consult WaveLinx LITE system pages for additional details and compatibility.		

Metalux CGTX

TYPE - L6

Product Specifications

Construction
- Robust die-formed steel back plate to ensure durability
- Housing is absent of holes to resist debris/bug intrusion
- Aluminum frame weld and ground for a seamless appearance

Mounting
- Integral grid/EQ clips provided and include suspension / wire retention features
- Grid clip includes fold up hang points. Use FPSUS24-ML or other desired suspension methods for direct suspension
- Large junction box constructed of code gauge galvanized steel with access plate
- Multiple 7/8" KO's provided, suitable for up to 12AWG wiring
- Surface kits available for use in grid or hard surfaces
- Factory installed MWS fixture fitting or flexible conduit available to reduce installation time
- FPSUS2-ML is a 2-point suspension kit includes aircraft cable, carabiner, ceiling connection, SO cord, cord connectors, round 4" J-box cover and #8 sheet metal screws

Controls
- 0-10V dimming to 10% standard, 1% dimming available
- Integrated WaveLinx options provide wireless individual fixture control and enable code compliance, increased energy savings, grouping of fixtures, and connection to WaveLinx control systems
- DALI 2.0, Lutron, and step-dimming available

Electrical
- TM21 life at 60,000 hours up to L86 and calculated L70 exceeds 120,000 hrs
- Driver rated for FCC part 15 Class B for use in residential or commercial applications
- LED's available in 3000K, 3500K, 4000K, or 5000K at 80 CRI or 90 CRI minimum
- Color accuracy ≤3-Step MacAdam ellipse (SDCM)
- Integral emergency battery pack options available in 7W, 10W, and 14W. Test switch located on fixture lens band. Self-diagnostic options available
- Emergency/generator transfer options available
- Drivers available in 120-277V; 0-10V drivers also available in 347V

Optical Shielding
- Micro-optics enable uniform distribution of the LEDs for uniform lens illumination
- Frosted smooth lens provides uniform illumination across the entire lens
- Durable lens with surface texture to minimize scratch and impact damage

Compliance
- cULus listed for 25°C ambient environments, indoor applications
- IC rated for direct insulation contact
- UL Damp Location listed
- IP5X rated from the room side with no modification needed
- Tested to IESNA LM-79 and LM-80
- Stated life per TM21 standards
- DesignLights Consortium® Qualified and classified for DLC Standard and DLC Premium, refer to www.designlights.org for details.
- Suitable for State of California Title 24 high efficacy luminaire
- FCC part 15 class A compliant
- Fixture is rated for NSF/ANSI standard 2 - Light fixture for Splash Zone and Non-Food Zone

BABA Domestic Preference Compliance
- FHWA and FTA agencies are utilizing their BAA rules for BABA compliance. Cooper's products with a BAA designation are manufactured in the US and utilize a BAA COTS exemption rule for compliance. To verify a configured product with specific accessories and options meet BABA Domestic Preference Requirements; submit this catalog number to Cooper Lighting Quotation team for validation by our Engineering and Manufacturing teams. Please refer to the DOMESTIC PREFERENCES website or consult the CLS Domestic Preferences team for more information. Components shipped separately may be separately analyzed under domestic preference requirements.

Warranty
- Five year warranty
- Extended warranty to 10 years available

Surface Mounting Options

Catalog No.	Description	UPC	Kit Height
CGTSURF24	2x4 CGT Surface Mount Kit	080083083107	3-7/8"
CGTSURF22	2x2 CGT Surface Mount Kit	080083083121	3-7/8"
CGTSURF14	1x4 CGT Surface Mount Kit	080083083145	3-7/8"
SK-24-WS	2x4 SK Surface Mount Kit, Shallow	080083719389	5-1/16"
SK-22-WS	2x2 SK Surface Mount Kit, Shallow	080083719402	5-1/16"
SK-14-WT	1x4 SK Surface Mount Kit, Tall	080083906703	6-1/4"
Note: Cannot be used with EL10W, EL10WSD, GTRD, 100HE lumen output, MWS, or 347V with alternative driver. Metalux Universal Surface Mount kits are compatible with these configurations – see #SK-24, #SK-22, and #SK-14). Metalux Universal Surface Mount			

Shipping Data

	1x4	2x2	2x4
Packaged Weight (lb.)	10	10	16
Pallet Qty - Standard (Tall)	17 (11)	34 (22)	16 (11)
Pallet Size	30x53		
Note: Base configurations; options may add weight.			

Drywall Frame Kit

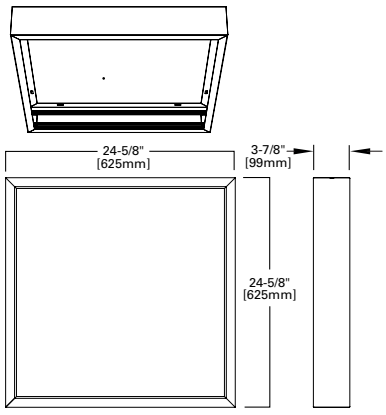
Catalog No.	Description	UPC
DF-24W-U	2x4 dry wall frame kit	662401232970
DF-22W-U	2x2 dry wall frame kit	662401232963
DF-14W-U	1x4 dry wall frame kit	662401232949

Surface Mount Kit

Size	Width	Length
1x4	12-5/8"	48-5/8"
2x2	24-5/8"	24-5/8"
2x4	24-5/8"	48-5/8"

Suspension Kit

Catalog	UPC	Description
FPSUS2-ML	080083802784	ML / Max Load Kit for CGTX with options. 2 point Y-hanger suspension kit includes aircraft cable, carabiner, ceiling connection, SO cord, cord connectors, round 4" J-box cover plate, and #8 sheet metal screws.
Mounting height from ceiling **Min.**=7-1/4" [184mm] **Max.**=27" [286mm] **Note**: Suspension kit is intended to be used without surface mount box.		



CGTSURF22 Shown

Metalux

CGTX

TYPE - L6

Energy and Performance Data

Electrical & Optical Performance - CGTX (3500K, 80 CRI)

Size	Lumen Pkg	Delivered Lumens	Input Watts	Efficacy lm/W	Current (A)		Glare Performance	
					120V	277V	UGR (1)	Max Luminance (1)
1x4	2000	1815	16.4	120	0.14	0.06	18.3	1590
	3000	2679	23.9	122	0.20	0.09	19.7	2347
	4200	3911	31.7	134	0.26	0.11	21	3427
1x4 HE	2000 HE	1877	14.8	138	0.12	0.05	18.4	1645
	3000 HE	2820	22.4	137	0.19	0.08	19.9	2471
	4200 HE	3984	31.9	136	0.27	0.12	21.1	3491
	7000 HE	6372	52.5	132	0.44	0.19	22.7	5583
	8000 HE	7346	61.9	129	0.52	0.22	23.2	6437
2x2	2000	2041	15.1	135	0.13	0.05	18.8	1786
	2500	2536	18.9	134	0.16	0.07	19.5	2219
	3500	3606	27.9	129	0.23	0.10	20.8	3155
	4500	4424	36.1	123	0.30	0.13	21.5	3870
2x2 HE	2000 HE	2024	14.8	137	0.12	0.05	18.8	1771
	2500 HE	2598	19.2	135	0.16	0.07	19.6	2272
	3500 HE	3633	27.2	134	0.23	0.10	20.8	3178
	4500 HE	4650	36.2	128	0.30	0.13	21.7	4068
	5000 HE	5121	40.0	128	0.33	0.14	22	4480
	6000 HE	6004	47.4	127	0.40	0.17	22.5	5253
2x4	2000	2232	16.7	134	0.14	0.06	16.8	982
	3000	3135	23.7	132	0.20	0.09	18	1378
	3500	3742	28.4	132	0.24	0.10	18.6	1646
	4000	4008	30.3	132	0.25	0.11	18.8	1763
	4500	4649	35.6	131	0.30	0.13	19.4	2044
	5500	5546	44.1	126	0.37	0.16	20	2439
	6500	6606	53.4	124	0.45	0.19	20.6	2905
	7200	7416	60.9	122	0.51	0.22	21	3261
2x4 HE	2000 HE	2031	14.9	136	0.12	0.05	16.5	893
	3000 HE	2988	21.9	136	0.18	0.08	17.8	1314
	3500 HE	3480	25.6	136	0.21	0.09	18.3	1530
	4000 HE	4052	29.9	136	0.25	0.11	18.9	1782
	4500 HE	4662	34.7	134	0.29	0.13	19.4	2050
	5500 HE	5509	41.3	133	0.34	0.15	19.9	2422
	6500 HE	6610	49.9	132	0.42	0.18	20.6	2907
	7200 HE	6969	53.6	130	0.45	0.19	20.8	3064
	8000 HE	8176	63.5	129	0.53	0.23	21.3	3595
	9000 HE	9001	70.3	128	0.59	0.25	21.6	3957
	10000 HE	10451	82.6	127	0.69	0.30	22.2	4596

Notes:
(1) UGR values per CIE 190:2010 with 4H, 8H, Reflectance: 70% Ceiling, 50% Wall, 20% Ref. Plane.
Luminance measured at 45-90 degrees from nadir.
UGR and Luminance values that meet WELL v2 L04 requirements for Managing Glare are shown with green highlighted cell (UGR < 16, Luminance < 6,000).
UGR and Luminance values that meet LEED v4.1 requirements for Glare Control are shown with green text (UGR < 19, Luminance < 7,000).

Key

	Meets WELL v2
TEXT	Meets LEED v4.1

Lumen Adjustment Factors

CCT Multiplier	80 CRI	90 CRI (2)
3000K	0.99	0.83
3500K	1.00	0.85
4000K	1.03	n/a
5000K	1.05	0.89

Notes: (2) 90 CRI only available in HE lumen outputs.

Example of Lumen Adjustment Calculation

24CGTX-45-L850
at 5000K

Lumen Adjustment Factor = 1.05

Total Light Output =
4,537 lm x 1.05 = 4,764 lm

$$Efficacy = \frac{4{,}764\ lm}{35.6\ W} = 133\ lm/W$$

Lumen Maintenance

TM-21 Lumen Maintenance (60,000 hours) (3)	Theoretical L70 (Hours) (4)
> 86%	> 120,000

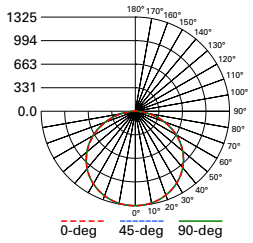
Notes: (3) Supported by IES TM-21 standards. (4) Theoretical values represent estimations commonly used; however, refer to the IES position on LED Product Lifetime Prediction, IES PS-10-18, that explains proper use of IES TM-21 and LM-80.

Metalux

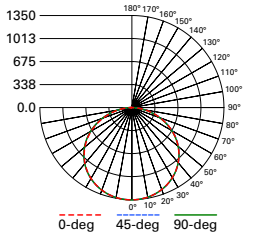
CGTX

TYPE - L6

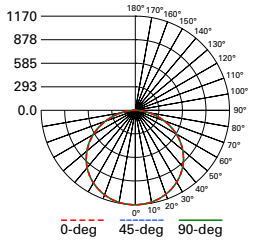
Photometric Data



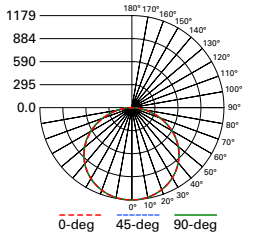
14CGTX-42-L835
Electronic Driver
LED 3500K
Spacing criterion: (II) 1.26 x mounting height, (⊥) 1.27 x mounting height
Lumens: 3911
Input Watts: 31.7W
Efficacy: 134 LPW
Test Report: 14CGTX-42-L835.IES



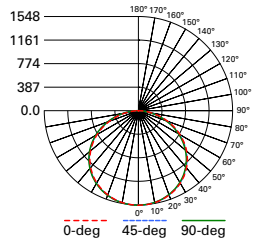
14CGTX-42HE-L835
Electronic Driver
LED 3500K
Spacing criterion: (II) 1.26 x mounting height, (⊥) 1.27 x mounting height
Lumens: 3984
Input Watts: 31.9W
Efficacy: 136 LPW
Test Report: 14CGTX-42HE-L835.IES



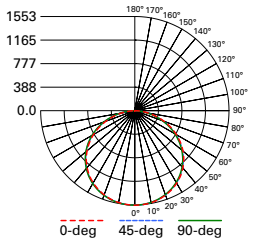
22CGTX-35-L835
Electronic Driver
LED 3500K
Spacing criterion: (II) 1.26 x mounting height, (⊥) 1.26 x mounting height
Lumens: 3606
Input Watts: 27.9W
Efficacy: 129 LPW
Test Report: 22CGTX-35-L835.IES



22CGTX-35HE-L835
Electronic Driver
LED 3500K
Spacing criterion: (II) 1.26 x mounting height, (⊥) 1.26 x mounting height
Lumens: 3633
Input Watts: 27.2W
Efficacy: 134 LPW
Test Report: 22CGTX-35HE-L835.IES



24CGTX-45-L835
Electronic Driver
LED 4000K
Spacing criterion: (II) 1.27 x mounting height, (⊥) 1.26 x mounting height
Lumens: 4649
Input Watts: 35.6W
Efficacy: 131 LPW
Test Report: 24CGTX-45-L835.IES



24CGTX-45HE-L835
Electronic Driver
LED 4000K
Spacing criterion: (II) 1.27 x mounting height, (⊥) 1.26 x mounting height
Lumens: 4662
Input Watts: 34.7W
Efficacy: 134 LPW
Test Report: 24CGTX-45HE-L835.IES

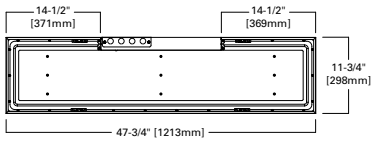
Metalux CGTX

TYPE - L6

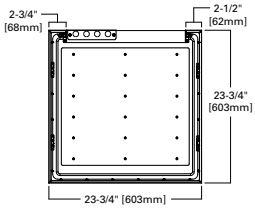
Dimensional and Mounting Details

Standard driver - no controls, EM, or flex

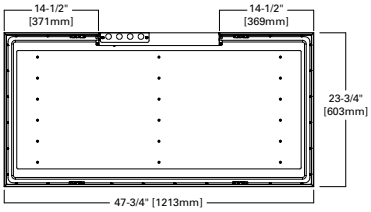
1x4



2x2

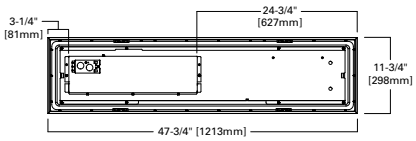


2x4

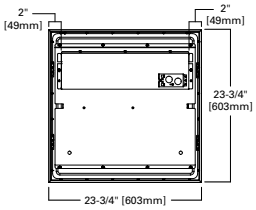


Alternative driver, with controls, EM and/or flex

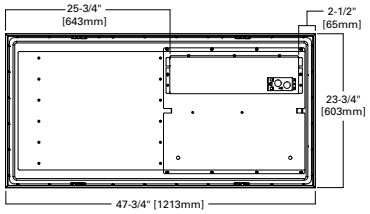
1x4



2x2



2x4



Metalux

CGTX

TYPE - L6

Control Solutions

- WaveLinx LITE wireless
- WaveLinx PRO wireless
- WaveLinx CAT wired
- WaveLinx Wired

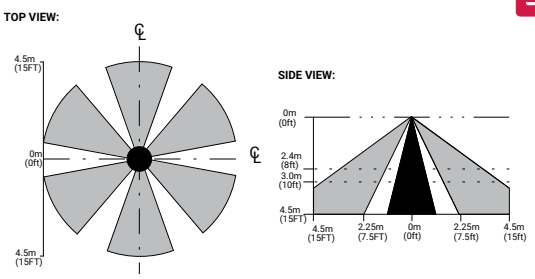
WaveLinx Digital Lighting Control Solutions

The CGTX with WaveLinx offers no-hassle lighting control with multiple luminaire level control solutions.

WaveLinx PRO is a wireless lighting control solution, for connected spaces, that significantly reduces a building's energy consumption. From a single floor to an entire campus, WaveLinx PRO connects more than lighting assets; it shares aggregated sensor data with the WaveLinx CORE platform and other building systems, so building owners can improve operations, spaces environment, and tenants' experience. WaveLinx PRO offers a rich portfolio of wireless devices, WaveLinx PRO-enabled luminaires, and an intuitive WaveLinx mobile app for office, education, warehouse, and parking garage applications.

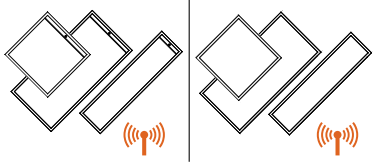
WaveLinx LITE is a cost effective, wireless digital lighting control solution, with out-of-the-box functionality, that saves energy and meets code. It's designed for applications that require occupancy-based, daylighting, or manual light control. Customize installations for office, education, warehouse and parking garages using the secure, simple mobile app.

Integrated Sensor Coverage Pattern



***Note**: Installation of integrated sensors within 3-ft (1m) of HVAC air vents is not recommended. The pattern shown is intended solely as a general guide and is not to scale.*

With Integrated WaveLinx Sensor | **With Integrated WaveLinx Node**



Add a hidden WaveLinx sensor node (WPN, WLN) to your space lighting design!

Allows to:

- Keeps luminaire aesthetics
- Connect fixtures without the realestate to include sensor option such as downlights
- Connect sealed fixtures without a standard sensor option such as products for clinical space.

Integrated Controls Options					
Option	**Out of the Box Functionality**	**Luminaire Level Lighting Control (LLLC)**	**Automatic Dimming Photocell**	**Occupancy Sensing**	**CCT Control**
WLS	X	X	X	X	
WLN		X			
WPS		X	X	X	X
WPN		X			X

Note: WaveLinx utilizes scenes to allow users to change an area's fixtures Correlated Color Temperature (CCT) and intensity using commissioned manual wireless wallstation scene control. To enable CCT adjustments through WaveLinx, include WPS or WPN devices in addition to VividTune or BioUp technologies for integrated fixture control.

Systems comparison chart

Cooper Lighting Solutions provides many lighting system solutions designed to satisfy code requirements and meet the unique needs of any project.

	Luminaire with standalone sensor	**Standalone Spaces** WaveLinx LITE	**Standalone Spaces** WaveLinx CAT	**Networked Spaces** WaveLinx PRO	**Enterprise** WaveLinx CORE
Occupancy	Yes	Yes	Yes	Yes	Yes
Daylighting	Yes	Yes	Yes	Yes	Yes
Wallstations	–	Yes	Yes	Yes	Yes
Gateways	–	–	–	1 WAC	300 WACs
Devices (MAX)	–	40 per Area (1120 per space)	40 per Area	200 per WAC2	32,500 per CORE Enterprise
Software	–	WaveLinx LITE Mobile App	WaveLinx CAT Mobile App	WaveLinx Mobile App	CORE
Areas	–	28 per Space	Unlimited	50 per WAC2	up to 3,000
Zones	–	16 per Area	16 per Area	16 per Area	up to 9,000
Scheduling	–	–	–	Local	Global
VividTune™	–	–	–	Yes	Yes
Plug-Load Control	–	Yes	Yes	Yes	Yes
Low-Voltage Power	–	–	Yes	Yes	Yes
Integration	–	–	–	–	BACnet, API
Dashboards	–	–	–	–	Energy, Occupancy
Configuration	–	Installer	Installer	Technician	Technician / IT

COOPER Lighting Solutions
a ◎ignify business

Cooper Lighting Solutions
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

Project		Catalog #		Type	TYPE - OL1
Prepared by		Notes		Date	

Streetworks

GAW Galleon Wall

Wall Mount Luminaire

Product Features

Light ARchitect™

Interactive Menu

Product Certifications

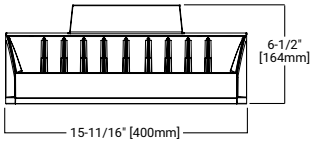
Quick Facts

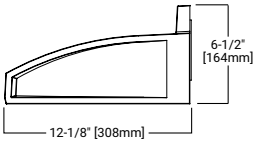
- Choice of thirteen high-efficiency, patented AccuLED Optics
- Downward and inverted wall mounting configurations
- Eight lumen packages from 3,215 up to 17,056
- Efficacies up to 154 lumens per watt

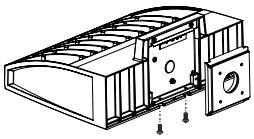
Connected Systems

- WaveLinx PRO Wireless
- WaveLinx LITE Wireless
- Enlighted

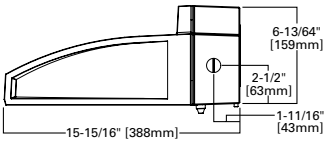
Dimensional Details



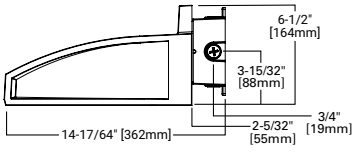




GAW with CBP option installed
(Thru-Branch Back Box accessory MA1059XX)



GAW with accessory BB/GAWXX Back Box installed



NOTES:
1. Visit https://www.designlights.org/search/ to confirm qualification. Not all product variations are DLC qualified.
2. IDA Certified for 3000K CCT and warmer only.

Streetworks — GAW Galleon Wall

TYPE - OL1

ARCH TO SELECT FINISH

Ordering Information

SAMPLE NUMBER: **GAW-SA2C-740-U-T4FT-GM**

Product Family [1]	Light Engine		Color Temperature	Voltage	Distribution	Finish
	Configuration	Drive Current				
GAW=Galleon Wall **BAA-GAW**=Galleon Wall, Buy American Act Compliant [34] **TAA-GAW**=Galleon Wall, Trade Agreements Act Compliant [34]	**SA1**=1 Square **SA2**=2 Squares [2]	**A**=615mA **B**=800mA **C**=1000mA **D**=1200mA [4]	**722**=70CRI, 2200K **727**=70CRI, 2700K **730**=70CRI, 3000K **735**=70CRI, 3500K **740**=70CRI, 4000K **750**=70CRI, 5000K **760**=70CRI, 6000K **827**=80CRI, 2700K **830**=80CRI, 3000K **AMB**=Amber, 590nm [3, 4]	**U**=120-277V **1**=120V **2**=208V **3**=240V **4**=277V **8**=480V [6,7] **9**=347V [6] **DV**=277-480V DuraVolt Drivers [7, 8, 36]	**T2**=Type II **T3**=Type III **T4FT**=Type IV Forward Throw **T4W**=Type IV Wide **SL2**=Type II w/Spill Control **SL3**=Type III w/Spill Control **SL4**=Type IV w/Spill Control **SLL**=90° Spill Light Eliminator Left **SLR**=90° Spill Light Eliminator Right **RW**=Rectangular Wide Type I **5NQ**=Type V Square Narrow **5MQ**=Type V Square Medium **5WQ**=Type V Square Wide	**AP**=Grey **BZ**=Bronze **BK**=Black **DP**=Dark Platinum **GM**=Graphite Metallic **WH**=White

Options (Add as Suffix)	Controls and Systems Options (Add as Suffix)	Accessories (Order Separately)[35]
F=Single Fused (120, 277 or 347V. Must Specify Voltage) **FF**=Double Fused (208, 240 or 480V. Must Specify Voltage) **10K**=10kV Surge Module **20K**=20kV UL 1449 Surge Protective Device **2L**=Two-Circuit Light Engine [37] **DIM**=External 0-10V Dimming Leads [9, 10] **CBP**=Battery Pack with Back Box, Cold Weather Rated [2, 4, 14, 32] **CBP-CEC**=Battery Pack with Back Box, Cold Weather Rated, CEC compliant [2, 4, 14] **BB**=Shipped with Back Box Accessory [38] **L90**=Optics Rotated 90° Left **R90**=Optics Rotated 90° Right **HSS**=Factory Installed House Side Shield [23] **GRSBK**=Factory Installed Glare Shield, BK [4, 27] **GRSWH**=Factory Installed Glare Shield, WH [4, 27] **UPL**=Uplight Housing [13] **HA**=50°C High Ambient [12] **LCF**=Light Square Trim Plate Painted to Match Housing [22] **MT**=Factory Installed Mesh Top **CC**=Coastal Construction finish [5] **CE**=CE Marking and Small Terminal Block [24] **AHD145**=After Hours Dim, 5 Hours [16] **AHD245**=After Hours Dim, 6 Hours [16] **AHD255**=After Hours Dim, 7 Hours [16] **AHD355**=After Hours Dim, 8 Hours [16] **DALI**=DALI Driver [11] **DXXXXX**=Department of Transportation - Customer specific details [40] **UXXXXX**=Utility - Customer specific details [40]	**BPC**=Button Type Photocontrol (120, 208, 240 or 277V. Must Specify Voltage) **PR**=NEMA 3-PIN Twistlock Photocontrol Receptacle **PR7**=NEMA 7-PIN Twistlock Photocontrol Receptacle [15] **FADC**=Field Adjustable Dimming Controller [39] **SPB1**=Dimming Occupancy Sensor with Bluetooth Interface, <8' Mounting [19, 33] **SPB2**=Dimming Occupancy Sensor with Bluetooth Interface, 8'-20' Mounting [19, 33] **SPB4**=Dimming Occupancy Sensor with Bluetooth Interface, 21'-40' Mounting [19, 33] **MS-LXX**=Motion Sensor for On/Off Operation [17, 18, 19] **MS/DIM-LXX**=Motion Sensor for Dimming Operation [17, 18, 19] **WPS2XX**=WaveLinx Pro, SR Driver, Dimming Motion and Daylight, WAC Programmable, 7' - 15' Mounting [30, 31, 41] **WPS4XX**=WaveLinx Pro, SR Driver, Dimming Motion and Daylight, WAC Programmable, 15' - 40' Mounting [30, 31, 41] **WLS2XX**=WaveLinx Lite, SR Driver, Dimming Motion and Daylight, Bluetooth Programmable, 7' - 15' Mounting [31, 41] **WLS4XX**=WaveLinx Lite, SR Driver, Dimming Motion and Daylight, Bluetooth Programmable, 15' - 40' Mounting [31, 41] **LWR-LW**=Enlighted Wireless Sensor, Wide Lens for 8'-16' Mounting Height [19, 20, 21] **LWR-LN**=Enlighted Wireless Sensor, Narrow Lens for 16'-40' Mounting Height [19, 20, 21]	**OA/RA1013**=Photocontrol Shorting Cap **OA/RA1016**=NEMA Photocontrol - Multi-Tap 105-285V **OA/RA1201**=NEMA Photocontrol - 347V **OA/RA1027**=NEMA Photocontrol - 480V **MA1252**=10kV Circuit Module Replacement **MA1059XX**=Thru-branch Back Box (Must Specify Color) **BB/GAWXX**=Back Box (Must Specify Color) **LS/HSS**=Field Installed House Side Shield [23, 25] **LS/GRSBK-2PK**=Glare Shield, Black [25, 27] **LS/GRSWH-2PK**=Glare Shield, White [25, 27] **LS/PFS**=Perimeter Shield, Black [28] **FSIR-100**=Wireless Configuration Tool for Occupancy Sensor [17] **WOLC-7P-10A**=WaveLinx Outdoor Control Module (7-pin) [26, 29]

NOTES:

1. DesignLight Consortium® Qualified. Refer to www.designlights.org, Qualified Products List under Family Models for details.
2. Two light squares with CBP options limited to 25°C. CBP not available in combination with sensor options at 1200mA.
3. Narrow-band 590nm +/- 5nm for wildlife and observatory use. Choose drive current A; supplied at 500mA drive current only. Exact luminaire wattage available in IES files. Available with 5WQ, 5MQ, SL2, SL3 and SL4 distributions. Can be used with HSS option.
4. Not available with HA option.
5. Coastal construction finish salt spray tested to over 5,000-hours per ASTM B117, with a scribe rating of 9 per ASTM D1654.
6. Require the use of a step down transformer. Not available in combination with sensor options at 1200mA.
7. 480V not to be used with ungrounded or impedance grounded systems.
8. DuraVolt drivers feature added protection from power quality issues such as loss of neutral, transients and voltage fluctuations. Visit www.signify.com/duravolt for more information.
9. Cannot be used with other control options.
10. Low voltage control leads extended 18" from fixture.
11. Not available in 1200mA. When used with CBP or HA options, only available with single light square.
12. Not available in 1200mA, UPL or CBP options. Available with single light square.
13. Not available with SL2, SL3, SL4, HA, CBP, PR or PR7 options.
14. Operates a single light square only. Operates at -20°C to +40°C. Backbox is non-IP rated. Control option limited to BPC.
15. Compatible with standard 3-PIN photocontrols, 5-PIN or 7-PIN ANSI controls.
16. Requires the use of BPC photocontrol or the PR7 or PR photocontrol receptacle with photocontrol accessory. See After Hours Dim supplemental guide for additional information.
17. The FSIR-100 configuration tool is required to adjust parameters such as high and low modes, sensitivity, time delay and cutoff. Consult your lighting representative at Cooper Lighting Solutions for more information.
18. Replace LXX with L08 (<8' mounting), L20 (8'-20' mounting) or L40W (21'-40' mounting.)
19. Includes integral photosensor.
20. Enlighted wireless sensors are factory installed requiring network components in appropriate quantities.
21. Bronze sensor is shipped with Bronze fixtures. White sensor shipped on all other housing color options.
22. Not available with HSS or GRS options.
23. Not for use with 5NQ, 5MQ, 5WQ or RW optics. The light square trim plate is painted black when the HSS option is selected.
24. CE is not available with the 1200, DALI, LWR, MS, MS/DIM, BPC, PR or PR7 options. Available in 120-277V only.
25. One required for each light square.
26. Requires PR7.
27. Not for use with T4FT, T4W or SL4 optics.
28. Set of 4 pcs. One set required per Light Square.
29. Cannot be used in conjunction with additional photocontrol or other controls systems (BPC, PR, PR7, MS, LWR).
30. WAC Gateway required to enable field-configurability: Order WAC-PoE and WPOE-120 (10V to PoE injector) power supply if needed.
31. Replace XX with sensor color (WH, BZ, or BK).
32. Specify 120V or 277V.
33. Smart device with mobile application required to change system defaults. See controls section for details.
34. Only product configurations with these designated prefixes are built to be compliant with the Buy American Act of 1933 (BAA) or Trade Agreements Act of 1979 (TAA), respectively. Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analyzed under domestic preference requirements.
35. Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information.
36. Not available in 1 square configuration at 800mA or below. Not available with any control option except SPB.
37. 2L not available with FF, AHD or DALI options. Controls and/or battery packs operate only one of the two circuits when 2L is specified. 2L with controls options not available with 347V or 480V.
38. Not available with CBP or CBP-CEC options.
39. Cannot be used with PR7 or other motion response control options.
40. Customer specific specifications utilizes standard products with small adjustments to meet unique requirements such as packaging, labels, wattage adjustments, etc.
41. Controls system is not available with photocontrol receptacles (PR , PR7) or other controls systems (FADC, SPBx).

Product Specifications

Construction

- Driver enclosure thermally isolated from optics for optimal thermal performance
- Die-cast aluminum heat sinks
- IP66 rated housing
- 1.5G vibration rated

Optics

- Patented, high-efficiency injection-molded AccuLED Optics technology
- 13 optical distributions
- IDA Certified (3000 CCT and warmer only)

Electrical

- LED driver assembly mounted for ease of maintenance
- Standard with 0-10V dimming
- Optional 10kV or 20kV surge module
- Suitable for operation in -40°C to 40°C ambient environments. Optional 50°C high ambient (HA) configuration.

Mounting

- Gasketed and zinc plated rigid steel mounting attachment
- "Hook-N-Lock" mechanism for easy installation

Finish

- Housing finished in super durable TGIC polyester powder coat paint, 2.5 mil nominal thickness
- Heat sink is powder coated black
- RAL and custom color matches available
- Coastal Construction (CC) option available

Shipping Data

- Net Weight: 17.0 lbs (7.7 kgs)

Warranty

- Five year limited warranty, consult website for details. www.cooperlighting.com/legal

COOPER Lighting Solutions

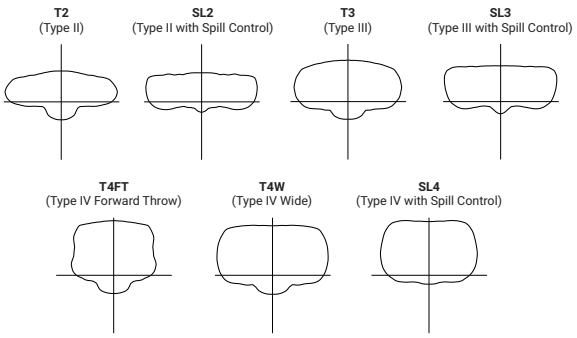
Streetworks

GAW Galleon Wall

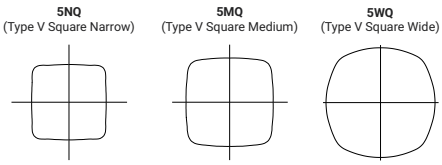
TYPE - OL1

Optical Distributions

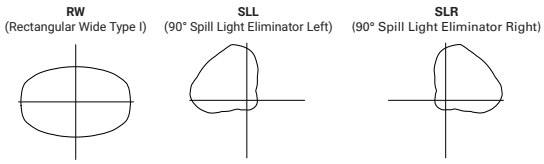
Asymmetric Area Distributions



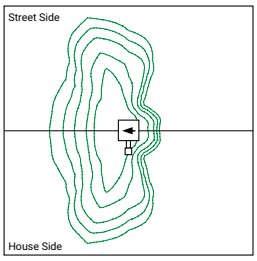
Symmetric Distributions



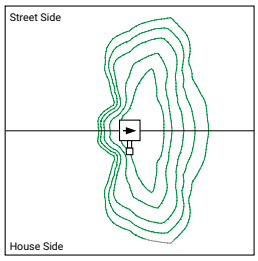
Specialized Distributions



Optic Orientation



Optics Rotated Left @ 90° [L90]



Optics Rotated Right @ 90° [R90]

Energy and Performance Data

Lumen Multiplier

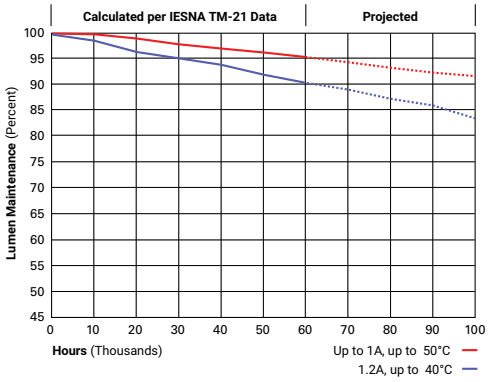
Ambient Temperature	Lumen Multiplier
0ºC	1.02
10ºC	1.01
25ºC	1.00
40ºC	0.99
50ºC	0.97

FADC Settings

FADC Position	Percent of Typical Lumen Output
1	25%
2	46%
3	55%
4	62%
5	72%
6	77%
7	82%
8	85%
9	90%
10	100%

Lumen Maintenance

Drive Current	Ambient Temperature	TM-21 Lumen Maintenance (60,000 Hours)	Projected L70 (Hours)
Up to 1A	Up to 50°C	> 95%	> 416,000
1.2A	Up to 40°C	> 90%	> 205,000



Streetworks **GAW Galleon Wall**

TYPE - OL1

Energy and Performance Data

4000K/5000K/6000K CCT, 70 CRI

Number of Light Squares		1				2			
Drive Current		615mA	800mA	1050mA	1.2A	615mA	800mA	1050mA	1.2A
Nominal Power (Watts)		34	44	59	67	66	86	113	129
Input Current @ 120V (A)		0.30	0.39	0.51	0.58	0.58	0.77	1.02	1.16
Input Current @ 208V (A)		0.17	0.22	0.29	0.33	0.34	0.44	0.56	0.63
Input Current @ 240V (A)		0.15	0.19	0.26	0.29	0.30	0.38	0.48	0.55
Input Current @ 277V (A)		0.14	0.17	0.23	0.25	0.28	0.36	0.42	0.48
Input Current @ 347V (A)		0.11	0.15	0.17	0.20	0.19	0.24	0.32	0.39
Input Current @ 480V (A)		0.08	0.11	0.14	0.15	0.15	0.18	0.24	0.30
Optics									
T2	Lumens	4,883	5,989	7,412	8,131	9,543	11,703	14,485	15,891
	BUG Rating	B1-U0-G1	B1-U0-G2	B1-U0-G2	B1-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G3	B2-U0-G3
	Lumens per Watt	144	136	126	121	145	136	128	123
T3	Lumens	4,978	6,105	7,556	8,288	9,729	11,929	14,764	16,196
	BUG Rating	B1-U0-G1	B1-U0-G2	B1-U0-G2	B1-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G3
	Lumens per Watt	146	139	128	124	147	139	131	126
T4FT	Lumens	5,008	6,140	7,599	8,337	9,783	11,998	14,850	16,290
	BUG Rating	B1-U0-G2	B1-U0-G2	B1-U0-G3	B1-U0-G3	B2-U0-G3	B2-U0-G3	B2-U0-G3	B2-U0-G3
	Lumens per Watt	147	140	129	124	148	140	131	126
T4W	Lumens	4,942	6,060	7,502	8,229	9,658	11,843	14,658	16,080
	BUG Rating	B1-U0-G2	B1-U0-G2	B1-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G3	B3-U0-G3
	Lumens per Watt	145	138	127	123	146	138	130	125
SL2	Lumens	4,874	5,979	7,399	8,117	9,528	11,684	14,461	15,863
	BUG Rating	B1-U0-G2	B1-U0-G2	B1-U0-G2	B2-U0-G3	B2-U0-G3	B2-U0-G3	B2-U0-G3	B3-U0-G3
	Lumens per Watt	143	136	125	121	144	136	128	123
SL3	Lumens	4,976	6,104	7,555	8,287	9,727	11,927	14,763	16,194
	BUG Rating	B1-U0-G2	B1-U0-G2	B1-U0-G2	B1-U0-G3	B1-U0-G3	B2-U0-G3	B2-U0-G3	B2-U0-G3
	Lumens per Watt	146	139	128	124	147	139	131	126
SL4	Lumens	4,729	5,799	7,178	7,873	9,239	11,333	14,025	15,387
	BUG Rating	B1-U0-G2	B1-U0-G2	B1-U0-G3	B1-U0-G3	B1-U0-G3	B1-U0-G3	B2-U0-G4	B2-U0-G4
	Lumens per Watt	139	132	122	118	140	132	124	119
5NQ	Lumens	5,134	6,296	7,793	8,547	10,033	12,303	15,226	16,704
	BUG Rating	B2-U0-G1	B2-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G2	B3-U0-G2
	Lumens per Watt	151	143	132	128	152	143	135	129
5MQ	Lumens	5,228	6,412	7,935	8,705	10,216	12,529	15,508	17,011
	BUG Rating	B3-U0-G1	B3-U0-G1	B3-U0-G2	B3-U0-G2	B3-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2
	Lumens per Watt	154	146	134	130	155	146	137	132
5WQ	Lumens	5,242	6,428	7,956	8,728	10,244	12,563	15,548	17,056
	BUG Rating	B3-U0-G1	B3-U0-G2	B3-U0-G2	B3-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2
	Lumens per Watt	154	146	135	130	155	146	138	132
SLL/SLR	Lumens	4,373	5,365	6,640	7,283	8,547	10,481	12,973	14,231
	BUG Rating	B1-U0-G2	B1-U0-G2	B1-U0-G2	B1-U0-G3	B1-U0-G3	B2-U0-G3	B2-U0-G3	B2-U0-G3
	Lumens per Watt	129	122	113	109	130	122	115	110
RW	Lumens	5,087	6,238	7,721	8,472	9,941	12,190	15,088	16,553
	BUG Rating	B2-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2
	Lumens per Watt	150	142	131	126	151	142	134	128

* Nominal lumen data for 70 CRI. BUG rating for 4000K/5000K. Refer to IES files for 3000K BUG ratings.

Streetworks

GAW Galleon Wall

TYPE - OL1

3000K CCT, 80 CRI

Number of Light Squares		1							
Drive Current		615mA	800mA	1050mA	1.2A	615mA	800mA	1050mA	1.2A
Nominal Power (Watts)		34	44	59	67	66	86	113	129
Input Current @ 120V (A)		0.30	0.39	0.51	0.58	0.58	0.77	1.02	1.16
Input Current @ 208V (A)		0.17	0.22	0.29	0.33	0.34	0.44	0.56	0.63
Input Current @ 240V (A)		0.15	0.19	0.26	0.29	0.30	0.38	0.48	0.55
Input Current @ 277V (A)		0.14	0.17	0.23	0.25	0.28	0.36	0.42	0.48
Input Current @ 347V (A)		0.11	0.15	0.17	0.20	0.19	0.24	0.32	0.39
Input Current @ 480V (A)		0.08	0.11	0.14	0.15	0.15	0.18	0.24	0.30
Optics									
T2	Lumens	3,880	4,759	5,890	6,461	7,583	9,300	11,510	12,628
	BUG Rating	B1-U0-G1	B1-U0-G1	B1-U0-G2	B1-U0-G2	B1-U0-G2	B1-U0-G2	B2-U0-G2	B2-U0-G3
	Lumens per Watt	114	108	100	96	115	108	102	98
T3	Lumens	3,956	4,851	6,004	6,586	7,731	9,479	11,732	12,870
	BUG Rating	B1-U0-G1	B1-U0-G1	B1-U0-G2	B1-U0-G2	B1-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G2
	Lumens per Watt	116	110	102	98	117	110	104	100
T4FT	Lumens	3,980	4,879	6,038	6,625	7,774	9,534	11,800	12,945
	BUG Rating	B1-U0-G2	B1-U0-G2	B1-U0-G2	B1-U0-G2	B1-U0-G3	B2-U0-G3	B2-U0-G3	B2-U0-G3
	Lumens per Watt	117	111	102	99	118	111	104	100
T4W	Lumens	3,927	4,816	5,961	6,539	7,675	9,411	11,648	12,778
	BUG Rating	B1-U0-G1	B1-U0-G2	B1-U0-G2	B1-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G3
	Lumens per Watt	116	109	101	98	116	109	103	99
SL2	Lumens	3,873	4,751	5,880	6,450	7,571	9,285	11,491	12,605
	BUG Rating	B1-U0-G2	B1-U0-G2	B1-U0-G2	B1-U0-G2	B1-U0-G3	B2-U0-G3	B2-U0-G3	B2-U0-G3
	Lumens per Watt	114	108	100	96	115	108	102	98
SL3	Lumens	3,954	4,851	6,004	6,585	7,729	9,478	11,731	12,868
	BUG Rating	B1-U0-G2	B1-U0-G2	B1-U0-G2	B1-U0-G2	B1-U0-G2	B1-U0-G3	B2-U0-G3	B2-U0-G3
	Lumens per Watt	116	110	102	98	117	110	104	100
SL4	Lumens	3,758	4,608	5,704	6,256	7,342	9,006	11,145	12,227
	BUG Rating	B1-U0-G2	B1-U0-G2	B1-U0-G2	B1-U0-G3	B1-U0-G3	B1-U0-G3	B1-U0-G3	B1-U0-G3
	Lumens per Watt	111	105	97	93	111	105	99	95
5NQ	Lumens	4,080	5,003	6,193	6,792	7,973	9,776	12,099	13,274
	BUG Rating	B2-U0-G0	B2-U0-G1	B2-U0-G1	B2-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G2
	Lumens per Watt	120	114	105	101	121	114	107	103
5MQ	Lumens	4,154	5,095	6,305	6,917	8,118	9,956	12,323	13,518
	BUG Rating	B2-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G2	B3-U0-G2	B4-U0-G2	B4-U0-G2
	Lumens per Watt	122	116	107	103	123	116	109	105
5WQ	Lumens	4,166	5,108	6,322	6,936	8,140	9,983	12,355	13,553
	BUG Rating	B3-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G2	B3-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2
	Lumens per Watt	123	116	107	104	123	116	109	105
SLL/SLR	Lumens	3,475	4,263	5,276	5,787	6,792	8,329	10,309	11,309
	BUG Rating	B1-U0-G2	B1-U0-G2	B1-U0-G2	B1-U0-G2	B1-U0-G3	B1-U0-G3	B2-U0-G3	B2-U0-G3
	Lumens per Watt	102	97	89	86	103	97	91	88
RW	Lumens	4,042	4,957	6,135	6,732	7,900	9,687	11,990	13,154
	BUG Rating	B2-U0-G1	B2-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G2	B3-U0-G2
	Lumens per Watt	119	113	104	100	120	113	106	102

* Nominal lumen data for 70 CRI. BUG rating for 4000K/5000K. Refer to IES files for 3000K BUG ratings.

Streetworks **GAW Galleon Wall**

TYPE - OL1

Control Options

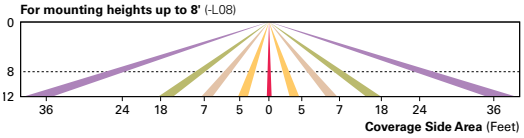
0-10V This fixture is offered standard with 0-10V dimming driver(s). The DIM option provides 0-10V dimming wire leads for use with a lighting control panel or other control method.

Photocontrol (BPC, PR, and PR7) Optional button-type photocontrol (BPC) and photocontrol receptacles (PR and PR7) provide a flexible solution to enable "dusk-to-dawn" lighting by sensing light levels. Advanced control systems compatible with NEMA 7-pin standards can be utilized with the PR7 receptacle.

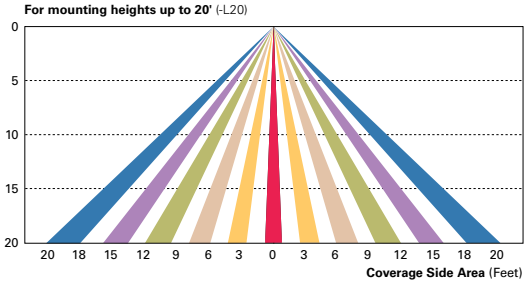
After Hours Dim (AHD) This feature allows photocontrol-enabled luminaires to achieve additional energy savings by dimming during scheduled portions of the night. The dimming profile will automatically take effect after a "dusk-to-dawn" period has been calculated from the photocontrol input. Specify the desired dimming profile for a simple, factory-shipped dimming solution requiring no external control wiring. Reference the After Hours Dim supplemental guide for additional information.

Dimming Occupancy Sensor (SPB, MS/DIM-LXX and MS-LXX) These sensors are factory installed in the luminaire housing. When the SPB or MS/DIM sensor options are selected, the occupancy sensor is connected to a dimming driver and the entire luminaire dims when there is no activity detected. When activity is detected, the luminaire returns to full light output. The MS/DIM sensor is factory preset to dim down to approximately 50 percent power with a time delay of five minutes. The MS-LXX sensor is factory preset to turn the luminaire off after five minutes of no activity. SPB motion sensors require the Sensor Configuration mobile application by Wattstopper to change factory default dimming level, time delay, sensitivity and other parameters. Available for iOS and Android devices. The SPB sensor is factory preset to dim down to approximately 10% power with a time delay of five minutes. The MS/DIM occupancy sensors require the FSIR-100 programming tool to adjust factory defaults.

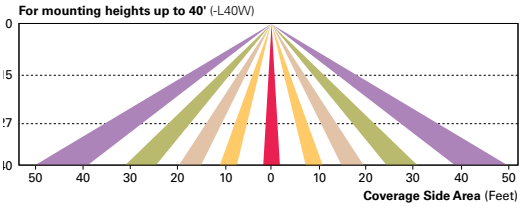
For mounting heights up to 8' (-L08)



For mounting heights up to 20' (-L20)

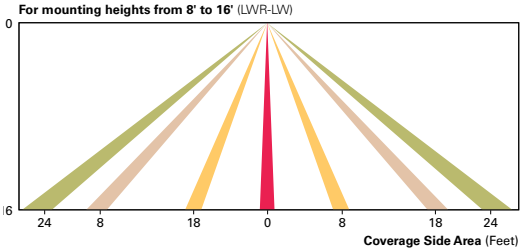


For mounting heights up to 40' (-L40W)

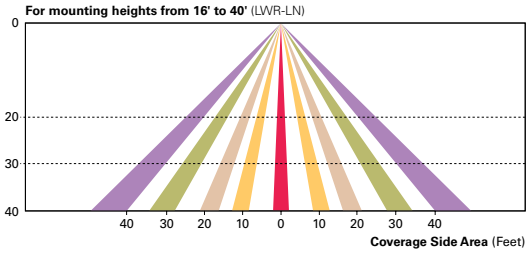


Enlighted Wireless Control and Monitoring System (LWR-LW and LWR-LN) The Enlighted control system is a connected lighting solution, combining LED luminaires with an integrated wireless sensor system. The sensor controls the lighting system in compliance with the latest energy codes while collecting valuable data about building performance and use. Software applications utilizing energy dashboards maximize data inputs to help optimize the use of other resources beyond lighting.

For mounting heights from 8' to 16' (LWR-LW)



For mounting heights from 16' to 40' (LWR-LN)



WaveLinx Wireless Outdoor Lighting Control Module (WOLC-7P-10A) The 7-pin wireless outdoor lighting control module enables WaveLinx to control outdoor area, site and flood lighting. WaveLinx controls outdoor lighting using schedules to provide ON, OFF and dimming controls based on astronomic or time schedules based on a 7 day week.

Project		Catalog #		Type	TYPE - X
Prepared by		Notes		Date	

Sure-Lites

CX Series

Die-Cast Aluminum
Surface Mount LED
Exit Lighting

Typical Applications

Office • Education • Healthcare • Hospitality • Retail • Industrial • Manufacturing

Interactive Menu

- Order Information page 2
- Product Warranty

Product Certification

UL CERTIFIED OSHA

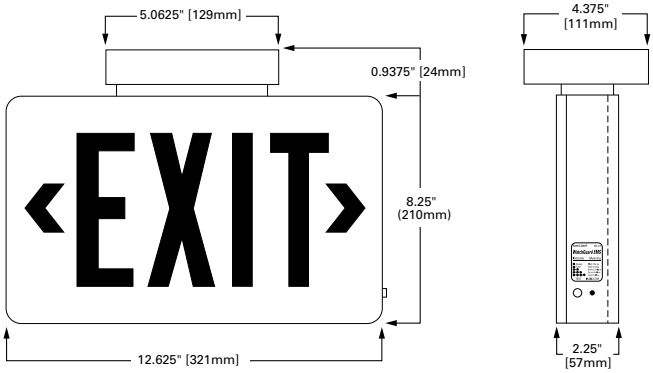
Product Features

damp location

Top Product Features

- Dual voltage input 120/277 VAC, 60 Hz
- 90 minutes of emergency run time with self-powered (battery backup) models
- Die-cast aluminum housing
- Die-cast canopy included
- Field selectable Red or Green LED illumination
- Laber savings self-diagnostics (CX7 only)

Dimensional Details



Sure-Lites — CX Series

TYPE - X

Ordering Information

SAMPLE ORDER NUMBER: **CX71SD, CX72WHSD, CX6SB7**

Family | Series | Face Options | Housing Finish | Options

Family	Series	Face Options	Housing Finish	Options [2]
CX=Die Cast Aluminum Exit, LED	**6**=AC only	**1**=Single **2**=Double **S**=Open Face for Signage [1]	**[Blank]**=Brushed Aluminum Face w/Black Housing **WH**=White **BK**=Black	**[Blank]**=No additional options **2C**=Two Circuit Option (CX6 only)
		Notes (1) Consult factory for additional custom signage options.		**Notes** (2) Consult factory for additional custom signage options.

Family | Series | Face Options | Housing Finish | Options

Family	Series	Face Options	Housing Finish	Options
CX=Die Cast Aluminum Exit, LED	**7**=Self Powered [3]	**1**=Single **2**=Double **S**=Open Face for Signage [4]	**[Blank]**=Brushed Aluminum Face w/Black Housing **WH**=White **BK**=Black	**SD**=Self-diagnostics (standard) with Fire Alarm Interface Capability (CX7 only)
	Notes (3) Self-powered units have battery backup to provide 90 minutes of run time when A/C power is lost. Units must be connected to A/C power for standard operation.	**Notes** (4) Consult factory for additional custom signage options.		

Options for non-EXIT signs

Signage Options (Color)	Signage Options (Common Signs)
Blank =EXIT sign **R**=Red letter, Red LED **G**=Green letter, Green LED	**Blank**=EXIT sign **1** ="AREA OF RESCUE" **2** ="SALIDA" **3** ="STAIRS" **4** ="AREA OF REFUGE" **5** ="IN USE" **6** ="NOT AN EXIT" **7** =(WHEEL CHAIR SYMBOL) **8** ="X-RAY ON" **9** ="LASER IN USE" **10** ="DO NOT ENTER"

Available Accessories (Order Separately)

Protection Devices	Pendant Kit
WG10=Wall mount wire guard **WGS11**=Ceiling or End mount wire guard **VS1**=Polycarbonate Vandal Shield **VS1WP**=Polycarbonate Vandal Shield, Weather Proof	**CAX18PKWH**=18" Pendant Kit, White **CAX18PKBK**=18" Pendant Kit, Black **CAX18PKHTWH**=18" Hang True Pendant Kit, White

Product Specifications

Electrical

- **General Features**
- Field selectable red and green sign capability standard on all units (units shipped red, field convert to green with supplied parts)
- Dual Voltage Input 120/277 VAC,60Hz
- **AC Only**
- Optional 2C (Two circuit, FTBR) available in 120/277 VAC in standard and emergency operation. 2C models does not accept two hot circuits.
- **Self Powered ***
- Sure-Lites EZ Key patented external battery disconnect feature – prevents unnecessary battery drainage, saves on installation time
- Solid-state Voltage Limited Charger
- Brownout Circuit
- Low-Voltage Disconnect
- Test Switch/Power Indicator Light
- Standard 24 hour recharge time (max)
- Self-Diagnostic feature standard for CX7 self-powered series

Housing Construction

- Die cast aluminum housing
- Injection molded, color stable, high impact polycarbonate faces
- Die cast canopy included (for mounting convenience only, no electrical components in canopy)
- Universal pattern knockouts on rear of single face housing for direct mounting to junction box
- Knockout provided on housing for surface attachment
- Exit can be universally mounted: ceiling, wall or end
- Choice of three finishes: black housing with brushed aluminum face, white housing with white face or black housing with black face
- NFPA 101 compliant knockout chevrons allow quick conversion to directional signs
- Single and double faced signs available, order separately

Code Compliance

- UL 924 Listed
- UL Damp Location (0-40° C)
- Life Safety NFPA 101
- NEC/OSHA
- Most State and Local Codes
- Suitable for Floor Proximity Installation
- UL Listed for 2C (FTBR)

Lamp Data

- AC LED: Red and green LED lamps provide uniform diffused illumination
- DC: Red and green LED DC lamps (Brighter in emergency mode)

Warranty

- Exit – 5 year
- Battery: 7-Year pro-rata

*Self-powered units have battery backup to provide 90 minutes of run time when A/C power is lost. Units must be connected to A/C power for standard operation.

Sure-Lites — CX Series

TYPE - X

Technical Data

Lamps
- Long life, red and green LEDs, provide uniform diffuse illumination of the exit face
- Low operating costs and no maintenance required
- Consumes on average less than one watt.

Housing Construction
- Die cast aluminum with Brushed Aluminum face and black trim standard.
- Optional finishes include White and Black.
- NFPA 101 compliant knockout chevrons for easy conversion to directional sign.
- Universal pattern knockouts are in the back of the single face housing for direct mounting to junction box.
- Die cast aluminum alloy canopy included for universal mounting. Canopy is included for mounting convenience only–no electrical components in canopy.

Lens
- Lenses for the CX Series Exits are made from durable, impact resistant polycarbonate.
- All exit faces are designed with full 3/4" stroke snap-out or snap-in chevron directional indicators to insure maximum visibility and compliance with the latest codes.
- Units come with red lenses installed and green lenses included for field selectable red or green signs.

Sure-Lites EZ Key External Battery Disconnect (Self Powered Only*)
- The Patented EZ key is an external battery disconnect that allows the product to be shipped with the battery connected internally.
- This prevents battery drain during the construction cycle to insure that the battery isn't damaged and is fully charged for inspection.
- EZ Key also saves the labor of internally connecting the battery after construction is complete.

*Self-powered units have battery backup to provide 90 minutes of run time when A/C power is lost. Units must be connected to A/C power for standard operation.

Brownout Circuit (Self Powered Only*)
- Monitors the flow of AC current
- Activates the emergency lighting system when a predetermined reduction/dip of AC power occurs (a dip in voltage will cause most ballasted products to extinguish, causing loss of normal lighting even though a total power failure has not occurred)

Solid-State Transfer (Self Powered Only*)
- The CX Series Exit incorporates solid-state switching which eliminates corroded and pitted contacts or mechanical failures associated with relays. The switching circuit is designed to detect a loss of AC voltage and automatically energizes the lamps using DC power. Upon restoration of AC power, the DC power will be disconnected and the charger will automatically recharge the battery.

Low Voltage Disconnect (Self Powered Only*)
- When the battery's terminal voltage falls, the low-voltage circuitry disconnects the lighting load. The disconnect remains in effect until normal utility power is restored, preventing deep battery discharge.

Test Switch/Power Indicator Light (Self Powered Only*)
- A test switch located on the side of the exit permits the activation of the emergency circuit for a complete operational systems check. The Power Indicator Light provides visual assurance that the AC power is on.

Sealed Nickel Cadmium Battery (Self Powered Only*)
- Sure-Lites sealed nickel cadmium batteries are maintenance-free with a life expectancy of 10 years. The sealed rechargeable nickel cadmium battery offers high discharge rates and stable performance over a wide range of temperatures, from 0-40° C. The specially designed re-sealable vent automatically controls cell pressure, assuring safety and reliability. This battery is best suited for harsh ambient temperatures because the electrolyte is not active in the electrochemical process.

"2C" (AC Only)
- The "2C" Option enables the Exits to operate per the requirements of UL 924 when connected simultaneously to both normal and emergency power circuits (two circuit operation–UL Category FTBR–Emergency Lighting and Power Equipment). The "2C" Option alters the standard Exit such that it complies with and is UL Listed under the FTBR Category. This option should only be used for exits which are intended to be connected simultaneously to normal and emergency power circuits, but cannot support two hot inputs. Only one of the normal or emergency circuits can be powered. If both are powered simultaneously, it will make the Exit inoperable. Both circuits have universal 120/277 VAC standard.

Self Diagnostics Option (Self Powered Only*)
- The self-diagnostic unit will automatically perform all tests required by UL924, and NFPA 101. The system indicates the status of the exit at all times using the LED indicator near the test switch on the side of the unit. A 90 minute battery power (emergency mode) simulation test will occur randomly once every 12 months. A 30 second battery power simulation test will occur every 30 days.

Photocell Test Switch
- Allows verification of proper operation of the transfer circuit and emergency lamps with a laser pointer (laser is sold as an accessory). The emergency lamps will test for 30 seconds when activated.

Laser tester
Part Number = LASER
(sold separately)

Warranty
- All Sure-Lites' products are backed by a firm five-year warranty against defects in material and workmanship. Maintenance-free, long-life, sealed nickel cadmium batteries carry a seven-year pro-rata warranty.

Energy and Performance Data

Maximum power consumption under all charge conditions:

AC Only, 120V - Red

Amps:	Watts:	Power Factor:
0.07	0.98	0.12

AC Only, 120V - Green

Amps:	Watts:	Power Factor:
0.07	1.02	0.13

AC Only, 277V - Red

Amps:	Watts:	Power Factor:
0.07	1.04	0.06

AC Only, 277V - Green

Amps:	Watts:	Power Factor:
0.07	1.12	0.06

Self Powered, 120V - Red

Amps:	Watts:	Power Factor:
0.07	0.98	0.12

Self Powered, 120V - Green

Amps:	Watts:	Power Factor:
0.07	1.00	0.13

Self Powered, 277V - Red

Amps:	Watts:	Power Factor:
0.07	1.03	0.06

Self Powered, 277V - Green

Amps:	Watts:	Power Factor:
0.07	1.09	0.05

COOPER Lighting Solutions

Cooper Lighting Solutions
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SECTION 31 2020 - EARTHWORK FOR BUILDINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Excavation and backfill for foundations and structures shown on Structural Drawings.
    a. This Section applies to the building footprint, plus an area outside the building footprint within 5 feet thereof.
2. Preparation of subgrade for building slabs.
3. Fill course for support of building slabs.

B. Related Work Specified Elsewhere:

1. Excavation and fill of trenches within building lines, and earthwork outside building lines is specified in Division 31.
2. Tree and shrub removal and filling depressions caused by clearing and grubbing operations is specified elsewhere.

1.03 DEFINITIONS

A. Unclassified Excavation:

1. Excavation of all materials encountered regardless of character of materials and obstructions encountered.

B. Bulk Excavation:

1. Excavation more than 10 feet in width and more than 30 feet in length.

C. Confined Excavation:

1. Excavation of lesser dimensions than those for “Bulk Excavation”.

D. Unauthorized Excavation:

1. The removal of materials beyond designed subgrade elevations without specific direction of Owner's Representative.

E. Additional Excavation:

1. The removal and disposal of materials beyond designed subgrade elevations with specific direction of the Owner's Representative.

F. Existing Grade:

1. The surface of the site at start of construction.

G. Subgrade:

1. The limit of excavation to undisturbed earth acceptable to support new construction.

H. Finish Grade:

1. The specified final surface of the site.

I. Subbase:

1. The layer or layers of material specified to be placed on the subgrade.

J. Base Course:

1. The layer or layers of material specified to be placed on a subbase or a subgrade.

K. Fill:

1. Material specified to be used for raising the level of grade or for the filling of excavations.

L. Subsoil:

1. Any material below topsoil either natural or manmade exclusive of rock.

M. Rock:

1. Bulk Excavation:

a. Rock materials in beds, ledges, unstratified masses, conglomerate deposits and boulders of rock material that exceed 1 (one) cubic yard that cannot be removed by rock excavating equipment to the following in size and performance ratings, without systematic drilling, ram hammering, ripping or blasting when permitted.

1) Caterpillar Model No. 973C with less than 10,000 hours use time.

2) Late model, track mounted loader with less then 10,000 hours use time, rated at no less than 230-hp flywheel power and developing a minimum of 47,900 lbf. break-out force with a general purpose bare bucket. Measurements are according to SAE J-732.

2. Confined Excavation:

a. Rock materials in beds, ledges, unstratified masses, conglomerate deposits and boulders of rock material that exceed 3/4 cubic yard for footing, trench or pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping or blasting when permitted.

1) Caterpillar Model No. 320-CL with less than 10,000 hours use time.

2) Late model, track mounted hydraulic excavator; with less then 10,000 hours use time, equipped with 42-inch-wide, short-tip-radius rock bucket; rated at no less than 138-hp flywheel power with bucket-curling force of no less than 28,700 lbf. and stick-crowd force of not less than 18,400 lbf. with extra long boom reach. Measurements are according to SA SAE J-732.

N. Structure:

1. Buildings, foundations, slabs, tanks, curbs, drainage structures (such as, manholes and catchbasins), or either man-made stationary features occurring above or below the ground surface.

O. Drip Line:

1. The point where the foliage cover concentrates main water on the ground. This line follows the general configuration of the outermost edge of a tree or shrub formed by its leaves and branches.

1.04 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

B. Testing and Inspection Service: See Division 1, Sections "Quality Control - General", and "Testing and Inspection Services - Building".

1.05 ACTION SUBMITTALS

A. Test Reports: Submit the following reports directly to Architect from the testing services, with copy to Contractor.

1. Test reports on borrow material.

a. Testing for material certification of compliance with ASTM and MDOT Standards shall be performed not more than 90 days from receipt of submittal by the Architect.

2. Verification of suitability of each footing subgrade material, in accordance with specified requirements.

3. Field reports; in-place soil density tests.
4. One optimum moisture-maximum density curve for each type of soil encountered.
5. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.

1.06 PROJECT CONDITIONS

A. Site Information:
1. Data in subsurface investigation reports was used for the basis of the design and are available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.
2. For additional information, see Document "Geotechnical Data".
3. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.

B. Existing Utilities:
1. Locate existing underground utilities in areas of excavation work. Coordinate with Miss-Dig and Owner’s Utility Locator, as applicable. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
2. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
3. Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Owner's Representative and then only after acceptable temporary utility services have been provided.
    a. Provide minimum of 5 working day notice to Owner's Representative, and receive written notice no less than 48 hours to proceed before interrupting any utility.

C. Use of Explosives:
1. Use of explosives is prohibited.

D. Protection of Persons and Property:
1. Barricade open excavations occurring as part of this work and post with warning lights.
2. Operate warning lights as recommended by authorities having jurisdiction.
3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

E. Use of Vibratory or Impact Equipment:
1. Do not use vibratory or impact equipment that may disrupt the function of the adjacent buildings.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Satisfactory Soil materials are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP.

B. Unsatisfactory Soil materials are defined as those complying with ASTM D2487 soil classification groups GC, SC, ML, MH, CH, OL, OH, and PT.

1. Unsatisfactory Soils also include Satisfactory Soils not maintained within 2 percent of optimum moisture content at time of compaction.

C. Unsuitable Material:

1. Organic material, oil, alkali, chemical compounds, ice, snow, frozen materials, rubble, rubbish, wood, and other substances subject to decomposition.
2. Loose non-compacted fill, loose soil or obviously compressive materials.

D. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2 inch sieve and not more than 5 percent passing a No. 4 sieve. Loss by washing: 0 to 3 percent.

E. Non-Frost Susceptible:

1. MDOT Class 1, granular, modified.
   a. Gradation:

Sieve Size	Percent Passing
2”	100
½”	45 – 85
No. 4	20 – 85
No. 30	5 – 30

   b. Maximum loss by Washing:
      1) 0 to 3 percent.

F. Pea Stone:

1. Natural gravel, stone or gravel crushings, conforming to ASTM D 448, Table 1, Size 67

G. Granular Fill:

1. MDOT 21AA [ODOT 30A] aggregate or well-graded natural sand and gravel, containing not more than seven (7) percent by weight passing the No. 200 Sieve, sixty (60) to one-hundred (100) percent passing a one (1) inch Sieve, with a maximum particle size of three (3) inches.

H. Lean Concrete:

1. Normal weight, 1500 psi 28-day compressive strength, conforming to applicable requirements of ASTM C 94.

I. Open Graded Aggregate:

1. Aggregate produced by crushing, washing and screening limestone. Particle size vary from 1-1/2” to dust.
2. MDOT 4G. (MDOT Special Provisions for open-graded drainage courses, 03 SP 303 (A); FHWA approved 11-01-08).
3. Gradation:

Sieve Size:	1-1/2”	1”	½”	#8	#30	LBW
Percent Passing:	100	85-100	40-70	13-35	5-20	8.0 Max.

4. Provide and install crusher fines for choke course (stabilizing cushion).

J. Dense Graded Aggregate:

1. Aggregate produced b crushing, washing and screening limestone. Particle size vary from 1-1/2” to dust.
2. MDOT 21AA

a. Gradation:

Sieve Size:	1-1/2”	1”	½”	#4	#8	LBW
Percent Passing:	100	90-100	65-85	30-50	4-8	25 Min.

K. Low Strength Flowable Fill Concrete:

1. Mixture Components: Portland cement, fly ash, water.
2. Compressive strength at 28 days shall be 50 psi. Testing shall be accomplished in accordance with ASTM C 495.

L. Clay Fill:

1. Clayey gravel and sand mixture capable of compacting to a dense composite.

M. Fill Materials Not Permitted:

1. Crushed concrete.
2. Slag.

N. Geotextile Fabric:

1. Manufacturer’s standard woven pervious geotextile fabric of polypropylene, nylon or polyester fibers, one of the following:
   a. Geotex 3 x 3 HF by Propex (geotextile.com).
   b. Mirafi HP 370 by TenCate (tencate.com).

PART 3 - EXECUTION

3.01 EXAMINATION AND ACCEPTANCE OF CONSTRUCTION IN PLACE

A. Examine site and construction in place.

1. Notify the Owner's Representative in writing of conditions detrimental to the proper and timely completion of the work.
2. Defects which may influence satisfactory completion and performance of the work shall be corrected in accordance with the requirements of the applicable section of the specifications and in a manner acceptable to the Owner's Representative, prior to commencement of the work.
3. Commencement will be construed as site and construction in place being acceptable for satisfying the requirements of this section.

B. Contractor is responsible for all earthwork quantities and volumes necessary for total Project to facilitate proposed grades and improvements shown on the Drawings.

1. These quantities and volumes are to be considered incidental and at Contractor's expense.

3.02 PREPARATION

A. Request that representatives of each entity directly concerned with Earthwork for Buildings attend conference including, but not limited to the following:

1. Contractor’s Superintendent.
2. Agency responsible for Geotechnical Inspection/Testing.
3. Disciplines installing under-ground utilities.
4. Owner’s Representative.
5. Architect’s Representative.

B. Field Measurements and Tolerances:

1. Take field measurements to verify or supplement dimensions shown. Be responsible for accurate fit of specified Work.

2. If any soil surface is placed or graded outside of the tolerances of this specification, or if utilities are misplaced or omitted, any remedial work or resulting additional work of other trades, as may be directed by the Architect, shall be performed by the Contractor at his expense. The cost of evaluation and redesign of remedial work by the Architect shall be borne by the Contractor.

3.03 WATER CONTROL

A. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding or impairing project site and surrounding property.

1. Do not use trench excavations as temporary drainage ditches.
2. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations.
3. Maintain water to a minimum of 2 feet below subgrade levels receiving compaction; and in the case where footings bear on soil, 2 feet below bottom of footing.
4. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
5. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas.

3.04 EROSION CONTROL

A. In general, the Contractor shall take necessary precautions to positively prevent erosion and resultant sediment run-off into existing open or enclosed drains.

1. Inspect each operational erosion control installation after each storm and perform any needed repairs, cleaning of filter media or other adjustments.

B. The erosion and sediment control systems must remain in operable condition until final site restoration has been completed.

C. Necessary permits and all related fees shall be the Contractor's responsibility.

1. The Contractor shall comply with all applicable federal, state and local statures, codes, rules and regulations regarding erosion control.
2. Contact the Owner for information concerning the permit and the agency having jurisdiction over this requirement.

3.05 EXCAVATION

A. Excavation Classification: Excavation is “Classified”. Materials to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross-sectioned by the Owner or his designate.

1. Earth excavation includes excavating pavements and obstruction visible on surface. Underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
2. Excavate to required elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
    a. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
    b. Pile Foundations: Stop excavation 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

c. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions required. Do not disturb bottom of excavation intended as bearing surfaces.

3. Rock Excavation:

a. Typical of materials classified as rock are solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.

b. Intermittent drilling, blasting, or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

c. Do not perform rock excavation work until material to be excavated has been cross-sectioned and classified by Architect. Such excavation will be paid on basis of Contract Conditions relative to changes in work.

d. Rock payment lines are limited to the following:

1) Two feet outside of concrete work for which forms are required, except footings.

2) One foot outside perimeter of footings.

3) In pipe trenches, 6 inches below invert elevation of pipe and 2 feet wider than inside diameter of pipe, but not less than 3 feet minimum trench width.

4) Outside dimensions of concrete work where no forms are required.

5) Under slabs on grade, 6 inches below bottom of concrete slab.

B. Excavation for Structures:

1. General:

a. Remove vegetation, debris, unsuitable material, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to proof rolling and placement of fills.

1) Soils containing 4% or greater organic content shall be removed.

b. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection.

2. Excavations for footings and foundations:

a. Do not disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.

1) If bottom of excavation is disturbed, or if bearing pressure cannot be obtained:

a) Excavate until bearing strata is reached.

b) For disturbance only: recompact or excavate.

b. For pile foundations, stop excavations from 6 inches to 12 inches above bottom of footing before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grate, leaving solid base to receive concrete pile caps.

3. Excavation for Utilities:

a. Excavation for utilities is covered in the documents for each affected utility.

b. Utilities adjacent to column footings and parallel to wall footings.

1) Do not undermine footings.

2) Do not excavate below bottom of footing.

a) When bottom of excavation is below bottom of footing, excavation shall be outside a slope of (2) two horizontal to (1) one vertical from the edge of footings.

b) Utilities perpendicular to wall footing: See structural documents for added requirements.

C. Material Storage:

1. Stockpile excavated materials acceptable for fill where directed. Place, grade, and shape stockpiles for proper drainage.
2. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
3. Dispose of excess excavated soil material and materials not acceptable for use as fill.

D. Cold Weather Protection:

1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.06 EXCAVATION STABILITY

A. General:

1. Comply with local codes, ordinances, and requirements of agencies having jurisdiction.
2. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Temporarily shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of filling.

3.07 PROOFROLLING

A. General:

1. Proofrolling identifies areas containing soft pockets and excess yielding.
2. Proofroll all cut areas after cutting and all fill areas prior to filling.
   a. Pavement and building subgrade shall be proofrolled prior to placement of surface materials.
   b. Any pumping or yielding of material judged to be excessive by the Independent Testing Agency for geotechnical items while proofrolling, shall be:
      1) Removed and replaced with granular fill.
      2) Or shall be removed, aerated and recompacted to satisfaction of the Independent Testing Agency for geotechnical items.
3. Proofrolling method shall meet the requirements of the Independent Testing Agency for geotechnical items.

B. Proofrolling:

1. The proofrolling equipment, as a minimum, should consist of a fully-loaded, ten-wheel, tandem-axle dump truck, twenty-five (25) tons gross weight.
   a. Two (2) coverages, one perpendicular to the other, of this equipment can be considered as adequate.
   b. Limit vehicle speed to 3 mph.
2. In small areas not accessible to a dump-truck, use a two (2) foot x two (2) foot hoe-pack plate mounted to a back-hoe or light compaction equipment (less than 4,000 pounds gross weight).

C. Timing:

1. Once the site has been proof-rolled and stabilized, the proof-rolled subgrades shall not be exposed to wet conditions.
    a. In the case that proof-rolled subgrades do become exposed to wet conditions start the proof-roll process again.

3.08 FROST CONDITIONS

A. Preparation:
1. Do not place new fill on frozen ground, ground containing lenses of frozen material, ice or snow.

B. Placing:
1. Do not use fill containing frozen material.

C. Protection:
1. Protect subgrade against freezing when subsequent work, such as fill, slab on grade, footings, etc., will be placed on it.
2. Protect areas at and adjacent to unprotected footings from freezing at the footing bearing surface.

3.09 FILL AND BACKFILL

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

B. Placement:
1. Fill excavations as promptly as work permits, but not until completion of the following:
    a. Inspection, testing and approval of subgrade by the Testing Agency.
    b. Acceptance of construction below finish grade including, where applicable; dampproofing, waterproofing, and perimeter insulation.
    c. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
    d. Removal of concrete formwork.
    e. Removal of shoring and bracing.
    f. Filling of voids with satisfactory materials.
    g. Removal of trash and debris from excavation.
2. Place fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
3. Place fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of fill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.
4. Place base course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting base material during placement operations.
5. When a compacted base course is indicated to be 6 inches thick or less, place material in a single layer. When indicated to be more than 6 inches thick, place material in equal layers, except no single layer more than 6 inches or less than 3 inches in thickness when compacted.

C. Structures:

1. Slabs On Grade:
    a. Specific requirements below slab on grade are noted on the drawings.
2. Utilities:
    a. Bedding and fill requirements are listed in the documents for each affected utility.
    b. Where utility documents do not indicate fill requirements, use “Building Slabs on Grade” requirements specified above in this section.

D. Filling of Unauthorized Excavations:
1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Use Granular Fill, or Lean Concrete.
2. Interior and exterior walls without drain-tile:
    a. Granular materials.
3. Interior and exterior walls with drain-tiles:
    a. As shown on Structural Document.
        1) If not specifically shown use granular materials.
4. In locations other than those above, fill and compact unauthorized excavations as specified for authorized excavations of same classification.

3.010 COMPACTION

A. Compaction, General:
1. After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density.
2. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content.
    a. Moisture content of fill at time of placement shall be within 2% of the optimum moisture.
3. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification.
    a. Do not place fill material on surfaces that are muddy, frozen, or contain frost or ice.
4. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below.
    a. Correct improperly compacted areas or lifts as directed by the Geotechnical Testing Agency if soil density tests indicate inadequate compaction.

B. Moisture Control:
1. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
    a. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
    b. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

C. Percentage of Maximum Density Requirements:
1. Compact fill to not less than the following percentages of maximum density, in accordance with ASTM D 1557:

a. Under structures, building slabs and steps, compact top 18 inches of subgrade and each layer of fill material at minimum 95 percent maximum density.

D. Compaction Testing Results:

1. If, based on testing service reports and inspection, subgrade or fills that have been placed are below specified density, perform additional compaction until specified density is obtained.

3.011 GRADING

A. General:

1. Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

B. Grading Surface of Fill under Building Slabs:

1. Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2 inch when tested with a 10-foot straightedge.

C. Grade Control:

1. During construction, maintain lines and grades including crown and cross-slope of subbase course.

3.012 FIELD QUALITY CONTROL

A. General:

1. Allow Geotechnical Testing Agency to inspect and approve each subgrade and fill layer before further fill or construction work is performed.

B. Testing Agency:

1. Refer to Division 1 Sections "Quality Control - General" and "Testing and Inspection Services - Building" regarding employing and paying for Independent Testing Agency services.

C. Quality Control Testing During Construction:

1. Refer to contract documents for “Testing and Inspection Services”.

D. Retesting:

1. Where testing indicated noncompliance with Specification requirements, retest area again after Contractor's reworking operations are completed.

3.013 MAINTENANCE

A. Protection of Graded Areas:

1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
2. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.

B. Reconditioning Compacted Areas:

1. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

3.014 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal from Owner's Property:

1. Remove excess excavated material, trash, debris, and waste materials and legally dispose of it off Owner’s property.

END OF SECTION

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