SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 CONDITIONS

A. Conditions of the contract (General and Supplementary Conditions) and Division 01 - General Requirements, govern the work of this section.

B. This section includes all material, and related service necessary to furnish all finish hardware indicated on the drawings or specified herein.

C. Furnish UL listed hardware for all labeled and 20 min. openings in conformance with the requirements for the class of opening scheduled. Underwriters' requirements shall have precedence over specification where conflicts exist.

D. All work shall be in accordance with all applicable state and local building codes. Code requirements shall have precedence over this specification where conflicts exist.

1.2 WORK INCLUDED

A. This section includes the following:

1. Furnish door hardware (for hollow metal, wood and aluminum doors) specified herein, listed in the hardware schedule, and/or required by the drawings.
2. Cylinders for Aluminum Doors
3. Thresholds and Weather-stripping (Aluminum frame seals to be provided by aluminum door supplier)
4. Electro-Mechanical Devices
5. Access Control components and or systems specified within this section.

B. Where items of hardware are not definitely or correctly specified and is required for the intended service, such omission, error or other discrepancy should be directed to the Architect prior to the bid date for clarification by addendum. Otherwise furnish such items in the type and quantity established by this specification for the appropriate service intended.

1.3 RELATED WORK IN OTHER SECTIONS

A. This section includes coordination with related work in the following sections:

1. Division 06 Section "Finish Carpentry".
2. Division 06 Section "Cabinet Hardware"
3. Division 08 Section "Hollow Metal Doors and Frames".
4. Division 08 Section "Wood Doors"
5. Division 08 Section "Aluminum Entrances and Storefronts"
6. Division 26 Sections “Electrical”
7. Division 28 Sections "Electronic Safety and Security".

1.4 REFERENCES

A. Publications of agencies and organizations listed below form a part of this specification section to the extent referenced.

1. DHI – Installation Guide for Doors and Hardware (2020).
2. NFPA 80 - Standards for Fire Doors and Windows.
3. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.
4. UL - Building Material Directory.
5. DHI - Door and Hardware Institute
6. WHI - Warnock Hersey
7. BHMA - Builders Hardware Manufacturers Association
8. ANSI – American National Standards Institute

9. IBC - International Building Code 2018 Edition (as adopted and amended by local building code)

1.5 SUBMITTALS

A. Within ten days after award of contract, submit detailed hardware schedule in quantities as required by Division 01 - General Requirements.

B. Schedule format shall be consistent with recommendations for a vertical format as set forth in the Door & Hardware Institute's (DHI) publication "Sequence and Format for the Hardware Schedule". Hardware sets shall be consolidated to group multiple door openings which share similar hardware requirements. Schedule shall include the following information:

1. Door number, location, size, handing, and rating.
2. Door and frame material, handing.
3. Degree of swing.
4. Manufacturer
5. Product name and catalog number
6. Function, type and style
7. Size and finish of each item
8. Mounting heights
9. Explanation of abbreviations, symbols, etc.
10. Numerical door index, indicating the hardware set/ group number for each door.

C. The schedule will be prepared under the direct supervision of a certified Architectural Hardware Consultant (AHC), or certified Door Hardware Consultant (DHC) employed by the hardware distributor. The hardware schedule shall be signed and embossed or stamped with the DHI certification seal of the supervising AHC or DHC. The supervising AHC or DHC shall attend any meetings related to the project when requested by the architect.

D. Check the specified hardware for suitability and adaptability to the details and surrounding conditions.

E. Review drawings from related trades as required to verify compatibility with specified hardware. Indicate unsuitable or in compatible items, and proposed substitutions in the hardware schedule.

F. Provide documentation for all hardware to be furnished on labeled fire doors indicating compliance with positive pressure fire testing UL 10C.

G. Furnish manufacturers' catalog data for each item of hardware in quantities as required by Division 01 - General Requirements.

H. Submit a sample of each type of hardware requested by the architect. Samples shall be of the same finish, style, and function as specified herein. Tag each sample with its permanent location so that it may be used in the final work.

I. Furnish with first submittal, a list of required lead times for all hardware items.

J. After final approved schedule is returned, transmit corrected copies for distribution and field use in quantities as required by Division 01 - General Requirements.

K. Furnish approved hardware schedules, template lists, and pertinent templates as requested by related trades.

L. Furnish necessary diagrams, schematics, voltage and amperage requirements for all electro-mechanical devices or systems as required by related trades. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.

M. After receipt of approved hardware schedule, Hardware supplier shall initiate a meeting including the owner’s representative to determine keying requirements. Upon completion of initial key meeting, hardware supplier shall prepare a proposed key schedule with symbols and

abbreviations as set forth in the door and hardware institute's publication "Keying Procedures, Systems, and Nomenclature". Submit copies of owner approved key schedule for review and field use in quantities as required by Division 01 - General Requirements. Wiring diagrams shall be included in final submittals transmitted for distribution of field use.

1.6 QUALITY ASSURANCE

A. Manufacturers and model numbers listed are to establish a standard of function and quality. Similar items by approved manufacturers that are equal in design, function, and quality may be considered for prior approval of the architect, provided the required data and physical samples are submitted for approval as set forth in Division 01 - General Requirements.

B. Where indicated in this specification, products shall be independently certified by ANSI for compliance with relevant ANSI/BHMA standards A156.1 - A156.36 – Standards for Hardware and Specialties. All products shall meet or exceed certification requirements for the respective grade indicated within this specification. Supplier shall provide evidence of certification when requested by the architect.

C. Obtain each type of hardware (hinges, latch & locksets, exit devices, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.

D. Electrical drawings and electrical specifications are based on the specific electrified hardware components specified in hardware sets. When electronic hardware components other than those indicated in hardware sets are provided, the supplier shall be responsible for all costs incurred by the design team and their consultants to review and revise electrical drawings and electrical specifications. Supplier shall also be responsible for any additional costs associated with required changes in related equipment, materials, installation, or final hook up to ensure the system will operate and function as indicated in the construction documents, including hardware set operational / functional descriptions.

E. All hardware items shall be manufactured no earlier than 6 months prior to delivery to site.

F. Hardware supplier shall be factory trained and certified by the manufacturer to provide and support all computer managed locks and system components.

G. Installation of hardware shall be installed or directly supervised and inspected by a skilled installer certified by the manufacturer of locksets, door closers, and exit devices used on the project, or with not less than 3 years' experience in successful completion of projects similar in size and scope.

H. Provide hardware for all labeled fire doors, which complies with positive pressure fire testing UL 10C.

I. Comply with all applicable provisions of the standards referenced within section 1.4 of this specification.

J. Hardware supplier shall participate when reasonably requested to meet with the contractor and or architect to inspect any claim for incorrect or non-functioning materials; following such inspection, the hardware supplier shall provide a written statement documenting the cause and proposed remedy of any unresolved items.

1.7 DELIVERY, STORAGE AND HANDLING

A. Hardware supplier shall deliver hardware to the job site unless otherwise specified.

B. All hardware shall be delivered in manufacturers' original cartons and shall be clearly marked with set and door number.

C. Coordinate with contractor prior to hardware delivery and recommend secure storage and protection against loss and damage at job site.

D. Contractor shall receive all hardware and provide secure and proper protection of all hardware items to avoid delays caused by lost or damaged hardware. Contractor shall report shortages to the Architect and hardware supplier immediately after receipt of material at the job site.

E. Coordinate with related trades under the direction of the contractor for delivery of hardware items necessary for factory installation.

1.8 PRE-INSTALLATION MEETING

A. Schedule a hardware pre-installation meeting on site to review and discuss required door operating clearances and the installation of continuous hinges, locksets, door closers, exit devices, overhead stops, and electromechanical door hardware.

B. Meeting attendees shall be notified 7 days in advance and shall include: Architect, Contractor, Door Hardware Installers (including low voltage hardware), Manufacturers representatives for above hardware items, and any other effected subcontractors or suppliers.

C. All attendees shall be prepared to distribute installation manuals, hardware schedules, templates, and physical hardware samples.

1.9 WARRANTY

A. All hardware items shall be warranted against defects in material and workmanship as set forth in Division 01 - General Requirements.

B. Repair, replace, or otherwise correct deficient materials and workmanship without additional cost to owner.

PART 2 - PRODUCTS

2.1 FASTENERS

A. All exposed fasteners shall be Phillips head or as otherwise specified and shall match the finish of the adjacent hardware. All fasteners exposed to the weather shall be non-ferrous or stainless steel. Furnish correct fasteners to accommodate surrounding conditions.

B. Coordinate required reinforcements for doors and frames. Seek approval of the architect prior to furnishing through-bolts. Furnish through-bolts as required for materials not readily reinforced.

2.2 BUTT HINGES

A. Acceptable manufacturers and respective catalog numbers:

	Ives	Stanley	Hager	McKinney
1. Standard Weight, Plain Bearing	5PB1	F179	****	T2714
2. Standard Weight, Ball Bearing	5BB1	BB179	BB1279	TB2714
3. Standard Weight, Ball Bearing, Non-Ferrous	5BB1	FBB191	BB1191	TB2314
4. Heavy Weight, Ball Bearing	5BB1HW	FBB168	BB1168	T4B3786
5. Heavy Weight, Ball Bearing, Non-Ferrous	5BB1HW	FBB199	BB1199	T4B3386

B. Hinges shall be independently certified by ANSI for compliance with ANSI A156.1 (2006). Hinges shall meet or exceed the following ANSI grade requirements as indicated below:
   1. Standard Weight, Plain Bearing Hinges: Grade 3
   2. Standard Weight, 2 Ball Bearing Hinges: Grade 2
   3. Heavy Weight, 4 Ball Bearing Hinges: Grade 1

C. Unless otherwise specified, furnish the following hinge quantities for each door leaf.
   1. 3 hinges for doors up to 90 inches.
   2. 1 additional hinge for every 30 inches on doors over 90 inches.
   3. 4 hinges for Dutch door applications.

D. Unless otherwise specified, top and bottom hinges shall be located as specified in Division 08 Section "Hollow Metal Doors and Frames". Intermediate hinges shall be located equidistant from others.

E. Unless otherwise specified, furnish hinge weight and type as follows:
   1. Standard weight: plain bearing hinge 5PB1 or ball bearing hinge 5BB1 for interior openings through 36 inches wide without a door closer.
   2. Standard weight: ball bearing hinge 5BB1 for interior opening over 36 through 40 inches wide without a door closer, and for interior openings through 40 inches wide with a door closer.
   3. Heavyweight: 4 ball bearing hinge 5BB1HW for interior openings over 40 inches wide, and for all vestibule doors.
   4. Heavyweight: 4 ball bearing hinge 5BB1HWss for exterior openings unless otherwise listed in groups.
   5. Heavyweight: 4 ball bearing hinge 5BB1HWss for all exterior doors or 4 ball bearing hinge 5BB1HW for interior doors, that have an automatic operator, unless otherwise listed in groups.

F. At existing frames receiving new hinges, match existing hinge size and weight.

G. Unless otherwise specified, furnish brass, bronze, or stainless-steel base metal for hinges at exterior doors. Unless otherwise specified, furnish steel base metal for hinges at interior and labeled doors.

H. Furnish stainless steel base metal for hinges at showers, pools, and wash bay doors.

I. Unless otherwise specified, furnish hinges in the following sizes:
   1. 5" x 5" 2-1/4" thick doors
   2. 4-1/2" x 4-1/2" 1-3/4" thick doors
   3. 3-1/2" x 3-1/2" 1-3/8" thick doors

J. Furnish hinges with width to accommodate trim and allow for 180-degree swing.

K. Unless otherwise specified, furnish hinges with flat button tips with non-rising pins at interior doors, non-removable loose pins (NRP) at exterior, and out-swinging lockable interior doors.

L. Unless otherwise specified, furnish all hinges to template standards.

2.3 CONTINUOUS GEARED HINGES

A. Acceptable manufacturers and respective catalog numbers:

	Ives	Hager	Pemko	Stanley
1. Full Mortise	112HD	780-112HD	FMSLFHD	661HD

A. Hinges shall be independently certified by ANSI for compliance with ANSI A156.26, Grade 1 (2012).

B. Continuous hinges shall be geared type hinge providing full height door support up to 600 lbs.

C. Hinge shall be non-handed with symmetrical template hole pattern and factory drilled.

D. Hinge to be able to carry Warnock Hersey Int. or UL for fire rated doors and frames up to 90 minutes.

E. Provide machine screws for doors which have been reinforced to accept machine screws.

F. Note: Fire label for doors and frames should be placed on the header and top rail of fire rated doors and frames.

2.4 POWER TRANSFERS

A. Acceptable manufacturers and respective catalog numbers:

	Von Duprin	ASSA
1. Concealed Two Wire	EPT-2	CEPT-10

2. Concealed Ten Wire	EPT-10	CEPT-10

B. Door cords shall be armored cable with screw on caps.

C. Concealed power transfers shall be concealed in the door and frame when the door is closed.

D. Concealed power transfers shall have a steel tube to protect wires from being cut.

E. Concealed power transfers with spring tubes shall be rejected.

F. Concealed power transfers shall be supplied with a mud box to house all terminations.

2.5 FLUSH BOLTS AND DUST PROOF STRIKES

A. Acceptable manufacturers and respective catalog numbers:

	Ives	Trimco	Hager
1. Dust Proof Strike	DP2	3910	280X
2. Auto Flush Bolt (Metal Door)	FB31P	3810	292D
3. Auto Flush Bolt (Wood Door)	FB41P	3815L	291D
4. Constant Latching Bolt (Metal Door)	FB51P	3820	293D
5. Constant Latching Bolt (Wood Door)	FB61P	3825L	294D
6. Manual Flush Bolt	FB458	3915	282D

B. Unless otherwise specified, provide 12" rods for manual flush bolts for door 7'6" or less, 24" top rods for doors over 7'6" to 8'6".

C. Unless otherwise specified, provide doors over 8'6" with automatic top bolts.

D. Provide automatic flush bolts where required to maintain fire door listing and or egress requirements on pairs of doors.

E. All flush-bolt applications shall be UL listed to be installed with top flush-bolt only. Provide auxiliary fire bolt as required for fire rated openings where less bottom bolt has been specified.

F. Provide all bottom flush bolts with non-locking dust proof strikes.

2.6 EXIT DEVICES

A. Acceptable manufacturers and respective catalog numbers:

	Von Duprin	No Substitution
1. Wide Stile, Push Pad	99 Series	
2. Wide Stile, Electric Latch Retraction	QEL 99 Series	
3. Lever Trim	996 Series	
4. Pull Trim	990 Series	

B. Exit devices shall be independently certified by ANSI for compliance with ANSI A156.3, Grade 1 (2008).

C. Obtain exit devices from a single manufacturer, although several may be indicated as offering products complying with requirements.

D. All exit devices shall be equipped with a sound-dampening feature to reduce touch pad return noise.

E. Quiet Electric Latch Retraction shall be accomplished using a motor driven assembly, and shall incorporate the following features:

1. Motor shall retract both the push pad assembly and latchbolt.
2. Automatic calibration of latch throw and pull.
3. Built-in time delay.
4. On-board installation and troubleshooting diagnostics built into power supply and device.
5. Retry mode if device does not pull on the first try.

F. On full glass doors there shall be no exposed fasteners on the back of the mechanism visible through the glass.

G. All exit devices shall be provided with flush end caps to reduce potential damage from impact.

H. All exit devices shall be provided with dead-locking latch bolts to ensure security.

I. All exit devices shall be U.L. listed for accident hazard. Exit device for use on fire doors shall also be U.L. listed for fire exit hardware.

J. Provide optional strikes, special length rods, and adapter plates to accommodate door and frame conditions. Provide narrow style series devices in lieu of wide stile series devices where optional strikes will not accommodate door and frame conditions.

K. Coordinate with related trades to ensure adequate clearance and reinforcement is provided in doors and frames. Provide thru bolts as required.

L. Refer to hardware groups for exit device applications utilizing the option of: "less bottom rod and floor strike" (LBR)

M. All exit devices shall be provided with optional trim designs to match other lever and pull designs used on the project.

N. Provide glass bead kits as required to accommodate door conditions. Screws shall not be visible through full glass doors.

O. Where specified, provide compatible keyed mullions with cylinder for pairs of doors.

P. Provide Von Duprin #154 or equivalent mullion/frame stabilizers at the following application(s):
   1. Lockable exterior or vestibule paired openings with a fixed or removable hollow metal or aluminum mullion.
   2. Lockable exterior or vestibule single doors in aluminum frames.

2.7 LOCKS AND LATCHES

A. Acceptable manufacturers and respective catalog numbers:

	Corbin	No Substitution
1. Grade 1 Cylindrical	CLX3300 NZD	

B. Bored locks shall be independently certified by ANSI for compliance with ANSI A156.2 (2011). Mortise locks shall be independently certified by ANSI for compliance with ANSI A156.13 (2012).

C. Unless otherwise specified, all locks and latches to have:
   1. 2-3/4" Backset
   2. 1/2" minimum throw latchbolt
   3. 1" throw deadbolt
   4. ANSI A115.2 strikes

D. Provide guarded latch bolts for all locksets and latch bolts with throw to maintain fire rating of both single and paired door assemblies.

E. Provide strike with lip length adequate to clear surrounding trim.

F. Provide wrought boxes for strikes at inactive doors, wood frames, and metal frames without integral mortar covers.

2.8 PULLS, PUSH BARS, PUSH/PULL PLATES

A. Acceptable manufacturers and respective catalog numbers:

	Ives	Burns	Trimco
1. Straight Pull (1" dia., 10" CTC)	8103-0	26C	1195E-2
2. Straight Pull (3/4” dia., 8” CTC)	8102-8	25B	1194E-2
3. Offset Door Pull (1" dia., 10" CTC)	8190-0	39C	1191-3

4.	Offset Pull (1” dia., 18” CTC Pull)	8190-18	39G	1191E-5
5.	Push-Bar (1” dia., 10” CTC Pull)	9100	422	1741E
6.	Pull / Push-Bar (1" dia., 10" CTC Pull)	9103-0	422 x 26C	1731EG
7.	Offset Pull / Push-Bar (1" dia., 10" CTC Pull)	9190-0	422 x 39C	1737
8.	Offset Pull / Push-Bar (1” dia., 18” CTC Pull)	9190-18	422 x 39G	1739
9.	Push Plate (.050 4"X 16")	8200 4 x 16	54	1001-3
10.	Push Plate (.050 6"X 16")	8200 6" X 16"	56	1001-9
11.	Pull Plate (1" dia., 10" CTC - .050" X 4" X 16")	8303-0 4" X 16"	5426C	1018-3B
12.	Flush Pull	960	459C	1115

A. Adjust dimensions of push plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, push plates shall be factory drilled for cylinders or other mortised hardware. All push plates shall be beveled 4 sides and counter sunk.

B. Where required on wide stile doors, install straight pull offset of cylinder to allow for access to cylinder.

C. Where possible, provide back-to-back, and concealed mounting for pulls and push bars. Push bar length shall be 3" less door width, or center of stile to center of stile for stile & rail or full glass doors.

2.9 COORDINATORS

A. Acceptable manufacturers and respective catalog numbers:

	Ives	Trimco	Hager
1. Bar Coordinator	COR x FL	3094	297D x 297F
2. Mounting Bracket	MB Series	3095/3096	297 Series

B. Provide coordinators at all pairs of doors having automatic flush bolts and closers on the inactive leaf, and for pairs of doors having vertical rod/mortise exit device combinations with overlapping astragals.

C. Provide appropriate filler bars, closer mounting brackets, carry bars, and special top latch preparations as required by adjacent hardware.

2.10 CLOSERS

A. Acceptable manufacturers and respective catalog numbers:

	LCN	No Substitution
1.	4011 /4111 EDA	

B. Door closers shall be independently certified by ANSI for compliance with ANSI A156.4, Grade 1 (2013).

C. Obtain door closers from a single manufacturer, although several may be indicated as offering products complying with requirements.

D. Provide extra heavy-duty arm (EDA / HD) when closer is to be installed using parallel arm mounting.

E. Hardware supplier shall coordinate with related trades to ensure aluminum frame profiles will accommodate specified door closers.

F. Provide “SPECIAL TEMPLATE - #1728 / #0723” closer arms as required to accommodate aluminum frame head details with “non-structural stops” when closers will be required to utilize parallel arm mounting positions. Frame mounting shoe shall be shortened, and pivot hub height shall be increased to permit frame mounted shoe to be positioned on frame rabbit (rather than

the frame stop), and behind the frame stop rather than on top of the frame stop. Contact LCN Door Closers at: 877-671-7011 for pricing and design assistance.

G. Closers shall use high strength cast iron cylinders, forged main arms, and one-piece forged steel pistons.

H. Closers shall utilize a stable fluid withstanding temperature range of +120deg F to -30deg F without seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with standards UL10C.

I. Unless otherwise specified, all door closers shall have full covers and separate adjusting valves for sweeps, latch, and backcheck.

J. Provide closers for all labeled doors. Provide closer series and type consistent with other closers for similar doors specified elsewhere on the project.

K. Provide closers with adjustable spring power. Size closers to ensure exterior and fire rated doors will consistently close and latch doors under existing conditions. Size all other door closers to allow for reduced opening force not to exceed 5 lbs.

L. Install closers on the room side of corridor doors, stair side of stairways and interior side of exterior doors.

M. Closers shall be furnished complete with all mounting brackets and cover plates as required by door and frame conditions, and by adjacent hardware.

N. Door closers shall be provided with a powder coat finish to provide superior protection against the effects of weathering. Powder coat finish shall successfully pass a 100 hour salt spray test.

O. Pressure Relief Valve, PRV, shall not be acceptable.

2.11 LOW ENERGY ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

A. Acceptable manufacturers and respective catalog numbers:

	LCN
1. Electro-Hydraulic Operator	4640

B. Low energy operators shall be independently certified by ANSI for compliance with ANSI A156.19 (2002).

C. Where low kinetic energy, as defined by ANSI/BHMA Standard A156.19, power operators are indicated for doors required to be accessible to the disabled, provide electrically powered operators complying with the ADA for opening force and time to close standards.

D. The closing action shall be controlled by modern type cast iron door closer cylinder filled with a flat viscosity fluid, stable from +120F to -30F that would require no seasonal adjustments. The closer shall have field adjustable spring power; have two independent closing speed adjustment valves, and hydraulic back-check.

E. Full closing force shall be provided when the power or assist cycle ends.

F. All power operator systems shall include the following features and functions:
   1. Provisions for separate conduits to carry high and low voltage wiring in compliance with the National Electrical Code, section 725-31.
   2. The operator will be designed with an electronically controlled mechanical clutching mechanism to prevent damage to the operator if the system is actuated while the door is latched or if the door is forced closed during the opening cycle.
   3. All covers, mounting plates and arm systems shall be powder coated and successfully pass a minimum of 100 hours testing as outlined in ANSI/BHMA Standard A156.18.
   4. UL listed for use on labeled doors.
   5. All operators shall be non-handed with spring power over a range of at least four sizes; either 1 through 4 or 2 through 5.

6. The power operator shall incorporate microprocessor controlled digital controls including factory default memory settings, on-board diagnostics, non-volatile memory, and integrated delay and relay for controlling door release devices.
7. Provisions in the control box or module shall provide control {inputs and outputs) for; electric strike delay, auxiliary contacts, sequential operation, fire alarms systems, actuators, swing side sensors, and stop side sensors.
8. Exterior switches shall be weather resistant and mount on a single gang electrical box furnished by Division 26.

G. All electrically powered operators shall include the following features or functions:
1. When an obstruction or resistance to the opening swing is encountered, the operator will pause at that point, then attempt to continue opening the door. If the obstruction or resistance remains, the operator will again pause the door.
2. Easily accessible main power and maintain hold open switches will be provided on the operator.
3. An electronically controlled clutch to provide adjustable opening force.
4. A microprocessor to control all motor and clutch functions.
5. An on-board power supply capable of delivering both 12V and 24V outputs up to a maximum of 1.0 ampere combined load.
6. All input and output power wiring shall be protected by slow blow fuses. These fuses shall be easily replaceable without special tools or component replacement.
7. If electrical failure occurs, the unit shall operate as a standard door closer.

H. Power Operators shall be warranted by the manufacturer to be free from defects in material and workmanship for a period of two years.

2.12 KICK PLATES AND MOP PLATES

A. Furnish protective plates as specified in hardware groups.

B. Where specified, provide 10" kick plates, 34" armor plates, and 4" mop plates. Unless otherwise specified, metal protective plates shall be .050" thick; plastic plates shall be 1/8" thick.

C. Protective plates shall be 2" less door width, or 1" less door width at pairs. All protective plates shall be beveled 4 sides and counter sunk.

D. Protection plates over 16" shall not be provided for labeled doors unless specifically approved by door manufacturers listing. When protection plates over 16” are provided for labeled doors, the plate shall be labeled.

E. Where specified, provide surface mounted door edges. Edges shall butt to protective plates. Provide edges with cutouts as required adjacent hardware.

F. Adjust dimensions of protection plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, protection plates shall be factory drilled for cylinders or other mortised hardware.

2.13 OVERHEAD STOPS

A. Acceptable manufacturers and respective catalog numbers:

	Glynn-Johnson	Rixson	Sargent
1. Heavy Duty Surface Mount	GJ900 Series	9 Series	590
2. Heavy Duty Concealed Mount	GJ100 Series	1 Series	690

B. Unless otherwise specified, furnish GJ900 series overhead stop for hollow metal or 1-3/4” solid core doors equipped with regular arm surface type closers that swing more than 140 degrees before striking a wall, for hollow metal or 1-3/4” solid core doors that open against equipment, casework, sidelights, or other objects that would make wall bumpers inappropriate, and as specified in hardware groups.

C. Furnish sex bolt attachments for wood and mineral core doors unless doors are supplied with proper reinforcing blocks.

D. Do not provide holder function for labeled doors.

2.14 WALL STOPS AND HOLDERS

A. Acceptable manufacturers and respective catalog numbers:

	Ives	Trimco	Burns
1. Wrought Convex Wall Stop	WS406CVX	1270CX	570
2. Wrought Concave Wall Stop	WS406CCV	1270CV	575
3. Automatic Wall Holder	WS40	1254	533

B. Furnish a stop or holder for all doors.

C. Provide concave style wall stop at all adjacent integral push button locks; provide convex style wall stop at all other locations.

D. Where wall stops are not applicable, furnish overhead stops.

E. Furnish floor stops or hinge pin stops only where specified in hardware sets.

F. Do not provide holder function for labeled doors.

2.15 MAGNETIC HOLD OPENS

A. Acceptable manufacturers and respective catalog numbers:

	LCN	ABH	Edwards
1. Wall Holder	SEM 7800	2000	1500

B. Magnetic hold opens shall be independently certified by ANSI for compliance with ANSI A156.15, Grade 1 (2006).

C. Magnetic holder's housing and armature shall be constructed of a die cast zinc material.

D. Provide types as listed in groups.

E. Where wall conditions do not permit the armature to reach the magnet, provide extensions.

F. Provide proper voltage and power consumption as required by Division 16.

G. Coordinate electrical requirements and mounting locations with other trades.

2.16 WEATHERSTRIP, GASKETING

A. Acceptable manufacturers and respective catalog numbers:

	Zero	Pemko	NGP	Reese
1. Weatherstrip	429	2891_PK	700NA	755
2. Adhesive Gasket	188	S88	5050	797
3. Mullion Seal/Silencer	8780	5110	5100N	628
4. Meeting Edge Seals	8193	18041	9605	959
5. Sweep (Brush)	8192	18061_NB	B606	964
6. Sweep (Neoprene)	39	315_N	200N	323
7. Sweep w/ drip	8198	345_N	C627	354
8. Drip Cap	142	346	16	R201

B. Weatherstrip and gasketing shall be independently certified by ANSI for compliance with ANSI A156.22 (2005).

C. Where specified in the hardware groups, furnish the above products unless otherwise detailed in groups.

D. Provide weatherstripping all exterior doors and where specified.

E. Provide intumescent and other required edge sealing systems as required by individual fire door listings to comply with positive pressure standards UL 10C.

F. Provide Zero 188 smoke gaskets at all fire rated doors and smoke and draft control assemblies.

G. Provide gasketing for all meeting edges on pairs of fire doors. Gasketing shall be compatible with astragal design provided by door supplier as required for specific fire door listings.

2.17 THRESHOLDS

A. Acceptable manufacturers and respective catalog numbers:

	Zero	Pemko	NGP	Reese
1. Saddle Thresholds	8655	171	425	S205
2. Half Saddle Thresholds	1674	227	324	S239
3. Interlocking Threshold	74A	114	442-5	T550
4. ¼" Saddle Thresholds	63	151	411	S263

A. Thresholds shall be independently certified by ANSI for compliance with ANSI A156.21 (2001).

B. Hardware supplier shall verify all finish floor conditions and coordinate proper threshold as required to ensure a smooth transition between threshold and interior floor finish.

C. Threshold Types:

1. Unless otherwise specified, provide saddle threshold similar to Zero 8655 for all exterior openings with an interior floor finish less than or equal to 1/4" in height.
2. Unless otherwise specified, provide half saddle threshold similar to Zero 1674 for all exterior openings with an interior floor finish greater than 1/4" in height. Threshold height shall match thickness of interior floor finish.

2.18 FINISHES AND BASE MATERIALS

A. Unless otherwise indicated in the hardware groups or herein, hardware finishes shall be applied over base metals (steel-based at labeled doors) as specified in the following finish schedule:

HARDWARE ITEM	BHMA FINISH AND BASE MATERIAL AT WD AND HM DOORS	BHMA FINISH AND BASE MATERIAL AT ALUMINUM DOORS
1. Butt Hinges: Exterior, or Non-Ferrous	630 (US32D - Satin Stainless Steel)	614 (US10A - Oxidized Bronze)
2. Butt Hinges: Interior or Ferrous	652 (US26D - Satin Chromium on Steel)	641 (US10A - Oxidized Bronze on Steel)
3. Continuous Hinges	630 (US32D - Satin Stainless Steel)	710 (313AN - Dark Bronze Anodized)
4. Flush Bolts	626 (US26D - Satin Chromium)	643e (Aged Bronze)
5. Exit Devices	626 (US26D - Satin Chromium)	313AN (Anodized Duranodic)
6. Locks and Latches	626 (US26D - Satin Chromium)	643e (Dark Bronze)
7. Pulls and Push Plates/Bars	630 (US32D - Satin Stainless Steel)	695 (Dark Bronze)
8. Coordinators	600 (Prime painted or mill alum.)	711 (Black Anodized)
9. Closers	689 (Powder Coat Aluminum)	695 (Powder Coat Dark Bronze)
10. Protective Plates	630 (US32D - Satin Stainless Steel)	695 (Dark Bronze)
11. Overhead Stops	630 (US32D - Satin Stainless Steel)	SP313 (Powder coat dark bronze)
12. Wall Stops and Holders	630 (US32D - Satin Stainless Steel)	643e (Aged Bronze)
13. Thresholds	719 (Mill Aluminum)	719 (Mill Aluminum)
14. Weather-strip,	Aluminum Anodized	Dark Bronze Anodized

Sweeps Drip Caps (wood and hollow metal doors)		
15. Weather-strip, Sweeps Drip Caps (aluminum doors)	Match finish of aluminum doors.	Match finish of aluminum doors.
16. Magnetic Holders	689 (Powder Coat Aluminum)	695 (Powder Coat Dark Bronze)
17. Magnetic Locks	628 (US28)	628 (US28)
18. Miscellaneous	626 (US26D - Satin Chromium)	643e (Aged Bronze)

2.19 KEYING

A. Provide all cylinders in keyways as required to accommodate owner's existing Corbin Russwin key system.

B. Provide interchangeable cores for all locks and cylinders if required by the owner.

C. All locks under this section shall be keyed as directed by the owner to an existing Master Key System.

D. Furnish a total of 2 keys per cylinder. Actual cut keys to be determined by owner.

E. Master keys, control keys, and change keys shall be delivered by registered mail to the owner. Construction keys shall be delivered to the contractor.

2.20 KEY CABINETS

A. Acceptable manufacturers and respective catalog numbers:

	Lund	Key Control	Telkee
1.	1200-1205 AA	M228-2480	RWC-AWC

B. Furnish 1 each model 1200 or 1205 AA key cabinet with a capacity 1.5 times the number of key sets.

C. Provide one key cabinet with at least one hook for each key set, plus additional hooks for 50% expansion.

D. Furnish key cabinet complete with cam lock, permanent key tags, and change key cards.

E. Hardware supplier shall prepare all key change index records, tag all keys and place permanent file keys in cabinet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of hardware, installer shall examine door frame installation to ensure frames have been set square and plumb. Installer shall examine doors, door frames, and adjacent wall, floor, and ceiling for conditions, which would adversely affect proper operation and function of door assemblies. Do not proceed with hardware installation until such deficiencies have been corrected.

3.2 INSTALLATION

A. Before hardware installation, general contractor/construction manager shall coordinate a hardware installation seminar with a 1 week notice to all parties involved. The seminar is to be conducted on the installation of hardware, specifically of locksets, closers, exit devices, continuous hinges and overhead stops. Manufacturer's representative of the above products to present seminar. Seminar to be held at the job site and attended by installers of hardware

(including low voltage hardware) for aluminum, hollow metal and wood doors. Training to include use of installation manuals, hardware schedule, templates and physical products samples.

B. Shim doors as required to maintain proper operating clearance between door and frame.

C. Install all hardware in accordance with the approved hardware schedule and manufacturer's instructions for installation and adjustment.

D. Set units level, plumb and true to the line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

E. Provide blocking or reinforcement for all hardware mounted to drywall construction, including wall mounted door stops and holders.

F. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accord with industry standards.

G. Drill appropriate size pilot holes for all hardware attached to wood doors and frames.

H. Unless otherwise specified, locate all hardware in accordance with the recommended locations for builders hardware for standard doors and frames as published by the Door and Hardware Institute (TDH-007-20).

I. Use only fasteners supplied by or approved by the manufacturer for each respective item of hardware.

J. Mortise and cut to close tolerance and conceal evidence of cutting in the finished work.

K. Conceal push and pull bar fasteners where possible. Do not install through bolts through push plates.

L. Install hardware on UL labeled openings in accordance with manufacturer's requirements to maintain the label.

M. Apply self-adhesive gasketing on frame stop at head & latch side and on rabbet of frame at hinge side.

N. Install hardware in accordance with supplemental "S" label instructions on all fire rated openings.

O. Install wall stops to contact lever handles or pulls. Do not mount wall stops on casework, or equipment.

P. Where necessary, adjust doors and hardware as required to eliminate binding between strike and latchbolt. Doors should not rattle.

Q. Overhead stops used in conjunction with electrified hold open closers shall be templated and installed to coincide with engagement of closer hold open position.

R. Install door closers on corridor side of lobby doors, room side of corridor doors, and stair side of stairways.

S. Adjust spring power of door closers to the minimum force required to ensure exterior and fire rated doors will consistently close and latch doors under existing conditions. Adjust all other door closers to ensure opening force does not to exceed 5 lbs.

T. Adjust "sweep", "latch", & "back check" valves on all door closers to properly control door throughout the opening and closing cycle. Adjust total closing speed as required to comply with all applicable state and local building codes.

U. Install "hardware compatible" (bar stock) type weatherstripping continuously for an uninterrupted seal. Adjust templating for parallel arm door closers, exit devices, etc., as required to accommodate weatherstripping.

V. Unless otherwise specified or detailed, install thresholds with the bevel in vertical alignment with the outside door face. Notch and closely fit thresholds to frame profile. Set thresholds in full bed of sealant.

W. Compress sweep during installation as recommended by sweep manufacturer to facilitate a water-resistant seal.

X. Deliver to the owner 1 complete set of installation and adjustment instructions, and tools as furnished with the hardware.

3.3 FIELD QUALITY CONTROL

A. After installation has been completed, the hardware supplier and manufacturers representative for locksets, door closers, exit devices, and overhead stops shall check the project and verify compliance with installation instructions, adjustment of all hardware items, and proper application according to the approved hardware schedule. Hardware representative shall submit a list of all hardware that has not been installed correctly.

B. After installation has been completed, the hardware supplier and manufacturers representative shall meet with the owner to explain the functions, uses, adjustment, and maintenance of each item of hardware. Hardware supplier shall provide the owner with a copy of all wiring diagrams. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.

3.4 ADJUSTMENT AND CLEANING

A. At final completion, and when H.V.A.C. equipment is in operation, installer shall make final adjustments to and verify proper operation of all door closers and other items of hardware. Lubricate moving parts with type lubrication recommended by the manufacturer.

B. All hardware shall be left clean and in good operation. Hardware found to be disfigured, defective, or inoperative shall be repaired or replaced.

3.5 HARDWARE SCHEDULE

A. The following schedule of hardware groups are intended to describe opening function. The hardware supplier is cautioned to refer to the preamble of this specification for a complete description of all materials and services to be furnished under this section.

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HW SET: 01

1	EA	CONT. HINGE	112XY EPT	IVE
1	EA	POWER TRANSFER	EPT10	VON
1		CYLINDER	AS REQUIRED	C-R
1	EA	ELEC PANIC HARDWARE	QEL-99-NL-OP	VON
1	EA	MULLION STABILIZER	154	VON
1	EA	DOOR PULL, 1" ROUND	8103 10"	IVE
1	EA	OH STOP	100S	GLY
1	EA	SURF. AUTO OPERATOR	4642	LCN
2	EA	ACTUATOR	8310-856	LCN
1	EA	RAIN DRIP	142	ZER
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	
1	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	THRESHOLD	PROFILE AS REQUIRED	ZER
1	EA	CREDENTIAL READER	BY DIV 28	BYO
1	EA	DOOR CONTACT	679-05	SCE
1	EA	POWER SUPPLY	BY DIV 28	BYO
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED.
PRESENTATION OF VALID CREDENTIAL MOMENTARILY RETRACTS LATCH.
ACCESS CONTROL SYSTEM CONTROLS OUTSIDE ACTUATOR. INSIDE ACTUATOR ALWAYS ACTIVE TO MOMENTARILY RETRACT LATCH THEN OPEN DOOR.

HW SET: 02

1	EA	CONT. HINGE	112XY EPT	IVE
1	EA	POWER TRANSFER	EPT10	VON
1		CYLINDER	AS REQUIRED	C-R
1	EA	ELEC PANIC HARDWARE	QEL-99-NL-OP	VON
1	EA	MULLION STABILIZER	154	VON
1	EA	DOOR PULL, 1" ROUND	8103 10"	IVE
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	RAIN DRIP	142	ZER
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	
1	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	THRESHOLD	PROFILE AS REQUIRED	ZER
1	EA	CREDENTIAL READER	BY DIV 28	BYO
1	EA	DOOR CONTACT	679-05	SCE
1	EA	POWER SUPPLY	BY DIV 28	BYO
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED.
PRESENTATION OF VALID CREDENTIAL MOMENTARILY RETRACTS LATCH.

HW SET: 03

1	EA	CONT. HINGE	112XY	IVE
1	EA	PUSH/PULL BAR	9103 10"- 1" DIA	IVE

1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4111 EDA	LCN

HW SET: 04

1	EA	CONT. HINGE	112XY	IVE
1	EA	PUSH/PULL BAR	9103 10"- 1" DIA	IVE
1	EA	OH STOP	100S	GLY
1	EA	SURF. AUTO OPERATOR	4642	LCN
2	EA	ACTUATOR	8310-856	LCN

HW SET: 05

	EA	HINGE	AS REQUIRED	IVE
1	EA	INSTITUTION/UTIL LOCK	CLX3332	C-R
1	EA	SURFACE CLOSER	4111 SHCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	SET	WEATHERSTRIP	429	ZER
1	EA	DOOR SWEEP	8192	ZER
1	EA	DOOR CONTACT	679-05	SCE

FUNCTION: INSTITUTION LOCK
LATCHBOLT RETRACTED BY KEY EITHER SIDE. BOTH LEVERS ALWAYS IN OPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 06

	EA	HINGE	AS REQUIRED	IVE
1	EA	POWER TRANSFER	EPT10	VON
1		CYLINDER	AS REQUIRED	C-R
1	EA	ELEC PANIC HARDWARE	QEL-99-NL	VON
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	SET	WEATHERSTRIP	429	ZER
1	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	THRESHOLD	PROFILE AS REQUIRED	ZER
1	EA	CREDENTIAL READER	BY DIV 28	BYO
1	EA	DOOR CONTACT	679-05	SCE
1	EA	POWER SUPPLY	BY DIV 28	BYO
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. PRESENTATION OF VALID CREDENTIAL MOMENTARILY RETRACTS LATCH.
OPENINGS 815B, AND 823B ARE WITHOUT CARD READER BUT CONTROLLED AS ACCESS CONTROL SYSTEM.

HW SET: 07

	EA	HINGE	AS REQUIRED US32D	IVE
1	EA	PASSAGE	CLX3310	C-R
1	EA	WALL STOP	WS406/407CCV	IVE

FUNCTION: PASSAGE LATCH
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HW SET: 08

	EA	HINGE	AS REQUIRED	IVE
1	EA	COMMUNICATING LOCK	CLX3362	C-R
1	EA	ARMOR PLATE	8400 34" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE

FUNCTION: COMMUNICATING LOCK
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE UNLESS LEVER IS LOCKED BY KEY ON EACH LEVER INDEPENDENTLY. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 09

	EA	HINGE	AS REQUIRED US32D	IVE
1	EA	PASSAGE	CLX3310	C-R
1	EA	ARMOR PLATE	8400 34" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE

FUNCTION: PASSAGE LATCH
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HW SET: 10

	EA	HINGE	AS REQUIRED US32D	IVE
1	EA	PASSAGE	CLX3310	C-R
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	GASKETING	188S	ZER
1	EA	DOOR SWEEP	8192	ZER

FUNCTION: PASSAGE LATCH
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HW SET: 11

	EA	HINGE	AS REQUIRED	IVE
1	EA	PASSAGE	CLX3310	C-R
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	GASKETING	188S	ZER
1	EA	DOOR SWEEP	8192	ZER

FUNCTION: PASSAGE LATCH
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HW SET: 12

	EA	HINGE	AS REQUIRED	IVE
1	EA	PASSAGE	CLX3310	C-R
1	EA	OH STOP	90S	GLY
1	EA	GASKETING	188S	ZER
1	EA	DOOR SWEEP	8192	ZER

FUNCTION: PASSAGE LATCH
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HW SET: 13

	EA	HINGE	AS REQUIRED	IVE
1	EA	PASSAGE	CLX3310	C-R
1	EA	SURFACE CLOSER	4011/4111 EDA	LCN
1	EA	ARMOR PLATE	8400 34" X 2" LDW B-CS	IVE
1	EA	WALL STOP/HOLDER	WS40	IVE

FUNCTION: PASSAGE LATCH
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HW SET: 14

	EA	HINGE	AS REQUIRED	IVE
1	EA	PASSAGE	CLX3310	C-R
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	GASKETING	188S	ZER
1	EA	DOOR SWEEP	8192	ZER

FUNCTION: PASSAGE LATCH
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HW SET: 15

	EA	HINGES AND SEALS	BY DOOR MFR	BYO
1	EA	PASSAGE	CLX3310	C-R
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE

FUNCTION: LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES. COORDINATE HARDWARE WITH STC DOOR MFR REQUIREMENTS.

HW SET: 16

	EA	HINGE	AS REQUIRED	IVE
2	EA	MANUAL FLUSH BOLT	FB458	IVE
1	EA	DUST PROOF STRIKE	DP2	IVE
1	EA	PASSAGE	CLX3310	C-R
2	EA	ARMOR PLATE	8400 34" X 1" LDW B-CS	IVE
2	EA	OH STOP	90S	GLY
1	EA	GASKETING	188S	ZER
2	EA	MEETING EDGE SEAL	8193	ZER
2	EA	DOOR SWEEP	8192	ZER

FUNCTION: PASSAGE LATCH
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HW SET: 17

	EA	HINGE	AS REQUIRED	IVE
1	EA	DOOR PULL, 1" ROUND	8103 10"	IVE
1	EA	PUSH PLATE	8200 6" X 16"	IVE
1	EA	SURFACE CLOSER	4011/4111 EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP/HOLDER	WS40	IVE

HW SET: 18

	EA	HINGE	AS REQUIRED	IVE

1	EA	PRIVACY LOCK	CLX3320 OUTSIDE IND	C-R
1	EA	SURFACE CLOSER	4011	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	GASKETING	188S	ZER

FUNCTION: PRIVACY LOCK PUSH-BUTTON LOCKING. CAN BE OPENED FROM OUTSIDE WITH EMERGENCY RELEASE TOOL, TURNING INSIDE LEVER OR CLOSING DOOR RELEASES BUTTON.
OUTSIDE WHITE/RED INDICATOR.

HW SET: 19

	EA	HINGE	AS REQUIRED	IVE
1	EA	PRIVACY LOCK	CLX3320 OUTSIDE IND	C-R
1	EA	SURFACE CLOSER	4011	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE

FUNCTION: PRIVACY LOCK PUSH-BUTTON LOCKING. CAN BE OPENED FROM OUTSIDE WITH EMERGENCY RELEASE TOOL, TURNING INSIDE LEVER OR CLOSING DOOR RELEASES BUTTON.
OUTSIDE WHITE/RED INDICATOR.

HW SET: 20

	EA	HINGE	AS REQUIRED	IVE
1	EA	CLASSROOM LOCK	CLX3355	C-R
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	GASKETING	188S	ZER
1	EA	DOOR SWEEP	8192	ZER

FUNCTION: CLASSROOM LOCK
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE UNLESS OUTSIDE IS LOCKED BY KEY. UNLOCKED FROM OUTSIDE BY KEY. INSIDE LEVER ALWAYS FREE FOR IMMEDIATE EXIT. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED..

HW SET: 21

	EA	HINGE	AS REQUIRED	IVE
1	EA	CLASSROOM LOCK	CLX3355	C-R
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	GASKETING	188S	ZER
1	EA	DOOR SWEEP	8192	ZER
1	EA	THRESHOLD	63	ZER

FUNCTION: CLASSROOM LOCK
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE UNLESS OUTSIDE IS LOCKED BY KEY. UNLOCKED FROM OUTSIDE BY KEY. INSIDE LEVER ALWAYS FREE FOR IMMEDIATE EXIT. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED..

HW SET: 22

	EA	HINGE	AS REQUIRED	IVE
1	EA	CLASSROOM LOCK	CLX3355	C-R
1	EA	SURFACE CLOSER	4011/4111 EDA	LCN
1	EA	ARMOR PLATE	8400 34" X 2" LDW B-CS	IVE
1	EA	WALL STOP/HOLDER	WS40	IVE
1	EA	GASKETING	188S	ZER
1	EA	DOOR SWEEP	8192	ZER

FUNCTION: CLASSROOM LOCK
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE UNLESS OUTSIDE IS LOCKED BY KEY. UNLOCKED FROM OUTSIDE BY KEY. INSIDE LEVER ALWAYS FREE FOR IMMEDIATE EXIT. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 23

	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM/CLOSET LOCK	CLX3357	C-R
1	EA	OH STOP	90S	GLY

FUNCTION: STOREROOM LOCK
LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 24

	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM/CLOSET LOCK	CLX3357	C-R
1	EA	SURFACE CLOSER	4011/4111 EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	GASKETING	188S	ZER

FUNCTION: STOREROOM LOCK
LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 25

	EA	HINGE	AS REQUIRED	IVE
1	EA	PANIC HARDWARE	LD-9927-EO-LBR	VON
1	EA	PANIC HARDWARE	LD-9927-L-BE-LBR	VON
1	EA	OH STOP & HOLDER	90H	GLY
1	EA	SURFACE CLOSER	4111 SHCUSH	LCN
2	EA	ARMOR PLATE	8400 34" X 1" LDW B-CS	IVE
1	EA	GASKETING	188S	ZER
2	EA	MEETING EDGE SEAL	8193	ZER
2	EA	DOOR SWEEP	8192	ZER

FUNCTION: LATCHBOLT RETRACTED BY DEPRESSING THE ACTUATION BAR. ENTRANCE BY LEVER, ALWAYS ACTIVE. FUNCTION: LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD. EXIT ONLY.

HW SET: 26

	EA	HINGE	AS REQUIRED	IVE
1	EA	MANUAL FLUSH BOLT	FB458	IVE
1	EA	CONST LATCHING BOLT	FB51T	IVE
1	EA	DUST PROOF STRIKE	DP2	IVE
1	EA	UTILITY LOCK	ML2057 MULTIFUNCTION LEVER @ PULL SIDE	C-R
2	EA	WALL STOP/HOLDER	WS40	IVE

FUNCTION: LATCHBOLT RETRACTED BY KEY. KEYSIDE LEVER IS RIGID. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 27

	EA	HINGE	AS REQUIRED	IVE

1	EA	STOREROOM/CLOSET LOCK	CLX3357	C-R
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	CREDENTIAL READER	BY DIV 28	BYO
1	EA	DOOR CONTACT	679-05	SCE
1	EA	POWER SUPPLY	BY DIV 28	BYO
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: STOREROOM LOCK
LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.PRESENTATION OF VALID CREDENTIAL MOMENTARILY ENERGIZES ELECTRIC STRIKE.

HW SET: 28

	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM/CLOSET LOCK	CLX3357	C-R
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE

FUNCTION: STOREROOM LOCK
LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 29

	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM/CLOSET LOCK	CLX3357	C-R
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE

FUNCTION: STOREROOM LOCK
LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 30

	EA	HINGE	AS REQUIRED	IVE
1		CYLINDER	AS REQUIRED	C-R
1	EA	FIRE EXIT HARDWARE	99-L-F	VON
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	GASKETING	188S	ZER

FUNCTION: LATCHBOLT RETRACTED BY DEPRESSING THE ACTUATION BAR. ENTRANCE BY LEVER. KEY LOCKS OR UNLOCKS LEVER.

HW SET: 31

	EA	HINGE	AS REQUIRED	IVE
1	EA	FIRE EXIT HARDWARE	9927-EO-F-LBR	VON
1	EA	FIRE EXIT HARDWARE	9927-L-BE-F-LBR	VON
2	EA	SURFACE CLOSER	4111 EDA	LCN
2	EA	ARMOR PLATE	8402 34" X 1" LDW B-CS	IVE
2	EA	FIRE/LIFE WALL MAG	SEM7800	LCN

1	EA	GASKETING	188S	ZER
2	EA	MEETING EDGE SEAL	8193	ZER
2	EA	DOOR SWEEP	8192	ZER

FUNCTION: LATCHBOLT RETRACTED BY DEPRESSING THE ACTUATION BAR. ENTRANCE BY LEVER, ALWAYS ACTIVE. FUNCTION: LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD. EXIT ONLY.

HW SET: 32

	EA	HINGE	AS REQUIRED	IVE
4		CYLINDER	AS REQUIRED	C-R
2	EA	PANIC HARDWARE	CD-9927-L-LBR	VON
2	EA	SURFACE CLOSER	4111 SHCUSH	LCN
2	EA	ARMOR PLATE	8400 34" X 1" LDW B-CS	IVE
1	EA	GASKETING	188S	ZER
2	EA	MEETING EDGE SEAL	8193	ZER
2	EA	DOOR SWEEP	8192	ZER

FUNCTION: LATCHBOLT RETRACTED BY DEPRESSING THE ACTUATION BAR. ENTRANCE BY LEVER. KEY LOCKS OR UNLOCKS LEVER. ACCESS FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.

HW SET: 33

	EA	HINGE	AS REQUIRED	IVE
1	EA	POWER TRANSFER	EPT10	VON
1		CYLINDER	AS REQUIRED	C-R
1	EA	ELEC PANIC HARDWARE	QEL-99-L-NL	VON
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	CREDENTIAL READER	BY DIV 28	BYO
1	EA	DOOR CONTACT	679-05	SCE
1	EA	POWER SUPPLY	BY DIV 28	BYO
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. PRESENTATION OF VALID CREDENTIAL MOMENTARILY RETRACTS LATCH.

HW SET: 34

	EA	HINGE	AS REQUIRED	IVE
1	EA	POWER TRANSFER	EPT10	VON
1		CYLINDER	AS REQUIRED	C-R
1	EA	ELEC PANIC HARDWARE	QEL-99-L-NL	VON
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	GASKETING	188S	ZER
1	EA	DOOR SWEEP	8192	ZER
1	EA	CREDENTIAL READER	BY DIV 28	BYO
1	EA	DOOR CONTACT	679-05	SCE
1	EA	POWER SUPPLY	BY DIV 28	BYO
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. PRESENTATION OF VALID CREDENTIAL MOMENTARILY RETRACTS LATCH.

HW SET: 35

	EA	HINGE	AS REQUIRED	IVE
1	EA	POWER TRANSFER	EPT10	VON
1		CYLINDER	AS REQUIRED	C-R
1	EA	ELEC PANIC HARDWARE	QEL-99-L-NL	VON
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	GASKETING	188S	ZER
1	EA	DOOR SWEEP	8192	ZER
1	EA	CREDENTIAL READER	BY DIV 28	BYO
1	EA	DOOR CONTACT	679-05	SCE
1	EA	POWER SUPPLY	BY DIV 28	BYO
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. PRESENTATION OF VALID CREDENTIAL MOMENTARILY RETRACTS LATCH.

HW SET: 36

	EA	HINGE	AS REQUIRED	IVE
1	EA	PASSAGE	CLX3310	C-R
1	EA	SURFACE CLOSER	4011	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP/HOLDER	WS40	IVE
1	EA	GASKETING	188S	ZER
1	EA	DOOR SWEEP	8192	ZER

FUNCTION: PASSAGE LATCH
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HW SET: 37

	EA	HINGE	AS REQUIRED	IVE
1	EA	MANUAL FLUSH BOLT	FB458	IVE
1	EA	CONST LATCHING BOLT	FB51T	IVE
1	EA	DUST PROOF STRIKE	DP2	IVE
1	EA	UTILITY LOCK	ML2057 MULTIFUNCTION LEVER @ PULL SIDE	C-R
1	EA	OH STOP	90H	GLY
~~2~~ 1	EA	WALL STOP/HOLDER	WS40	IVE

FUNCTION: LATCHBOLT RETRACTED BY KEY. KEYSIDE LEVER IS RIGID. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

SECTION 08 8000
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Glazing compounds.

1.02 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).

D. ASTM C1036 - Standard Specification for Flat Glass; 2025.

E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.

F. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.

G. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2024.

H. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

I. GANA (GM) - GANA Glazing Manual; 2022.

J. GANA (SM) - GANA Sealant Manual; 2008.

K. GANA (LGRM) - Laminated Glazing Reference Manual; 2019.

L. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).

M. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.

N. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

O. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.04 SUSTAINABILITY REQUIREMENTS

A. See Section 01 8113 B3 Sustainability Design Requirements.

B. See Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data on Insulating Glass Unit Glazing Types: 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. Certificate: Certify that products of this section meet or exceed specified requirements.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.

B. 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).

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
   1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.

D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

C. Heat Soaked Tempered Glass: Provide a ten (10) year manufacturer warranty to include coverage for spontaneous breakage of fully tempered glass caused by nickel sulfide (NiS) inclusions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glass Fabricators:
   1. Viracon, Apogee Enterprises : www.viracon.com/#sle.
   2. Cardinal Glass Industries; www.cardinalcorp.com
   3. Oldcastle Building Envelope; www.oldcastle.com
   4. Vitro Architectural Glass; www.vitroglazings.com
   5. Pilkington; www.pilkington.com
   6. Guardian Glass; www.guardianglass.com
   7. Saint-Gobain Glass; www.saint-gobain-northamerica.com
   8. Substitutions: See Section 01 6000 - Product Requirements.

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. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   3. 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 6.3 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. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   3. Heat-Soak Testing (HST): Provide HST of fully tempered glass used on all applications of project, to reduce risks of spontaneous breakage due to nickel sulfide (NiS) induced fractures in accordance with industry established testing requirements.
   4. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality - Q3, with color and performance characteristics as indicated.
   5. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

2.04 INSULATING GLASS UNITS

A. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

B. 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: Manufacturer's standard 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 sealed.

C. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
   1. Applications: Exterior glazing unless otherwise indicated.
   2. Space between lites filled with air.
   3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
      a. Tint: To match Vitro Solargray.
      b. Coating: Low-E (passive type), on #2 surface.
   4. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
      a. Tint: Clear.
   5. Total Thickness: 1 inch.

6. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.29, nominal.
7. Visible Light Transmittance (VLT): 35 percent, nominal.
8. Solar Heat Gain Coefficient (SHGC): 0.25, nominal.
9. Visible Light Reflectance, Outside: 6 percent, nominal.
10. Glazing Method: Dry glazing method, gasket glazing.
11. Tempered Safety Glass: Provide where requried by code.
12. Bird Safe Glazing: Provide where indicated on Drawings.
    a. Ceramic frit fused into glass createing permanent designs.
        1) Pattern: See Drawings.
        2) Percent/Density of Pattern: See Drawings.
        3) Color: See Drawings.

2.05 GLAZING UNITS

A. Type GL-1 - Monolithic Interior Vision Glazing:
    1. Applications: Interior glazing unless otherwise indicated.
    2. Glass Type: Fully tempered float glass.
    3. Tint: Clear.
    4. Thickness: 1/4 inch, nominal.
    5. Tempered Safety Glass: Provide where requried by code.

2.06 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. 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, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

E. Glazing Clips: Manufacturer's standard type.

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 within maximum of 24 hours 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, etc.

3.04 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.

3.05 INSTALLATION - PRESSURE GLAZED SYSTEMS

A. Application - Exterior Glazed: Set glazing infills from exterior side of 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 pressure plates without displacing glazing gasket; exert pressure for full continuous contact.

E. Install cover plate.

3.06 FIELD QUALITY CONTROL

A. Glass product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.07 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.

3.08 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 09 0561
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Fluid-applied 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. Remedial floor treatment.

1.02 PRICE AND PAYMENT PROCEDURES

A. Alternates: See Section 01 2300 - Alternates.

1.03 REFERENCE STANDARDS

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

D. ASTM F3513 - Standard Practice for Single Component, Fluid-Applied Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings; 2024.

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 3000 - Administrative Requirements for submittal procedures.

B. 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.

C. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
   1. Certificate: Manufacturer's certification of compatibility with types of flooring applied over remedial product.
   2. Manufacturer's installation instructions.
   3. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

D. 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. Product data for recommended remedial coating.
7. Submit report to Architect.
8. Submit report not more than two business days after conclusion of testing.

E. 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. Remedial Floor Coating, Single Component: Resistant to water vapor transmission meeting flooring manufacturer's emission limits; single or double layer; resistant to alkalinity (pH) level found, and suitable for flooring adhesion without further treatment.
1. Material: Comply with ASTM F3513.
2. Thickness: As required for application and in accordance with manufacturer's installation instructions.
3. Products:
   a. ARDEX Engineered Cements; ARDEX VB 100: www.ardexamericas.com/#sle.
   b. LATICRETE International, Inc; VAPOR BAN Primer W: www.laticrete.com/#sle.
   c. Maxxon Corporation; Maxxon MVP One Primer: www.maxxon.com/#sle.
   d. Sika Corporation; Sikafloor 1620: usa.sika.com/#sle.
   e. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:

1. Preliminary cleaning.
2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
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 SECTION INCLUDES

A. Metal stud wall framing.

B. Metal channel ceiling framing.

C. Acoustic insulation.

D. Cementitious backing board.

E. Gypsum wallboard.

F. Joint treatment and accessories.

1.02 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. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.

D. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.

E. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

F. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

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; 2024.

I. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

J. ASTM C1288 - Standard Specification for Fiber-Cement Interior Substrate Sheets; 2023.

K. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).

L. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.

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-216 - Application and Finishing of Gypsum Panel Products; 2024.

O. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide data on metal framing, gypsum board, accessories, and joint finishing system.
   2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

C. Structural calculations and certification as identified in 05 4000 for Non-Standard Framing and Load-Bearing Framing Components.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

B. Non-Standard Framing and Load-Bearing Framing Components: Comply with requirements of 05 4000 - Cold-Formed Metal Framing including submittal of engineering calculations signed by a Professional Engineer licensed in the State in which the Project is located.
   1. Partitions supporting items including, but not limited to, toilets, grab bars, sinks, counters, changing tables, and overhead doors.
   2. Partitions having configuration, openings, partial height walls, knee walls or loading other than metal framing manufacturer's standard configuration and loading.
   3. Partitions supporting floors, roofs, mezzanines, and walk-able ceilings.

PART 2 PRODUCTS

2.01 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. ClarkDietrich: www.clarkdietrich.com/#sle.
   2. MarinoWARE: www.marinoware.com/#sle.
   3. Phillips Manufacturing Co: www.phillipsmfg.com/#sle.
   4. R-stud: www.rstud.com/#sle.
   5. SCAFCO Corporation: www.scafco.com/#sle.

C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 at the framing spacing, with maximum deflection of wall framing of L/360 at 5psf for plaster or stucco applied to partition, L/240 for other brittle finishes applied to partition, and L/180 at 5psf for flexible finishes including plain gypsum. Minimum 25-gage thick
   1. Studs: C-shaped with punched holes for utility access.
   2. Runners: U shaped, sized to match studs.

D. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short.

E. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.

F. Non-structural Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.

G. At framed doors and windows, metal studs shall be minimum 20-gage.

2.02 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. American Gypsum Company: www.americangypsum.com/#sle.
   2. CertainTeed Corporation: www.certainteed.com/#sle.
   3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
   4. Gold Bond Building Products, LLC provided by National Gypsum Company: www.goldbondbuilding.com/#sle.
   5. USG Corporation: www.usg.com/#sle.
   6. Substitutions: See Section 01 6000 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; tapered edges.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   3. Thickness:
      a. Vertical Surfaces: 5/8 inch
      b. Ceilings: 5/8 inch.

C. Abuse Resistant Wallboard:
   1. Application: High-traffic areas including at building circulation corridors and vestibules.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Type: Fire-resistance-rated Type X, UL or WH listed.
   4. Thickness: 5/8 inch.
   5. Edges: Tapered.

D. Mold/Moisture-Resistant Gypsum Panels
   1. Application: Furring at exterior wall assemblies
   2. Mold Resistance: Meets or exceeds ASTM C1396 specifications when tested in accordance with ASTM D3273
   3. Thickness: 5/8 inch
   4. Edges: Tapered

E. Backing Board For Wet Areas: One of the following products:
   1. Application: Surfaces behind tile.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
      a. Thickness: 1/2 inch.
      b. Products:
         1) PermaBASE Building Products, LLC provided by National Gypsum Company; PermaBase Cement Board: www.goldbondbuilding.com/#sle.
         2) USG Corporation; Fiberock Brand Aqua-Tough AR Interior Panels Regular 1/2 in. (12.7 mm): www.usg.com/#sle.
         3) Substitutions: See Section 01 6000 - Product Requirements.
   4. ASTM Cement-Based Board: Non-gypsum-based, cementitious board complying with ASTM C1288.
      a. Thickness: 1/2 inch.
      b. Products:
         1) James Hardie Building Products, Inc: www.jameshardie.com/#sle.
         2) Substitutions: See Section 01 6000 - Product Requirements.

2.03 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced; thickness to suit thickness of wall framing.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

C. Finishing Accessories: ASTM C1047, galvanized steel sheet ASTM A924/A924M G90, galvanized steel wire, or rolled zinc, unless noted otherwise.
   1. Types: As detailed or required for finished appearance.

D. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
   1. Corner Beads: Low profile, for 90 degree outside corners.

2. L-Trim with Tear-Away Strip: Sized to fit 5/8-inch thick gypsum wallboard.
3. Control / Expansion Joints:
    a. Type: V-shaped metal with factory-installed protective tape.

E. Decorative Metal Trim:
1. Material: Extruded aluminum alloy 6063-T5 temper.
2. Finish: Anodized, clear.
3. Type: As indicated on drawings.
    a. Products:
        1) Fry Reglet. www.fryreglet.com
        2) Substitutions: See Section 01 6000 - Product Requirements.

F. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
2. Joint Compound: Drying type, vinyl-based, ready-mixed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
1. Level ceiling system to a tolerance of 1/1200.

C. Studs: Space studs at 16 inches on center (maximum).
1. Extend partition framing to structure in all locations.
2. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
3. Stud splicing is not allowed.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs placed back-to-back at jambs.

E. Blocking: Install wood blocking for support of:
1. Framed openings.
2. Wall-mounted cabinets.
3. Plumbing fixtures.
4. Toilet partitions.
5. Toilet accessories.
6. Wall-mounted door hardware.
7. Where indicated in Manufacturer's product installation instructions.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
1. Place one bead continuously on substrate before installation of perimeter framing members, including under runners
2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.04 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

C. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

D. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Partitions or ceilings of dissimilar construction meet and remain in same plane.
   2. Wings of "L-", U-", and "T-" shaped ceiling areas.
   3. Expansion or control joints occur in base wall construction and/or building structure.
   4. Use in the face of gypsum partitions and ceilings when the size of surface exceeds the following:
      a. Partitions: 30 ft maximum in either direction.
      b. Interior ceilings (with perimeter relief): 50 ft maximum in either direction.
      c. Interior ceiligins (without perimeter relief): 30 ft maximum in either direction.
      d. Exterior ceilings: 30 ft maximum in either direction.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

3.06 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

B. 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.

3.07 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.08 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION

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SECTION 09 3000
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for wall applications.

B. Non-ceramic trim.

1.02 REFERENCE STANDARDS

A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2024.

B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.

C. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.

D. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.

E. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.

F. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.

G. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.

H. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.

I. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2024).

J. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.

K. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).

L. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.

M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).

N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.

O. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs; 2020.

P. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2019.

Q. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2023.

R. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.

S. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).

T. ASTM C648 - Standard Test Method for Breaking Strength of Ceramic Tile; 2020.

U. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2025.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Verification Samples: Provide one full-size sample of each tile type specified.

D. Installer's Qualification Statement:

E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Tile: 1 percent of each size, color, and surface finish combination, but not less than one full box of each type.

1.04 QUALITY ASSURANCE

A. Maintain one copy of ANSI A108/A118/A136 and TCNA (HB) on site.

B. Installer Qualifications:
   1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.05 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for general requirements for mock-up.

B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
   1. Minimum size of mock-up is indicated on drawings.
   2. Approved mock-up may remain as part of work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers:
   1. Dal-Tile Corporation: www.daltile.com.
   2. Caesar Ceramiche USA: www.caesarceramicsusa.com.
   3. Landmark Ceramics: www.landmarkceramics.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Glazed Wall Tile, Type CT3: ANSI A137.1 standard grade.

1. Moisture Absorption: 7.0 to 20.0 percent as tested in accordance with ASTM C373.
2. Size: 4 by 16 inch, nominal.
3. Thickness: 3/8 inch, nominal.
4. Edges: Cushioned.
5. Surface Finish: High gloss.
6. Color(s): As indicated on drawings.
7. Breaking Strength: 120 to 230 pounds, when tested in accordance with ASTM C648 .
8. Scratch Hardness (MOHS): 4.0 to 6.0.
9. Products:
    a. Dal-Tile Corporation; Color Wheel Linear: www.daltile.com/#sle.
    b. Substitutions: See Section 01 6000 - Product Requirements.

C. Glazed Ceramic Tile, Type CT1 and CT2: ANSI A137.1 standard grade.
1. Moisture Absorption: Less than 7.0 percent as tested in accordance with ASTM C373.
2. Size: 12 by 24 inch, nominal.
3. Thickness: 5/16 inch, nominal.
4. Edges: Cushioned.
5. Surface Finish: Matte glaze.
6. Color(s): As indicated on drawings.
7. Breaking Strength: Greater than 250 pounds, when tested in accordance with ASTM C648 .
8. Scratch Hardness (MOHS): 7.0.
9. Chemical Resistance: Resistant, when tested in accordance with ASTM C650.
10. Products:
    a. Dal-Tile Corporation; Core Fundamentals / Choice: www.daltile.com/#sle.
    b. Substitutions: See Section 01 6000 - Product Requirements.

2.02 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: Brushed stainless steel, style and dimensions to suit application, for setting using tile mortar or adhesive.
1. Applications:
    a. Wall corners, outside: JOLLY.
    b. Floor to wall joints: DILEX-AHKA.
2. Manufacturers:
    a. Schluter-Systems: www.schluter.com/#sle.
    b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Manufacturers:
1. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
2. Custom Building Products: www.custombuildingproducts.com/#sle.
3. H.B. Fuller Construction Products, Inc; TEC Specialties: www.tecspecialty.com/#sle.
4. LATICRETE International, Inc: www.laticrete.com/#sle.
5. Mapei; www.mapei.com.
6. Substitutions: See Section 01 6000 - Product Requirements.

C. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
2. Products:
    a. ARDEX Engineered Cements; ARDEX X 5: www.ardexamericas.com/#sle.

b. H.B. Fuller Construction Products, Inc; TEC TotalFlex 150 Universal Mortar: www.tecspecialty.com/#sle.
c. LATICRETE International, Inc; TRI-LITE: www.laticrete.com/#sle.
d. Mapei Corporation; Ultraflex LFT: www.mapei.com/#sle.
e. Substitutions: See Section 01 6000 - Product Requirements.

2.04 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. Manufacturers:
1. Custom Building Products: www.custombuildingproducts.com/#sle.
2. H.B. Fuller Construction Products, Inc: www.tecspecialty.com/#sle.
3. LATICRETE International, Inc: www.laticrete.com/#sle.
4. Mapei Corporation: www.mapei.com/#sle.
5. Substitutions: See Section 01 6000 - Product Requirements.

C. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
2. Color(s): As selected by Architect from manufacturer's full line.
3. Products:
a. Custom Building Products; Prism Color Consistent Grout: www.custombuildingproducts.com/#sle.
b. H.B. Fuller Construction Products, Inc; TEC AccuColor Plus Grout: www.tecspecialty.com/#sle.
c. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com/#sle.
d. Mapei, Ultracolor Plus FA; www.mapei.com
e. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. 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 tile.

B. Verify that required wall-mounted utilities are in correct location.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Verify that surfaces are ready to receive work. Starting installation constitutes acceptance of substrate conditions. If substrate preparation is the responsbility of another contractor notify architect of unsatisfactory preparation before proceeding.

C. Vacuum clean surfaces and damp clean.

D. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

A. Install tile and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align wall joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles with non-ceramic trim.

F. Install non-ceramic trim in accordance with manufacturer's instructions.

G. Sound tile after setting. Replace hollow sounding units.

H. Keep control and expansion joints free of mortar, grout, and adhesive.

I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

J. Grout tile joints unless otherwise indicated.

K. At changes in plane and tile-to-tile control joints, or dissimiliar materials, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244.

B. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

3.05 CLEANING

A. Clean tile and grout surfaces.

3.06 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

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SECTION 09 5100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 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; 2023.

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 C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019 (Reapproved 2025).

D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2024a.

E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

F. CHPS (HPPD) - High Performance Products Database; Current Edition.

G. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Samples: Submit two samples 6 by 6 inch in size illustrating material and finish of acoustical units. Samples of suspension materials are not necessary.

D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed. One full carton minimum.

1.04 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.

1.05 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
   2. USG Corporation: www.usg.com/ceilings/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Suspension Systems:

1. Same as for acoustical units.

2.02 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
   1. VOC Content: Certified as Low Emission by one of the following:
      a. Product listing in UL (GGG).
      b. Product listing in CHPS (HPPD).
   2. Recycled Content: Minimum 50% recycled content.

B. Acoustical Panels, Type ACT1: Painted mineral fiber, with the following characteristics:
   1. Classification: ASTM E1264 Type III.
      a. Form: 4, cast or molded.
      b. Pattern: "E" - lightly textured.
   2. Size: 24 by 24 inches.
   3. Thickness: 3/4 inch.
   4. Light Reflectance: 89 percent, determined in accordance with ASTM E1264.
   5. Noise Reduction Coefficient (NRC): 0.75.
   6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
   7. Panel Edge: Reveal.
   8. Tile Edge: Beveled.
      a. Joint: Kerfed and rabbeted.
   9. Suspension System: Exposed grid.
   10. Products:
      a. USG Corporation; Frost High-LR Acoustical Panels: www.usg.com/ceilings/#sle.

C. Acoustical Panels, Type ACT2: Mineral fiber with membrane-faced overlay, washable and soil-resistant finish; impact and scratch resistant, with the following characteristics:
   1. Application(s): Public areas.
   2. Classification: ASTM E1264 Type IV.
      a. Form: 2, water felted.
      b. Pattern: "E" - lightly textured.
   3. Size: 24 by 24 inches.
   4. Thickness: 1 inch.
   5. Light Reflectance: 90 percent, determined in accordance with ASTM E1264.
   6. Noise Reductin Coefficient (NRC): 90, determined in accordance with ASTM E1264.
   7. Ceiling Attenuation Class (CAC): 30, determined in accordance with ASTM E1264.
   8. Panel Edge: Beveled.
   9. Color: White.
   10. Suspension System: Exposed grid.
   11. Products:
      a. Armstrong World Industries, Inc; Optima: www.armstrongceilings.com/#sle.
      b. USG Corporation; Mars Healthcare High-NRC Acoustical Panels: www.usg.com/ceilings/#sle.
      c. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, 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-dipped galvanized steel grid with steel cap.

1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
2. Profile: Tee; 15/16 inch face width.
3. Finish: Baked enamel.
4. Color: White.
5. Products:
    a. Armstrong World Industries, Inc; Prelude XL 15/16" Exposed Tee: www.armstrongceilings.com/#sle.
    b. USG Corporation; Donn Brand DX/DXL 15/16" Acoustical suspension system: www.usg.com/ceilings/#sle.
    c. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

C. Hold-Down Clips: Manufacturer's standard clips to suit application.

D. Perimeter Moldings: Same metal and finish as grid.

E. Metal Edge Trim for Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system. Compatible with acoustic suspension grid system.
1. Trim Height: 4 inch.
2. Finish: Baked enamel.
3. Color: White.
4. Corners: Factory-mitered 90 degree outside corner trim.
5. Recycled Content: Minimum of 40 percent recycled content.
6. Warranty: 10-year limited warranty; 30-year system warranty.
7. Products:
    a. Armstrong World Industries, Inc; Axiom Classic Straight Perimeter Trim: www.armstrongceilings.com/#sle.
    b. USG Corporation; Compasso Suspension Trim: www.usg.com/ceilings/#sle.
    c. Substitutions: See Section 01 6000 - Product Requirements.

F. Touch-up Paint: Type and color to match acoustical and grid units, and perimeter trim.

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.

3.02 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Overlap and rivet corners.

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. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

J. Install metal edge trim at acoustical clouds per manufacturer's instructions, with tight, square seams.

3.04 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. 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.

F. Where round obstructions occur, provide preformed closures to match perimeter molding.

G. Install hold-down clips on panels within 20 ft of an exterior door and in sloped ceilings.

3.05 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.06 CLEANING

A. Clean surfaces.

B. Replace damaged or abraded components.

END OF SECTION

SECTION 09 6500
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient base.

B. Installation accessories.

1.02 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2025.

B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

C. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021 (Reapproved 2025).

D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Shop Drawings: Indicate seaming plans and floor patterns.

D. Verification Samples: Submit two samples, 6 by 6 inch min in size illustrating color and pattern for each wall base product specified.

E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Wall Base: 20 linear feet of each type and color.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum five years documented experience.

B. Installer Qualifications: Company specializing in installing specified flooring with minimum five years documented experience.

C. Testing Agency Qualifications: Independent firm specializing in performing concrete slab moisture testing and inspections of the type specified in this section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. 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. Do not double stack pallets.

1.06 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 RESILIENT BASE

A. Resilient Base - Type RB1: ASTM F1861, Type TS, rubber, vulcanized thermoset; style as scheduled.
   1. Manufacturers:
      a. Flexco Corporation: www.flexcofloors.com/#sle.
      b. Johnsonite, a Tarkett Company; Baseworks Thermoset Rubber Wall Base: www.johnsonite.com/#sle.
      c. Roppe Corporation: www.roppe.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
   3. Height: 4 inches.
   4. Thickness: 0.125 inch.
   5. Finish: Satin.
   6. Length: Roll.
   7. Color: As indicated on drawings.

2.02 ACCESSORIES

A. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
   1. VOC Content Limits: As specified in Section 01 6116.

B. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION

A. 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.

B. For applications on concrete, verify curing, hardening or breaking compounds have not been used. If there are any, do not proceed until compounds have been removed.

3.02 PREPARATION

A. Clean substrate.

B. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

A. 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.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

E. Fill voids with plastic filler along the top edge of resilient wall base on masonry surfaces or other similar irregular substrates.

3.05 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.06 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

B. Protect work until substantial completion.

END OF SECTION

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SECTION 09 6700
FLUID-APPLIED FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fluid-applied resinous flooring system.

1.02 PRICE AND PAYMENT PROCEDURES

A. See Section 01 2300 - Alternatesfor alternate work affecting this section.

1.03 REFERENCE STANDARDS

A. ASTM D2370 - Standard Test Method for Tensile Properties of Organic Coatings; 2016 (Reapproved 2021).

B. ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test; 2022.

C. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser; 2025.

D. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:
   1. Architect.
   2. Flooring Installer.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.

C. Samples: Submit two samples, 6 by 6 inch in size illustrating color, pattern, texture and top coat sheen for each floor material for each color specified.

D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and application rate for each coat.

F. Manufacturer's Qualification Statement.

G. Applicator's Qualification Statement.

H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Top Coat Materials: 1 gallons.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section.
   1. Minimum five years of documented experience.
   2. Approved by manufacturer.

1.07 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. 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. Use approved design samples as basis for mock-ups.
   4. Locate where directed.
   5. Minimum Size: 60 inches by 60 inches.

C. See Section 01 4000 - Quality Requirements for additional requirements.

D. Obtain approval of mock-up by Architect before proceeding with work.

E. Approved mock-up may remain as part of the work if .

1.08 DELIVERY, STORAGE, AND HANDLING

A. All components of the system shall be delivered to the site in the Manufacturer's packaging, clearly identified with the product type and batch number.

B. Store resin materials in a dry, secure area.

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 of 60 degrees F.

B. Store materials in area of installation for minimum period of 24 hours prior to installation.

C. Substrate temperature must be at least 5 F degrees above the dew point and relative humidity below 85 percent.

D. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fluid-Applied Flooring:
   1. Sherwin-Williams High-Performance Flooring: www.sherwin-williams.com/resin-flooring/#sle.
   2. Sika Corporation: www.sikafloorusa.com/#sle.
   3. Terrazzo & Marble Supply Companies: www.tmsupply.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FLUID-APPLIED FLOORING SYSTEMS

A. Fluid-Applied Flooring Type FAF1: Decorative epoxy-based floor coating, with broadcast aggregate.
   1. Basis of Design: Resuflor Deco Flake II as manufactured by Sherwin-Williams Co.: www.sherwin-williams.com/resin-flooring.
   2. Aggregate: Vinyl flakes.
   3. Aggregate Size: 1/4 inch.
   4. System Thickness: 60 mils, nominal, dry film thickness (DFT).
   5. Texture: Slip resistant.
   6. Sheen: Satin.
   7. Color: As indicated on drawings.
      a. Source: Torginol Flakes: www.torginol.com/floors/products/flake.
      b. Collection: Signature.
   8. Flooring System Materials:
      a. Primer: Sherwin-Williams Co., Resuflor Glaze WB resin and hardener.
      b. First Broadcast Coat: Sherwin-Williams Co., Resuflor Gard OPF resin and hardener.

1) Chips: Torginol Flakes.

c. Second Broadcast and Grout Coat: Sherwin-Williams Co., Resuflor Glaze resin and Water Clear hardener.
   1) Chips: Torginol Flakes.

d. Grout coat: Sherwin-Williams Co., Resuflor Glaze resin and Water Clear hardener.

e. Topcoat: Sherwin-Williams Co., Resutile AT resin, hardener and grit.
   1) Percent Solids: 95 percent.
   2) Dry film thickness of 3 mils.

9. Hardness: 4H, when tested in accordance with ASTM D3363.
10. Tensile Strength: 7,000 psi, when tested in accordance with ASTM D2370.
11. Abrasion Resistance (Gloss): 4 mg loss with grit and 10 mg loss without grit, when tested in accordance with ASTM D4060.
12. Abrasion Resistance (Satin): 8 mg loss with grit and 12 mg loss without grit, when tested in accordance with ASTM D4060.

2.03 ACCESSORIES

A. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.

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 subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.

C. 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 Section 09 0561.
   2. Obtain instructions if test results are not within limits recommended by fluid-applied flooring manufacturer.
   3. Follow moisture and alkalinity remediation procedures in Section 09 0561.

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Mechanically remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
   1. Chemical Surface Preparation: Chemical surface preparation (acid etching) is unacceptable and will void manufacturer’s warranty.

B. Mechanically prepare substrates as follows
   1. Prepare concrete surface in accordance with manufacturer’s instructions.
   2. Remove dirt, dust, debris, oil, grease, curing agents, bond breakers, paint, coatings, sealers, silicones, and other surface contaminants which could adversely affect application of flooring system.
   3. Steel shot blast concrete to a minimum surface profile of ICRI 310.2R, CSP 5.
   4. Key-cut termination points with 1/4-inch (6-mm) by 1/4-inch (6-mm) cut.
   5. Patch depressions, divots, and cracks in concrete in accordance with manufacturer’s instructions.
   6. Mechanically remove loose, delaminated, and damaged concrete and repair in accordance with manufacturer’s instructions.
   7. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
   8. Joints: Fill joints in accordance with manufacturer’s instructions.

C. Protection of In-Place Conditions: Protect adjacent surfaces and adjoining walls from contact with flooring system materials.

D. Vacuum clean substrate.

E. Apply primer to surfaces required by flooring manufacturer.

3.03 INSTALLATION - FLOORING

A. Allow concrete to cure a minimum of 7 days before applying flooring system.

B. Apply in accordance with manufacturer's instructions.
   1. Apply flooring system materials to obtain consistent mil thickness and smooth, uniform appearance and texture.
   2. Follow manufacturer’s written recommendations on terminations and connections to walls, drains, doorways, columns and floor-to-floor transitions.

C. Broadcast aggregate to rejection. The broadcast coat shall be applied as a double broadcast system.

D. Apply each coat to minimum thickness indicated by manufacturer.

3.04 PROTECTION

A. Prohibit traffic on floor finish for 48 hours after installation.

B. Barricade area to protect flooring until fully cured. Beware of air flow and changes in air flow that could introduce dust, debris, and particles into the area.

C. Freshly applied material should be protected from dampness, condensation and water for at least 72 hrs.

END OF SECTION

SECTION 09 6813
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.02 REFERENCE STANDARDS

A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).

B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2025.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

D. CRI 104 - Standard for Installation of Commercial Carpet; 2018.

E. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.

F. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

E. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed (minimum of one full carton) of each color and pattern installed.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.05 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tile Carpeting:
   1. Basis of Design: Shaw Contract; Steppin Out Collection: www.shawcontract.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Entryway Carpet Tile, Type CPTW1: Needlebond Hobnail modular tile, manufactured in one color dye lot.
   1. Product: Steppin Out / Welcome II Tile (5T031) manufactured by Shaw Contract.
   2. Tile Size: 24 by 24 inch, nominal.
   3. Thickness: 0.362 inch.
   4. Backing: Ecoworx Tile.
   5. Dye Method: 100% Solution dyed.
   6. Wear Layer: 100% Pet polyester.
   7. Tufted Weight: 49.0 oz/sq. yd..
   8. Protective Treatment: Inherent stain resistance.
   9. Color: As indicated on drawings.
   10. Pattern: Quarter turn.
   11. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
   12. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
   13. Maximum Electrostatic Charge: 3 Kv. at 20 percent relative humidity.

2.03 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Adhesives:
   1. Type recommended by carpet tile manufacturer for substrate conditions.
   2. Compatible with materials being adhered; maximum VOC content as specified in Section 01 6116.

C. Metal Reducer Transition Trim:
   1. Type designed to cover the exposed edge of carpet tile and transition to floor level.
      a. In compliance with ADA Accessibility Guidelines.
      b. Product:
         1) Genotek; Rigid Ruducer: www.genotek.com.
         2) Substitutions: Section 01 6000 - Product Requirements.

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.
   2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.

B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

C. Vacuum clean substrate.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in quarter-turn pattern, set parallel to building lines.

F. Locate change of color or pattern between rooms under door centerline.

G. Fully adhere carpet tile to substrate.

H. Trim carpet tile neatly at walls and around interruptions.

I. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

3.05 PROTECTION

A. Protect work until substantial completion.

END OF SECTION

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SECTION 09 9123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Materials for backpriming wood panels.

D. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Mechanical and Electrical:
      a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, and hangers, brackets, collars and supports, unless otherwise indicated.
      b. In finished areas, paint shop-primed items.
      c. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.

E. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
   6. Floors, unless specifically indicated.
   7. Ceramic and other tiles.
   8. Glass.
   9. Concealed pipes, ducts, and conduits.

1.02 PRICE AND PAYMENT PROCEDURES

A. See Section 01 2300 - Alternatesfor alternate work affecting this section.

1.03 REFERENCE STANDARDS

A. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

B. SSPC-SP 2 - Hand Tool Cleaning; 2024.

C. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

D. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

1.04 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   3. Manufacturer's installation instructions.
   4. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

C. Manufacturer's Instructions: Indicate special surface preparation procedures.

D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Paint and Finish Materials: 2 gallons of each color; from the same product run, store where directed.
   2. Label each container with color in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum five years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Manufacturers:
   1. Basis of Design:
      a. Sherwin-Williams Company.
      b. Contact: Shawn Faulkner; (c) 414-396-0300, email *shawn.faulkner@sherwin.com*.
   2. Comparable products by listed manufacturers may be submitted in accordance with the requirements of 01 6000 - Product Requirements .
      a. Benjamin Moore, Inc.
      b. Pittsburgh Paints.

c. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. Supply each paint material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content: Comply with Section 01 6116.

C. Material Content: Comply with Section 01 8113 .

D. Flammability: Comply with applicable code for surface burning characteristics.

E. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

F. Colors: To be selected from manufacturer's full range of available colors.
   1. Selection to be made by Architect after award of contract.
   2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
   3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

2.03 PAINT SYSTEMS - INTERIOR

A. Concrete/Masonry, Opaque, Latex, 3 Coat (unfinished):
   1. One coat of block filler; minimum volume solids 48 percent.
      a. Sherwin-Williams Co.; PrepRite Block Filler, B25W25.
   2. Semi-gloss: Two coats of 100 percent acrylic enamel; minimum volume solids 39 percent, Gloss Level 4.
      a. Sherwin-Williams Co.; ProMar 200 HP Zero VOC Latex Semi-Gloss, B31 Series.
   3. Eg-Shel: Two coats of 100 percent acrylic enamel; minimum volume solids 41 percent, Gloss Level 3.
      a. Sherwin-Williams Co.; ProMar 200 HP Zero VOC Latex Eg-Shel, B20 Series.
   4. Flat: Two coats of 100 percent acrylic enamel; minimum volume solids 36 percent, Gloss Level 1.
      a. Sherwin-Williams Co.; ProMar 200 HP Zero VOC Latex Flat, B30 Series.

B. Ferrous Metals, Unprimed, Latex, 3 Coat:
   1. One coat of latex primer; minimum volume solids 38 percent.
      a. Sherwin-Williams Co.; Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series.
   2. Semi-gloss: Two coats of 100 percent acrylic enamel; minimum volume solids 36 percent, Gloss Level 4.
      a. Sherwin-Williams Co.; Pro Industrial Acrylic Semi-Gloss, B66-651 Series.

C. Ferrous Metals, Primed, Latex, 2 Coat:
   1. Touch-up with latex primer; minimum volume solids 38 percent..
   2. Semi-gloss: Two coats of 100 percent acrylic enamel; minimum volume solids 36 percent, Gloss Level 5.

a. Sherwin-Williams Co.; Pro Industrial Acrylic Semi-Gloss, B66-651 Series.

D. Galvanized Metals, Latex, 3 Coat:
   1. One coat of galvanized primer; minimum volume solids 38 percent.
      a. Sherwin-Williams Co.; Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series.
   2. Semi-gloss: Two coats of 100 percent acrylic enamel; minimum volume solids 36 percent, Gloss Level 5.
      a. Sherwin-Williams Co.; Pro Industrial Acrylic Semi-Gloss, B66-651 Series.

E. Ferrous Metal, Single Component, Epoxy Enamel, Primed, 2 Coat:
   1. Touch Up with latex primer; minimum volume solids 38 percent.
      a. Sherwin-Williams Co.; Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series.
   2. Two coats of precatalyzed acrylic epoxy enamel; minimum volume solids 35 percent, Gloss Level 5.
      a. Sherwin-Williams Co.; Pro Industrial Pre-Catalyzed Waterbased EpoxySemi-Gloss, K46 Series.

F. Ferrous Metal, Epoxy Enamel, Primed, 2 Coat:
   1. Touch Up with latex primer; minimum volume solids 38 percent.
      a. Sherwin-Williams Co.; Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series.
   2. Two coats of catalyzed acrylic epoxy enamel; minimum volume solids 39 percent, Gloss Level 3-4.
      a. Sherwin-Williams Co.; Pro Industrial Waterbased Catalyzed Epoxy Eg-Shel, B73 Series.

G. Concrete/Masonry, Single Component, Epoxy Enamel, 3 Coat (Dry Environments):
   1. One coat of catalyzed epoxy primer, minimum volume solids 40 percent.
      a. Sherwin-Williams Co.; Loxon Concrete Masonry Primer Sealer, LX02W50.
   2. Semi-Gloss: Two coats of precatalyzed acrylic epoxy; min. volume solids 35%, Gloss Level 5.
      a. Sherwin-Williams Co.; Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46 Series.

H. Concrete/Masonry, Epoxy Enamel, 3 Coat (Wet Environments):
   1. One coat of catalyzed epoxy primer, minimum volume solids 68 percent.
      a. Sherwin-Williams Co.; Cement-Plex 875.
   2. Gloss: Two coats of catalyzed acrylic epoxy; min. volume solids 39%, Gloss Level 6.
      a. Sherwin-Williams Co.; Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46 Series.

I. Gypsum Board/Plaster, Latex, 3 Coat:
   1. One coat of latex primer sealer; minimum volume solids 24 percent.
      a. Sherwin-Williams Co.; ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
   2. Semi-gloss: Two coats of 100 percent acrylic enamel; minimum volume solids 39 percent, Gloss Level 4.
      a. Sherwin-Williams Co.; ProMar 200 HP Zero VOC Latex Semi-Gloss, B31 Series
   3. Eggshell: Two coats of 100 percent acrylic enamel; minimum volume solids 41 percent, Gloss Level 3.
      a. Sherwin-Williams Co.; ProMar 200 HP Zero VOC Latex Eg-Shel, B20 Series.
   4. Flat: Two coats of 100 percent acrylic enamel; minimum volume solids 36 percent, Gloss Level 1.
      a. Sherwin-Williams Co.; ProMar 200 HP Zero VOC Latex Flat, B30 Series.

J. Gypsum Board/Plaster, Dryfall, 2 Coat:
   1. Flat: Two coats of acrylic dryfall: minimum volume solids 32 percent.
      a. Sherwin-Williams Co.; Waterborne Acrylic Dryfall Semi-Gloss, B42 Series

K. Metals, Dryfall, 2 Coat:

1. Flat: Two coats of acrylic dryfall: minimum volume solids 32 percent.
    a. Sherwin-Williams Co.; Waterborne Acrylic Dryfall Semi-Gloss, B42 Series.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been adequately prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
    1. Gypsum Wallboard: 12 percent.
    2. Plaster and Stucco: 12 percent.
    3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Concrete:
    1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
    2. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
    3. Prepare concrete slab for stiping as recommended by manufacturer.

H. Masonry:
    1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
    2. Prepare surface as recommended by top coat manufacturer.

I. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high-alkali surfaces.

J. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.

K. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

L. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.

M. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.

N. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions.

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

G. Sand metal surfaces lightly between coats to achieve required finish.

H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. Owner will provide field inspection.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 10 1100
VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Porcelain enamel steel markerboards.

B. Tackboards.

1.02 REFERENCE STANDARDS

A. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).

B. ANSI A208.1 - American National Standard for Particleboard; 2022.

C. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's data on porcelain enamel steel markerboard, tackboard, trim, and accessories.

C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.

D. Samples: Color charts for selection of color and texture of porcelain enamel steel markerboard, tackboard, and trim.

E. Test Reports: Show compliance to specified surface burning characteristics requirements.

F. Manufacturer's printed installation instructions.

G. Maintenance Data: Include data on regular cleaning, stain removal , and recommended maintenance precautions..

1.04 QUALITY ASSURANCE

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

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 VISUAL DISPLAY UNITS

A. Porcelain Enamel Steel Markerboards:
   1. Manufacturers:
      a. ASI Visual Display Products: www.asi-visualdisplayproducts.com/#sle.
      b. Claridge Products and Equipment, Inc: www.claridgeproducts.com/#sle.
      c. Nelson Adams NACO: www.nelsonadamsnaco.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Color: White.

3. Steel Face Sheet Thickness: 24 gauge, 0.0239 inch .
4. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
5. Backing: Galvanized steel sheet, laminated to core.
6. Size: As indicated on drawings.
7. Frame: Extruded aluminum , with concealed fasteners.
8. Frame Finish: Anodized, natural.
9. Flame Spread Rating: Comply with ASTM E84, with flame spread rating of 25.
10. Accessories: Provide marker tray and map rail.

B. Tackboards: Seamless 1/4" thick sealed cork surface "Nairn Bulletin Board Cork" (Forbo-Nairn Ltd..
1. Cork Thickness: 1/4 inch.
2. Color: As selected from manufacturer's full range.
3. Backing: Hardboard, 1/4 inch thick, laminated to tack surface.
4. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
5. Size: As indicated on drawings.
6. Frame: Same type and finish as for markerboard, where indicated on drawings.
7. Frame Finish: Anodized, natural.

2.02 MATERIALS

A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.

B. Hardboard for Cores: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides).

C. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.

D. Aluminum Sheet Backing: 27 gauge, 0.014 inch thick.

E. Steel Sheet Backing: 28 gauge, 0.0149 inch, galvanized.

F. Adhesives: Type used by manufacturer.

2.03 ACCESSORIES

A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories , full width of frame.

B. Map Supports: Formed aluminum sliding hooks and roller brackets to fit map rail.

C. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.

D. Flag Holders: Cast aluminum bored to receive 1 inch diameter flag staff, bracketed to fit top rail of board.

E. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.

F. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 PREPARATION

A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.

3.03 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.

B. Secure units level and plumb.

C. Butt Joints: Install with tight hairline joints.

3.04 CLEANING

A. Clean board surfaces in accordance with manufacturer's instructions.

B. Cover with protective cover, taped to frame.

C. Remove temporary protective cover at Date of Substantial Completion.

END OF SECTION

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SECTION 10 1419
DIMENSIONAL LETTER SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dimensional letter signage.

1.02 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements 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 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.

F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package dimensional letter signs as required to prevent damage before installation.

B. Store under cover and elevated above grade.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Dimensional Letter Signs:
   1. Gemini Incorporated: geminimade.com
   2. A.R.K. Ramos: www.arkramos.com/#sle.
   3. Impact Signs; impactsigns.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DIMENSIONAL LETTERS

A. Applications: Building identification.
   1. Use individual metal letters.
   2. Mounting Location: Exterior as indicated on drawings.
   3. Allow for total of 56 letters.

B. Metal Letters:
   1. Material: Aluminum sheet, flat.
   2. Thickness: 1/4 inch minimum.
   3. Letter Height: 12 inches.
   4. Text and Typeface:
      a. Character Font: As selected from Manufacturer's standard sans serif fonts.
   5. Finish: Anodized.

6. Color: As selected from Manufacturer's full range.
7. Mounting: Projected mount with collars.

2.03 ACCESSORIES

A. Projected mounting, color and material to match specified letters.

B. Other accessories as required by the Manufacturer for a complete installation.

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 with horizontal edges level.

END OF SECTION

SECTION 10 1423
PANEL SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Panel signage.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements 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 one sample of Sign Types B and C1, of size similar to that required for project, indicating sign style, font, and method of attachment. Samples may be installed in the project if undamaged during approval process.

E. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

F. Manufacturer's qualification statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store under cover and elevated above grade.

D. Store tape adhesive at normal room temperature.

1.06 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 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.

2.02 PANEL SIGNAGE

A. Metal Panel Signage; To match Owner's existing sign system:
   1. Application: Room and door signs.
   2. Description: Framed metal signs with applied character metal panel media, tactile characters.
   3. Size: As indicated on drawings.
   4. Sign Edges: Squared.
   5. Corners: Squared.
   6. Color and Font, unless otherwise indicated:
      a. Character Font: Helvetica, Arial, or other sans serif font.
      b. Character Case: Upper case only.
      c. Character Color: As indicated on drawings.
   7. Material: Metal sheet panel.
      a. Finish: Natural (clear) anodized.
   8. Profile: Flat panel in aluminum frame.
      a. Frame Finish: Natural (clear) anodized.
   9. Tactile Letters: Raised 1/32 inch minimum.
   10. Braille: Grade II, ADA-compliant.

2.03 SIGNAGE APPLICATIONS

A. Room and Door Signs:
   1. General Rooms: Identify with room numbers, and braille.
   2. Service Rooms: Identify with room names and numbers indicated on drawings, and braille.
   3. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN" as indicated on drawings, and braille.
   4. Exit Signs: Identify with the name "EXIT" as indicated on drawings, and braille.

2.04 ACCESSORIES

A. Tape Adhesive: Double-sided tape, permanent adhesive.

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 with horizontal edges level.

C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 2113.17
PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Phenolic toilet compartments.

B. Urinal screens.

1.02 REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and floors.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on panel construction, hardware, and accessories.

C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

D. Samples: Submit two samples of partition panels, 4 by 4 inch in size illustrating panel finish, color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Phenolic Toilet Compartments:
   1. ASI Accurate Partitions; Ultimate Privacy Color-Thru Phenolic Partitions: www.asi-accuratepartitions.com/#sle.
   2. Bradley Corporation; Phenolic Privacy Partitions: www.bradleycorp.com/#sle.
   3. Hadrian; Phenolic Toilet Partitions: www.hadrian-inc.com/#sle.
   4. Substitutions: Section 01 6000 - Product Requirements.

2.02 PHENOLIC TOILET COMPARTMENTS

A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid phenolic core panels with integral melamine finish, floor-mounted headrail-braced.
   1. Color: Single color as selected.

B. Doors:
   1. Thickness: 3/4 inch.
   2. Width: 24 inch.
   3. Width for Handicapped Use: 36 inch, out-swinging.
   4. Height: 72 inch.

C. Panels:
   1. Thickness: 3/4 inch inch.
   2. Height: 72 inch.
   3. Depth: As indicated on drawings.

D. Pilasters:
   1. Thickness: 3/4 inch.
   2. Width: As required to fit space; minimum 3 inch.

E. Screens: Without doors; to match compartments; mounted to wall with continuous panel brackets with vertical support/bracing same as compartments.

2.03 ACCESSORIES

A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Head Rails: Hollow anodized aluminum, 1 inch by 1-1/2 inch size, with anti-grip profile and cast socket wall brackets.

C. Wall and Pilaster Brackets: Polished stainless steel; manufacturer's standard type for conditions indicated on drawings.

D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts ; tamper proof.

E. Hardware: Polished stainless steel:
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
   2. Door Latch: Slide type with exterior emergency access feature.
   3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
   4. Coat hook with rubber bumper; one per compartment, mounted on door.
   5. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify correct spacing of and between plumbing fixtures.

C. 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. Attach panel brackets securely to walls using anchor devices.

C. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

D. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

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 partial opening position when unlatched. Return out-swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 2600
WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Corner guards.

B. Protective wall panels.

1.02 REFERENCE STANDARDS

A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2024.

B. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2021.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

D. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2023.

E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Indicate physical dimensions and features.

C. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.

D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.

E. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.

F. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall protection items in original, undamaged protective packaging. Label items to designate installation locations.

B. Protect work from moisture damage.

C. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.

D. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Corner Guards:
   1. Construction Specialties, Inc; Stainless Steel Corner Guards: www.c-sgroup.com/#sle.
   2. Inpro; Surface Mount Stainless Steel Corner Guards: www.inprocorp.com/#sle.
   3. Koroseal Interior Products; Stainless Steel Corner Guards: www.koroseal.com/#sle.
   4. ProTek Systems, Inc.; CG-51 Stainless Steel Corner Guard: www.proteksystem.com.

5. Substitutions: See Section 01 6000 - Product Requirements.

B. Protective Wall Panels: :
   1. ProTek Systems, Inc.; WPS-12 Stainless Steel Wall Panel: www.proteksystem.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE CRITERIA

A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.

B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance complying with applicable provisions of ASTM D543.

C. Fungal Resistance: Unless otherwise noted, provide protection products and assemblies which pass ASTM G21 testing.

2.03 PRODUCT TYPES

A. Corner Guards - Surface Mounted:
   1. Material: Type 304 stainless steel, No. 4 finish, 16 gauge, 0.06 inch thick.
   2. Performance: Resist lateral impact force of 100 lbs at any point without damage or permanent set.
   3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
   4. Width of Wings: 2 inches.
   5. Corner: Radiused.
   6. Color: Number 4 finish.
   7. Height: One piece, refer to drawings.
   8. Mounting: Adhesive.

B. Protective Wall Panels:
   1. Material: Stainless steel wall panel.
   2. Material: Type 304.
   3. Sheet Thickness: 14 gauge, 0.075 inch.
   4. Panel Size: 5 feet by 8 feet and 5 feet by 10 feet.
   5. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 55 or less, when tested in accordance with ASTM E84.
   6. Texture: As indicated on drawings.
   7. Finish:
      a. Remove tool marks, die marks, and stretch lines before finishing.
      b. Directional Satin: No.4.
   8. Accessories: Provide manufacturer's standard stainless steel No. 4 finish trim and moldings.
      a. Outside Corner Trim: Flat.
   9. Mounting: Mechanical fasteners, stainless steel.

C. See Section 06 1000 for wood blocking for wall and corner guard anchors.

D. Accessories:
   1. VOC Content Limits: As specified in Section 01 6116.
   2. Adhesives: Type recommended by manufacturer for substrates.
   3. Sealant: Clear silicone.
   4. Fasteners: Stainless steel, suitable for substrate.

2.04 FABRICATION

A. Fabricate components with tight joints, corners and seams.

B. Pre-drill holes for attachment.

C. Form end trim closure by capping and finishing smooth.

D. Fit and shop assemble items in largest practical sections for delivery to site.

E. Fabricate items with joints tightly fitted and secured.

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.

2.05 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

B. Verify that field measurements are as indicated on drawings.

C. Verify that substrate surfaces for adhered items are clean and smooth.

1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.

D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

B. Position corner guard at top of wall base. Height as indicated on drawings.

C. Position wall protection panels at top of wall base. Railroad panel to minimize vertical seams. Horizontal seams are not allowed.

1. Use preformed corners to return panel to primary wall, fully covering furring wall to height indicated.
2. Seal vertical seams with clear silicone sealent.

3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch.

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

A. Clean wall protection items of excess adhesive, dust, dirt, and other contaminants.

B. Protect wall protection items until Substantial Completion.

END OF SECTION

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SECTION 10 2800
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Under-lavatory pipe supply covers.

C. Electric hand/hair dryers.

D. Utility room accessories.

1.02 REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

B. ASTM C1036 - Standard Specification for Flat Glass; 2025.

C. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Schedule of products and where located

D. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Accessories:
   1. American Specialties, Inc: www.americanspecialties.com/#sle.
   2. Bradley Corporation: www.bradleycorp.com/#sle.
   3. Bobrick: www.bobrick.com
   4. Substitutions: Section 01 6000 - Product Requirements.

B. Electric Hand/Hair Dryers:
   1. American Specialties, Inc: www.americanspecialties.com/#sle.
   2. Excel Dryer: www.exceldryer.com/#sle.
   3. Savortex: www.savortex.com/#sle
   4. World Dryer Corporation: www.worlddryer.com/#sle.
   5. Substitutions: Section 01 6000 - Product Requirements.

2.02 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.

B. Stainless Steel Sheet: ASTM A666/A666M, Type 304.

C. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

D. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 COMMERCIAL TOILET ACCESSORIES

A. Owner Provided Toilet Accessories: Contractor to install the following toilet accessories provided by Owner.
   1. Soap dispensers.
   2. Paper towel dispensers.
   3. Toilet paper dispensers.
   4. Sanitary napkin disposal units.

B. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
   2. Size: As indicated on drawings.
   3. Frame: 0.05 inchangle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   4. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.

C. Grab Bars: Stainless steel, peened surface.
   1. Heavy Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force, minimum.
      b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
      c. Finish: Satin.
      d. Length and Configuration: As indicated on drawings.

2.05 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Specified in 22 4000 - Plumbing Fixtures.

2.06 ELECTRIC HAND/HAIR DRYERS

A. Electric Hand Dryers: Traditional fan-in-case type, with downward fixed nozzle; ADA c.
   1. Operation: Automatic, sensor-operated on and off.
      a. Energy efficie
   2. Mounting: Wall-mounted - surface.
   3. Cover: Stainless steel with brushed finish.
      a. Tamper-resistant screw attachment of cover to mounting plate.
      b. Screened or shielded air intake.
   4. Electric Hand Dryer Products:
      a. Excel Dryer Inc; XLERATOReco: www.exceldryer.com/#sle.
      b. Savortex; EcoCurve: www.savortex.com/#sle.
      c. World Dryer Corporation; SMARTdri: www.worlddryer.com/#sle.
      d. Substitutions: Section 01 6000 - Product Requirements.

2.07 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
   1. Drying rod: Stainless steel, 1/4 inch diameter.
   2. Hooks: Two, 0.06 inch stainless steel rag hooks at shelf front.
   3. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
   4. Length: 30 inches.

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.

E. See Section 06 1000 for installation of blocking in walls.

3.02 PREPARATION

A. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As indicated on drawings and as required by accessibility regulations, unless otherwise indicated.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

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SECTION 10 4400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 REFERENCE STANDARDS

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

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, and anchorage details.

C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

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. Substitutions: See Section 01 6000 - Product Requirements.

B. Fire Extinguisher Cabinets and Accessories:
   1. Activar Construction Products Group, Inc. - JL Industries; Ambassador Series: www.activarcpg.com/#sle.
   2. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
   3. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

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: 5 pound.
   3. Finish: Baked polyester powder coat, red color.
   4. Temperature range: Minus 40 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

A. Cabinet Construction: Non-fire rated.
   1. Formed primed steel sheet; 0.036 inch thick base metal.

B. Cabinet Configuration: Semi-recessed type.
   1. Exterior nominal dimensions of 12-3/8 inch wide by 21-3/8 inch high by 5-1/2" inch deep.
   2. Projected Trim: Returned to wall surface, with 2-1/2 inch projection, and 1-11/16 inch wide face.

C. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.

D. Door Glazing: Tempered glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.

E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

F. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.

G. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

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. Secure rigidly in place.

C. Place extinguishers in cabinets.

END OF SECTION

SECTION 10 5113
METAL LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal lockers.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

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; 2024.

C. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).

D. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.

C. Shop Drawings: Show lockers in detail, method of installation, fillers, trim, base, and accessories. Include locker numbering sequence information.

D. Samples: Submit two samples 3 by 6 inches in size showing color and finish of metal locker material.

E. Manufacturer's Installation Instructions: Indicate component installation assembly.

F. Maintenance Data: For adjusting, repairing and replacing locker doors and latching mechanisms to include in maintenance manuals specified in Division 01.

1.04 QUALITY ASSURANCE

A. Uniformity and Single Manufacturer Requirements: Provide each type of metal locker as produced by a single manufacturer, including necessary mounting accessories, fittings, and fastenings.

B. Installers Qualifications: Lockers to be installed by an experienced agent of the manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Do not deliver metal lockers until building is enclosed and ready for locker installation.

B. Storage and Protection: Protect materials from damage during delivery, handling, storage and installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Lockers:
   1. ASI Storage Solutions; Traditional Plus Collection: www.asi-storage.com/#sle.
   2. DeBourgh Manufacturing Co; Rebel Plus Welded Lockers: www.debourgh.com/#sle.
   3. Hadrian; Hadrian Emperor Series: www.hadrian-inc.com/#sle.
   4. Penco Products, Inc; Welded Gen2 Lockers: www.pencoproducts.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 LOCKER APPLICATIONS

A. Student Lockers: Metal lockers, free-standing for base indicated on drawings.
   1. Width: 18 inches.
   2. Depth: 18 inches.

3. Height: 72 inches.
4. Configuration: Two tier.
5. Fittings: Size and configuration as indicated on drawings.
    a. Hooks: Two single prong.
6. Ventilation: Louvers at top and bottom of door panel.
7. Locking: Padlock hasps, for padlocks provided by Owner.
    a. Locking Action: Positive, automatic type, whereby locker may be locked when open, then closed without unlocking.
8. Provide sloped top across all locker.

2.03 METAL LOCKERS

A. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.

B. Locker Case Construction:
    1. Heavy-Duty, Welded Construction: Made of formed and welded together sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
        a. Assembly: Do not use bolts, screws, or rivets to assemble locker bodies.
        b. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
            1) Expanded Steel Sheet: Made from ASTM A1008/A1008M carbon steel sheet and complying with ASTM F1267, Type II, expanded and flattened, style 3/4 - 16, with a minimum 70 percent open area.
                (a) Class 2, hot-dip zinc-coated, galvanized or galvannealed.
            2) Body and Shelves: 16 gauge, 0.0598 inch.
            3) Backs: 16 gauge, 0.0598 inch.
            4) Base: 16 gauge, 0.0598 inch, minimum.
                (a) Height: 4 inches.
        c. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
            1) Door Frame: 16 gauge, 0.0598 inch, minimum.
        d. Tier Dividers: Full depth cold rolled steel securely welded on all four sides, to combine with tops, bottoms, sides, and intermediate partitions.
        e. Where ends or sides are exposed, provide flush panel closures.
        f. Provide filler strips where indicated or required, securely attached to lockers.

C. Doors: Channel edge; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.
    1. Door Thickness: 16 gauge, 0.0598 inch, minimum.
    2. Form recess for operating handle and locking device.

D. Latches and Door Handles: Manufacturer's standard.
    1. Latching: Manufacturer's standard for locking arrangement selected.
        a. Three-Point Lift Handle Gravity Latch: Pocket-mounted, provide for doors 18 inches or taller.
            1) Handle Pocket, Recess: Stainless steel flush-mounted cup recessed into face of door.
            2) Handle: Steel finger lift mechanism with exposed portion encased in molded plastic trigger.
                (a) Padlock Eye: Integral with lift trigger, sized for use with 9/32 inch diameter padlock shackles.
            3) Rubber bumpers riveted to door stops for silent operation.

E. Hinges: Continuous piano hinge with powder coat finish to match locker color.

F. Sloped Top: 20 gauge, 0.0359 inch, with closed ends.
   1. All welded slope top with 25 degree pitch, attached at factory with concealed fasteners. Slope top to be in addition to standard 16 gauge flat top.

G. Trim: 20 gauge, 0.0359 inch.

H. Coat Hooks: Stainless steel or zinc-plated steel.

I. Number Plates: Provide oval shaped aluminum plates. Form numbers ____ inch high of block font style with ADA designation, in contrasting color.

J. Locks: Locker manufacturer's standard type indicated in Applications article above.

K. Closed Base: Provide 4-inch high, 14 gauge welded steel base enclosed on all four sides securely welded to locker bottom.

L. Locker Groups: Gang lockers in groups of two or three and assemble in factory for shipment as a single unit.

2.04 LOCKER FINISH

A. Complete locker unit to be thoroughly cleaned, phosphatized and sealed.

B. Finish to be baked powder coat with a minimum 2-3 mil thickness.

C. Color: As indicated on drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place and secure on prepared base.

C. Install lockers plumb and square.

D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.

E. Bolt adjoining locker units together to provide rigid installation.

F. Install end panels, filler panels, and sloped tops.

G. Install fittings if not factory installed.

H. Replace components that do not operate smoothly.

3.02 CLEANING

A. Clean locker interiors and exterior surfaces.

END OF SECTION

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SECTION 12 2400
WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior motorized roller shades.

B. Motor controls.

1.02 REFERENCE STANDARDS

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

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

C. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

D. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
   2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.

B. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.

C. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
   2. Do not install shades until final surface finishes and painting are complete.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for 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.
   1. Motorized Shades: Include power requirements and standard wiring diagrams for specified products.

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, and operation direction.
   1. Motorized Shades: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.

D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.

E. Selection Samples: Include fabric samples in full range of available colors and patterns.

F. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

G. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.

I. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

J. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty 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 ten years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum five years of experience with shading systems of similar size and type.
   1. Manufacturer's authorized representative.
   2. Factory training and demonstrated experience.

C. Shade Cloth Anti-Microbial Characteristics. 'No Growth' per ASTM G 21 results for fungi.

1.06 MOCK-UP

A. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams and batten pockets when applicable.
   1. Full-sized mock-up may become part of the final installation.

1.07 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.

1.08 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: Minimum of five years.
   2. Fabric: Minimum of fifteen years.
   3. Aluminum and Steel Coatings: One year.
   4. Installation: One year

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Motorized Roller Shades, Motors and Motor Controls:
   1. Basis of Design: Draper, Inc; Motorized FlexShade 2: www.draperinc.com/#sle.
   2. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com/#sle.
   3. MechoShade Systems LLC: www.mechoshade.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

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.

3. Motorized Shades: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed or recognized to UL 325.
    a. Comply with NFPA 70.
    b. Electrical Components: Listed, classified, and labeled as suitable for the purpose intended. Where applicable, system components to be FCC compliant.
    c. Motors: Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated; integrated into shade operating components and concealed from view; fully compatible with controls to be installed.

B. Interior Roller Shades - Basis of Design: Draper, Inc; FlexShade 2: www.draperinc.com/#sle.
1. Description: Single roller, motor-operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and other components necessary for complete installation.
    a. Drop Position: Regular roll.
    b. Roll Direction: Roll down, closed position is at window sill.
    c. Mounting: Wall mounted.
    d. Size: As indicated on drawings.
    e. Fabric: As indicated under Shade Fabric article.
2. Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
3. Multiple Shade Operation: Provide hardware as necessary to operate more than one shade using a single motor.
4. Roller Tubes: As required for type of shade operation; designed for removal without removing mounting hardware.
    a. Material: Extruded aluminum or steel, with wall thickness and material selected by manufacturer.
    b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
    c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
    d. Capable of being removed and reinstalled without affecting roller shade limit adjustments.
5. Hembars: Designed to maintain bottom of shade straight and flat, selected from manufacturer's standard options.
    a. Style: Exposed hembar; aluminum rectangular hembar with plastic end caps.
6. Shade Motor: Standard 120V AC motor, located as indicated on drawings.
7. Accessories:
    a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to mounting end caps, without exposed fasteners; clear anodized finish.
        1) Color: To be selected from manufacturers standard colors.
    b. Exposed Headbox: Extruded aluminum, size as required to conceal shade mounting; clear anodized finish.
        1) Color: To be selected from manufacturers standard colors.
    c. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

2.03 SHADE FABRIC

A. Fabric - Type WT1A: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
1. Manufacturers:
    a. Mermet Corporation: www.mermetusa.com/#sle.
    b. Basis of Design: Phifer, Inc; Sheerweave Style 2410: www.phifer.com/#sle.
    c. Substitutions: See Section 01 6000 - Product Requirements.
2. Material: Vinyl coated fiberglass.

3. Material Certificates and Product Disclosures:
    a. Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
4. Performance Requirements:
    a. Flammability: Pass NFPA 701 large and small tests.
5. Openness Factor: As indicated on drawings.
6. Weight: 14 ounces per square yard, mi.
7. Color: As selected by Architect from manufacturer's full range of colors.

2.04 MOTOR CONTROLS

A. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.

B. Provide all components and connections necessary to interface with other systems as indicated.

C. Shade Motor and Control System.
1. Standard Motor: 120V AC, single phase, 60 HZ, instantly reversible, lifetime lubricated, and equipped with internal thermal overload protector, electric brake, and pre-set accessible limit switches. Tubular motor concealed inside each shade roller tube.
2. Quiet 120V AC motor operates at 38 Db measured 3 feet from the motor. Makes no audible clicks when motor stops or starts. Tubular motor concealed inside each shade roller tube.
3. Individual Control:
    a. Wall Switch – Toggle three position wall switch.
    b. Wall Switch – Key operated three position wall switch.
4. Group Control:
    a. 1 Motor Controller. Single motor controller for use with motorized roller shades systems. Can be used as a standalone device or part of a network. When networked, can still be independently operated and can be configured to respond to wall switches, RF remotes, and signals from 3rd party systems. On-board contact closure interface. RS-485 network with built-in network termination. On-board buttons for testing and configuring motors. Pluggable terminal blocks. Input power: 110-230VAC @ 50 / 60Hz. Output power: Maximum 6A at input power. Material: ABS plastic. Operating temperature: 32 - 140 ° F. Dimensions: 2¾" x 3½" x 2 1/8". Enclosure: 4" x 4" X 4".
    b. 1 Motor Isolating Relay (1ISO) – One ISO relay per motor. Allows 110-120V group switching. Allows for up to 12 motors on one double throw switch. Input Voltage: 120V AC/60Hz. Output Voltage: 120V AC/60Hz. Max Output Current: 4.0 Amps.
5. Individual and Group Control: IGC4N1. Individual and Group control of up to four motors with up to three intermediate positions per motor.

2.05 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 stool.
2. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4 inch total.
3. Horizontal Dimensions - Outside Mounting: Cover window frames, trim, and casings completely.

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. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. 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.
   1. Under no circumstances should products of this section be mounted or attached to curtain wall or window frames.
   2. If shop drawings indicate attachment to the curtain wall or window frames. Do not proceed and notify the Architect.

B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.

C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

D. Install the following items to conceal roller and operating mechanism. Do not use exposed fasteners.

3.04 SYSTEM STARTUP

A. Test motorized window shades to verify that controls, limit switches, interface to other building systems, and other operating components are functional. Correct deficiencies.

B. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

3.05 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.06 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

B. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours training by manufacturer's authorized personnel at location designated by the Owner.

3.07 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

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SECTION 12 3600
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.

1.02 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.

C. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

F. PS 1 - Structural Plywood; 2023.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.

D. Verification Samples: For each finish product specified, minimum size 4 inches square, representing actual product, color, and patterns.

E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

F. Installation Instructions: Manufacturer's installation instructions and recommendations.

G. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Stainless Steel Countertops: , Type 304, stainless steel sheet; 16 gauge, 0.0625 inch nominal sheet thickness.
   1. Finish: 4B satin brushed finish.
   2. Back and End Splashes: Same material; welded 1/4 inch radius coved joint to countertop; square top edge with 1 inch wide top surface and minimum 1/2 inch turndown.
   3. Splash Dimensions: 4 inch high by 1 inch thick, unless otherwise indicated.

2.02 MATERIALS

A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.

B. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.

C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.

D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

E. Joint Sealant: Mildew-resistant silicone sealant, clear.

2.03 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets ___ inch except where top butts against cabinet or wall.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Stainless Steel: Fabricate tops up to 144 inches long in one piece including nosings and back and end splashes; accurately fitted mechanical field joints in lengths over that dimension are permitted.
   1. Weld joints; grind smooth and polish to match.
   2. Provide stainless steel hat channel stiffeners, welded or soldered to underside, where indicated on drawings.
   3. Provide wall clips for support of back/end splash turndowns.
   4. Sound Deadening: Apply water resistant, fire resistant sound deadening mastic to entire bottom surface.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Attach stainless steel countertops using stainless steel fasteners and clips.

C. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.

B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly per manufacturer's instructions.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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SECTION 21 0500
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, fittings, sleeves, escutcheons, seals, and connections for sprinkler systems.

1.02 REFERENCE STANDARDS

A. ASME A112.18.1 - Plumbing Supply Fittings; 2024.

B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025, with Errata.

C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2010.

D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.

E. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.

F. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).

G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

H. AWWA C606 - Grooved and Shouldered Joints; 2022.

I. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.

C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

D. Project Record Documents: Record actual locations of components and tag numbering.

1.04 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of the type specified this section.
   1. Minimum three years experience.

C. Conform to UL, FM, and Warnock Hersey requirements.

D. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 PRODUCTS

2.01 FIRE PROTECTION SYSTEMS

A. Sprinkler Systems: Conform to NFPA 13.

B. Welding Materials and Procedures: Conform to ASME BPVC-IX.

2.02 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A 53 Schedule 40, black (Must pass ASTM A-653 Zinc Adhesion Test).
   1. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
   2. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
   3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
   4. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

2.03 PIPE SLEEVES

A. Pipe Passing Through Mechanical, Laundry, and Floors above Basement:
   1. Galvanized steel pipe or black iron pipe with asphalt coating.
   2. Connect sleeve with floor plate except in mechanical rooms.

2.04 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Modular/Mechanical Seal:
   1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
   2. Provide watertight seal between pipe and wall/casing opening.
   3. Elastomer element size and material in accordance with manufacturer's recommendations.
   4. Glass reinforced plastic pressure end plates.

2.05 ESCUTCHEONS

A. Manufacturers:
   1. Fire Protection Products, Inc: www.fppi.com.com.
   2. Tyco Fire Protection Products: www.tyco-fire.com.
   3. Viking Group Inc: www.vikinggroupinc.com.
   4. Substitutions: See Section 01 2500 - Substitution Procedures.
   5. Chrome-plated.
   6. Metals and Finish: Comply with ASME A112.18.1.
   7. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.06 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.

C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

D. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.

E. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.

F. Vertical Support: Steel riser clamp.

G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.07 MECHANICAL COUPLINGS

A. Manufacturers:
   1. Victaulic Company: www.victaulic.com.
   2. COOPLOK Smith.

3. Substitutions: See Section 01 2500 - Substitution Procedures.
4. Dimensions and Testing: Comply with AWWA C606.
5. Minimum Working Pressure: 300 psig.
6. Housing Material: Fabricate of ductile iron conforming to ASTM A536.
7. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
8. Bolts and Nuts: Hot dipped galvanized or zinc electroplated steel.

2.08 DRAIN VALVES

A. Compression Stop:
   1. Bronze with hose thread nipple and cap.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
   6. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   7. Place hangers within 12 inches of each horizontal elbow.
   8. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   9. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

B. Provide sleeves when penetrating walls and partitions and seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
   1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
   2. Aboveground Piping:
      a. Pack solid using mineral fiber conforming to ASTM C592.
      b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
   3. All Rated Openings: Caulk tight with fire stopping material conforming to ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.
   4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
   5. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
   6. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
   7. Locate piping in center of sleeve or penetration.

8. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
9. Tighten bolting for a water-tight seal.
10. Install in accordance with manufacturer's recommendations.
11. Install and firmly attach escutcheons at piping penetrations into finished spaces.
12. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
13. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.

C. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

D. Provide drain valves at main shut-off valves, low points of piping and apparatus.

3.03 CLEANING

END OF SECTION

SECTION 21 0523
GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bronze butterfly valves with indicators.

B. Iron butterfly valves with indicators.

C. Check valves.

D. Bronze OS&Y gate valves.

E. Iron OS&Y gate valves.

F. Indicator posts.

G. Trim and drain valves.

1.02 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).

B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2010.

C. ASME B31.9 - Building Services Piping; 2025.

D. FM (AG) - FM Approval Guide; Current Edition.

E. FM Approval Guide; Factory Mutual Global; current edition.

F. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2025.

H. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Obtain valves for each valve type from single manufacturer.
   2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

B. Where listed products are specified, provide products listed, classified, and labeled by FM (AG), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for the purpose indicated.

C. Installer and Maintenance Contractor Qualifications:
   1. Company specializing in performing the work of this section with minimum five years documented experience.
   2. Trained and approved by manufacturer to design, install, test and maintain the equipment specified herein.
   3. Complies with manufacturer's certification requirements.

4. Complies with manufacturer's insurance requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:
   1. Maintain valve end protection and protect flanges and specialties from dirt.
      a. Provide temporary inlet and outlet caps.
      b. Maintain caps in place until installation.
   2. Store valves in shipping containers and maintain in place until installation.
      a. Store valves indoors and maintain at higher than ambient dew point temperature.
      b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.

C. Use the following precautions for handling:
   1. Do not use operating handles or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. FM Global Approved: Provide valves listed in FM (AG) Approval Guide under the following headings:
   1. Automated Sprinkler Systems:
   2. Valves:
      a. Single check valves.
      b. Miscellaneous valves.

B. ASME Compliance:
   1. ASME B16.1 for flanges on iron valves.
   2. ASME B1.20.1 for threads on threaded-end valves.
   3. ASME B31.9 for building services piping valves.

C. Comply with NFPA 13 and NFPA 13R for valves.

D. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Actuator Types:
   1. Worm-gear actuator with handwheel for quarter-turn valves, except trim and drain valves.
   2. Handwheel: For other than quarter-turn trim and drain valves.
   3. Hand-lever: For quarter-turn trim and drain valves 2 NPS and smaller.

2.02 CHECK VALVES

A. Minimum Pressure Rating: 175 psig.

B. Type: Center guided check valve.

C. Body Material: Cast iron, ductile iron.

D. Center guided check with elastomeric seal.

E. Hinge Spring: Stainless steel.

F. End Connections: Flanged, grooved, or threaded.

2.03 IRON OS&Y GATE VALVES

A. Minimum Pressure Rating: 175 psig.

B. Body and Bonnet Material: Cast or ductile iron.

C. Wedge: Cast or ductile iron, or bronze with elastomeric coating.

D. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.

E. Stem: Brass or bronze.

F. Packing: Non-asbestos PTFE.

G. Supervisory Switch: External.

H. End Connections: Flanged.

2.04 TRIM AND DRAIN VALVES

A. Ball Valves:
   1. Description:
      a. Pressure Rating: 175 psig.
      b. Body Design: Two piece.
      c. Body Material: Forged brass or bronze.
      d. Port Size: Full or standard.
      e. Seat: PTFE.
      f. Stem: Bronze or stainless steel.
      g. Ball: Chrome-plated brass.
      h. Actuator: Hand-lever.

B. Angle Valves:
   1. Description:
      a. Pressure Rating: 175 psig.
      b. Body Material: Brass or bronze.
      c. Ends: Threaded.
      d. Stem: Bronze.
      e. Disc: Bronze.
      f. Packing: Asbestos free.
      g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:
   1. Description:
      a. Pressure Rating: 175 psig.
      b. Body Material: Bronze with integral seat and screw-in bonnet.
      c. Ends: Threaded.
      d. Stem: Bronze.
      e. Disc Holder and Nut: Bronze.
      f. Disc Seat: Nitrile.
      g. Packing: Asbestos free.
      h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Confirm valve interior to be free of foreign matter and corrosion.

B. Remove packing materials.

C. Examine guides and seats by operating valves from the fully open position to the fully closed position.

D. Examine valve threads and mating pipe for form and cleanliness.

3.02 INSTALLATION

A. Comply with specific valve installation requirements and application in the following Sections:

B. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.

C. Install check valve in water supply connections and backflow preventer at potable water supply connections.

D. Valves with threaded connections to have unions at equipment arranged for easy access, service, maintenance, and equipment removal without system shutdown.

E. Valves in horizontal piping installed with stem at or above the pipe center.

F. Position valves to allow full stem movement.

G. Install valve tags. Comply with Section 21 0553 requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

SECTION 21 0553
IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

D. Ceiling tacks.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Automatic Controls: Tags.

B. Control Panels: Nameplates.

C. Instrumentation: Tags.

D. Major Control Components: Nameplates.

E. Small-sized Equipment: Tags.

F. Valves: Nameplates and ceiling tacks where above lay-in ceilings.

2.02 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch.
   3. Background Color: Black.
   4. Thickness: 1/8 inch.
   5. Plastic: Conform to ASTM D709.

2.03 TAGS

A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

2.04 PIPE MARKERS

A. Color: Conform to ASME A13.1.

B. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.05 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 21 1300
FIRE SUPPRESSION SPRINKLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wet-pipe sprinkler system.

B. Dry-pipe sprinkler system.

C. System design, installation, and certification.

1.02 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide; Current Edition.

B. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.

C. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Refer to Section 21 0500, 1.03C.
   2. Submit shop drawings to Authorities Having Jurisdiction for approval. Submit proof of approval to Architect.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Sprinklers: Type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
   3. Sprinkler Wrenches: For each sprinkler type.

D. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

1.04 QUALITY ASSURANCE

A. Conform to FM (AG) requirements.

B. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Equipment and Components: Provide products that bear FM (AG) label or marking.

D. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.06 EXTRA MATERIALS

A. Provide extra sprinklers under provisions of NFPA 13.

B. Provide suitable wrenches for each sprinkler type.

C. Provide metal storage cabinet located adjacent to alarm valve.

PART 2 PRODUCTS

2.01 SPRINKLER SYSTEM

A. Sprinkler System: Provide coverage for entire building.

B. Occupancy: Ordinary hazard, Group 1 and Light hazard; comply with NFPA 13.

C. Provide fire department connections where indicated.

D. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

2.02 SPRINKLERS

A. Suspended Ceiling Type: Semi-recessed pendant type with matching push on escutcheon plate.
   1. Finish: Chrome plated.
   2. Escutcheon Plate Finish: Chrome plated.
   3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

B. Exposed Area Type: Standard upright type .
   1. Finish: Chrome plated.
   2. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

C. Sidewall Type: Standard horizontal sidewall type with matching push on escutcheon plate and guard.
   1. Finish: Chrome plated.
   2. Escutcheon Plate Finish: Chrome plated.
   3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

D. Guards: Finish to match sprinkler finish.

2.03 PIPING SPECIALTIES

A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:

B. Backflow Preventer: Reduced pressure principle valve assembly backflow preventer with drain and OS & Y gate valve on each end.

C. Test Connections:
   1. Backflow Preventer Test Connection:
      a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5 inch National Standard male hose threads with cap and chain.

D. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with referenced NFPA design and installation standard.

B. Install equipment in accordance with manufacturer's instructions.

C. Install buried shut-off valves in valve box. Provide post indicator.

D. Provide approved backflow preventer assembly at sprinkler system water source connection.

E. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.

F. Locate outside alarm gong on building wall as indicated.

G. Place pipe runs to minimize obstruction to other work.

H. Place piping in concealed spaces above finished ceilings.

I. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.

J. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

K. Install and connect to fire pump system in accordance with Section 21 3000.

L. Flush entire piping system of foreign matter.

M. Install guards on sprinklers in areas subject to physical damage including but not limited to mechanical & storage rooms.

N. Hydrostatically test entire system.

O. Require test be witnessed by Authority Having Jurisdiction.

3.02 INTERFACE WITH OTHER PRODUCTS

A. Ensure required devices are installed and connected as required to fire alarm system.

END OF SECTION

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SECTION 22 0516
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flexible pipe connectors.

B. Expansion joints and compensators.

C. Pipe loops, offsets, and swing joints.

D. Manufactured expansion loops.

E. Field fabricated expansion loops.

F. Pipe guides.

1.02 REFERENCE STANDARDS

A. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2013.

B. EJMA (STDS) - EJMA Standards; Tenth Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature, pressure rating, materials of construction, pipe joint, hose wall construction, and braid structure.
2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.

D. Project Record Documents: Record installed locations of expansion joints, expansion loops, pipe anchors, and pipe guides.

PART 2 PRODUCTS

2.01 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

A. Inner Hose: Corrugated bronze.

B. Exterior Sleeve: Braided bronze.

C. Pressure Rating: 125 psi and 450 degrees F.

D. Joint: Flanged.

E. Size: Use pipe sized units.

F. Maximum offset: 3/4 inch on each side of installed center line.

G. Application: Copper piping.

2.02 EXPANSION JOINTS - COPPER WITH PACKED SLIDING SLEEVE

A. Working Pressure: 125 psi.

B. Maximum Temperature: 250 degrees F.

C. Joint: Flanged.

D. Size: Use pipe sized units.

E. Application: Copper or steel piping 2 inches and over.

2.03 MANUFACTURED EXPANSION LOOPS

A. Prefabricated flexible expansion loops of size and material noted. Loops shall consist of two sections of corrugated metal hose with protective braid suitable for operating pressure and temperature of the system.
   1. Drain plug for downward install loops.
   2. Automatic air vent for upward installed loops.

B. Connections:
   1. Threaded: 0.5 inch to 1.5 inch.
   2. Soldered: 0.5 inch to 2 inch.
   3. Flanged: 2-1/2 inch and up.

2.04 FIELD FABRICATED EXPANSION LOOPS

A. Fabricated from same pipe material and joints as service pipe.

B. Fabricate pipe expansion loops in U-bend configuration in accordance with ASHRAE HVAC Systems and Equipment Handbook.

C. Determine thermal expansion using following criteria:
   1. Domestic hot water:
      a. Copper: 1.02 inches per 100 feet.

2.05 ACCESSORIES

A. Pipe Alignment Guides:
   1. Two piece fabricated steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.

C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E. Provide factory-built or field-fabricated guides located along the pipelines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.

F. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

G. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION

SECTION 22 0519
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pressure gauges and pressure gauge taps.

B. Thermometers and thermometer wells.

1.02 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.

B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi; 2007.

C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2025).

D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014.

E. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012.

F. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

PART 2 PRODUCTS

2.01 LIQUID FLOW METERS

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
   2. Venture Measurement, a Danaher Corporation Company: www.venturemeasurement.com/#sle.
   3. McCrometer, Inc: www.mccrometer.com/#sle.

B. Calibrated {\rs\#1} venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gauge in case.

C. Annular element flow stations with meter set.
   1. Measuring Station: Type 316 stainless steel pitot type flow element inserted through welded threaded couplet, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
      a. Pressure rating: 275 psi.
      b. Maximum temperature: 400 degrees F.
      c. Accuracy: Plus 0.55 percent to minus 2.30 percent.

2.02 PRESSURE GAUGES

A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
   1. Case: Steel with brass bourdon tube.
   2. Size: 4-1/2 inch diameter.
   3. Mid-Scale Accuracy: One percent.
   4. Scale: Psi and kPa.

2.03 PRESSURE GAUGE TAPPINGS

A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.

B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.04 STEM TYPE THERMOMETERS

A. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
   1. Size: 7 inch scale.
   2. Window: Clear Lexan.
   3. Accuracy: 2 percent, per ASTM E77.
   4. Calibration: Degrees F.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.

C. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

D. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

E. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.02 SCHEDULES

A. Pressure Gauges, Location and Scale Range:
   1. Pumps, 0 to 50 psi.
   2. Expansion tanks, 0 to 50 psi.
   3. Backflow preventers, 0 to 150 psi.

B. Stem Type Thermometers, Location and Scale Range:
   1. Domestic hot water supply and recirculation.

END OF SECTION

SECTION 22 0523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Applications.

B. General requirements.

C. Angle valves.

D. Ball valves.

E. Check valves.

1.02 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).

B. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2013.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

D. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2025.

E. ASME B31.9 - Building Services Piping; 2025.

F. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017 (Reapproved 2025).

G. MSS SP-45 - Drain and Bypass Connections; 2020.

H. MSS SP-67 - Butterfly Valves; 2022.

I. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.

J. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

K. NSF 61 - Drinking Water System Components - Health Effects; 2024.

L. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.03 SUBMITTALS

A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

1.04 QUALITY ASSURANCE

A. Manufacturer:
   1. Obtain valves for each valve type from single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Use the following precautions during storage:
   1. Maintain valve end protection and protect flanges and specialties from dirt.
      a. Provide temporary inlet and outlet caps.
      b. Maintain caps in place until installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Provide the following valves for the applications if not indicated on drawings:
   1. Shutoff: Ball, butterfly, plug.
   2. Throttling: Provide ball.
   3. Swing Check (Pump Outlet):
      a. 2 NPS and Smaller: Bronze swing check valves with bronze disc.

B. Domestic, Hot and Cold Water Valves:
   1. 2 NPS and Smaller:
      a. Bronze and Brass: Provide with solder-joint ends.
      b. Bronze Angle: Class 125, bronze disc.
      c. Ball: One piece, full port, brass or bronze with brass trim.
      d. Bronze Swing Check: Class 125, bronze disc.
      e. Bronze Globe: Class 125, bronze disc.

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve-End Connections:
   1. Threaded End Valves: ASME B1.20.1.
   2. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
   3. Solder Joint Connections: ASME B16.18.

D. General ASME Compliance:
   1. Solder-joint Connections: ASME B16.18.
   2. Building Services Piping Valves: ASME B31.9.

E. Valve Materials for Potable Water: NSF 61 and NSF 372.

F. Valve Bypass and Drain Connections: MSS SP-45.

G. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE ANGLE VALVES

A. Class 125: CWP Rating: 200 psig:.
   1. Comply with MSS SP-80, Type 1.
   2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
   3. Ends: Threaded.
   4. Stem: Bronze.
   5. Disc: Bronze.
   6. Packing: Asbestos free.
   7. Handwheel: Bronze or aluminum.

2.04 BRONZE BALL VALVES

A. Two Piece, Standard Port with Bronze Trim:
   1. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends with union.

2.05 BRONZE SWING CHECK VALVES

A. Class 125: CWP Rating: 200 psig (1380 kPa).
   1. Comply with MSS SP-80, Type 3.
   2. Design: Horizontal flow.
   3. Body: Bronze, ASTM B62.
   4. Ends: Threaded as indicated.
   5. Disc: Bronze.

2.06 BRONZE GLOBE VALVES

A. Class 125: CWP Rating: 200 psig:
   1. Comply with MSS SP-80, Type 1.
   2. Body: ASTM B62, bronze with integral seat and screw-in bonnet.

3. Ends: Threaded joint.
4. Stem: Bronze.
5. Disc: PTFE.
6. Packing: Asbestos free.
7. Handwheel: Bronze or aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

D. Install check valves where necessary to maintain direction of flow as follows:
1. Swing Check: Install horizontal maintaining hinge pin level.

END OF SECTION

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SECTION 22 0529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other plumbing work.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2025.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).

F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

I. MFMA-4 - Metal Framing Standards Publication; 2004.

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with MSS SP-58 and Minnesota Plumbing Code.
   2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      c. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Metal Channel (Strut) Framing Systems:
   1. Comply with MFMA-4.

2. Channel Material:
    a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
3. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.

C. Hanger Rods per Minnesota Plumbing Code Table 313.6: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
    a. Equipment Supports: 1/2 inch diameter.
    b. Piping 1/2 to 4 inches: rod - 3/8 inch diameter.
    c. Piping 5 to 8 inches: rod - 1/2 inch diameter.
    d. Piping 10-12 inches: rod - 5/8 inch diameter.
    e. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

D. Thermal Insulated Pipe Supports:
1. General Construction and Requirements:
    a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with {\rs\#1} or {\rs\#1}.
    c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch iron pipes.
    d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by a 360 degree, PVC jacketing.
2. PVC Jacket:
    a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
    b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
    c. Thickness: 60 mil.

E. Pipe Supports:
1. Liquid Temperatures Up To 122 degrees F:
    a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
    b. Support From Below: MSS SP-58 Types 35 through 38.
2. Operating Temperatures from 122 to 446 degrees F:
    a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
    b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
    c. Sliding Support: MSS SP-58 Types 35 through 38.

F. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

G. Pipe Hangers: For a given pipe run use hangers of the same type and material.
1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

H. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

G. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Secure fasteners according to manufacturer's recommended torque settings.

I. Remove temporary supports.

END OF SECTION

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SECTION 22 0553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

D. Ceiling tacks.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

B. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Piping: Pipe markers.

B. Pumps: Nameplates.

C. Small-sized Equipment: Tags.

D. Tanks: Nameplates.

E. Valves: Tags and ceiling tacks where located above lay-in ceiling.

F. Water Treatment Devices: Nameplates.

2.02 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/2 inch.
   3. Background Color: Black.

2.03 TAGS

A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

2.04 PIPE MARKERS

A. Comply with ASME A13.1.

B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.05 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
   1. Plumbing Valves: Green.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Identify new and existing piping and equipment.

C. Install tags with corrosion resistant chain.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Identify valves in main and branch piping with tags.

F. Identify piping, concealed or exposed, with plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

G. Locate ceiling tacks to locate valves above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 22 0716
PLUMBING EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment insulation.

B. Covering.

1.02 REFERENCE STANDARDS

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, with Editorial Revision (2023).

B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

C. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2013.

D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

F. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, RIGID

A. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
   1. K Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Water Vapor Absorption: 5.0 percent by weight.
   4. Maximum Density: 8.0 lb/cu ft.

B. Vapor Barrier Jacket:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
   3. Secure with self-sealing longitudinal laps and butt strips.

4. Secure with outward clinch expanding staples and vapor barrier mastic.

2.03 JACKETS

A. PVC Plastic:
   1. Jacket: Sheet material, off-white color.
      a. Maximum Service Temperature: 150 degrees F.
      b. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
      c. Thickness: 10 mil.
      d. Connections: Brush on welding adhesive.
   2. Covering Adhesive Mastic: Compatible with insulation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. For fiberglass insulated equipment containing fluids below ambient temperature, provide vapor barrier jackets, factory-applied or field-applied, and finish with glass cloth and vapor barrier adhesive.

C. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

D. Fiberglass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

E. Inserts and Shields:
   1. Application: Equipment 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between hangers and inserts.
   3. Insert location: Between support shield and equipment and under the finish jacket.

F. Finish insulation at supports, protrusions, and interruptions.

G. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

H. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

3.03 SCHEDULES

A. Plumbing Systems:
   1. Domestic Hot Water Storage Tanks:
      a. Glass Fiber, Rigid Insulation: 1 inches thick.
   2. Domestic Cold Water Pressure Tanks:
      a. Glass Fiber, Rigid Insulation: 1 inch thick.

END OF SECTION

SECTION 22 0719
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).

C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.

D. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.05 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 GLASS FIBER

A. Manufacturers:
   1. Knauf Insulation: www.knaufusa.com.
   2. Johns Manville Corporation: www.jm.com.
   3. Owens Corning Corp: www.owenscorning.com.
   4. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. K Value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.
   1. Compatible with insulation.

2.02 JACKETS

A. PVC Plastic.
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil.
      e. Connections: Brush on welding adhesive.
   2. Covering Adhesive Mastic: Compatible with insulation.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
   1. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
   2. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
   1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H. Glass fiber insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:
   1. Application: Piping 2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert Location: Between support shield and piping and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 8 feet (2.5 meters) above finished floor): Finish with PVC jacket and fitting covers.

3.03 SCHEDULES

A. Plumbing Systems:
   1. Domestic Hot Water Supply:
      a. Glass Fiber Insulation:
         1) Operating Temperature 105-140F & Pipe Size Range: Less than 1-1/2 inch.
            (a) Thickness: 1 inch.
         2) Operating Temperature 105-140F & Pipe Size Range: 1-1/2 & greater inch.
            (a) Thickness: 1-1/2 inch.
   2. Domestic Hot Water Recirculation:
      a. Glass Fiber Insulation:
         1) Operating Temperature 105-140F & Pipe Size Range: Less than 1-1/2 inch.
            (a) Thickness: 1 inch.
   3. Domestic Cold Water: Ferrous and copper piping.
      a. Glass Fiber Insulation:
         1) Operating Temperature 40-60F & Pipe Size Range: Less than 1-1/2 inch.
         2) Thickness: 1/2 inch.
      b. Glass Fiber Insulation:
         1) Operating Temperature 40-60F & Pipe Size Range: 1-1/2 inch and greater
         2) Thickness: 1 inch.
   4. Roof Drainage Above Grade:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: All sizes.
         2) Thickness: 1 inch.
   5. Plumbing Vents Within 10 Feet of the Exterior:
      a. Glass Fiber Insulation:
         1) Thickness: 1 inch.

END OF SECTION

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SECTION 22 1005
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.
   1. Sanitary sewer.
   2. Radon Mitigation.
   3. Domestic water.
   4. Storm water.
   5. Gas.
   6. Flanges, unions, and couplings.
   7. Check.
   8. Strainers.

1.02 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.

C. ASME B31.1 - Power Piping; 2024.

D. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2025, with Errata.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

G. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2025.

H. ASTM B32 - Standard Specification for Solder Metal; 2020.

I. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

J. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020 (Reapproved 2024).

K. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2025.

L. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.

M. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.

N. AWWA C651 - Disinfecting Water Mains; 2023.

O. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.

P. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.

Q. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.

R. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2012.

S. NSF 61 - Drinking Water System Components - Health Effects; 2024.

T. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.03 SUBMITTALS

A. Project Record Documents: Record actual locations of piping.

1.04 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State of Minnesota plumbing code.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.06 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: CISPI 301, hubless, listed to NSF.
   1. Fittings: Cast iron, CISPI, listed by NSF
   2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

B. PVC Pipe: ASTM D2665.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron, CISPI marked.

B. PVC Pipe: ASTM D2665.

2.04 RADON MITIGATION

A. Below slab: Perforated schedule 40 PVC pipe (ASTM D2665) and solid fittings with solvent welded joints.

B. Above slab: Solid schedule 40 PVC pipe and fittings with solvent welded joints.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints:
      a. Soldered, ASTM B 32, alloy Sn95 solder.

2.06 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

B. PVC Pipe: ASTM D2665
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.07 STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron, CISPI marked.
   2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to CISPI 310.

2.08 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASTM A234/A234M, wrought steel welding type.
   2. Joints: ASME B31.1, welded.
   3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2.09 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded or welded to ASME B31.1.
      a. Inaccessible joints shall be welded.

2.10 FLANGES, UNIONS, AND COUPLINGS

A. Flanges for Pipe Size Over 1 Inch:
   1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
   2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

2.11 PIPE HANGERS AND SUPPORTS

1. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
   a. Bases: High-density polypropylene.
   b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   c. Steel Components: Stainless steel or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
   d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion-resistant material.
   e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.

B. Plumbing Piping - Drain, Waste, and Vent:
   1. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
   2. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
   3. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

C. Plumbing Piping - Water:
   1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
   2. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

2.12 BALL VALVES

A. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends with union.

2.13 PIPING SPECIALTIES

A. Flow Controls:

1. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
2. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

2.14 SWING CHECK VALVES

A. Up to 2 Inches:
   1. 1, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder ends.

2.15 RELIEF VALVES

A. Pressure:
   1. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

B. Temperature and Pressure:
   1. ANSI Z21.22, AGA certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME BPVC-IV certified and labelled.

2.16 STRAINERS

A. Size 2 inch and Under:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 0516.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Establish elevations of buried piping outside the building to ensure not less than 7 ft of cover.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

J. Provide support for utility meters in accordance with requirements of utility companies.

K. Install valves with stems upright or horizontal, not inverted. Refer to Section 22 0523.

L. PVC Pipe: Make solvent-welded joints in accordance with ASTM D 2855 and MN Code.

M. Caulk and seal non rated interior wall penetrations tight to restrict the passage of smoke.

N. Fire and smoke seal all rated wall penetrations see section 07 8000 for additional information.

O. Pipe Hangers and Supports:
   1. Support horizontal piping as indicated.
   2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   3. Place hangers within 12 inches of each horizontal elbow.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Provide plug valves in natural and propane gas systems for shut-off service.

D. Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/8 inch per foot slope, or as indicated on the plans.

B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

C. For piping 2 inches diameter or smaller, minimum slope shall be 1/4 inch per foot.

3.06 TESTING

A. ~~Hydrotest acid waste piping.~~

3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.08 SERVICE CONNECTIONS

A. Provide new sanitary and storm sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service complete with approved double check backflow preventer and water meter with by-pass valves.
   1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

3.09 SCHEDULES

A. Pipe Hanger Spacing:
   1. Metal Piping:
      a. Pipe Size: 1/2 inches to 1-1/4 inches:

1) Maximum Hanger Spacing: 6.5 ft.
2) Hanger Rod Diameter: 3/8 inches.

b. Pipe Size: 1-1/2 inches to 2 inches:
1) Maximum Hanger Spacing: 10 ft.
2) Hanger Rod Diameter: 3/8 inch.

c. Pipe Size: 2-1/2 inches to 4 inches.
1) Maximum Hanger Spacing: 10 ft.
2) Hanger Rod Diameter: 3/8 inch.

d. Pipe Size: larger than 4 inches to 6 inches:
1) Maximum Hanger Spacing: 10 ft.
2) Hanger Rod Diameter: 1/2 inch.

e. Pipe Size: 8 inches to 12 inches:
1) Maximum hanger spacing: 14 ft.
2) Hanger Rod Diameter: 5/8 inch.

2. Plastic Piping:
a. All Sizes:
1) Maximum Hanger Spacing: 6 ft.
2) Hanger Rod Diameter: 3/8 inch.

END OF SECTION

SECTION 22 1006
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Drains.

B. Cleanouts.

C. Hydrants.

D. Backflow preventers.

E. Water hammer arrestors.

F. Sanitary waste interceptors.

G. Mixing valves.

H. Relief valves.

1.02 REFERENCE STANDARDS

A. ASME A112.6.3 - Floor Drains; 2022.

B. NSF 61 - Drinking Water System Components - Health Effects; 2024.

C. NSF 372 - Drinking Water System Components - Lead Content; 2024.

D. PDI-WH 201 - Water Hammer Arresters; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

C. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors.

D. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

1.05 EXTRA MATERIALS

A. See Section 01 6000 - Product Requirements, for additional provisions.

B. Supply for Owner's use in maintenance of project:
   1. Two loose keys for outside wall hydrants.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

A. Floor Drain Manufacturers:
   1. Josam Company: www.josam.com.
   2. MIFAB, Inc: www.mifab.com/#sle.
   3. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
   4. Zurn Industries, LLC: www.zurn.com.
   5. Wade.
   6. Watts.
   7. Substitutions: Not permitted.

B. Overflow Roof Drains:
   1. Body: Lacquered cast iron with sump.
   2. Strainer: Removable cast iron dome with vandal proof screws.
   3. Accessories: Coordinate with roofing type, refer to Roofing Sections :
      a. Membrane flange and membrane clamp with integral gravel stop.
      b. Adjustable under deck clamp.
      c. Waterproofing flange.
      d. Leveling frame.
      e. Adjustable extension sleeve for roof insulation.
      f. Perforated stainless steel ballast guard extension.
   4. Manufacturers:
      a. Josam Company, Model 21500
      b. MIFAB, Inc., Model RD1200-JD - STR

C. Standard Roof Drains:
   1. Body: Lacquered cast iron with sump.
   2. Strainer: Removable cast iron dome.
   3. Accessories: Coordinate with roofing type, refer to Roofing Sections :
      a. Membrane flange and membrane clamp with integral gravel stop.
      b. Adjustable under deck clamp.
      c. Waterproofing flange.
      d. Leveling frame.
      e. Adjustable extension sleeve for roof insulation.
      f. Perforated stainless steel ballast guard extension.
   4. Manufacturers:
      a. Josam Company, Model 21500
      b. MIFAB, Inc., Model RD1200-JD-S
      c. Substitutions: Not permitted.

D. Standard Floor Drain (FD-1):
   1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.
      a. Provide floor drain with square, adjustable, nickel-bronze strainer in all locations with tile flooring.

E. Prefabricated Trench Drain (TD-1): Trench drain system assembled from factory fabricated, polymer concrete castings in standard lengths and variable depths, with integral joint flanges and integral grating support rails; includes joint gaskets and grating. Trench drain to form continuous channel without use of cross framing to allow for ease of maintenance.
   1. Grating Material and Style: Extra Heavy Duty Grate ADA heel proof, Load Class D, 1.5" thickness.
   2. Trench Width: 6 inches. Interior channel width. See plans for specific lengths.
   3. Grating Support Rail: Load bearing Galvanized steel with independent anchors.

F. Floor Sink (FS-2):
   1. Square lacquered cast iron body with integral seepage pan, epoxy coated interior, aluminum dome strainer, sediment bucket, full grate.

2.03 CLEANOUTS

A. Cleanouts at Interior Finished Floor Areas:
   1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

B. Cleanouts at Interior Finished Wall Areas:

1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

C. Cleanouts at Interior Unfinished Accessible Areas: Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.04 HOSE BIBBS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Watts Regulator Company: www.wattsregulator.com.
3. Zurn Industries, LLC: www.zurn.com.

B. Interior Hose Bibbs:
1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with handwheel, integral vacuum breaker in compliance with ASSE 1011.

2.05 WALL HYDRANTS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Watts
3. Woodford
4. Zurn Industries, LLC: www.zurn.com.
5. Substitutions: See Section 01 6000 - Product Requirements.

B. Wall Hydrants:
1. ASSE 1053; freeze resistant, self-draining type with chrome plated wall plate hose thread spout, lockshield and removable key, and integral vacuum breaker.
a. Woodford Model 68.

2.06 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventers:
1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.07 WATER HAMMER ARRESTORS

A. Manufacturers:
1. Sioux Chief; Model "Hydra-rester".

B. Water Hammer Arrestors:
1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.08 SANITARY WASTE INTERCEPTORS

A. Oil Interceptors:
1. Construction:
a. Material: Epoxy coated fabricated steel.
b. Rough-in: Fully recessed (shallow rough-in) with anchor flange.
c. Accessories: Integral deep seal trap, removable integral flow control, adjustable draw-off assembly, sediment bucket.
d. Cover: Steel, epoxy coated, non-skid with gasket, securing handle, and enzyme injection port.

B. Sand/Sediment Interceptors:

1. Epoxy coated cast iron body and secured extra heavy duty grated cover with removable stainless steel sediment bucket.

2.09 MIXING VALVES

A. Thermostatic Mixing Valves:
   1. Manufacturers:
      a. Lawler; Model 911, Unit 84701.
      b. ESBE: www.esbe.se/en.
      c. Lenard Valve Company.
      d. Speakman
      e. Powers
   2. Each Mixing Valve shall employ two fully independent control mechanisms which split the flow in half, blend each half to the design temperature and then integrate each stream at the outlet. The valve shall control outlet temperature over a wide range of flow and shall be suitable for deluge shower or eyewash applications in order to comply with ANSI standard Z358.1-2009. The valve shall include three thermometers to measure the temperature of each stream and the merged flow.
      a. Temperature adjustment shall be vandal-resistant.
      b. Unit shall be completely assembled and tested. Cabinet, with clear view port for the thermometers.
      c. In the event of interruption of the cold water supply, each control mechanism closes off the hot water port, stopping all flow. Positive hot water shut-off.
      d. In the event of interruption of the hot water supply, each control mechanism shall allow cold flow through both the fixed and variable by pass.
   3. Valve: Cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
   4. Capacity: 2 to 60 gpm at 30 psi differential.
   5. Accessories:
      a. Check valve and ball valve on inlets.
   6. Cabinet: 16 gage, 0.0598 inch prime coated steel, for recessed mounting with keyed lock.

2.10 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Plumbing contractor to perform all under-roof, roof drain work. Roof drain above roof work is provided and installed by roofing contractor.

D. Install floor cleanouts at elevation to accommodate finished floor.

E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

F. Pipe relief from backflow preventer to nearest drain.

G. Install water hammer arrestors complete with accessible isolation valve on cold water supply piping to plumbing fixtures, appliances and appurtenances with 3/8" or larger openings and with solenoid actuated quick closing valves.. All water hammer arrestors shall be installed in accessible locations.

H. Pipe Hangers and Supports:
    1. Install in accordance with ASME B31.9.

3.02 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install ball valves for throttling, bypass or manual flow control services.

3.03 PREPARATION

A. Ream pipe and tube ends, remove burrs, bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

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SECTION 22 1500
GENERAL-SERVICE COMPRESSED-AIR SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe and pipe fittings.

B. Reciprocating air compressors.

C. System filters.

D. Air dryers.

E. Air outlets.

1.02 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.

C. ASME B31.1 - Power Piping; 2024.

D. ASME B31.3 - Process Piping; 2024.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

F. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2025.

G. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

H. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

I. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2024).

J. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate manufacturer's installation instructions, hoisting and setting requirements, starting procedures.

D. Maintenance Data: Submit for air compressor, air receiver, and accessories, aftercooler, refrigerated air dryer, and pressure reducing station.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide five year manufacturer warranty for compressor.

PART 2 PRODUCTS

2.01 RECIPROCATING AIR COMPRESSORS

A. Manufacturers:

1. Atlas Copco USA: www.atlascopco.com/#sle.
2. Ingersoll Rand, Inc: www.ingersollrandproducts.com/#sle.
3. Sullair, LLC: www.sullair.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Electrically-driven, air-cooled compressor unit; factory assembled on surface-mount tank with heat exchangers, air intake filters, gauges, sight glasses, vibration isolators, thermostats, safeties, differential pressure oil pump, thermal overload protections, oil separator, moisture separator with drain trap, oil charging valve, and compressor bearings with ABMA STD 9, L10 life expectancy at 100,000 hours.

C. Receiver Accumulator Tank: 120 gal, mount compressor on horizontal aligned tank.

D. Enclosure: Sound masking enclosure capable of reducing equipment generated noise down to 50 percent of generated loudness.

E. Controls:
   1. Indicators:
      a. Air temperature.
      b. Oil temperature.
      c. Hour meter.
      d. Air discharge pressure.
      e. Sump pressure.
      f. Air intake filter loading.
      g. Anti-recycle timer.
      h. Phase loss/reversal monitor.
   2. Pushbutton or Handswitch: Start/stop and load/unload functions.

F. Electrical:
   1. Factory mount disconnect switch with terminal box with each circuit identified and spare spare to accommodate field-installed components. Ground each component to base of assembly.

2.02 PIPE AND PIPE FITTINGS

A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded or welded to {\rs\#1}.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), annealed.
   1. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.

C. Aluminum Tube: ASME B31.3, 6063 alloy, T5 temper.
   1. Fittings and Joints:
      a. Rigid Mechanical Couplings for Grooved Joints: Comply with ASTM F1476.

2.03 AIR OUTLETS

A. Quick Connector: 3/8 inch brass, snap-on connector with self closing valve, Style Coordinate sizes and types with owner.

2.04 AIR DRYERS (INTEGRAL MOUNTED TO COMPRESSOR AND TANK)

A. Type: Self-contained mechanical refrigeration type complete with heat exchanger, refrigeration compressor, automatic controls, moisture removal trap, internal wiring and piping, and full refrigerant charge.

B. Air Connections: Inlet and outlet connections at same level, factory insulated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Install compressor unit on concrete housekeeping pad.

C. Make air cock and drain connection on horizontal casing.

D. Install line size gate valve and check valve on compressor discharge.

E. Connect condensate drains to nearest floor drain.

F. Install takeoffs to outlets from top of main, with shut off valve after takeoff. Slope takeoff piping to outlets.

END OF SECTION

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SECTION 22 3000
PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Domestic-water heat exchangers.

B. Water softeners.

C. In-line circulator pumps.

1.02 REFERENCE STANDARDS

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .

B. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

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

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittals procedures.

B. Product Data:
   1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.

C. Shop Drawings:
   1. Indicate heat exchanger dimensions, size of tappings, and performance data.
   2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

PART 2 PRODUCTS

2.01 DOMESTIC-WATER HEAT EXCHANGERS

A. Type: Double wall type that separates the potable water from the heat transfer medium with a space vented to the atmosphere in accordance with ICC IPC.

B. Plates shall be AISI 316 stainless steel, and the gaskets shall be EPDM material.

C. Code: ASME BPVC-VIII-1 for service pressures, ASME "U" symbol stamped on heat exchanger.

D. Accessories:
   1. Wells for temperature regulator sensor at heated water outlet.
   2. ASME rated pressure and temperature relief valve on heated water discharge.
   3. ASME rated pressure relief valves from tapping on heated water side, set at 120 psig.
   4. ASME rated pressure relief valve on water inlet on downstream side of control valve.
   5. Thermometers and pressure gauge tappings on water inlets and outlets.

2.02 WATER SOFTENERS

A. Salt-Based Ion-Exchange Water Softener:
   1. Manufacturers:
      a. Water Control Corporation
      b. Culligan International Company: www.culligan.com/#sle.
      c. Substitutions: See Section 01 6000 - Product Requirements.
   2. Type: Separate ion exchange and feed tanks.
   3. Tank Materials: Glassfiber reinforced plastic ion exchange with one-piece resin for feed.
   4. Solenoid Valves: Brass or other process-resistant suitable material.
   5. Connections: 2 inch inlet, outlet, and backwash or regeneration with drain pipe.

6. Multifunctional Controller:
    a. Allows metered, timed cycle, or continuous duty usage.
    b. Full control of both softening and backwashing processes.
    c. Includes setting to enable automated system water bypass.
    d. Stores maximum and minimum usage when in continuous duty.
    e. Displays setting, usage, and flow, date, time, and other related specifics.
    f. Provides status and historical usage data including ability to filter specifics.

2.03 IN-LINE CIRCULATOR PUMPS

A. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.

B. Impeller: Bronze.

C. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.

D. Seal: Carbon rotating against a stationary ceramic seat.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.

C. Domestic Water Heat Exchangers:
    1. Support unit on pipe stand.
    2. Pipe relief valves and drains to nearest floor drain.

END OF SECTION

SECTION 22 4000
PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water closets.

B. Urinals.

C. Lavatories.

D. Sinks.

E. Mop sinks.

F. Electric water coolers.

G. Combination Emergency shower/Eye & Face wash

1.02 REFERENCE STANDARDS

A. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2014.

B. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).

C. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2024.

1.03 SUBMITTALS

A. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

B. Manufacturer's Instructions: Indicate installation methods and procedures.

C. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for electric water cooler.

1.07 EXTRA MATERIALS

A. See Section 01 6000 - Project Requirements, for additional provisions.

B. Supply two sets of faucet washers.

PART 2 PRODUCTS

2.01 HIGH EFFICIENCY FLUSH VALVE WATER CLOSETS

A. Wall Hung: WC-1 - Elongated Siphon Jet, WC-1A - ADA accesible height Elongated Siphon Jet.

1. Manufacturers:

a. American Standard Inc: www.americanstandard.com.
b. Kohler Company: www.kohlerco.com.
c. Zurn: www.zurn.com

2. ASME A112.19.2M; wall hung, siphon jet vitreous china closet bowl, with elongated rim, 1-1/2 inch top spud, china bolt caps.
3. Seat:
   a. Manufacturers:
      1) Bemis Manufacturing Company: www.bemisseats.com.
      2) Church Seat Company; Model 9500C: www.churchseats.com.
      3) Olsonite: www.olsonite.com.
   b. Solid black plastic, open front, extended back, brass bolts, without cover.
4. Flush Valve Manufacturers:
   a. American Standard: www.americanstandard-us.com
   b. Sloan Valve Company: www.sloanvalve.com.
   c. Zurn Industries, Inc: www.zurn.com.
   d. Sensor Operated Flush Valve: battery operated sensor.
      1) ASME A112.18.1; exposed chrome plated brass, piston type with battery operated solenoid, infrared sensor and over-ride button, concealed stop and vacuum breaker; maximum 1.28 gallon flush volume.
5. Water Closet Carrier:
   a. Manufacturers:
      1) JOSAM Company: www.josam.com.
      2) Mifab Manufacturing, Inc: www.mifab.com.
      3) Wade Drains, Division of Tyler Pipe: www.wadedrains.com.
      4) Zurn Industries, Inc: www.zurn.com.
      5) Watts.
   b. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.02 WALL HUNG URINALS

A. High Efficiency Urinal: UR-1
   1. Manufacturers:
      a. American Standard Inc; Model Washbrook #6590.501.020: www.americanstandard.com.
      b. Kohler Company: www.kohlerco.com.
      c. Zurn
      d. Sloan
      e. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. 1/2 GPF ASME A112.19.2M; vitreous china, wall hung siphon jet urinal with shields, 18 inch rim to top dimension, integral trap, <> top spud, steel supporting hanger.

B. Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Sloan Valve Company: www.sloanvalve.com.
   3. Zurn Industries, Inc: www.zurn.com.
   4. Sensor Operated Flush Valve:
      a. ASME A112.18.1; exposed chrome plated, diaphragm type with battery operated solenoid operator, infrared sensor and over-ride button in chrome plated plate, wheel handle stop and vacuum breaker; maximum 0.125 gallon flush volume.

C. Carriers:
   1. Manufacturers:
      a. JOSAM Company: www.josam.com.

b. Mifab Manufacturing, Inc: www.mifab.com.
c. Wade Drains, Division of Tyler Pipe: www.wadedrains.com.
d. Zurn Industries, Inc: www.zurn.com.
e. Watts.

2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.03 LAVATORIES

A. Vitreous China Wall Hung Basin: LV-1

1. ASME A112.19.2; vitreous china wall hung lavatory 15 x 15 inch minimum, with 4 inch high back, rectangular basin with splash lip, front overflow, and soap depression.
2. Sensor-Operated Faucet: Cast brass, chrome plated, deck mounted, 4" faucet mount holes.
   a. Spout Style: Standard.
   b. Power Supply: Battery, easily replaceable, alkaline or lithium, minimum 200,000 cycles.
      1) Low battery indicator warning light at 30 days remaining life and continuous light a 2 weeks.
   c. Thermostatic Mixing Valve: limited to maximum temperature of 110 degrees F, that meets ASSE 1070 or CSA B125.3.
   d. Mixing Valve: Internal, automatic.
   e. Water Supply: 3/8 inch compression connections.
   f. Aerator: Vandal resistant, 0.5 GPM, laminar flow device.
   g. Automatic Shut-off: 30 seconds.
   h. Sensor range: Factory set at a minimum of 3 inch adjustable up to 24 inch.
   i. Finish: Polished chrome.
   j. Faucet Manufacturers:
      1) American Standard Inc: www.americanstandard.com.
      2) Chicago Faucet Inc: www.chicagofaucet.com.
      3) Delta Faucet Company: www.deltafaucet.com.
      4) Zurn Industries, Inc: www.zurn.com.
3. Accessories:
   a. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
   b. Screwdriver stops.
   c. Flexible supplies.
   d. Carrier:
      1) ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, bearing plate and studs.
   e. Under Sink Protective Enclosures:
      1) ADA compliant under sink protection fully enclosing all piping traps and valves under sink.
         (a) Manufacturer: Truebro "LAV SHIELD" model 2018.
   f. Thermostatic Mixing Valve: limited to maximum temperature of 110 degrees F, that meets ASSE 1070 or CSA B125.3.
4. Manufacturers:
   a. American Standard Inc; Model Lucerne #0355.012 (4 inch)/#30356.015 (8 inch)/#0356.421 (single hole): www.americanstandard.com.
   b. Kohler Company: www.kohlerco.com.
   c. Zurn: www.zurn.com

2.04 SINKS

A. Single Compartment Bowl: SK-1

1. ASME A112.19.3M; 22 x 19 x 5.5 inch outside dimensions, 18 Gage thick, Type 304 stainless steel, wall hung
    a. Drain: 2 inch chromed brass drain.
    b. Manufacturers:
        1) Elkay: www.elkay.com.
        2) Kindred: www.kindred-sinkware.com.
        3) Just Manufacturing: www.justmfg.com.
        4) Moen Incorporated: www.moen.com.
2. Supply Faucet:
    a. Countertop mount mixing faucet, polished chrome plated brass, Single hole, with 8 inch gooseneck, 1.5 gpm vandal resistant pressure compensating laminar outlet, electronic sensor battery operated faucet.
    b. Supply Faucet Manufacturers:
        1) Chicago Faucet Inc: www.chicagofaucet.com.
        2) Delta Faucet Company: www.deltafaucet.com.
        3) Elkay: www.elkay.com
        4) Zurn Industries, Inc: www.zurn.com.
3. Accessories: Chrome plated 17 gage brass P-trap and arm with escutcheon, screwdriver stop, flexible supplies.

B. Wall Hung Multistation Hand Sink: SK-2
1. Manufacturers:
    a. Elkay: www.elkay.com
    b. Just
    c. Eljer
2. ASME A112.19.3M; 60 x 20 x 8 inch outside dimensions 14 gage thick, Type 304 stainless steel, self-rimming, buffed Satin Finish, three faucets, center drain placement.
    a. Drain: 3-1/2 inch with tailpiece.
    b. 10" high backsplash with 8 inch center faucet mounting.
3. Supply Faucet:
    a. Backsplash mounted commercial gooseneck faucet, 8 inch centers, wrist blade handles; Elkay LK940GN05T4H (typical of three).
    b. Supply Faucet Manufacturers:
        1) Chicago Faucet Inc: www.chicagofaucet.com.
        2) Delta Faucet Company: www.deltafaucet.com.
        3) American Standard.
        4) Elkay.
        5) Zurn Industries, Inc: www.zurn.com.
4. Accessories: Chrome plated 17 gage brass P-trap, continuous waste and arm with escutcheon, screwdriver stop, flexible supplies. Provide plaster trap for ADA sink in Room 1630.

C. Single Compartment Bowl: SK-3
1. ASME A112.19.3M; 19 x 19 x 5 inch outside dimensions, 18 Gage thick, Type 304 stainless steel, und and undercoated, with ledge back drilled for trim.
    a. Drain: 1-1/2 inch chromed brass drain.
    b. Manufacturers:
        1) Elkay: www.elkay.com.
        2) Kindred: www.kindred-sinkware.com.
        3) Just Manufacturing: www.justmfg.com.
        4) Moen Incorporated: www.moen.com.
        5) Advance Tabco.
2. Supply Faucet:

a. Deckmount mixing faucet, polished chrome plated brass, two hole 4 inch spread, with 8 inch gooseneck, 1.5 gpm vandal resistant pressure compensating laminar outlet, wrist blade handles ; Elkay LK406LGN08T4.
b. Supply Faucet Manufacturers:
1) Chicago Faucet Inc: www.chicagofaucet.com.
2) Delta Faucet Company: www.deltafaucet.com.
3) Elkay.
4) Zurn Industries, Inc: www.zurn.com.

3. Accessories: Chrome plated 17 gage brass P-trap and arm with escutcheon, screwdriver stop, flexible supplies.

2.05 ELECTRIC WATER COOLERS

A. Electric Water Cooler Manufacturers:
1. Acorn Aqua
2. Elkay Manufacturing Company; Model LZSTL8WSVRSK: www.elkay.com.
3. Haws Corporation: www.hawsco.com.

B. Dual Height Fountain w/ bottle filler:
1. Water Cooler: Electric, mechanically refrigerated; surface handicapped mounted; stainless steel top, stainless steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, integral infrared bottle filler with digital counter, push button, mounting bracket; integral air cooled condenser and stainless steel grille.
2. Electrical: 115 V, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.
a. Capacity: 8 gpm of 50 degree F water with inlet at 80 degree F and room temperature of 90 degree F.
b. Electrical: Maximum 0.25 hp compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.

2.06 SERVICE SINKS

A. Mop Basin: MB-1
1. Bowl: 24 x 24 x 10 inch high white molded stone, floor mounted, with one inch wide shoulders, vinyl bumper guard, stainless steel strainer.
a. Mustee 65M.311
b. Substitutions: See Section 01 2500 - Substitution Procedures.
2. Trim:
a. ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges. Delta 28T9.
3. Accessories:
a. 5 feet of 1/2 inch diameter plain end reinforced plastic hose.
b. Hose clamp hanger.
c. Mop hanger.
4. Trim Manufacturers:
a. Chicago Faucet Inc: www.chicagofaucet.com.
b. Delta Faucet Company: www.deltafaucet.com.
c. Moen, Inc.: www.moen.com.
d. Zurn Industries, Inc: www.zurn.com.

2.07 EMERGENCY EYE AND FACE WASH

A. Manufacturers:
1. Encon
2. Haws Corporation: www.hawsco.com.

3. Substitutions: See Section 01600 - Product Requirements.

B. Wall Mounted: EEW-1
   1. ANSI Z358.1; barrier-free, wall-mounted, self-cleaning, non-clogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor, twin eye wash heads , stainless steel dust cover, copper alloy control valve and fittings.

C. Pedestal Mounted: EEW-2
   1. ANSI Z358.1; barrier-free, free standing, self-cleaning, non-clogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor, twin eye wash heads , stainless steel dust cover, copper alloy control valve and fittings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall carriers and bolts.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

3.06 CLEANING

A. Clean plumbing fixtures and equipment.

3.07 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 23 0100
HVAC GENERAL PROVISIONS

PART 1 GENERAL

1.01 CONDITIONS OF THE CONTRACT

A. The conditions of the construction Contract and applicable provisions of Division 1, as well as these general provisions, shall apply to all sections of Division 23.

1.02 SCOPE

A. The work to be done under this Division of the specifications shall include the furnishing of all labor, materials, equipment and services necessary for the proper completion of all of the HVAC work as shown on the drawings and herein specified.

B. In general, this shall include the furnishing and installing of all HVAC systems, complete with auxiliaries, as may be required to make a complete and properly operating installation.

C. Only such items as are hereinafter specified or indicated on the drawings to be furnished by others, shall be considered to be furnished by others. All other items are to be considered as a part of this Contract, and shall be so bid.

D. The omission of specific reference to any parts necessary to, or reasonably incidental to, a complete installation shall not be construed as releasing the Contractor from furnishing and installing same.

1.03 DEFINITIONS

A. Provide: Under this Contract, Contractor shall furnish and install item or items specified. Contractor shall perform all labor and furnish all materials and equipment necessary to that specified item or system to be complete and operational in every respect.

B. Furnish: Under this Contract, Contractor shall deliver to the site item(s) specified, as well as additional specialized materials and/or accessories necessary for the use and operation of item or items specified.

C. Install: Under this Contract, Contractor shall set in position, connect (including sub-assemblies furnished), and adjust for use. Contractor shall furnish miscellaneous specialty items such as hangers, valves, unions, piping, sheet metal, etc., as obviously necessary for a complete and operating installation.

1.04 DRAWINGS

A. In general, the drawings of the HVAC systems and equipment are to scale, however, to determine exact locations of walls and partitions, the Contractor shall consult the Architectural and/or Structural Drawings. Drawings shall not take precedence over field measurements. Plans of piping and ductwork, although shown on scale drawings, are diagrammatic only. They are intended to indicate the size and/or capacity where stipulated, approximate location and/or direction, and approximate general arrangement of one phase of work to another, but not the exact detail or exact arrangement of construction.

B. Because the drawings are to a relatively small scale to show as large a portion as is practical, the fact that only certain features of the system are indicated does not mean that other similar or different features or details will not be required. Contractor shall furnish all incidental labor, materials, or equipment for the systems, so that each system is a complete and operating one unless otherwise specifically stipulated in the detailed body of the specifications.

C. The Contractor shall be responsible for determining all field measurements before commencing construction, giving due consideration to building design and other equipment to be installed. Plumbing equipment not dimensioned on the drawings shall be field located, giving due consideration to the work of other trades and clearances required by Code and for maintenance. The Contractor shall verify all dimensions before proceeding with the work.

D. Dimensions shall not be scaled from the drawings. If the Contractor discovers any discrepancy between actual measurements and those shown on the drawings which prevents good practice, good arrangement, or which is contrary to the intent of the drawings and specifications, request direction from the Architect before proceeding with the work.

1.05 SITE INSPECTION

A. Before submitting a proposal for the work contemplated in these specifications and accompanying drawings, each bidder shall examine the site and familiarize themselves with existing conditions and limitations, including the extent of demolition, cutting and patching to be done by the Contractor for HVAC work. No extras will be allowed because of the Contractor's misunderstanding as to the amount of work involved, or lack of knowledge of any condition in connection with the work.

1.06 CODES & STANDARDS

A. The entire project shall comply with any and all OSHA, Federal, State and local codes, including, but not limited to State Building Code, National Electrical Code, NFPA 13 and IBC Standards.

B. Code requirements shall supersede details shown on the drawings or described in these specifications.

1.07 PRODUCT/ASSEMBLY/SYSTEM SUBSTITUTION

A. Refer to Division 1 for substitution product request procedure.

B. Where the Bid Documents stipulate a particular product, substitutions will be considered by the Engineer up to 7 days before receipt of bids.

C. The submission shall provide sufficient information to determine acceptability of such products.

D. When a request to substitute a Product is made, the Engineer may approve the substitution and will issue approval by Addendum.

E. The cost of any changes of other trades as a result of use of a substitution material or equipment must be borne by the Contractor submitting such material or equipment.

1.08 EQUIPMENT

A. All equipment shall be new and in first-class condition unless explicately noted that reuse of existing equipment or components is the intent or is acceptable. Equipment shall not be used for purposes other than intended by the manufacturer.

B. Manufacturer's nameplate, name or trademark shall be permanently affixed to all equipment and material furnished under this specification. Nameplate of Subcontractor or distributor will not be acceptable. Nameplate shall be masked prior to any painting. Remove masking after completion.

C. Equipment specified and furnished shall be of a type and manufacturer that has a local representative and a local replacement and service outlet to give complete coverage on parts and service at all times.

1.09 WARRANTY

A. The Contractor shall be held responsible for any and all defects in equipment and workmanship which appear for one (1) full year after the date of Substantial Completion. All such defects must be repaired or defective equipment promptly replaced by the Contractor at no expense to the Owner.

1.10 INSPECTIONS AND FEES

A. The Contractor shall obtain all permits and licenses required in connection with the work under Division 23. Cost for such shall be paid by the Contractor.

B. When application for utility service is the Owner's responsibility, the Contractor shall be responsible for all phases of the installation other than the application itself and shall coordinate the utility's work with the installation.

1.11 SUBMITTALS

A. Cost Breakdown:
   1. Before submittal of the first request for payment, the Contractor shall submit to the Architect, an itemized cost breakdown, **including separation of labor and material**, for work under Division 23. The breakdown shall be divided in such detail as requested to aid in approval of payment requests based on work completed and shall include at a minimum the following:.
      a. Special HVAC conditions (bonds, mobilization, etc.)
      b. 23 0593 Testing Adjusting & Balancing.
      c. 23 0713 0716 0719 HVAC Insulation

B. Shop Drawings and Product Submittals:
   1. See Division 1 for submittal procedures. This section supplements the requirements of Division 1. In case of differences, the greater requirement applies.
   2. Shop drawings shall be submitted for all major equipment under each section of this specification.
   3. Shop drawings must first be checked by the Contractor for capacities, conformance to design requirements, and space conformance, and so stamped prior to submittal to the Architect.

C. Operating and Maintenance Manuals:
   1. See Division 1 for submittal procedures. This section supplements the requirements of Division 1. In case of differences, the greater requirement applies.
   2. The Contractor shall prepare one electronic version in PDF format with table of contents of links sequentially numbered for each division section. Each section that includes more than one product shall include a cover sheet with links to the first page of each product. All pages shall have text in horizontal orientation. Actual model numbers of products installed shall be clearly identified. Upon completion of the manuals the Contractor shall submit them to the Architect for approval and delivery to the Owner.
   3. Instructions shall include the following information:
      a. Include full instructions on lubrication, servicing and maintenance scheduling.
      b. Include operating instructions including start up, emergency shut down and start-up, seasonal servicing and start up, etc.
      c. Include owner’s manuals for each item of equipment.
      d. Include all equipment wiring diagrams.
      e. Include full parts lists and exploded schematic diagrams.
      f. Include backflow prevention device certification and yearly certification requirements per local code.
      g. Include full warranty information.
      h. Include full names, addresses, phone numbers, suppliers, service companies, contract numbers and other points of contact/information relative to the job.

D. Record Drawings:
   1. The Contractor shall keep a complete set of all HVAC drawings in the job site office for purposes of showing "As-Built" installation of HVAC systems and equipment.
   2. This set of drawings shall be used for no other purpose. Where any material, equipment or system components are installed different from that shown on the drawings, such differences shall be clearly and neatly shown on this set of drawings using ink, or indelible pencil. The change notations shall be kept up-to-date on a daily basis. At the completion of the project, the set of drawings shall be turned over to the Architect for approval and delivery to the Owner.

1.12 TEMPORARY UTILITIES

A. Contractor shall refer to Division 1 for temporary requirements during construction.

1.13 HAZARDOUS MATERIALS

A. Where the Contractor connects to existing piping suspected to be covered with asbestos containing materials, the Owner will be responsible for removal of the existing pipe covering at the point of connection. The Contractor shall be responsible for re-insulating said portion of the existing pipe.

1.14 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.15 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 WORKMANSHIP

A. Workmanship shall be first-class in every respect. Standard accepted practice in the various trades shall be considered as minimum. The Architect reserves the right to reject any workmanship not in accordance with the specifications, either before or after installation of equipment.

3.02 COORDINATION

A. The Contractor shall coordinate locations and arrangements of equipment with other Contractors and Subcontractors working on the project. Before starting work, the Contractor shall examine the Architectural, Structural, Mechanical, and Electrical drawings and specifications, as well as shop and vendor drawings, for all divisions, to ascertain locations, levels, arrangements and dimensions of other work and shall confer and cooperate with all other Contractors or Subcontractors to avoid all interferences. Provide Contractors for other trades with information regarding locations, arrangements and dimensions of the equipment.

B. In cases of interferences between various items of equipment or between equipment and building members, if simplified construction is made possible by the relocation of certain equipment, changes in arrangements may be made only if authorized by the Architect.

C. Interferences between the work of different divisions which cannot be resolved by the parties involved shall be submitted to the Architect who shall decide upon final location and arrangement without respect to which work was installed first.

3.03 DEMOLITION AND REMODELING

A. Where cutting and patching is required, each Contractor shall be responsible for their own work.

B. Relocation of existing equipment and piping systems, which of necessity must provide continuous uninterrupted service, shall be accomplished in the least possible time. Work shall be scheduled so as to minimize down time for the respective systems involved. This will require for existing services being revamped and/or relocated, that all interconnecting portions of these systems shall be installed as complete as practicable prior to actual shutdown for final connections.

C. Locate existing piping and make connection where required and/or where shown on the drawings. Do not cut into existing services without first ascertaining that the pipe involved is the desired service. In any area where work performed under Division 23 is the only work involved, restore the area to its original condition upon completion of the work.

D. All existing services and equipment shall be maintained unless otherwise indicated on the drawings.

E. Work that interrupts any service (this includes cutting into existing lines for new connection), shall be performed at times to cause least interference to the normal operation of the building. Anticipate scheduling work at periods which will result in additional construction costs, such as nights or weekends, and include cost in the proposal.

F. The Owner shall be fully informed in advance of any shut-off which will occur and which will be affected for a specific period of time. Only after the Owner is fully informed and has agreed to the schedule of cut-offs, can the work then proceed accordingly.

G. Provide temporary bracing, shoring, underpinning and support during demolition, cutting, remodeling and related new construction as necessary for the execution of the work and the of persons and property.

H. Provide protective coverings and enclosures necessary to prevent damage to existing work to remain. Protect temporary openings in exterior walls and roofs so as to prevent damage from water and the elements and prevent excessive heat loss from the existing building.

I. Demolish and remove existing construction to be removed. Where new work is to be installed in or adjacent to existing construction or existing work is to be replaced, remove or cut the existing construction to the extent necessary to install or join the new work to the existing construction as necessary to complete the Work of the Project.

J. Clean demolition areas and remove debris, waste and rubbish from the building at the conclusion of each day's work. Transport debris and rubbish in such a manner as to prevent the spread of dust. Remove debris, waste and rubbish promptly from the site. Do not burn debris, waste and rubbish on the site.

K. Owner shall have first rights to salvage existing equipment not indicated to be reused. All existing materials not designated to be reused or to remain the property of the Owner, shall become the property of the Contractor and shall be removed from the site.

L. Existing materials indicated on the drawings to be reused shall be stored on the site and protected until reuse.

M. Patch existing construction to match. All painting shall comply with the specifications laid out in the General Contractor's portion of the specifications. Examine existing surfaces where existing surfaces are to be patched before proceeding with the work. Report all conditions where existing materials, colors, and finishes cannot be matched to the Architect, and do not proceed until the Architect has issued instructions. Existing construction that has been damaged as a result of the work shall be repaired to an extent and as required to match adjacent undamaged construction.

N. Where duct and/or piping is removed from existing partitions which are to remain, it is this Contractor's responsibility to patch voids to match existing construction.

3.04 JOB INSPECTION

A. Periodic job site observations will be made throughout the construction to review applications for payment, observe methods and materials of construction, and review requirements of the Bid Documents.

B. Contractor shall notify the authority having jurisdiction, and arrange for observation of installation prior to backfill or concealing of systems. Contractor shall, to the maximum practical extent, schedule work to allow for the observation of systems' installation in groups rather than individually.

C. Upon completion of all work, and submittal and approval of closeout documents, Contractor shall notify the Architect and shall make arrangements for a Substantial Completion inspection.

D. After the inspection is made, the Contractor will receive a list of items requiring adjustment, correction, replacement or completion.

E. The Contractor shall promptly comply completely with all the listed requirements. Should the Contractor fail to perform promptly, the Architect reserves the right to have the work completed by others and the cost deducted from the contract price.

3.05 TRAINING

A. Contractor shall instruct the Owner's personnel in the operation and maintenance procedures of all equipment and systems. Contractor shall confirm in writing prior to the final inspection that Owner has been satisfactorily instructed in the operation of all systems. Coordinate with the Owner.

B. Complete on-site training shall be included for all HVAC equipment and systems. Training shall be complete with all materials included in the contract. Training shall be provided by factory-trained instructors, or factory-certified equipment suppliers.

END OF SECTION

SECTION 23 0513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General construction and requirements.

B. Applications.

C. Single phase electric motors.

D. Three phase electric motors.

1.02 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).

B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.

C. NEMA MG 00001 - Motors and Generators; 2024.

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

1.03 SUBMITTALS

A. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

PART 2 PRODUCTS

2.01 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 104 degrees F environment.
   3. Design for temperature rise in accordance with NEMA MG 00001 limits for insulation class, service factor, and motor enclosure type.
   4. All motors shall be premium efficiency unless noted otherwise.
   5. Provide grounding rings on all VFD rated motors, verify with mechancial schedules for motors controlled with VFD's.

B. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

C. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.02 APPLICATIONS

A. Single phase motors for fans, pumps, blowers, and air compressors: Capacitor start type.

2.03 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

2.04 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Design, Construction, Testing, and Performance: Comply with NEMA MG 00001 for Design B motors.

B. Insulation System: NEMA Class B or better.

C. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

D. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 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.

E. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

F. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 23 0516
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flexible pipe connectors.

B. Expansion joints and compensators.

C. Pipe loops, offsets, and swing joints.

1.02 REFERENCE STANDARDS

A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2025.

B. EJMA (STDS) - EJMA Standards; Tenth Edition.

1.03 SUBMITTALS

A. Product Data:
   1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
   2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

B. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.

C. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

PART 2 PRODUCTS

2.01 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

A. Manufacturers:
   1. Mercer Rubber Company: www.mercer-rubber.com.
   2. Metraflex Company: www.metraflex.com.
   3. Apache Hose.
   4. Flexonics Model FCS..

B. Inner Hose: Bronze.

C. Exterior Sleeve: Single braided, stainless steel.

D. Pressure Rating: 125 psi and 450 degrees F.

E. Joint: Flanged.

F. Size: Use pipe sized units.

G. Maximum offset: 3/4 inch on each side of installed center line.

2.02 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

A. Manufacturer:
   1. Mercer Rubber Company: www.mercer-rubber.com.
   2. Metraflex Company: www.metraflex.com.
   3. Apache Hose.
   4. Flexonics Model FCS.

B. Inner Hose: Bronze.

C. Exterior Sleeve: Braided bronze.

D. Pressure Rating: 125 psi and 450 degrees F.

E. Joint: Flanged.

F. Size: Use pipe sized units.

G. Maximum offset: 3/4 inch on each side of installed center line.

2.03 EXPANSION JOINTS - STEEL WITH PACKED SLIDING SLEEVE

A. Manufacturers: Flexonics Model Series H

B. Working Pressure and Temperature: Class 150.

C. Joint: Flanged.

D. Size: Use pipe sized units.

E. Application: Steel piping 2 inches and over.

2.04 EXPANSION JOINTS - COPPER WITH PACKED SLIDING SLEEVE

A. Manufacturers: Flexonics Model HB.

B. Working Pressure: 125 psi.

C. Maximum Temperature: 250 degrees F.

D. Joint: Flanged.

E. Size: Use pipe sized units.

F. Application: Copper or steel piping 2 inches and over.

2.05 ACCESSORIES

A. Stainless Steel Pipe: ASTM A269/A269M, seamless type, Grade TP304.

B. Pipe Alignment Guides:

1. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Not all expansion loops are shown on the drawings. Where required by installation provide expansion loops or compensators.

C. **Where site conditions permit and where installation details require, provide properly sized expansion loops. Contact Engineer for assistance in sizing loops.**

D. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.

E. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

F. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

G. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION

SECTION 23 0519
METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Liquid flow meters.

B. Pressure gage taps.

C. Thermometers and thermometer wells.

D. Static pressure gauges.

E. Filter gauges.

1.02 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.

B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi; 2007.

C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2025).

D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014.

E. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

B. Project Record Documents: Record actual locations of components and instrumentation.

1.04 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 LIQUID FLOW METERS

A. CalibratedASME MFC-3M Venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gauge in case.

B. Annular element flow stations with meter set.
   1. Measuring Station: Type 316 stainless steel pitot type flow element inserted through welded threaded couplet, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
      a. Pressure rating: 275 psi.
      b. Maximum temperature: 400 degrees F.
      c. Accuracy: Plus 0.55 percent to minus 2.30 percent.

2.02 PRESSURE GAUGES

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com.
   2. Moeller Instrument Company, Inc: www.moellerinstrument.com.
   3. Omega Engineering, Inc: www.omega.com.
   4. Weiss Instruments; Model 4CTS-1.

B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
   1. Case: Cast aluminum with phosphor bronze bourdon tube.
   2. Size: 3-1/2 inch diameter.
   3. Mid-Scale Accuracy: One percent.
   4. Scale: Psi.

2.03 PRESSURE GAUGE TAPPINGS

A. Gage Cock: Tee or lever handle, 303 stainless for maximum 200 psi, as manufactured by Weiss Instruments Model TC-14735-6.

B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi, as manufactured by Weiss Instruments Model 25NVBR.

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.04 STEM TYPE THERMOMETERS

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com.
   2. Omega Engineering, Inc: www.omega.com.
   3. Weiss Instruments Model DVU35.
   4. Weksler Glass Thermometer Corp: www.wekslerglass.com.

B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
   1. Size: 9 inch scale.
   2. Window: Clear glass.
   3. Stem: 3/4 inch NPT brass.
   4. Accuracy: 2 percent, per ASTM E77.
   5. Calibration: Degrees F.

2.05 DIAL THERMOMETERS

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com.
   2. Omega Engineering, Inc: www.omega.com.
   3. Weksler Glass Thermometer Corp: www.wekslerglass.com.
   4. Weiss Instruments Model 5VBM4.

B. Thermometer: ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
   1. Size: 4 inch diameter dial.
   2. Lens: Clear glass.
   3. Accuracy: 1 percent.
   4. Calibration: Degrees F.

2.06 THERMOWELLS

A. Stainless Steel with 2-1/2 inches lagging extension. Insertion depth if well equal 1/2 the pipe diameter up to a maximum of 6 inches long.

2.07 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gauges, one gauge adapters with 1/8 inch probes, two 1 inch dial thermometers.

2.08 STATIC PRESSURE GAUGES

A. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

B. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

C. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Provide siphon on gauges in steam systems. Extend nipples and siphons to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

F. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

G. Locate test plugs adjacent to control device sockets.

3.02 SCHEDULE

A. Liquid Consumption Meters, Location:
   1. Heating water system, new branch serving building.
   2. Chilled water system.

B. Pressure Gauges, Location and Scale Range:
   1. Pumps, 0 to 2 X pump operating pressure psi. Provide 1 gage piped with Needle valves to inlet and outlet of pump.
   2. Expansion tanks, 0 to 60 psi.

C. Pressure Gauge Tappings, Location:
   1. Control valves 3/4 inch & larger - inlets and outlets.
   2. Major coils - inlets and outlets.
   3. Chiller - inlets and outlets.

D. Stem Type Thermometers, Location and Scale Range:
   1. Coil banks - inlets and outlets.
   2. Chiller - inlets and outlets.

E. Static Pressure and Filter Gauges, Location and Scale Range:
   1. Built up filter banks.

END OF SECTION

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SECTION 23 0529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other HVAC/hydronic work.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).

E. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

F. MFMA-4 - Metal Framing Standards Publication; 2004.

G. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 1.5. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   1. Comply with MFMA-4.

C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
   1. Minimum Size, Unless Otherwise Indicated or Required:
      a. Equipment Supports: 1/2 inch diameter.
      b. Piping up to 1 inch (27 mm) nominal: 1/4 inch diameter.
      c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
      d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

D. Pipe Supports:
   1. Liquid Temperatures Up To 122 degrees F:
      a. Overhead Support: MSS SP-58 Types 1, 3 through 12.

b. Support From Below: MSS SP-58 Types 35 through 38.

2. Operating Temperatures from 122 to 446 degrees F:
   a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
   b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
   c. Sliding Support: MSS SP-58 Types 35 through 38.

E. Riser Clamps:
   1. Provide copper plated clamps for copper tubing support.
   2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.

F. Pipe Hangers: For a given pipe run, use hangers of the same type and material.
   1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
   2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

G. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
   1. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.

H. Anchors and Fasteners:
   1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

G. Secure fasteners according to manufacturer's recommended torque settings.

H. Remove temporary supports.

END OF SECTION

SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Adhesive-backed duct markers.

D. Stencils.

E. Pipe markers.

F. Ceiling tacks.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

1.03 SUBMITTALS

A. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 PRODUCTS

2.01 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch.
   3. Background Color: Black.

2.02 TAGS

A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

B. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.03 ADHESIVE-BACKED DUCT MARKERS

A. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.

B. Style: Multiple Markers on a Roll.

C. Color: Yellow/Black.

2.04 STENCILS

A. Stencils: With clean cut symbols and letters of following size:
   1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
   2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
   3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.

2.05 PIPE MARKERS

A. Color: Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.06 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers and Smoke Dampers: Red.
   3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions, and every 20 feet and on changes in direction per owners requirements.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify thermostats relating to terminal boxes or valves with nameplates.

I. Identify valves in main and branch piping with tags.

J. Identify air terminal units and radiator valves with numbered tags.

K. Tag automatic controls, instruments, and relays. Key to control schematic.

L. Identify piping, concealed or exposed, with plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

M. Install ductwork with plastic labels every 20 feet and changes in direction. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

N. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic systems.

C. Measurement of final operating condition of HVAC systems.

D. Commissioning activities.

1.02 REFERENCE STANDARDS

A. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2024, with Errata (2025).

B. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems; 2015, Eighth Edition.

C. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2023.

1.03 SUBMITTALS

A. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Submit to Architect.
   2. Include at least the following in the plan:
      a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      c. Identification and types of measurement instruments to be used and their most recent calibration date.
      d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      e. Final test report forms to be used.
      f. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
      g. Procedures for formal deficiency reports, including scope, frequency and distribution.

C. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Revise TAB plan to reflect actual procedures and submit as part of final report.
   2. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.
   3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.

4. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
6. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
7. Units of Measure: Report data in I-P (inch-pound) units only.
8. Include the following on the title page of each report:
    a. Name of Testing, Adjusting, and Balancing Agency.
    b. Address of Testing, Adjusting, and Balancing Agency.
    c. Telephone number of Testing, Adjusting, and Balancing Agency.
    d. Project name.
    e. Project location.
    f. Project Architect.
    g. Project Contractor.
    h. Project altitude.
    i. Report date.

E. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

F. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
1. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
2. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems, or TAB.
3. SMACNA (TAB).
4. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
2. Having minimum of three years documented experience.
3. Certified by one of the following:
    a. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
    b. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Air coil fins are cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
   10. Air outlets are installed and connected.
   11. Duct system leakage is minimized.
   12. Hydronic systems are flushed, filled, and vented.
   13. Pumps are rotating correctly.
   14. Proper strainer baskets are clean and in place.
   15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

B. Identify locations where additional balancing devices as required and report on deficiency report.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
   1. Running log of events and issues.
   2. Discrepancies, deficient or uncompleted work by others.
   3. Contract interpretation requests.
   4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

G. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Total sum of air outlets and inlets is larger than full AHU CFM due to expected occupant diversity, full flow in one area may be simulated with temporary restriction of air flow to other areas.

3.07 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

3.08 COMMISSIONING

A. Perform prerequisites prior to starting commissioning activities.

B. Fill out Prefunctional Checklists for:
   1. Air side systems.
   2. Water side systems.

C. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.

D. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for 100 percent of the air handlers plus a random sample equivalent to 10 percent of the final TAB report data as directed by Commissioning Authority.
   1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
   2. Use the same test instruments as used in the original TAB work.
   3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
   4. For purposes of re-check, failure is defined as follows:
      a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
      b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
      c. Temperatures: Deviation of more than two degree F.
      d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
   5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.

E. In the presence of the Commissioning Authority, verify that:
   1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
   2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
   3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.09 SCOPE

A. Test, adjust, and balance the following:
   1. Plumbing Pumps.
   2. HVAC Pumps.
   3. Air Source Heat Pumps.
   4. Computer Room Air Conditioning Units.
   5. Air Coils.
   6. Variable Air Volume Terminals.
   7. Air Handling Units.
   8. Fans.
   9. Air Filters.
   10. Air Inlets and Outlets.
   11. Tailpipe exhaust

12. Welding exhaust
13. Domestic hot water recirculation balancing valves.

B. HVAC/Plumbing Equipment Documentation.
1. Provide Nameplate and capacity information for each piece of plumbing and HVAC equipment installed as part of this project.

3.10 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
1. Manufacturer.
2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Starter size, rating, heater elements.
8. Sheave Make/Size/Bore.

B. V-Belt Drives:
1. Identification/location.
2. Required driven RPM.
3. Driven sheave, diameter and RPM.
4. Belt, size and quantity.
5. Motor sheave diameter and RPM.
6. Center to center distance, maximum, minimum, and actual.

C. Pumps:
1. Identification/number.
2. Manufacturer.
3. Size/model.
4. Impeller.
5. Service.
6. Design flow rate, pressure drop, BHP.
7. Actual flow rate, pressure drop, BHP.
8. Discharge pressure.
9. Suction pressure.
10. Total operating head pressure.

D. Heat Exchangers:
1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Steam pressure, design and actual.
8. Primary water entering temperature, design and actual.
9. Primary water leaving temperature, design and actual.
10. Primary water flow, design and actual.
11. Primary water pressure drop, design and actual.

E. Cooling Coils:
1. Identification/number.
2. Location.
3. Service.

4. Manufacturer.
5. Air flow, design and actual.
6. Entering air DB temperature, design and actual.
7. Entering air WB temperature, design and actual.
8. Leaving air DB temperature, design and actual.
9. Leaving air WB temperature, design and actual.
10. Water flow, design and actual.
11. Water pressure drop, design and actual.
12. Saturated suction temperature, design and actual.
13. Air pressure drop, design and actual.

F. Heating Coils:
1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Water flow, design and actual.
7. Water pressure drop, design and actual.
8. Entering water temperature, design and actual.
9. Leaving water temperature, design and actual.
10. Entering air temperature, design and actual.
11. Leaving air temperature, design and actual.
12. Air pressure drop, design and actual.

G. Air Moving Equipment:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

H. Return Air/Outside Air:
1. Identification/location.
2. Design air flow.
3. Actual air flow.
4. Design return air flow.
5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Required mixed air temperature.
11. Actual mixed air temperature.

I. Exhaust Fans:
   1. Location.
   2. Manufacturer.
   3. Model number.
   4. Serial number.
   5. Air flow, specified and actual.
   6. Total static pressure (total external), specified and actual.
   7. Inlet pressure.
   8. Discharge pressure.
   9. Sheave Make/Size/Bore.
   10. Number of Belts/Make/Size.
   11. Fan RPM.

J. Duct Traverses:
   1. System zone/branch
   2. Duct size
   3. Area
   4. Design velocity
   5. Design air flow
   6. Test velocity
   7. Test air flow
   8. Duct static pressure
   9. Air temperature
   10. Air correction factor

K. Welding and Tailpipe exhaust:
   1. System zone/branch.
   2. Duct size.
   3. Area.
   4. Design velocity.
   5. Design air flow.
   6. Test velocity.
   7. Test air flow.
   8. Duct static pressure.
   9. Air temperature.
   10. Air correction factor.

L. Duct Leak Tests:
   1. Description of ductwork under test.
   2. Duct design operating pressure.
   3. Duct design test static pressure.
   4. Duct capacity, air flow.
   5. Maximum allowable leakage duct capacity times leak factor.
   6. Test apparatus:
      a. Blower.
      b. Orifice, tube size.
      c. Orifice size.
      d. Calibrated.
   7. Test static pressure.
   8. Test orifice differential pressure.
   9. Leakage.

M. Air Monitoring Stations:
   1. Identification/location.

2. System.
3. Size.
4. Area.
5. Design velocity.
6. Design air flow.
7. Test velocity.
8. Test air flow.

N. Flow Measuring Stations:
1. Identification/number.
2. Location.
3. Size.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Design Flow rate.
8. Design pressure drop.
9. Actual/final pressure drop.
10. Actual/final flow rate.
11. Station calibrated setting.

O. Terminal Unit Data:
1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model number.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.
11. Inlet static pressure.

P. Air Distribution Tests:
1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Design velocity.
6. Design air flow.
7. Test (final) velocity.
8. Test (final) air flow.
9. Percent of design air flow.

Q. Domestic water recirculation balancing valves:
1. Location
2. Setpoint/test flowrate
    a. Add physical mark on valve to designate original setpoint.

END OF SECTION

SECTION 23 0713
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Insulation jackets.

1.02 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.

E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

1.03 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 GLASS FIBER, FLEXIBLE

A. Manufacturer:
   1. Knauf Insulation: www.knaufusa.com.
   2. Johns Manville: www.jm.com.
   3. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
   4. Certain-teed.
   5. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Insulation: ASTM C553; flexible, noncombustible blanket.

1. K value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 150 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.
4. Density: 1 lb/cu ft.

C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.029 ng/Pa s m (0.02 perm inch), when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

2.02 GLASS FIBER, RIGID

A. Manufacturer:
1. Knauf Insulation: www.knaufusa.com.
2. Johns Manville: www.jm.com.
3. Owens Corning Corp: www.owenscorning.com.
4. CertainTeed Corporation: www.certainteed.com.
5. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Insulation: ASTM C612; rigid, noncombustible blanket.
1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum service temperature: 150 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent.
4. Maximum Density: 3 lb/cu ft.

C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

2.03 JACKETS

A. Aluminum Jacket: ASTM B209 (ASTM B209M).
1. Thickness: 0.016 inch sheet.
2. Finish: Embossed.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.020 inch thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated ducts conveying air below ambient temperature:
1. Provide insulation with vapor barrier jackets.

2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated ducts conveying air above ambient temperature:
1. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. Ducts Exposed in Finished Spaces (below 10 feet above finished floor): Finish with aluminum jacket primed for painting.

3.03 SCHEDULES

A. Minimum Code Compliance is required for installed insulation "R" values.

B. Exhaust Ducts Within 10 ft of Exterior Openings:
1. Flexible Glass Fiber Duct Insulation: 3 inches thick.
2. Rigid Glass Fiber Duct Insulation: 2 inches thick.

C. Outside Air Intake Ducts:
1. Flexible Glass Fiber Duct Insulation: 3 inches thick.
2. Rigid Glass Fiber Duct Insulation: 2 inches thick.

D. Supply Ducts:
1. Flexible Glass Fiber Duct Insulation in concealed areas: 1-1/2 inches thick.

E. Use Rigid Glass Fiber in Mechanical Rooms:
1. Rigid Glass Fiber Duct Insulation: 2 inches thick.

END OF SECTION

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SECTION 23 0716
HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment insulation.

B. Covering.

1.02 REFERENCE STANDARDS

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, with Editorial Revision (2023).

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

D. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2013.

E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, RIGID

A. Manufacturer:
   1. Knauf Insulation: www.knaufusa.com.

2. Johns Manville Corporation: www.jm.com.
3. Owens Corning Corp: www.owenscorning.com.
4. CertainTeed Corporation: www.certainteed.com.

B. Insulation: ASTM C612or ASTM C592; rigid, noncombustible.
1. K Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 850 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.
4. Maximum Density: 8.0 lb/cu ft.

C. Vapor Barrier Jacket:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with self-sealing longitudinal laps and butt strips.

D. Facing: 1 inch galvanized steel hexagonal wire mesh stitched on one face of insulation.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.
1. Compatible with insulation.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
1. ASTM C195; hydraulic setting on mineral wool.

2.03 JACKETS

A. PVC Plastic:
1. Jacket: Sheet material, off-white color.
a. Maximum Service Temperature: 150 degrees F.
b. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
c. Thickness: 10 mil.
d. Connections: Brush on welding adhesive.
2. Covering Adhesive Mastic: Compatible with insulation.
a. Compatible with insulation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Exposed Equipment: Locate insulation and cover seams in least visible locations.

C. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

D. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

E. Fiber glass insulated equipment containing fluids below ambient temperature; provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.

F. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.

G. Inserts and Shields:

1. Application: Equipment 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between hangers and inserts.
3. Insert Location: Between support shield and equipment and under the finish jacket.

H. Finish insulation at supports, protrusions, and interruptions.

I. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers or aluminum jacket.

J. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

3.03 SCHEDULE

A. Heating Systems:
1. Heat Exchangers/Converters:
a. Rigid Glass Fiber formed insulation.
1) 1-1/2 inches thick.
2. Air Separators:
a. Rigid Glass Fiber Formed insulation.
1) 1-1/2 inches thick.
3. Expansion Tanks:
a. Rigid Glass Fiber formed insulation.
1) 1-1/2 inches thick.

END OF SECTION

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SECTION 23 0719
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).

D. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2024).

E. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

F. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).

G. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.

H. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.

I. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).

1.03 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.06 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 GLASS FIBER, RIGID

A. Manufacturers:
   1. Knauf Insulation: www.knaufinsulation.com.
   2. Johns Manville Corporation: www.jm.com.
   3. Owens Corning Corp: www.owenscorning.com.

4. CertainTeed Corporation: www.certainteed.com.

B. Insulation: ASTM C547and ASTM C795; rigid molded, noncombustible.
   1. K Value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.
   1. Factory applied double pressure sensitive adhesive along longitudinal joints. Joints at insulation sections sealed with butt strips with adhesive factory applied.

F. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
   1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

G. Insulating Cement: ASTM C449.
   1. ASTM C449/C449M.

2.02 HYDROUS CALCIUM SILICATE

A. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.
   1. K Value: 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
   2. Maximum Service Temperature: 1200 degrees F.
   3. Density: 15 lb/cu ft.

B. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

C. Insulating Cement: ASTM C449.
   1. ASTM C449/C449M.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
   1. Armacell LLC; AP Armaflex: www.armacell.us/#sle.
   2. Rubatex.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
   1. Minimum Service Temperature: Minus 40 degrees F.
   2. Maximum Service Temperature: 180 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.04 JACKETS

A. PVC Plastic.
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil.
      e. Connections: Brush on welding adhesive.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
   1. Thickness: 0.016 inch sheet.

2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature; insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

G. Glass fiber insulated pipes conveying fluids above ambient temperature.
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.

H. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.

J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

K. Piping 3 inches or larger located in shafts or chases: Provide PVC jacket over insulation.

L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

3.03 SCHEDULE

A. Heating Systems:
   1. Heating Water Supply and Return (Up to 200 degrees):
      a. Glass Fiber Insulation:
         1) Pipe Size Range: Less than 1-1/2 inch
            (a) Thickness: 1-1/2 inch.
         2) Pipe Size Range: 1-1/2 inch and greater.
            (a) Thickness: 2 inch.
   2. Low Pressure Steam Piping:
      a. Hydrous Calcium Silicate Insulation:
         1) Pipe Size Range: 2-1/4" to 5"
            (a) Thickness: 3 inch.
   3. Low Pressure Steam Condensate:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: 1-1/4" to 2"
            (a) Thickness: 1-1/2 inch.

B. Cooling Systems:
   1. Chilled Water:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: 1-1/2 inch and greater.
            (a) Thickness: 1 inch.
   2. Cold Condensate Drains:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: All sizes.
            (a) Thickness: 1 inch.
   3. Refrigerant Suction:
      a. Cellular Foam Insulation:
         1) Pipe Size Range: Up to 1-1/4 inch.
            (a) Thickness: 1/2 inch.
   4. Refrigerant Hot Gas:
      a. Cellular Foam Insulation:
         1) Pipe Size Range: Up to 1 inch.
            (a) Thickness: 1 inch.

END OF SECTION

SECTION 23 0915
VARIABLE FREQUENCY CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Variable frequency controllers.

1.02 REFERENCES

A. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems; National Electrical Manufacturers Association; 1995.

B. NFPA 70 - National Electrical Code; National Fire Protection Association; 1996.

1.03 SUBMITTALS

A. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Manufacturer's Field Reports: Indicate start-up inspection findings.

E. Operation Data: NEMA ICS 7.1. Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.

F. Maintenance Data: NEMA ICS 7.1. Include routine preventive maintenance schedule.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Danfoss

B. Substitutions: Not permitted.

2.02 DESCRIPTION

A. Variable Frequency Controllers: Enclosed controllers suitable for operating the indicated loads, in conformance with requirements of NEMA ICS 7. Select unspecified features and options in accordance with NEMA ICS 3.1.
   1. Employ microprocessor-based inverter logic isolated from power circuits.
   2. Employ pulse-width-modulated inverter system.

3. Design for ability to operate controller with motor disconnected from output.
4. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.

B. Enclosures: NEMA 250, Type 1, suitable for equipment application in places accessible only to qualified personnel.

2.03 OPERATING REQUIREMENTS

A. Rated Input Voltage: 208 volts, three phase, 60 Hertz.

B. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.

C. Compliance to IEEE 519 - harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).
1. a) The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFD's shall include a minimum of 5% impedance reactors, no exceptions.

D. Operating Ambient: 0 degrees C to 40 degrees C.

E. Volts Per Hertz Adjustment: Plus or minus 10 percent.

F. Current Limit Adjustment: 60 to 110 percent of rated.

G. Acceleration Rate Adjustment: 0.5 to 30 seconds.

H. Deceleration Rate Adjustment: 1 to 30 seconds.

I. Input Signal: BACnet or native BAS system interface compatable with Niagara.

J. Minimum of two programmable digital contact outputs for status and VFD failure.

K. Minimum of two programmable digital inputs for preset speed selection.

L. Limit starting current to 125% of the motor full load current.

M. RS485 serial communication port programmed to interface to DDC system.

N. Display VFD information on building management system via BacNet display, provide information including but not limited to: VFD status, voltage, amperage, frequency, etc.

2.04 COMPONENTS

A. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.

B. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.

C. Furnish HAND-OFF-AUTOMATIC selector switch and manual speed control.

D. Include undervoltage release.

E. Door Interlocks: Furnish mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.

F. Safety Interlocks: Furnish terminals for remote contact to inhibit starting under both manual and automatic mode.

G. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.

H. Disconnecting Means: Include integral circuit breaker or Fused Disconnects on the line side of each controller.

I. Wiring Terminations: Match conductor materials and sizes indicated.

2.05 SOURCE QUALITY CONTROL

A. Shop inspect and perform standard productions tests for each controller.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surface is suitable for controller installation.

B. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.

C. Verify that field measurements are as indicated on shop drawings.

3.02 INSTALLATION

A. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.

B. Tighten accessible connections and mechanical fasteners after placing controller.

C. Neatly type label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place in clear plastic holder.

D. Provide separate load and line conduits.

3.03 FIELD QUALITY CONTROL

A. Perform inspections and tests listed in NETA ATS, Section 7.17.

3.04 MANUFACTURER'S FIELD SERVICES

A. Provide the service of the manufacturer's field representative to prepare and start controllers.

3.05 ADJUSTING

A. Make final adjustments to installed controller to assure proper operation of load system. Obtain performance requirements from installer of driven loads.

3.06 DEMONSTRATION

A. Demonstrate operation of controllers in automatic and manual modes.

END OF SECTION

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SECTION 23 0916
AIRFLOW MEASUREMENT STATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Airflow Measurement Stations.

1.02 RELATED SECTIONS

1.03 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association; 2002.

1.04 PERFORMANCE REQUIREMENTS

A. Conform to UL Assembly.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings

C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 AIRFLOW MEASUREMENT STATION

A. Manufacturers:
   1. Ebtron Inc., Model GTA 116-P, Gold Series.
   2. No Substitutions will be permitted.

B. Central Processing Panel
   1. Electronic: Microprocessor Based, totally solid state.
   2. Display: backlighted 80 character, multi-line, alpha numeric.
   3. Keypad: sixteen key.
   4. Satellite Sensor Inputs: 4 Satellite Sensor Ports
      a. Satellites per panel: 28 maximum.
   5. I/O: 12 Plug-in Cards
      a. Digital Outputs: BacNet.
   6. Power Requirement: 24 VAC, isolated from other devices and not grounded.
   7. Datalogger: outside air flow rates.
      a. Readings: 4096 events.
      b. Frequency of Events: User programmable.
      c. Download Method: RS-232 with factory provided software.
   8. Panel Operating Ranges:
      a. Temperature: 45 to 120F.
      b. Humidity: 0-95% RH.
   9. User Programmable Options:
      a. User selectable scaling and display output.
      b. Multi-point recalibration routine.
   10. Diagnostics: Complete sensor hardware.
   11. Power Loss Protection:
      a. Program Memory: EEPROM.
      b. Log: Lithium Battery.

12. Electronics Enclosure
    a. Powder Coated Steel, Indoor Use Only.

C. Air Flow and Temperature Measurement: Thermal anemometer using instrument grade self-heated thermistor sensors with thermistor temperature sensors. Flow measurement drift shall not exceed Manufacturer's repeatability statement for the life of the equipment. Manufacturer shall provide test data for accuracy performance prior to bid date. Pitot tube and differential pressure sensing arrays are not acceptable. Auto zeroing sensors are not acceptable.
   1. Duct Mounted Satellite Sensor
      a. Flow Station Construction
         1) Type: Duct Mounted.
         2) Sensors: Glass encapsulated self-heated thermistor and epoxy encapsulated temperature sensor.
         3) Sensor Housing: Noryl.
         4) Sensors per Satellite Probe: 1 to 8.
         5) Support Struts: Tubular aluminum 6061.
         6) Supporting Brackets: Aluminum 6063.
      b. Electronics
         1) Type: Microprocessor Based, totally solid state, industrial grade integrated circuits.
         2) Electrical Connections Electronics to IAQ Enforcer Panel: 3 conductors, 22 AWG, provided by others.
         3) Enclosure: Aluminum, insert: NEMA 4 X, outdoor use.
      c. Performance
         1) Electronics Temperature Range: -20 to 160F.
         2) Flow Station Temperature Range: -20 to 160F.
         3) Flow Station Velocity Range: 0 to 5,000 ft./min.
         4) Flow Station Pressure Drop: less than 0.005 inwc @ 2,000 ft./min.
         5) Flow Station Humidity Range: 0 to 99% RH (non-condensing).
         6) Digital Output Signals to IAQ Enforcer:
            (a) Sensor velocity accuracy: +/- 10 ft./min. <500 ft./min., +/- 2% reading >500 ft./min.
            (b) Sensor temperature accuracy: typ. 0.18F, max. 0.36F.
            (c) Repeatability: +/- 0.2% scale.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide Two AFMS systems per Air Handling Unit, on outside air intake ductwork and on Relief air outlet ducwork .

END OF SECTION

SECTION 23 0923
CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. BAS Description.

B. BAS Architecture.

C. Supervisory and DDC Controllers.

D. Input and Output Characteristics.

1.02 BAS DESCRIPTION

A. Work in this section includes Direct Digital Control (DDC) panels, main communication trunk, software programming, and all equipment and accessories necessary to constitute a complete Direct Digital Control (DDC) system.

B. Hermantown City Hall is operated from a Niagara platform with Siemens Desigo at the equipment control level. There are various manufacturer control components through-out the building. The owners desire is to replace the majority of the components and have one companys control devices and control system (i.e. actuators, t-stats, VFD's, control programming, etc.)

C. Include a 5 years warranty on all software.

D. Building Automation System (BAS) shall be a complete system designed for scalable implementation from small stand-alone use to large, networked systems. Contractor shall be responsible for coordination with the owner’s IT staff to ensure that the BAS will perform in the owner’s environment without disruption to any of the other activities taking place on that LAN.

E. All points of user interface shall be accessible on a standard Web Browser

F. Work of the single BAS Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.

G. BAS work shall consist of the provision of all labor, materials, tools, equipment, software, interfaces, wiring, installation, labeling, calibration, documentation, submittals, testing, commissioning, training services, permits and licenses required for a complete, fully functional and commissioned BAS.

H. Provide a complete, neat and workmanlike installation. Use only manufacturer approved employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

I. Manage and coordinate the BAS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

J. BAS as provided shall incorporate, as required the following integrated features, functions and services:
   1. Operator information, alarm management and control functions.
   2. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
   3. Diagnostic monitoring and reporting of BAS functions.
   4. Offsite monitoring and management access.
   5. Energy management.
   6. Standard applications for terminal HVAC systems.

1.03 REFERENCE STANDARDS

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2012.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit the following:
   1. BAS network architecture diagrams including all nodes and interconnections.
   2. Systems schematics, sequences and flow diagrams.
   3. Points schedule for each point in the BAS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
   4. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
   5. Details of all BAS interfaces and connections to the work of other trades.
   6. Product data sheets or marked catalog pages including part number, photo and description for all products including software.

C. Shop Drawings: Submit a list of all shop drawings with submittals dates within 45 days of contract award.

D. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.

E. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BAS work.

F. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BAS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.

G. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.

H. BAS Contractor shall correct any errors or omissions noted in the first review.

1.05 QUALITY ASSURANCE

A. Building Automation System Contractor shall be a dealer that is regularly engaged in the engineering, programming, installation and service of total integrated building management systems.

B. BAS Contractor shall have a fully staffed branch facility within a 50-mile radius of the job site supplying complete maintenance and support services on a 24-hour, 7-day-a-week basis.

C. As evidence and assurance of the contractor’s ability to support the Owner's system with service and parts, the contractor must have been in the BAS business for at least the last five (5) years.

D. See Part 3, Installation Requirements, for additional installer requirements

1.06 QUALITY MANAGEMENT PROGRAM

A. Designate a competent and experienced employee to provide BAS Project Management. The designated Project Manger shall be empowered to make technical, scheduling and related decisions on behalf of the BAS Contractor. At minimum, the Project Manager shall:
   1. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
   2. Manage the financial aspects of the BAS contract.
   3. Coordinate as necessary with other trades.
   4. Be responsible for the work and actions of the BAS workforce on site.

1.07 COMMISSIONING

A. This contractor shall provide a qualified to technician to perform testing and demonstrate functionality of all mechanical systems controlled and/or monitored as part of this project under the direction of the Commissioning Agent as specified in Section 23 08 00: Commissioning of HVAC.

1.08 RECORD DOCUMENTATION

A. Operation and Maintenance Manuals
   1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media or DVD, and include the following for the BAS provided:
      a. Table of contents.
      b. As-built system record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
      c. Manufacturer’s product data sheets or catalog pages for all products including software.
      d. System Operator’s manuals.
      e. BAS network diagrams.
      f. Interfaces to all third-party products and work by other trades.

B. On-Line documentation: After completion of all tests and adjustments the contractor shall provide a copy of all as-built information and product data to be installed on a customer designated computer workstation or server.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

C. Within this period, upon notice by the Owner, any defects in the BAS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.

D. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the warranty period. In addition, all factory or sub-vendor upgrades to software shall be added to the systems, when they become available, at no additional cost. New products are not considered upgrades in this context.

E. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all software is functioning correctly.

F. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.

G. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

H. All controllers are to include a five-year software maintenance upgrade agreement that allows updates to the latest revision of the controller firmware.

I. The Owner shall grant to the Control System Contractor reasonable access to the BAS during the warranty period. Remote access to the BAS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

J. As part of the Extended Warranty Alternate, include the cost of providing an extended warranty under the above terms for an additional three (3) year period.

PART 2 PRODUCTS

2.01 MANUFACTURERS PER BUILDING OWNER STANDARD

A. Building Automation Installer:
   1. Automated Logic by Automated Technologies. Contact: Doug Straus dstraus@automatedtech.net.
   2. Substitutions: Not permitted.

2.02 BAS ARCHITECTURE

A. Automation Network
   1. The automation network shall be configured as a Client/Server network with a web server operating on the Client's LAN/WAN. The web browser interface is extended over the LAN/WAN. Monitoring and control of the BAS is available using the web browser interface.
   2. The automation network shall include the option of a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
   3. The BAS shall network multiple user interface clients, system controllers and systems supervisors as required for systems operation.
   4. The automation network option shall be capable of operating at a communication speed of 100 Mbps.
   5. The automation network option will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

B. Control Network
   1. The BAS Supervisory Controller.
   2. Control networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
   3. Programmable Controllers shall reside on the control network.

C. Integration
   1. Hardwired
      a. Analog and digital signal values shall be passed from one system to another via hardwired connections.
      b. There will be one separate physical point on each system for each point to be integrated between the systems.
   2. Direct Protocol (Integrator Panel)
      a. The BAS shall include appropriate hardware equipment and software to allow bi-directional data communications between the BAS system and 3rd party manufacturers' control panels. The BAS shall receive, react to, and return information from multiple building systems, including but not limited to the chillers, boilers, variable frequency drives, power monitoring system, lighting and medical gas.
      b. All data required by the application shall be mapped into the BAS, and shall be transparent to the operator.
      c. Point inputs and outputs from the third party controllers shall have real-time interoperability with BAS software features such as: Schedules, Control Software, Energy Management, Custom Process Programming, Alarm Management, Historical Data and Trend Analysis, Totalization, and Local Area Network Communications.
   3. BACnet Protocol Integration
      a. BACnet over Ethernet and BACnet MS/TP shall comply with the ASHRAE BACnet standard 135-2004.

b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
c. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.

4. Modbus Protocol Integration
   a. BAS shall provide direct connection to Modbus devices without the use of protocol converters.
   b. All data required by the application shall be mapped into the BAS and shall be transparent to the operator.
   c. Point inputs and outputs from the Modbus devices shall have real-time interoperability with BAS software features such as: Schedules, Control Software, Energy Management, Custom Process programming, Alarm Management, Historical Data and Trend Analysis, Totalization and local area network communications.

2.03 SUPERVISORY CONTROLLER

A. Software License Agreement
   1. It is the express goal of this specification to implement an open system that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. The user / owner shall be the named license holder of all software associated with any and all incremental work on the project(s). Any and all required Ids and passwords for access to any component or software program shall be provided to the Owner. Provide all software necessary for developing software algorithms in all supervisory, programmable, and application specific direct digital controllers which is licensed to the owner.
   2. Programming tools for programmable and application specific controllers shall not be restricted to any specific manufacturer. Tools and controllers shall be able to connect to any brand of equipment that is provided under this specification Section.

B. Browser Based Operator Interface
   1. The system shall not rely the use of JAVA to display graphics
   2. The Web browser client shall be set up to support, at a minimum, the following functions:
      a. User log-on identification and password shall be required. If an unauthorized user attempts access, notice of access failure shall be displayed. Security using authentication and encryption techniques to prevent unauthorized access shall be implemented.
      b. HTML programming shall not be required to display system graphics or data on a Web page. Editing of the Web page shall be allowed if the user desires a specific look or format.
      c. Storage of the graphical screens shall be in the Supervisory Controller or the server, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
      d. Real-time values displayed on a web page shall update automatically without requiring a manual “refresh” of the web page.
      e. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
         1) Modify common application objects, such as schedules and setpoints in a graphical manner.
         2) Commands binary objects to start and stop.
         3) View logs and charts.
         4) View alarms.
      f. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.
   3. Alarms

a. Alarm feature shall allow user configuration of criteria to create, route, and manage alarms and events. It shall be possible for specific alarms from specific points to be routed to specific alarm recipients. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
    1) Allow configuration to generate alarms on any numeric, binary, or data point in the system.
    2) Generate alarm records that contain a minimum of a timestamp, original state, acknowledged state, alarm class and priority.
    3) Allow the establishment of alarm classes that provide the routing of alarms with similar characteristics to common recipients.
    4) Allow a user, with the appropriate security level, to manage alarms - including sorting, acknowledging, and tagging alarms.

4. Reports and Summaries
    a. Reports and Summaries shall be generated and directed to the user interface displays. As a minimum, the system shall provide the following reports:
        1) All points in the BAS
        2) All points in each BAS application
        3) All points in a specific controller
        4) All points in a user-defined group of points
        5) All points currently in alarm
        6) All BAS schedules
        7) All user defined and adjustable variables, schedules, interlocks and the like
    b. The system shall allow for the creation of custom reports and queries.
5. Schedules
    a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
        1) Regular schedules
        2) Repeating schedules
        3) Exception Schedules
    b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
    c. It shall be possible to define one or more exception schedules for each schedule including references to calendars.
    d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days. Holidays and special days shall be user-selected with the pointing device or keyboard.
6. Password
    a. Multiple-level password access protection shall be provided to allow the system manager to assign user interface control, display, and database manipulation capabilities deemed appropriate for each user based on an assigned password.
    b. Each user shall have the following: a user name, a password, and access levels.
    c. The system shall provide the capability to require a password of minimum length and require a combination of characters and numerical or special characters.
    d. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
    e. The system shall provide unlimited flexibility with access rights. A minimum of four levels of access shall be provided along with the ability to customize the system to provide additional levels.
    f. A minimum of 100 unique passwords shall be supported.
    g. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.

h. The system shall automatically generate a report of log-on/log-off and system activity for each user.
i. All log data shall be available in .pdf, .txt, and .csv formats.

7. Dynamic Color Graphics
   a. The graphics application program shall be supplied as an integral part of the User Interface and shall not rely on the use of JAVA
   b. The graphics applications shall include a create/edit function and a runtime function.
   c. The graphics shall be able to display real-time data that is acquired, derived, or entered.
   d. Graphics runtime functions -Each graphic application shall be capable of the following functions:
      1) All graphics shall be fully scalable
      2) The graphics shall support a maintained aspect ratio.
      3) Multiple fonts shall be supported.
      4) Unique background shall be assignable on a per graphic basis.
   e. Operation from graphics - It shall be possible to change values (setpoints) and states in systems controlled equipment within the Web browser interface.
   f. Graphic editing tool - A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all runtime binding.
8. Historical Data Collection
   a. All numeric, binary or data points in the system database shall allow their values to be logged over time (trend log). Each historical record shall include the point's name, a time stamp including time zone, and the point's value.
   b. The configuration of the historical data collection shall allow for recording data based on change of value or on a user-defined time interval.
   c. The configuration of the historical data collection shall allow for the collection process to stop or rollover when capacity has been reached.
   d. A historical data viewing utility shall be provided with access to all history records. This utility shall allow historical data to be viewed in a table or chart format.
   e. The historical data chart view shall allow different point histories to be displayed simultaneously, and also provide panning and zooming capabilities.
9. Audit Log
   a. For each log entry, provide the following data;
      1) Time and date
      2) User ID
      3) Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.
10. Database Backup and Storage
    a. The user shall have the ability to backup the Supervisory Controller databases.

2.04 DDC SYSTEM CONTROLLERS

A. General Purpose Programmable Controllers (PCG)
   1. The General Purpose Programmable Controller (PCG) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
      a. The PCG shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
         1) A BACnet Protocol Implementation Conformance Statement shall be provided for the PCG.
         2) The Conformance Statement shall be submitted 10 days prior to bidding.
   2. The PCG shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.

3. The PCG shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
4. The PCG shall include troubleshooting LED indicators to identify the following conditions:
    a. Power On
    b. Power Off
    c. Download or Startup in progress, not ready for normal operation
    d. No Faults
    e. Device Fault
    f. Field Controller Bus - Normal Data Transmission
    g. Field Controller Bus - No Data Transmission
    h. Field Controller Bus - No Communication
    i. Sensor-Actuator Bus - Normal Data Transmission
    j. Sensor-Actuator Bus - No Data Transmission
    k. Sensor-Actuator Bus - No Communication
5. The PCG shall accommodate the direct wiring of analog and binary I/O field points.
6. The PCG shall support the following types of inputs and outputs:
    a. Universal Inputs - shall be configured to monitor any of the following:
        1) Analog Input, Voltage Mode
        2) Analog Input, Current Mode
        3) Analog Input, Resistive Mode
        4) Binary Input, Dry Contact Maintained Mode
    b. Binary Inputs - shall be configured to monitor either of the following:
        1) Dry Contact Maintained Mode
        2) Pulse Counter Mode
    c. Analog Outputs - shall be configured to output either of the following
        1) Analog Output, Voltage Mode
        2) Analog Output, current Mode
    d. Binary Outputs - shall output the following:
        1) 24 VAC Triac
    e. Configurable Outputs - shall be capable of the following:
        1) Analog Output, Voltage Mode, Current Mode
        2) Binary Output Mode
7. The PCG shall have the ability to reside on a Field Controller Bus (FC Bus).
    a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
    b. The FC Bus shall support communications between the PCGs and the Supervisory Controller.
    c. The FC Bus shall also support Expansion I/O (PCX) communications with the PCG and with the Supervisory Controller.
    d. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the PCG and the furthest connected device.
8. The PCG shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
    a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.
    b. The SA Bus shall support up to 10 devices per trunk.
    c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the PCG and the furthest connected device.
9. The PCG shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.

10. The PCG shall support, but not be limited to, functional programming to perform all defined sequence of operations for equipment.

B. Programmable Controller Expansion I/O Modules (PCX)
   1. The Programmable Controller Expansion I/O Module (PCX) provides additional inputs and outputs for use in the PCG.
   2. The PCX shall communicate with the PCG over the FC Bus or the SA Bus.
   3. The PCX shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
      a. A BACnet Protocol Implementation Conformance Statement shall be provided for the PCG.
      b. The Conformance Statement shall be submitted 10 days prior to bidding.
   4. The PCX shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
   5. The PCX shall have a minimum of 4 points to a maximum of 17 points.
   6. The PCX shall support the following types of inputs and outputs:
      a. Universal Inputs - shall be configured to monitor any of the following:
         1) Analog Input, Voltage Mode
         2) Analog Input, Current Mode
         3) Analog Input, Resistive Mode
         4) Binary Input, Dry Contact Maintained Mode
      b. Binary Inputs - shall be configured to monitor either of the following:
         1) Dry Contact Maintained Mode
         2) Pulse Counter Mode
      c. Analog Outputs - shall be configured to output either of the following
         1) Analog Output, Voltage Mode
         2) Analog Output, current Mode
      d. Binary Outputs - shall output the following:
         1) 24 VAC Triac
      e. Configurable Outputs - shall be capable of the following:
         1) Analog Output, Voltage Mode
         2) Binary Output Mode
   7. The PCX shall include troubleshooting LED indicators to identify the following conditions:
      a. Power On
      b. Power Off
      c. Download or Startup in progress, not ready for normal operation
      d. No Faults
      e. Device Fault
      f. Normal Data Transmission
      g. No Data Transmission
      h. No Communication

C. Programmable VAV Box Controller (PCV)
   1. The Programmable VAV Box Controller (PCV) shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall control both single and dual duct applications.
   2. The PCV shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
   3. The PCV shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.
   4. The PCV shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.

5. The PCV shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
6. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.
7. The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.
8. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.
9. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
10. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.
11. The controller shall provide the ability to download and upload VAV controller configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated table of controller parameters.
12. Control setpoint changes initiated over the network shall be written to PCV non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.
13. The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.
14. The controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.
15. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain (“K” factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.
16. The controller shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality), and shall be capable of resetting the box minimum airflow based on the percent of outdoor air in the primary air stream.
17. The controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.
18. Inputs:
    a. Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:
        1) 0-10 VDC Sensors
        2) 1000 ohm RTDs
        3) NTC Thermistors
    b. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing.”
    c. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.
    d. Provide side loop application for humidity control.
19. Outputs
    a. Analog outputs shall provide the following control outputs:
        1) 0-10 VDC
    b. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.

c. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.

20. Application Configuration
    a. The PCV shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.
21. Sensor Support
    a. The PCV shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.
    b. The PCV shall support an LCD display room sensor.
    c. The PCV shall also support standard room sensors as defined by analog input requirements.
    d. The PCV shall support humidity sensors defined by the AI side loop.

2.05 INPUT DEVICE CHARACTERISTICS

A. General Requirements
1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Acceptable Manufacturers:
1. Siemens.
2. Setra
3. ACI.

C. Temperature Sensors
1. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
2. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
3. Room Temperature Sensors
    a. Room sensors shall be constructed for either surface or wall box mounting.
    b. Room sensors shall have the following options when specified:
        1) Setpoint adjustment providing a +3 degree (adjustable) range
        2) Dial adjustment for setpoint value or warmer or cooler requests. The dial shall also initiate temporary occupancy during unoccupied times.
        3) A momentary override request push button for activation of after-hours operation
        4) Backlit LCD temperature display shall display temperature and setpoint with units.
4. Thermo wells
    a. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
    b. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
    c. Thermo wells and sensors shall be mounted in a threadolet or ½-inch NFT saddle and allow easy access to the sensor for repair or replacement.
    d. Thermo wells shall be constructed of 316 stainless steel.
5. Outside Air Sensors
    a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
    b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
    c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
6. Duct Mount Sensors

a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

7. Averaging Sensors
   a. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
   b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
   c. Capillary supports at the sides of the duct shall be provided to support the sensing string.

D. Humidity Sensors
   1. Acceptable Manufacturers:
      a. Siemens
      b. Veris Industries.
      c. ACI.
   2. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer design. The sensor element shall resist service contamination.
   3. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
   4. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 degree F unless specified elsewhere.
   5. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
   6. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
   7. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.

E. Differential Pressure Transmitters
   1. General Air and Water Pressure Transmitter Requirements:
      a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
      b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
      c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
      d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
   2. Acceptable Manufacturers:
      a. Setra.
      b. Mamac.

F. Building Differential Air Pressure Applications (-1” to +1” w.c.)

1. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA or 0-10V output in response to variation of differential pressure or air pressure sensing points.
2. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
    a. -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)
    b. 4-20 mA or 0-10V output
    c. Maintain accuracy up to 20 to 1 ratio turndown.
    d. Reference Accuracy: +0.2% of full span.
3. Acceptable Manufacturers:
    a. Siemens
    b. Setra.

G. Status and Safety Switches
1. General Requirements
    a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BAS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.
2. Current Sensing Switches
    a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
    b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
    c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
    d. Acceptable Manufacturers:
        1) Veris Industries.
        2) RIB.
        3) ACI.
3. Air Filter Status Switches
    a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120 VAC.
    b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
    c. Provide appropriate scale range and differential adjustment for intended service.
    d. Acceptable Manufacturers:
        1) Siemens
        2) Cleveland Controls.
4. Air Flow Switches
    a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
    b. Acceptable Manufacturers:
        1) Siemens
        2) Cleveland Controls.
5. Air Pressure Safety Switches

a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120 VAC.
b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
c. Acceptable Manufacturers:
1) Siemens
2) Cleveland Controls.

6. Water Flow Switches
a. Water flow switches shall be equal to the Johnson Controls P74.

7. Low Temperature Limit Switches
a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120 VAC.
b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
d. The low temperature limit switch shall be equal to Johnson Controls A70.

8. Carbon Monoxide (CO) Sensor
a. Provide a CO sensor that shall utilize non-dispersive infrared (NDIR) technology.
1) The sensor shall have a linear analog output over a range of 0-2000 ppm and have built in display CO level.
2) The sensor shall have an automatic calibration algorithm that will compensate for sensor drift over time due to sensor element degradation.
3) Unit shall be provided with a 0-10VDC of 4-20mA analog output that is selectable and a field adjustable relay alarm output.
4) Accuracy shall be better than +/- 5% of reading or +/- 50ppm whichever is higher.
5) The sensor shall be user calibratable with a minimum calibration interval of five years.

9. Nitrogen Dioxide (NO2) Sensor
a. Provide a NO2 sensor that shall utilize non-dispersive infrared (NDIR) technology.
1) The sensor shall have a linear analog output over a range of 0-2000 ppm and have built in display N level.
2) The sensor shall have an automatic calibration algorithm that will compensate for sensor drift over time due to sensor element degradation.
3) Unit shall be provided with a 0-10VDC of 4-20mA analog output that is selectable and a field adjustable relay alarm output.
4) Accuracy shall be better than +/- 5% of reading or +/- 50ppm whichever is higher.
5) The sensor shall be user calibratable with a minimum calibration interval of five years.

2.06 OUTPUT DEVICE CHARACTERISTICS

A. Actuators
1. General Requirements
a. Damper and valve actuators shall be electronic and/or pneumatic, as specified in the System Description section.

B. Electronic Damper Actuators
1. Electronic damper actuators shall be direct shaft mount.

2. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction and a gear release to allow manual positioning.
3. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for troubleshooting purposes.
4. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.
5. Acceptable Manufacturers:
    a. Siemens
    b. Schneider Electric.
    c. Belimo.
    d. Mamac.

C. Electronic Valve Actuators
1. Electronic valve actuators shall be manufactured by the valve manufacturer.
2. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.
3. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.
4. Modulating actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for troubleshooting purposes.
5. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.
6. Acceptable Manufacturers:
    a. Siemens.
    b. Schneider Electric.
    c. Belimo.

D. External Manual Override Stations

1. External manual override stations shall provide the following:
    a. An integral HAND/OFF/AUTO switch shall override the controlled device pilot relay.
    b. A status input to the Building Automation System shall indicate whenever the switch is not in the automatic position.
    c. A Status LED shall illuminate whenever the output is ON.
    d. An Override LED shall illuminate whenever the HOA switch is in either the HAND or OFF position.
    e. Contacts shall be rated for a minimum of 1 ampere at 24 VAC.

E. Electronic/Pneumatic Transducers
1. Electronic to Pneumatic transducers shall provide:
    a. Output: 3-15 psig.
    b. Input: 4-20 mA or 0-10 VDC.
    c. Manual output adjustment.
    d. Pressure gauge.
    e. External replaceable supply air filter.
2. Acceptable Manufacturers:
    a. Siemens.
    b. Mamac.

PART 3 EXECUTION

3.01 INSTALLER REQUIREMENTS

A. Installer must have a service and installation office within 100 miles of project site

B. Installer must have successfully installed a Siemens Talon Building Automation System prior to project start date. Must be able to provide references upon request.

3.02 INSTALLATION PRACTICES

A. BAS Wiring
1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Automation System, as herein specified, shall be provided by the BAS Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
2. All BAS wiring materials and installation methods shall comply with BAS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BAS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BAS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring
    a. All Class 2 (24 VAC or less) wiring shall be installed in conduit unless otherwise specified.
    b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5’ from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
5. Class 2 signal wiring and 24 VAC power can be run in the same conduit. Power wiring 120 VAC and greater cannot share the same conduit with Class 2 signal wiring.
6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. BAS Line Voltage Power Source
   1. 120-volt AC circuits used for the Building Automation System shall be taken from panel boards and circuit breakers provided by Division 26.
   2. Circuits used for the BAS shall be dedicated to the BAS and shall not be used for any other purposes.
   3. DDC terminal unit controllers may use AC power from motor power circuits.

C. Penetrations
   1. Provide fire stopping for all penetrations used by dedicated BAS conduits and raceways.
   2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
   3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
   4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

D. BAS Panel Installation
   1. The BAS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
   2. The BAS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

E. Input Devices
   1. All Input devices shall be installed per the manufacturer recommendation
   2. Locate components of the BAS in accessible local control panels wherever possible.

F. HVAC Input Devices - General
   1. All Input devices shall be installed per the manufacturer recommendation
   2. Locate components of the BAS in accessible local control panels wherever possible.
   3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
   4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
   5. Outside Air Sensors
      a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
      b. Sensors shall be installed with a rain proof, perforated cover.
   6. Water Differential Pressure Sensors
      a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
      b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
      c. The transmitters shall be installed in an accessible location wherever possible.
   7. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
      a. Air bleed units, bypass valves and compression fittings shall be provided.
   8. Building Differential Air Pressure Applications (-1" to +1" w.c.):
      a. Transmitter's exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
      b. The interior tip shall be inconspicuous and located as shown on the drawings.
   9. Duct Temperature Sensors:
      a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.

b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
d. The sensor shall be mounted to suitable supports using factory approved element holders.

10. Space Sensors:
    a. Shall be mounted per ADA requirements.
    b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
11. Low Temperature Limit Switches:
    a. Install on the discharge side of the first water or steam coil in the air stream.
    b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
    c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
12. Air Differential Pressure Status Switches:
    a. Install with static pressure tips, tubing, fittings, and air filter.
13. Water Differential Pressure Status Switches:
    a. Install with shut off valves for isolation.

G. HVAC Output Devices
1. All output devices shall be installed per the manufacturer's recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.

3.03 INSTALLATION REQUIREMENTS

A. BAS Wiring
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2. Circuits used for the BAS shall be dedicated to the BAS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use AC power from motor power circuits.

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   a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
   b. Sensors shall be installed with a rain proof, perforated cover.
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   a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
   b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
   c. The transmitters shall be installed in an accessible location wherever possible.
7. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
   a. Air bleed units, bypass valves and compression fittings shall be provided.
8. Building Differential Air Pressure Applications (-1" to +1" w.c.):
   a. Transmitter's exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.

b. The interior tip shall be inconspicuous and located as shown on the drawings.

9. Duct Temperature Sensors:
   a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
   b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
   c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
   d. The sensor shall be mounted to suitable supports using factory approved element holders.
10. Space Sensors:
   a. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
11. Low Temperature Limit Switches:
   a. Install on the discharge side of the first water or steam coil in the air stream.
   b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
   c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
12. Air Differential Pressure Status Switches:
   a. Install with static pressure tips, tubing, fittings, and air filter.
13. Water Differential Pressure Status Switches:
   a. Install with shut off valves for isolation.

G. HVAC Output Devices
   1. All output devices shall be installed per the manufacturer's recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
   2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.

3.04 TRAINING

A. The BAS contractor shall provide the following training services:

B. Minimum of 24 hours of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BAS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

END OF SECTION

SECTION 23 0993
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
   1. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in Contract Documents.
   2. Include at least the following sequences:
      a. Start-up.
      b. Warm-up mode.
      c. Normal operating mode.
      d. Unoccupied mode.
      e. Shutdown.
      f. Capacity control sequences and equipment staging.
      g. Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
      h. Seasonal operational differences and recommendations.
   3. Include initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
   4. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.

C. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.

D. Points List: Submit list of all control points indicating at least the following for each point.
   1. Name of controlled system.
   2. Point abbreviation.
   3. Point description; such as dry bulb temperature, airflow, etc.
   4. Display unit.
   5. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.
   6. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
   7. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
   8. Calculated point (Yes / No); i.e. a “virtual” point generated from calculations of other point values.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 23 2113
HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hydronic system requirements.

B. Heating water piping, buried.

C. Heating water and glycol piping, buried.

D. Heating water and glycol piping, above grade.

E. Chilled water piping, buried within 5 ft of building outline.

F. Chilled water piping, above grade.

G. Valves:
   1. Ball valves.
   2. Butterfly valves.
   3. Check valves.

1.02 REFERENCE STANDARDS

A. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).

B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).

D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

E. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2025.

F. ASTM B32 - Standard Specification for Solder Metal; 2020.

G. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

H. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

I. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.

J. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2025a.

K. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2023.

L. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2020.

M. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.

N. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2008).

O. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; 2011 and errata.

P. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

Q. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.

R. AWWA C606 - Grooved and Shouldered Joints; 2022.

S. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.

1.03 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Use grooved mechanical couplings and fasteners in accessible locations.

C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

D. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

E. Use ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

F. Use ball valves for throttling, bypass, or manual flow control services.

G. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

1.04 SUBMITTALS

A. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

B. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

C. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

1.06 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

D. Valves: Provide valves where indicated:

2.02 HEATING WATER AND GLYCOL PIPING, BURIED

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black. All carbon steel pipe shall have ends cut square and beveled for butt-welding. Section of pipe shall have 6" of exposed pipe at each end for field joint fabrication. Insulation shall be polyurethane foam either spray applied or injected with one shot into the annular space between carrier pipe and jacket. Insulation shall be rigid, 90% minimum closed cell polyurethane with a minimum 2.0 lbs per cubic foot density, compressive strenth 30 psi, and coefficient of thermal conductivity (K-factor) of not higher than 0.18 @ 75 degrees F per ASTM C-518., Jacketing shall be extruded, black high density polyethylene (HDPE), having a wall thickness not less than 100 mils. No tape jacket allowed. The inner surface of the HDPE jacket shall be treated to ensure a secure bond between the jacket and foam insulation preventing any ingression of water at the jacket/foam interface..

B. Fittings shall be insulated and jacketed in the same manner as the straight lengths of piping.

C. Expansion/contraction compensation shall be accomplished utilizing factory pre-fabricated and pre-insulated expansion elbows, Z-bends, expansion loops, and anchors specifically designed for intended application.

2.03 HEATING WATER AND GLYCOL PIPING, STAIRWAY/SIDEWALK SNOWMELT

A. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM 877.
   1. Oxygen Barrier: Limit oxygen diffusion through the tube to maximum 0.000044 grains per cu ft/day at 104 degrees F in accordance with DIN 4726.

2.04 HEATING WATER AND GLYCOL PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
   1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper. press fittings.
      a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
      b. Braze: 1 BCuP copper/silver alloy.
   2. Joints:
      a. Soldered, ASTM B 32, alloy Sn95 solder.
      b. Extracted Tee Fittings: Mechanically extracted collars with notched and dimpled brand tube brazed joint.

2.05 CHILLED WATER PIPING, BURIED

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.
   1. Fittings: ASTM A234/A234M, wrought steel welding type with double layer, half-lapped polyethylene tape.
   2. Joints: Welded in accordance with AWS D1.1/D1.1M.
   3. Casing: Closed glass cell insulation.

B. Manufacturers:
   1. Xtru-Therm (Perma-Pipe)
   2. Thermacor (Chill-therm)

2.06 CHILLED WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
   2. Threaded Joints: ASME B16.3, malleable iron fittings.
   3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
   4. Fittings: ASME B16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type.

5. Joints: Threaded or AWS D1.1 welded.

B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), hard drawn; using one of the following joint types:
   1. Joints:
      a. Soldered, ASTM B 32, alloy Sn95 solder.
      b. Extracted Tee Fittings: Mechanically extracted collars with notched and dimpled brand tube brazed joint.

2.07 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
   1. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.

B. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
   1. Fittings: ASTM D2466 or D2467, PVC.
   2. Joints: Solvent welded in accordance with ASTM D2855.

2.08 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with IMC 305.4 and space complying with IMC 305.4.

2.09 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches and Less:
   1. Ferrous Piping: 150 psig malleable iron, threaded.
   2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe 2 Inches and Greater:
   1. Ferrous Piping: 150 psig forged steel, slip-on.
   2. Copper Piping: Bronze.
   3. Gaskets: 1/16 inch thick preformed neoprene.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
   1. Dimensions and Testing: In accordance with AWWA C606.
   2. Mechanical Couplings: Comply with ASTM F1476.
   3. Housing Clamps: Malleable iron galvanized to engage and lock, designed to permit some angular deflection, contraction, and expansion.
   4. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
   5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
   6. When pipe is field grooved, provide coupling manufacturer's grooving tools.
   7. Manufacturers:
      a. Victaulic Company: www.victaulic.com.
      b. COOPLOK Smith.
      c. Substitutions: See Section 01 2500 - Substitution Procedures.

2.10 BALL VALVES

A. Manufacturers:
   1. Conbraco Industries: www.apollovalves.com.
   2. Nibco, Inc: www.nibco.com.
   3. Milwaukee Valve Company: www.milwaukeevalve.com.
   4. Hammond Valve

B. Up To and Including 2 Inches:

1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.
2. Bronze one piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle , solder ends .

C. Over 2 Inches:
1. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

2.11 BUTTERFLY VALVES

A. Body: Cast or ductile iron with resilient replaceable EPDM seat, grooved ends, extended neck.

B. Disc: Construct of stainless steel, ductile iron with EPDM encapsulation, or Buna-N encapsulation.

C. Operator: 10 position lever handle.

2.12 SWING CHECK VALVES

A. Manufacturers:
1. Hammond Valve: www.hammondvalve.com.
2. Nibco, Inc: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Hammond Valve

B. Up To and Including 2 Inches:
1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.

C. Over 2 Inches:
1. Iron body, bronze trim, stainless steel or bronze swing disc, renewable disc and seat, flanged or grooved ends.
2. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. Refer to Section 23 2500 for additional requirements.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and to avoid interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls and floors.

G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified07 8000.

H. Caulk and seal non rated interior wall penetrations tight to restrict the passage of smoke.

I. Slope piping and arrange to drain at low points.

J. Underground system shall be buried in a trench not less than two feet deeper than the top of the pipe and not less than eighteen inches wider than the combined).D. of all piping systems. Backfill shall be compacted and tamped to deter future water infiltration.

K. Underground piping insulation shall meet 1-1/2" thick insulation for buried pipe per Minnesota Commerical Energy Code.

L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 0516.

M. Grooved Joints:
   1. Install in accordance with the manufacturer's latest published installation instructions.
   2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.

N. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

O. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
   2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   3. Place hangers within 12 inches of each horizontal elbow.
   4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

P. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 0719.

Q. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 3100 .

R. Install valves with stems upright or horizontal, not inverted.

END OF SECTION

SECTION 23 2114
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion tanks.

B. Air vents.

C. Air separators.

D. Strainers.

E. Combination pump discharge valves.

F. Pressure-temperature test plugs.

G. Balancing valves.

H. Flow meters.

I. Relief valves.

1.02 REFERENCE STANDARDS

A. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2013.

B. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .

1.03 SUBMITTALS

A. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.

B. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

C. Project Record Documents: Record actual locations of balancing valves.

D. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 EXPANSION TANKS

A. Manufacturers:
   1. Amtrol Inc: www.amtrol.com.
   2. ITT Bell & Gossett: www.bellgossett.com.
   3. Taco, Inc: www.taco-hvac.com.
   4. Wessels, Inc.

B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psi, with flexible EPDM diaphragm or bladder sealed into tank, and steel support stand.

C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psi.

D. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass with capped hose bibb connection.

2.02 AIR VENTS

A. Manufacturers:
   1. Armstrong International, Inc: www.armstronginternational.com.
   2. ITT Bell & Gossett: www.bellgossett.com.
   3. Taco, Inc: www.taco-hvac.com.

B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

C. Float Type:
   1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
   2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

D. Maximum Fluid Pressure: 150 psi.

E. Maximum Fluid Temperature: 250 degrees F.

2.03 AIR SEPARATORS

A. In-line Air Separators:
   1. Manufacturers:
      a. Armstrong International, Inc: www.armstronginternational.com.
      b. ITT Bell & Gossett: www.bellgossett.com.
      c. Taco, Inc: www.taco-hvac.com.
   2. Cast iron for sizes 1-1/2 inch and smaller, or steel for sizes 2 inch and larger; tested and stamped in accordance with ASME BPVC-VIII-1; for 125 psi operating pressure.
   3. Maximum Allowable Service Temperature: 450 degrees F.

B. Coalescing Air/Dirt Separators:
   1. Tank: Fabricated steel tank; tested and stamped in accordance with ASME BPVC-VIII-1; for 150 psi operating pressure and 270 degrees F maximum operating temperature; subject to the requirements of the application and the manufacturer's standard maximum operating conditions.
   2. Coalescing Medium: Provide structured copper, stainless steel, or _____ medium filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100 percent free air, 100 percent entrained air, and 99.6 percent dissolved air at the installed location.
   3. Air Vent: Integral float actuated air vent at top fitting of tank rated at 150 psi, threaded to the top of the separator.
   4. Inlet and Outlet Connections: Threaded for 2 NPS and smaller; Class 150 flanged connections for 2-1/2 NPS and larger.
   5. Blowdown Connection: Threaded.
   6. Size: Match system flow capacity.
   7. Maximum Fluid Service Pressure: 150 psi.
   8. Maximum Fluid Service Temperature: 250 degrees F.

2.04 STRAINERS

A. Size 2 inch and Under:
   1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 2-1/2 inch to 4 inch:
   1. Flanged iron body for 175 psi working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2.05 COMBINATION PUMP DISCHARGE VALVES

A. Manufacturers:
   1. ITT Bell & Gossett: www.bellgossett.com.
   2. Taco, Inc: www.taco-hvac.com.
   3. Victaulic Company of America: www.victaulic.com.
   4. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psi operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.06 PRESSURE-TEMPERATURE TEST PLUGS

A. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.

B. Application: Use extended length plugs to clear insulated piping.

2.07 BALANCING VALVES

A. Manufacturers:
   1. ITT Bell & Gossett: www.bellgossett.com.
   2. Griswold Controls: www.griswoldcontrols.com.
   3. Nibco, Inc; Model T or S 1710.
   4. Taco, Inc; Model Accu-Flow.
   5. Victaulic/TA Hydronics; Model 787U.

B. Cast iron or bronze body with union on inlet, globe style, balance valve with handwheel with vernier type ring setting and memory stop, drain connection, readout valves equipped with integral check valves and gasketed caps.

C. Construction: Class 125, Brass or bronze body with union on inlet , temperature and pressure test plug on inlet and outlet .

D. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi psi.

2.08 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.09 SNOWMELT MANIFOLDS

A. Copper or bronze manifolds with loop valves, loop flow indicators, and fully enclosed lockable cabinet of white enameled steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

E. Provide air separator on suction side of system circulation pump and connect to expansion tank.

F. Provide valved drain and hose connection on strainer blow down connection.

G. Provide pump suction fitting on suction side of base mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.

H. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps where indicated.

I. Support pump fittings with floor mounted pipe and flange supports.

J. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

K. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

L. Pipe relief valve outlet to nearest floor drain.

M. Clean and flush glycol system before adding glycol solution. Refer to Section 23 2500.

N. Perform tests determining strength of glycol and water solution and submit written test results.

SECTION 23 2123
HYDRONIC PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. End-suction pump systems.

1.02 REFERENCE STANDARDS

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

1.03 SUBMITTALS

A. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

B. Millwright's Certificate: Certify that base mounted pumps have been aligned.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Armstrong Fluid Technology, Inc: www.armstrongfluidtechnology.com/#sle.

B. Bell & Gossett, a Xylem Inc. brand: www.bellgossett.com.

C. Taco

D. Substitutions: Not permitted.

2.02 HVAC PUMPS - GENERAL

A. Products Requiring Electrical Connection: Listed and classified by UL or testing agency acceptable to Authority Having Jurisdiction as suitable for the purpose specified and indicated.

2.03 CIRCULATORS

A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125 psi maximum working pressure.

B. Casing: cast iron or bronze, with flanged pump connections.

C. Impeller: Non-ferrous keyed to shaft.

D. Bearings: Permanently-lubricated ball bearings.

E. Shaft: ceramic or stainless steel with bronze sleeve, integral thrust collar.

F. Seal: Mechanical seal, 225 degrees F maximum continuous operating temperature.

2.04 END-SUCTION PUMP SYSTEMS

A. Casing: Cast iron, with suction and discharge gauge port, casing wear ring, seal flush connection, drain plug, flanged suction, and discharge.

B. Impeller: stainless steel, fully enclosed, keyed directly to motor shaft or extension.

C. Shaft: Stainless steel with stainless steel impeller cap screw or nut and bronze sleeve.

D. Seal: Mechanical seal, 225 degrees F maximum continuous duty temperature.

E. Drive: Flexible coupling with coupling guard.

F. Baseplate: Cast iron or fabricated steel with integral drain rim.

G. Electrical:
   1. Motor: 1,750 rpm, total-enclosed, fan-cooled (TEFC); see Section 23 0513.
   2. Wiring Terminations: Single point connection, provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

D. Provide line sized shut-off valve and strainer on pump suction, and line sized combination pump discharge valve on pump discharge.

E. Provide air cock and drain connection on horizontal pump casings.

F. Check, align, and certify alignment of base-mounted pumps prior to start-up.

G. Lubricate pumps before start-up.

END OF SECTION

SECTION 23 3100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

B. Nonmetal ductwork.

1.02 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; 2023.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

D. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.

E. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012, 2nd Edition.

F. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.03 PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes permitted except by permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.04 SUBMITTALS

A. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK).

B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.06 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

A. Regulatory Requirements: Construct ductwork to comply with {\rs\#1} standards.

2.02 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating. Thickness; minimum 24 gauge.

B. **Exposed uninsulated ducts: "Paint grip"; phosphatized galvanized steel sheet.**

C. Insulated Flexible Ducts:

1. Black polymer film supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
    a. Pressure Rating: 4 inches WG positive and 0.5 inches WG negative.
    b. Maximum Velocity: 4000 fpm.
    c. Thermal properties: minimum R-va;ue of 6.
    d. Temperature Range: -20 degrees F to 175 degrees F.

D. Ducts: Galvanized steel, unless otherwise indicated.

E. Supply: 2 inch w.g. pressure class, galvanized steel.

F. Return and Relief: 1 inch w.g. pressure class, galvanized steel.

G. General Exhaust: 1 inch w.g. pressure class, galvanized steel.

H. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

I. Fume Hood and Snorkel Exhaust: 2 inch w.g. pressure class, 304 galvanized steel.

J. Outside Air Intake: 1 inch w.g. pressure class, galvanized steel.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.

B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. T's, bends, and elbows: Construct according to SMACNA (DCS).

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

F. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

G. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Flat Oval Ducts: Machine made from round spiral lockseam duct.
1. Manufacture in accordance with SMACNA (DCS).
2. Fittings: Manufacture at least two gages heavier metal than duct.
3. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Flexible Ducts: Black polymer film supported by helically wound spring steel wire.
1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
2. Pressure Rating: 4 inches WG positive and 0.5 inches WG negative.
3. Maximum Velocity: 4000 fpm.
4. Temperature Range: Minus 20 degrees F to 175 degrees F.

D. Transverse Duct Connection System: SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).

E. Fume Hood Exhaust: Minimum 20 gage thick, single wall, galvanized.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install in accordance with manufacturer's instructions.

C. Comply with safety standards NFPA 90A and NFPA 90B.

D. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

E. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

F. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

H. Use double nuts and lock washers on threaded rod supports.

I. See hangers and supports for ductwork running exposed on the roof for support distances required.

J. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

K. Connect flexible ducts to metal ducts with draw bands.

L. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

M. At exterior wall louvers, slope and seal duct to louver frame.

3.02 SCHEDULES

A. Ductwork Material:
   1. Low Pressure Supply: Galvanized steel and insulated flexible duct.
   2. Return and Relief: Galvanized steel.
   3. General Exhaust: Galvanized steel.
   4. Outside Air Intake: Galvanized steel.

B. Ductwork Pressure Class:
   1. Supply: 2 inch.
   2. Return and Relief: 1 inch.
   3. General Exhaust: 1 inch.
   4. Outside Air Intake: 1 inch.

END OF SECTION

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SECTION 23 3300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air turning devices/extractors.

B. Backdraft dampers.

C. Duct access doors.

D. Duct test holes.

E. Flexible duct connections.

F. Volume control dampers.

1.02 REFERENCE STANDARDS

A. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.03 SUBMITTALS

A. Product Data: Provide for shop fabricated assemblies including volume control dampers and duct access doors.

1.04 PROJECT RECORD DOCUMENTS

A. Record actual locations of access doors and test holes.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

A. Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with push-pull operator strap.

2.02 BACKDRAFT DAMPERS

A. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.03 DUCT ACCESS DOORS

A. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.

1. Less Than 12 inches Square: Secure with sash locks.
2. Up to 18 inches Square: Provide two hinges and two sash locks.
3. Up to 24 by 48 inches: Three hinges and two compression latches with outside and inside handles.

B. Access doors with sheet metal screw fasteners are not acceptable.

2.04 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.05 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
      a. Net Fabric Width: Approximately 2 inches wide.
   2. Metal: 3 inches wide, 24 gage, 0.0239 inch thick galvanized steel.

2.06 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Single Blade Dampers:
   1. Fabricate for duct sizes up to 6 by 30 inch.
   2. Blade: 24 gage, 0.0239 inch, minimum.

C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
   1. Blade: 18 gage, 0.0478 inch, minimum.

D. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

E. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 3100 for duct construction and pressure class.

B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

C. Provide duct test holes where indicated and required for testing and balancing purposes.

D. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

E. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

F. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

G. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 3416
CENTRIFUGAL HVAC FANS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Backward inclined centrifugal fans.

B. Bearings and drives.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).

B. AMCA (DIR) - [Directory of] Products Licensed Under AMCA International Certified Ratings Program; http://www.amca.org/certified/search/company.aspx.

C. AMCA 99 - Standards Handbook; 2025.

D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2025.

E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

G. NEMA MG 00001 - Motors and Generators; 2024.

H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on centrifugal fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Greenheck.

B. Loren Cook Company: www.lorencook.com/#sle.

C. PennBarry, Division of Air System Components: www.pennbarry.com/#sle.

D. Twin City Fan & Blower: www.tcf.com/#sle.

E. ACME Engineering and Manufacturing Corporation[<>]: www.acmefan.com/#sle

2.02 PERFORMANCE REQUIREMENTS

A. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

C. Fabrication: Comply with AMCA 99.

D. Performance Base: Sea level conditions.

E. Temperature Limit: Maximum 300 degrees F.

F. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

2.03 WHEEL AND INLET

A. Backward Inclined: Steel or aluminum construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded or riveted to flange and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.

2.04 HOUSING

A. Heavy gage steel, spot weldedfor AMCA 99 Class I and II fans and continuously welded for Class III, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut.

2.05 BEARINGS AND DRIVES

A. Bearings: Heavy duty pillow block type, selfgreasing ball bearings, with ABMA STD 9 life at 50,000 hours.

B. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil, and shaft guard.

C. Drive: Direct Driven motor.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install flexible connections between fan inlet and discharge ductwork; refer to Section 23 3300. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

C. Pipe scroll drains to nearest floor drain.

END OF SECTION

SECTION 23 3423
HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof exhausters.

B. Ceiling exhaust fans.

C. Inline centrifugal fans and blowers.

1.02 REFERENCE STANDARDS

A. AMCA (DIR) - [Directory of] Products Licensed Under AMCA International Certified Ratings Program; http://www.amca.org/certified/search/company.aspx.

B. AMCA 99 - Standards Handbook; 2025.

C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.

D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2025.

E. AMCA 211 - Certified Ratings Program Product Rating Manual for Fan Air Performance; 2022, with Editorial Revision (2023).

F. AMCA 260 - Laboratory Methods of Testing Induced Flow Fans for Rating; 2020.

G. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.

H. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

I. AMCA 311 - Certified Ratings Program Product Rating Manual for Fan Sound Performance; 2016.

J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

K. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.

C. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

PART 2 PRODUCTS

2.01 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: Comply with AMCA 204.

B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.

C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.

D. Fabrication: Comply with AMCA 99.

E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.02 ROOF EXHAUSTERS

A. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.

B. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.

C. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm gets attained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.03 INLINE CENTRIFUGAL FANS AND BLOWERS

A. Manufacturers:
   1. Greenheck Fan Corporation: www.greenheck.com/#sle.
   2. Loren Cook Company: www.lorencook.com/#sle.
   3. PennBarry, Division of Air System Components: www.pennbarry.com/#sle.
   4. Twin City Fan & Blower: www.tcf.com/#sle.

B. Centrifugal Fan Unit: V-belt or direct driven, with galvanized steel housing lined with acoustic insulation, resiliently-mounted motor, gravity backdraft damper in discharge.

C. Forward Curved Blower:
   1. Direct-driven, resiliently mounted motor, heavy-duty ball bearings, galvanized steel housing for indoor or outdoor service, and removable service panels.
   2. Accessories: Provide external vibration isolator spring.

D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm gets reached with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.

C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.

D. Hung Cabinet Fans:
   1. Install fans with resilient mountings and flexible electrical leads, see Section 23 0548.
   2. Install flexible connections between fan and ductwork; see Section 23 3300. Ensure metal bands of connectors are parallel with minimum 1 inch flex between ductwork and fan while running.

END OF SECTION

SECTION 23 3433
AIR CURTAINS

PART 1 GENERAL

1.01 SECTION INCLUDE

A. Air curtains.

1.02 REFERENCE STANDARDS

A. AMCA 220 - Laboratory Methods of Testing Air Curtain Units for Aerodynamic Performance Rating; 2021.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's descriptive literature for products specified in this section; indicate options specified.

C. Manufacturer's Instructions: Printed installation instructions for each product specified.

D. Shop Drawings: Indicate installation and connection details for air curtains.

E. Operation and Maintenance Data: Manufacturer's printed instructions for operating and maintaining air curtain components.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products of this section in manufacturer's unopened packaging until installation.

B. Maintain dry, heated storage area for products of this section until installation of products.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Supply manufacturer's standard warranty against defects in product workmanship and materials.

PART 2 PRODUCTS

2.01 AIR CURTAINS

A. Description: Self-contained, electrically operated air curtain. Suitable for mounting at head or jamb of door or service window opening.
   1. Rated Maximum Mounting Height: As indicated on drawings.
   2. Rated Opening Width: As indicated on drawings.

B. Housing:
   1. Material: Aluminum.
   2. Factory-provided mounting brackets.
   3. Finish: anodozed aluminum.

C. Air Intake: Aluminum mesh air-intake filter; removable and cleanable.

D. Blower Assembly: Heavy-duty motor; forward curved centrifugal fans, double inlet, double width.

E. Performance: Tested in accordance with AMCA 220
   1. Average Outlet Velocity: As indicated on drawings.
   2. Air Flow: Indicated on drawings.

F. Controls:
   1. ON/OFF control; air curtain turns on when door is opened and off when door is closed.
   2. Door Limit Switches: Commercial surface mounted magnetic switch, 24Volt

G. Heat: None.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that space is ready for installation of units.

3.02 INSTALLATION

A. Install air curtains in accordance with shop drawings and manufacturer's printed installation instructions.

B. Maintain clearances required to maintain the units.

END OF SECTION

SECTION 23 3516
ENGINE EXHAUST SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Centrifugal fans.

B. Ductwork and duct accessories.

C. Exhaust system accessories.

1.02 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; 2023.

B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

C. SMACNA (ROUND) - Round Industrial Duct Construction Standards; 2013.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturers literature and data sheets indicating rated capacities, dimensions, weights and point loadings, accessories, electrical characteristics and connection requirements, wiring diagrams, and location and sizes of field connections.

C. Shop Drawings: Indicate dimensions, sizes, weights and point loadings, and locations and sizes of field connections.

D. Operation and Maintenance Data: Include instructions for fan lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 FIELD CONDITIONS

PART 2 PRODUCTS

2.01 CENTRIFUGAL FANS

A. Wheel and Inlet: Steel construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded to flange and back plate; cast iron hub riveted to back plate and keyed to shaft with set screws.

B. Housing: Heavy gauge steel, spot welded with inlet bell and shaped cut-off, factory finished with enamel or prime coat.

2.02 DUCTWORK AND DUCT ACCESSORIES

A. Materials:
   1. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

B. Ductwork:
   1. Fabricate and support in accordance with:
      a. SMACNA (DCS).
   2. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline.
   3. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

4. Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA (ROUND).

2.03 EXHAUST SYSTEM ACCESSORIES

A. Tail Pipe Adapters: Rubber formed to tapered cone with spring clip attachment, adapter size 10 inch, for connection to 8 inch diameter hose.

B. Flexible Exhaust Hose: Heat resistant neoprene coated fabric spring steel wire reinforced, rated for duty to 260 degrees F and 20 inches WG positive or negative.

C. Exhaust Hose Reel: Motor operated reel with direct-mounted override switch on motor. The reel to consist of 16-gauge, cold rolled steel cylinder with internal aluminum flexible pipe, zinc plated steel stand, two steel springs, brake mechanism, hose stop, hose guide and 16 feet of 2-1/2-inch diameter hose.

D. Provide manufacture control box for fan and hose reel control of NEMA 3R construction with: UP, DOWN, FAN ON and FAN OFF buttons or switches.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Install flexible connections at fan inlet and discharge. Ensure metal bands of connectors are parallel with minimum 1-inch flex between ductwork and fan while running.

C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

END OF SECTION

SECTION 23 3600
AIR TERMINAL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single-duct terminal units.
   1. Single-duct, variable-volume units.

1.02 REFERENCE STANDARDS

A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).

B. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).

C. AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets; 2008, with Addendum (2011).

D. ASHRAE Std 130 - Methods of Testing Air Terminal Units; 2008 (R2014).

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

F. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.

C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.

E. Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 SINGLE-DUCT, VARIABLE-VOLUME UNITS

A. General:
   1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
   2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.

B. Unit Casing:
   1. Minimum 22 gage, 0.0299 inch galvanized steel.
   2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.

3. Unit Discharge: Rectangular, with slip-and-drive connections.

C. Damper Assembly:
   1. Heavy-gage, galvanized steel or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
   2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
   3. Incorporate low leak damper blades for tight airflow shutoff.

D. Hot Water Heating Coil:
   1. Coil Casing: Minimum 22 gage, 0.0299 inch galvanized steel, factory-installed on terminal discharge with rectangular outlet, duct connection type.
      a. Access Door: Gasketed and insulated located on bottom, on top, and downstream of coils.
   2. Coil Fins: Aluminum or aluminum plated fins, mechanically-bonded to seamless copper tubes.
      a. Fins to be formed in a high heat transfer sine wave configuration.
   3. Coil leak tested to minimum 350 psig.
   4. Base performance data on tests run in accordance with AHRI 410 and units to bear AHRI 410 label.

E. Controls:
   1. DDC (Direct-Digital Controls):
      a. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
      b. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFM's.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.

C. Provide ceiling access doors or locate units above easily removable ceiling components.

D. Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 23 0548.

E. Do not support from ductwork.

F. Connect to ductwork in accordance with Section 23 3100.

END OF SECTION

SECTION 23 3700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Diffusers.

B. Louvers.

C. Gravity ventilators.

1.02 REFERENCE STANDARDS

A. ADC 1062: GRD - Test Code for Grilles, Registers & Diffusers; Air Diffusion Council; 1984.

B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.

C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.

D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.03 SUBMITTALS

A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

B. Project Record Documents: Record actual locations of air outlets and inlets.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. J&J

B. Krueger: www.krueger-hvac.com.

C. Metal Aire.

D. Nailor UNI.

E. Breidert.

F. Price Industries: www.price-hvac.com.

G. Titus:

H. Tuttle and Bailey: www.tuttleandbailey.com/#sle.

I. Substitutions: See Section 01 2500 - Substitution Procedures.

2.02 RECTANGULAR CEILING DIFFUSERS

A. Type: Square, adjustable pattern, stamped, multi-core diffuser to discharge air in 360 degree pattern .

B. Frame: Inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.

C. Fabrication: Steel with baked enamel off-white finish.

2.03 DUCT-MOUNTED SUPPLY AND RETURN REGISTERS/LOUVERS

A. Type: Duct-mounted, rectangular register for round-spiral duct with adjustable pivot-ended blades, end caps, built-in volume damper, and dual cover flanges to lay flush on duct surface regardless of diameter. Performance to match manufacturer's catalog data.

B. Material: 22 gage, 0.0299 inch.
   1. Provide crossing spiral fitting-body of matching duct diameter.

2.04 CEILING EGG CRATE EXHAUST AND RETURN GRILLES

A. Type: Egg crate style face consisting of 1/2 x 1/2 x 1/2 inch grid core.

B. Fabrication: Grid core consists of aluminum with mill aluminum finish.

C. Color: As indicated.

D. Frame: Channel lay-in frame for suspended grid ceilings.

2.05 WALL SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical face, single deflection.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Steel with 20 gage, 0.0359 inch minimum frames and 22 gage, 0.0299 inch minimum blades, steel and aluminum with 20 gage, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.

D. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory off-white enamel finish , color to be selected.

2.06 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.

B. Frame: 1-1/4 inch margin with countersunk screw mounting.

C. Fabrication: Steel frames and blades, with factory off-white enamel finish , color to be selected.

2.07 LOUVERS

A. Type: High Efficiency 6 inch deep with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch square mesh screen over exhaust and 1/2 inch square mesh screen over intake.

B. Color: To be selected by Architect from manufacturer's standard range.
   1. Minimum 57% free area
   2. Fabrication: 12 gage thick extruded aluminum, welded assembly, with factory fluoropolymer spray finish color to be selected.
   3. Manufacturers:
      a. Ruskin ELF6375X.
      b. Industrial Louvers.
      c. United Enertech.

2.08 GRAVITY VENTILATORS

A. Hood Intake and Relief Gravity Ventilator:
   1. General:
      a. Low silhouette for intake and relief applications with natural gravity or negative pressure system(s).
      b. Performance ratings and factory testing to be in accordance with AMCA 511 and AMCA 550.
      c. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
   2. Hood and Base:
      a. Material: Aluminum.
      b. Hood Construction: Precision formed, arched panels with interlocking seams.
      c. Vertical End Panels: Fully locked into hood end panels.
      d. Curb Cap: Pre-punched mounting holes for installation.
   3. Birdscreen:
      a. Construction: 1/2 inch Galvanized mesh.
      b. Horizontally mounted across hood intake area.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install diffusers to ductwork with air tight connection.

B. Provide balancing dampers on duct take-off to diffusers, and grilles and registers.

C. Paint ductwork visible behind air outlets and inlets matte black. Refer to Division 09.

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SECTION 23 5700
HEAT EXCHANGERS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Plate type heat exchangers.

B. Accessories and trim.

1.02 REFERENCE STANDARDS

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate dimensions, locations, and size of tappings and performance data.
   1. Design Data: Indicate in sufficient detail to verify that heat exchangers meet or exceed specified requirements.

C. Certificates: Certify that Products meet or exceed specified requirements.

D. Manufacturer's Instructions: Indicate installation and support requirements.

E. Operation and Maintenance Data: Include start up and shut down instructions, assembly drawings, and spare parts lists.

F. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect internals from entry of foreign material by temporary caps on flanged openings.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide five year manufacturer warranty for _____.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with ASME BPVC-VIII-1 for manufacture of tubular heat exchangers and heat exchanger shells and plate and frame type heat exchangers.

2.02 PLATE AND FRAME TYPE HEAT EXCHANGER

A. Comply with ASME BPVC-VIII-1 for manufacture of plate and frame type heat exchangers.

B. Frames: Carbon steel with baked epoxy enamel paint, stainless steel side bolts and shroud.

C. Plates: Stainless steel Type 304.

D. Gaskets: Nitrile rubber.

E. Nozzles: 125 psi rated lined flange type.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install to permit removal of plates with minimum disturbance to installed equipment and piping.

C. Support heat exchangers on concrete housekeeping pad.

D. Pipe relief valves to nearest floor drain.

E. Pipe drain valves to nearest floor drain.

3.02 WATER TO WATER HEAT EXCHANGER TRIM

A. Water Inlets and Outlets: Thermometer wells, pressure gauge tappings.

B. Heated Water Outlet: Thermometer well for temperature regulator sensor, ASME rated pressure and temperature relief valve, valved drain; see Section 23 2114.

END OF SECTION

SECTION 23 7200
AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Energy recovery ventilators.

1.02 REFERENCE STANDARDS

A. AHRI 1060 (I-P) - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment; 2023.

B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2025.

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2025.

E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

G. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's installation instructions, product data, and engineering calculations.

C. Shop Drawings: Show design and assembly of energy recovery unit and installation and connection details.

1.04 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Store products in manufacturer's unopened packaging until ready for installation.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 1-year manufacturer warranty for equipment including parts, materials, workmanship, and operation commencing on date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 ENERGY RECOVERY VENTILATOR

A. Manufacturers:
   1. Greenheck; _____: www.greenheck.com/#sle.
   2. RenewAire; _____: www.renewaire.com/#sle.

B. ERV Equipment Construction Requirements:
   1. Energy Recovery Exchanger Type: Membrane plate.
   2. Supply and Return Duct Connection Orientation: As indicated on drawings.
   3. Casing and Frame:

a. Frame: Galvanized steel body or welded extruded aluminum tubular frame capable of supporting components and casings including integral base lifting holes.
b. Double Wall Panels: Minimum of 18 gauge, 0.040 inch galvanized steel.
c. Doors: Construct doors of same construction and thickness as wall panels. Include p-shaped extruded neoprene gasket, prop rod, chain with spring, exterior handle, and interior 3-point latching device. Label each door to identify equipment located within.
d. Insulation Requirements:
    1) Mold Resistance: "Pass" when tested in accordance with ASTM C1338.
    2) Fungal Resistance: No growth when tested in accordance with ASTM G21.
    3) Bacteria Resistance: No growth when tested in accordance with UL 181.
    4) Flame spread index of 25 or less and maximum smoke developed index of 50.
e. Isolation and Sealing: Form continuous, thermally isolated, weathertight seal between inner wall of panels and structural framing with closed cell PVC foam gasketing and seal seams to prevent job site caulking.
f. Access Panels: Provide access to components through a large, tightly sealed and easily removable hinged or screwed access panel.
g. Finish: Polyurethane enamel over weather-protected, corrosion-resistant assembly.
h. Nameplate: Permanent name plate listing manufacturer, model number, serial number, voltage with tolerance, and amp ratings mounted inside door near electrical panel.

4. Supply and Exhaust Fans:
    a. Provide separate non-overloading, statically and dynamically balanced, draw-through, forward curved centrifugal fan or fan-array for each air stream.
    b. Fan Motor: Constant Speed, high efficiency, load matched, belt-driven, open drip proof, thermal overload protected TEFC motor with variable-sheave belt drive, and adjustable-removable motor-slide base. Size drives to 150 percent of load, minimum.
    c. Belt Guards: Full sized, hinged, painted with high-visibility safety color, and accessible with standard tools.
    d. Motor Bearings: Permanently lubricated sealed ball bearings rated for not less than 200,000 hours of operation with accessible greased fittings.
5. Filter Sections:
    a. Outdoor-Intake and Exhaust Sides: 2 inch thick, pleated, MERV 7 filters, ASHRAE Std 52.2.
    b. Filter Racks: Bolt-on rack constructed of aluminum with minimum size of 1/12 inch thick. Include hinged side access door and snap fasteners.
6. Configuration: Adjust listed requirements in conformance with ASHRAE Std 90.1 I-P.
7. Certification: AHRI 1060 (I-P) labeled, include copy of published ratings for operating conditions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that structure is ready for installation including openings, ductwork, mechanical utilities, and electrical utilities.

3.02 INSTALLATION

A. Install equipment in accordance with manufacturer's written installation instructions.

B. Do not obstruct maintenance access to equipment piping, electrical conduit, or any other utility.

C. Vibration Isolation: Provide corrosion-resistant equipment isolation products; see Section 23 0548.

D. Electrical: Provide equipment raceway, wiring, and cables; see Section 26 0583.

E. Coordinate installation and fire alarm system interface of system compatible duct-mounted smoke detectors and other appurtenances following NFPA 90A guidelines.

F. Start system and adjust controls and equipment for satisfactory operation.

G. Coordinate hardwired or software interfacing links to enable coordinate as minimum start-stop, occupied, unoccupied functions as well as specific schedules and setpoints functions with other DDC controls onboard airside systems serving common spaces; see Section 23 0923.

H. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface; see Section 25 1500.

END OF SECTION

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SECTION 23 7313
MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Casing construction.

B. Fan section.

C. Coil section.

D. Filter and air cleaner section.

E. Damper section.

F. Energy Recovery

G. Access section.

H. Turning and discharge plenum section.

1.02 REFERENCE STANDARDS

A. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings; 1990 (Reapproved 2008).

B. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).

C. AMCA (DIR) - [Directory of] Products Licensed Under AMCA International Certified Ratings Program; http://www.amca.org/certified/search/company.aspx.

D. AMCA 99 - Standards Handbook; 2025.

E. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2025.

F. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.

G. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

H. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.

I. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2025.

J. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

L. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Published Literature: Indicate dimensions, weights, capacities, ratings, gauges and finishes of materials, and electrical characteristics and connection requirements.
   2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
   3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
   4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
   5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

C. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

D. Manufacturer's Instructions: Include installation instructions.

E. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

D. Manufacturer to Deliver to site sectionalized, see plans for length and width limitations, successful installation contractor to accept and take possession of unit coordination with the Manufacturer on delivery date. Installation contractor to make provisions for unloading the units from the truck and any storage required.

E. Provide portions of unit as knock-down, pre-dissassembled with each component wrapped in plastic. Provide with detailed manufacturers instructions for contractor re-assembly. The largest component must fit through a 60 inch doorway.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide a two year manufacturer's writen warranty to include all Air Handling components including but not limited to Fans, coils and dampers, five years manufacturer's writen warranty for energy recovery sections.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Daikin Applied: www.daikinapplied.com/#sle.

B. Trane Technologies, PLC: www.trane.com/#sle.

C. York, a brand of Johnson Controls International, PLC: www.york.com/#sle.

D. Substitutions: Not permitted.

2.02 CASING CONSTRUCTION

A. Full Perimeter Base Rail:
   1. Construct of galvanized steel.
   2. Provide base rail of 8 inch to raise unit for external trapping of condensate drain pans.

B. Casing:
   1. Construct of one piece, insulated, double wall panels per section.
   2. Provide mid-span, no through metal, internal thermal break.
   3. Construct outer panels of galvanized steel and inner panels of galvanized steel.
   4. Casing Air Pressure Performance Requirements:
      a. Able to withstand up to 8 in-wc positive or negative static pressure.
      b. Not to exceed 0.0042 inches per inch deflection at 1.5 times design static pressure up to a maximum of plus 8 in-wc in positive pressure sections and minus 8 in-wc in negative pressure sections.

C. Access Doors:
   1. Construction, thermal and air pressure performance same as casing.

2. Provide surface mounted handles on hinged, swing doors.
3. Provide shatterproof viewing window designed to withstand operating pressures.

D. Unit Flooring: Construct with sufficient strength to support expected people and equipment loads associated with maintenance activities.

E. Casing Leakage: Seal joints and provide airtight access doors so that air leakage does not exceed one percent of design flow at the specified casing pressure.

F. Insulation:
1. Provide minimum thermal thickness of 12 R throughout.
2. Completely fill panel cavities in each direction to prevent voids and settling.
3. Comply with NFPA 90A.

G. Drain Pan Construction:
1. Provide cooling coil sections with an insulated, double wall, stainless steel drain pan complying with ASHRAE Std 62.1 for indoor air quality and sufficiently sized to collect all condensate.
2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.
3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.

H. LED Lights:
1. Provide factory-mounted, water- and dust-resistant LED fixture(s) where indicated on drawings, with the following characteristics:
a. Non-ferrous metal housing.
b. Glass or polycarbonate lens.
c. Factory wired to a single switch within factory provided service module.
d. Instant on white light with minimum 8,000 hour service life.

I. Finish:
1. Indoor Units:
a. Provide exterior, galvanized steel panels without paint.

2.03 FAN SECTION

A. Type: Backward inclined, single width, single inlet, centrifugal plug fan, in accordance with AMCA 99. See Section 23 3413

B. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.

C. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.

D. Bearings: Self-aligning, grease lubricated, with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing.

E. Mounting:
1. Locate fan and motor internally on welded steel base coated with corrosion resistant paint.
2. Factory mount motor on slide rails.
3. Provide access to motor, drive, and bearings through removable casing panels or hinged access doors.

F. External Motor Junction Box: Factory mount NEMA 4 external junction box and connect to extended motor leads from internally mounted motors.

G. Motor Wiring Conduit: Factory wire fan motor wiring to the unit mounted starter-disconnect, variable frequency drive, and external motor junction box.

H. Drives:

1. Comply with AMCA 99.
2. Bearings: Heavy duty pillow block type, roller bearings with ABMA STD 11 L-50 life at 400,000 hours.
3. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil. Provide shaft grounding rings on all motor shafts.
4. Direct Drive: No belts required.

2.04 COIL SECTION

A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.

B. Drain Pans: 24 inch downstream of coil and down spouts for cooling coil banks more than one coil high.

C. Air Coils:
1. Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.

D. Fabrication:
1. Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.
2. Fins: Aluminum.
3. Casing: Die formed channel frame of galvanized steel.

E. Water Heating Coils:
1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

F. Refrigerant Coils:
1. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
2. Headers: Seamless copper tubes with silver brazed joints.
3. Liquid Distributors: Brass or copper venturi distributor with seamless copper distributor tubes.
4. Configuration: Down feed with bottom suction.

2.05 FILTER AND AIR CLEANER SECTION

A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.

B. Pre-Filters:
1. Media: 2 inch, pleated, 8 MERV prefilter, pleated, fine-fiber, cartridge filter, sealed into gasketed, metal headers, and capable of operating up to a maximum of 625 fpm for without loss of efficiency and holding capacity.
2. Filter Rack: Side-access rack designed to hold the metal headers.

C. Final Filters:
1. Media: 4 inch closely spaced, pleated, fine fiber, hi-efficiency filter, sealed into a rigid frame, and capable of operating up to a maximum of 625 fpm without loss of efficiency and holding capacity.
2. Filter Rack: Side-access designed to hold rigid frames.
3. Minimum Efficiency Reporting Value: 13 MERV when tested in accordance with ASHRAE Std 52.2.

D. Differential Pressure Gauge:
1. Provide factory installed dial type differential pressure gauge, flush mounted with casing outer wall, and fully piped to both sides of each filter to indicate status.

2. Maintain plus/minus 5 percent accuracy within operating limits of 20 degrees F to 120 degrees F.

2.06 DAMPER SECTION

A. Mixing Section: Provide a functional section to support the damper assembly for modulating the volume of outdoor, return, and exhaust air.

B. Damper Blades:
   1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on each blade.
   2. Self-lubricating stainless steel or synthetic sleeve bearings.
   3. Comply with ASHRAE Std 90.1 I-P for rated maximum leakage rate.
   4. Provide leakage testing and pressure ratings in compliance with AMCA 500-D test methods.
   5. Arrange in parallel or opposed-blade configuration.

2.07 ENERGY RECOVERY

A. The energy recovery section shall utilize a fixed plate enthalpic energy exchange system within the cabinet.

B. Manufacturer:
   1. Xetex
   2. Innovent
   3. CORE

C. Energy recovery exchangers internal to the Air Handling Unit shall be certified by ARI within ARI Standard 1060 Certification program. At the nominal certified CFM, The enthalpy exchanger shall provide at least 60% total effectiveness in heating, and 50% total effectiveness in cooling conditions and 0% exhaust air transfer when tested at zero pressure differential between airstreams. The manufacturer shall provide independent testing of the enthalpy exchanger core to UL standards and have a flame spread rating of no more than 25 and a smoke developed rating of not more than 50. These results meet NFPA 90A and 90B for a component within a ducted air system. **The enthalpy exchanger core shall be warranted by the manufacturer in accordance with its standard terms and conditions to be free from manufacturing defects under normal use for a period of 5 years**. The remainder of the unit shall be warranted to be free of manufacturing defects under normal use for a period of 2 years.

D. The enthalpy exchanger shall provide high performance sensible and latent transfer between the airstreams. This transfer shall be accomplished by moving energy (both sensible and latent) through the enthalpy exchanger surface while keeping the airstreams physically separated. Because the unit is fixed plate, there will be no moving parts. The enthalpy exchanger shall operate with no frosting of condensation formed at outside air conditions to -10 degrees F and exhaust air RH below 40%. Infrequent excursions outside extreme conditions shall not impact the function of the exchanger. Drain pans are not required. Full bypass for economizer cycle shall be required. Enthalpy exchanger shall be washable.

E. Construction:
   1. Core: The air to air enthalpy exchanger shall be of fixed plate type and have no moving parts.
   2. The unit shall be capable of both summer and winter operation with no condensation buildup or condensation management.
   3. Optionally, provide additional cores or alternate arrangements to minimize Air Handling Unit length, see plans for space limitations.

2.08 ACCESS SECTION

A. Provide where indicated on drawings to allow for inspection, cleaning, and maintenance of field-installed components.

B. Construct access doors same as previously specified within this Section.

2.09 TURNING AND DISCHARGE PLENUM SECTION

A. Provide plenum to efficiently turn and discharge air.
   1. Scale plenum vertical height to accommodate discharge duct height.
   2. Scale plenum horizontal length to accommodate required dimensional constraints.

B. Acoustical Liner:
   1. Fabricate from corrosion-proof, perforated stainless steel with completely encapsulated fiberglass insulation.
   2. Prevent breakaway, flake off, or delamination when tested at 9000 fpm in accordance with UL 181.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Bolt sections together with gaskets.

C. Isolate fan section with flexible duct connections.

D. Provide fixed sheaves required for final air balance.

E. Make connections to coils with unions or flanges.

F. Hydronic Coils:
   1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
   2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
   3. Locate water supply at bottom of supply header and return water connection at top.
   4. Provide manual air vents at high points complete with stop valve.
   5. Ensure water coils are drainable and provide drain connection at low points.

G. Refrigerant Coils: Provide sight glass in liquid line within 12 inches of coil.

H. Cooling Coils:
   1. Pipe drain and overflow to nearest floor drain.

3.02 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals for closeout submittals.

END OF SECTION

SECTION 23 8124
COMPUTER ROOM AIR CONDITIONERS - WALL MOUNTED

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air conditioning units.

B. Controls and control panels.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate manufactured products and assemblies. Indicate water, drain, refrigeration, rough-in connections, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

E. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Filters: One set for each individual unit.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.04 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Warranty: Include coverage of refrigeration compressors.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Stultz

B. Mitsubishi

C. Liebert

2.02 AIR CONDITIONING UNITS

A. Description: Packaged, air cooled, factory assembled, pre-wired and pre-piped unit, consisting of cabinet, fans, filters, humidifier, and controls.

B. Assembly: Up-flow air delivery, in draw-through configuration.

2.03 CABINET AND FRAME

A. Structural Frame: 10 gage, 0.1345 inch welded steel suitably braced for rigidity, capable of supporting compressors and other mechanical equipment and fittings with welded tubular steel floor stand with adjustable legs and vibration isolation pads.

B. Doors and Access Panels: 18 gage, 0.0478 inch galvanized steel with polyurethane gaskets, hinges to allow removal of panels, and concealed fastening devices.

C. Insulation: Thermally and acoustically line cabinet interior with 1 inch thick acoustic liner. Insulation shall not be exposed to airstream.

D. Finish of Exterior Surfaces: Baked-on textured vinyl enamel; color as selected.

2.04 EVAPORATOR FANS AND MOTORS

A. Fans: Double inlet, forward curved centrifugal fans, statically and dynamically balanced, on steel shaft with self-aligning grease lubricated ball bearings, and V-belt drive.

B. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed, variable and adjustable pitch motor sheave, minimum of two matched belts, drive rated minimum 2.0 times nameplate rating of motor.

2.05 COMPRESSORS

A. Type: Semi-hermetic with suction gas cooled motors, vibration isolators, thermal overloads, oil sight glass, manual reset high pressure switch, pump down low pressure switch, suction line strainer, reversible oil pumps, 1750 rpm.

B. Compressors: Individually serviceable without dismantling other components or removing unit from service.

C. Refrigeration Circuits: Two, each with hot gas mufflers, thermal expansion valve with external equalizer, liquid line solenoid valve, liquid line filter-drier, refrigerant sight glass with moisture indicator, service shut-off valves and charging valves and accumulator sized for liquid seal under light load.

2.06 EVAPORATOR COILS

A. Alternate row circuits, direct expansion cooling coils of seamless copper tubes expanded into aluminum fins in A-frame configuration.

B. Mount coil assembly in stainless steel drain pan.

2.07 CONDENSERS

A. Air Cooled Refrigerant Condenser:
   1. Corrosion resistant cabinet.
   2. Copper tube aluminum fin coils arranged for two circuits.
   3. Multiple direct drive propeller fans with permanently lubricated ball bearings.
   4. Single phase motors with internal overload protection.
   5. Provide capacity control by cycling fans.

2.08 FILTERS

A. Media: Pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded wire grid; enclosed in cardboard frame; 2 inch nominal thickness.

2.09 REFRIGERANT REHEAT COIL

A. Hot gas refrigerant coil of seamless copper tubes expanded into aluminum fins with three way solenoid valve on first stage refrigerant circuit.

2.10 HUMIDIFIER

A. Evaporative Pan Type: Stainless steel pan and cover, serviceable without disconnecting water, drain, or electrical connections; pre-piped with stainless steel or brass float valve mechanism; electric heating coil and low water cut-off switch; with flush cycle timer and solenoid drain valve.

2.11 ELECTRICAL PANEL

A. Control Cabinet: NEMA EN 10250; Type 2 enclosure, UL listed, with piano hinged door, grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control circuit transformer.

B. Disconnect Switch: Non-automatic molded case circuit breaker with handle accessible with panel closed and capable of preventing access until switched to "off" position.

2.12 MICROPROCESSOR CONTROL SYSTEM

A. Logic Circuitry: Microprocessor shall continuously monitor operation of process cooling system; continuously digitally display room temperature and room relative humidity; sound alarm on system malfunction and simultaneously display problem. When more than one malfunction occurs, display fault in sequence with room temperature, remember alarm even when malfunction cleared, and continue to display fault until reset.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that flooring system is ready to receive work and opening dimensions are as instructed by the manufacturer.

B. Verify that proper power supply is available and of the correct characteristics.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Coordinate installation of computer room air conditioning units with computer room raised floor installer.

C. Provide adequate drainage connections for condensate and humidifier flushing system.

D. Provide shut-off valves in hot water heating inlet and outlet piping to reheat coils.

3.03 SYSTEM STARTUP

A. Prepare and start systems. Set initial temperature and humidity set points.

END OF SECTION

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SECTION 23 8129
AIR COOLED UNITARY HEAT PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air-source outdoor units.

1.02 REFERENCE STANDARDS

A. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

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

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings indicated in Contract Documents:
   1. Outdoor Units:
      a. Refrigerant Type and Size of Charge.
      b. Output and Input Cooling Capacity: Btu/h.
      c. Output and Input Heating Capacity: Btu/h.
      d. Operating Temperature Range, Cooling and Heating.
      e. Fan Capacity: Flow in cfm with respective fan curves.
      f. External Static Pressure (ESP): In-wc.
      g. Sound Pressure Level: dB(A).
      h. Electrical Data: Complete including motor size.
      i. Maximum number of indoor units that can be served.
      j. Maximum refrigerant piping run from outdoor unit to indoor unit(s).
      k. Maximum height difference between outdoor unit to Indoor unit(s), both above and below.
   2. Control Panels: Complete data of controllers, input-output points, and zones.

C. Shop Drawings: Installation drawings custom-made for this project; include as-designed HVAC layouts, locations of equipment items, refrigerant piping sizes and locations, condensate piping sizes and locations, remote sensing devices, control components, electrical connections, control wiring connections. Include:
   1. Detailed piping diagrams, with branch balancing devices.
   2. Condensate piping routing, size, and pump connections.
   3. Detailed power wiring diagrams.
   4. Detailed control wiring diagrams.
   5. Locations of required access through fixed construction.
   6. Drawings required by manufacturer.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.

PART 2 PRODUCTS

2.01 AIR-SOURCE OUTDOOR UNITS

A. Heat Pump Type:
   1. DX refrigeration unit piped to one or more compatible indoor units either directly or indirectly through one or more intermediate refrigeration branch units.

B. Unit Cabinet:

1. Capable of being installed with wiring and piping to the left, right, rear or bottom.
2. Designed to allow side-by-side installation with minimum spacing and vibration isolation.
3. Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
4. Sound Pressure Level: 60 dB measured at 3 feet from front of unit.

C. Heat Sink Side:
1. Condenser Fans:
a. Provide minimum of 2 fans for each condenser within the outdoor unit.
b. Minimum External Static Pressure: Factory set at 0.12 in-wc.
c. Fan Type: Vertical discharging, direct-driven propeller type with variable speed operation using DC-controlled ECM motors mechanically connected using permanently lubricated bearings having whole assembly protected with fan guards.
2. Condenser Coils:
a. Hi-X seamless copper tubes expanded into aluminum fins to form mechanical bond; waffle louver fin and rifled bore tube design to ensure high efficiency performance.

D. Refrigeration Side:
1. Factory assembled and wired with instrumentation, switches, and controller(s) to handle unit specifics with direct coordination of remote controller(s) from indoor unit(s).
2. Refrigeration Circuit: ECM driven dual scroll compressors, fans, condenser heat sink coil, expansion valves, solenoid valves, distribution headers, capillaries, filters, shutoff valves, oil separators, service ports, and refrigerant regulator.
3. Variable Volume Control: Modulate compressed refrigerant capacity automatically to maintain constant suction and condensing pressures under varying refrigerant volume required to handle remote loads. Include defrost control.
4. Provide refrigerant subcooling to ensure the liquid refrigerant does not flash when supplying to use indoor units.
5. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle, oil return, or defrost is not permitted due to potential reduction in space temperature.
6. Power Failure Mode: Automatically restarts operation after power failure without loss of programmed settings.
7. Safety Devices: High pressure sensor with cut-out switch, low pressure sensor with cut-out switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, overcurrent protection for the inverter and antirecycling timers.
8. Oil Recovery Cycle: Automatic, occurring 2 hours after start of operation and then every 8 hours of operation; maintain continuous heating during oil return operation.

E. Local Controls:
1. Include factory-wired instruments, sensors, switches, and safeties for unit control.

F. Power:
1. Electrical Requirement: 460 VAC, 3-phase, 60 Hz.
2. Outdoor Mounted: Provide fused NEMA EN 10250 Type 4X disconnect switch.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Perform wiring in accordance with NFPA 70, National Electric Code (NEC).

C. Coordinate with installers of systems and equipment connecting to this system.

3.02 SYSTEM STARTUP

A. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.

B. Adjust equipment for proper operation within manufacturer's published tolerances.

END OF SECTION

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SECTION 23 8200
CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finned tube radiation.

B. Convectors.

C. Unit heaters.

D. Cabinet unit heaters.

E. Electric baseboard heaters.

1.02 REFERENCE STANDARDS

A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.

B. AHRI 350 (SI/I-P) - Sound Performance Rating of Non-Ducted Indoor Air-Conditioning and Heat Pump Equipment; 2025.

C. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).

D. AHRI 440 - Performance Rating of Room Fan-Coils; 2008.

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

F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

1.03 SUBMITTALS

A. Product Data: Provide typical catalog of information including arrangements.

B. Shop Drawings:
   1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
   2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
   3. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
   4. Submit the following for blower-coil units indicating:
      a. Overall dimensions including installation, operation, and service clearances.
      b. Lift points, recommendations, and center of gravity.
      c. Unit shopping, installation, and operating weights including dimensions.
      d. Fan curves with specified operating point clearly plotted.
      e. Safety and start-up instructions.

PART 2 PRODUCTS

2.01 HYDRONIC FINNED TUBE RADIATION

A. Required Directory Listing: AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.

B. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

C. Enclosures: 18 gage, 0.0478 inch sheet steel up to 18 inches in height, 16 gage, 0.0598 inch sheet steel over 18 inches in height or aluminum as detailed, with easily jointed components for wall to wall installation.

D. Finish: Factory applied baked enamel of color as selected.

E. Damper: Where not thermostatically controlled, provide knob-operated internal damper at enclosure air outlet.

F. Access Doors: For otherwise inaccessible valves, provide factory-made permanently hinged access doors, 6 by 7 inch minimum size, integral with cabinet.

2.02 HYDRONIC UNIT HEATERS

A. Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.

B. Perform factory run test under normal operating conditions, water, and steam flow rates.

C. Casing: Minimum 18 gage, 0.0478 inch thick sheet steel casing with threaded pipe connections for hanger rods for horizontal models and minimum 18 gage, 0.0478 inch thick sheet steel top and bottom plates for vertical projection models.

D. Finish: Factory applied baked primer coat.

E. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.

F. Air Outlet: Adjustable pattern diffuser on vertical projection models and two or four way louvers on horizontal projection models.

G. Control: Local solid state disconnect switch.

2.03 HYDRONIC CABINET UNIT HEATERS

A. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.

B. Coils:
   1. Evenly spaced aluminum fins mechanically bonded to copper tubes.

C. Cabinet: Minimum 16 gage, 0.0598 inch thick sheet steel front panel with exposed corners and edges rounded, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles.

D. Finish: Factory applied baked primer coat on visible surfaces of enclosure or cabinet.

E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.

F. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.

G. Control: Factory wired, solid state, infinite speed control, located in cabinet.

H. Filter: Easily removed, 1 inch thick glass fiber throw-away type, located to filter air before coil.

I. Control: Local solid state disconnect switch.

2.04 ELECTRIC BASEBOARD HEATERS

A. Manufacturers:
   1. Runtal.
   2. Panel Radiator.

B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL) as suitable for the purpose indicated.

C. Heating Elements:
   1. Welded steel construction with powder coat finish, pedistal/wall mounted, high output.

D. Finish:
   1. Factory applied, polyester powder coat finish.
   2. Color: by architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

3.03 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.

C. Do not damage equipment or finishes.

D. Finned Tube Radiation:
   1. Locate on outside walls and run cover continuously wall-to-wall unless otherwise indicated.
   2. Center elements under window with elements of equal length centered under each window for multiple windows.
   3. Install wall angles where units butt against walls and align cabinet joints with window mullions.

E. Convectors:
   1. Install where indicated.
   2. Coordinate to ensure correct recess size for recessed convectors.

F. Unit Heaters:
   1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.
   2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

G. Cabinet Unit Heaters:
   1. Install as indicated.
   2. Coordinate to ensure correct recess size for recessed units.

END OF SECTION

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SECTION 26 0100

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 20: Testing and Adjustments to Electrical Systems

1.3 SUMMARY

A. Section Includes:

1. Work consists of furnishing labor, materials, equipment and services required for the complete installation of work shown in the Contract Documents and specified in Division 26.
2. Include all parts and labor which are incidental and necessary for a complete and operable installation even though not specifically mentioned in the Contract Documents. Such items include nuts, bolts, anchors, brackets, sleeves, offsets in conduit, fittings, relays, etc.
3. Some equipment and materials provided under Divisions 21, 22, 23, 25, 26, 27 and 28 may require composite work crews because of trade jurisdiction. Where this occurs, include in the bid this portion of the composite crew labor costs. It is the Contractor's responsibility to review Divisions 21, 22, 23, 25, 26, 27 and 28 Contract Documents to determine where these composite crews are required.
4. Arrange with appropriate utility companies to provide temporary and permanent utility services as required and coordinate their installation with construction progress of this project.
5. Pay all fees and costs charged by utility company for installation of temporary utility services.
6. Obtain all temporary and permanent permits and licenses required in connection with this Division's work. Pay all fees and expenses required for such permits and licenses.
7. Pay all fees and costs charged by utility companies for utility services.
8. Request inspections as required by regulating agencies and/or regulations. Pay all charges for inspections by regulating agencies of installations of plans specifications.
9. Include State and Local sales taxes in the bid. Keep accurate records of these taxes and furnish such records to the Owner upon request.
10. Provide the Owner with a certificate of final inspection and approval by enforcement authorities.

B. Commissioning – Mechanical and electrical systems on this project will be commissioned by an independent commissioning agent. Scope of electrical work includes, but is not limited to the following:

1. Attending all commissioning meetings.
2. Verifying electrical connections and operation of commissioned systems, including but not limited to lighting, electrical distribution, fire alarm, security and low voltage systems.
3. Measuring, testing and documenting statuses of components within the scope of mechanical and electrical commissioning.
4. Demonstrating electrical systems to the Owner and commissioning agent.
5. Correcting Work as indicated by the Commissioning agent if also directed by the Engineer.

6. Providing written reports and test reports as indicated in specific specification sections.

C. Related Sections:

1. Divisions 0 and 1 apply to all work of Division 26 and are an integral part of this Section. Where the conditions specified are at variance with other Divisions, Section 26 01 00 takes precedence. Section 26 01 00 specifies conditions, procedures, equipment and material particular to the electrical work and applies to all electrical work of the Contract Documents.

2. Division 0 and 1 and Section 26 01 00 and all Addenda form a part of and apply to all contracts or sub-contracts relating to Division 26 work. Copy these documents to all Sub-contractors receiving other Sections of Division 26.

3. Where a Specification Section refers to other Sections under the Article on Related Sections, this is done for Contractor's convenience only. It shall in no way relieve the Contractor of responsibilities stated in other Sections of the Specifications, even though these Sections are not specifically referenced. The Contractor is responsible for all information contained in this Division's Specifications as well as for information contained in all other Divisions.

1.4 ALTERNATES

A. Refer to Bid Form and Instruction to Bidders.

1.5 ALLOWANCES

A. Refer to Bid Form and Instruction to Bidders.

1.6 REFERENCES

A. Meet or exceed all current applicable codes, ordinances and regulations for all installations. Promptly notify the Engineer, in writing, if the contract documents appear to conflict with governing codes and regulations. Contractor assumes all responsibility and costs for correcting non-complying work installed without notifying the Engineer.

B. Higher quality of workmanship and materials indicated in the Contract Documents takes precedence over that allowed in referenced codes and standards.

C. Perform all work in compliance with the currently adopted version of the following codes and standards for this project:

National Electric Code
State and Local Electrical Codes
International Building Code
International Fire Code
International Mechanical Code
State and Local Building Codes and Ordinances
State Industrial Commission Regulations
State and Local Fire Codes and Regulations
State and Local Mechanical Codes
State Elevator Code
Occupational Safety and Health Administration Regulations
Americans with Disabilities Act
Uniform Federal Accessibility Standards
State Board of Health
NFPA 101 Life Safety Code
State Energy Code

D. Use the Standard where referenced in the specifications by the following abbreviations:

AIA: American Insurance Association
AIA: American Institute of Architects
ANSI: American National Standards Institute
ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers

ASTM: American Society of Testing and Materials
EPA: Environmental Protection Agency
FM: Factory Mutual Insurance Association
IEEE: Institute of Electrical and Electronic Engineers
IES: Illuminating Engineering Society of North America
ICEA: International Cable Engineers Association
NBS: National Bureau of Standards
NEMA: National Electrical Manufacturers Association
NFPA: National Fire Protection Association
NSC: National Safety Council
UL: Underwriter's Laboratories
EIT/TIA Standards: Commercial Bldg Telecommunications wiring and spaces.
BICSI: Building Industry Consulting Services International.
NECA: National Electrical Contractors Association

1.7 DEFINITIONS

A. The terms defined below apply to all work included in Division 26.

1. The work – as defined in AIA Document A201: “The term ‘Work’ means the construction and services required by the Contract Documents whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor’s obligations. The Work may constitute the whole or a part of the Project.”
2. Furnish – to obtain in new condition ready for installation into the work.
3. Install – to store, set in place, connect and place into operation into the work.
4. Provide – to furnish and install.
5. Connect – to bring service to the equipment and make final attachment including necessary switches, outlets, boxes, terminations, etc.
6. Conduit – includes in addition to conduit, all fittings, pull boxes, hangers and other supports and accessories related to such conduit.
7. Concealed – hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction, in crawl spaces or buried.
8. Exposed: not installed underground nor concealed as defined above.
9. Building structure or building structural members - consists of steel columns, steel beams, steel joists (top chord and at panel points), concrete walls and concrete block walls. Metal decking, joist bridging and bottom chords of bar joists shall not be construed as building structure nor as a building structural member for the purpose of support.

B. The drawing and specifications constitute the Contract Documents. Any item noted in the specification or shown on the drawings is included in the Contract Documents.

C. All electrical details and drawings are diagrammatic, unless specifically noted. Field-verify all dimensions and notify the Engineer of any conflicts of discrepancies, in writing, prior to installation.

1.8 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Initiate, maintain and supervise all safety precautions required with this work in accordance with the regulations of the Occupational Safety and Health Administration (OSHA) and other governing agencies.

B. Environmental Requirements:

1. Do not remove or disturb any asbestos containing materials from the project. Immediately stop work and notify the Owner if asbestos containing materials are suspected.
2. Do not dispose of any PCB containing materials. Disposal of all PCB containing materials will be the responsibility of the Owner.

C. Provide new, first quality material for all products specified. Do not reuse materials unless indicated or approved by the Engineer.

D. Comply with the NEC as applicable to the construction and installation of equipment specified in this section.

E. Provide equipment specified in this section that has been listed and labeled by a nationally recognized testing laboratory.

F. Comply with ANSI as applicable to equipment specified in this section.

G. Comply with NEMA as applicable to equipment specified in this section.

H. Comply with NECA, NEIS (National Electrical Installation Standards) for workmanship and installation requirements.

1.9 SUBMITTALS

A. Refer to section 26 01 05, Submittals, Closeout Documents, Training and Spare Parts.

1.10 PROJECT/SITE CONDITIONS

A. Site Inspections:

1. Before submitting a proposal on the work contemplated, examine the site of the proposed work and become thoroughly familiar with existing conditions and limitations. No extra compensation will be allowed because of misunderstanding as to the amount of work involved nor bidders lack of knowledge of existing conditions which could have been discovered or reasonably anticipated prior to bidding.
2. Conduits, pipes, ducts, lights, devices, speakers, etc., shown on the drawings as existing have been based on existing plans and casual site observations, and may not be installed as originally shown. It is the Contractor's responsibility to visit the site and make exact determination of the existence, location and condition of such facilities prior to submitting a bid.

B. Correlation of Work:

1. Consult the drawings and specifications of of all other Divisions for correlating information and lay out work so that it will coordinate with other trades. Verify dimensions and conditions (i.e., finished ceiling heights, footing and foundation elevations, beam depths, etc.) with the Architectural and Structural drawings. Notify the Architect/Engineer of any conflicts that cannot be resolved, in the field, by affected trades. Replacement of work due to lack of coordination and failure to verify existing conditions will be completed at no cost to the Owner.
2. Install all conduit, cable tray, busduct, equipment, etc. allowing proper code and maintenance clearances and to avoid blocking passageways and access panels.
3. Where work must be replaced due to the failure of the Contractor to verify the conditions existing on the job, such replacement must be accomplished at no cost to the Owner. This applies to shop fabricated work as well as to work fabricated in place.
4. Throughout the course of the work, minor changes and adjustments to the installation may be requested by the Engineer. The Contractor shall make adjustments without additional cost to the Owner, where such adjustments are necessary to the proper installation and operation within the intent of the Contract Documents. This does not include work already completed.

5. Equipment outlines shown on detail plans of 1/4"=1'-0" scale or larger and/or dimensions indicated on the plans are limiting dimensions. Do not install any equipment that exceeds the equipment outlines shown or reduces indicated clearances.
6. Obtain exact location of connection to equipment, furnished by others, from the person furnishing the equipment.
7. Drawings and specifications are complementary and what is called for in either on is as binding as if called for in both.
8. Include the better quality, greater quantity or higher cost for an item or arrangement where a disagreement exists in the drawings and specifications.

1.11 FIRESTOPPING

A. Provide firestopping around all new penetrations, sleeves and openings through all partitions, walls and floors.

B. Provide UL listed components installed by a certified and factory trained personnel.

1.12 SEQUENCING AND SCHEDULING

A. Refer to General Conditions and Requirements.

PART 2 PRODUCTS

2.1 TAMPERPROOF HARDWARE

A. Where tamperproof hardware is called out, provide torx head with center pin reject hardware for the following electrical work:

1. Light fixture housings
2. Covers to electrical enclosures, pullboxes, cabinets, junction boxes, wireways
3. Coverplates (both maximum security and stainless steel coverplates)

2.2 SLEEVES

A. Provide Schedule 40 galvanized steel pipe sleeves 1 ½" larger than O.D. of pipe that adhere ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Provide minimum of three (3) concrete anchors for Schedule 40 pipe sleeves.

D. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:
    a. For sleeve cross-selection rectangle perimeter less than .50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    b. For sleeve cross-section rectangle perimeter equal to, or more than .50 inches and 1 or more sides equal to, or more that 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Rectangular Pathways:

1. 4" x 4-5/8" nominal pathway cross section with accommodations for wall thicknesses up to 20".
2. UL tested and classified in accordance with ASTM E814 (UL1479).
3. Fire and smoke sealing system that automatically adjusts to the amount of cables installed.
4. Manufacturers:
    a. Specified Technologies Inc. (STI), "EZ-PATH 44".

b. Approved equal.

2.3 MANUFACTURED SEAL ASSEMBLIES (SLEEVE SEALS)

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

B. Provide factory-assembled wall and floor seals. Provide watertight seals around conduit pipe, or tubing passing through concrete below grade floors and wall. Construct with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.

C. Sealing Elements: [EPDM] [NBR] <Insert other> interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

1. Pressure Plates: [Plastic] [Carbon steel] [Stainless steel]. Include two for each sealing element.

2. Connecting Bolts and Nuts: [Carbon steel with corrosion-resistant coating] [Stainless steel] of length required to secure pressure plates to sealing elements. Include one for each sealing element.

D. Approved Manufacturers:

1. Advance Products & Systems, Inc.

2. Calpico, Inc.

PART 3 EXECUTION

3.1 CONSTRUCTION LIGHTING AND POWER SYSTEM

A. Refer to temporary facilities and controls in Division 1 for temporary power and lighting systems.

3.2 CONSTRUCTION LIGHTING & POWER SYSTEM – NEW CONSTRUCTION

A. Provide construction power and lighting that adheres to NEC Article 590 – “Temporary Installations”

B. Furnish, install and maintain a construction lighting and power system, as directed herein for the use of all trades. As soon as a directive to proceed is issued, arrange with the power company suitable temporary power:

1. Provide not less than ½ watt per square foot for temporary lighting with a minimum of one (1) light per room or space. Provide 200 watt, inside frosted, incandescent lamps for each outlet. Provide at least one (1) 200 watt incandescent lamp, or the equivalent lighting, for each 625 square feet of floor area with at least one (10 light in each room. Provide additional lights in corridors and stairwells as necessary to provide adequate illumination. Furnish and maintain all lamps for the temporary lighting system for a continuous working system.

2. Provide 20 amp, 120 volt, single phase duplex, grounding type, receptacles and 50 amp, 240 volt, single phase receptacles. Locate receptacles so no location in the building is more than 75 feet from either type of receptacle. Provide ground fault protection as required by the NEC.

3. Provide minimum #12 AWG conductors for all 120V branch circuits with total conductor length less than 75 feet, provide #10 AWG conductors for branch circuits exceeding 75 feet.

C. Materials furnished for the temporary light and power system remain Contractors property. Remove when there is no longer any need for temporary light and power or when directed by the Architect.

D. Electrical energy costs for the temporary separate system paid by the Contractor.

E. Power company’s connect-and-disconnect charges paid by the Contractor.

3.3 PREPARATION

A. Continuity of Service:

1. No Division 26 systems are to remain inactive at the end of the workday. Assure that the systems are all operational at the end of each workday. Coordinate temporary outages with the Owner.
2. Coordinate/schedule all work with the Owner to minimize any disruptions. Confine all interruptions to the smallest possible area. Provide temporary connections if required to provide continuity of service.
3. Inspect all areas affected by the interruptions and return all automatically controlled equipment, electrically operated equipment to the same operating condition prior to the interruption.

B. Use of Facility:

1. Do not disturb normal use of the facility, except within the immediate construction area. Keep walks, driveways, entrances, etc. free and clear of equipment, material and debris.
2. Store all equipment and material in a place and manner that minimizes congestion and is approved by the Owner.

3.4 INSTALLATION

A. Material and Workmanship:

1. Provide new material and equipment, unless noted otherwise. Protect equipment and material from damage, dirt and the weather.
2. Provide the highest quality workmanship and perform all work only by skilled mechanics. Install material and equipment in accordance with manufacturers' recommendations, instructions and current NECA standards.
3. The Engineer reserves the right to reject material or workmanship not in accordance with the specifications, before or after installation.

B. Excavation and Backfilling:

1. Provide all excavation and backfilling required to complete the installation of the electrical system. Conform with the provisions of Division 31 Earthwork of these specifications for all work.
2. Bed all conduit and structures on a 6" thick compacted layer of granular material. Should unsatisfactory soil conditions be discovered, the Engineer/Architect will inspect the excavation and determine the necessary additional support required.
3. Backfill around conduit and structures by hand using coarse sand, pit run gravel or the native material if it is similar to the above. Remove all large stones, frozen lumps, perishable rubbish and excessive amounts of clay. Carefully compact this material in 6" layers to a depth of 8" above the conduit, cable or duct. Compact to not less than 90% outside the building and 95% within the building limits of maximum density given by ASTM D698-70T (Standard Proctor Density). Architect/Engineer reserves the right to require soil compaction tests in any areas which do not appear to be compacted properly with the cost of the test paid by the Contractor.
4. Replace all existing surface improvements (i.e.,-street pavement, curbs, sidewalks, finish sodding, etc.) removed or damaged in the course of the work unless such improvements are to be reconstructed under the general contract. Make all necessary arrangements to perform such repairs, pay all costs in connection therewith and include them in the bid.

C. Cutting and Patching:

1. Perform all cutting and patching necessary to work, unless specifically delegated to be performed under a different Division.

2. Obtain special permission from the Engineer before cutting structural members or finished material.
3. Perform all patching in a manner as to leave no visible trace and return the area affected to the condition of undisturbed work. Perform all patching by workers experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted.
4. Patch all holes left as a result of demolition of electrical equipment and devices.
5. Drill all holes in masonry with rotary drill. Impact tools are not allowed. Core drill all holes in masonry and concrete for electrical raceway. Provide and dispose of all water required for core drilling. Coordinate with other trades to prevent damage from water.
6. Prevent the spread of dust, debris, and other material into adjacent areas.
7. Replace all ceiling tiles damaged during installation of work, with new tile.

D. Painting:
1. Refinish all electrical equipment damaged during shipping and/or installation to its original condition. Remove all rust; prime, and paint per manufacturer's recommendations for finish equal to original.
2. Paint all new raceway systems in exposed finished areas to match existing finish.

E. Sleeves:
1. Provide sleeves where required for the installation of all Division 26, 27, and 28 systems as part of the contractor's means and methods of installation. Sleeves shall be separated per system type (i.e. no combined systems in a single sleeve) without approval of the Engineer. Where telecommunications or other system sleeves are shown on the Drawings, they are included as a convenience to the Contractor and this does not alleviate the requirement to provide other sleeves where required.
2. Set all sleeves true to line, grade and position and plumb or level after concrete is poured. Correct any deviation from proper position.
3. Caulk spaces between pipe and floor sleeves inside the building with a waterproof caulking material. Caulk spaces between pie and exterior partition sleeves with glass fiber insulation.
4. Tighten sleeve seal nuts until sealing grommets have expended to form watertight seal.
5. Furnish sealable penetration pockets compatible with the building roofing system where conduits pass through the roof. Turn pockets over to the General Contractor.
6. Provide fire barriers around conduit, pipe, tubing, bus ducts and cables passing through smoke and fire rated floors and walls. Provide CP 25, 303, and PSS7904 Series by 3M, or "flame-Safe" system by Thomas and Betts Corp for fire seals.
7. Subject to compliance with requirements, provide water-tight seals by Thunderline or pre-approved equal.

F. Precast Construction:
1. The Electrical Contractor is to include in their bid all labor, material and other necessary items for the installation of the outlet (junction) boxes, cabinets, conduit, etc. within the pre-cast panels at the manufacturing plant.
2. The Electrical Contractor will furnish and install all items at the pre-cast manufacturing plant as part of the fabrication process.
3. Pre-cast panels are not to be fabricated until the electrical contractor has provided written confirmation that all required electrical items have been installed in the pre-cast panels.
4. Prior to fabrication, the electrical contractor will provide the Engineer with pre-cast panel shop drawings (elevations) indicating all electrical rough-in locations and mounting heights.

3.5 FIRESTOPPING

A. Provide firestopping around all new penetrations, sleeves and openings through all partitions, walls and floors.

B. Install firestopping on both sides of each partition, completely filling the void around the opening.

C. Firestopping of interior of conduits and sleeves is by the contractor providing the cabling inside the conduit or sleeve.

3.6 FIELD QUALITY CONTROL

A. Testing: Refer to Section 26 01 20: Testing and Adjustments to Electrical Systems.

B. Final Inspection:

1. A final inspection of the electrical systems will be required before the Contract can be closed out. Request a final inspection by the Engineer after all systems are fully completed and operational. The Engineer will schedule an inspection and generate a list of items to be corrected or completed before Contract Closeout. If the Engineer is requested to make a final inspection by the Contractor, and the Engineer finds the work is not complete enough to perform that inspection, the Contractor will compensate the Engineer for his time. The Contractor will then perform the necessary work to complete the project and again request a Final Inspection.

3.7 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish, caused by his employees or work, at all times. Remove rubbish, tools, scaffolding, and surplus materials from and about the building, and leave work areas "broom clean" or its equivalent upon completion of the work. Clean electrical equipment and remove temporary identification. In case of dispute the Owner will remove the rubbish and charge the cost to the Contractor.

B. After tests have been made and accepted clean light fixtures, panels and other equipment installed by the Contractor, leaving the entire work area in a clean and complete working order.

3.8 PROTECTION

A. Cover openings and equipment, where set, to prevent obstruction to conduits, breakage, misuse, or disfigurement of equipment. Cover openings in equipment immediately upon uncrating or receipt at the job site and keep covered until permanent connection is made.

B. Contractor is responsible for any damage to electrical equipment or materials until final acceptance of the entire project by the Owner. Keep all equipment clean materials until final acceptance of the entire project by the Owner.

C. If a portion of the project is to be occupied by the Owner prior to Substantial Completion of the entire project make arrangements with the Owner to transfer responsibilities for protection and housekeeping.

3.9 FINAL OBSERVATION

A. A final observation of the electrical systems by the Architect/Engineer will be conducted before the contract can be considered complete. The Contractor shall inform the Engineer when the electrical installation is complete and ready for final observation. The Engineer shall visit the project and provide a list of items that need to be corrected or completed to achieve final completion. Should the Engineer attaend the project to conduct the final observation and discovers that the work is not sufficiently complete to perform this task, then the contractor shall compensated the Engineer for this time. The Contractor shall remain responsible for completing their work and requesting the Engineer to return for a final observation.

END OF SECTION

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SECTION 26 0105

SUBMITTALS, CLOSEOUT DOCUMENTS, TRAINING AND SPARE PARTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0120: Testing and Adjustments to Electrical Systems

1.3 PRIOR APPROVALS

A. Submit approval form for each request for prior approval.

B. Submit written electronic requests to use unspecified items, to the Engineer, no later than ten (10) calendar days prior to the bid opening. Submit detailed information for proposed material or equipment specific to the project, clearly indicating all options included in the submittal.

C. Accepted substitutions will be incorporated in an Addendum to the Contract Documents.

D. Contractor is responsible for dimensional differences, electrical requirements and any other resulting changes, when using accepted substitutions. Contractor is responsible for any additional costs incurred as a result of substitutions, including other contractors and Architect/Engineer fees.

E. Material and equipment not specified or accepted in an Addendum will be removed and replaced at no cost or inconvenience to the Owner.

1.4 PAY REQUEST COST BREAKDOWN

A. Provide Schedule of Values for the utilization of submitting a “Pay Request”. Allocate appropriate share of overhead and profit to each item. Separate each item into labor and material.

B. Submit cost breakdown on AIA document G703. Provide minimum breakdown as indicated below. Provide additional breakdown as required for clarity or requested by the Engineer.

1. General Conditions
2. 600 V Conductors and Cables
3. Raceway, Fittings, and Boxes
4. Occupancy Sensors, Daylight Sensors
5. Emergency Lighting Relay
6. Lighting Control Equipment
7. Transformers
8. Distribution Panelboards
9. Panelboards
10. Wiring Devices
11. Safety Switches
12. Motor Control Equipment
13. Surge Protection Devices
14. Light Fixtures
15. LED Lamps and Drivers
16. Emergency Lighting and Lighting Inverters

17. Exit Signs

18. Poles

19. Lighting Poles and Standards

1.5 SHOP DRAWINGS AND SAMPLES-ELECTRONIC COPY

A. Submit in accordance with the Division 0 and Division 1. Submit drawings to the Engineer for review within 30 calendar days after award of Contract.

B. Submit separately-compiled electronic documents in PDF format for each submittal listed in the table at the end of this section. Combination submittals will be returned to the contractor without review. Do not combine submittals.

C. Include project name, name of Architect, name of Engineer, contractor, sub-contractor, manufacture, supplier and sales representative, include name, address, and phone number for the sales representative. Clearly identify section number and description of equipment submitted. Shop drawings not including all of this information will be returned without review.

D. Where equipment wiring diagrams, floorplans, equipment arrangements, etc. are specified as required submittals in individual specification sections, provide contractor-created documentation. Scans, copied reproductions, etc. of Engineer's drawings are unacceptable and will be rejected without review.

E. Examine all shop drawings noting capacity, arrangement and physical dimensions. Clearly mark all relevant items on catalog data and cross-out unrelated information. Review and stamp shop drawing prior to submitting to the Engineer.

F. Submit all shop drawings electronically using the established file transfer system in place as part of this project. Coordinate distribution with General Contractor, other team members, etc.

G. All shop drawings must be reviewed and accepted by the Engineer prior to fabrication and installation.

H. Shop Drawings will be reviewed by the Engineer who will attach a review letter pdf with submittal comments and with one of the following actions checked on the submittal stamp:

1. NO EXCEPTIONS TAKEN—Indicates the Submittal appears to conform to the design concept of the Work and that the Contractor at his discretion, may proceed with fabrication and/or procurement and installation.

2. MAKE CORRECTIONS NOTED—Indicates that the Submittals, after noted corrections are made, would appear to conform to the design concept of the Work and that the Contractor, at his discretion, may proceed with fabrication and/or procurement and installation, if the corrections are accepted by the Contractor without an increase in Contract Sum or Time.

3. REJECTED—Indicates that the Submittal does not appear to conform to the specifications, and that a complete resubmittal is required. The Contractor shall not proceed with fabrication or procurement.

4. NO ENGINEER ACTION REQUIRED—Indicates the Contractor may proceed without review of the Submittal based on provisions of the Contract Documents.

I. Allow a minimum of fourteen (14) calendar days for the Engineer to review the shop drawings. Time is from the receipt of drawings in the Engineers office until they are shipped out of the office.

J. If the Engineer rejects (Make corrections noted/Submit corrected copy, Rejected/Submit specified item) two (2) times for the same section the Engineer will be compensated for the additional reviews. Compensation will be incorporated by Change Order and deducted from the Contractor's application for payment. Contractor is responsible for delays caused by the resubmittal process.

K. Refer to the end of this section for list of Shop Drawings required for this project.

L. Provide all order service, commissioning, shop drawing preparation, on-site field-service and testing, etc. for all electrical equipment and materials through local representation.

1.6 DRAWING FILES

A. The electrical Revit drawing files prepared by Hallberg Engineering, Inc. for this project are Instruments of Service of Hallberg Engineering, Inc. for use solely with respect to this project and will not be made available to the Contractor.

B. Request AutoCad or Revit drawing files of Architectural floor plans, elevations, sections, etc. directly from the Architect.

1.7 DEMONSTRATION / TRAINING

A. Fully lubricate, charge, fill, etc. all equipment, per manufacture's recommendation, prior to start-up.

B. Operate equipment and systems in all their operating modes, to verify proper operation, prior to final inspection and Owner instructions. Notify the Engineer, in writing, that all systems have been tested and are functioning and operating properly.

C. Fully instruct the Owner's designated personnel in the operation of each electrical system at the time it is put into service. Provide instruction using competent instructors and factory-trained personnel.

D. Include documentation of instructions in the Operation and Maintenance Manuals.

E. Obtain a written statement from the Owner that his designated personnel have been instructed.

F. Refer to the end of this section for training requirements for each system

1.8 OPERATING AND MAINTENANCE MANUALS:

A. Submit to the Engineer two (2) Operating and Maintenance manuals. Submit in portfolio form neatly edited with similar equipment grouped, tabbed and indexed. Provide printed or typewritten materials. Provide the following in each manual:

1. Shop drawings, approved manufacturer's bulletins, and other appropriate data from specific manufacturer of each piece of equipment furnished and/or installed. Shop drawings, manufacturer's bulletin, and other data shall be appropriately marked to reflect the "as-built" condition. Cross out or delete all information shown on shop drawings or literature not applying to this specific project.
2. Copies of manufacturer's warranties.
3. Operating instruction for equipment.
4. Wiring and installation instructions for equipment.
5. Recommended maintenance schedules and procedures for equipment.
6. Recommended trouble shooting procedures for equipment.
7. Equipment parts list.
8. Settings/adjustments/calibrations for systems as required.
9. Adjustable circuit breaker and ground fault settings and field-testing procedures.
10. Local equipment suppliers/reps names, addresses, and telephone numbers.
11. Equipment manufacturers names, addresses, and telephone numbers.
12. Sub-contractors names, addresses, and telephone numbers.
13. Refer to individual Sections in Division 26 for additional requirements.
14. Test reports.

1.9 RECORD DRAWINGS

A. Provide record drawings in accordance with the requirements of Division 0, Division 1 and this section.

B. Preparation of as-built drawings does not constitute authorization to make changes unknown to or unapproved by Owner or the Owners representative.

C. As work progresses, in a neat and legible manner, record the following information on the record set of plans:

1. Update the contract documents to show all modifications including but not limited to Addendums, Change Orders, approved Proposal Requests and Architect's Supplemental Instructions. Cut and paste original documents to the as-built set.

2. Indicate exact location and depth of underground feeders to panelboards, transformers, distribution panels, generators and motor control centers, complete from each end. Indicate the routing of the conduits as accurately as possible, showing elbows, sweeps, and turns.

3. Provide plans that indicate exact routing of outside underground feeders and services, showing dimensions from structural foundation walls or columns. Indicate depth and type of conduits.

4. Provide plans that indicate routing of conduit from outlet to outlet, routing of conduit underfloor, overhead, in walls or exposed, combining of circuits into a common conduit, exact sizes of conduits and conductors, revisions to circuit breaker quantity or arrangement in panelboards.

5. Record exact location and elevation of underground conduits dedicated to technology systems including backbone fiber conduits, telephone conduits and cable TV conduits. Where spare underground conduits are terminated underground (i.e. property line), indicate exact dimensions from two different points of the foundation wall corner or structural columns.

6. Indicate exact locations and depth of spare conduits stubbed from concrete pole bases.

7. Record routing of cable tray where it varies from the plans.

8. Record changes to branch circuit numbers on the plan when they deviate from the circuit numbers shown on the Contract Documents.

9. Include the locations of the following devices on the record drawings:

   a. Emergency Lighting Relays (Section 26 09 25) mounted above ceilings.

   b. Occupancy Sensor Power Packs (Section 26 09 23) mounted above ceilings.

   c. Daylight Sensor Power Packs (Section 26 09 24)

D. The Engineer will recommend withholding payment if as-built drawings are not being maintained on-site.

E. Submit record drawings to the Engineer for review at completion of the Work. Submit final record drawings as part of the Operation and Maintenance Manual package after the completion of the project.

1.10 DOCUMENT TURNOVER

A. Construction Documents CD's, Owner and Operation Manuals (O&M's), As-Builts, Specifications and other documents turned over at the completion of the projects shall be furnished to the Owner in both paper hard copy and digital Adobe PDF.

1. Construction Documents:

   a. PDF Creation: Each roll of drawings shall be scanned or converted to PDF to one single PDF document.

      1) Scanning:

i) 150DPI Color

ii) Cropped to original size

iii) Color corrected and despeckled

b. Bookmarking: Each page of the PDF shall be bookmarked with the number and name of the sheet.

c. Naming: The PDF shall be labeled: “Building Name_Year_Title_Spec_Type”

1) Name = Building Name

2) Year = Date of Documents

3) Title = “Addition” “Remodel,” etc…

4) CD = Construction Document

5) Type = Arch, Mech, Electrical Communications or a combination of the above

2. Specifications

a. PDF Creation: All specifications shall be scanned or converted to one single PDF file.

1) Scanning:

i) 150DPI Color

b. Bookmarking: Not required.

c. Naming: The PDF shall be labeled: “Building Name_Year_Title_Spec_Type”

1) Name = Building Name

2) Year = Date of Documents

3) Title = “Addition” “Remodel,” etc…

4) CD = Construction Document

5) Type = Arch, Mech, Electrical Communications or a combination of the above

3. Operation and Maintenance Manuals

a. O & M’s shall be turned over by the Contractor.

b. PDF Creation: All Operation and Maintenance Manuals shall be scanned or converted to one single PDF file.

1) Scanning:

i) 150DPI Color

c. Bookmarking: Bookmarking of O & M Manuals shall be extensive.

1.11 WARRANTY

A. Guarantee and maintain the stability of work and materials and keep same in perfect repair and condition for the period of one (1) year after the final completion of the work as evidenced by issuance of the final certificate by the Architect unless a longer warranty period is specified in the individual specification sections or indicated in the forms table included in this section.

B. Defects of any kind due to faulty work or materials appearing during the above mentioned period must be immediately made good by the Contractor at his own expense to the entire satisfaction of the Owner and Architect and Engineer. Include damage to the finish or the building resulting from the original defect or repairs.

C. Guarantee does not apply to injuries occurring after final acceptance and due to wind, fire, violence, abuse or carelessness or other Contractors or their employees or the agents of the Owner.

D. Guarantee does not apply where other guarantees for different lengths of time are specifically called for.

E. Refer to the end of this section for a list of specific warranty items for each system.

1.12 FORMS

Section	Equipment	Shop Dwgs Req'd?	Warranty (all 1-year unless noted otherwise)	Owner Training	AHJ Cert. Req'd?	System Testing and report required?
26 0519	Wire and cable	Yes		No	No	Yes
26 0533	Surface Raceway	Yes		No	No	No
26 0534	Technology Raceway System	Yes		No	No	No
26 0800	Commissioning of Electrical Systems	Yes				
26 0921	Contactors	Yes		No	No	No
26 0923	Occupancy Sensors	Yes	1 Yr parts &labor 5 Yrs sensor	2 Hrs	No	Yes
26 09 24	Daylight Sensors	Yes	1 Yr parts &labor 5 Yrs sensor	2 Hrs	No	Yes
26 09 25	Emergency Lighting Relay	Yes	3 years parts & labor	Yes	Yes	Yes
26 09 26	Photocells	Yes		No	No	No
26 09 26	Time Clocks	Yes		No	No	No
26 09 44	Lighting Control Equipment	Yes		4 Hrs	No	Yes
26 22 13	Transformers	Yes	10 Yrs for Harm. Cancellation Xfmr	No	No	No
26 24 13	Switchboards	Yes		No	No	No
26 24 16	Distribution Panelboards	Yes		No	No	No
26 24 16	Panelboards	Yes		No	No	No
26 27 13	Electricity Metering Cabinets	Yes		No	No	No
26 27 16	Fuse Cabinet	Yes		No	No	No
26 27 26	Dimmers	Yes		No	No	No
26 27 26	Wiring Devices	Yes		No	No	Yes
26 28 13	Low Voltage Fuses	Yes		No	No	No
26 28 16	Safety Switches	Yes		No	No	No
26 29 13	Combination Starters	Yes		No	No	No
26 29 13	MSS	Yes		No	No	No
26 29 13	Overload Relays	Yes		No	No	No
26 29 13	Phase Monitoring Relays	Yes		No	No	No

Section	Equipment	Shop Dwgs Req'd?	Warranty (all 1-year unless noted otherwise)	Owner Training	AHJ Cert. Req'd?	System Testing and report required?
26 29 13	Starters	Yes		No	No	No
26 29 23	Variable Frequency Drives	Yes	2 Yrs	4 Hours	No	Yes
26 31 00	Electric Hand Dryers	Yes	10 Yrs parts and labor	No	No	No
26 32 00	Electric Heating Units	Yes	1 Yr parts &labor	No	No	No
26 32 13	Packaged Natural Gas Engine Generator System	Yes	5 Yrs parts &labor	4 Hrs	Yes	Yes
26 32 14	Packaged Diesel Engine Generator System	Yes	5 Yrs parts &labor	4 Hrs	Yes	Yes
26 33 54	Uninterruptible Power Supply	Yes	2 Yrs parts &labor 20 Yrs battery pro-rated	8 Hrs	No	Yes
26 33 55	Central Battery Lighting Inverter	Yes	2 Yrs parts &labor 10 Yrs battery pro-rated	8 Hours	No	Yes
26 41 13	Lightning Protection System	Yes		No	Yes	Yes
26 43 13	Surge Protection Devices	Yes	10 Yrs parts & labor for Service Entrance TVSS/SPD and 5 Yrs parts and labor for TVSS/SPD Panelboards	No	No	Yes
26 43 13	SPD Panelboards	Yes	5 Yrs	No	No	Yes
26 52 00	Emergency Lighting	Yes	Unit Equip:3 Yrs Battery Ballasts:5 yr	No	Yes	No
26 52 00	Inverters	Yes	3 Yrs	No	No	No
26 53 00	Exit Signs	Yes	5 Yrs Unit / 10 yrs Pro-rated battery, lifetime LED	No	Yes	No
26 55 61	Auditorium Luminaires	Yes		Yes	No	Yes
26 55 62	Blackbox Light Fixture	Yes		Yes	No	Yes
26 55 63	Auditorium House Track Lighting	Yes		Yes	No	Yes
26 56 13	Poles	Yes	5 Yrs	No	No	No

END OF SECTION

SECTION 26 0120

TESTING AND ADJUSTMENTS TO ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0120: Testing and Adjustments to Electrical Systems

1.3 DESCRIPTION OF WORK

A. Testing of electrical systems.

B. Submissions of reports of tests.

PART 2 PRODUCTS

2.1 MATERIALS

A. Miscellaneous testing equipment as detailed.

PART 3 EXECUTION

3.1 INSTALLATION

A. Test the equipment and systems and demonstrate their proper operation to the Engineer.

1. Do not test equipment until it has been fully prepared, connected, and made ready for normal operation. Repair any equipment damaged by improper operation or testing at no cost to the Owner, before final inspection and acceptance.

3.2 LIFE SAFETY LIGHTING SYSTEM TESTING

A. Emergency Lighting Relay Testing

1. Test all emergency switching relays and the Lighting Control Equipment to ensure proper operation during a normal power outage. Coordinate with the generator testing.
2. Simulate a power outage at each emergency switching relay by turning off the normal power lighting circuit and observing the operation of the relay, and observe the lighting being energized in the room or area. Verify that the toggle switch in the same room or area cannot turn OFF the emergency lighting as long as the normal source is not present.
3. Simulate a power outage at the lighting control panel(s), and observe that the emergency relays are forced ON, energizing the life safety light fixtures controlled by the lighting control panel(s).

3.3 FEEDER TESTING

A. Megger all lighting and power circuit feeders. If insulation resistance on any circuit is less than 1 megohm, such circuits are to be considered defective and must be replaced. Submit test results for each phase of each feeder from the output report files of the tester. Document all readings and submit to the Engineer.

3.4 OVERALL ELECTRICAL SYSTEM

A. Conduct voltage tests at the time of energization of the distribution system, in the presence of the Engineer and carry out such corrective measures as may be required.

B. Adjust all systems and leave in proper operating condition.

C. Test all wiring and leave free of defective installation and unintentional grounds.

D. Balancing Three Phase Loads

1. Prior to turning the building over to the Owner turn on all equipment in the building including lighting and with an amprobe, read the current drawn on each hot leg of feeder supplying each distribution panel. If the current in any one leg varies more than 5% (plus or minus) from the arithmetic average of the current in all the hot legs, reconnect the branch circuits to obtain a balanced loading.

3.5 GROUNDING ELECTRODE TESTING

A. Perform ground resistance testing in accordance with IEEE 142 at the main service grounding electrode.

3.6 OCCUPANCY SENSOR TESTING

A. Upon completion of the installation phase, test and adjust each occupancy sensor to insure proper operation.

B. General rooms and offices: Set the time delay to OFF as indicated in the sequence of operations on the drawings. Set the sensitivity of each device to trip the lights ON from anywhere in the room, but not so sensitive to trigger the lights on from motion outside the room.

C. Corridors and hallway: Set the time delay to OFF as indicated in the sequence of operations on the drawings. Set the sensitivity of each device to trip the lights ON from anywhere in the corridor/hall.

D. For dual technology sensors, set the sensor to maintain an ON condition if either technology is triggered from within the room after an initial ON. Set the device to initiate an ON condition only if both technologies sense motion from within the room.

E. Test all operational features of the system at this time.

F. Where required, make appropriate correction(s) and adjustments.

3.7 DAYLIGHT SENSOR TESTING

A. Upon completion of the installation phase, test and adjust each daylight sensor to insure proper operation.

B. Test all operational features of the system at this time.

C. Where required, make appropriate correction(s) and adjustments.

D. Specific adjustments:

1. At night (or with the shades closed) set a digital light meter at floor level, and while increasing the light level in the space, set the ON, OFF and deadband footcandle setpoints to the levels specified.

E. Repeat adjustments for all spaces.

3.8 LIGHTING CONTROL SYSTEM TESTING

A. Refer to specific section for requirements.

3.9 GROUND FAULT TESTING

A. Perform testing after protective device coordination study is performed, reviewed and approved by the engineer.

B. Test ground fault protective devices immediately after installation. Submit settings and testing report to the Engineer.

C. Include a copy of the GF test report in the O & M manuals.

END OF SECTION

SECTION 26 0519

600 VOLT CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0120: Testing and Adjustments to Electrical Systems

C. This section includes these materials as defined by the NEC:

1. Multi-Wire Branch Circuit: (NEC Article 210.4)
2. Conductors for General Wiring (NEC Article 310)
3. Metal Clad Cable: Type MC (NEC Article 330)

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 CONDUCTORS

A. Provide copper conductors with 90ºC insulation system, 600 volt rating, U.L. approved and listed for specific application. Aluminum conductors are not allowed

B. Indoor, dry location (branch circuit, non-feeder application), single conductor, insulated wire.

1. Provide THHN, THHW, THWN-2, XHHW, XHHW-2 insulation.
2. No. 12 AWG and No. 10 AWG or smaller: Provide solid conductors.
3. No. 8 AWG and larger: Provide stranded conductors.

C. Underground or wet location single conductor, insulated wire.

1. Provide XHHW, XHHW-2 insulation
2. No. 12 AWG and No. 10 AWG: Provide solid or stranded conductors.
3. No. 8 AWG and larger: Provide stranded conductors.

D. All Indoor/Outdoor Feeders (non- 2 Hour Fire Resistive application), single conductor, insulated wire.

1. Provide XHHW-2 insulation
2. No. 12 AWG and No. 10 AWG: Provide solid or stranded conductors.
3. No. 8 AWG and larger: Provide stranded conductors.

E. Indoor/Outdoor single conductor, insulated wire, 2 Hour Fire Resistive Cable with the following specifications.

1. Insulation: Provide RHW-2, 600 Volt, 90 Degree C (Wet/Dry) insulation. High Temperature Mica Tapes layer, Ceramifiable Silicone, Low Smoke Zero Halogen (LSZH).
2. Jacket: Cross-linked polyolefin (XLPO), Low Smoke Zero Halogen (LSZH)
3. Stranded conductors.

4. Sunlight Resistant.
5. FT4 Rated.
6. ST1
7. IEEE 1202
8. Approved for use as a 2 Hour assembly under UL-2196.
9. UL E2268

F. Provide conductors for other systems as specified in the section in which they are described.

G. Provide minimum No. 12 AWG conductor size, unless noted otherwise.

H. Class 1 Control Circuits: Type THHN-THWN, in raceway.

I. Class 2 Control Circuits: Type THHN-THWN, in raceway.

J. Acceptable manufacturers
1. Southwire
2. Essex
3. General Cable

K. Acceptable manufacturers – RHW-2
1. DRAKA CABLETEQ USA INC — Type RHW-2 Lifeline
2. Prior approved equal complying with UL-2196.

L. Copper Conductors: Comply with NEMA WC 70

2.2 MC CABLE

A. Provide MC cable only where specifically allowed in part 3.3 below.

B. Provide UL Listed cable.

C. Provide copper phase, neutral and ground conductors.

D. Provide factory assembly of one or more conductors enclosed in a metallic sheath that consists of a continuous corrugated aluminum tube conforming to the requirements for a single conductor insulated wire.

E. Provide separate insulated ground wire(s) in each cable.

F. Provide oversized neutral for circuits from Technology Panelboards (TVSS-grade panelboards).

G. Approved manufacturers
1. Southwire
2. Alflex
3. AFC
4. pre-approved equal.

PART 3 EXECUTION

3.1 CABLE CONDUCTOR INSTALLATION

A. Encase all conductors in a continuous raceway system.

B. Examine all conductor before installation. Do not use any conductor with insulation that is damaged in any way.

C. Do not pull conductor into the conduit until the conduit system is complete. Pull all conductors into raceway at the same time.

D. Route one A phase conductor and one B phase conductor and one C phase conductor (and neutral and grounding conductors if applicable) within the same raceway for each of the parallel raceways. Provide identical length conductors for all phases and neutrals for each parallel feeder.

E. Test all cable and wire for continuity and for shorts prior to energizing any circuits.

F. Provide separate hot, neutral and ground conductors for each circuit wired to Technology Panelboards.

G. Provide separate hot and neutral conductors for each multi-conductor branch circuit. Do not share neutral conductors.

H. 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.

I. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

J. Provide conductors color coded as follows:

1. 208/120 Volt Systems
    a. Phase A - Black.
    b. Phase B - Red.
    c. Phase C - Blue.
    d. Neutral - White.
    e. Ground - Green.
2. 480/277 Volt Systems
    a. Phase A - Brown.
    b. Phase B - Orange.
    c. Phase C - Yellow.
    d. Neutral - Gray.
    e. Ground - Green.

K. All Conductors are No. 12 AWG copper unless indicated or specified otherwise.

L. All conductor sizes indicated on the drawings are based on copper conductors. Do not substitute smaller conductors with higher temperature rated insulation.

M. Maximum number of conductors in raceways and boxes shall conform to the requirements of the National Electrical Code. Neatly trim and lace wiring inside boxes, equipment, and panels.

N. If copper-clad aluminum, or aluminum alloy conductors are used in lieu of copper conductors, the conductor size must be adjusted to provide equal or greater ampacity of the conductor indicated. This adjustment shall be based on using the ampacity for the equivalent insulation of the conductor indicated.

O. If copper clad Aluminum or aluminum-alloy conductors are used, all raceways must be adjusted to accommodate increased conductor sizes.

P. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

Q. Fire Resistive Cable Installation – Type RHW-2

1. Install conductors in raceways per UL 2196, FHIT 25A, B, or C as required for a 2 Hour fire rating.
2. Comply with the support strut, anchoring, strut clamp, and raceway requirements of UL 2196.

3.2 SPLICES, TAPS AND TERMINATIONS

A. Splices to feeders and service entrance conductors are not permitted unless specifically noted on the plans.

B. Provide "pigtail"type splices and taps in conductor No. 8 AWG and smaller. Use "wire-nut" self insulating connectors.

C. Use pressure or compression type connectors for all splices or taps in copper conductors.

D. Do not splice conductors of dissimilar metals together.

E. Use only compression type connectors for all splices, taps, and terminations using copper-clad aluminum or aluminum alloy conductors.

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.

G. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

3.3 MC CABLE INSTALLATION

A. Provide MC cable only where specifically allowed.

B. MC cable is approved for use exclusively as the maximum 6’ connection to a light fixture. MC cable may be used for individual cable drops from a junction box to light fixtures. A maximum of 4 drops per junction box. Direct fixture to fixture connections are not allowed.

C. Use for power connections to receptacles, switches, motors, and all other electrical devices is prohibited.

3.4 ADJUSTING AND TESTING

A. Test all wiring and leave free of defective installation and unintentional grounds.

B. Refer Section 26 01 20: “Testing and Adjustments to Electrical Systems”.

END OF SECTION

SECTION 26 0524

CONNECTIONS TO EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Electrical Materials and Methods section, and is part of each Division 21, 22, 23, 25 and 26 section making reference to electrical connections for equipment specified herein.

1.2 DESCRIPTION OF WORK

A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

B. Applications of electrical power connections specified in this section include the following:

1. From electrical source to motor starters.
2. From motor starters to motors.
3. To lighting fixtures.
4. To lighting control system terminations and control devices.
5. To temperature control equipment.
6. To shop equipment.
7. To miscellaneous equipment forming part of other divisions.

C. Make electrical connections to all motors, appliances and other equipment and the associated control devices in accordance with the schedules on the drawings and as hereinafter specified.

1. In each case verify connections and physical data from approved shop drawing, manufacturers' wiring diagrams and/or detail drawings provided by relevant trade subcontractor.
2. Make connections to all motors and equipment furnished and set in place by others. Provide starters, manual controls and auxiliary equipment where indicated in schedules and specified herein. Provide all disconnect switches as indicated in schedules, specified herein and required by code.

D. Electrical connections for equipment, not furnished as integral part of equipment, are specified in Division 21, 22, 23, 25 and 26 sections, and are work of this section.

E. Motor starters and controllers, not furnished as integral part of equipment, are specified in applicable Division 26 sections.

F. Refer to Division 21, 22, 23 and 25 sections for connection requirements for temperature control equipment.

G. Junction boxes and disconnect switches required for connecting motors and other electrical units of equipment are specified in applicable Division 26 sections.

H. Electrical identification for wire/cable conductors is specified in Division 26 section, "Electrical Identification".

I. Raceways and wires/cables required for connecting motors and other electrical units of equipment are specified in applicable Division 26 sections.

J. Refer to sections of other Divisions for specific individual equipment power requirements.

1.3 QUALITY ASSURANCE

A. Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches.

B. Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.

C. Comply with UL Std 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are listed and labeled by nationally recognized testing laboratories.

PART 2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. Provide complete assembly of materials, including but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations for each electrical connection indicated.

B. Raceways and Fittings:

1. Provide raceways and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Provide products complying with Division 26 basic electrical materials and methods section "Raceways, Fittings, and Boxes".

C. Conductors, Cables and Connectors:

1. Provide wires, cables, and connectors complying with Division 26 basic electrical materials and methods section "600V Conductors and Cables".

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.

B. Coordinate with work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

E. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

F. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.

H. Provide flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration. Refer to Section 26 05 33: “Raceways, Fittings, and Boxes”

I. Fasten identification markers to each electrical power supply wire/cable conductor in accordance with “Section 26 05 53: Identification for Electrical Systems.” Affix markers on each terminal conductor, as close as possible to the point of connection.

3.3 CONNECTIONS TO LIGHTING CONTROL SYSTEM EQUIPMENT

A. Make electrical connections required for a complete operating system. Follow manufacturer's written instructions. Coordinate with the manufacturer.

3.4 CONNECTIONS TO TEMPERATURE CONTROL EQUIPMENT

A. Make electrical connections as indicated in the plans and specifications to temperature control devices according to the manufacturer’s written instructions. Coordinate with Divisions 21, 22, 23 and 25.

3.5 CONNECTIONS TO SHOP EQUIPMENT

A. Make connections to shop equipment with flexible portable cable 3 or 4 conductors as noted on the drawings. Conductors shall be #12 minimum and cable shall have neoprene sheath. Cables are to be supported directly above equipment with an Appleton #BD-1 or equal fitting which is to be secured to the ceiling with a spring to keep cable right at all times.

3.6 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION

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SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

A. Grounding and Bonding (NEC Article 250)

B. Section 26 0553: Identification for Electrical Systems

1.3 DESCRIPTION

A. Grounding Electrode System.

B. Equipment grounding Conductors.

C. Main Bonding Jumpers, Supply-Side Bonding Jumpers, and System Bonding Jumpers.

D. Telecommunications Grounding System.

E. Connections to Systems.

1.4 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittlas, Closeout doucments, Trainng and Spare Parts”.

PART 2 EQUIPMENT

2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:

1. No. 4 AWG minimum, soft-drawn copper.
2. Conductor Protector: Half-round PVC or wood molding; if wood, use pressure-treated fir, cypress, or cedar.

2.2 GROUND RODS

A. Ground Rods: Copper-clad stainless steel, sectional type; 3/4 inch by 10 feet 5/8 by 96 inches in diameter.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
2. Backfill Material: Electrode manufacturers recommended material.

C. Acceptable Manufactures:

1. Erico
2. Approved Equal

2.3 GROUNDING CONNECTORS

A. Clamps and pressure connectors.

1. Clamps for connection to piping and conduit, OZ Gedney type ABG or equal.
2. Clamps for connection to enclosures and buswork, OZ Gedney type KGM or equal.

B. Welded connections using non-reversable exothermic process. Acceptable manufacturers: Cadweld, Thermoweld.

2.4 GROUND BUSBAR

A. Solid copper grounding busbars, minimum ¼" thick, in sizes as shown on the drawings or otherwise specified in part 3 below.

B. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/2 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Compliant with ASTM®B187-C11000.

D. 2" Polyamide Standoff Isolators with 1/8" stainless steel brackets and stainless steel fasteners.

E. For use with two-hole connector lugs as specified in paragraph 2.5.

F. Acceptable Manufactures:

1. Erico
2. Approved Equal

2.5 GROUNDING LUGS

A. Acceptable Manufacturers:

1. Thomas and Betts
2. ILSCO
3. Approved equal

B. Acceptable Materials:

1. Two hole compression lugs: Thomas and Betts, "Two Hole Lugs Long Barrel Type" color code blue 54800 series, high conductivity wrought copper, electro tin plated, or approved equal.

PART 3 EXECUTION

3.1 GROUNDING ELECTRODE SYSTEM

A. Grounding Electrode Conductors. Provide grounding electrode conductors, sized at minimum sizes required by NEC Article 250 and NEC Table 250.66 or as otherwise shown on the drawings.

1. Provide a grounding electrode conductor from each of the grounding electrodes listed in Paragraph 3.1.C below to the Grounding Electrode System Busbar.

2. Provide a properly-sized bonding jumper over water meters and similar equipment on water main services.
3. At each separately-derived 3 phase, 4 wire wye-secondary service derived from a transformer, provide an unspliced Grounding Electrode Conductor from the transformer XO terminal (Neutral) to the nearest grounding electrode (building steel, ground bar, or as otherwise indicated on the drawings).
4. Provide a grounding electrode system conductor from the Grounding Electrode System Busbar to the service entrance equipment ground busbar.
5. Provide a grounding electrode conductor from the TMGB to the Grounding Electrode System Busbar.
6. Comply with NEC 250.64 (B) for securing and protection of grounding electrode conductors against damage.

B. Grounding Electrode System Busbar

1. Provide a 4”x24” grounding busbar, located as shown on the drawings and connect grounding electrode conductors from the electrodes/connections specified in Paragraph 3.1.A.

C. Grounding Electrodes

1. Provide a minimum of 20'-0” of #3/0 concrete-encased electrode installed within the foundation of the building, tied to the steel reinforcing, in accordance with NEC section 250.50.
2. Underground metal water piping within 10’-0” of the point of entrance.
3. Metal frame of building or structure.

D. Minimum of three (3) ground rods, or as otherwise shown on the drawings, installed in equilateral triangular fashion, spaced at a minimum of 10’-0” center to center of rods. Bond all rods utilizing Grounding Electrode Conductor.

3.2 EQUIPMENT GROUNDING CONDUCTORS/EQUIPMENT GROUNDING

A. Provide equipment grounding conductors, sized as shown on the drawings or at minimum sizes required by NEC Table 250.122. Solidly ground all conduit systems, switch boxes, cabinets, motor frames, switchgear, transformers, and all other permanently installed equipment to form a continuous, permanent and effective grounding system. Bond expansion joints and metal raceway sections.

B. Provide equipment ground conductors in all feeder and branch circuits. Use of raceway systems to serve exclusively as equipment ground conductors is prohibited.

3.3 MAIN BONDING JUMPERS, SYSTEM BONDING JUMPERS, AND SUPPLY-SIDE BONDING JUMPERS

A. Provide bonding jumpers, sized as shown on the drawings or at minimum sizes required by NEC Table 250.102(C)(1), at each of the following locations:

1. At the electrical service, provide an unspliced main bonding jumper to connect the equipment grounding conductor(s) and service disconnect enclosure to the grounded conductor (neutral) within the service enclosure (if manufacturer-provided N-G bond is not installed).
2. At each separately-derived 3 phase/4 wire wye-secondary service derived from a transformer, provide:
    a. An unspliced system bonding jumper from the transformer X0 terminal (neutral) to the transformer ground bar or enclosure (as provided).

b. As part of the associated secondary feeder, provide an unspliced supply-side bonding jumper from the transformer X0 terminal (neutral) to the ground bus of the secondary overcurrent device enclosure, and from this ground bus to the enclosure of the secondary overcurrent device. See Feeder Schedule on drawings for requirements.

c. See Grounding Electrode System for Transformer Secondary Grounding Electrode Connections.

3.4 TELECOMMUNICATIONS SYSTEMS GROUNDING

A. Telecommunications Main Grounding Busbar (TMGB)

1. Size: 4"x24."
2. Located in Telecommunications Main Equipment Room (MER), Entrance Facility (EF), or as otherwise indicated on the drawings.
3. Provide a grounding electrode conductor from the TMGB to the Grounding Electrode System Busbar with #3/0 copper conductor or as otherwise shown on the drawings.
4. Provide individual #6AWG copper ground conductors (or sized as otherwise shown on drawings) from the TMGB to all telecommunications, audio-visual equipment, or electronic safety and security equipment in the room where the TMGB is installed. Ground to equipment using equipment manufacturer-approved grounding means (including removal of any painted surfaces to ensure conductivity).

B. Telecommunications Grounding Busbar(s) (TGB)

1. Size: 4"xl5."
2. Located in each Telecommunications Room (TR) or other space with telecommunications equipment, audio-visual equipment, or electronic safety and security equipment as indicated on the drawings.
3. Provide a connection from each TGB to the TMGB, in star (radial) topology, with #3/0 copper conductor or as otherwise shown on the drawings.

C. Provide individual #6AWG copper ground conductors (or sized as otherwise shown on drawings) from each TGB to all telecommunications, audio-visual equipment, or electronic safety and security equipment in the room where the given TGB is installed. Ground to equipment using equipment manufacturer-approved grounding means (including removal of any painted surfaces to ensure conductivity.

3.5 CONNECTIONS TO OTHER SYSTEMS

A. Refer to specific systems equipment sections for additional grounding and bonding information.

3.6 FIELD QUALITY CONTROL/TESTING

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.
    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
5. Pad-Mounted Equipment: 5 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.7 IDENTIFICATION

A. Comply with requirements in Section 26 05 53: “Identification for Electrical Systems”.

END OF SECTION

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SECTION 26 0529

SUPPORTING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

A. 26 0100: Common Work Results for Electrical

B. 26 0533: Raceways, Fittings, and Boxes

C. 26 0534: Technology Raceway System

D. 26 0535: Wireways

E. 26 0536: Cable Trays

F. 26 2500: Enclosed Bus Assemblies

G. 26 2716: Electrical Cabinets and Enclosures

H. 26 5113: Lighting

I. 26 5200: Emergency Lighting

J. 26 5300: Exit Signs

1.3 DESCRIPTION OF WORK

A. Types of supports, anchors, sleeves and seals specified in this section include the following:

1. Clevis hangers
2. Riser clamps
3. C-clamps
4. I-beam clamps
5. One-hole conduit straps
6. Two-hole conduit straps
7. Round steel rods
8. Expansion anchors
9. Toggle bolts
10. Wall and floor seals

B. Supports, anchors and sleeves furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 26 sections.

1.4 QUALITY ASSURANCE

A. Provide supporting devices, of types, sizes, and ratings required that are manufactured by firms regularly engaged in the manufacture of such devices.

B. Comply with NEC as applicable to construction and installation of electrical supporting devices.

C. Comply with applicable requirements of ANSI/NEMA std Pub No. FB 1, "Fittings and Supports for Conduit and Cable Assemblies".

D. Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports and equipment mounting.

E. Provide electrical components which are UL-listed and labeled.

PART 2 PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

A. Provide supporting devices; complying with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation; and as herein specified. Where more than one type of device meets indicated requirements, selection is Installers' option.

B. Provide supports and anchors constructed of stainless steel or equivalent corrosion resistant material in chemical storage rooms.

C. Provide supporting devices of types, sizes and materials indicated, and having the following construction features:

1. Provide clevis hangers for supporting 2" rigid metal conduit; galvanized steel; with 1/2" dia. hole for round steel rod.
2. Provide riser clamps for supporting metal conduit; black steel; with 2 bolts and nuts, and 4" ears.
3. Provide C-clamps of black malleable iron; 1/2" rod size.
4. Provide I-Beam clamps of galvanized steel, 1-1/4" x 3/6" stock; 3/8" cross bolt; flange width 2".
5. Provide one-hole conduit straps for supporting metal conduit; galvanized steel.
6. Provide two-hole conduit straps for supporting metal conduit; galvanized steel; 3/4" strap width.
7. Provide hexagon nuts for 1/2" rod size; galvanized steel.
8. Provide round steel rod of galvanized steel; 1/2" dia.

D. Provide anchors of types, sizes and materials indicated; and having the following construction features:

1. Expansion Anchors: 1/2".
2. Toggle Bolts: Springhead; 3/16" x 4".

E. Provide U-channel strut system for supporting electrical equipment, 16-gage hot dip galvanized steel, or types and sizes indicated; construct with 9/16" dia. holes, 8" o.c. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel:

1. Fixture hangers
2. Channel hangers
3. End caps
4. Beam Clamps
5. Wiring stud
6. Thinwall conduit clamps
7. Rigid conduit clamps
8. Conduit hangers
9. U-bolts

F. For UL-2196 Fire Resistive Cable Installations as specified on the drawings, provide U-channel strut system for supporting EMI raceway associated with Fire Rated Systems, 12-gauge hot dip galvanized steel, painted or unpainted, 1-1/2" wide or 1-5/8" wide, and with the following fittings which mate and match with U-channel:

1. Channel supports per UL-2196 FHIT 25A, B or C.
2. End caps.
3. Conduit clamps, 16 gauge steel minimum, 1-114" wide, trade size per associated EMT outside dimension, per UL-2196 FHIT 25A, B or C.

PART 3 EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

A. Install hanger, anchors and sleeves in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements of NECA, NEC and ANSI/NEMA. Extend sleeves 3/4" above floor surface.

B. For UL-2196 Fire-Resistive Cable Installation as specified on the drawings, installed per UL-2196 FHIT 25A, B or C. Lengths of slotted steel channels 5 ft. and less shall be seared to the wall or floor with a minimum of 2-1/4" diameter (or larger) by 2-1/4" minimum long concrete screws or *W'* in diameter (or larger) by 1-3/4" long minimum steel masonry anchors. One (1) screw or anchor to be located at each end of the slotted steel channel. Lengths of one (1) centrally located within the length of the channel. The supports shall be spaced a minimum of 5 feet OC. When installed cable(s) in vertical runs, the maximum distance of cable within EMT shall be 37 feet between terminating points.

C. For UL-2196 Fire-Resistive Cable Installation as specified on the drawings using trapeze-type supports, the raceways shall be installed on/from trapeze-type supports. The trapeze-type supports shall be secured from the surface of the floor. The supports shall be spaced a maximum of 5 feet OC per FHIT 25A, B or C.

D. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

E. Install hangers, supports, clamps and attachments to support piping properly from building structure. Support suspended conduit runs threaded rod and galvanized conduit hangers. Attach the hanger rod to concrete structural members with malleable iron inserts, to existing or precast concrete structural members with self-drilling anchors, to structural steel with steel "C" clamps, and to wood with suitable sized lag screws and angles. Support multiple parallel conduit runs on trapeze hangers constructed of steel rod hangers and structural channel. Include three (3) nuts jam-locked, on all threaded rod hangers, to rigidly support the conduit. Install supports with maximum spacings indicated.

F. Support surface mounted conduit runs with galvanized pipe straps. Fasten pipe straps to masonry surfaces with self-drilling anchors or toggle bolts. Fasten pipe straps to wood or sheetmetal surfaces with pan head sheetmetal screws.

G. Support wall mounted electrical equipment on 3/4" thick C-D exterior fir plywood painted with two (2) coats of ASA-49 gray enamel.

H. Provide stainless steel screws where electrical equipment is mounted on or attached to fire treated plywood. Hold equipment away from the plywood with either plastic or stainless steel washers or spacers.

I. I. Support all ceiling mounted receptacles with a listed tile bridge spanning the suspended ceiling grid, plus a 1/4" threaded rod anchored to a structurally sound member directly above the outlet box.

J. Provide finish of supporting devices in the chemical storage room as follows:

1. Provide PVC-coated galvanized concrete inserts and pipe straps.
2. Provide stainless steel for all bolts, nuts, washers, and screws.
3. Provide PVC-coated individual hangers and trapeze hangers.
4. Provide individual galvanized rods with two (2) coats of epoxy paints.

3.2 LIGHT FIXTURE SUPPORTS

A. Securely support all light fixtures directly from building structural members or 11/2" or larger steel ceiling framing channels. Use steel channel equivalent to Kindorf #6029 where it is necessary to span the building structural members for fixture support. Wood supporting members or wires will not be acceptable. Provide minimum ¼" diameter lag screws when anchoring into wood structural members. Penetrate wood structural members a minimum of 2" with all screws. Provide steel or lead, expandable type, anchors with minimum penetration of 11/2" when anchoring to concrete.

B. DO NOT suspend any conduit, light fixtures, or ballasts from metal roof deck or from the ceiling suspension wires. Support all lay-in fixtures independent of the ceiling support system. Provide fastening clips on each corner of each fixture.

C. Equip all fixtures using conduit stems with ball swivel hangers. In finished areas, provide canopies for the hangers.

D. Support all surface mounted fluorescent fixtures with a minimum of one hanger per fixture plus one per row. Support individual fixtures with a minimum of two hangers. Attach fixture hangers to the ceiling grid per code.

E. Support all suspended fluorescent fixtures with a minimum of two fixture hangers. Attach each hangar to a dedicated anchor. Locate hangars directly above the corners of the light fixtures.

END OF SECTION

SECTION 26 0533

RACEWAYS, FITTING, AND BOXES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0526: Grounding and Bonding for Electrical Systems

C. Section 26 0529: Supporting Devices

D. Section 26 2726: Wiring Devices

E. Intermediate Metal Conduit (NEC Article 342).

F. Rigid Metal Conduit (NEC Article 344).

G. Flexible Metal Conduit (NEC Article 348).

H. Liquidtight Flexible Metal Conduit (NEC Article 350).

I. Rigid Nonmetallic Conduit (NEC Article 352).

J. Electrical Metallic Tubing (NEC Article 358).

K. Multioutlet Assembly (NEC Article 380)

L. Surface Metal Raceways (NEC Article 386)

M. Surface Non-Metallic Raceways (NEC Article 388)

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit a coordinated, dimensioned plan drawing prior to installation that indicates the following information:

1. Routing of all underground feeders to-and-between all panelboards, switchboards and distribution panels. Indicate locations where feeders rise up through the floor and transition to overhead feeders.

2. Routing of all overhead feeders to panelboards, switchboards and distribution panels. Indicate locations of all pullboxes and sizes.

3. Routing of all underground conduits exterior to the building.

C. Precast Concrete:

1. Submit a coordinated set of shop drawings with the precast manufacturer, that indicates electrical box locations, cabinet locations and conduit routing locations.

PART 2 PRODUCTS

2.1 CONDUIT AND TUBING AND FITTINGS

A. Steel Rigid Metal Conduit (RMC) and fittings.

1. Provide hot-dip galvanized or electro-galvanized (inside and outside) conduit having a bichromate finish conforming to UL standard UL-6.

2. Provide zinc coated, threaded type fittings, couplings, and bushings.

B. PVC-coated Steel Rigid Metal Conduit (RMC) and fittings.

1. Provide hot dip galvanized or electro-galvanized rigid steel conduit.
2. 40 mil. PVC coated inside surface and outside surface.
3. Provide threaded type fittings, couplings and bushings with the same coating as the conduit.
4. Provide brush-on PVC touch-up compound.
5. Comply with NEMA RN-1.

C. Intermediate Metal Conduit (IMC) and fittings.

1. Provide hot-dip galvanized steel conduit conforming to UL Standard 1242 and Federal Specification WW-C-581E.
2. Provide zinc coated, threaded type fittings, couplings, and bushings.

D. Electrical Metallic Tubing (EMT) and fittings.

1. Provide electro-galvanized tubing conforming to UL Standard UL797, with the interior having a smooth coating of aluminum lacquer or enamel.
2. Do not thread tubing.
3. Provide concrete-tight steel compression or set-screw type fittings, couplings and bushings. Cast or indentor type devices are not acceptable.

E. Flexible Metal Conduit (FMC) and fittings.

1. Provide Type U.A., hot-dip galvanized tubing conforming to U.L. Standard ULI.
2. Provide steel or malleable iron type fittings, couplings and bushings. Cast type devices are not acceptable.

F. Liquidtight Flexible Metal Conduit (LFMC) and fittings.

1. Provide Type U.A. conduit covered with an extruded, polyvinyl chloride sheath.
2. Provide steel or malleable iron, water-tight type fittings, couplings, and bushings approved for use with liquid-tight flexible metal conduit. Cast type devices are not acceptable.

G. Rigid Non-Metallic Conduit (RNMC) and fittings.

1. Provide Schedule 40 polyvinyl chloride (PVC) rigid plastic conduit conforming to NEMA Specifications TC-2.
2. Provide plastic fittings, couplings, and bushings per manufacturer's recommendations for rigid non-metallic conduit, designed for use with solvent cement.

H. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. O-Z/Gedney; a brand of EGS Electrical Group.
3. Republic Conduit.
4. Robroy Industries.
5. Thomas & Betts Corporation.

I. Manufacturers of Raceways for UL-2196 Fire Resistive Cabling Systems

1. Allied Tube & Conduit Corp — Type Emt E-Z Pull Brand
2. Western Tube & Conduit Corp — Type EMT

3. FRE COMPOSITES (2005) INC — BreathSaver Brand Type XW Conduit and Type XW elbows and couplings
4. Prior approved equal complying with UL-2196.

2.2 OUTLET AND JUNCTION BOXES

A. Provide galvanized code gauge metal outlet and junction boxes with screw-on covers of type, shape and size listed for each application.

B. Provide gasketed covers in damp and dusty locations, and also where required to meet the listed use (i.e. wet locations).

C. Provide cast metal boxes (FS and FD) for all locations where IMC and RMC is required under Section 26 05 33 under the Raceway Application Table.

D. Provide 4" square, welded minimum trade size square boxes for all outlet and junction boxes. Provide appropriate mudrings, tile rings or raised covers, depending on the application and allowable installation.

E. Provide 4 11/16” square minimum trade size boxes where indicated on the drawings (edit – rare). Provide with minimum 1” knock-outs.

F. Provide 3½” deep boxes where installed in masonry, including precast construction. Provide 2⅛” minimum deep boxes where installed in non-masonry locations. Shallower boxes (1½”, 1¼”) are allowed only at locations where the wall cavity depth does not permit deeper boxes to be installed concealed within the wall.

G. Provide outlet boxes with green grounding pigtail pre-terminated to the interior of the box, to be used to ground the wiring device(s).

H. Refer to other sections for additional outlet box requirements specific to other systems.

I. Approved steel box manufacturers:
   1. Raco
   2. Steel City
   3. Pre-approved equal

J. Approved cast metal box manufacturers:
   1. Appleton
   2. Crouse-Hinds
   3. Killark
   4. Bell
   5. Red Dot
   6. Pre-approved equal

2.3 INTERIOR PULLBOXES

A. Provide listed metal boxes with removeable screw-on covers.

B. Size pullboxes boxes to adhere to the NEC.

C. Provide enclosures that have a NEMA rating that meet or exceed the environment in which they are installed.

D. Approved manufacturers:
   1. Hoffman Enclosures
   2. Electro Mechanical Industries (EMI)

3. American Midwest Power (AMP)
4. Pre-approved equal

2.4 EXTERIOR IN-GROUND HAND HOLES AND BOXES

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Carson Industries LLC.
   b. CDR Systems Corporation; Hubbell Power Systems.
   c. Oldcastle Precast, Inc.; Christy Concrete Products.
   d. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC."
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of cast iron.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armorcast Products Company.
   b. Carson Industries LLC.
   c. CDR Systems Corporation; Hubbell Power Systems.
   d. NewBasis.
   e. Nordic Fiberglass, Inc.
   f. Oldcastle Precast, Inc.; Christy Concrete Products.
   g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
2. Standard: Comply with SCTE 77.
3. Color of Frame and Cover: Gray.

4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, "ELECTRIC."
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.5 CONDUIT BODIES

A. Provide malleable cast iron or aluminum conduit bodies of type, shape and size required to suit each installation and conduit system. Do not use conduit bodies for conduits larger than 1½" unless specifically allowed on the plans.

B. Approved manufacturers

1. Appleton
2. Crouse-Hinds
3. Killark
4. Bell
5. Red Dot
6. Pre-approved equal

2.6 SURFACE RACEWAY WITH DIVIDER

A. Surface Metal Raceway with Divider

1. Two-channel, metal paintable two-piece raceway.
2. Matching fittings, boxes, endcaps, connectors and accessories to provide a complete system.
3. Ivory-colored factory-painted raceway, boxes, fittings and hardware.
4. Listed for the rated voltage of the wiring installed in the raceways.
5. Provide stainless steel overlapping coverplates with duplex receptacle and technology outlets at locations along the length of the surface raceway assembly. Coordinate technology outlet type with Division 27. Match coverplates specified in Section 26 27 26: "Wiring Devices".
6. Provide full-capacity elbows and entrance end fittings to allow maximum cable capacity for the technology cabling to be installed in the low voltage section of the raceway.
7. Provide "bridge" fittings at T's and cross connections, in order to maintain isolation of low voltage technology cabling from line voltage wiring.
8. Approved Manufacturers:

a. Wiremold 4000 series raceway with 4047 overlapping device plates, 4010DFC series elbows and 4075D series bridge fittings.

b. Mono Systems SMS4200 with equivalent Wiremold accessories listed above.

c. Pre-approved equal

PART 3 EXECUTION

3.1 RACEWAY USAGE TABLE

A. Refer to table at the end of section for allowable usages of raceways and conduit.

3.2 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. Refer to Section 26 0529: "Supporting Devices" for supporting requirements.

C. Install all line voltage (120, 208, 277 and 480 volts) conductors in a continuous raceway system. Refer to individual low voltage and communications specification sections for raceway requirements for non-line voltage wiring.

D. Provide pull and junction boxes as required by the NEC.

E. Provide minimum 3/4" conduit size for branch circuit homeruns. Provide minimum 112" conduit size everywhere else.

F. Verify conduit sizes indicated on the plans prior to installation. Provide proper size conduit based on the NEC maximum fill requirements, including any derating factors. Where conduit sizes are indicated on the plans, it is a minimum size allowed and it is based on based on EMT usage. If other allowable types of conduits are used, it is the Contractor's responsibility to provide the proper conduit size, including any grounding conductors and flexible connections to equipment.

G. Do not route any conduits across rooftops, unless specifically allowed and noted on the plans to do so. Ifconduits are allowed to be routed across rooftops, install conductors in Rigid Metal Conduit and provide proper derating of the conductor ampacities to account for the high ambient temperature as required in NEC Art. 310-15. Mount on roof blocks specifically designed for the intended environment.

H. Support all trapezes and all above-ground conduits from the building structure. Provide conduit supports, not to exceed 7' O", for all conduit less than 1" in diameter.

I. Route all horizontal raceway above water piping, where possible.

J. Do not support conduit with wire, nylon ties, nor perforated pipe straps. Remove wire used for temporary supports.

K. Do not attach conduit to ceiling support wires.

L. Conceal all conduit work in new construction, except mechanical rooms. Conduit and boxes in mechanical spaces may be run exposed. Run all exposed conduit in a neat, workmanlike manner parallel to the building lines, tight to the wall and ceiling surfaces, and firmly support with conduit clamps or hangers. Provide one (1) hole mounting straps, minimum three (3) feet on center, for all surface conduit mounted on walls less than six (6) feet above finished floor.

M. Do not run conduits in columns except to feed column mounted devices. Do not route conduit through structural slabs, beams, or columns, unless approved by the Structural Engineer. Do not route any conduit in any concrete topping.

N. Place conduits at least 8" away from all hot piping and surfaces including domestic hot water lines. Do not route conduits through the same penetrations through floors and walls as mechanical piping unless noted otherwise or if approved by the Engineer.

O. 0. Do not mount conduit on mechanical equipment except where necessary to connect electrical devices mounted on the equipment. Provide flexible conduit in all runs "bridging" vibration mountings.

P. Do not run conduit on or directly in front of access doors, removable panels, equipment removal spaces, control devices or other spaces necessary for normal maintenance and repair of the equipment.

Q. Install all exterior underground branch circuit conduits continuous from the source to the load. Do not install in-ground boxes as pull boxes. Oversize the conduits if required.

R. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system. Install exterior underground conduits to drain away from the building.

S. Provide suitable fittings to accommodate expansion, contraction and deflection where conduits cross seismic, control and expansion joints. Avoid crossing expansion joints where possible.

T. Cap or p lug conduit ends during construction. Cap or plug ends of conduit that are to remain empty and make watertight. Clean and swab conduits prior to pulling in conductors.

U. Provide nylon pull string in all empty conduit with a stamped plastic label indicating future use.

V. Provide watertight seal, approved by the Architect, for all roof penetrations.

W. Provide air tight seals for all raceway penetrating air plenums. Repair all damage to insulation and vapor barriers. Seal vapor barriers tight to conduit penetrating vapor barriers.

X. Seal all conduit penetrations of smoke or fire rated walls or floors with intumescent type fire barriers, 3M or equal.

Y. Seal all conduits where they pass through exterior walls and where they enter exterior fixtures.

Z. Seal all conduits where temperature differential between adjacent spaces is greater than 30 degrees Fahrenheit.

AA. For UL 2196 Fire Resistive Cabling Systems install per the requirments of UL 2196 FHIT- 25A, B or C for a 2 hour rated system.

3.3 OUTLET AND JUNCTION BOX INSTALLATION

A. Maintain accessibility to all outlet and junction boxes as required by the NEC.

B. Provide recessed outlet boxes in all new construction, except mechanical rooms. Outlet boxes in mechanical rooms may be installed exposed.

C. Provide concealed junction boxes in all new construction, except mechanical rooms. Junction boxes in mechanical rooms may be installed exposed.

D. Mounting heights indicated on the drawings are from the center of the outlet box to the finished floor directly below the outlet. Exterior heights are from inside adjacent door, or if no door, from the first floor above grade, unless noted otherwise.

E. Coordinate the location of all outlets with Architectural and Mechanical drawings before installation. Verify mounting heights and locations of all outlet boxes, including the following:

1. Outlets located on walls with baseboard radiation. Mount to the side of radiation covers.
2. Switch boxes at doors. Verify door swings. Install switchboxes on the latch side of the door if possible.
3. Outlet boxes at casework. Mount outlet boxes above counters and above backsplashes.
4. Outlet boxes at undercounter refrigerators. Mount outlet boxes in the space reserved for the refrigerator.
5. Outlet boxes adjacent to marker boards or other wall-hung Architectural items. Verify top edge and bottom edge of wall-hung items and mount outlets on clear wallspace.

F. Do not mount boxes back-to-back and nippled together.

G. Do not use through-wall boxes unless specifically called out on the plans.

H. Field-gangable boxes are not allowed. Provide manufactured, multi-gang boxes.

I. Provide separate switch boxes for lighting dimmer switches to maintain full dimmer rating.

J. Close openings in all outlet boxes during plaster and concrete work with plain paper or slip-on plastic or metal plates.

K. Provide knockout closures to cap used knockout holes.

L. Provide FS and FD boxes in wet, damp and exterior locations.

M. Maintain vapor barriers around boxes and/or provide suitable boxes listed for use in vapor barriers.

N. Provide air-tight seals for all boxes in air plenums that can allow air to pass through connecting conduit. Repair all damage to insulation and vapor barriers.

O. Where boxes and concrete are installed in masonry, provide listed equipment or the means acceptable to the AHJ necessary to provide concrete-tight connections and boxes required by the NEC.

3.4 INTERIOR PULLBOX INSTALLATION

A. Provide concealed pullboxes in all new construction, except mechanical rooms. Pullboxes in mechanical rooms may be installed exposed.

B. Terminate all conduits at cabinets and boxes with locknuts and bushings. Provide insulating bushings on all conduit 1” and larger.

C. Provide pull boxes in accessible locations. Provide accessiblility to the pullbox cover. Coordinate location of pull/junction boxes with other divisions (trades) prior to installation. Do not locate pull boxes in exposed finished spaces without the specific approval of the Engineer and Architect.

D. Provide ½” clear space behind boxes when mounting in wet or damp locations.

3.5 EXTERIOR IN-GROUND HANDHOLES

A. Refer to the details on the plans for installation requirements.

B. Comply with NEC 314.30 for handhole requirements and installation.

3.6 CONDUIT BODY INSTALLATION

A. Provide conduit bodies in accessible locations. Provide accessiblility to the cover. Coordinate location of conduit bodies with other divisions (trades) prior to installation. Do not locate conduit bodies in exposed finished spaces without the specific approval of the Engineer and Architect.

3.7 SURFACE RACEWAY INSTALLATION

A. Coordinate frames with technology cabling installer, and provide the proper frame and coverplate.

B. Provide surface raceway for lighting, power, low voltage systems and technology systems in finished areas of existing construction, or at other locations specifically called out on the plans. Surface raceway is not allowed in areas of new construction unless specifically called out on the plans.

C. Verify routing of surface raceway with the Architect, Owner and Engineer prior to installation. Route surface raceway orthogonal to building lines.

D. Provide the shortest lengths of surface raceway possible, following building lines. Route raceway into accessible ceiling space and/or accessible tunnel space.

E. Unless specifically sized on the plans, use the smallest (cross-sectional area) size raceway for the use or number of conductors installed in the raceway.

F. Provide bushing on raceways stubbed into ceiling spaces for technology cabling.

G. Do not route surface raceway through walls or floors.

H. Use manufacturer's base and cover cutter to make field cuts to the raceway.

I. Ground and bond all metal raceways.

3.8 IDENTIFICATION

A. Provide identification of each junction box and pullbox located in accessible areas (i.e. above accessible ceilings) in accordance with Section 26 05 53: "Identification for Electrical Systems".

3.9 RACEWAY APPLICATION TABLE

Raceway Type→ Application ↓	Steel RMC	PVC-coated RMC	IMC	EMT	FMC	LFMC	RNMC	Surface Metal Raceway
Dry, concealed interior locations not listed below	A		A	A				
Exposed exterior locations	A	A						
Exposed unfinished interior locations installed below 46" above finished floor	A		A					
Exposed unfinished interior locations installed above 46" above finished floor				A				
Underground or under concrete slabs on grade	A	A					A[1]	
Inside exterior masonry wall cavities	A		A					
Wet Locations	A	A						
Exposed inside tunnels	A	A	A					
Motor Connections – dry locations					A[2]			
Transformer Connections – dry locations					A[2]			
Non-Transformer Vibrating Equipment – dry locations					A[2]			
Motor Connections – wet or damp locations						A[2]		
Transformer Connections – wet or damp locations						A[2]		
Vibrating Equipment – wet or damp locations						A[2]		
Lay-in light fixture connections					A[3]			
Service entrance feeder		A					A[4]	

[1] Provide PVC Coated RMC elbows for all elbows installed under and/or through concrete slabs on grade.
[2] Provide conduit minimum length of 18" and a maximum length of 48".
[3] Provide maximum 6' long whip from outlet box located at building structure.
[4] Provide concrete-encased ductbank with PVC-coated Steel RMC elbows. Steel RMC elbows not required if the entire elbow is encased in concrete.

Floorboxes in slab on grade	A	A					A[1]	
Floorboxes in concrete topping above grade		A					A	
Exposed finished areas								A[55]
Voltages over 600 volts	A							
Lightning Protection System downlead conduits							A[6]	

Legend: A=Acceptable; (blank) = Not Acceptable

[5] Provide surface raceway only in areas of existing construction where recessed conduit and boxes are not possible.
[6] Install raceway in non-plenum spaces only.
[7] Only allowed for manufacturers specified in Part 2 as compliant with UL-2196.

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SECTION 26 0534

TECHNOLOGY RACEWAY SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0526: Grounding and Bonding for Electrical Systems

C. Section 26 0529: Supporting Devices

D. Section 26 0533: Raceways, Fittings, and Boxes

E. Section 26 0536: Cable Trays

F. Section 26 0550: Floorboxes and Pokethroughs

G. Section 27 1300: Technology Cabling System

H. Division 28

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit a coordinated, dimensioned plan drawing prior to installation that indicates the following information:

1. Routing of all underground conduits to-and-between data rooms. Indicate locations where conduits rise up through the floor and transition to overhead conduits.

2. Routing of exterior conduits used for utility entrance cables (CATV, Telephone, Fiber, Outside Plant cables, spares, etc.).

3. Routing of all overhead backbone conduits to-and between data rooms. Indicate locations of all pullboxes and sizes.

C. Precast concrete:

1. Submit a coordinated set of shop drawings with the precast manufacturer, that indicates technology outlet box locations, cabinet locations and conduit routing locations.

2. Refer to Article 3.4.E in Section 26 0100 for additional information.

1.4 SYSTEM DESCRIPTION

A. Provide all labor and materials for a complete raceway system including some or all of the following components:

1. Outlet boxes

2. Conduit

3. Surface raceway and matching boxes

4. Sleeves and approved fireproofing

5. Pullboxes, pullstrings, bushings

6. Backboards

7. Grounding

1.5 CABLE TRAYS

A. Refer to Division 28 specifications for requirements.

PART 2 PRODUCTS

2.1 OUTLET BOXES

A. Provide 4” welded square boxes for each recessed outlet box. Provide 3½” deep masonry type in recessed masonry installations.

B. Provide single gang mud or tile ring as required for all boxes.

C. Refer to specification Section 26 05 33: “Raceways, Fittings and Boxes” for approved box manufacturers.

2.2 OUTLET DEVICES AND COVERPLATES

A. Outlet devices and coverplates are provided under Section 27 1300: “Technology Cabling System”.

B. Provide blank coverplates meeting the requirements of Section 26 2726: “Wiring Devices”.

2.3 SURFACE RACEWAY

A. Provide a 2-section surface raceway with divider for all outlet boxes installed in areas of existing construction. Provide raceway as described in specification Section 26 0533: “Racways, Fittings and Boxes” and as indicated on the drawings.

B. Provide paintable metallic raceway. Provide ivory colored raceway.

C. Provide paintable non-metallic raceway. Provide ivory colored raceway.

2.4 FLOORBOXES

A. Provide floorboxes as described in Section 26 0550: “Floorboxes and Pokethroughs”.

2.5 MISCELLANEOUS

A. Provide plywood terminal boards on all walls of each IDF, MDF, Technology and Data rooms. Plywood to be 3/4” x 8’-0” high and shall be painted with two coats of fire retardant marine grey enamel on both sides. Mount plywood 2” above finished floor, with the 8’ dimension in the vertical plane.

B. Provide grounding system per Section 26 0526: “Grounding and Bonding for Electrical Systems.”

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide empty raceway system from each technology outlet box to accessible lay-in ceiling space.

B. Rough-in requirements - New Construction

1. Accessible ceiling (lay-in grid) or accessible tunnel

   a. Provide an empty box with (1) 1” conduit stubbed into ceiling space or tunnel for each telephone outlet indicated on the drawings.

   b. Provide an empty box with (2) 1” conduits stubbed into ceiling space or tunnel for each voice/data outlet indicated on the drawings.

   c. Provide an empty box with (2) 1” conduits stubbed into ceiling space or tunnel for each data outlet indicated on the drawings.

d. Provide an empty box with (2) 1” conduits stubbed into ceiling space or tunnel for each fiber optic outlet indicated on the drawings.

2. Inaccessible ceilings (plaster, spline, gypsum, security grid, plank, etc.)

a. Provide an empty box with (1) 1” conduit routed to the nearest telephone backboard location for each telephone outlet, unless noted otherwise on the plans.

b. Provide an empty box with (2) 1” conduits routed to the nearest communications closet backboard location for each voice/data outlet, unless noted otherwise on the plans.

c. Provide an empty box with (2) 1” conduits routed to the nearest communications closet backboard location for each data outlet, unless noted otherwise on the plans.

d. Provide an empty box with (2) 1” conduits routed to the nearest communications closet backboard location for each fiber optic outlet, unless noted otherwise on the plans.

3. Floorboxes

a. Provide floorboxes with (2) 1” conduits routed in the slab or under the slab to the nearest accessible ceiling space or accessible tunnel space.

C. Provide a minimum of (2) 4” conduit sleeves between floors at each backboard location, unless noted otherwise. Provide a minimum of (4) 2” conduits from each backboard location to the accessible ceiling space in the corridor adjacent to the backboard location, unless noted otherwise.

D. Provide at least one isolated grounding double duplex receptacle wired to a dedicated 120 volt, 20 amp circuit at each backboard location for Owner equipment. Provide a separate hot, neutral and ground conductor. Coordinate with the Owner or designated installer. Refer to the plans for additional information.

E. Fireproof all sleeves with an approved fireproofing sealer to maintain the fire integrity of the slab or wall. Refer to Section 26 0100: “Common Work Results for Electrical”.

F. Bush all conduits. Provide a pullstring in each conduit.

G. Permanently label the ends of each conduit stub with the Architectural room numbers, in order to identify each outlet box for the technology cable installer.

END OF SECTION

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SECTION 26 0535

WIREWAYS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0529: Supporting Devices

C. Metal Wireways (NEC Article 376)

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 WIREWAYS

A. Provide "lay-in" type wireway with lengths and connectors hinged to provide unobstructed lay-in of conductors. All fittings must be so constructed to continue the "lay-in" feature through the entire installation.

B. Provide all sheet metal parts with a rust-inhibiting phosphatizing coating and finished in baked enamel. Plate all hardware to prevent corrosion.

C. Provide raintight construction with gasketed cover for all exterior wireways.

D. Provide wireways without knockouts, except for exterior wireway.

E. Provide hinged cover.

F. Provide U.L. label and listing for all lengths, connectors and fittings. Install in accordance with the National Electrical Code and the drawings. U.L. listing of lengths without listing connectors or fittings is not acceptable.

G. Approved manufacturers:

1. Square D "Square-Duct"
2. Hoffman
3. Pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide wireways only where specifically allowed by the Engineer, and only prior to installation. Wireway is not allowed to be a substitution for conduit, pullboxes or other raceways or conduit bodies. Do not use wireway as an auxiliary gutter above or below panelboards.

B. Install parallel and perpendicular to building lines.

C. Provide all fittings required along the entire route of wireway.

D. Size wireways for a maximum of 20% fill after any ampacity derating factors have been applied to the cables.

E. Provide wireway sufficiently sized to accommodate the cable bending radius requirements for cables.

END OF SECTION

SECTION 26 0550

FLOORBOXES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0529: Supporting Devices

C. Section 26 0533: Raceways, Fitting and Boxes

D. Section 26 0534: Technology Raceway System

E. Section 27 1300: Technology Cabling System

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical boxes and fittings, of types and sizes required, whose products have been in satisfactory use in similar service.

B. NEC Compliance: Comply with NEC as applicable to construction and installation of floor outlets.

C. UL Compliance: Provide floor outlets which have been UL listed and labeled.

D. ANSI/NEMA Standards Compliance: Comply with ANSI C134.1 (NEMA Standards Pub No. OS 1) as applicable to floor outlets.

1.4 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 FLOORBOXES

A. Provide floorboxes that adhere to the following specifications:

1. UL Listed for scrub water exclusion.
2. Cast metal construction
3. Accommodates two (2) duplex receptacles and two (2), single-gang technology frames.
4. Provide the frames for the technology outlets, to allow the technology outlets to be secured in the box. Refer to the Section 27 13 00: “Technology Cabling System” for requirements.
5. Coordinate finish with the architect.
6. Approved manufacturers
    a. Wiremold RFBA Series c/w floor box plate and cover.
    b. Pre-approved equal.

2.2 OUTDOOR GROUND BOX

A. Provide outdoor ground box for use in outdoor spaces with the following minimum specifications:

1. U.L SOE Type 6P listing for year round operation.

2. NEMA 4X construction for use in ground to protect deices and receptacles from water, snow and ice.
3. ANSI/SCTE 77 Tier 5 rating capable and 5000 lbs. of load.
4. ADA compliant.
5. Modular design to accommodate power, audio/visual and technology system devices.
6. Flush to the finished ground (grass, walkways, concrete, etc.) with tamper resistant back.
7. Provide gray finish.

B. Acceptable manufacturers:
1. Wiremold XB814 Series or Wiremold Evolution Series 6 poke thru device.
2. Pre-approved equal.

PART 3 EXECUTION

3.1 FLOORBOX INSTALLATION

A. Install floor outlets where indicated, complying with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation" and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Install floorbox so the finished face is flush with the surrounding floor. Maintain vapor barrier(s) around each floorbox. Install carpet flanges where carpets are installed.

C. Fasten flush boxes securely to concrete forms to assure box will not move during placement of concrete.

D. Provide multi-gang boxes wherever possible to accommodate all devices within an area. Maintain 24" separation from boxes if multi-ganging is not possible, or if the quantity of devices require more gangs than are available from the floorbox manufacturer.

E. Install and connect devices in floor outlets

F. Verify exact locations of floorboxes with the Architect, to ensure the boxes are at the equipment served, and to ensure accessibility. Contact the Architect at least ten (10) days prior to floor box installation to provide the Architect sufficient time to provide final location dimensions.

G. Provide carpet flanges in all carpet areas. Carpet flanges shall be polished brass or aluminum as per the architect and be compete with flathead screws.

3.2 OUTDOOR GROUND BOX

A. Fully comply with manufacturers recommended installation procedures.

B. Locate ground boxes as indicated on the drawings. Verify exact location with Architect/Civil Engineer.

C. Locate in well drained area, away from inlets and outfalls. Install where grade (grass) is within 1% of level. Install in sidewalks, concrete, brick, pavers where grade is less than 2% in all directions.

D. Do not install boxes at low points or in areas prone to accumulate standing water.

E. Do not install boxes in locations subject to regular vehicular traffic.

END OF SECTION

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Refer to individual Division 27 and 28 sections.

B. Section 26 0921: Contactors

C. Section 26 0925: Emergency Lighting Relay

D. Section 26 0526: Grounding and Bonding for Electrical Systems

E. Section 26 0533: Raceways, Fitting and Boxes

F. Section 26 0943: Lighting Control Equipment

G. Section 26 2213:Transformers

H. Section 26 2413: Switchboards

I. Section 26 2416: Panelboards

J. Section 26 2816: Safety Switches

K. Section 26 2913:Motor Control

PART 2 PRODUCTS

2.1 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Minimum 118" thick laminated bakelite: White face with black lettering.

B. Engrave characters with a minimum height of 1/4".

C. Minimum plate size: I" x 3.5". Provide larger plate if necessary to fit all lettering on it.

D. Approved manufacturers

1. Square D
2. Siemens
3. Eaton
4. General Electric
5. Pre-approved equal

2.2 SERVICE IDENTIFICATION NAMEPLATES

A. Provide signage per NEC Articles 110.22, 230.2(E) and 230.70(B)

B. B. Provide nameplates on each main service disconnecting means describing what areas are served by the disconnecting means, and where the other disconnecting means are located.

2.3 SOURCE OF SUPPLY IDENTIFICATION NAMEPLATES

A. Provide source of supply nameplates for all disconnecting means, disconnects, etc. as required by 2020 NEC 110.22. (A).

B. Provide source of supply names for all switchboards, panelboards, etc. as required by 2020 NEC 408.4. (B).

C. Nameplate to indicate where the source of power originates from.

2.4 FAULT CURRENT AND ARC FLASH WARNING SIGNS

A. Provide Arc Flash warning signs on all electrical equipment as required by 2020 NEC 110-16:
"Electrical equipment, such as switchboards, pane/boards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment."

B. Minimum size: 3W'x 5"; B302 polyester or vinyl with laminate overlay.

C. Approved manufacturers

1. Brady
2. Seton
3. Pre-approved

2.5 FAULT CURRENT LABELS

A. Provide Fault Current Labels on all switchboards, panelboards, etc. as required by 2020 NEC 408.6.

B. Label to include available fault current and date calculation was performed and be marked on each enclosure at the point of supply.

C. Minimum size: 3W'x 5"; B302 polyester or vinyl with laminate overlay.

D. Approved manufacturers

1. Brady
2. Seton
3. Pre-approved

2.6 EMERGENCY LIGHTING RELAY IDENTIFICATION

A. Provide pressure laminate ID labels on all Emergency Lighting Relays

B. Approved manufacturers:

1. Kroy
2. Brady

2.7 BOX IDENTIFICATION

A. Approved manufacturers

1. Sharpie
2. Avery Marks-A-Lot
3. Pre-approved equal

2.8 CONDUIT IDENTIFICATION

A. Provide stenciling of conduits located in accessible areas.

B. Provide black epoxy spray paint and 1" high stenciled lettering.

2.9 COVERPLATE IDENTIFICATION

A. Provide 1.1" high engraved black-infilled lettering or laser etching when engraved coverplates are specified or noted on the plans.

B. Approved manufacturers

1. Cooper
2. Pass and Seymour
3. Hubbell
4. Leviton
5. pre-approved equal

2.10 WARNING TAPE

A. Provide 4" wide, detectable type yellow warning tape with black lettering "WARNING – UNDERGROUND ELECTRICAL" above all underground conduits and ductbanks along the entire length.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Comply with governing regulations and governing authority for identification of electrical work.

3.2 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Provide identification plates on the following electrical equipment:

1. Each panelboard, distribution panel, switchboard, motor control center and switchgear. Provide the following information on each nameplate: panel name, voltage, wire configuration, feeder conduit size, phase wire size, neutral size, and ground wire.
   Example:

   TLP-1-1
   208/120V, 3P4W
   2"C - 3#2/0, #350 NEUT
   #4 GND, THWN

2. Each overcurrent device in distribution panels, switchboards, motor control center and switchgear
3. Transformers
4. Disconnect switches (engrave per the equipment served)
5. Motor starter switches, motor starters, remote motor control stations (engrave per the equipment served)
6. Power factor correction capacitors
7. SPD equipment cabinets
8. Contactor cabinets
9. Lighting control panels

B. Install nameplate parallel to equipment lines.

C. Install nameplates inside covers in finished areas using approved contact cement.

D. Install nameplates outside covers in unfinished areas by mechanical fasteners (screws or rivets).

3.3 FAULT CURRENT ARC FLASH WARNING SIGNS

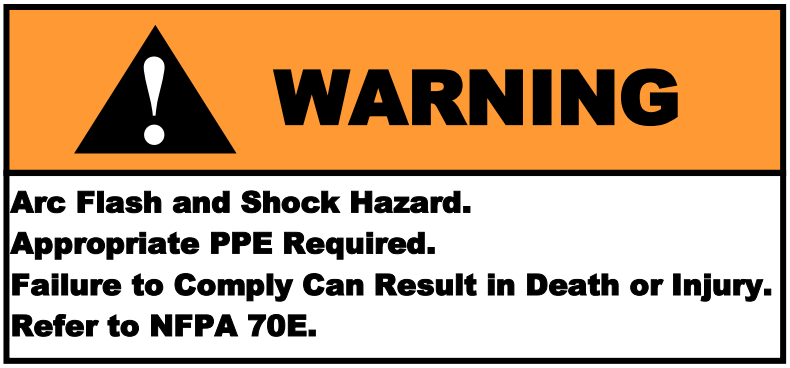
A. Provide signs suitable for the environment in which they are located:

1. Provide engraved plates with the physical specifications called out in paragraph 2.1 above for exterior equipment.
2. Provide laminated, pressure sensitive signs adhered to the outside covers of equipment in unfinished areas.
3. Provide laminated, pressure sensitive signs adhered to the inside covers of equipment in finished areas.

B. Provide labels that indicate the available fault current and the date that the calculations was performed.

C. Provide signs that indicate that an arc-flash hazard exists at this location, and that proper personnel protective equipment should be worn prior to servicing the equipment.

Example:



3.4 BOX IDENTIFICATION

A. Provide panel and circuit number(s) identification on the cover of all junction boxes and pullboxes located in accessible areas (i.e. above accessible ceilings).

B. Provide clear, hand-printed lettering using black permanent marker.

C. Perform stenciling after the building has been painted so that overspray from building painting does not cover up stenciling performed under this specification section. Re-label any boxes that have been painted over by the painter.

3.5 CONDUIT IDENTIFICATION

A. Provide stenciling of conduits and pullboxes of the following:

1. Medium Voltage and High Voltage feeder conduits and pullboxes
2. Panelboard, distribution panel, switchboard, motor control center and switchgear feeder conduits and pullboxes.
3. Service entrance conduits and pullboxes at the point of accessibility for cable TV, Telephone and Fiber Optic cables.
4. Lightning Protection System download conduits

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Perform stenciling after the building has been painted so that overspray from building painting does not cover up stenciling performed under this section.

D. Perform stenciling on 50' centers, maximum, along entire accessible length of conduits

3.6 COVERPLATE IDENTIFICATION

A. Provide printed label on the plate immediately above the wiring device, unless noted otherwise.

3.7 WARNING TAPE

A. Install warning tape 8" below finished grade directly above the following electrical conduits:

1. Any concrete encased ductbank
2. Medium Voltage and High Voltage feeder conduits
3. Line voltage service-entrance feeders
4. Underground conduits to exterior light poles, signs, receptacles, bollards, and power equipment (irrigation equipment, maintenance buildings, etc.).
5. Service entrance conduits for cable TV, Telephone and Fiber Optic cables.

B. Identify exact locations of underground conduits on the as-built documents. Indicate critical dimensions from the comers of the building.

END OF SECTION

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SECTION 26 0559

CONCRETE PADS FOR ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Division 03: Concrete

B. Section 26 0100: Common Work Results for Electrical

C. Section 26 2213: Transformers

D. Section 26 2413: Switchboards

E. Section 26 2416: Panelboards

F. Section 26 2713: Electricity Metering Cabinets

G. Section 26 2913: Motor Controls

H. Section 26 5613: Lighting Poles and Standards

PART 2 EQUIPMENT

2.1 UTILITY TRANSFORMER PAD

A. Provide a concrete transformer pad to comply with local electrical utility company rules and regulations.

B. Refer to detail on the drawings.

C. If a connection cabinet is included in the project under Section 26 27 13: Electricity Metering Cabinets, provide a continuous pad for both the utility transformer and the connection cabinet.

D. Precast pads are preferred, but a precast cable vault under pad is required.

2.2 EQUIPMENT PADS

A. Provide concrete pads for all floor-mounted equipment, unless already called out to be provided under Division 3, which may include the following equipment:

1. Switchboards
2. Distribution Panelboards
3. Transformers
4. Electricity Metering Cabinets
5. UPS equipment and battery cabinets/battery racks
6. Any other floor-mounted electrical equipment.

PART 3 EXECUTION

3.1 UTILITY TRANSFORMER PAD

A. Provide proper soil correction and preparation as required by the local electrical utility company standards.

B. Primary Conduits: Provide two (2) 4” conduits with 36” sweep elbows stubbed up into the primary opening of the transformer, and extended out 5 feet from the pad location for utility primary cables.

3.2 EQUIPMENT PADS

A. Provide minimum 4” high concrete pads for all floor mounted equipment.

B. Provide 8” minimum thick concrete pads for engine-generator sets. Coordinate structural requirements of engine-generator pads with the generator manufacturer.

C. Size pad to provide a minimum 2” overlap around perimeter of equipment, including future sections to switchboards.

D. Provide steel reinforcement as required for load or as indicated on the drawings.

END OF SECTION

SECTION 26 0573

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. The Life Safety (NEC 700), Legally-Required Standby (NEC 701), and parts of the Optional Electrical Distribution (NEC 702 including Elevators and as otherwise noted) systems derived from the emergency generator (down to the branch circuit breaker level) need to be provided as a selectively coordinated complete system per the requirements of the National Electrical Code.

B. A complete fault current study and coordination study needs to be provided by each electrical distribution system equipment manufacturer for review by the Engineer to qualify the bids and assure that the submitted systems provides a selectively coordinated distribution system meeting the intent of this Section.

C. The electrical distribution system equipment identified on the drawings and elsewhere in the specifications is based on Square D. Electrical distribution system equipment proposed to be provided by Cutler Hammer, Siemens, or General Electric must be equal to or exceed the identified Square D equipment and must provide a selectively coordinated system.

D. This section includes computer-based, fault-current and overcurrent protective device coordination studies.

E. Electrical Contractor to provide field adjustments for all protective devices based on results of the final, approved protective device coordination study.

1.3 SUBMITTALS

A. Qualification Data: For coordination-study specialist.

B. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed and approved. Submittals shall both be provided in hard-copy and digital form.

1. Final coordination-study input data, including completed computer program input data sheets.
2. Final Study and Equipment Evaluation Reports.
3. Final Coordination-Study Report.

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

PART 2 PRODUCTS

2.1 COMPUTER SOFTWARE

A. Utilize SKM Power Tools for Windows for all studies.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine proposed overcurrent protective devices for compliance with electrical distribution system coordination requirements and other conditions affecting performance.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Gather and tabulate the following input data to support coordination study as appropriate for this project:

1. Product Data for proposed overcurrent protective devices. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
    a. Circuit-breaker ratings and types.
    b. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
    c. Motor horsepower and code letter designation according to NEMA MG 1.
    d. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
    e. Special load considerations, including starting inrush currents and frequent starting and stopping.
    f. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    g. Generator thermal-damage curve.
    h. Ratings, types, and settings of utility company's overcurrent protective devices.
    i. Special overcurrent protective device settings or types stipulated by utility company.
    j. Time-current-characteristic curves of devices indicated to be coordinated.
    k. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    l. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    m. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

B. Fault-current Study

1. Calculate the maximum available short-circuit current in amperes rms symmetrical at all power sources and bus locations throughout the electrical distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit.

2. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions. Include the following system switching scenarios:
    a. Operating on normal service only.
    b. Operating on emergency generator only.
    c. Operating on both normal service and emergency generator during a closed transition operation.
3. Calculate momentary and interrupting duties on the basis of maximum available fault current.
4. See Editing Instruction No. 4 in the Evaluations for discussion of standards listed in first paragraph below.
5. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, IEEE 241 and IEEE 242.
6. Transformers:
    a. ANSI C57.12.10.
    b. ANSI C57.12.22.
    c. ANSI C57.12.40.
    d. IEEE C57.12.00.
    e. IEEE C57.96.
7. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
8. Low-Voltage Fuses: IEEE C37.46.

C. Study Report
1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

D. Coordination Study
1. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
    a. Calculate the maximum and minimum 1/2-cycle short-circuit current
    b. Calculate the maximum and minimum ground-fault currents.
2. Comply with IEEE 141, IEEE 241, and IEEE 242 recommendations for fault currents and time intervals.
3. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
    a. Tabular Format of Settings Selected for Overcurrent Protective Devices:
        1) Device tag.
        2) Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
    b. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between all devices installed in series, including power utility company's upstream devices down to the panelboard branch circuit breaker level. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1) Device tag.

2) Voltage and current ratio for curves.

3) Maximum fault-current cutoff point.

4. Completed data sheets for setting of overcurrent protective devices.

3.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include the following in the Operation and Maintenance Manuals:

1. The following items from the overcurrent protective device coordination study report:

   a. One-line diagram.

   b. Protective device coordination study.

   c. Time-current coordination curves.

END OF SECTION

SECTION 26 0921

CONTACTORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0553: Identification for Electrical Systems

C. Section 26 2716: Electrical Cabinets and Enclosures

D. Nema ICS 2 and UL 508.

1.3 QUALITY ASSURANCE

A. Comply with NEC as applicable to construction and installation of electrical supporting devices.

B. Provide electrical components which are UL-listed and labeled.

1.4 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Indicate short circuit current ratings for all equipment.

PART 2 EQUIPMENT

2.1 LIGHTING CONTACTORS

A. Provide multi-pole, mechanically held A.C. lighting contactors as indicated on the Drawings. Provide contactors with a 120 volt coil (except as indicated on the plans), contacts rated 30 amps at 277 volts. Contactors shall have six (6) contacts except as indicated on the Drawings.

B. Group mount contactors in a Hoffman enclosures or individually mounted in NEMA 1 enclosures.

C. Provide wiring diagram indicating connections to control devices (i.e. photocells, time switches, etc). Provide labeling of all wiring, contactors, terminals strips, etc.

D. Provide contactors with a short circuit current rating equal to or larger than the available fault current at the source panel.

E. Approved manufacturers – mechanically held

1. Square D Class 8903
2. ASCO 917
3. Siemens CLM

F. Pre-approved equal

2.2 POWER CONTACTORS.

A. Provide minimum three-pole, electrically held, magnetic contactors. Provide 120V coil and 480 volt rated contacts sized as indicated on the Drawings.

B. Provide contactor in NEMA 1 enclosure, Contactors may be group mounted in a Hoffman enclosure.

C. Provide contactors with a short circuit current rating equal to or larger than the available fault current at the source panel.

D. Approved manufacturers:

1. Allen-Bradley Bull 500.
2. Eaton Class C30
3. Square D 8502
4. Pre-approved equal.

2.3 CONTACTOR ENCLOSURES

A. Provide an enclosure for contactors. Refer to Section 26 2716: "Electrical Cabinets and Enclosures"

PART 3 EXECUTION

3.1 CONTACTORS

A. Group mount contactors in a contactor enclosure except as indicated on the drawings. Enclosures shall be sized for the contactors indicated plus space for one (1) future contactor. Where more than fourteen (14) contactors are located in one area or room, two contactor enclosures may be used. Refer to Section 26 2716: "Electrical Cabinets and Enclosures".

B. Individually mounted open type contactors shall be installed in a contactor enclosure.

3.2 IDENTIFICATION

A. Provide engraved nameplates as specified in Section 26 0553: "Identification for Electrical Systems" on all contactors and contactor cabinets. Label per the name of the device controlled unless noted otherwise on the plans.

END OF SECTION

SECTION 26 0923

OCCUPANCY SENSORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0120: Testing and Adjustments to Electrical Systems

C. Section 26 0924: Daylight Sensors

D. Section 26 0943: Lighting Control Equipment

E. Section 26 5113: Lighting

1.3 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC as applicable to location and installation.

B. UL Compliance: Provide equipment which is UL listed and labeled.

1.4 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit a complete shop drawing package of the proposed system.

C. Provide clearly legible shop drawings.

D. Submit shop drawings in a neatly bound comb or three ring binder with protective covers. Indicate on the front cover the date submitted, project name, specification section number, electrical contractor's name, address, telephone number and the submitting equipment supplier’s address and telephone number. Allow enough clear area on the title sheet for shop drawing review stamps.

E. Submit rough-in requirements including box sizes, conduits, mounting heights, etc.

F. Submit wiring diagrams indicating all system components and the wiring necessary to connect the components. Indicate conduit sizes and wire counts and a legend indicating the type of wiring.

G. Submit original drawings produced by the supplier/manufacturer. Submitting reproductions of the Contract Documents is not acceptable.

H. Submit reproducible floor plans that indicate quantity and locations of power packs and sensors required to provide total coverage. Include orientation of directional sensors where applicable.

I. Submit a material list showing quantity, manufacturer, type and description of each item being furnished. Indicate in a separate list, the quantity and description of all spare parts to be turned over to the Owner at the end of the project. Indicate clearly the locations of additional sensors (if any) recommended by the manufacturer in order to provide adequate coverages (see paragraph 3.1.B below).

J. Submit original prints of the manufacturer product sheets with complete technical data for each item being provided. Circle, arrow or provide other permanent marking on each data sheet to clearly indicate the specific product included in the submittal. Remove or crosshatch out any product on the data sheets not applicable to the project or not being submitted for review.

K. Submit physical and schematic drawings of special and custom components or hardware.

L. Submit complete description of system operating sequence.

M. Submit complete mounting details and instructions for all equipment to be installed.

N. Submit complete operating description of the devices. Indicate how to make sensitivity and time delay adjustment to each type of device.

O. Shop drawings not containing all the information listed above will be rejected without review.

1.5 SYSTEM DESCRIPTION

A. Where occupancy sensors are indicated on the plans or specified herein, provide all components, power packs, mounting hardware, brackets, wiring and terminations required to provide on/off control of the light fixtures in the space served by the occupancy sensors.

B. Provide occupancy sensors with sufficient coverage to ensure positive detection of activity from any location within the room or space. Provide additional occupancy sensors than those shown on the plans if required or recommended by the manufacturer to ensure proper coverage of the entire space.

C. Provide the proper type of occupancy sensor based on the type of space, use, and size of the room. The following chart indicates the proper type of occupancy sensor based on typical use spaces. Refer to the plans for specific types and applications.

Type of space	Dual Technology (DT)	Ultrasonic (US)	Passive Infrared (PIR)
Public Restrooms		√	
Stairwells		√	
Corridors		√	
Conference Rooms		√	
Classrooms	√		
Hard Offices		√	
Open Office Areas			√
Work Rooms	√		
Vestibules			√
Adverse environments			√

D. Dual technology occupancy sensors are identified on the plans as type “DT”. Ultrasonic motion sensors are identified on the plans as type “US”. Passive infrared motion sensors are identified on the plans as type “PIR”.

1.6 SYSTEM OPERATION

A. In locations where light switches and occupancy sensors are indicated in the room or space, provide the following operation:

1. If the light switch(es) are in the OFF position, the lights shall remain OFF. Activity in the room shall not energize the lighting.

2. If the light switch (es) are in the ON position, the lights shall be controlled by the occupancy sensor(s). Activity in the room shall energize the lighting. Lack of activity (maintained for a predetermined time period) shall de-energize the lighting.

B. In locations where occupancy sensors are the sole controlling unit in the room or space, provide the following operation:

1. The lights shall be controlled by the occupancy sensor(s). Activity in the room shall energize the lighting. Lack of activity (maintained for a predetermined time period) shall de-energize the lighting.

C. Provide occupancy sensors that fail in the energized state for occupancy sensors controlling egress lighting (i.e. corridors).

D. Provide occupancy sensors with integral Form C relay to allow control of external devices including the following:

1. Thermostats
2. EMS data gathering modules
3. Ceiling fans
4. HVAC equipment such as VAV boxes, unit ventilators and fan coil units.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Equipment supplied by manufacturers as listed herein are considered approved for bidding on this project. Where specific models are referred to, the intent is to establish a minimum level of features and performance.

B. Systems manufactured by the following are approved for bidding purposes on this project. Approval for installation is subject to review and approval of shop drawings.

1. Dual Technology Sensors
    a. Ceiling:
        1) Wattstopper DT300 (for 500 sq. ft. rating and 1000 sq. foot rating only)
        2) Wattstopper DT200 (for 2000 sq. ft. rating only)
        3) Leviton OSC (05) (10) (20)-MWW
        4) Current Control Systems Solutions OMNIDT series
        5) Cooper equal
        6) NLight equal
2. Ultrasonic Sensors
    a. Rooms - Ceiling
        1) Wattstopper WT (600) (1100) (2200)
        2) Leviton OSC (05) (10) (20)-UOW
        3) Current Control systems Solutions OMNIUS series
        4) Cooper equal
        5) NLight equal
    b. Corridors - Ceiling
        1) Wattstopper WT (2250)
        2) Leviton OSW12-MWW
        3) Hubbell Control Solutions approved equal
        4) Cooper equal
        5) NLight equal
3. Passive Infrared Sensors
    a. Ceiling

1) Wattstopper CI-(200) (200-1)
2) Leviton OSC15-RIW
3) Current Systems Control Solutions approved equal
4) Cooper equal
5) NLight equal

2.2 OCCUPANCY SENSORS - ALL

A. Provide the following specifications for all occupancy sensors
   1. Solid state, operates at 24VDC supplied by a power module.
   2. Load Ratings: 20 amps fluorescent, 20 amps HID and 13 amps incandescent loads.
   3. Optional integral isolated Form C relay rated at 0.5 amp @24VDC.
   4. High impact, injection molded plastic housing.
   5. Mounting hardware designed for the particular application: wall, ceiling, corner surface, wall switch retrofit, etc.
   6. Immune to RFI and EMI.
   7. Adjustable time delay (8 minutes to 30 minutes).
   8. Adjustable sensitivity.
   9. LED activity indicators.
   10. Operating temperature: +32°F to +104°F at 5% to 95% non-condensing humidity.
   11. UL Listed.
   12. 5 year replacement warranty.

2.3 DUAL TECHNOLOGY OCCUPANCY SENSORS (TYPE DT)

A. Provide dual technology occupancy sensors that adhere to the specification listed above in paragraph 2.2, plus the following specifications:
   1. Utilizes passive infrared and ultrasonic technologies for detection.
   2. Field configurable to allow any combinations of one, either or both technologies to energize, de-energize or maintain ON status.

2.4 ULTRASONIC OCCUPANCY SENSORS (TYPE US)

A. Provide ultrasonic occupancy sensors that adhere to the specification listed above in paragraph 2.2, plus the following specifications:
   1. Operates at a minimum frequency of 32kHz

2.5 PASSIVE INFRARED OCCUPANCY SENSORS (TYPE PIR)

A. Provide PIR occupancy sensors that adhere to the specification listed above in paragraph 2.2, plus the following specifications:
   1. 360° coverage
   2. Dense Fresnel lens

2.6 VANDAL GUARDS

A. Where vandal guards are indicated on the plans, provide heavy duty guard over the entire device, mounted to structure using dedicated tamperproof hardware (torx head with center pin reject).

B. Provide unbreakable polycarbonate guards.

C. Approved manufacturers:

1. Safety Technology International
2. Pre-approved equal

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide complete and operational system including all line voltage wiring, power packs, occupancy sensors, low voltage wiring, conduit, terminations, setup, testing, calibration, etc.

B. Provide occupancy sensor coverage at rooms and spaces shown on the plans. It is the intent of the plans and specifications to show all necessary occupancy sensors; however, because coverages vary from manufacturer to manufacturer and model to model, additional (or fewer) sensors may be required in each space. Coordinate locations and quantities with the manufacturer prior to bidding. **If additional sensors are required, they will be added at no extra cost to the Owner.**

C. Verify the practical location of each occupancy sensor prior to rough-in. Locations or applications that obviously will not provide the intended coverage or that have obstructions should be brought to the attention of the Engineer immediately. Changes required after the occupancy sensors are installed because of obstacles or other detrimental conditions that were obvious when the sensor was installed shall be done at no cost to the Owner.

D. Connect the power pack(s) on the line side of any local switches serving the controlled lighting. Locate the required power packs above the ceiling in the room served by the sensor(s), or in an adjacent space away from the finished area. Maintain accessibility to the power pack(s) as required by the NEC.

E. Mount ultrasonic detectors away from HVAC diffusers and away from doors leading out of the space.

F. Mount PIR sensors at “line of sight” locations to maximize probability of detection.

G. Install and wire all equipment in accordance with this specification, project drawings and shop drawings.

H. Provide all wiring, conduit, junction boxes and outlet boxes required for the system, including terminations to devices furnished by others.

I. Install all wiring in concealed conduit in new construction. Provide surface raceway and boxes in finished areas of existing construction. Reuse existing conduit and boxes wherever possible.

J. Provide color coded wiring throughout. Test all wiring for opens, shorts and grounds before system startup.

3.2 TESTS AND ADJUSTMENTS

A. Refer to Section 26 01 20: Testing and Adjustments to Electrical Systems

3.3 TRAINING

A. Provide a minimum of two (2) hours of on-site instruction and training to the person or persons so designated by the Owner.

3.4 FINAL CHECKOUT AND ACCEPTANCE

A. Demonstrate the operation and use of the system to the Architect/Engineer, to the Owner's representative(s).

B. Verify the following before scheduling the system demonstration:

1. The installation is complete.

2. The installation is fully operational.

C. Verify the following before requesting final approval:

1. Owner training is complete.

2. As-built documentation is complete and turned over to the Engineer.

D. Provide a letter to the Owner certifying that the installation is complete, fully operational and successfully tested.

E. Final acceptance of the system will be given upon completion of all of the above requirements.

3.5 WARRANTY

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of **one (1) year**. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period. Provide a **five (5) year** replacement warranty on occupancy sensors and power packs.

3.6 SPARE PARTS

A. Provide the following spare parts:

1. Provide two (2) dual technology 1000 square foot rated occupancy sensors

2. Provide two (2) power packs.

B. Turn spare parts over to Owner at the completion of the project. Provide written documentation signed by the Owner that the spare parts were turned over at the completion of the project.

END OF SECTION

SECTION 26 0925

EMERGENCY LIGHTING RELAYS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0500: Common Work Results for Electrical

B. Section 26 0533: Raceways, Fitting and Boxes

C. Section 26 0553: Identification for Electrical Systems

D. Section 26 0923: Occupancy Sensors

E. Section 26 0120: Testing and Adjustments to Electrical Systems

F. Section 26 0924: Daylight Sensors

G. Section 26 0943: Lighting Control Equipment

H. Section 26 5113: Lighting

I. UL 924.

1.3 QUALITY ASSURANCE

A. Comply with NEC as applicable to construction and installation of electrical supporting devices.

B. Provide electrical components which are UL 924-listed and labeled.

1.4 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 EMERGENCY LIGHTING RELAY

A. Provide emergency lighting relays as shown on the plans that adhere to the following specifications:

1. Provide switching of normal and emergency egress lighting in an area, but automatically switches ON the emergency light fixtures during a power outage, regardless of the position of the switch.
2. Meets the requirements of NEC Article 700-12 and NFPA Section 5-9.
3. UL 924 listed
4. Rated for emergency loads of up to 10 amps at 277 volts
5. Rated for normal power loads of up to 20 amps at 277 volts.
6. Factory pre-wired and pre-tested.
7. Functions with 0-10Vdc controls.

B. Approved manufacturers:

1. Entertainment Networks model EPC 120 and EPC 277:
2. McPhilben: MTD20 120 and MTD20 277

3. Wattstopper
4. LVS, EPC-D-F (for 0-10Vdc applications)
5. Pre-approved equal

PART 3 EXECUTION

3.1 INSTALLATION

A. Mount all relays to electrical boxes.

B. Provide flush mounted boxes in all finished areas. Provide surface mounted boxes in unfinished areas.

C. Mount relays flush in accessible ceiling tiles for ceiling 10'-0' and lower. Wall mount relays in areas of higher ceilings at 9'-6".

D. Mount the Emergency Switching Relay in the ceiling above the light switches in the room served, or at the location specifically indicated on the plans.

E. Install an unswitched normal power conductor to each Emergency Switching Relay, fed from the normal powered branch circuit serving the normal powered lighting in the space.

3.2 IDENTIFICATION

A. Provide a nameplate on the cover of each Emergency Lighting Relay that indicates that it is an emergency lighting relay, the load served and the source power for the relay (e.g. "Track Lighting: HP-0-1, circuit 1; SHP-0-1, circuit 3").

B. Refer to Section 26 05 53: "Identification for Electrical Systems"

3.3 WARRANTY

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of **three (3) years**. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period.

3.4 SPARE PARTS

A. Provide quantity of spare emergency lighting relays per Section 26 0105: "Submittals, Closeout Documents, Training and Spare Parts".

B. Turn spare parts over to Owner at the completion of the project. Provide written documentation signed by the Owner that the spare parts were turned over at the completion of the project.

END OF SECTION

SECTION 26 0926

MISCELLANEOUS LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCE

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0553: Identification for Electrical Systems

C. Section 26 0943: Lighting Control Equipment

D. Section 26 2726: Wiring Devices

E. Section 26 5113: Lighting

1.1 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC as applicable to location and installation.

B. UL Compliance: Provide equipment which is UL listed and labeled.

1.2 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Indicate short circuit current rating for all equipment.

PART 2 PRODUCTS

2.1 TIME SWITCHES

A. Solid State type

1. Provide solid state, programmable 24 hour or 7-day, electric time switch with one (1) SPST contact rated 20A at 240 volts. Provide long life lithium battery backup to maintain time and memory setting during a power outage.

2. UL listed.

3. Provide astronomical control.

4. Provide contactors with a short circuit current rating equal to or larger than the available fault current at the source panel.

B. Acceptable manufacturers

1. Paragon EC7000 series

2. Tork Model D100 series

3. pre-approved equal

2.2 PHOTOCELLS

A. Provide photoelectric switch control with a set of SPST contacts rated at 120 volt AC, 1800VA in a NEMA 3R enclosure.

B. UL listed.

C. If used as a sensor input to the other lighting control equipment, provide photocell controllers fully-compatible with the lighting control panels used on this project. Refer to Section 26 0943: “Lighting Control Equipment”.

D. Approved manufacturers:

1. Paragon CW/210 series
2. Tork 2101 series

2.3 PACKAGED TIMESWITCH AND RELAYS PANEL

A. Provide 120/277V U.L. listed relay panel complete with integral astronomic time control and remote photocell.

B. Provide eight (8) relays rated 20A and suitable for HID lighting in a NEM 1 enclosure. Provide relays with manual override.

C. Provide integral solid state, programmable time controller with LCD display. Provide 8 time and/or photo controlled outputs.

D. Provide remote Photo sensor to permit the setting for precise light levels for each output.

E. Acceptable Manufacturer: Douglas Lite Pak WPAK Series Panel with WPC-5527 Remote Photometric Sensor.

PART 3 EXECUTION

3.1 PHOTOCELL(S)

A. Install photocell(s) per manufacturer's recommendations.

B. Aim away from artificial light sources such as street lights or security lights.

C. Seal penetrations through roof or penthouse wall.

3.2 TIME SWITCHES

A. Install time switches adjacent to the source lighting panel, unless specifically located elsewhere on the plans.

B. Set longitude and latitude settings and the astronomical time.

C. Provide time settings per the Owner’s direction.

3.3 CONTACTOR

A. Mount electronically held lighting contactors with elastometric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory installed vibration isolators.

3.4 IDENTIFICATION

A. Provide "nameplates" a specified in Section 26 0553: “Identification for Electrical Systems” for all contactors and time switches. Label contactors and time switches to indicate load served (e.g., canopy lights, store sign, etc.).

3.5 DEMONSTRATION

A. Train Owner’s maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

SECTION 26 0944

DIGITAL LIGHTING CONTROL EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Provide digital lighting management system including network manager, room controllers, relays and controls for control of all interior and exterior lighting.

B. Provide control devices including, but not limited to:

1. Network Manager (headend).
2. Digital On/Off Room controller (not shown on plans, refer to detail sheets).
3. Digital On/Off/0-10 Volt Dimming Room controller.
4. Photo sensors.
5. Digital Ceiling mounted occupancy sensors.
6. Momentary contact switches or low voltage wall stations.
7. Low voltage dimmer switches and/or low voltage digital switches.

1.3 REFERENCES

A. Division 25: Integrated Automation

B. Section 26 0100: Common Work Results for Electrical

C. Section 26 0120: Testing and Adjustments to Electrical Systems

D. Section 26 0533: Raceways, Fitting and Boxes

E. Section 26 0923: Occupancy Sensors

F. Section 26 0924: Daylight Sensors

G. Section 26 0926: Miscellaneous Lighting Control Devices

H. Section 26 5113: Lighting

I. Section 26 2726: Wiring Devices

J. Federal Communications Commission

K. Underwriters Laboratories

L. 2002 National Electric Code.

M. International Building Code with Minnesota State Amendments

N. NFPA 101 - Life Safety

O. Applicable Energy Codes

1.4 SYSTEM DESCRIPTION

A. Provide a complete lighting control system as described herein and as shown on the plans.

B. Provide a digital low voltage lighting management system with software and relays and associated low voltage switches.

C. System shall include, but not be limited to:

1. Digital network manager
2. Digital on/off room controllers
3. Digital input/output interface
4. BAS interface module
5. Peripheral devices
6. Remote access connection modem

D. Where system is controlling LED luminaires provide digital on/off/0-10 volt dimming room controllers.

1.5 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals Closeout Training and Spare Parts”.

B. Provide a complete shop drawing package of the system.

C. Provide clearly legible shop drawings.

D. Submit shop drawings in a neatly bound comb or three ring binder with protective covers. Indicate on the front cover the date submitted, project name, specification section number, electrical contractor's name, address, telephone number and the submitting equipment supplier’s address and telephone number. Allow enough clear area on the title sheet for shop drawing review stamps.

E. Submit original drawings for each floor plan produced by the supplier/manufacturer. Submitting reproductions of the Contract Documents is not acceptable. Drawings are to show locations of all devices and include updated sequence of operation.

F. Submit a material list showing quantity, manufacturer, type and description of each item being furnished.

G. Indicate short circuit current rating of all equipment.

H. Submit original prints of the manufacturer product sheets with complete technical data for each item being provided. Circle, arrow or provide other permanent marking on each data sheet to clearly indicate the specific product included in the submittal. Remove or crosshatch out any product on the data sheets not applicable to the project or not being submitted for review.

I. Submit wiring diagrams for all components including but not limited to, software network manager, relays, low voltage switches, occupancy sensors and daylighting controls.

J. Submit a one line diagram of the system configuration proposed if it differs from the system that is shown and described on the drawings.

K. Submit physical drawings of components.

L. Shop drawings not containing all the information listed above will be rejected without review.

1.6 QUALITY ASSURANCE

A. Factory pretest and burn-in all components and assemblies are to be prior to installation.

B. Qualification of the Manufacturer: Minimum of three years experience in the manufacture of lighting control equipment and components.

C. Provide all assemblies in compliance with FCC emissions standards specified in Part 15 Subpart J for Class A application.

D. All applicable products must be UL/CUL listed.

1.7 WEB-BASED REMOTE CONNECTIVITY

A. Provide web-based network whereby the Owner can access, modify and revise schedules, perform programming, adjust settings and manually override the system via the Owner's LAN.

B. Provide system that uses a standard browser, and does not rely on software to be installed on individual computers to operate. Coordinate IP addresses with Owner's IT staff.

C. Provide all communications wiring required to connect all lighting control panels to the same system as an integrated system.

D. Physical LAN UTP Ethernet connection from the Lighting Control Equipment to the Owner's network will be provided under Division 27. Provide the required gateway in this system to provide connectivity and communication to the Owner's LAN.

1.8 SYSTEM OPERATION – LIGHTING CONTROL PANELS

A. Normal operation

1. Sweep off schedule. Provide scheduling of any relay or group of relays to automatically turn off at predetermined times of the day or night. Scheduling will be determined by the Owner.

2. Daylight sensors. Provide daylight sensor input to the lighting control equipment that automatically varies the lighting in the room or rooms. All adjustments to the levels, rate, delay, etc., must be performed at the lighting control panel through software, and not at the remote sensor.

B. Life Safety Operation

1. All life safety relays shall fail closed, and must revert to the closed state upon loss of normal utility power, regardless of the status of the life safety relay prior to the power outage. The relays shall remain in the closed state until normal power is restored, regardless of any inputs that may be "requesting" that the relay open.

2. After any utility power outage (momentary or long duration), all normal relays shall revert back to whatever state they were in prior to the normal power outage.

C. Power Supply – Battery backup

1. Provide sufficient battery backup of the lighting control system to ride through generator starting times and other power interruptions. Provide 5 minutes minimum for all panels and equipment on the entire Lighting Control System.

1.9 SYSTEM OPERATION – DIGITAL LIGHTING MANAGEMENT SYSTEM

A. Refer to Sequence Of Operation on the drawings.

B. Normal operation

1. All zones of control are to be controlled by master switches.

2. Provide momentary contact switches/low voltage digital switches where local switching is required to override the time clock and photo sensors.

3. The programming of the system is performed in each room, area and relay panel. Memory is to be retained in the event of a power failure.

4. The system is to be capable of providing the following functions:

a. Multiple zoning of different areas required for both switching and time controls.

b. Timed on/off sweeps with off warning mode.

c. Master switch override within each building zone and building entrances.

d. low voltage dimming switches and/or digital switches control for classroom lighting.

e. Automatic photo sensor control/timer control of exterior lighting and day lighting zones.

5. Occupancy Sensors. Occupancy sensor inputs are to be wired directly to the soft switch inputs of the lighting control panels, or room controllers without the need for power packs.
6. Toggle switches and Momentary Contact switches. Switches wired to the soft inputs of the lighting control panels will also be used to provide manual overrides from a central location.
7. Sweep off schedule. Provide scheduling of any relay or group of relays to automatically turn off at predetermined times of the day or night. Scheduling will be determined by the Owner.
8. Daylight sensors. Provide daylight sensor input to the lighting control equipment that automatically varies the lighting in the room or rooms. All adjustments to the levels, rate, delay, etc., must be performed at the lighting control panel through software, and not at the remote sensor.

C. Life Safety Operation

1. All life safety relays shall fail closed, and must revert to the closed state upon loss of normal utility power, regardless of the status of the life safety relay prior to the power outage. The relays shall remain in the closed state until normal power is restored, regardless of any inputs that may be "requesting" that the relay open.
2. After any utility power outage (momentary or long duration), all normal relays shall revert back to whatever state they were in prior to the normal power outage.

PART 2 - PRODUCTS

2.1 DIGITAL LIGHTING MANAGEMENT (DLM) SYSTEM

A. Acceptable manufacturers:

a. N. Light (refer to section 01 2100 for allowance)

B. General System Description

1. The Digital Lighting Management System will consist of digital network manager, room controllers, relays, low voltage switches, occupancy sensors and/or photo sensors, as well as their associated wiring. All components shall be supplied by the same manufacturer.
2. The room controllers will be mounted in the ceilings directly above the room switches as shown on the drawings.
3. Low voltage switches will be mounted in the spaces as shown on the drawings. Low voltage wiring from the switches and sensors to the relay panel will be CLASS 2 or CLASS 2P (plenum rated) as required by the National Electrical Code and local standards. Each low voltage wire will be labeled with the channel letter (A-P) at each switch or sensor. Use only properly color coded, stranded #20 AWG (or larger) wire as indicated on the drawings. All relays and switches are to be tested after installation to confirm proper operation and the loads recorded on the directory card in each panel.
4. Interface lighting control panels with digital lighting management system.

C. Hardware Features

1. Digital Network Manager
   a. Provide Digital Network Manager capable of, but not limited to; global control, monitoring, adjustment and scheduling of networked lighting control components and lighting control panels.
   b. Communicate with lighting control network and BAS via BACnet.
   c. Web based browser interface with scalable security and remote log in.
2. Digital On/Off Room controllers relays will be UL listed and consist of the following:
   a. Input/output voltage: 120/277VAC, 50/60Hz.

b. Maximum 20A combined load per room controller, each relay rated for:

1) Ballast or incandescent: 20A

2) Motor load: 1 HP

c. Class 2 output to DLM local network: 24NDC, 150mA across 3 RJ45 ports.

d. Maximum current: 600mA, category 5e cable, up to 1,000 feet, maximum of 4 room controllers, controlling up to 8 loads, up to 24 communicating devices.

e. Operating conditions: for indoor use only; 32-104^{0}F (0-40^{0}C); 5-95% RH, non-condensing.

f. Provide Room Controllers as necessary to accomplish switching indicated on plans.

3. Digital On/Off/0-10 Volt Dimming Room Controller

a. Provide digital room controllers with on/off/01- volt dimming capabilities for control of LED lighting.

b. Provide digital on/off/0-10 volt dimming room controllers to support energy saving manual-50% on, and dimming control strategies.

c. The digital on/off/0-10 volt dimming room controller will be UL listed and comprise of the following:

d. Input/output voltage: 120/230/277VAC, 50/60 Hz.

e. Load ratings per relay and per room controller:

1) Ballast: 20A @ 120/277 VAC

2) Incandescent: 20A @ 120 VAC

3) Motor load: 1 Hp @ 120 VAC

f. Class 2 dimming control signal: 1-10 VDC, sinking or sourcing (automatic adjustment based on load).

g. Class 2 output to DLM local network: 24 VDC, up to 250 MA across 4 RJ45 ports.

h. DLM local network parameters with LMRC-210 Series Room Controllers; network may include up to 4 LMRC-100 Series and/or LMPL-101 Room Controllers:

1) Maximum current: 800 mA

2) Category 5e cable, up to 1,000 feet; 300 feet maximum between communication devices

3) Up to 64 loads

4) Up to 48 communicating devices

i. Operating conditions: for indoor use only; 32-158^{0}F (0-70^{0}C); 4-95% RH, non-condensing.

j. Provide Room Controllers as necessary to accomplish switching indicated on plans.

4. Photo Sensors

a. Provide Photo Sensors capable of direct integration to digital lighting network.

b. The sensor shall be a self-contained control device that detects changes in light levels. The sensor shall adjust the light levels by raising or lowering the light level, by controlling fixture 0 to 10 volt dimming ballast or controlling a 50% to 100% stepped level dimming ballast or provide ON/OFF switching of the fixture circuit with either a power pack or relay in the control panel. Coordinate with light fixture and lighting control schedules as to type of control to be provided.

c. The sensor shall be either a closed loop device that measures both the daylight contribution and the controlled electric light contribution or an open loop device that measures just the daylight contribution. Type of device will be determined by the application.

d. The sensor shall be a low voltage device, powered by 24 VDC or 24 VAC voltage supplied by a power pack.

e. The sensor shall have a linear response with greater than 1% accuracy over the sensed range.

f. The sensor shall have a control range of 10-100 foot-candles.

g. To ensure quality and reliability, sensor shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.

h. Sensor styles for indoor and skylight/atrium installations to be ceiling mounted or as required and as shown on drawings. Verify sensor mounting location(s) with Architect prior to installation.

i. Outdoor sensors shall be weatherproof and located as shown on drawings. Exterior lights shall be controlled by a combination sensor and time clock. The photo sensor shall provide the ON function at dusk and the time clock shall control specific circuit(s) OFF functions during dark hours.

j. Provide dual zone sensors where indicated.

5. Digital Ceiling Mounted Occupancy Sensors

a. Provide occupancy sensor capable of direct integration to digital lighting network.

b. Solid state, operates at 5VDC supplied by the room controller.

c. Load Ratings: 20 amps fluorescent, 20 amps HID and 13 amps incandescent loads.

d. Integral isolated Form C relay rated at 0.5 amp @24VDC.

e. High impact, injection molded plastic housing.

f. Mounting hardware designed for the particular application: wall, ceiling, corner surface, wall switch retrofit, etc.

g. Immune to RFI and EMI.

h. Adjustable time delay (8 minutes to 30 minutes).

i. Adjustable sensitivity.

j. LED activity indicators.

k. Operating temperature: $+32^0$F to $+104^0$F at 5% to 95% non-condensing humidity.

l. UL Listed.

m. 5 year replacement warranty.

6. Low Voltage Dimmer Switches

a. Provide dimmer switch capable of direct integration to digital lighting network.

b. Provide dimmer with LED dim indicator. Dim to indicate power to switch. Bright to indicate load or scene is active.

c. Provide Specification Grade 0-10 volt grey dimmer switch. Provide (1) dimmer switch for each dimmer switch shown on plans.

d. Where shown provide four (4) button dimmer switches with dedicated on/off/up/down buttons. Label each button accordingly.

e. Provide matched Specification Grade plates of materials and color as specified in Section 26.

7. Low Voltage Momentary Contact Switches/Plates
   a. Provide Specification Grade standard three position center off momentary contact toggle switches as shown on the plans for overriding the relays.
   b. Connect such that up is on and down is off.
   c. Provide matched Specification Grade plates of materials and color as specified in Section 26 27 26.
8. Low Voltage Wall Stations
   a. Provide low voltage wall stations as shown and described on the drawings.
   b. Provide matching devices for:
      1) Single on/off
      2) Dual on/off
      3) Quad on/off
   c. All devices are to be recessed into two (2) gang outlet boxes.
   d. All devices are to have a minimum of two (2) RJ-45 ports.
   e. Devices shall be gray to match wiring devices specified in Section 26 27 26.

2.2 DIGITAL LIGHTING MANAGEMENT SYSTEM NETWORK

A. General System Description

1. Provide a digital network manager that provides global control of the room controllers described in the previous article.
2. Software Feature
   a. The network manager will be UL listed and consist of the following:
      1) Operating voltage: 15VDC from 120VAC plug-in power supply (included) or auxiliary enclosure.
      2) Plastic housing, mounting via integral DIN rail slot or screw down tabs on housing.
      3) RJ45 Ethernet port for TCP/IP (LAN) connection, green link status LED.
      4) Embedded power PC platform @ 524 Mhz.
      5) QNX real time operating system.
      6) RS485 network, BACnet MS/TP twisted pair, baud rate 9600, 19200, 38400 or 76800 selectable
         i) LMSM-3E: three segment networks
         ii) LMSM-6E: add NB-ROUTERs as needed for up to 300 rooms
      7) Segment network parameters:
         i) LM-MSTP wire rated for BACnet MS/TP (RS485)
         ii) Linear topology; 4000 feet maximum per segment
         iii) Up to 40 local networks or panels per segment
      8) Status LEDs for power and normal operation.

9) Operating conditions: for indoor use only; 32-122^{0}F (0-50^{0}C); 5-90% RH, non-condensing.

2.3 DIGITAL INPUT/OUTPUT INTERFACE

A. General System Description:

1. Provide input/output interface device for integration of third party devices.
2. The digital input/output interface will be UL listed and consists of the following:
   a. Input/output voltage: 24VDC from DLM network
   b. Maximum current consumption: 20mA
   c. DLN local network connection: 2 RJ45 ports
   d. Removable terminal block for connections to isolated relay output and third party inputs
   e. Isolated relay rating:
      1) 24VDC/VAC, 1A, SPDT
      2) Normally open (N/O), normally closed (N/C) and common outputs
   f. Input ratings:
      1) Input max. sink/source current: 1-5 mA
      2) Logic input signal voltage High: >18 VDC
      3) Logic input signal voltage Low: <2 VDC
   g. Operating conditions; for indoor use only; 32-131^{0}F (0-55^{0}C).

2.4 DIGITAL BACNET MODULE

A. General System Description:

1. Provide driver module for integration between the Digital Lighting Management System (DLM) and the Building Automation System (BAS).
2. Provide driver module for integration between the Control Panels and the Building Automation System (BAS).
3. The digital driver module will be UL listed and consist of the following:
   a. Free driver to streamline integration between Digital Lighting Management and Niagara AX framework.
   b. Access to additional non-BACnet parameters.
   c. Maps DLM points into a Niagara AX station.
   d. Automatic discovery of DLM rooms, including BACnet objects.
   e. Built-in sunrise/sunset astronomic output schedules – no weather service required.

2.5 REMOTE ACCESS

A. General System Description

1. Provide secured DLM network modem topology to allow the vendor remote access connection to the system for trouble shooting.

B. Provide network enclosure with segment manager, DLM modem and antenna. Requirements shall include, but not be limited to, the following:

1. Input power 12 VDC, 1.5A
2. Operating temperature -4^{0}F to 140^{0}F

3. Operating humidity 10%-85% operating, non-condensing
4. 12” Omni directional high gain 6.5 dBi maximum antenna
5. Cellular modem

C. Vendor is to provide fist year cellular plan at no cost to the Owner.

2.6 CONDUCTORS AND CABLES

A. Power wiring to supply side of remote-control power sources: Not smaller than No. 12 AWG, complying with Division 26.

B. Classes 2 and 3 Control Cable: Multi-conductor shielded cable with stranded copper conductors not smaller than No. 18 AWG, complying with Division 26.

C. Class 1 Control Cable: Multi-conductor cable with stranded copper conductors not smaller than No. 14 AWG, complying with Division 26.

D. Unshielded, twisted-pair cable for control and signal transmission conductors, complying with Division 27 Section “Technology Cabling System”. Minimum specifications are Category 6 UTP, plenum-rated where required above lay-in ceilings and installed in conduit in exposed/non-accessible ceilings.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION MEETING AND SERVICES

A. Contractor to arrange a pre-installation meeting with Owner/Engineer and lighting control manufacturer prior to start of lighting control system installation. The Contractor shall schedule the pre-installation site visit, after receipt of the approved shop drawings, to review the following:

1. Confirm the location and mounting of all digital devices, with special attention to placement of occupancy sensors, daylighting sensors and room controllers.
2. Review the specifications for low voltage control wiring and termination.
3. Discuss the functionally and configuration of all products, including sequences of operation, per design requirements.
4. Discuss requirements for integration with other trades.

B. Coordination with Owner’s IT Network Infrastructure:

1. The Contractor will required to coordinate with the Owner’s Representative to secure all require network connections to the Owner’s IT network infrastructure.
    a. The Contractor will provide to the Owner’s Representative all network infrastructure requirements of the networked lighting control system.
    b. The Contractor shall provide to the Manufacturer’s Representative all necessary contacts pertaining to the Owner’s IT infrastructure, to ensure that the system is properly connected and started up.

C. Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs.

D. **Where projects require phased occupation; programming will be required at each phase of occupation. Refer to Division 0 and 1 of the specifications for phasing requirements**.

E. Contactor to install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cables are required due to length of run, the Contractor is responsible for testing each field-terminated cable following installation, and shall supply the Engineer and lighting controls manufacturer with test results. Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitutions not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer's specification. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.

F. Install the work of this Section in accordance with manufacturers printed instruction unless otherwise indicated. Before start up, Contractor is required to test all devices to ensure proper communication.

G. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current license for software.

H. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two (2) years.

I. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two (2) years from date of Substantial Completion. Upgrading software is to include operating system and new or revised licenses for using software.

J. Upgrade Notice: Provide the owner with at least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.2 INSTALLATION

A. Install all Equipment in accordance with manufacturers recommendations. Provide complete system as indicated on the drawings. Make all necessary wiring connections to internal/external control devices.

B. Locate DLM network manager and BAS interface adjacent to panelboard as indicated on the drawings.

C. Install room controller and low voltage switches as indicated on the floor plans and detail sheets.

D. Label all low voltage switch wires and corresponding room controller to identify which relay(s) and switch(es) control associated rooms.

E. Stub ¾" empty EMT conduit from each switch outlet box to accessible ceiling. Provide an insulating bushing on end of conduit.

F. Comply with Section 26 for conduit installation. Minimum size conduit will be ¾ inch.

3.3 WIRING INSTALLATION

A. 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.

B. Wiring within Accessible (Lay-in and similar) Ceilings: Route all system cabling perpendicular and/or parallel to building structure. Secure to structure using approved means and methods.

C. Wiring within Inaccessible Ceilings (Gypsum Wallboard and similar): Install all conductors in raceway. Route all system raceways perpendicular and/or parallel to building structure.

D. Wiring within areas with no ceilings/exposed structure and similar: Install all conductors in raceway. Route all system raceways perpendicular and/or parallel to building structure.

E. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 OCCUPANCY SENSOR INSTALLATION

A. Where occupancy sensors are indicated on the plans or specified herein, provide all components, power packs, mounting hardware, brackets, wiring and terminations required to provide on/off control of the light fixtures in the space served by the occupancy sensors.

B. Provide occupancy sensors with sufficient coverage to ensure positive detection of activity from any location within the room or space. Provide additional occupancy sensors than those shown on the plans if required or recommended by the manufacturer to ensure proper coverage of the entire space.

C. Provide the proper type of occupancy sensor based on the type of space, use, and size of the room. The following chart indicates the proper type of occupancy sensor based on typical use spaces. Refer to the plans for specific types and applications.

Type of space	Dual Technology (DT)	Ultrasonic (US)	Passive Infrared (PIR)
Public Restrooms		√	
Stairwells		√	
Corridors		√	
Conference Rooms		√	
Classrooms	√		
Hard Offices		√	
Open Office Areas			√
Work Rooms	√		
Vestibules			√
Adverse environments			√

3.5 RELAY PANEL INSTALLATION

A. Receive, inspect, handle and store panels according to NECA 407.

B. Examine panels before installation. Reject panels that are damaged or reused or have been subjected to water saturation.

C. Examine elements and surfaces to receive panels for compliance with installation tolerance and other conditions affecting performance of the work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Comply with NECA 1.

F. Install panels and accessories according to NECA 407.

G. Mount top of trim 72 inches above finished floor unless otherwise indicated.

H. Mount panel cabinet plumb and rigid without distortion of box.

I. Install filler plates in unused spaces.

3.6 BUILDING AUTOMATION SYSTEM

A. Provide all conduit, wire, connection, testing and programming necessary to connect the Digital Lighting control system to the building automation system provided by the Mechanical Contractor.

B. Provide all conduit, wire, connection, testing and programming necessary to connect the Lighting control panels to the building automation system provided by the Mechanical Contractor.

C. Coordinate with manufacturer and HVAC BAS Controls Contractor, Division 23 to validate integrated BACnet point integration mapping and control effort, to be completed by HVAC BAS Controls Contractor.

3.7 IDENTIFICATION

A. Identify system components, wiring, cabling and terminals. Comply with requirements for identification specified in Section 26 05 53 “Identification for Electrical Systems”.

B. Identify each wire and associated termination point on the terminal blocks. Provide a permanent labeling method. Provide identification based on the final identification/number system coordinated with the Owner. Provide as-built relay schedule in the cabinet and in the project O & M Manuals.

C. Create a directory to indicate loads served by each relay; incorporate Owner’s final room designations. Obtain approval before installing. Use a PC to create directory; handwritten directories are unacceptable.

D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 26 05 53 “Identification for Electrical Systems”.

3.8 SYSTEM START-UP

A. The Electrical Contractor will provide both the manufacturer and the Electrical Engineer with three (3) weeks written notice of the system start-up and adjustment date. All vendors are required to have programming technicians available with three (3) weeks’ notice. Some projects have phased occupation and/or substantial completion dates. Programming will be required at each phase of occupancy.

B. Upon completion of the system start-up, the factory authorized technician will provide the proper training to the Owners personnel on the adjustment and maintenance of the system.

C. Upon completion of installation by the installer, including completion of all required varication and documentation required by the manufacturer, the system will be started up and programmed by an authorized representative of the manufacturer.

1. Perform low voltage network cable testing prior to system start up. Provide test results to the Engineer.

D. System start-up and programming is to include:

1. Verifying operation 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.
5. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controls area remains lighted while occupied.

E. Initial start-up and programming is to occur on site. Programming will be required at:

1. Each substantial completion
2. Six months after occupancy

3. At the 11 month warranty walk-thru

F. Provide programming remotely over the internet as necessary.

G. Provide written or computer generated documentation on the configuration of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities and daylighting setpoints.

2. Sequence of operation (e.g. manual ON, auto OFF, etc.)

3. Load parameters (e.g. blink warning, etc.)

3.9 DEMONSTRATION AND TRAINING

A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training".

B. Provide the Owner with hands on instruction on the use and maintenance of the systems in two (2) 4 hour sessions. The Contractor is required to digitally video record all of the training sessions.

C. In addition to the above hour requirements, the Electrical Contractor is required to include four (4) additional hours of training to be used after six month of occupancy. These additional hours can be used at the Owners discretion for any or all of the system included.

3.10 TESTING

A. Test the operation and function of each room controller/relay. Record the results of the test and provide as part of the as-built drawings.

B. Perform the following field tests and inspections and prepare test reports:

1. After installing all 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.

C. Remove and replace lighting control devices where test results indicate they do not comply with specified requirements.

3.11 FINAL CHECKOUT AND ACCEPTANCE

A. Demonstrate the operation and use of the system to the Architect/Engineer and to the Owner's representative(s).

B. Verify the following before scheduling the system demonstration:

1. System installation is complete.

2. System is fully operational.

C. Verify the following before requesting final approval:

1. Owner training is complete.

2. As-built documentation is complete and turned over to the Engineer.

D. Provide a letter to the Owner certifying that the installation is complete, fully operational and successfully tested.

E. Close-Out Documentation:

1. System Documentations:

a. Submit software database file with desired device labels and notes completed.

2. Owner Training

a. Provisions for onsite training for Owner and designated attendees to be included in submittal package.

F. Final acceptance of the system will be given upon completion of all of the above requirements

3.12 COMMISSIONING

A. System shall be completely commissioned by factory trained and authorized service personnel. This commission process must be completed prior to Owner's commissioning agent performing commission. Coordinate commissioning of products specified in this section with commissioning requirements for low voltage programmable lighting control systems specified in Section 26 09 23 "Lighting Control Devices".

B. Factory commissioning shall consist of three (3) visits:

1. Pre-Wire Inspection: During this visit the factory representative shall define conduit, wire and confirm device location requirements.

2. Start-Up of System: During this visit factory personnel will confirm conduit wire requirements and provide calibration for all lighting control devices to include but not limited to day light sensors, occupancy sensors and lighting control panels. Device calibration will be provided for each space. This visit shall be coordinated with the Architect/Engineer.

3. Commissioning Trip: This trip will consist of demonstrating to the Engineer of Record the complete and functional lighting control system as defined in this section. Where needed, correct malfunctioning units at site, then re-test to demonstrate compliance otherwise remove and replace with new units, and proceed with re-testing. Testing and re-testing at no cost to Owner.

3.13 COMMISSIONING SUPPORT SERVICES

A. On this project, a commissioning agent will be hired to verify the installation and programming of all building system, which includes the lighting control system. Manufacturer should include an extra day of technician's time to review the functionality and settings of the lighting control hardware with the commissioning agent, including reviewing submittal drawings and ensuring that instructions on how to configure each device are readily available. Manufacturer is NOT responsible for helping the commissioning agent inspect the individual devices. It will be the commissioning agent's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the agent with this task.

B. The commissioning agent is required to work with the electrical contractor during installation of the lighting control hardware to become familiar with the specific products. The agent may also accompany the manufacturer's technicians during their start-up work to better understand the process of testing, calibration and configuration of the products. However, the Contractor and manufacturer will ensure that interfacing with the agent does not prevent them from completing the requirements outlined in the contract documents.

3.14 MANUALS

A. Submit complete operating and maintenance manuals in the format required by 26.01.05 to include:

1. "As built" set of complete wiring diagrams, details and floor plans indicating all of the devices. The Contractor will be responsible for documenting installed location of all networked devices, including networked luminaires. This includes responsibility to provide as-built plan drawing showing device address barcodes corresponding to locations of installed equipment.

2. Data sheets required to operate the equipment and system.

3. Data sheets required for testing, repair, trouble shooting and recommended maintenance intervals.

4. Provide a replacement parts list and name and address where available.

5. Provide a copy of the digitally recorded training sessions.

B. “As installed” Bill of Materials to include catalog cuts of all components of the lighting control system.

3.15 MAINTENANCE AND SPARE PARTS

A. Provide spare relays in quantities indicated on the Lighting Control Panel schedules.

B. Provide new parts, upgrades, and/or replacements available for minimum of five (5) years available to the owner.

C. Provide free telephone technical support.

3.16 WARRANTY

A. The Contractor and successful vendor is to provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of five (5) years, except for network manager provide one (1) year warranty. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period.

3.17 ADJUSTING

A. Adjustments: When requested at 11 months from date of Substantial Completion, provide onsite assistance in adjusting all sensors to suit actual occupied conditions. This visit to project will need to occur during other-than-normal occupancy hours.

1. For occupancy sensors, verify operation at outer limits of detector range. Set time delay to suit Owners operations.

2. For daylighting controls, adjust set points and dead band controls to suit owners operations.

END OF SECTION

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