SPECIFICATIONS FOR THE
ECONOMIC DEVELOPMENT CENTER
AND
ROWAN MEDICINE

at

Rowan College at Gloucester County
1400 Tanyard Road
Sewell, New Jersey 08080

for

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GA #17-108
BOOK 2 OF 2
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SECTION 08110- STEEL DOORS AND FRAMES

1.1 GENERAL

A. Submit Product Data for each type of door and frame specified.

B. Quality Assurance: Comply with ANSI/SDI 100.

C. Fire-Rated Door Assemblies: NFPA 80, identical to assemblies tested per ASTM E 152, and labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1.2 PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

1. Amweld Building Products, Inc.
2. Benchmark Commercial Doors.
3. Ceco Door Products.
4. Copco Door Co.
5. Curries Co.
6. Deansteel Manufacturing Co.
7. Fenestra Corp.
8. Kewanee Corp.
9. Mesker Door, Inc.
11. Republic Builders Products.
12. Steelcraft.
13. Or approved equal.

B. Cold-Rolled Steel Sheets: ASTM A 366 (ASTM A 366M), commercial quality, or ASTM A 620 (ASTM A 620M), drawing quality.

C. Galvanized Steel Sheets: ASTM A 526 (ASTM A 526M), commercial quality, or ASTM A 642 (ASTM A 642M), drawing quality, with A 60 or G 60 (Z 180 or ZF 180) coating designation, mill phosphatized.

D. Steel Doors: Provide 1-3/4-inch- (44-mm-) thick doors of materials and ANSI/SDI 100 grades and models specified below, or as indicated on Drawings or schedules:

1. Interior Doors: Grade II, heavy-duty, Model 2, seamless design, minimum 16 gage thick cold-rolled steel sheet faces.
2. Exterior Doors: Grade III, extra heavy-duty, Model 2, seamless design, minimum 16 gage thick galvanized steel sheet faces with insulation core to have a minimum R Value of 11.25.
3. INTERIOR WOOD GRAINED EMBOSSED DOORS: Grade I, heavy-duty, Model 2, seamless design, minimum 16 gage thick, wood grain pattern, engraved with factory painting/staining with UV protective topcoat to be selected from manufacturer’s full range of finish selections, including custom finish to match Owner’s established building standard. NOTE: Factory finishing process and final finish must meet or exceed that established by Steelcraft Graintech Series.
SECTION 08110- STEEL DOORS AND FRAMES

Owner/Architect reserve the right to reject any noticeably different or less aesthetically acceptable specialty finish by others.

E. Frames: Provide frames for doors, sidelights, borrowed lights, and other openings that comply with ANSI/SDI 100; fabricate to be rigid, neat in appearance, and free from defects, warp, or buckle.

1. For interior frames provide units with mitered or cope and continuously welded corners, formed from 16 gage thick cold-rolled steel.
2. For exterior frames provide units with mitered or cope and continuously welded corners, formed from 16 gage thick galvanized steel sheet.
3. Door Silencers: 3 on strike jambs of single-door frames and 2 on heads of double-door frames.
4. Plaster Guards: Provide where mortar might obstruct hardware operation and to close off interior of openings.
5. For new frame install in existing opening. Knock down frame is allowed to secure to existing opening.
6. Grout: As specified in Division 4 Section "Unit Masonry."

F. Tolerances: Comply with SDI 117.

G. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.

H. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to SDI 107 and the hardware specification.

I. Glazing Stops: Minimum 0.0359-inch- (0.9-mm-) thick steel or 0.040-inch- (1-mm-) thick aluminum.

1. Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
2. Provide screw-applied, removable, glazing beads on inside of glass, louvers, and other panels in doors.

J. Finishes, General: Comply with NAAMM's "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

1. Apply primers to doors and frames after fabrication.

K. Galvanized Steel Sheet Finishes: Comply with SDI 112 and the following:

1. Surface Preparation: Clean surfaces with nonpetroleum solvent so that surfaces are free of oil or other contaminants. After cleaning, apply a conversion coating of the type suited to the organic coating applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified to comply with ASTM A 780.
2. Galvanizing Repair Paint: SSPC-Paint 20, high-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight.
SECTION 08110- STEEL DOORS AND FRAMES

3. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply air-dried primer specified below immediately after cleaning and pretreatment.
   a. Shop Primer: Zinc-dust, zinc-oxide primer paint complying with performance requirements of FS TT-P-641, Type II.

4. Field Painted Finish: Immediately after cleaning and pretreating, apply 2-coat finish consisting of prime coat and finish coat. See Section 09900, "Painting."

L. Steel Sheet Finishes: Comply with SSPC-PA 1, "Paint Application Specification No. 1."
   1. Surface Preparation: Solvent-clean surfaces according to SSPC-SP 1. Remove mill scale and rust to comply with SSPC-SP 5 (White Metal Blast Cleaning) or SSPC-SP 8 (Pickling).
   2. Pretreatment: Immediately after surface preparation, apply a conversion coating suited to organic coating applied over it.
   3. Factory Priming for Field-Painted Finish: Apply shop primer that complies with ANSI A224.1 acceptance criteria, is compatible with finish paint systems indicated, and has capability to provide a sound foundation for field-applied topcoats. Apply primer immediately after surface preparation and pretreatment.

1.3 EXECUTION

A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.

B. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.
   1. Except for frames located in existing concrete, masonry, or gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.
   2. Install at least 3 anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb.
   3. In-place gypsum board partitions, install knock-down, slip-on, drywall frames.
   4. Install fire-rated frames according to NFPA 80.
   5. Coordinate installation of all required wiring/conduit prior to frame installation.

C. Door Installation: Fit exiting hollow-metal doors accurately in new hollow-metal frames, within clearances specified in ANSI/SDI 100, including new door in existing frame.
   1. Fire-Rated Doors: Install with clearances specified in NFPA 80.
   2. Smoke-Control Doors: Comply with NFPA 105.

D. Prime Coat Touchup: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
SECTION 08110- STEEL DOORS AND FRAMES

E. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

F. Labeling of the Existing Doors and Frames: The doors and frames indicated on the drawings are to remain and be repaired so that they may meet the label standard for the indicated fire rating per NFPA80. The work is to include the repair of existing hollow metal frames, fill holes in frames by installing steel plugs of the same gauge and thickness as the metal frame, provide new filler plates, secure frame to sub-frame, repair door surface, fill holes, replace hardware, replace glazing and glazing frame, fit existing door in frame, provide intumescent seal and all notes as shown on the drawings. The Contractor shall prime and repaint the entire frame to match the existing frames or the Owner’s color selection. It is the Contractor’s responsibility to repair / modify the doors and frames to obtain the fire rating. When the work is completed, the Contractor shall contact one of the following testing labs or approved equal, for field inspections, required documentation and required door/frame labels. All associated costs to certify and label modified doors/frames shall be paid for by the Contractor.

3. Or approved equal.

END OF SECTION 08110
SECTION 08211 - FLUSH WOOD DOORS

1.1 GENERAL

A. Submittals: In addition to product data, submit the following:
   1. Shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for veneer matching and factory finishing and other pertinent data. For factory-machined doors, indicate dimensions and locations of cutouts for locksets and other cutouts adjacent to light and louver openings.
   2. Samples of actual materials in small sections for each face material and finish.

B. Quality Standard: Comply with the following standard:

C. Fire-Rated Wood Doors: Provide wood doors labeled and listed by UL, Warnock Hersey, or another testing and inspection agency acceptable to authorities having jurisdiction. Provide certification for fire rating required acceptable to authorized agencies having jurisdiction for oversize fire rated doors over 4'-0" wide

D. Warranty
   1. Provide manufacturer’s warranty to the following term:
      a. Interior Solid Core Doors: “Full Life of Original Installation” including rehang and refinish if door(s) do not comply with Warranty tolerance standards.

1.2 PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide doors by one of the following or approved equal:
   1. Marshfield Door Systems, Inc., quality as defined in this section.
   2. Algoma Wood Doors Inc., quality as defined in this section.
   3. Eggers Wood Doors Inc., quality as defined in this section.
   4. Mohawk Wood Doors Inc., quality as defined in this section.
   5. V-T Industries Inc., quality as defined in this section.
   6. Buell Door Company, quality as defined in this section.
   7. Or approved equal.

B. Interior Solid Core Doors for Transparent Finish: As follows:
   NOTE: ALL WOOD VENEER MUST APPEAR UNIFORM AND LIGHT IN APPEARANCE
   1. Faces: Select White Birch, plain sliced.
C. Interior Fire-Rated Solid Core Doors: As follows:

1. Faces and Grade: Provide faces and grade to match non-fire-rated doors in same area of building, unless otherwise indicated.
2. Edge Construction: Provide manufacturer's standard laminated-edge construction for improved screw-holding capability and split resistance.
3. Pairs: Furnish formed-steel edges and astragals for pairs of fire-rated doors, unless otherwise indicated.
4. Pairs: Provide fire-rated pairs with fire-retardant stiles that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals.

D. Pairs and Sets: Provide pair matching and set matching.

E. Fabricate flush wood doors to comply with following requirements:

1. In sizes indicated for job-site fitting.
2. Factory fit doors to comply with clearance requirements of referenced quality standard. Comply with requirements of NFPA 80 for fire-resistance-rated doors.
3. Factory machine doors for hardware that is not surface applied.
   a. Metal Removable Mullions: Premachine locks and formed-steel edges for hardware for pairs of doors requiring removable Mullions. See the Hardware Schedule.
4. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
   a. Light Openings: Trim openings with moldings of material and profile indicated. * To be selected from manufacturer’s standard profiles and colors unless noted otherwise. At existing buildings, metal trim shall be required to match adjacent existing to remain.
   b. Louvers: Factory install louvers in prepared openings.
5. Provide metal flashing at top of outswinging units.

F. Finish wood doors at factory as factory finished.

1. Transparent Finish: Comply with requirements indicated for grade, finish system, staining effect, and sheen.
   a. Grade: Custom.
SECTION 08211 - FLUSH WOOD DOORS

b. Finish: Manufacturer's standard finish with performance requirements comparable to either AWI System TR-2 catalyzed lacquer or AWI System TR-4 conversion varnish.
c. Staining: Match Architect's sample or existing schools' wood doors.
d. Effect: Filled finish.
e. Sheen: Semigloss.

G. Provide sound proof seal as noted in the Hardware Schedule. Adjust Hardware and frame to align properly to have the best acoustical effect.

1.3 EXECUTION

A. Examination

1. Verify substrate-openings conditions.
2. Verify that opening sizes and tolerances are acceptable and ready to receive this work.
3. Do not install doors in frame openings that are not plumb or are out of tolerance for size or alignment.

B. Installation

1. Install fire-rated and non-rated doors in accordance with NFPA 80, manufacturers' instructions and fire rated labeling requirements.
2. Trim non-rated door width by cutting equally on both jamb edges.
3. Trim door height by cutting bottom edges to a maximum 3/4 inch (19mm).
4. Trim fire door height at bottom edge only, in accordance with fire rating requirements.
5. Pilot drill screw and bolt holes using templates provided by hardware manufacturer. (Use threaded through bolts for half surface hinges.)
6. Coordinate installation of doors with installation of frames and hardware.
7. Coordinate installation of glass and glazing.
8. Install door louvers and light kits plumb and level.
9. Re seal or refinish any doors that required site alteration.

C. Warranty Tolerances

1. Conform to WDMA standards and testing methods for warp, cup, bow and telegraphing.

D. Adjusting

1. Adjust work under provisions Division 1.
2. Adjust doors for smooth and balanced door movement.

E. Door and Frame Components Schedules

1. Refer to door and frame schedule.

END OF SECTION 08211

FLUSH WOOD DOORS
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Electric operated overhead insulated rolling doors.

1.2 SYSTEM DESCRIPTION

A. Design Requirements:

1. Air Infiltration to Comply With:
   b. IECC® (International Energy Conservation Code) 2012 requirements of less than 1.0 CFM/FT2

2. Wind Loading:
   a. Supply doors to withstand up to 35 psf design wind load

3. Cycle Life:
   a. Design doors of standard construction for normal use of up to 20 cycles per day maximum, and an overall maximum of 50,000 operating cycles for the life of the door

5. Insulated Door Slat Material Requirements:
   a. Flame Spread Index of 0 and a Smoke Developed Index of 10 as tested per ASTM E84
   b. Sound Transmission Class (STC) rating up to 30 for the curtain and up to 22 for the entire assembly. If an STC of 32 is desired, additional options are required. All configurations are evaluated per ASTM E90 and based on testing a complete, operable assembly.
   c. Minimum R-value of 8.0 (U-value of 0.125) as calculated using the ASHRAE Handbook of Fundamentals
   d. Insulation to be CFC Free with an Ozone Depletion Potential (ODP) rating of zero.

6. Safety:
   a. Chain operated doors shall be designed so that the door immediately stops upward or downward travel and is maintained in a stationary position when the hand chain is released by user.
A. Reference Section 01300 - Submittals; submit the following items:

1. Product Data
2. Shop Drawings: Include special conditions not detailed in Product Data. Show interface with adjacent work.
3. Quality Assurance/Control Submittals: Provide letters certifying the following:
   a. Provide manufacturer ISO 9001:2015 registration
   b. Provide manufacturer and installer qualifications - see below
   c. Provide manufacturer's installation instruction
   d. Manufacturer must provide independent testing lab results proving .3 CFM/FT2 or less air infiltration
   e. Provide a letter from the manufacturer certifying the installer.

4. Closeout Submittals:
   a. Operation and Maintenance Manual
   b. Certificate stating that installed materials comply with this specification

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer Qualifications: ISO 9001:2015 registered and a minimum of five (5) years of experience in producing doors of the type specified
2. Installer Qualifications: Manufacturer's approval

1.5 WARRANTY

A. Standard Warranty: Two (2) years from date of Substantial Completion against defects in material and workmanship

B. Installer’s Warranty: Two (2) years from date of Substantial Completion against defects in material and workmanship

PART 2 PRODUCT

2.1 MANUFACTURER

A. Manufacturer:

1. The Basis of Design is Cornell: 24 Elmwood Avenue, Mountain Top, PA 18707.
   Telephone: (800) 233-8366
2. Cookson
3. Or Approved Equal

2.2 PRODUCT INFORMATION
SECTION 08331 – ELECTRIC INSULATED OVERHEAD COILING DOOR

A. Model: ESD30 by Cornell or approved equal.

2.3 MATERIALS

A. Curtain: Air infiltration rate of less than .3 CFM/FT2, as tested per ASTM E283 validated by an independent testing agency. Test report required.

1. Fabrication:

a. Slat Material: No. 6F, (Listed Exterior/Interior):

1) Galvanized Steel/Galvanized Steel: Manufacturer recommended gauge based on performance requirements. Minimum 24/24 gauge, Grade 40, ASTM A 653 galvanized steel zinc coating.

b. Insulation: 7/8 inch (22 mm) foamed-in-place, closed cell urethane
c. Total Slat Thickness: 15/16 inch (24 mm)
d. Flame Spread Index of 0 and a Smoke Developed Index of 10 as tested per ASTM E84
e. R-value: 8.0
f. STC Rating: Sound Transmission Class (STC) rating up to 30 for the curtain and up to 22 for the entire assembly. If an STC of 32 is desired, additional options are required. All configurations are evaluated per ASTM E90 and based on testing a complete, operable assembly

2. Exterior Slat Finish:

a. SpectraShield® Coating System (or approved equal) (Color Selected by Architect to match the brick):

1) ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding, gray baked-on base coat and gray baked-on polyester finish coat
2) Zirconium treatment followed by baked-on polyester powder coat, with color as selected by Architect from manufacturer's standard color range; minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D-3363 pencil hardness: H or better

3. Interior Slat Finish:

a. SpectraShield® Coating System (or approved equal) (Color Selected by Architect):

1) ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding, gray baked-on base coat and gray baked-on polyester finish coat
2) Zirconium treatment followed by baked-on polyester powder coat, with color as selected by Architect from manufacturer's standard color range; minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D-3363 pencil hardness: H or better
B. Endlocks: Fabricate interlocking sections with high strength galvanized cast iron endlocks on alternate slats each secured with two ¼" (6.35 mm) rivets. Provide windlocks as required to meet specified wind load.

1. Galvanized cast iron: Required if above 21'-5” width (DBG - Distance Between Guides)

C. Bottom Bar

1. Configuration:
   a. Insulated Bottom Bar: Reinforced extruded aluminum interior face with full depth insulation and exterior skin slat to match curtain material and gauge. Minimum 4” tall x 1-1/16” thickness.

2. Finish:
   a. Exterior: Match slats
   b. Interior: Powder coat to match slats

3. Air Infiltration Certification Label: Must be affixed to bottom bar

D. Guides:

1. Fabrication:
   a. Thermal break required. Minimum 3/16 inch (4.76 mm) structural steel angles. Provide windlock bars of same material when windlocks are required to meet specified wind load. Top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar. Top 16 ½” (419.10 mm) of coil side guide angles to be removable for ease of curtain installation and as needed for future curtain service

2. Finish:
   a. SpectraShield® (or approved equal) Coating System (Color Selected by Architect): Zirconium treatment followed by baked-on polyester powder coat, color as selected by Architect from manufacturer’s standard color range; minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D-3363 pencil hardness: H or better

E. Counterbalance Shaft Assembly:

1. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot (2.5 mm per meter) of width.
SECTION 08331 – ELECTRIC INSULATED OVERHEAD COILING DOOR

2. Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs (110 N). Provide wheel for applying and adjusting spring torque.

F. Brackets: Fabricate from minimum 3/16 inch (5 mm) steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures.

1. Finish:
   a. SpectraShield® (or approved equal) Coating System (Color Selected by Architect): Zirconium treatment followed by baked-on polyester powder coat, color as selected by Architect from manufacturer's standard color range; minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D-3363 pencil hardness: H or better

G. Hood: Minimum 24 gauge galvanized steel with reinforced top and bottom edges. Provide minimum 1/4 inch (6.35 mm) steel intermediate support brackets as required to prevent excessive sag.

1. Finish:
   a. SpectraShield® Coating System (Color Selected by Architect):
      1) ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding, gray baked-on base coat and gray baked-on polyester finish coat
      2) Zirconium treatment followed by baked-on polyester powder coat, with color as selected by Architect from manufacturer's standard color range; minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D-3363 pencil hardness: H or better

H. Weatherstripping:

1. Bottom Bar:
   a. Motor Operated Doors: Sensing/weather edge with neoprene astragal extending full width of door bottom bar.

2. Guides: Replaceable vinyl strip on guides sealing against both sides of curtain
3. Lintel Seal: Double brush seal with EPDM sandwiched between the two brush seals at door header to impede air flow.
4. Hood: Neoprene/rayon baffle to impede air flow above coil
2.4 OPERATION

A. Motor – Standard Use – Model MG (Industrial Duty Gear Head) Operator: The operator must not extend above or below the door coil when mounted front-of-coil. Rated for a maximum of 20 cycles per hour (not to be used for consecutive hours) cULus listed (to comply with UL requirements in The United States and Canada), Totally Enclosed Non Ventilated gear head operator(s) rated (1/3) (1/2) or (3/4) hp as recommended by door manufacture for size and type of door, 115 Volts, Single Phase. Provide complete with electric motor and factory pre-wired motor control terminals, maintenance free solenoid actuated brake, emergency manual chain hoist and control station(s). Motor shall be high starting torque, industrial type, protected against overload with an auto-reset thermal sensing device. Primary speed reduction shall be heavy-duty, lubricated gears with mechanical braking to hold the door in any position. Operator shall be equipped with an emergency manual chain hoist assembly that safely cuts operator power when engaged. A disconnect chain shall not be required to engage or release the manual chain hoist. Operator drive and door driven sprockets shall be provided with #50 roller chain. Provide an integral Motor Mounted Interlock system to prevent damage to door and operator when mechanical door locking devices are provided. Operator shall be capable of driving the door at a speed of 8 to 9 inches per second (20 to 23 cm/sec). Fully adjustable, driven linear screw type cam limit switch mechanism shall synchronize the operator with the door. The electrical contractor shall mount the control station(s) and supply the appropriate disconnect switch, all conduit and wiring per the overhead door wiring instructions.

B. Control Station:

1. Surface mounted: "Open/Close/Stop," push buttons with keyed lock-out, not masterkeyable; NEMA 4

C. Control Operation:

1. Constant Pressure to Close:

   a. 2-wire, electric sensing edge seal extending full width of door bottom bar. Contact before door fully closes shall cause door to immediately stop downward travel and reverse direction to the fully opened position. Provide a self-coiling cable connection to control circuit.


   a. NEMA 1 photo eye sensors consisting of a transmitter and receiver that are to be mounted within 6" (152.4 mm) of the floor, projecting an IR beam across the entire width of the door. Electrical contractor to provide low voltage wiring from the transmitter and receiver to the door operator.

3. Sensing/Weather Edge: Automatic reversing control by an automatic sensing switch within neoprene or rubber astragal extending full width of door bottom bar
SECTION 08331 – ELECTRIC INSULATED OVERHEAD COILING DOOR

a. Electric sensing edge device. Provide a wireless sensing edge connection to motor operator eliminating the need for a physical traveling electric cord connection between bottom bar sensing edge device and motor operator.

2.5 ACCESSORIES

A. Locking:

1. None

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates upon which work will be installed and verify conditions are in accordance with approved shop drawings

B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.

C. Commencement of work by installer is acceptance of substrate.

3.2 INSTALLATION

A. General: Install door and operating equipment with necessary hardware, anchors, inserts, hangers and supports.

B. Follow manufacturer's installation instructions.

3.3 ADJUSTING

A. Following completion of installation, including related work by others, lubricate, test, and adjust doors for ease of operation, free from warp, twist, or distortion.

3.4 CLEANING

A. Clean surfaces soiled by work as recommended by manufacturer.

B. Remove surplus materials and debris from the site.

3.5 DEMONSTRATION

A. Demonstrate proper operation to Owner's Representative.

B. Instruct Owner's Representative in maintenance procedures.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Special Conditions and other Division 0 and Division 1 Project Manual Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. This Section Includes:

1. Exterior curtain wall framing.
2. Exterior and interior manual-swing entrance doors and door-frame units.
4. All Interior first floor windows shall be provided with a site applied film. After installation provide Sonera window film by 3M or approved equal. Film to be selected from manufacturer's standard selection of 3 mil frosted or milky white opaque films. Provide samples on the mock-up wall for Owner selection.

1.3 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:
   a. Deflection exceeding specified limits.
   b. Thermal stresses transferring to building structure.
   c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
   d. Noise or vibration created by wind and by thermal and structural movements.
   e. Loosening or weakening of fasteners, attachments, and other components.
   f. Sealant failure.
   g. Failure of operating units.
B. Structural Loads:

1. Wind Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding wind-load design pressures calculated according to requirements of authorities having jurisdiction or the American Society of Civil Engineers’ ASCE 7 “Minimum Design Loads for Buildings and Other Structures,” 6.4.2, “Analytical Procedure,” whichever are more stringent.
3. Design wind load velocity at the project site is 90 mph.
4. The wind load design pressures for this project are 23.0 psf @ non-corner zones and 25 psf @ corner zones.

C. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/240 + ½" at openings greater than 13’6” and shall not exceed L/175 at openings lesser than 13’6” of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits. The maximum wind load design pressure for this project is 25 psf.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (75 Pa).

F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa). The storefront systems shall have a maximum no leakage water performance of 12 psf and the curtain wall systems shall have a maximum no leakage water performance of 15 psf.

G. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

H. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 57 for the framing when tested according to AAMA 1503-98.

I. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.55 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) when tested according to AAMA 1503-98.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
   2. Submit to architect approved shop drawings for Structural Stamp and Calculations provided by Professional Engineer registered in the state of New Jersey for all local jurisdiction codes and wind velocities indicated. Calculations shall indicate the adequacy of the storefront and curtain wall systems perimeter anchors and attachments and the structural integrity of the fenestration system framing members. The final shop drawings must be readable for field personnel to use as an installation guideline regarding fastener type and locations.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
   1. Joinery, including concealed welds.
   2. Anchorage.
   5. Flashing and drainage.

F. Other Action Submittals:
1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

G. Qualification Data: For qualified Installer. Provide a letter from the Manufacturer certifying the installer.

H. Welding certificates.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

J. Source quality-control reports.

K. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

L. Warranties: Submit a copy of the Manufacturer’s Special Ten (10) year Warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative is to verify installation contractor’s approval for ability to complete installation of units required for this Project.

B. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not revise intended aesthetic effects as judged solely by the architect, except with architect’s approval. If revisions or substitutions are proposed, submit comprehensive explanatory data to architect within thirty (30) days of Notice to Proceed per Specification Section 01300, “Submittals”. After thirty (30) days, no substitution products will be considered.

2. No stock length materials will be allowed for this project. All materials are to be factory fabricated by the manufacturer at their facility in order to be utilized for this project.

C. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

D. Single-Source Responsibility: Provide windows, storefront, curtain wall and related fenestration system sections, as well as all necessary accessories from one source and produced by a single manufacturer.
E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Failure to meet performance requirements.
   b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
   c. Faulty operation of movable sash and hardware.
   d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
   e. Failure of insulating glass.
   f. Noise or vibration caused by thermal movement
   g. Water Leakage through fixed glazing and framing areas

2. Warranty Period: Ten (10) years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 10 years from date of Substantial Completion.
1.9 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following or approved equal:

1. Efco Corporation, a Pella Company.
2. Wausau Window & Wall Systems.
4. Other Approved equal.

B. Basis of Design Products: Subject to compliance with requirements, provide Efco products; series 402, & 403 storefronts and entrance packages, and series 5600 curtain walls with a 2 1/2” face dimension. Approved equal manufacturer’s will be considered in accordance with Specification Section 01300 – Submittals.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: storefront systems are screw spline construction and curtain wall systems are shear block construction.
2. Glazing System: Retained mechanically with gaskets on four sides.

B. Framing Members, General:

1. All storefront members shall have a minimum wall thickness of .080". The face dimension for the storefront system will be not less than 2" and the frame depth will not be less than 4 ½". All exposed work shall be carefully matched to produce continuity of line and design with all joints. System design will be such that raw edges will not be visible at joints.
2. All curtain wall members shall have a minimum wall thickness of .125". The face dimension for the curtain wall system will be not less than 2 1/2" and the overall frame depth will be indicated on the architectural drawings. All exposed work shall be carefully matched to produce continuity of line and design with all joints. System design will be such that raw edges will not be visible at joints.
3. Efco Model 5600 Curtain Wall System, and 401, 402 & 403 Storefront, or approved equal. No stocklength materials will be allowed for this project. All materials are to be factory fabricated by the manufacturer at their facility in order to be utilized for this project.
4. Any manufacturer bidding this project with their storefront and curtain wall systems must provide their own internal steel reinforcement members as required to meet the project wind load design criteria and a minimum 25 psf wind load design pressure. Provide New Jersey Professional Engineer’s signed and sealed structural calculations.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Fasteners and Accessories: Provide nonmagnetic stainless steel or ceramic coated fasteners warranted by the fenestration system installer to be non-corrosive and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Provide New Jersey Professional Engineer’s signed and sealed structural calculations showing fastener types, size and locations.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
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F. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.

G. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

B. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

2.5 ENTRANCE DOOR SYSTEMS

A. Entrance Door Hardware: As specified in Division 08 Section "Door Hardware."

B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch-(3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

2. Door Design: Wide stile; 5-inch (127-mm) nominal width. Minimum bottom rail height of 10" as indicated on architectural drawings.

   a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.


2.6 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762-mm) thickness per coat.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.
B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. General: Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designing finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. High Performance Organic Finish: AA-C12C42R1X (Chemical Finish: Cleaned & inhibitive chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer’ written instructions.

1. Fluoropolymer two coat system: Manufacturer’s standard two-coat, thermocured system consisting of specifically formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70% polyvinylidene fluoride resin by weight; complying with AAMA 2605. Architect is to select a standard color (non-metallic / non-exotic), which the fenestration system manufacturer can match “in house”. Architect will select the standard color during the shop drawing review process.
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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 08 Section "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
H. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
   1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
   2. Alignment:
      a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
      b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
   1. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
      a. Test Area: A minimum area of 75 feet (23 m) by 1 story of aluminum-framed systems. Field Test to be in accordance with Test Method “A” under AAMA 501.2.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.
3.5 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

3.6 CLEANING

A. Adjust doors and hardware to provide tight fit at contact points and weather stripping, smooth operation, and weather tight closure.

B. Remove excess sealant and glazing compounds, and dirt from surfaces.

3.7 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08411
SECTION 08422 – SLIDING AUTOMATIC ENTRANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following types of automatic entrances:
   1. Exterior and interior, single slide and bi-parting, sliding automatic entrances with access control locking.

1.3 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. Underwriters Laboratories (UL):
   1. UL 325 – Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

C. American National Standards Institute (ANSI) / Builders’ Hardware Manufacturers Association (BHMA):
   2. ANSI/BHMA A156.5: Standard for Auxiliary Locks and Associated Products

D. American Society for Testing and Materials (ASTM):
   2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

E. American Association of Automatic Door Manufacturers (AAADM):

F. National Fire Protection Association (NFPA):

G. International Code Council (ICC):

H. International Organization for Standardization (ISO):
SECTION 08422 – SLIDING AUTOMATIC ENTRANCES

1. ISO 9001 - Quality Management Systems

I. National Association of Architectural Metal Manufacturers (NAAMM):

1. Metal Finishes Manual for Architectural and Metal Products.

J. American Architectural Manufacturers Association (AAMA):

1. AAMA 607.1 - Clear Anodic Finishes for Architectural Aluminum.
4. AAMA 701 Voluntary Specification for Pile Weatherstripping and Replaceable Fenestration Weatherseals.

1.4 DEFINITIONS

A. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.

B. Safety Device: Device that prevents a door from opening or closing, as appropriate.

1.5 PERFORMANCE REQUIREMENTS

A. General: Provide automatic entrance door assemblies capable of withstanding loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Operating Range: Minus 30 deg F (Minus 34 deg C) to 130 deg F (54 deg C).

C. Opening-Force Requirements for Egress Doors: Force shall be adjustable; but, not more than 50 lbf (222 N) required to manually set swinging egress door panel(s) in motion.

D. Closing-Force Requirements: Not more than 30 lbf (133 N) required to prevent door from closing.

E. Sliding automatic entrances specified with access control locking shall be designed to function as follows when set for secure operation:

1. Entrances shall be normally closed and locked by access control locking system with exterior motion activation system disabled. Interior motion activation system to remain enabled; free egress.

2. Upon signal from exterior secure activation device, sliding automatic entrances will unlock and open enabling motion activation system. Entrance will be held open as long as an object or pedestrian remains in the activation or safety zones.

3. Once all activation and safety zones have cleared the entrance will close and re-lock, returning to normal state.

4. At any time during the cycle emergency egress can be achieved by utilizing the emergency breakaway feature.

SLIDING AUTOMATIC ENTRANCES 08422 - 2
1.6 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

B. Shop Drawings: Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work.

C. Color Samples for selection of factory-applied color finishes.

D. Installer Qualifications: Provide a certified letter from the Manufacturer that the installer is an authorized installer. Also provide a certificate issued by AAADM, that the installer is trained for installation and maintenance of units required for this Project.

E. Manufacturer Qualifications: Provide a certified letter from the Manufacturer that the manufacturing facility is certified under ISO 9001.

1.7 QUALITY ASSURANCE

A. Manufacturer shall have in place a national service dispatch center providing 24 hours a day, 7 days a week, emergency call back service.

B. Certifications: Automatic sliding door systems shall be certified by the manufacturer to meet performance design criteria in accordance with the following standards:

1. ANSI/BHMA A156.10.
3. UL 325 listed.
4. IBC 2015 New Jersey Edition

C. Source Limitations: Obtain automatic entrance door assemblies through one source from a single manufacturer.

D. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of automatic entrance door assemblies and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrances serving as a required means of egress.

1.8 PROJECT CONDITIONS

A. Field Measurements: General Contractor shall verify openings to receive automatic entrance door assemblies by field measurements before fabrication and indicate measurements on Shop Drawings.
B. Mounting Surfaces: General Contractor shall verify all surfaces to be plumb, straight and secure; substrates to be of proper dimension and material.

C. Other trades: General Contractor shall advise of any inadequate conditions or equipment.

1.9 COORDINATION

A. Templates: Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic entrances to comply with indicated requirements.

B. Electrical System Roughing-in: Coordinate layout and installation of automatic entrance door assemblies with connections to power supplies, and security access control system.

C. System Integration: Integrate sliding automatic entrances with other systems as required for a complete working installation. Provide electrical interface control capability for activation of sliding automatic entrances by security access system on doors with electric locking.

1.10 WARRANTY

A. Automatic Entrances shall be free of defects in material and workmanship for a period of two (2) years from the date of substantial completion.

B. During the two (2) year warranty period the Contractor shall provide a factory-trained technician to perform service and affect repairs. A safety inspection shall be performed after each adjustment or repair and a completed inspection form shall be submitted to the Owner.

PART 2 - PRODUCTS

2.1 AUTOMATIC ENTRANCES

A. Manufacturer: Stanley Access Technologies; Dura-Glide™ 2000 Series sliding automatic entrances or approved equal.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.

B. Sealants and Joint Fillers: Performed under Division 7 Section "Joint Sealants".

2.3 AUTOMATIC ENTRANCE DOOR ASSEMBLIES

A. General: Provide manufacturer's standard automatic entrance door assemblies including doors, sidelights, framing, headers, carrier assemblies, roller tracks, door operators, activation and safety devices, and accessories required for a complete installation.

B. Sliding Automatic Entrances:
1. Single Slide Entrances:
   a. Configuration: One sliding leaf and one full sidelight.
   c. Emergency Breakaway Capability: Sliding leaf only.
   d. Mounting: Between jambs.

2. Bi-Parting Entrances:
   a. Configuration: Two sliding leaves and two full sidelights.
   c. Emergency Breakaway Capability: Sliding leaves only.
   d. Mounting: Between jambs.

2.4 COMPONENTS

A. Framing Members: Manufacturer's standard extruded aluminum reinforced as required to support imposed loads.
   1. Nominal Size: 1 3/4 inch by 4 1/2 inch (45 by 115 mm).
   2. Concealed Fastening: Framing shall incorporate a concealed fastening pocket, and continuous flush insert cover, extending full length of each framing member.

B. Stile and Rail Doors and Sidelights: Manufacturer's standard 1 ¾ inch (45 mm) thick glazed doors with extruded-aluminum tubular stile and rail members. Incorporate concealed tie-rods that span full length of top and bottom rails.
   2. Stile Design: Medium stile; 3 ½ inch (95 mm) nominal width.
   3. Bottom Rail Design: Minimum 10 inch (254 mm) nominal height.
   4. Muntin Bars: Horizontal tubular rail member for each door; 4 1/4 inch (108 mm) nominal height.

C. Glazing: Provided under Division 8 Section Glazing. All Glazing provided under separate section shall be as follows:
   1. Exterior Entrances: 1 inch (25 mm) tempered insulated glazing units with not less than 1/2 inch (13 mm) air space and 1/4” tempered glass.
   2. Interior Entrances: 1/4 inch (6 mm) tempered.

D. Headers: Fabricated from extruded aluminum and extending full width of automatic entrance door units to conceal door operators, carrier assemblies, and roller tracks. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
   1. Mounting: Concealed, with one side of header flush with framing.
   2. Capacity: Capable of supporting up to 220 lb (100 kg) per panel, up to four panels, over spans up to 14 feet (4.3 m) without intermediate supports.
SECTION 08422 – SLIDING AUTOMATIC ENTRANCES

E. Carrier Assemblies and Overhead Roller Tracks: Manufacturer's standard carrier assembly that allows vertical adjustment of at least 1/8 inch (3 mm); consisting of urethane with precision steel lubricated ball-bearing wheels, operating on a continuous roller track. Support panels from carrier assembly by load wheels and anti-riser wheels with factory adjusted cantilever and pivot assembly. Minimum two ball-bearing load wheels and two anti-rise rollers for each active leaf. Minimum load wheel diameter shall be 2 1/2 inch (64 mm); minimum anti-rise roller diameter shall be 2 inch (51 mm).

F. Thresholds: Manufacturer's standard thresholds as indicated below:

1. Exterior Bi-Parting Entrances: Continuous standard tapered extrusion square by bevel, with bevel to exterior.
2. Interior Bi-Parting Entrances: Continuous standard tapered extrusion square by bevel, with bevel to interior.
4. All thresholds to conform to details and requirements for code compliance.

G. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.

H. Signage: Provide signage in accordance with ANSI/BHMA A156.10.

2.5 DOOR OPERATORS

A. General: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, operation under normal traffic load for type of occupancy indicated.

B. Electromechanical Operators: Self-contained overhead unit powered by a minimum of 1/4 horsepower, permanent-magnet DC motor with gear reduction drive, microprocessor controller; and encoder.

2. Features:

   a. Adjustable opening and closing speeds.
   b. Adjustable open check and close check speeds.
   c. Adjustable hold-open time between 0 and 30 seconds.
   d. Obstruction recycle.
   e. On/Off switch to control electric power to operator.
   f. Energy conservation switch that reduces door-opening width.
   g. Closed loop speed control with active braking and acceleration.
   h. Adjustable obstruction recycle time delay.
   i. Self-adjusting stop position.
   j. Self-adjusting closing compression force.
   k. Onboard sensor power supply.
   l. Onboard sensor monitoring.
   m. Provide Switch to open/Switch to close operation.
   n. Fire alarm interface, configurable to safely open or close the entrance on signal from fire alarm system.

4. Drive System: Synchronous belt type.

C. Electrical service to door operators shall be provided under Division 16 Electrical. Minimum service to be 120 VAC, 5 amps.

2.6 ELECTRICAL CONTROLS

A. Electrical Control System: Electrical control system shall include a microprocessor controller and a high-resolution position encoder. The encoder shall monitor revolutions of the operator shaft and send signals to microprocessor controller to define door position and speed.

1. The high-resolution encoder shall have a resolution of not less than 1024 counts per revolution. Systems utilizing external magnets and magnetic switches are not acceptable.
2. Electrical control system shall include a 24 VDC auxiliary output rated at 1 amp.

B. Performance Data: The microprocessor shall collect, and store performance data as follows:

1. Counter: A non-resetable counter to track operating cycles.
2. Event Reporting: Unit shall include non-volatile event and error recording including number of occurrences of events and errors, and cycle count of most recent events and errors.
3. LED Display: Display presenting the current operating state of the controller.

C. Controller Protection: The microprocessor controller shall incorporate the following features to ensure trouble free operation:

2. Main Fuse Protection.
3. Electronic Surge Protection.
5. Resetable sensor supply fuse protection.

D. Soft Start/Stop: A “soft-start” “soft-stop” motor driving circuit shall be provided for smooth normal opening and recycling.

E. Obstruction Recycle: Provide system to recycle the sliding panels when an obstruction is encountered during the closing cycle. If an obstruction is detected, the system shall search for that object on the next closing cycle by reducing door closing speed prior to the previously encountered obstruction location, and will continue to close in check speed until doors are fully closed, at which time the doors will reset to normal speed. If obstruction is encountered again, the door will come to a full stop. The doors shall remain stopped until obstruction is removed and operate signal is given, resetting the door to normal operation.

F. Programmable Controller: Microprocessor controller shall be programmable and shall be designed for connection to a local configuration tool. Local configuration tool shall be a software driven handheld interface. The following parameters may be adjusted via the configuration tool.

1. Operating speeds and forces as required to meet specified ANSI/BHMA standard.
2. Adjustable and variable features as specified in 2.5, B, 2.
3. Reduced opening position.
4. Fail Safe/Secure control.
5. Firmware update.
6. Trouble Shooting
   a. I/O Status.
   b. Electrical component monitoring including parameter summary.
7. Software for local configuration tool shall be available as a free download from the sliding automatic entrance manufacturer’s internet site. Software shall be compatible with the Android® operating system platform (or approved equal system for substitute manufacturer).
8. Manual programming shall be available through local interface which has a two-digit display with a selection control including three push buttons.

2.7 ACTIVATION AND SAFETY DEVICES

A. Motion Sensors: Motion sensors shall be mounted on each side of door header to detect pedestrians in the activating zone, and to provide a signal to open doors in accordance with ANSI/BHMA A156.10. Units shall be programmable for bi-directional or uni-directional operation and shall incorporate K-band microwave frequency to detect all motion in both directions.

B. Presence Sensors: Presence sensors shall be provided to sense people or objects in the threshold safety zone in accordance with ANSI/BHMA A156.10. Units shall be self-contained, fully adjustable, and shall function accordingly with motion sensors provided. The sensor shall be enabled simultaneously with the door-opening signal and shall emit an elliptical shaped infrared presence zone, centered on the doorway threshold line. Presence sensors shall be capable of selectively retuning to adjust for objects which may enter the safety zone; tuning out, or disregarding, the presence of small nuisance objects and not tuning out large objects regardless of the time the object is present in the safety zone. The door shall close only after all sensors detect a clear surveillance field.

C. Photoelectric Beams: In addition to the threshold sensor include a minimum of two (2) doorway holding beams. Photoelectric beams shall be pulsed infrared type, including sender receiver assemblies for recessed mounting. Beams shall be monitored by electrical controls for faults and shall fail safe.

D. Presence Sensor Monitoring: Sliding automatic entrances control system shall include a means to verify the functionality of all active presence sensors in accordance with ANSI/BHMA A156.10. A detected fault shall cause automatic operation to cease until the fault is corrected.

2.8 HARDWARE

A. General: Provide units in sizes and types recommended by automatic entrance door and hardware manufacturers for entrances and uses indicated.

B. Emergency Breakaway Feature: Provide release hardware that allows panel(s) to swing out in direction of egress to full 90 degrees from any position in sliding mode. Maximum force to open panel shall be 50 lbf (222 N) according to ANSI/BHMA A156.10. Interrupt powered operation of panel operator while in breakaway mode.
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1. Emergency breakaway feature shall include at least one adjustable detent device mounted in the top of each breakaway panel to control panel breakaway force.

2. Limit Arms: Limit arms shall be provided to control swing of sliding panels on break-out; swing shall not exceed 90 degrees. Limit arms shall be spring loaded to prevent shock, and include adjustable friction damping.

C. Access Control Locking System: Provide access control locking hardware on sliding automatic entrances as follows:

1. System shall include:
   a. A fail-secure electric solenoid locking device with a self contained solid state electronic control factory mounted inside the header.
   b. Vertical rod exit devices incorporated into the sliding door panels that prevent breakout until rod is released.

2. When set for secure operation, the automatic sliding entrance(s) shall electrically latch in the closed position preventing door panels from sliding manually, returning the system to its locked status.

3. During a power interruption:
   a. The solenoid lock shall be engaged, preventing the doors from sliding manually.
   b. Means of egress shall be accomplished by exit device. Exit device shall be concealed vertical rod tamper proof exit device with recessed flush mounted interior release hardware that shall prohibit manual breakout of door(s) from exterior. Flush mounted release hardware shall be concealed within the horizontal muntin bar.

D. Control Switch: Provide manufacturer’s standard header mounted rocker switches and door position switch to allow for full control of the automatic entrance door. Controls to include, but are not limited to:

1. One-way traffic
2. Reduced Opening
3. Open/Closed/Automatic

E. Power Switch: Sliding automatic entrances shall be equipped with a two position “On/Off” illuminated rocker switch to control power to the door.

F. Sliding Weather Stripping: Manufacturer's standard replaceable components complying with AAMA 701; made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

G. Weather Sweeps: Manufacturer's standard adjustable nylon brush sweep mounted to underside of door bottom.

2.9 FABRICATION

A. General: Factory fabricates automatic entrance door assembly components to designs, sizes, and thickness indicated and to comply with indicated standards.
1. Form aluminum shapes before finishing.
2. Use concealed fasteners to greatest extent possible.
   a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
   b. Reinforce members as required to receive fastener threads.

B. Framing: Provide automatic entrances as prefabricated assemblies.
   1. Fabricate tubular and channel frame assemblies with manufacturer's standard mechanical or welded joints. Provide sub-frames and reinforcement as required for a complete system to support required loads.
   2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
   3. Form profiles that are sharp, straight, and free of defects or deformations.
   4. Prepare components to receive concealed fasteners and anchor and connection devices.
   5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.

E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated.

F. Hardware: Factory install hardware to the greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site.

2.10 ALUMINUM FINISHES

A. General: Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designing finishes. Finish designations prefixed by AA comply with system established by Aluminum Association for designing finishes.

B. All Four (4) Interior Suite Doors shall have Class II, Clear Anodic Finish: AA-M12C22A31 Mechanical Finish: as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.40 mils minimum complying with AAMA 611-98, and the following:
   1. AAMA 607.1
   2. Applicator must be fully compliant with all applicable environmental regulations and permits, including wastewater and heavy metal discharge.
   3. Provide clear anodic finish for interior single slide entrances.

C. The Exterior Door and Vestibule Door shall have Superior-Performance Organic Finish: AA-C12C40R1x Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating.
1. Fluoropolymer Three-Coat System: Manufacturer’s standard three-coat, thermocured system; including but not limited to mica, metallic, and bright white; consisting of inhibitive primer and fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight.

2. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

3. Minimum dry film thickness shall be 1.2 mils.

4. Color and Gloss: As selected by Architect from manufacturer’s standard colors and gloss for paint system specified.


PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Do not install damaged components. Fit frame joints to produce joints free of burrs and distortion. Rigidly secure non-movement joints.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.

C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 Sections.

D. Glazing: Performed under Division 8 Section "Glazing" in accordance with sliding automatic entrance manufacturer’s instructions.

E. Sealants: Comply with requirements specified in Division 7 Section "Joint Sealants".

3.3 FIELD QUALITY CONTROL

A. Testing Services: Factory Trained Installer shall test and inspect each automatic entrance door to determine compliance of installed systems with applicable ANSI standards.

3.4 ADJUSTING

A. Adjust door operators, controls, and hardware for smooth and safe operation, for tight closure, and complying with requirements in ANSI/BHMA A156.10.
3.5 CLEANING AND PROTECTION

A. Clean glass and aluminum surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish. Comply with requirements in Division 8 Section “Glazing”, for cleaning and maintaining glass.
PART 1 - GENERAL

1.1 SUMMARY:

Section includes requirements for daylighting skylight insulated translucent panel system as shown and specified herein.

1.2 WORK INCLUDED:

A. Design, engineer, manufacture and installation of two panels insulated translucent skylights panel system. An assembly of two independent insulated single glazing polycarbonate panels in one integrated daylighting panel assembly, incorporated into a complete aluminum framed system that has been tested and warranted by the manufacturer as a single source system. Design shall provide for the replacement of the exterior panel using tools, independently of the interior single panel and without exposing the interior or compromising the weather tightness or interfering with the normal working functions of the building. The interior single insulated panel remains intact for the life of the building envelope. Single panel extruded polycarbonate cellular or fiberglass sandwich panel systems will not meet these requirements and are not acceptable.

B. All anchors, brackets, and hardware attachments necessary to complete the specified structural assembly, weatherability and water-tightness performance requirements. All flashing up to but not penetrating adjoining work are also required as part of the system and shall be included.

C. Trained and factory authorized labor with supervision to complete the entire panel installation.

1.3 QUALITY ASSURANCE

A. The manufacturer shall be responsible for the configuration and fabrication of the complete panel system, in accordance with the requirements of this specification.

1.4 SUBMITTALS

A. Submit shop drawings and color samples in accordance with section 01300 – Submittals.

B. Provide a certification letter that the glazing panels have been evaluated and listed by recognized building code evaluation organization: International Council Evaluation Service Inc (ICC-ES)

C. Provide a certification letter that the materials and products were manufactured by a company continuously and regularly employed in the manufacturing, engineering, and designing, stocking and building of skylights using the specified material and system for a period of at least ten (10) years. Manufacturers shall provide a list of at least ten (10) projects having been in place a minimum of ten (10) years, with similar size, scope, climate and type.
D. Provide a list of projects and contacts stating that the installer is a factory-approved installer who has been in the business of erecting similar material for at least five (5) consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

E. Manufacturer shall submit written guarantee accompanied by substantiating data, stating that the products to be furnished are in accordance with or exceed these specifications.

F. The manufacturer shall submit certified test reports made by an independent organization. Reports shall verify that the material will meet all performance requirements of this specification. Previously completed test reports will be acceptable if they are indicative of products used on this project. Test reports required are:

1. Self-Ignition Temperature (ASTM 1929-3)
2. Smoke Density (ASTM D-2843)
3. Burning Extent (ASTM D-635)
4. Interior Flame Spread (ASTM E-84)
5. Class C roof construction per ASTM E108, FM 4470, NFPA 256, UBC 32-7, ULC-S107, UL 790
6. Color Difference (ASTM D-2244-85)
7. Tests on a weathered system after approximately 10 years of actual exposure in Florida field conditions. Tests shall include:
   a. Uniform static air pressure per ASTM 330
   b. Impact loading per ASTM E695
   c. Cyclic static air pressure and missile impact level D per ASTM 1886 & ASTM E1996.
8. Weathering Evaluation before and after exposure to 300°F, 25 minutes include Light Transmission and Color Change, per ASTM E-1175, and ASTM D-2244 respectively.
9. Large Missile Test - Impact Resistance per SFBC PA 201-94
10. Impact Loading per ASTM E695
11. Insulation’s ‘U’ value - Center of Glazing per NFRC100.
12. Insulation’s ‘U’ value for skylight system, glazing and aluminum framing, per NFRC 100 & NFRC 700 certification.
13. Visible light Transmission (VT) per ASTM E972 & ASTM E1084
14. Solar Heat Gain Coefficient (SHGC) based on tests or calculations which are based on tests per methodology and procedure given in the NFRC/Calorimeter Standard.
15. Maximum air infiltration rate, for fenestration assemblies per NFRC400 or ASTM E283
16. Water Penetration (ASTM E-331)
17. Load Bearing Capability (ASTM E-330-97)
18. Performance of exterior windows, curtain walls when impacted by wind-borne debris per ASTM E 1996-02, Level D
19. Haze per ASTM D 1003 for glare measurement.
20. ICC evaluation service report for compliance with IBC building code for polycarbonate glazing as an approved light transmission plastic with CC1 rating per chapter 26, and class A interior finish glazing per chapter 8.
SECTION 08450 – INSULATED TRANSLUCENT SKYLIGHT SYSTEM

G. MAINTENANCE DATA: The manufacturer shall provide recommended maintenance procedures, schedule of maintenance and materials required or recommended for maintenance.

H. Submit Installer Certificate signed by installer, certifying compliance with project qualification requirements.

1.5 WARRANTY: Provide these five (5) documents as a Shop Drawing Submission.

A. Provide a single source skylight system manufacturer warranty against defective materials and fabrication. Submit manufacturer’s written warranty agreeing to repair skylight system work, which fails in materials within five (5) years from date of substantial completion.

B. Provide single source skylight’s manufacturer 10-year glazing panel warranty. Third party warranty for glazing panels shall not be acceptable. Glazing warranty to include:

   1. Change in light transmission of no more than 6% per ASTM D-1003
   2. No delamination of panel affecting appearance, performance or structural integrity of the panel or the system
   3. Thermal aging - the light transmission and the color shall not change after exposure to heat of 300°F for 25 minutes (when measured per ASTM D-1003 and ASTM D-2244 respectively).

C. In addition to and separate from the manufacturer’s warranty, provide an installer’s written warranty agreeing to repair installation workmanship, defects and leaks within two years from date of Substantial Completion.

D. Provide Signed and Sealed Structural Calculations and Drawings from a New Jersey Licensed Professional Engineer meeting or exceeding the design requirements and all applicable codes including the IBC 2015 New Jersey Edition.

E. EXPOSED ALUMINUM FINISH: CPICRF™ - PREMIUM PLUS 70% base resin PVDF wet paint per AAMA-2605 non-exotic, non-metallic with 20 year warranty or approved equal.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The Basis of design and performance criteria of this job are based on the Quadwall – 2 panel skylight systems as manufactured by CPI Daylighting, Inc. Phone: (800) 759-6985, Fax (847) 816-0425 Website: www.cpidaylighting.com

B. Other approved manufacturer’s will be reviewed in accordance with Specification Section 01300 – Submittals.
2.2 TRANSLUCENT PANEL PERFORMANCE AND APPEARANCE

A. Panel construction for Longevity and Resistant to Buckling and Pressure:
   1. Translucent panels must be constructed of tight cell sizes not exceeding \(0.18\)\". Wide cell I size exceeding \(0.18\)\" shall not be acceptable.
   2. The translucent panel shall include an integral extruded tight-cell structural core. The panel's exterior skins shall be connected with supporting continuous ribs, perpendicular to the skins, at a spacing not to exceed \(0.18\)\" (truss-like construction). In addition, the space between the two exterior skins shall be divided by multiple parallel horizontal surfaces, at a spacing not to exceed \(0.18\)\".

B. Translucent Skylight Panel - Two Panel Assembly:
   1. Design, engineer, manufacture and installation of two panel insulated translucent skylight system. An assembly of two independent insulated single glazing polycarbonate panels in one integrated daylighting panel assembly, incorporated into a complete aluminum framed system that has been tested and warranted by the manufacturer as a single source system. Design shall provide for the replacement of the exterior panel using tools, independently of the interior single panel and without exposing the interior or compromising the weather tightness or interfering with the normal working functions of the building. The interior single insulated panel remains intact for the life of the building envelope. Single panel extruded polycarbonate cellular or fiberglass sandwich panel systems will not meet these requirements and are not acceptable.
   2. Panel glazing assembly thickness shall be a minimum [4" two panel system with concealed interlocking connector/H battens]. Minimum thickness of the exterior and the interior single panels shall be 0.315" thick each.

C. Thermal and Solar Performance:
   1. Insulation “U” Value performance per NFRC100 & 700, is required by the IBC/IECC/ASHRE energy code. Such performance values must be certified and labeled by NFRC. Labels shall be displayed on the product. NFRC certified and labeled products shall be published in the Certified Products Directory (CPD) on the NFRC official web site.
   2. U value for standard panel assembly with no bat or aerogel insulation, Center of Glazing per NFRC 100: 0.23
   3. U value for panel system assembly with no bat or aerogel insulation and including skylight aluminum framing per NFRC100 & NFRC700: 0.31 for mill finish frame
   4. Visible Light Transmission Center of Glass (V.T. %) 23% per ASTM E972 ASTM & E1084.
   5. Solar Heat Gain Coefficient (SHGC) [32] independently tested or calculated based on testing per methods and procedures given in the NFRC Calorimeter
   6. Standard Color: Blue over Ice white matte
D. Translucent Panel Joint System:
1. Panel shall be extruded in one single formable length. Transverse connections are not acceptable.
2. The panels should be manufactured with grip-lock double tooth upstands that are integral to the unit. The upstands shall be 90 degrees to the panel face (standing seam dry glazed concept). Welding or gluing of upstands or standing seam is not acceptable.
3. The H battens shall have a grip-lock double tooth locking mechanism to ensure maximum uplift capability.
4. The metal retention clip shall be configured with a 0.4" wide top flange that extends continuously across the web from end to end and from side to side. To allow safety factor, the clip must be tested to meet a wind uplift standard of 90 PSF per ASTM E330.
5. Water Penetration: No water penetration of the panel H joint connection length at test pressure of 6.24 PSF per ASTM E-331
6. Free movement of the panels shall be allowed to occur without damage to the weather tightness of the completed system.

E. Flammability:
1. The exterior and interior panels shall be an approved light transmitting panel with a CC1 fire rating classification per ASTM D-635. Flame spread no greater than 25 per ASTM E-84. Smoke density no greater than 75 per ASTM D2843 and a minimum self-ignition temperature of 1000°F per ASTM 1929.
2. Interior flame spread classification of Class A per ASTM E84.
3. The translucent panel shall be rated Class C per ASTM E108, FM 4470, NFPA 256, UBC 32-7, ULC-S107, UL 790 roof construction.

F. Impact Resistance - the panels shall pass the following tests:
2. ASTM E 695 - Impact loading per for 500 ft. lbs.
3. ASTM E-1996-02 - Must comply with standard specification for performance of exterior windows or curtain walls when impacted by windborne debris at level D and after cyclic wind loading at the specified design load.

G. OSHA Life Safety Standards 29 CFR 1926.502 (i) (2) and 29 CFR 1910.23 (e) (8):
SECTION 08450 – INSULATED TRANSLUCENT SKYLIGHT SYSTEM

H. Cyclic Wind Load:

1. Translucent Panels shall be tested for cyclic wind loads and impact resistance per ASTM E 1886-97 and ASTM E 1996-02 at test load to verify the positive and negative design loads and level D impact.

I. Weatherability:

1. The light transmission shall not decrease more than 6% as measured by ASTM D-1003 over 10 years, or after exposure to temperature of 300°F for 25 minutes (thermal aging performance standard).

2. The weathering performance should be justified by successful testing of the glazing panel’s performance after exposure to actual Florida weather conditions for approximately 10 years in comparison to a new panel assembly. This performance must be demonstrated by providing independent lab test reports for the exposed and a new panel assembly of 6’ wide x 12’ long for:
   a. ASTM 330 - Uniform static air pressure per at negative load of -105psf and positive load of 130psf.
   b. ASTM E695 - Impact loading per of 500 ft.-l bs.
   c. ASTM 1886 & ASTM E1996- Cyclic static air pressure at 65psf and impact level D

3. The weathering performance should be justified by successful testing of the glazing panel’s performance after exposure to actual Florida weather conditions for approximately 10 years in comparison to a new panel assembly. This performance must be demonstrated by providing independent lab test reports for the exposed and a new panel assembly of 6’ wide x 12’ long for:
   a. ASTM 330 - Uniform static air pressure per at negative load of -105psf and positive load of 130psf.
   b. ASTM E695 - Impact loading per of 500 ft.-lbs.
   c. ASTM 1886 & ASTM E1996- Cyclic static air pressure at 65psf and impact level D Test results must show that there is no deterioration in performance for the 10 year’s exposed panels versus a new panel

4. Panels must be manufactured from polycarbonate resin with a permanent, co-extruded ultra-violet protective layer. Post-applied coatings or films of dissimilar materials are unacceptable.

5. The faces shall not become readily detached when exposed to temperatures of 300°F and 0°F for 25 minutes.

6. The panel shall not change color more than 4.0 units DELTA-E per ASTM D2244 after 60 months outdoor weathering in Arizona as determined by an average of at least two samples.

7. Thermal aging - the interior and exterior panel shall not change color in excess of 0.75 Delta E per ASTM D2244 and shall not darken more than 0.3 units Delta L per ASTM D2244 and shall show no cracking or crazing when exposed to 300°F for 25 minutes.

8. Panel shall be factory sealed at the sill to restrict dirt ingress.

J. Glare and Diffused Light Transmission:

1. To avoid glare per IECC requirements, the panels shall have a matte finish with a minimum Haze measurement of 90% per ASTM D1003.
2.3 METAL FRAME STRUCTURE

A. Design criteria shall be:
   1. Per ASCE 7-10

B. The skylight framing is designed to be self-supporting between the support constructions. The deflection of the structural framing members in a direction normal to the plane of the glazing, when subjected to a uniform load deflection, shall not exceed L/60 for the unsupported span. The skylight will impose reactions to the support construction. All adjacent and support construction must support the transfer of all loads including horizontal and vertical, exerted by the skylight. Design or structural engineering services for the supporting structure or building components is not included in the skylight scope of this section.

C. Water Penetration: The metal framed skylight panels shall allow no water penetration at a minimum differential static pressure of 6.24 lbs. per SQF per AAMA 501 pressure difference recommendations and as demonstrated by prior testing of typical framing sample per ASTM E-331.

D. Water test of metal frame structure shall be conducted according to procedures in AAMA 501.2.

E. Maximum air infiltration rate for fenestration of the two panel assemblies of skylight shall be per NFRC 400.

2.4 METAL MATERIALS

A. Extruded Aluminum shall be ANSI/ASTM B221; 6063-T6: 6063-T5 or 6005-T5.

B. Flashing:
   1. 5005 H34 aluminum
   2. Sheet metal flashings/closures/claddings are to be furnished shop formed to profile - when lengths exceed 10 ft. in nominal 10-ft lengths. Field trimming of the flashing and field forming the ends is necessary to suit as-built conditions. Sheet metal ends are to overlap at least 6-in. to 8-in., set in a full bed of sealant and riveted if required.

C. All Fasteners for aluminum framing to be stainless steel or cadmium plated steel, excluding the final fasteners to the building.

D. EXPOSED ALUMINUM FINISH CPICRF™ - PREMIUM PLUS 70% base resin PVDF wet paint per AAMA-2605 non-exotic, non-metallic with 20-year warranty or approved equal.
SECTION 08450 – INSULATED TRANSLUCENT SKYLIGHT SYSTEM

2.5 Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below and certified and labeled according to NFRC 100.

A. Thermal Transmittance (U-Factor): Fixed panel and mill finish aluminum framing whole assemblies shall have U-factor of not more than 0.31 Btu/sq. ft. x h x deg F (1.76 W/sq. m x K) sloped application as determined according to NFRC 100.

B. Solar-Heat-Gain Coefficient (SHGC): Panel assembly shall have an SHGC of no greater than .41 as determined according to NFRC 200.

C. Visible Light Transmittance (VT): 41% or greater according to NFRC 202

D. Air Infiltration: Maximum air leakage through fixed glazing and skylight framing assemblies of 0.30 cfm/sq. ft.

PART 3 - EXECUTIONS

3.1 EXAMINATION

A. General Contractor to verify when structural support is ready to receive all work in this section and to convene a Pre-Installation Conference at least one week prior to commencing work of this Section. Attendance required of General Contractor, skylight installer and all parties directly affecting and effected by the work of this section.

B. All submitted opening sizes, dimensions and tolerances are to be field verified by general contractor unless otherwise stipulated.

C. Installer shall examine area of installation to verify readiness of site conditions. Notify general contractor about any defects requiring correction. Do not work until conditions are satisfactory.

3.2 INSTALLATION

A. Install components in strict accordance with manufacturer’s instructions and approved shop drawings. Use proper fasteners, caulking and hardware for material attachments as specified.

B. Use methods of attachment to structure allowing sufficient adjustment to accommodate tolerances.

C. Remove all protective coverings on panels immediately after installation.

3.3 CLEANING

A. Follow manufacturer’s instructions when washing down exposed panel surfaces using a solution of mild detergent in warm water that is applied with soft, clean wiping cloths. Always test a small area before applying to the entire area.
SECTION 08450 – INSULATED TRANSLUCENT SKYLIGHT SYSTEM

B. Follow strict panel manufacturer guidelines when removing foreign substances from panel surfaces requiring mineral spirits or any solvents that are acceptable for use. Always test a small sample to validate compliance before applying to the entire glazing panels.

C. Installers shall leave panel system clean at completion of installation. Final cleaning is by others upon completion of project, following manufacturer’s cleaning instructions.

END OF SECTION
SECTION 08710 - FINISH HARDWARE

Part 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Door Hardware, including electric hardware.
   2. Storefront and entrance door hardware.
   3. Gate Hardware.
   4. Digital keypad access control devices.
   5. Card Access control system.
   6. Power supplies for electric hardware.
   7. Remote button release hardware.
   8. Wiring and riser diagrams for electric hardware.

B. Specific Omissions: Hardware for the following is specified or indicated elsewhere.

   1. Windows.
   2. Cabinets, including open wall shelving and locks.
   3. Signs, except where scheduled.
   4. Toilet accessories, including grab bars.
   5. Installation.
   6. Rough hardware.
   7. Folding partitions, except cylinders where detailed.

1.2 REFERENCES:

A. Use date of standard in effect as of Bid date.
B. American National Standards Institute – ANSI 156.18 – Materials and Finishes.
C. ANSI A117.1 – Specifications for making buildings and facilities usable by physically handicapped people.
D. ADA – Americans with Disabilities Act of 1990
E. BHMA – Builders Hardware Manufacturers Association
F. DHI – Door and Hardware Institute
G. NFPA – National Fire Protection Association

   1. NFPA 80 – Fire Doors and Windows
   3. NFPA 105 – Smoke and Draft Control Door Assemblies
   4. NFPA 252 – Fire Tests of Door Assemblies

H. UL – Underwriters Laboratories

   1. UL10C – Fire Tests of Door Assemblies (Positive Pressure)
   2. UL 305 – Panic Hardware
SECTION 08710 - FINISH HARDWARE

I. WHI – Warnock Hersey Incorporated
J. SDI – Steel Door Institute
K. WDI – Wood Door Institute
L. AWI – Architectural Woodwork Institute
M. NAAM – National Association of Architectural Metal Manufacturers

1.3 SUBMITTALS & SUBSTITUTIONS

A. SUBMITTALS: Submit six copies of schedule per Division 1. Organize vertically formatted schedule into “Hardware Sets” with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:

1. Type, style, function, size, quantity and finish of hardware items.
   Use BHMA Finish codes per ANSI A156.18.
2. Name, part number and manufacturer of each item.
3. Fastenings and other pertinent information.
4. Location of hardware set coordinated with floor plans and door schedule.
5. Explanation of abbreviations, symbols, and codes contained in schedule.
6. Mounting locations for hardware.
7. Door and frame sizes, materials and degrees of swing.
8. List of manufacturers used and their nearest representative with address and phone number.
9. Catalog cuts.
10. Manufacturer’s technical data and installation instructions for electronic hardware.
11. Date of jobsite visit.

B. Bid and submit manufacturer’s updated/improved item if scheduled item is discontinued.

C. Make substitution requests in accordance with Division 1. Include product data and indicate benefit to the Project. Furnish operating samples on request.

   1. Items listed with no substitute manufacturers have been requested by Owner to meet existing standard.

D. Furnish as-built/as-installed schedule with closeout documents, including keying schedule, wiring/riser diagrams, manufacturers’ installation, adjustment and maintenance information, and supplier’s final inspection report.

1.4 QUALITY ASSURANCE:

A. Qualifications:

   1. Hardware supplier: direct factory contract supplier who employs a certified architectural hardware consultant (AHC), available at reasonable times during course Work for project hardware consultation to Owner, Architect and Contractor.
      a. Responsible for detailing, scheduling and ordering of finish hardware.
SECTION 08710 - FINISH HARDWARE

B. Hardware: New, free of defects, blemishes and excessive play. Obtain each kind of hardware (latch and locksets, exit devices, hinges and closers) from one manufacturer.

C. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.

D. Fire-Rated Openings: In compliance with NFPA 80. Hardware UL10C/UBC-7-2 (positive pressure) compliant for given type/size opening and degree of label. Provide proper latching hardware, non-flaming door closers, approved-bearing hinges, plus resilient and required intumescent seals. Furnish openings complete.

1. Note: scheduled seals may exceed selected door manufacturer’s requirements. See 2.6.E for clarification.

E. Pre-Installation Meetings: Initiate and conduct with supplier, installer and related trades, coordinate materials and techniques, and sequence complex hardware items and systems installation. Convene at least one week prior to commencement of related work.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Delivery: coordinate delivery to appropriate locations (shop or field).

1. Permanent keys and cores: secured delivery direct to Owner’s representative.

B. Acceptance at Site: Items individually packaged in manufacturers’ original containers, complete with proper fasteners and related pieces. Clearly mark packages to indicate contents, locations in hardware schedule and door numbers.

C. Storage: Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.

1.6 PROJECT CONDITIONS:

A. Where exact types of hardware specified are not adaptable to finished shape or size of members requiring hardware, provide suitable types having as nearly as practical as the same operation and quality as type specified, subject to Architect’s approval.

B. Where electronic hardware and its related components are required: It shall be the responsibility of the Electrical Contractor to provide all necessary components, conduits, electrical boxes, wire, relays, modules and power supplies as required for a complete and functioning system/component.
SECTION 08710 - FINISH HARDWARE

1.7 SEQUENCING AND COORDINATION:

A. Coordinate with concrete.

B. Reinforce walls.

C. Coordinate finish floor materials and floor-mounted hardware.

D. Conduit and raceways as needed for electrical, electronic and electro-pneumatic hardware items. Fire/life-safety system interfacing. Point-to-point wiring diagrams plus riser diagrams to related trades.

E. Furnish manufacturer templates to door and frame fabricators.

F. Use hardware consultant to check Shop Drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation.

1. Confirm that door manufacturers furnish necessary UBC-7-2 compliant seal packages.

1.8 WARRANTY:

A. Part of respective manufacturers’ regular terms of sale. Provide manufacturers’ warranties:

1. Closers: Ten years mechanical, two years electrical.
2. Exit Devices: Three years.
3. Hinges: Life of Building.
4. Other Hardware: Two years.

1.9 COMMISSIONING:

A. Test door hardware operation with climate control system and stairwell pressurization system both at rest and while in full operation.

B. Test electrical, electronic and electro-pneumatic hardware systems for satisfactory operation.

C. Test hardware interfaced with fire/life-safety system for proper operation and release.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Listed acceptable alternate manufacturers: submit for review products with equivalent function and features of scheduled products. Approved equal manufacturers will be considered in accordance with Specification Section 01300 – Submittals.
SECTION 08710 - FINISH HARDWARE

ITEM: MANUFACTURER: ACCEPTABLE SUB:

Hinges (IVE) Ives Bommer, Stanley
Continuous Hinges (IVE) Ives Zero, Stanley
Key System (MED) Medeco X4 Approved Equal
Locks (YAL) Yale Approved Equal
Exit Devices (VD) Von Duprin Approved Equal
Closers (LCN) LCN Approved Equal
Overhead Stops (GLY) Glynn-Johnson Approved Equal
Flush Bolts (IVE) Ives DCI, BBW
Silencers (IVE) Ives Rockwood, BBW
Kickplates (IVE) Ives Rockwood, BBW
Thresholds (NGP) Nat'l Guard NGP, Reese
Seals & Bottoms (NGP) Nat'l Guard NGP, Reese
Bi-Fold Door Hdw. (JHN) Johnson Approved Equal

B. Provide hardware items required to complete the work in accordance with these specifications and manufacturers’ instructions.

1. Include items inadvertently omitted from this specification. Note these items in submittal for review.
2. Where scheduled item is now obsolete, bid and furnish manufacturers updated item at no additional cost to the project.
3. Where hardware items may require trim rings, cams, tailpieces, blocking rings, mounting plates, etc. it is required that all hardware be optimally installed for safety, durability, and that manufacturer’s instructions are followed. In addition, all doors and frames regardless of material shall be confirmed to be able to properly accommodate door hardware installation, mounting, and operation.

2.2 HANGING MEANS:

A. Conventional Hinges: Hinge open widths minimum, but, of sufficient throw to permit maximum door swing. Steel or stainless steel pins and concealed bearings.

1. Three hinges per leaf to 7 foot, 6 inch height. Add one for each additional 30 inches in height, or any fraction thereof.
2. Extra heavy weight hinges on doors over 3 foot, 5 inches in width.
4. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.
5. Provide shims and shimming instructions for proper door adjustment.

B. Continuous Hinges: Ives Aluminum Geared Continuous

1. UL 10C listed (90 minutes)
2. ANSI Certified-ANSI 156.25 Grade 2
3. Supports weights up to 450 lbs. 4’0” max. dr. width
4. Material to be extruded aluminum 6063-T6
5. Lengths- 83”, 85”, 95”, 120”- Custom Lengths available
SECTION 08710 - FINISH HARDWARE

6. Available Electric Modifications-EPT, TW, TWM, EC
7. All continuous geared hinges to be heavy duty-Amount of bearings varies by size
   83", 85"-32 bearings, 95"-36 bearings, 120"-47 bearings
8. Finishes Clear (CL)

2.3 LOCKSETS, LATCHSETS, DEADBOLTS:

A. Cylindrical Locksets and Latchsets:

1. Provide Yale Mortise Lockset PBCN-SL 8800 series to match College’s applications of lock functions. Provide as listed in Hardware Sets. Confirm the active trim design to ensure matching of existing style of rose, lever, and/or escutcheon of the facility. Approval of the hardware submittal by the Architect does not abate or mitigate the design matching requirement. Hardware supplier shall make a site visit to ensure hardware compatibility.

2.4 EXIT DEVICES/PANIC HARDWARE

A. General features:

1. Independent lab-tested 1,000,000 cycles.
3. ¾” throw deadlocking latchesbolts.
4. No exposed screws to show through glass doors.
5. Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.
6. Releasable with 32 lb. maximum pressure under 250 lb. load to the door.

B. Specific features:

1. Non-Fire Rated Devices: provide cylinder dogging, hex-key dogging not permitted
2. Lever Trim: Breakaway type, forged brass or bronze escutcheon min .130” thickness, match lockset lever design.
3. Concealed Cable vertical rod devices.
5. Impact recessed devices:
6. Delayed Egress Devices: Function achieved within single exit device component, including latch, delayed locking device, request-to-exit switch, nuisance alarm, remote alarm, key switch, indicator lamp, relay, internal horn, door position input, external inhibit input plus fire alarm input. NFPA 101 “Special Locking Arrangement” compliant.
7. Electrically Operated Devices: Single manufacturer source for electric latch retraction devices, electrically controlled trim, power transfers, power supplies, monitoring switches and controls.
SECTION 08710 - FINISH HARDWARE

2.5 CLOSERS

A. General: One manufacturer for closer units throughout the Work, including surface closers, high security closers, overhead concealed closers, floor closers, low-energy door operators and electromagnetic hold-open closers.

B. Surface Closers: (4011/4111)

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 10,000,000 cycles.
4. Thru-bolts and wood doors unless doors are provided with closer blocking. Non-sized and adjustable. Place closers inside building, stairs and rooms.
5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
6. Opening pressure: Exterior doors 8.5 lb., interior doors 5 lb., labeled fire doors 15 lb.
7. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
8. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
9. Exterior door closers: tested to 100 hours of ASTM B117 salt spray test, furnish data on request.
10. Exterior doors do not require seasonal adjustments in temperatures from 120 degrees F to −30 degrees F, furnish data on request.
11. Non-flaming fluid will not fuel door or floor covering fires.

2.6 OTHER HARDWARE

A. Automatic Door Operators and Accessories – LCN 9542 Series

B. Automatic Flush Bolts: Low operating force design, “LBR” type.

C. Overhead Stops: Stainless steel (100 & 450 & 900 series). Non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

D. Kick Plates: Four beveled edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of bronze or stainless steel to match other hardware.

E. Door Stops: Provide stops to protect walls, casework or other hardware.

1. Unless otherwise noted in Hardware Sets, provide wall type with appropriate fasteners. Where wall type cannot be used, provide overhead type.

F. Seals: Finished to match adjacent frame color. Resilient seal material: solid high-grade neoprene. UL label applied to seals on rated doors. Substitute products: certify that the products equal or exceed specified material’s thickness and durability. Proposed substitutions: submit for approval.
SECTION 08710 - FINISH HARDWARE

2. Non-corroding fasteners at in-swinging exterior doors.
3. Sound control openings: Use components tested as a system using nationally accepted standards by independent laboratories. Ensure that the door leaves have the necessary sealed-in-place STC ratings. Adhesive mounted components not acceptable. Fasten applies seals over bead of sealant.
4. Fire-rated Doors, Resilient Seals: UL10C/UBC-7-2 compliant. Coordinate with selected door manufacturers and selected frame manufacturer’s requirements. Where rigid housed resilient seals are scheduled in this section and the selected door manufacturer only requires an adhesive mounted resilient seal, furnish rigid housed seal at minimum, or both the rigid housed seal and the adhesive applied seal if necessary to fulfill door manufacturer’s requirement. Adhesive applied seal alone is deemed insufficient for this project where rigid housed seals are scheduled.
5. Fire-rated Doors, Intumescent Seals: Furnish fire-labeled opening assembly complete and in full compliance with UL10C/UBC-7-2. Furnished by selected door manufacturer, these seals vary in requirement by door type and door manufacture. Adhesive applied intumescent strips are not acceptable, use concealed-in-door-edge type or kerfed-in-frame type. Careful coordination required.

G. Automatic door bottoms: low operating force units. Doors with automatic door bottoms plus head and jamb seals cannot require more than two pounds operating force to open when closer is disconnected.

H. Thresholds: As scheduled and per details. Substitute products: certify that the products equal or exceed specified material’s thickness. Proposed substitutions: submit for approval.

1. Exteriors: Set in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements in Division 7 “Thermal and Moisture Protection”. Non-ferrous ¼ inch fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equivalent) Flat Head Sleeve Anchors (SS/FHSL).
2. Sound control openings: Set in bed of mastic sealant.

I. Fasteners: Generally, exposed screws to be Phillips or Robertson drive. Pinned TORX drive at high security areas. Flat head sleeve anchors (FHSL) may be slotted drive. Sheet metal and wood screws: full-thread. Sleeve nuts: full length to prevent door compression.

J. Silencers: Interior hollow metal frames, 3 for single doors, 4 for pairs of doors. Omit where adhesive mounted seal occurs. Leave no unfilled/uncovered pre-punched silencer holes.

2.7 FINISH:

A. Generally BHMA 626 Satin Chromium

1. Areas using BHMA 626 to have push-plates, pulls and protection plates of BHMA 630, Satin Stainless Steel, unless otherwise noted.
SECTION 08710 - FINISH HARDWARE

B. Door closers: factory powder coated to match other hardware, (BHMA 689) unless otherwise noted. Use Special Rust Inhibitive primer as listed on all closers and closer components exposed to environmental humidity.

C. Aluminum items: match predominant adjacent material. Seals to coordinate with frame color.

2.8 KEYING REQUIREMENTS:

A. Key System: Key to existing Medeco Keymark-X4 system
B. All cylinders and cores to be full sized interchangeable core except where noted for SFIC
C. Furnish all locks & cylinders with temporary construction cores.
D. Initiate and conduct meetings(s) with Owner’s Representative Paul Grasso to determine system keyway(s) and structure, Furnish Owner’s written approval of the system.

1. Furnish 12 construction keys.
2. Furnish 3 construction control keys.
3. Furnish 4 keys per change group.
4. Furnish 4 Key Blanks per core (these are for allowance purposes, obtain final cut keys as required by Owner, providing balance of key allowance as blank keys.
5. Furnish 5 Master Keys per group.
6. Furnish 3 Grand-Master Keys
7. Furnish 3 System Control Keys.

E. Key Cylinders: utility patented, 6-pin or 7 pin as determined by Owner’s representative Paul Grasso.
F. Cylinders/cores: keyed at factory of lock manufacturer where permanent records are maintained.
G. Furnish Yale blocking ring as indicated – stacked blocking rings not permitted. Blocking ring to be snug and proper size.
H. Permanent keys: secured shipment direct from point of origination to Owner.
I. Bitting List: Secured shipment direct from point of origination to designated Owner’s Representative upon completion.
J. Pinning List: Secured Shipment direct from point of origination to designated Owner’s Representative upon completion.
K. Furnish All keys Stamped with Industry Standard Keyset Symbol. (VKC) No Key Combinations or Bittings allowed on the key.
L. Furnish All Cylinders or Cores Engraved with Industry Standard Keyset Symbol in a concealed location.
M. Bitting and pinning lists provided on CD-ROM or other electronic format to Mr. Grasso.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS:

A. Factory trained, certified, and carries a factory-issued card certifying that person as a “Certified Installer”. Alternative: can demonstrate suitably equivalent competence and experience.
SECTION 08710 - FINISH HARDWARE

B. All Electronic Hardware including Electric Exit Devices, Automatic Operators, Electric Strikes, Power Supplies, Electric Power Transfers shall be coordinated with the Electrical Sub-Contractor.

3.2 PREPARATION:

A. Ensure that walls and frames are square and plumb before hardware installation.

B. Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes.

1. Notify Architect of any code conflicts before ordering material.
2. Where new hardware is to be installed near existing doors/hardware scheduled to remain, match locations of existing hardware.

C. Existing frames and doors scheduled to receive new hardware: carefully remove existing hardware, tag and bag, and turn over to Owner.

1. Patch and fill wood frames and doors with solid wood stock or dowel material before cutting for new hardware. Do not reuse existing screw holes -- fill and re-pilot.
2. Metal doors/frames: Weld or fasten with screws: filler pieces in existing hardware cut-outs and mortises not scheduled for re-use by new hardware. Leave surfaces smooth - no applied patches.

3.3 INSTALLATION

A. Install hardware per manufacturer’s instructions and recommendations. Do not install surface-mounted items until finishes have been completed on substrate. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate for proper installation and operation.

1. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
2. When hardware is to be attached to existing metal surface and insufficient reinforcement exists, use RivNuts, NutSerts or similar anchoring device for screws.

B. Locate floor stops not more than 4 inches from the wall.

C. Drill pilot holes for fasteners in wood doors and/or frames.

D. Lubricate and adjust existing hardware scheduled to remain. Carefully remove and give to Owner items not scheduled for reuse.

3.4 ADJUSTING

A. Initial Adjustment:
SECTION 08710 - FINISH HARDWARE

1. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

2. Adjust door closer sweep period so that from an open position of 70 degrees door will take at least 3 seconds to move to a point 3" from latch measured to leading edge of door.

B. Final Adjustment:

1. Return to Project during week prior to Substantial Completion and make final check and adjustment of hardware items.

2. Adjust hardware so doors operate in perfect order. Test and adjust hardware for quiet, smooth operation, free of sticking, binding, or rattling. Adjust closers for proper, smooth operation.

3. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

C. Six Month Adjustment:

1. Approximately six months after Date of Substantial Completion, installer shall perform following:
   a. Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware.
   b. Consult with, and instruct, Owner’s personnel on recommended maintenance procedures.
   c. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation.

D. Twelve Month Adjustment:

1. Approximately twelve months after Date of Substantial Completion, installer shall perform following:
   a. Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware.
   b. Consult with, and instruct, Owner’s personnel on recommended maintenance procedures.
   c. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation.

3.6 CLEANING

A. Exposed hardware shall be carefully cleaned by methods not injurious to finish, immediately preceding occupancy. Replace defective, damaged, or missing hardware.

B. Clean adjacent surfaces soiled by hardware installation.

C. Clean operating items as needed to restore proper function and finish.
SECTION 08710 - FINISH HARDWARE

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

3.8 PROTECTION

A. Provide final protection and maintain conditions that ensure door hardware shall be without damage or deterioration at time of Substantial Completion.

B. Protect door hardware items from abuse, corrosion and other damage until Owner accepts Project as complete.

3.9 HARDWARE SCHEDULES TO FOLLOW: PLEASE NOTE THAT THE HARDWARE SCHEDULE HAS BASIS OF DESIGN MANUFACTURERS LISTED. APPROVED EQUAL MANUFACTURERS WILL BE CONSIDERED IN ACCORDANCE WITH SPECIFICATION SECTION 01300 – SUBMITTALS.
SECTION 08710 - FINISH HARDWARE

ROWAN MEDICINE

HW SET: 001

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FINISH HARDWARE

08710-13
## SECTION 08710 - FINISH HARDWARE

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**FINISH HARDWARE**
**SECTION 08710 - FINISH HARDWARE**

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### SECTION 08710 - FINISH HARDWARE

**HW SET: 008**

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**FINISH HARDWARE**

08710-16
### SECTION 08710 - FINISH HARDWARE

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# SECTION 08710 - FINISH HARDWARE

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- BS2

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### SECTION 08710 - FINISH HARDWARE

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**FINISH HARDWARE**

08710-20
**SECTION 08710 - FINISH HARDWARE**

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08710-21
SECTION 08710 - FINISH HARDWARE

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## SECTION 08710 - FINISH HARDWARE

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- PROVIDE FACTORY POINT TO POINT WIRING DIAGRAMS
- PROVIDE RISER DIAGRAMS

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- PROVIDE FACTORY POINT TO POINT WIRING DIAGRAMS
- PROVIDE RISER DIAGRAMS

FINISH HARDWARE
## SECTION 08710 - FINISH HARDWARE

**HW SET: 025.2**

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- **A112**
- **A116**
- **D107**

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- **C119**
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**FINISH HARDWARE**
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**FINISH HARDWARE**

08710-26
### SECTION 08710 - FINISH HARDWARE

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FINISH HARDWARE

08710-27
### SECTION 08710 - FINISH HARDWARE

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**HW SET: 032**

**DOORS:**  
D117A

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**SECTIO**N 08710 - FINISH HARDWARE

HW SET: 033

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1 PROVIDE FACTORY POINT TO POINT WIRING DIAGRAMS

1 PROVIDE RISER DIAGRAMS

HW SET: 034

**DOORS:** NOT USED
### SECTION 08710 - FINISH HARDWARE

**HW SET: 035**

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1  Balance of Hardware by Door Manufacturer
1  Provide Factory Point to Point Wiring Diagrams
1  Provide Riser Diagrams
**SECTION 08710 - FINISH HARDWARE**

**HW SET: 037.1**

**DOORS:**
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1 PROVIDE FACTORY POINT TO POINT WIRING DIAGRAMS
1 PROVIDE RISER DIAGRAMS

**HW SET: 037.2**

**DOORS:**
E108.1

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FINISH HARDWARE
### SECTION 08710 - FINISH HARDWARE

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| E201 | E201.1 |

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### SECTION 08710 - FINISH HARDWARE

**HW SET: 038**

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**FINISH HARDWARE**

08710-33
### SECTION 08710 - FINISH HARDWARE

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### SECTION 08710 - FINISH HARDWARE

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FINISH HARDWARE 08710- 35
**SECTION 08710 - FINISH HARDWARE**

1 EA SALTO TO COORDINATE WITH F1/F2 FIRE ALARM CONTACTS – OWNER’S FIRE ALARM VENDOR TBD SAL
1 EA SALTO TO COORDINATE MAY NEED READER ON THE PUSH SIDE OF DOOR. TBD SAL

1 PROVIDE FACTORY POINT TO POINT WIRING DIAGRAMS
1 PROVIDE RISER DIAGRAMS

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## ECONOMIC DEVELOPMENT CENTER

HW SET: WF-001

NOT USED

HW SET: WF-002

**DOORS:**

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SECTION 08710 - FINISH HARDWARE

HW SET: WF-003

DOORS:
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FINISH HARDWARE 08710-39
## SECTION 08710 - FINISH HARDWARE

### HW SET: WF-004

### DOORS:

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**FINISH HARDWARE**

08710-40
### SECTION 08710 - FINISH HARDWARE

**HW SET: WF-005**

**DOORS:**

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**FINISH HARDWARE**

08710-41
SECTION 08710 - FINISH HARDWARE

HW SET: WF-006

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FINISH HARDWARE

08710- 42
### SECTION 08710 - FINISH HARDWARE

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FINISH HARDWARE 08710-43
## SECTION 08710 - FINISH HARDWARE

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**FINISH HARDWARE** 08710-44
## SECTION 08710 - FINISH HARDWARE

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1 PROVIDE FACTORY POINT TO POINT WIRING DIAGRAMS

1 PROVIDE RISER DIAGRAMS

**HW SET: WF-013**

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1 PROVIDE FACTORY POINT TO POINT WIRING DIAGRAMS

1 PROVIDE RISER DIAGRAMS

FINISH HARDWARE 08710-45
### SECTION 08710 - FINISH HARDWARE

**HW SET: WF-014**

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## SECTION 08710 - FINISH HARDWARE

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1 PROVIDE FACTORY POINT TO POINT WIRING DIAGRAMS

1 PROVIDE RISER DIAGRAMS

FINISH HARDWARE 08710-47
### SECTION 08710 - FINISH HARDWARE

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BALANCE OF HARDWARE BY DOOR MANUFACTURER

1 PROVIDE FACTORY POINT TO POINT WIRING DIAGRAMS

1 PROVIDE RISER DIAGRAMS

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**FINISH HARDWARE** 08710-48
SECTION 08710 - FINISH HARDWARE

1 EA  POWER SUPPLY                COORDINATE WITH OWNERS  600  TBD
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1 BALANCE OF HARDWARE BY DOOR
        MANUFACTURER
1 PROVIDE FACTORY POINT TO POINT
        WIRING DIAGRAMS
1 PROVIDE RISER DIAGRAMS

HW SET: WF-020

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1 PROVIDE FACTORY POINT TO POINT WIRING DIAGRAMS

1 PROVIDE RISER DIAGRAMS

END OF SECTION 08710

FINISH HARDWARE 08710- 50
SECTION 08800 – GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows
2. Doors.
3. Glazed curtain wall.

1.1 DEFINITIONS

A. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

B. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

C. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

D. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.2 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
SECTION 08800 – GLAZING

a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in 115 miles per hour at 33 feet (10 m) above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.

1) Basic Wind Speed: 100 MPH
2) Importance Factor: II (School).
3) Exposure Category: B.

b. Specified Design Snow Loads: 30 PSF, but not less than snow loads applicable to Project as required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7.0, "Snow Loads."

c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.

1) Load Duration: 60 seconds or less.

d. Minimum Glass Thickness for Exterior Lites: Not less than 1/4".

e. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick of thickness indicated.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite 1/4", 6.0 mm thick and a nominal 1/2-inch-12.7-mm-) wide interspace.
4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:

a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F (W/sq. m x K).

1.3 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.
B. Samples: 12-inch- (300-mm-) square, for each type of glass product indicated, other than monolithic clear float glass.

C. Glazing Schedule: Use same designations indicated on Drawings.

D. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer.

1.4 QUALITY ASSURANCE

A. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing according to ASTM C 1087, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:

B. Glazing for Fire-Rated Door Window Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257 and 16 CFR 1201.


D. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.


E. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the Insulating Glass Certification Council.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups.

1.5 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units
that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Ten years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified or approved equal.

2.2 GLASS PRODUCTS

A. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
2. Provide FT (fully tempered) float glass.

B. Coated Spandrel Float Glass: Float glass complying with other requirements specified and with the following:

1. Factory apply manufacturer's standard opacifier of the following material to coated second surface of lites, with resulting products complying with Specification No. 89-1-6 in GANA Tempering Division's "Engineering Standards Manual."
   a. Manufacturer's standard opacifier material
   b. Polyester film laminated to glass with solvent-based adhesive.


D. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.

1. Provide FT (fully tempered) float glass.
2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
4. Spacer Specifications: Manufacturer's standard spacer material and construction.
5. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
   a. Spacer Material: Aluminum with mill or clear anodic finish.
   b. Corner Construction: Manufacturer's standard corner construction.

2.3 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
   2. EPDM, ASTM C 864.
   4. Thermoplastic polyolefin rubber, ASTM C 1115.
   5. Any material indicated above.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
   1. Neoprene.
   2. EPDM.
   4. Thermoplastic polyolefin rubber.
   5. Any material indicated above.

2.4 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:
   1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
   3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

   1. Single-Component Neutral-Curing Silicone Glazing Sealants:
      a. Products:
         1) See Section 07920 - Joint Sealants.
SECTION 08800 – GLAZING

2) Type and Grade: S (single component) and NS (nonsag).
3) Class: 100/50.
4) Use Related to Exposure: NT (nontraffic).
5) Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

1. Type 1, for glazing applications in which tape acts as the primary sealant.
2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.7 FABRICATION OF GLAZING UNITS
SECTION 08800 – GLAZING

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.8 INSULATING GLASS UNITS

A. Passive Solar Low-E Insulating-Glass Units IG:

1. Product: Match the existing glazing at the Mathematics and Engineering Building (the Clock Tower Building).
2. Provide 1” IGU ½” clear tempered w/Solarban Z50 clear on #2 surface with ½” space and ¼” clear tempered glass.
3. Overall Unit Thickness and Thickness of Each Lite: 1” overall thickness, 1/4” interior and exterior sashes, ½” air space.
4. Interspace Content: Air.
5. Outdoor Lite: Class 2 float glass.
   a. Fully tempered

6. Indoor Lite: Class 1 (clear) float glass.
   a. Kind FT (fully tempered).

7. Low-E Coating: Pyrolytic or sputtered on second surface.
8. Visible Light Transmittance: 51 percent minimum.
9. Winter Nighttime U-Factor: 0.29 maximum.
10. Summer Daytime U-Factor: 0.27 maximum
11. Light to Solar Gain Ratio: 1-64
12. Shading Coefficient: 0.36
13. Exterior Reflectance: 8%
14. Solar Heat Gain Coefficient: 0.31

B. Acid Etched Spandrel Insulating-Glass Units:

1. Products by one of the following or approved equal:
   a. Walker Glass
   b. Guaradian
   c. Approved equal

2. Construction: Provide units that comply with requirements specified for insulating-glass units designated above for 1” overall thickness, ¼” interior and ¼” acid-etched glazing, ¼” air space except for indoor lite.

3. Glazing: Same as vision insulated unit for outdoor lite. ¼” acid etched (face 3) tempered glass unit for indoor lite.
   a. All sashes tempered glass
   b. Low-E Coating Location: Second surface.
   c. Color: Match vision insulated glass unit.
SECTION 08800 – GLAZING

PART 3 - EXECUTION

3.1 GLAZING

A. General: Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

1. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

2. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

3. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

4. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

5. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

6. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

7. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

B. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

1. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

2. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

3. Apply heel bead of elastomeric sealant.

4. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

5. Apply cap bead of elastomeric sealant over exposed edge of tape.

C. Gasket Glazing (Dry): Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
2. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

3. Install gaskets so they protrude past face of glazing stops.

D. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

   1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
   2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.2 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

B. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 08800
SECTION 08805 – INTERIOR DECORATIVE GLAZING

PART 1 – GENERAL

1.1 SUMMARY

A. Related Documents:
   1. Drawings and general provisions of the Subcontract apply to this Section.
   2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:
   1. Glass and glazing required throughout Project and not specified as a part of other Sections.

C. Related Sections:
   1. Division 01 Section "General Requirements."

D. Glass and glazing is specified with the following components. Unless otherwise noted, glass and glazing specified elsewhere shall conform to materials and glazing requirements and procedures specified in this Section.

1.2 REFERENCES

A. General:
   1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
   2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
   3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.


E. ANSI Z 97.1, "Safety Glass Test Requirements".

F. ASTM International.
   1. ASTM C864 Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
   2. ASTM C1036 Standard Specification for Flat Glass
   3. ASTM C1048 Standard Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass
SECTION 08805 – INTERIOR DECORATIVE GLAZING

4. ASTM E774    Standard Specification for the Classification of the Durability of Sealed Insulating Glass Units. (This standard is withdrawn and no replacement has been issued).

G. DD-G-1403.

H. Sealed Insulating Glass Manufacturers Association (SIGMA) Recommendations.

I. BAAQMD Regulation 8-51 - Adhesive and Sealant Products.

1.3 SYSTEM DESCRIPTION

A. Install each piece of glass watertight and airtight. Each installation shall withstand local, normal temperature changes, wind loading, impact loading (for operating sash and doors) without failure of any kind, including loss or breakage of glass, failure of sealants or gaskets to remain watertight, deterioration of glazing materials, and other defects of work.

B. Where no thickness of glass is given in the glass schedule, it shall be determined by glass manufacturer for the wind loads specified in the IBC 2015 New Jersey Edition.

1.4 SUBMITTALS

A. Product Data: Manufacturer’s product data, material safety data sheets, and specifications for installations indicated, listing specific materials proposed. Indicate completely, recommendations for use of primers, joint preparation and sealant dimensions, and shall state shelf life (from date of shipment by manufacturer to expiration date for use on a project) for the material. Provide necessary information required to translate batch number code into date of manufacture and to thereby determine the latest date of usage from manufacturer’s shelf life requirements.

B. Samples:

1. Samples 2-5/8 x 5 inch glass samples showing type, color, and pattern.

C. Certifications:

1. Certification that all insulating units furnished comply with Class CBA of ASTM E774 and the performance specified.

2. Certification that all sealants are fully compatible with the surfaces and finishes with which they are in contact.

D. Closeout Submittals: Material Safety Data: Sealant and adhesive quantity use for in accordance with requirements of BAAQMD Regulation 8-51.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Provide safety glass for locations subject to human impact as required by Building Code.
2. Safety glass: Tested and labeled to CPSC 16 CFR 1201. Safety film is not acceptable as alternative to tempered or laminated glass.

1.6 DELIVERY, STORAGE AND HANDLING

A. Package and deliver glass in manufacturer's sealed unopened containers, fully identified, and each pane clearly labeled with manufacturer's name and product designation.

B. Protect glass from damage and store in accordance with manufacturer's recommendations. Keep handling to a minimum. Protect edges of laminated and insulated glass from damage.

C. Glazing Sealants:

1. Deliver sealants and related accessories to the job site in factory sealed, unopened containers bearing manufacturer's name, product designation and batch number.
2. Store in unopened containers. Follow manufacturer's recommendations for storage temperatures and shelf life (see "Submittals" above).
3. Follow manufacturer's recommendations for handling products containing toxic materials. Keep flammable material away from heat, sparks and open flame. Use recommended solvents and cleaning agents for cleaning tools, equipment and skin.

1.7 ENVIRONMENTAL CONDITIONS

A. Perform no glazing operations when ambient temperature is at or below 40 deg F (4.4 deg C).

1.8 WARRANTIES

A. Laminated Glass: Warrant for 10 years from date of Substantial Completion of Project to be free from delamination and discoloration.

B. Glazing Sealants: Warrant for 10 years per sealant manufacturer's standard warranty of merchantable quality. Warranty shall certify that cured sealants:

1. Will perform as a watertight weatherseal.
2. Will not become brittle or crack due to weathering or normal expansion and contraction of adjacent surfaces.
3. Will not harden beyond a Shore A durometer of 50, nor soften below a durometer of 10.
4. Will not change color when used with compatible back-up materials.
5. Will not bleed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Glass Manufacturers: The Basis of design is S.A. Bendheim, Ltd. Approved equal manufacturers will be considered in accordance with Section 01300 – Submittals.
SECTION 08805 – INTERIOR DECORATIVE GLAZING

1. Textured Glass:
   b. Description: Linear, Clear. Low composite
   c. Type: Tempered.
   d. Thickness: ¼” inch.
   e. Edge treatment: Cut and seamed.

2. Tempered Glass
   a. Comply with ASTM C1048, ANSI Z97.1, and CPSC 16 CFR 1201, Category II
   b. Process in horizontal position so that inherent roller distortion will run parallel to building floor lines after installation

3. Glass Identification:
   a. Apply manufacturer's label indicating type and thickness to each light of glass. Show position of exterior face when installed, where applicable.
   b. Decorative Ribbed Glass (DGL-1) – Finish as selected from Manufacturer’s standard as indicated on Room Finish Schedule.
   c. Etch manufacturer’s label on each light of tempered or laminated glass.

B. Provide 1/2" Fully Tempered Laminated Glass: ASTM C 1172, and complying with other requirements specified and with the following:
   1. Interlayer: Polyvinyl butyral of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.

2.3 FABRICATION

A. Cut glass to full fit and play, consistent with glass and glazing material manufacturers’ recommendations and the requirements of the Drawings and References, Codes and Standards Article.

B. Follow code requirements and glass manufacturer's recommendations for minimum bite and edge and face clearances.

C. Cut lights to smooth straight edges, clean, free of nicks and flares; nipping not permitted.

D. Where glass edges (including cut openings) are required to be exposed, grind smooth and polish.

E. Tempered and heat strengthened glass shall be horizontally treated only. Fabrication and treatment shall, where at all possible, be such that roller distortion lines (where they may occur) will run horizontally (parallel to sill and head) after installation.

F. Glass Identification:
   1. Tempered and heat strengthened glass shall bear the manufacturer's identification as to type and thickness.
   2. Glazing in fire rated doors and fire rated windows shall bear UL classification marking in accordance with UL 9.
3. Manufacturer's and UL identifications for glazing shall be permanently etched so as to be visible after glass has been set in place and glazed.
4. Glass other than tempered, heat strengthened and UL-marked glass shall not have labels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect surfaces to receive glazing materials and report defects which might adversely affect the glazing work. Commencing work implies acceptance of surfaces as satisfactory.

B. Weep systems shall be open.

C. Surfaces shall be free of condensation and moisture.

D. Steel surfaces shall be primed and dry.

3.2 PREPARATION

A. Clean rebates and glazing reveals free of foreign matter, special coatings, dust, grease, projections and irregularities prior to setting glass. Solvents used for cleaning shall not etch or damage glass or metal surfaces.

B. Wipe glass free of dust and oil.

3.3 INSTALLATION

A. Conform to recommendations of glass manufacturer where such covers points not shown on Drawings or specified herein.

B. Remove "loose" stops furnished with the units and reinstall as a part of the glazing operation.

C. Handle lites so as to prevent nicks and flares on glass edges.

D. Install glass exceeding 1/8" thickness on identical setting blocks permanently mounted and centered at 1/4 points. If necessary to reduce deflection of horizontal supporting member, blocks may be placed at 1/8 points or with the nearest end 6" (whichever is greater) from edge of glass unit. Ensure that blocks are equidistant from centerline of glass. Do not obstruct weep holes.

E. Provide permanently mounted edge blocks at head and jambs of dry-glazed lights to prevent damage to glass edges during installation and lateral shifting of glass due to thermal and seismic loads and vibrations. Follow recommendations of Flat Glass Marketing Assn. Glazing Manual.

F. Set glass to maintain bite, edge and face clearance stipulated by code and the glass manufacturer.

G. Take special precautions to protect laminated glass edges from deterioration of vinyl interlayer by moisture.
H. Set interior non-wired glass in fixed stops with glazing tape one face.

I. Wire glass installed in metal frames and stops shall be embedded in metal sash putty, and all exposed joints between the metal and the glass struck and pointed.

J. Where butted glass without mullions is required, seal with silicone sealant in strict accord with sealant and glass manufacturer's directions. Set glass so that joint is plumb and glass edges are aligned to provide for a uniform joint width of 3/8" (max.). Mask edges of glass to confine sealant to joints and to avoid contact with either face. Use primers where so required. Neatly tool joints to slightly concave surface using recommended tooling agent. Remove masking from glass and clean glass surfaces completely free of sealant material.

K. Close and tightly seal all partly used sealant containers, and store protected in well-ventilated area at temperature recommended by sealant manufacturer.

3.4 FIELD QUALITY CONTROL

A. Test approximately 5 percent of total glazing system in locations which are typical of every joint condition and which can be inspected easily for leakage on opposite face. Conduct tests in presence of the Project Manager, who will determine actual percentage of joints to be tested and the actual period of exposure to water from hose, based upon extent of observed leakage or lack thereof.

B. Repair glazing installation at leaks or, where leakage is excessive, replace glazing sealants.

3.5 WASTE MANAGEMENT

A. Separate float glass and place in designated containers for recycling.

B. Separate tempered glass and place in designated containers for recycling.

C. Separate corrugated cardboard in accordance with the approved Waste Management Plan in Division 01 Section "Construction Waste Management", and place in designated containers for recycling.

D. Place used sealant containers in designated containers for legal disposal.

3.6 PROTECTION

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

B. Identification or caution markers shall not be applied to glass surfaces nor shall they be applied to metal surfaces in any way which would damage or stain the metal.

C. Replace glass broken or damaged prior to acceptance of Project. Costs occasioned by replacement shall be borne by those causing the damage.

3.7 GLASS SCHEDULE

A. Glass types are indicated on Drawings.

END OF SECTION 08805
1.1 SUMMARY

A. Related Documents:
   1. Drawings and general provisions of the Subcontract apply to this Section.
   2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:
   1. Window Film to be provide after the windows are installed on the First Floor of the Rowan Medicine Building.

1.2 SUBMITTALS

A. Product Data: Manufacturer's product data and specifications for installations indicated, listing specific materials proposed.

B. Samples:
   1. Provide an 8 1/2” x 11” installed sample of three (3) different levels of window frosting for the Owner to select one (1).

1.3 QUALITY ASSURANCE

A. The product shall be installed by a contractor who is approved by the Manufacturer and has Five (5) years of similar experience installing products by that manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING

A. Package and deliver film in sealed unopened containers, fully identified, and each package clearly labeled with manufacturer's name and product designation.

B. Protect film from damage and store in accordance with manufacturer's recommendations. Keep handling to a minimum.

1.5 ENVIRONMENTAL CONDITIONS

A. Do not install the film when ambient temperature is at or below 60 deg F and the permanent building systems are fully operational after final cleaning.

1.6 WARRANTIES

A. Provide a five (5) Year Warranty. The warranty shall include labor and material if there is a defect in the product or installation.

PART 2 - PRODUCTS
2.1 MANUFACTURERS

A. Manufacturers: The Basis of design is Sonera Window Art Frosted WA847-02. Approved equal manufacturers will be considered in accordance with Section 01300 – Submittals.

1. Window Film:

   b. Description: The window film shall be a matte translucent vinyl with a special finish designed to create a frosted look on the glass. It shall be designed to be used on flat or simple curved clear and translucent surfaces and for backlit graphics. It shall be suitable for interior and exterior application.
   c. Print Technology: UV
   d. Weight: 3 mil
   e. Fire Rating: Class A fire rated when tested in accordance with ASTM E-84 Tunnel Test.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean glazing so that it is free of foreign matter, special coatings, dust, grease, projections and irregularities prior to installing film. Solvents used for cleaning shall not etch or damage glass or metal surfaces.

B. Wipe glass free of dust and oil.

3.2 INSTALLATION

A. Conform to recommendations of the manufacturer.

B. Do not clean the film for 30 days after installation. When cleaning, use a soapy water solution such as dishwashing fluid and water sprayed into a clean, soft cloth to gently wipe down the film surface. Wipe dry with another clean, soft cloth. Do not use bristle brushes or abrasive sponges. NEVER USE HARSH CHEMICALS OR CLEANING AGENTS SUCH AS WINDEX. Do not spray any solution directly onto the film. Improper care and maintenance will void the warranty.

3.3 PROTECTION

A. Protect from damage due to subsequent construction operations.

END OF SECTION 08810
SECTION 08817 - FIRE RATED GLASS-CERAMIC GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire-rated glazing materials for Fire Resistance Rated Assemblies and for vision lights in fire-rated doors.

1.2 REFERENCES

A. American Standard for Testing of Materials (ASTM)

B. American National Standards Institute (ANSI):

C. Consumer Product Safety Commission (CPSC):

D. Glass Association of North America (GANA):

E. National Fire Protection Association (NFPA):

F. Underwriters Laboratories, Inc. (UL):
   1. UL 9 – Fire Tests of Window Assemblies.
   2. UL 10B – Fire Tests of Door Assemblies.
   3. UL 10C – Positive Pressure Fire Tests of Door Assemblies.

G. Standard Council of Canada:
   1. ULC Standard CAN4-S104: Fire Tests of Door Assemblies.
   2. ULC Standard CAN4-S106: Fire Tests of Window Assemblies.


1.3 PERFORMANCE REQUIREMENTS

A. Fire-rated glass ceramic laminated clear and wireless glazing material for use in impact safety-rated locations such as doors, transoms and borrowed lites with fire rating requirements ranging from 20 minutes to 3 hours with required hose stream test.
SECTION 08817 - FIRE RATED GLASS-CERAMIC GLAZING

B. Passes positive pressure test standards UL10C.

1.4 SUBMITTALS

A. Comply with requirements of Section 01300.

B. Product Data: Submit manufacturer’s technical data for each glazing material required, including installation and maintenance instructions.

C. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements. Separate certification will not be required for glazing materials bearing manufacturer’s permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction.

D. Product Test Listings: From UL indicating fire-rated glass complies with requirements, based on comprehensive testing of current product.

E. Samples: Submit, for verification purposes, approx. 8-invh by 10-inch sample for each type of glass indicated.

1.5 QUALITY ASSURANCE


B. Fire Protective Rated Glass: Each lite shall bear permanent, nonremovable label of UL certifying it for use in tested and rated fire protective assemblies.

C. Fire Protective Glazing Products for Door Assemblies: Products identical to those tested per ASTM E2074-00 and UL 10B, labeled and listed by UL.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials under provisions of Section 01600.

B. Deliver materials to specified destination in manufacturer or distributor’s packaging, undamaged, complete with installation instructions.

C. Store off ground, under cover, protected from weather and construction activities.

1.7 WARRANTY

A. Provide manufacturer’s limited warranty under provision of Section 01740.

B. Warranty Period: Five years from date of Substantial Completion.
2.1 FIRE-RATED GLAZING MATERIALS

A. Subject to compliance with specified requirements, provide products by one of the following manufacturers:
   1. Vetrotech Saint-Gobain; Keralite Select Laminated (L)
   2. Technical Glass Products (TGP); Firelite Plus
   3. Or approved equal.

B. Properties:
   2. Weight: 4.1 lbs./sq. ft.
   3. Approximate Visible Transmission: 82 percent.
   4. Fire-rating: 20 minutes to 3 hours for doors; 20 minutes to 90 minutes for other applications.
   6. STC Rating: Approximately 35 dB.
   7. Surface Finish: Select (polished).
   8. Positive Pressure Test: UL 10C

C. Maximum sheet sizes based on surface finish:
   1. Select: 44 inches by 96 inches.

D. Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 deg F (250 deg C) temperature-rise limitation; and the fire-resistance rating in minutes.

E. Fire Rating: Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 252/NFPA 257 or UL 9/10B/10C, CAN/ULC-S104 and S106, including the hose-stream test, and shall comply with NFPA 80.
   1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the hose-stream test.

F. Substitutions: No substitutions allowed.

2.2 FIRE AND SAFETY RATED GLAZING MATERIALS (20 minute rated glazing only)
SECTION 08817 - FIRE RATED GLASS-CERAMIC GLAZING

A. Pyrosweed 20, Fire Rated Tempered Glass: Fire rated, wireless, optically clear tempered glazing material for use in impact safety rated 20-min. doorlite applications. Provides smoke and flame barrier. Does not provide a barrier to radiant or conductive heat. For use in interior or exterior applications.

B. Fireglass 20 by TGP (Or Approved Equal).

C. Provide units with the following properties:

1. Thickness: 1/4 inch (6mm).
2. Weight: 3.2 lbs/sf (16 kg per sq. meter).
5. Labeling: Each lite shall be labeled with a permanent logo including the name of product, manufacturer, testing laboratory (Underwriters Laboratories), fire rating period and safety glazing standards.
7. Fire Rating Testing: Fire rating tested and listed by Underwriters Laboratories; tested in accordance with NFPA 252, UL 9, UL 10C and ASTM E 2074 (without hose stream test).
8. Framing System: Standard fire rated doors and frames as applicable.

2.3 GLAZING ACCESSORIES

A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.

B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Dow Corning Corporation.
   b. GE Construction Sealants; Momentive Performance Materials Inc.
   c. Tremco Incorporated.

C. Setting Blocks: Neoprene, EPDM, or silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.

D. Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

2.4 FABRICATION
SECTION 08817 - FIRE RATED GLASS-CERAMIC GLAZING

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine glass framing, with glazier present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
   2. Minimum required face or edge clearances.
   3. Observable edge damage or face imperfections.

B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

C. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.2 INSTALLATION (GLAZING)

A. Comply with referenced FGMA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.

B. Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.

C. Set units of glass in each series with uniformity of pattern, draw, bow, and similar characteristics.

D. Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.

E. Place setting blocks located at quarter points of glass with edge block no more than 6 inches from corners.

F. Glaze vertically into labeled fire-rated metal frames or partition walls with same fire rating as glass and push against tape for full contact at perimeter of pane or unit.

G. Place glazing tape on free perimeter of glazing in same manner described above.

H. Install removable stop and secure without displacement of tape.

I. Use specified glazing compound, without adulteration; bed glazing material in glazing compound; entirely fill all recess and spaces. Provide visible glazing compound with smooth and straight edges.

J. Install in vision panels in fire-rated doors to requirements of NFPA 80.
SECTION 08817 - FIRE RATED GLASS-CERAMIC GLAZING

K. Install so that appropriate [UL] markings remain permanently visible.

3.3 PROTECTION AND CLEANING

A. Protect glass from contact with contaminating substances resulting from construction operations. Remove any such substances by method approved by glass manufacturer.

B. Wash glass on both faces not more than four days prior to date scheduled for inspections intended to establish date of substantial completion. Wash glass by method recommended by glass manufacturer.
## SECTION 08817 - FIRE RATED GLASS-CERAMIC GLAZING

### 3.4 GLAZING SCHEDULE

<table>
<thead>
<tr>
<th>Rating</th>
<th>Assembly</th>
<th>Max. Exposed Area (Sq. In.)</th>
<th>Max. Width Of Exposed Glazing (In.)</th>
<th>OR</th>
<th>Max. Height Of Exposed Glazing (In.)</th>
<th>Stop Height</th>
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<tbody>
<tr>
<td>20 min.</td>
<td>Doors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HMS or Wood*</td>
<td>3,204</td>
<td>36</td>
<td>89</td>
<td>5/8”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other than doors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HMS or Wood</td>
<td>3,325</td>
<td>95</td>
<td>95</td>
<td>5/8”</td>
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</tr>
<tr>
<td>45 min.</td>
<td>Doors</td>
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<tr>
<td></td>
<td>HMS or Wood</td>
<td>3,204</td>
<td>36</td>
<td>89</td>
<td>5/8”</td>
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<tr>
<td></td>
<td>Other than doors</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>HMS or Wood</td>
<td>3,325</td>
<td>95</td>
<td>95</td>
<td>5/8”</td>
<td></td>
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<tr>
<td>60 min.</td>
<td>Doors (non-temp rise)</td>
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<tr>
<td></td>
<td>HMS or Wood</td>
<td>3,204</td>
<td>36</td>
<td>89</td>
<td>5/8”</td>
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<tr>
<td></td>
<td>Doors (temp rise)</td>
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<td>Other than doors</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HMS or Wood</td>
<td>3,325</td>
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<td>95</td>
<td>5/8”</td>
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<tr>
<td>90 min.</td>
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<tr>
<td></td>
<td>HMS or Wood</td>
<td>2,034</td>
<td>36</td>
<td>56½”</td>
<td>3/4”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Doors (temp rise)</td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>Other than doors</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>HMS</td>
<td>2,627</td>
<td>56½”</td>
<td>56½”</td>
<td>5/8”</td>
<td></td>
</tr>
<tr>
<td>3 hours</td>
<td>Doors</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>100</td>
<td>12</td>
<td>33</td>
<td>1/2”</td>
<td></td>
</tr>
</tbody>
</table>

* HMS indicates hollow metal steel framing. For wood frames, check with manufacturer for maximum tested glass sizes.

END OF SECTION
SECTION 09255 - GYPSUM BOARD ASSEMBLIES

1.1 GENERAL

A. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those of assemblies whose STC ratings were determined according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

B. Fire Resistance: Where fire resistance rated gypsum board assemblies are indicated, provide gypsum board assemblies that are identical to assemblies tested for fire resistant according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1.2 PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

1. Steel Framing and Furring:
   a. Clark Steel Framing, Inc.
   b. Consolidated Systems, Inc.
   c. Dale Industries, Inc.
   d. Dietrich Industries, Inc.
   e. Marino/Ware (formerly Marino Industries Corp.).
   g. Unimast, Inc.
   h. Or approved equal.

2. Grid Suspension Assemblies:
   a. Armstrong World Industries, Inc.
   b. Chicago Metallic Corp.
   c. USG Interiors, Inc.
   d. Worthington Steel Company (formerly National Rolling Mills).
   e. Or approved equal.

3. Gypsum Board and Related Products:
   a. GP Gypsum, LLC
   b. National Gypsum Co.; Gold Bond Building Products Division (NG).
   c. United States Gypsum Co. (USG).
   d. Or approval equal.

B. Steel Framing Components for Suspended and Furred Ceilings: Provide components complying with ASTM C 754 for conditions indicated.

1. Powder-Actuated Fasteners in Concrete: Corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190.

2. Wire Ties: ASTM A 641 (ASTM A 641M), Class 1 zinc coating, soft temper, 0.062 inch (1.6 mm) thick.
3. Wire Hangers: ASTM A 641 (ASTM A 641M), Class 1 zinc coating, soft temper, 0.162-inch (4.1-mm) diameter.
4. Hanger Rods: Mild steel and zinc coated or protected with rust-inhibitive paint.
5. Flat Hangers: Mild steel and zinc coated or protected with rust-inhibitive paint.
6. Channels: Cold-rolled steel, 16 ga minimum thickness of base metal and 7/16-inch- (11.1-mm-) wide flanges, and as follows:
   a. Carrying Channels: 2 inches (50.8 mm) deep, 590 lb/1000 feet (88 kg/100 m), unless otherwise indicated.

C. Steel Studs for Furring Channels: ASTM C 645, in depth indicated and with 0.0179 inch (0.45 mm) minimum base metal thickness, unless otherwise indicated.
   1. Protective Coating: ASTM A 653, G 40 (ASTM A 653M, Z 90) hot-dip galvanized coating for framing for exterior soffits and ceiling suspension members in areas within 10 feet (3 m) of exterior walls.

D. Steel Resilient Furring Channels: Standard product fabricated from steel sheet complying with ASTM A 653 (ASTM A 653M) or ASTM A 568 (ASTM A 568M) to form ½-inch- (12.7-mm-) deep channel of the following configuration unless otherwise indicated:
   1. Double-Leg Configuration: Hat-shaped channel with 1-1/2-inch- (38.1-mm-) wide face connected to flanges by double-slotted or expanded-metal legs (webs).

E. Grid Suspension System for Interior Ceilings: ASTM C 645, manufacturer's standard direct-hung system.

F. Steel Framing for Walls and Partitions: Provide a minimum of 20 gauge interior non-bearing steel framing members complying with the following requirements: (for all bearing walls refer to structural drawings)
   1. Protective Coating: ASTM A 653, G 40 (ASTM A 653M, Z 90) hot-dip galvanized coating for framing members attached to and within 10 feet (3 m) of exterior walls.
   2. Steel Studs and Runners: ASTM C 645 in depth indicated 20 gauge minimum base metal thickness, unless otherwise indicated.
### INTERIOR NON-BEARING GYPSUM STUD PARTITION HEIGHT LIMITATION & GAUGE TABLE

<table>
<thead>
<tr>
<th>INTERIOR NON-BEARING GYPSUM STUD PARTITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 5/8&quot; STUD 16&quot; O.C.</td>
</tr>
<tr>
<td>18 GA.</td>
</tr>
<tr>
<td>UP TO 12'-6&quot;</td>
</tr>
<tr>
<td>20 GA.</td>
</tr>
<tr>
<td>UP TO 8'-10&quot;</td>
</tr>
</tbody>
</table>

SEE STRUCTURAL DRAWINGS FOR OTHER FRAMING GAUGE & SIZE

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**G.** Steel Rigid Furring Channels: ASTM C 645, hat shaped, in depth indicated and with 20 gauge, minimum base metal thickness unless otherwise indicated.

**H.** Fasteners for Metal Framing: Type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

**I.** Gypsum Board Products: Types indicated in maximum lengths available that will minimize end-to-end butt joints in each area indicated to receive gypsum board application.

1. **Gypsum Wallboard:** ASTM C 1396, C 1178, C 1658, in thickness indicated.
   a. Type: Regular for vertical surfaces. (ToughRock® Mold-Guard™ by GP Gypsum or approved equal), unless otherwise indicated.
   b. Type: Foil backed where indicated.
   c. Type: Type X where required for fire-resistance-rated assemblies.
   d. Type: For ceiling surfaces (ToughRock® Mold-Guard™ by GP Gypsum or approved equal), unless otherwise indicated.
SECTION 09255 - GYPSUM BOARD ASSEMBLIES

e. Type: Moisture and mold resistant gypsum panel for wet locations without tile surfaces (ToughRock® Mold-Guard™, DensArmor Plus® interior panel by GP Gypsum, Gold Bond Brand XP Gypsum Board by NG, Fiberock Aqua-Tough Interior panel by USG, or approved equal).
f. Type: Water and mold resistant with tile surfaces. (DensShield® Tile Backer by GP Gypsum or approved equal)
g. Type: Proprietary type as required for specific fire-resistance-rated assemblies.
h. Type: Impact/Abuse Resistant. (Gold Bond High Impact XP by NG or approved equal)
i. Type: Sound Resistant. (Gold Bond Soundbreak XP by NG or approved equal)

2. Proprietary Gypsum Board Products: Subject to compliance with requirements, provide one of the following products or approved equal where proprietary gypsum wall board is indicated:

a. ToughRock® Fireguard® C, DensArmor Plus® Type C, by GP Gypsum or approved equal
b. Fire Shield G; National Gypsum Company; Gold Bond Building Products Division.
c. SHEETROCK Brand Gypsum Panels, FIRECODE C Core; United States Gypsum Company.
d. SHEETROCK Brand Gypsum Panels, ULTRACODE Core; United States Gypsum Company.
e. Or approved equal.

J. Gypsum Board Base Layer(s) for Multilayer Applications: ASTM C 1396 in thickness indicated:

1. Type: Type X where indicated or required for fire-resistance-rated assemblies.
2. Type: Sag-resistant type for ceiling surfaces, unless otherwise indicated.

K. Accessories for Interior Installations: Cornerbead, edge trim, and control joints complying with ASTM C 1047, formed metal or plastic, with metal complying with the following requirement:

1. Steel sheet zinc added space coated by hot dip proceed or rolled zinc.

L. Joint Treatment Materials: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.

1. Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated.

a. Use pressure-sensitive or staple-attached, open-weave, glass-fiber reinforcing tape with compatible joint compound where recommended by manufacturer of gypsum board and joint treatment materials for application indicated.
SECTION 09255 - GYPSUM BOARD ASSEMBLIES

2. Setting-Type Joint Compounds for Gypsum Board: Factory-packaged, job-mixed, chemical-hardening powder products formulated for uses indicated.
   a. For prefilling gypsum board joints, use formulation recommended by gypsum board manufacturer.
   b. For filling joints and treating fasteners of water-resistant gypsum backing board behind base for ceramic tile, use formulation recommended by gypsum board manufacturer.
   c. For topping compound, use sandable formulation.

3. Drying-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products complying with the following requirements for formulation and intended use.
      1. Taping compound formulated for embedding tape and for first coat over fasteners and face flanges of trim accessories.
      2. All-purpose compound formulated for both taping and topping compounds.

M. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 that is effective in reducing the airborne transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

N. Miscellaneous Materials: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.
   1. Laminating Adhesive: Special adhesive or joint compound recommended for laminating gypsum panels.
   2. Spot Grout: ASTM C 475, setting-type joint compound recommended for spot-grouting hollow metal door frames.
   3. Fastening Adhesive for Metal: Special adhesive recommended for laminating gypsum panels to steel framing.
   4. Steel drill screws complying with ASTM C 1002 for the following applications:
      a. Fastening gypsum board to steel members less than 0.033 inch (0.84 mm) thick.
      b. Fastening gypsum board to gypsum board.
   5. Steel drill screws complying with ASTM C 954 for fastening gypsum board to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
   6. Foam Gaskets: Closed-cell vinyl foam adhesive-backed strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit metal stud size indicated.
   7. Sound-Attenuation Blankets: Unfaced mineral-fiber blanket insulation to comply with ASTM C 665 for Type I.
   8. Polyethylene Vapor Retarder: ASTM D 4397, thickness and maximum permeance rating as follows:
      a. 6 mils (0.15 mm), 0.13 perms (7.5 ng/Pa x s x sq. m).
SECTION 09255 - GYPSUM BOARD ASSEMBLIES

9. Vapor Retarder Tape: Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.

1.3 EXECUTION

A. Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.

1. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
2. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
   a. Where building structure abuts ceiling perimeter or penetrates ceiling.
   b. Where partition framing and wall furring abut structure, except at floor.

3. Do not bridge building control and expansion joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.

B. Installing Steel Framing for Suspended and Furred Ceilings: as follows:

1. Sway-brace suspended steel framing with hangers used for support.
2. Install suspended steel framing components in sizes and at spacings indicated, but not less than that required by the referenced steel framing installation standard.
3. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

C. Installing Steel Framing for Walls and Partitions: Install steel studs and furring at spacings indicated.

1. Where studs are installed directly against exterior walls, install asphalt felt strips or foam gaskets between studs and wall.
2. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
3. Cut studs 1 inch short of full height to provide perimeter relief.
4. For STC-rated and fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid structural surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.
5. Frame door openings to comply with GA-219, and with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated.
6. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.
SECTION 09255 - GYPSUM BOARD ASSEMBLIES

7. Install polyethylene vapor retarder where indicated to comply with the following requirements:
   a. Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with mechanical fasteners or adhesives. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose mineral-fiber insulation.
   b. Seal vertical joints in vapor retarders over framing by lapping not less than 2 wall studs. Fasten vapor retarders to framing at top, end, and bottom edges, at perimeter of wall openings, and at lap joints; space fasteners 16 inches (400 mm) o.c.
   c. Seal joints in vapor retarders caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor retarder tape.
   d. Repair any tears or punctures in vapor retarder immediately before concealing it with the installation of gypsum board or other construction.

D. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.

1. Install sound-attenuation blankets, where indicated, prior to installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
2. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
3. Spot grout hollow metal door frames for solid-core wood doors, hollow metal doors, and doors over 32 inches (813 mm) wide. Apply spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.
4. Form control and expansion joints at locations indicated and as detailed, with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels.
5. Isolate perimeter of nonload-bearing gypsum board partitions at structural abutments, except floors, as detailed. Provide 1/4- to ½-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
6. Where STC-rated gypsum board assemblies are indicated, seal construction at perimeters, behind control and expansion joins, openings, and penetrations with a continuous bead of acoustical sealant including a bead at both faces of the partitions. Comply with ASTM C 919 and manufacturer’s recommendations for location of edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
7. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer’s recommendations.
   a. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications or as required by fire resistive design.
8. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.
9. Install water-resistant gypsum backing board panels at sink and where indicated. Install with 1/4-inch (6.4-mm) open space where panels abut other construction or penetrations.
SECTION 09255 - GYPSUM BOARD ASSEMBLIES

10. Single-Layer Fastening Methods: Apply gypsum panels to supports as follows:
   a. Fasten with screws.

11. Multilayer Fastening Methods: Apply base layers of gypsum panels and face layer to base layers as follows:
   a. Fasten both base layers and face layers separately to supports with screws.

E. Installing Trim Accessories: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer’s directions for type, length, and spacing of fasteners.

1. Install corner bead at external corners.
2. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.
   a. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
   b. Install L-bead where edge trim can only be installed after gypsum panels are installed.
   c. Install U-bead where indicated.
   d. Install control joints according to ASTM C 840 and manufacturer’s recommendations and in specific locations approved by Architect for visual effect.

F. Finishing Gypsum Board Assemblies: Treat gypsum board joints, interior angles, flanges of corner bead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.

1. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.
2. Apply joint tape over gypsum board joints, except those with trim accessories having flanges not requiring tape.
3. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214-15.
   a. Level 1 for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
   b. Level 4 for gypsum board surfaces, for all exposed areas unless otherwise indicated.
SECTION 09255 - GYPSUM BOARD ASSEMBLIES

4. Where Level 5 gypsum board finish is indicated, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories; and apply a thin, uniform skim coat of joint compound over entire surface. For skim coat, use joint compound specified for third coat, or a product specially formulated for this purpose and acceptable to gypsum board manufacturer. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects, tool marks, and ridges and ready for decoration.

5. For Level 4 gypsum board finish, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.

6. Finish water-resistant gypsum backing board to comply with ASTM C 840 and gypsum board manufacturer's directions.

END OF SECTION 09255
SECTION 09300 - TILE

1.1 General


C. Submittals: With manufacturer's product data and installation instructions for tile work, submit samples of each type, color, and texture of tile mounted on 12-inch-square backing with joints grouted.

D. Attic Stock: Provide 5 percent of amount installed, packaged with protective covering for storage, and identified with labels clearly describing contents, before installation begins. Furnish attic stock: Furnish not less than 1 box for each 50 boxes or a fraction thereof, of each type, color, pattern, and size as installed.

1.2 Products

A. Colors, Textures, and Patterns: For tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, comply with the following requirements:

1. Provide selections made by Architect from manufacturer's full range of standard colors, textures, and patterns for products of type indicated.
2. The Architect may use multiple color patterns.

B. Sizes and Thicknesses:

1. Porcelain Wall Tiles – Daltile or approved equal
   a. TL-1 – Veranda #P527 Dune, Unpolished, 13" x 20" x 3/8" thick
   b. TL-2 – Veranda #P500 Steel, Unpolished, 6½" x 20" x 3/8" thick
   c. TL-4 – Rittenhouse Square #0135/K165 Matte Almond, Semi-gloss 3" x 6” x 5/16" thick

2. Porcelain Wall Tiles – Porcelanosa or approved equal
   a. TL-3 – Laja Natural #V144042-10014144841, 13” x 40” x ½” thick

3. Continental Slate Porcelain Floor Tiles – Daltile or approved equal
   a. TL-5 - CS53, Asian Black, Unpolished, 6" x 6" AND 12" x 12" x 7/16" thick.

C. Tile Grade: If other than the basis of design, provide category tiles equal to or greater than the basis of design tiles as noted above.
D. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

E. Unglazed Ceramic Mosaic Floor Tile: Factory-mounted flat tile and as follows:
   2. Face: Standard design with cushion edges.

F. Glazed Wall Tile: Factory-mounted flat tile and as follows:
   1. Face: Plain with cushion edge.

G. Trim Shapes: Same material, size, color, and texture as basis of design tiles

H. Marble Thresholds: Group "A"; ASTM C 503, for interior use with minimum hardness of 10.0 per ASTM C 241; white with honed finish unless otherwise indicated.

J. Setting Materials: Provide setting materials as follows:
   1. Portland Cement Mortar: Materials complying with ANSI A 108.1 and as follows:
      a. Latex additive (water emulsion) as follows, replacing part or all of gauging water, specifically recommended by latex additive manufacturer for use with job-mixed portland cement and aggregate mortar bed.
         1) Latex Additive: Manufacturer's standard.
      a. Prepackaged dry mortar mix composed of portland cement, graded aggregate, and the following dry polymer additive in the form of a reemulsifiable powder to which only water is added at job site.
         1) Dry Polymer Additive: Manufacturer's standard.
      b. Latex additive AS described below, replacing part or all of gauging water, combined at job site with prepackaged dry mortar mix specified by latex additive manufacturer.
         1) Latex Type: Manufacturer's standard.
   4. Organic Tile Adhesive: ANSI A136.1, Type I.

K. Grouting Materials: Provide grouting materials from Custom Building Products - Grout Solutions or equivalent as follows:
SECTION 09300 - TILE

1. Latex-Portland Cement Grout: ANSI A118.6 of the following composition.
   a. Latex additive (water emulsion) replacing part or all of gauging water, added at job site with dry grout mixture, with type of latex and dry grout mix as follows:
      1) Latex Type: Manufacturer's standard.
      2) Dry Grout Mixture: Commercial portland cement specified or supplied by latex additive manufacturer.

L. Elastomeric Sealants: Manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that comply with requirements of Division 7 Section "Joint Sealers" including ASTM C 920 as referenced by Type, Grade, Class, and Uses.

1. One-Part Mildew-Resistant Silicone Sealants: ASTM C 920, Type S, Grade NS, Class 25, Uses NT, G, A, and O (for use in joints in nontraffic areas).

M. Miscellaneous Materials: Provide the following materials:

1. Metal Edge Strips: Stainless steel or zinc alloy, 1/8-inch wide at top edge.
2. Temporary Protective Coating: As follows, formulated to protect exposed surfaces of tile against adherence of mortar and grout, compatible with tile and mortar/grout products, and easily removable without damaging grout or tile.
   a. Petroleum paraffin wax, fully refined, tasteless, odorless, containing at least 0.5 percent oil, with a melting point of 120 deg F (49 deg C) to 140 deg F (60 deg C) per ASTM D 87.

1.3 Execution

A. Field-Applied Temporary Protective Coating: Where indicated under or needed to prevent adhesion or staining of exposed tile surfaces by grout, precoat tile with a continuous film of temporary protective coating indicated below:

1. Petroleum paraffin wax.


C. Joint Pattern: Use grid pattern with 1/16-inch-wide joints unless otherwise indicated.

D. Expansion, Control, Contraction, and Isolation Joints: As indicated.

1. Seal tile joints with elastomeric sealants to comply with Division 7 Section "Joint Sealers."

E. Edge Strips: Provide at exposed edge of tile meeting carpet, wood, or resilient flooring, unless otherwise indicated.
SECTION 09300 - TILE

F. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.

2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions but no sooner than 14 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

3. Remove temporary protective coating, by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

4. Floor drain: Slope setting mortar bed to floor drain for positive water flow.

END OF SECTION 09300
SECTION 09510 - ACOUSTICAL CEILINGS

PART-1 GENERAL

1.1 SUMMARY:

A. This Section includes acoustical ceilings consisting of suspended exposed-grid systems with lay-in acoustical panels.

1.2 SUBMITTALS:

A. Product Data: Manufacturer's complete technical descriptive literature for each item required, including specifications and installation recommendations.

B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Within 60 days after award of Contract, submit coordination drawings for all new or altered areas, drawn accurately to a scale no less than 1/8" = 1'-0", coordinating penetrations and ceiling-mounted items. Coordinate with other prime contractors to obtain necessary information and agreement on location of penetrations and ceiling-mounted items. Upon review and acceptance by Architect, incorporate revisions (if any) into an AutoCAD-based file. Furnish one hard copy of accepted shop drawings and one updated CA D-file copy to all other applicable prime contractors for their further information and use. Show the following:

1. Ceiling suspension system members.
2. Method of attaching hangers to building structure.
3. Bulkheads, soffits, areas with drywall ceilings (if any), and areas of exposed structure (if any).
4. Room names and numbers, ceiling types, and ceiling elevations above the finished floor.
5. Special moldings at walls, column penetrations, and other junctures with adjoining construction, including all curved walls and bulkheads.
6. Ceiling-mounted items, including light fixtures; HVAC air distribution devices; speakers; fire alarms; sprinkler heads; and other similar devices or fixtures.

D. Shop Drawings: Show details and information pertinent to construction, installation, and placement of all components required for continuous, smooth wall angles at curved walls, bulkheads and circular columns. Include sections of typical curved wall angle.

1.3 QUALITY ASSURANCE:

A. Installer Qualifications: Engage an experienced installer who has completed acoustical tile ceilings and finishes similar in material, design, and extent to that indicated for this Project and with a minimum five-year record of successful in-service performance.

B. Source Limitations for Ceiling Units: Obtain all acoustical panel and grid systems from one single source.
SECTION 09510 - ACOUSTICAL CEILINGS

1.4 DELIVERY, STORAGE AND HANDLING:

A. Deliver acoustical materials and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other detrimental conditions.

B. Before installing acoustical materials, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical tiles and panels carefully to avoid chipping edges or damaging units in any way.

1.5 PROJECT CONDITIONS:

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. The work area shall be broom clean and the structure in proper condition to receive acoustical materials. Acoustical work shall follow the installation of ductwork, piping and conduit located in ceiling space above ceilings.

1.6 COORDINATION:

A. Coordinate layout and installation of acoustical materials and suspension systems with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.7 EXTRA STOCK:

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Acoustical Ceiling Units:
   a. ACT Types 1 & 2: Six (6) extra cases of full-size units of each type.
   b. ACT Type 3: One (1) extra case of full size units

PART-2 PRODUCTS

2.1 ACOUSTICAL CEILINGS. GENERAL:

A. Humidity Resistance: Unless indicated otherwise, ceiling panels shall be rated for 90% humidity conditions and shall have a 10-year sag- and warp-resistance warranty, comparable to Armstrong’s "Humiguard Plus" products or approved equal.

B. Acoustical Ceiling Colors: Manufacturer's standard white, unless indicated otherwise.
C. Fire-Test-Response Characteristics: Provide ceilings (ceiling panels/tiles, grids and accessories) that comply with the following requirements:

1. Fire-response tests were performed by UU, ITS/Warnock Hersey, or another independent testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
2. Surface-burning characteristics of acoustical panels shall comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.

D. Dimensions: Length by width dimensions for lay-in ceiling panels are nominal dimensions. Actual dimensions are to be factory-cut sizes that fit within suspended ceiling grids having standard modular dimensions matching the specified panel nominal length and width.

2.2 ACOUSTICAL CEILING SYSTEMS:

A. ACT-“A”': 24 in. x 48 in. x 7/8 in. lay-in panels with square edge profile; minimum light reflectance (LR) rating of 0.90; and minimum noise reduction coefficient (NRC) of 0.90. Suspension system.

1. Subject to compliance with requirements, provide one of the following panel products or approved equal:

   a. Armstrong World Industries; School Zone #1714 Square Lay-in.
   b. or Approved Equal.

B. ACT-“A1”: 24 in. x 48 in. x 7/8 in. lay-in panels with beveled tegular profile; wet-formed panel composed of mineral fiber with a factory-applied latex paint finish; minimum light reflectance (LR) rating of 0.85 and minimum noise reduction coefficient (NRC) of 0.80. Suspension system.

1. Subject to compliance with requirements, provide one of the following panel products or approved equal:

   a. Armstrong World Industries; Ultima Health Zone #1448, High NRC.
   b. or Approved Equal.

C. ACT-“A2”: 24 in. x 48 in. x 7/8 in. lay-in panels with square edge profile; minimum light reflectance (LR) rating of 0.90; and minimum noise reduction coefficient (NRC) of 0.90. Suspension system.

1. Subject to compliance with requirements, provide one of the following panel products or approved equal:

   a. Armstrong World Industries; Clean Room VL #1721 – Square Lay-in.
   b. or Approved Equal.

2.3 SUSPENSION SYSTEMS:

ACOUSTICAL CEILINGS
SECTION 09510 - ACOUSTICAL CEILINGS

A. General: Unless indicated otherwise, suspension grids shall comply with ASTM C 635 "Intermediate Duty" Classification.

B. Suspension System Types:

1. Type A: Exposed grid system with 15/16 in. wide face, shall be Aluminum, Class A White. Armstrong World Industries: Co-Extruded Clean Room or approved equal.

C. Suspension System Accessories: Provide all accessories necessary to complete installation, including, but not limited to, the following:

1. Preformed, factory-finished, bull-nosed comers to match grid material and finish. Provide comers where grid meets bull-nosed block.
2. Provide impact clips at toilet room and gymnasium ceilings.
3. Provide retention clips for ceilings located in wind locks and vestibules.
4. Provide white, dual durometer polyvinylchloride (PVC) bellows-style filler for 1-inch expansion joints in suspended lay-in acoustical ceilings, selected from the following options:
   a. Allway HC/HCW Series; Construction Specialties, Inc.
   b. DX Series; MM Systems Corp.
   c. Wabo Fast Wrap CES Series; Watson Bowman Acme Corp.
   d. or Approved Equal.

PART-3 EXECUTION

3.1 CEILING INSTALLATION:

A. Suspend main beams spaced at 24 in. or 48 in. o.c., as indicated on Drawings, from structure above by minimum #12 gauge galvanized wire hangers spaced not more than 48 in. o.c.

B. Install interlocking cross-tees at 24 in. o.c. to form a 24 in. x 48 in., or 24 in. x 24 in. grid pattern.

C. System shall be accurately leveled to within 1/8 in. in 12 ft. 0 in. Deflection shall not exceed 1/360 of the span of any component.

D. Provide matching perimeter molding around separate room areas, abutting walls, and around columns and similar protrusions, unless indicated otherwise.

1. At radiused bulkheads and walls, provide curved wall angle, factory-formed to match diameter of bulkheads and walls; aluminum, finished to match ceiling grid. Field cut and formed edges made up of straight sections will not be permitted.

E. Where perimeter molding meets expansion joint trim, provide a clear break in the molding equal to no less than the expansion joint width.
F. Scribe and cut panels at borders and penetrations to provide a neat, precise fit. Coordinate with work of the HVAC, plumbing and electrical trades.

3.2 CLEANING:

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09510
SECTION 09521 - ACOUSTICAL WALL PANELS

Part 1  GENERAL

A.  Submittals: In addition to product data, submit the following:

1.  Shop Drawings: Show fabrication and installation of panels including plans, elevations, sections, details of components, and attachments to other construction.
2.  Samples: 12-inch- (300 mm-) square samples of each type of panel and in each color, texture and pattern indicated.

B.  Surface-Burning Characteristics: Flame spread, 25 or less; smoke developed, 200 or less; per ASTM E 84.

Part 2  PRODUCTS

A.  Colors, Textures, and Patterns: As indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard. See drawings for size and locations of all panels. All edges have to be finished and covered by finish surface material.

B.  Back-Mounted, Edge-Reinforced Acoustical Wall Panels: Manufacturers standard construction: facing material laminated to front, edges, and back border of molded glass fiberboard core; with edges chemically hardened:

1.  Core Density: 7 lb/cu. ft. (64-112 kg/cu. m).
2.  Thickness and NRC: Nominal overall panel thickness of 2 inches and NRC of not less than 0.95 for Type A (ABPMA No. 4) mounting.
4.  Panel Size: As indicated on the drawings.
5.  Edge Detail: Square.
6.  Corner Detail: Square.
7.  Products: Subject to compliance with requirements, provide one of the following, or approved equal:

   b.  Soundsoak AWP-1, Armstrong World Industries, Inc.
   c.  Whisper Wall Panels, Whisper Walls Co.

C.  Back-Mounting Accessories: Mechanical fasteners, including clips, hangers, and other attachment components, as required by manufacturer for concealed fastening of back-mounted panels to walls.

D.  Fabrication: Fabricate panels with finish facing material extended over edges. Attach or bond facing material to core material so there are no wrinkles, sags or blisters.

PART 3  EXECUTION

A.  Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, scribed to fit adjoining work accurately at borders and at penetrations. Comply with panel manufacturer's printed instructions for installation of panels.
SECTION 09521 - ACOUSTICAL WALL PANELS

B. Scribe acoustical wall panels to fit adjacent work. Apply accessories and fastenings as recommended by manufacturer.

C. Remove and Replace acoustical wall panels that are damaged and are unacceptable to Architect.

D. Maintenance Stock: Provide 3% of each type and color of the panels (minimum of one full sized panel if less than 3%).

END OF SECTION 09521
SECTION 09651 - RESILIENT TILE FLOORING

1.1 GENERAL

A. Submittals: As follows:

1. Product Data: For each type of product specified.
2. Samples of each different color and pattern of resilient product specified.
3. Maintenance Data: For resilient floor tile to include in the maintenance manuals specified in Division 1.

B. Extra Materials: Deliver extra materials to Owner as follows:

1. Furnish not less than one box for each 50 boxes or fraction thereof, of each type, color, pattern, class, wearing surface, and size of resilient tile flooring installed.

1.2 PRODUCTS

A. Manufacturers

1. Basis-of-Design: Interface, 1503 Orchard Hill Road, LaGrange GA 30240
   P: (800) 335-0344
2. Armstrong
3. Johnsonite
4. Or Approved Equal


1. LVT-1: Interface (or approved equal), Textured Stones – Level Set, Jersey Marble, size: 19.75” x 19.75”
2. LVT-2: Interface (or approved equal), Textured Stones – Level Set, Polished Cement, size: 19.75” x 19.75”
3. LVT-3: Interface (or approved equal), Natural Stones – Level Set, Jet Mist, size: 19.75” x 19.75”

C. Vinyl Composition Floor Tile (VCT-X): Products complying with ASTM F 1700 Class III Printed Vinyl Tile. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Flooring Inc., or approved equal. Size to be 12” x 12” Refer to Finish Schedule and Finish Plans for specifications.

1. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.
2. Wearing Surface: Smooth
3. Thickness: 0.125 Inch (3.2 Mm).
4. Size: 12 By 12 Inches (305 By 305 Mm).
5. Colors and Patterns: As Noted On Finish Schedule.

D. Resilient Wall Base: As specified in Section 09653.

E. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.
SECTION 09651 - RESILIENT TILE FLOORING

F. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

G. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of tiles, and in maximum available lengths to minimize running joints.

PART 2 - EXECUTION

A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer’s requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with the Manufacturer’s requirements specified.

1. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.

2. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Preparation: Comply with resilient product manufacturer’s written installation instructions for preparing substrates indicated to receive resilient products.

C. Tile Installation: Comply with tile manufacturer’s written installation instructions.

1. It is recommended that resilient floor covering installation shall not begin until all other trades are completed.

2. All substrates to receive LVT required proper moisture testing. Before installing over new or existing concrete subfloor, you must test the moisture and alkalinity levels of the concrete. All concrete substrates should be tested for moisture by use of the Situ Probe rth test method (ASTM F 2170) and ph following ASTM F 710 guidelines.

3. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter.

a. Lay tiles square with room axis, unless otherwise indicated.

4. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered.

a. Lay tiles with grain running in alternate direction.

D. After installation and prior to any construction foot traffic, clean and protect resilient products according to manufacturer’s written recommendations. All products to be utilized shall be in accordance with manufacturer’s recommendations. A final cleaning of resilient products before Substantial Completion is required.

END OF SECTION 09651
SECTION 09653 - RESILIENT WALL BASE AND ACCESSORIES

1.1 GENERAL

A. Submittals: As follows:
   1. Product Data: For each type of product specified.
   2. Samples: In manufacturer's standard sizes of each product color and pattern specified.

B. Extra Materials: Furnish not less than 10 linear feet (3 linear m) for each 500 linear feet (150 linear m) or fraction thereof, of each different type, color, pattern, and size of resilient product installed. Deliver extra materials to Owner.

1.2 PRODUCTS

A. Manufacturers

   1. Basis-of-Design: Roppe Corporation, 1602 N Union St., Fostoria, OH 44830. P: (800) 537 – 9527
   2. Johnsonite
   3. or Approved Equal

B. Resilient Wall Base

   1. **VCB-1** – Pinnacle – Rubber, Vulcanized Thermoset, Standard Toe, 6” high x 1/8” thick, Style B, Cove, Color – Nutmeg #628.
   3. **VCB-3** – Pinnacle – Rubber Vulcanized Thermoset, Standard Toe, 6” High x 1/8”, Style B, Cove, Color – Pine #630

C. Resilient Accessories: Products complying with requirements specified in the Resilient Wall Base and or Room Finish Schedule.

D. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1.3 EXECUTION

A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements, including those for maximum moisture content. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Preparation: Comply with manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.

C. Installation: Install resilient products according to manufacturer's written installation instructions.
SECTION 09653 - RESILIENT WALL BASE AND ACCESSORIES

1. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
   a. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
   b. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
   c. Do not stretch base during installation.
   d. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
   e. Form corners on job, from straight pieces of maximum lengths possible, without whitening at bends.

2. Place resilient products so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.

D. Clean and protect resilient products according to manufacturer's written recommendations. Clean resilient products after installation and not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project.

END OF SECTION 09653
SECTION 09680 – CARPET TILE

PART 1 - GENERAL

A. Submittals: Submit Product Data for each type of carpet, carpet cushion, and the following:

1. Shop Drawings showing carpet type, color, and dye lot, types, and methods; type of subfloor; type of installation.
2. Samples of each type of carpet material required.
3. Schedule of carpet using same room designations indicated on Drawings.
4. Maintenance data for carpet and cushion to include in the operation and maintenance manual.


1. Flame Spread: 25 or less per ASTM E 84.
2. Smoke Developed: 450 or less per ASTM E 84.

C. Project Conditions: Comply with CRI 104, Section 6: "Site Conditions."

D. Subfloor Moisture Conditions: Moisture emission rate of not more than 3 lb/1000 sq. ft./24 hours (14.6 kg/1000 sq. m/24 hours) when tested by calcium chloride moisture test in compliance with CRI 104, 6.2.1, with subfloor temperatures not less than 55 deg F (12.7 deg C).

E. Subfloor Alkalinity Conditions: A pH range of 5 to 9 when subfloor is wetted with potable water and pHydrion paper is applied.

F. Attic Stock: Furnish four (4) cases of carpet tile, packaged with protective covering for storage, and identified with labels clearly describing contents, before installation begins. The carpet attic stock must be from the same run and dye lot as the carpet installed on the project.

PART 2 - PRODUCTS

A. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the products specified in each carpet Product Data sheet at end of this Section or approved equal.

B. Concrete-Slab Primer: Nonstaining type as recommended by the following:

1. Carpet manufacturer.

C. Trowelable Underlayments and Patching Compounds: As recommended by the following:

1. Carpet manufacturer.

D. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated and to comply with flammability requirements for installed carpet as recommended by the following:

1. Carpet manufacturer.

E. Seaming Cement: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
SECTION 09680 – CARPET TILE

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subfloors and conditions are satisfactory for carpet installation and comply with requirements specified in this Section and those of the following:
   1. Carpet manufacturer.

B. Level subfloor within 1/4 inch in 10 feet (6 mm in 3 m), noncumulative, in all directions.
   1. Use leveling and patching compounds to fill cracks, holes, and depressions in subfloor as recommended by the following:
      a. Carpet manufacturer.

C. Remove subfloor coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone.

D. Broom or vacuum clean subfloors to be covered with carpet. Following cleaning, examine subfloors for moisture, alkaline salts, carbonation, or dust.

E. Concrete-Subfloor Preparation: Apply concrete-slab primer, according to manufacturer's directions, where recommended by the following:
   1. Carpet manufacturer.

F. Carpet with Attached-Cushion Backing Installation: Comply with CRI 104, Section 10: "Attached Cushion."

G. Comply with carpet manufacturer's recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under door in closed position. Bind or seal cut edges as recommended by carpet manufacturer.

H. Install pattern parallel to walls and borders.

K. Vacuum carpet using commercial machine with face-beater element.

L. Protection: Comply with CRI 104, Section 15: "Protection of Indoor Installation."

M. Provide PVC vinyl extrusion edge at all carpet edges and steps.
SECTION 09680 – CARPET TILE

Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the products specified in the following carpet Product Data sheets or approved equal.

**CPT-1: CARPET TILE**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Mohawk Group or approved equal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection</td>
<td>Step-up II</td>
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<tr>
<td>Product/Color/Number</td>
<td>Cobalt #955</td>
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<tr>
<td>Product Construction</td>
<td>Tufted Texture</td>
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<tr>
<td>Backing</td>
<td>Eco Flex ICT</td>
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<tr>
<td>Yarn System</td>
<td>Duracolor Premium Nylon</td>
</tr>
<tr>
<td>Yarn Manufacturer</td>
<td>Universal</td>
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<tr>
<td>Dye Method</td>
<td>100 % Solution Dyed</td>
</tr>
<tr>
<td>Dye Lots</td>
<td>Mergeable</td>
</tr>
<tr>
<td>Stain Release Technology</td>
<td>Permanent, Built into the Fiber</td>
</tr>
<tr>
<td>Soil Release Technology</td>
<td>Sentry Soil Protection</td>
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<td>Traffic Classification</td>
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<tr>
<td>Flooring Radiant Panel</td>
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</tr>
<tr>
<td>Smoke Density</td>
<td>ASTM E 662 Less than 450</td>
</tr>
<tr>
<td>Static</td>
<td>AATCC – 134 Under 3.5 KV</td>
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<tr>
<td>Warranty:</td>
<td>Lifetime Limited Carpet Tile Warranty</td>
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## CPT-2: CARPET TILE

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<tr>
<td>Collection</td>
<td>Layout</td>
</tr>
<tr>
<td>Product/Color/Number</td>
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<tr>
<td>Product Construction</td>
<td>Tufted Textured Loop</td>
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<tr>
<td>Backing</td>
<td>GlasBac</td>
</tr>
<tr>
<td>Yarn System</td>
<td>Post-Consumer Content Type 6.6 Nylon</td>
</tr>
<tr>
<td>Yarn Manufacturer</td>
<td>Universal</td>
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<tr>
<td>Dye Method</td>
<td>100 % Solution Dyed</td>
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<tr>
<td>Dye Lots</td>
<td>Mergeable</td>
</tr>
<tr>
<td>Soil/Stain Protection</td>
<td>Protekt</td>
</tr>
<tr>
<td>Preservative Protection</td>
<td>Intersept</td>
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<tr>
<td>Tufted Yarn Weight</td>
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<tr>
<td>Pile Height</td>
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<tr>
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<tr>
<td>Stitches</td>
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<tr>
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<tr>
<td>Total Thickness</td>
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<tr>
<td>Size</td>
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</tr>
<tr>
<td>Installation Method</td>
<td>Non-Directional</td>
</tr>
<tr>
<td>Traffic Classification</td>
<td>Severe Traffic</td>
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<tr>
<td>Flooring Radiant Panel</td>
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<tr>
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### CPT-3: CARPET TILE

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<td>Product Construction</td>
<td>Tufted Textured Loop</td>
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<td>Backing</td>
<td>Glasbac</td>
</tr>
<tr>
<td>Yarn System</td>
<td>Post Consumer Content Type 6.6 Nylon</td>
</tr>
<tr>
<td>Yarn Manufacturer</td>
<td>Universal</td>
</tr>
<tr>
<td>Dye Method</td>
<td>100 % Solution Dyed</td>
</tr>
<tr>
<td>Dye Lots</td>
<td>Mergeable</td>
</tr>
<tr>
<td>Soil/Stain Protection</td>
<td>Protekt</td>
</tr>
<tr>
<td>Preservative Protection</td>
<td>Intersept</td>
</tr>
<tr>
<td>Tufted Yarn Weight</td>
<td>17 oz/yd sq</td>
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<tr>
<td>Pile Height</td>
<td>0.14”</td>
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<tr>
<td>Pile Thickness</td>
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<tr>
<td>Stitches</td>
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<tr>
<td>Pile Density</td>
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<td>Total Thickness</td>
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<td>Size</td>
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<td>Installation Method</td>
<td>Non-Directional</td>
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<td>Traffic Classification</td>
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<td>Smoke Density</td>
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<td>Fiber Modification Ratio</td>
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<td>Warranty:</td>
<td>15 Year Standard, Non-Prorated Warranty</td>
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</tbody>
</table>

END OF SECTION 09680
1.1 GENERAL

A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.

1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. Block fill prime paint all CMU walls full height to the roof deck above ceiling and behind all built in casework, lockers, etc. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Submittals: For each paint system specified, provide the following:

1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.

2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.

E. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated. After color selection, the Architect will furnish color chips for surfaces to be coated.

F. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.

2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.

3. Submit Samples on the following substrates for the Architect's review of color and texture only:
   a. Concrete: Provide two 4-inch-(100-mm-) square samples for each color and finish.
   b. Concrete Masonry: Provide two 4-by-8-inch (100-by-200-mm) samples of masonry for each finish and color.
c. Stained or Natural Wood: Provide two 4-by-8-inch (100-by-200-mm) samples of natural- or stained-wood finish on actual wood surfaces.

d. Ferrous Metal: Provide two 4-inch- (100-mm-) square samples of flat metal and two 8-inch- (200-mm-) long samples of solid metal for each color and finish.

G. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

H. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Comply with procedures specified in PDCA P5. Duplicate finish of approved prepared samples.

1. The Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface as specified.

a. After finishes are accepted, the Architect will use the room or surface to evaluate coating systems of a similar nature.

I. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label.

J. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers in clean condition, free of foreign materials and residue. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

K. Project Conditions: Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

L. Additional Material: Provide one gallon for each 200 gallons paint used in each color and type (minimum one gallon) to Owner.

1.2 PRODUCTS

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat 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.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers.
C. Colors: Match colors indicated by reference to manufacturer's color designations.

1.3 EXECUTION

A. Examine substrates, areas, and conditions under which painting will be performed for compliance with paint application requirements. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates.

C. Preparation: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

D. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

E. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.

1. Cementitious Materials: Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

   a. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.

2. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

   a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

   b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
c. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

3. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
   a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

4. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

F. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

2. Use only thinners approved by paint manufacturer and only within recommended limits.

G. Application: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors and finishes shall be selected during construction. Contractor shall allow for use of up to (4) four different wall colors and (2) two different trim colors throughout the building interior, including use of accent walls and use of different colors within the same room/space. Contractor shall allow for use of (2) two different exterior paint colors. Additionally, the contractor may have to color match and paint items to match immediately adjacent pre-finished items and existing items as necessary throughout construction.

2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

3. Provide finish coats that are compatible with primers used.

4. The term "exposed surfaces" includes areas visible when permanent or built-in items are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.

5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

6. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

7. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

8. Sand lightly between each succeeding enamel or varnish coat.

H. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.

2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

3. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

I. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

J. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

K. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

L. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

M. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

N. Field Quality Control: The Owner reserves the right to engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.

1. The testing agency will perform appropriate tests as required by the Owner.

2. If tests show material being used does not comply with specified requirements, the Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.

O. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove
SECTION 09900 – PAINTING

spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

P. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

Q. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

R. Paint Schedules: Provide the following paint systems for the various substrates indicated by MAB/ Sherwin Williams or approved equal products:

S. Exterior Paint Systems:

1. Ferrous Metal:
   a. Full gloss enamel finish - rust inhibitive primer with acrylic finish
      Primer: KemBond Alkyd Primer
      1st Coat: DTM Acrylic Finish, semi-gloss
      2nd Coat: DTM Acrylic Finish, semi-gloss

2. Non-Ferrous Metal:
   a. Full gloss enamel finish - galvanized metal primer with acrylic finish
      (Lintels, Railings, Bollards, etc.)
      Primer: ProIndustrial Pro-Cryl Primer
      1st Coat: DTM Acrylic Finish, semi-gloss
      2nd Coat: DTM Acrylic Finish, semi-gloss

T. Interior Paint Systems:

1. Concrete, Masonry (not including CMU):
   a. Acrylic epoxy
      Primer: ProMar 200 zero VOC Primer
      2nd Coat: ProIndustrial Pre-Catalyzed Epoxy
      3rd Coat: ProIndustrial Pre-Catalyzed Epoxy

2. Concrete Masonry Units (CMU): Typical Walls (Block fill prime paint all CMU walls full height and behind all built in casework, lockers, etc.)
   a. Acrylic epoxy – eggshell finish
      Filler: Block Kote #2000
      2nd coat: ProIndustrial Pre-Catalyzed Epoxy, eggshell
      3rd Coat: ProIndustrial Pre-Catalyzed Epoxy, eggshell
SECTION 09900 – PAINTING

b. Acrylic epoxy – semi-gloss finish (Kitchen areas)
   Filler: Block Kote #2000
   2nd coat: ProlIndustrial Pre-Catalyzed Epoxy, semi-gloss
   3rd Coat: ProlIndustrial Pre-Catalyzed Epoxy, semi-gloss

3. Drywall and Plaster:

   a. Acrylic latex
      Primer: ProMar 200 zero VOC Primer
      2nd Coat: ProlIndustrial Pre-Catalyzed Epoxy
      3rd Coat: ProlIndustrial Pre-Catalyzed Epoxy

4. Wood:

   a. Acrylic epoxy
      Primer: Multi-Purpose Primer
      2nd Coat: ProlIndustrial Pre-Catalyzed Epoxy
      3rd Coat: ProlIndustrial Pre-Catalyzed Epoxy

   b. Transparent Stain with urethane finish
      1st coat: Minwax 250 Stain
      2nd Coat: Wood Classic Water Based Urethane
      3rd Coat: Wood Classic Water Based Urethane

5. Ferrous Metal:

   a. Gloss Finish - rust inhibitive primer with acrylic finish
      Primer: ProlIndustrial Pro-Cryl Primer
      1st Coat: DTM Acrylic Finish, semi-gloss
      2nd Coat: DTM Acrylic Finish, semi-gloss

6. Non-Ferrous Metal (New Galvanized and Aluminum):

   Primer: ProlIndustrial Pro-Cryl Primer
   1st Coat: DTM Acrylic Finish, semi-gloss
   2nd Coat: DTM Acrylic Finish, semi-gloss

7. Concrete Floors – light traffic (janitor closets and utility spaces)
   Primer: ArmorSeal Tread Plex Primer
   2nd coat: ArmorSeal Tread Plex Finish

8. Concrete Floors – High traffic epoxy
   Primer: ArmorSeal 1000HS @ 3.0-5.0 mils dft
   2nd coat: ArmorSeal 1000HS @ 3.0-5.0 mils dft

9. Exposed Ceiling Deck – dryfall coating
   Primer – Ferrous Metal: Kembond Alkyd Primer
   Primer – Non-Ferrous Metal: ProlIndustrial Pro-Cryl Primer
   Finish 1-2 coats: Waterborne Acrylic Dryfall

END OF SECTION 09900
SECTION 10156 - TOILET COMPARTMENTS (Plastic)

PART I  SCOPE

A. Requirements of the general conditions and special conditions apply to the work in this section.

B. Provide all labor, materials, etc. necessary for the completion of this section as specified or shown on the drawings.

C. Work of this section consists of, but is not limited to, the following:
   1. Toilet compartments
   2. Urinal screens
   3. Hardware, etc. for stalls
   4. Shop drawings

D. Work not included in this section:
   1. Toilet room accessories

PART II  SUBMITTALS

A. Submit electronic shop drawings, including details and a sample of each item of hardware for Architect's approval.

B. Provide drawings showing location for adequate steel reinforcements of wood blocking in walls to be provided by others for proper securement of the finished work.

C. Provide all manufacturer standard color and texture finish design options including traditional, bold, warm and metallic colors and finish options for Owner's selection.

D. Furnish documentation on hardware, headrail, and continuous wall bracket to meet specification as outlined.

PART III  MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
   1. Scranton Products
   2. Santana Products.
   3. Comtec Industries.
   5. or approved equal

B. Toilet compartment shall be floor mounted, overhead braced, with non-corrosive doors, panels, and pilasters.

C. Panels, doors and pilasters shall be fabricated from High Density Polyethylene (HDPE) containing a minimum of 10% recycled material manufactured under high pressure forming a single component section which is waterproof, nonabsorbent, and has a self-lubricating surface that resists marking with pens, pencils, or other writing utensils. All panels, doors, and pilasters to arrive at job site with special protective plastic covering.
SECION 10156 - TOILET COMPARTMENTS (Plastic)

D. Characteristics:

1. Dual component compression molded high density polyethylene (HDPE) of solid Poly-Mar HD, virgin resin materials in colors that extend throughout the surface; the panels, doors and pilasters shall have combined recycled and/or virgin material (HDPE) as the core material.
2. Doors, panels and pilasters shall be a minimum of 1" thick and all edges machined to a radius of .250" and all exposed surfaces to be free of saw marks.

E. Fabrication:

1. Dividing panels shall be 55" high and mounted at 14" above finished floor.
2. Doors shall be 55" and mounted 14" above finished floor.
3. Pilasters shall be 82" high, mounted within a one piece molded plastic shoe with one way theft proof, stainless steel sex bolts.
4. Aluminum edging strips to be fastened to the bottom edge of all doors and panels using vandal proof stainless steel fasteners.
5. Minimum clear height from finish floor to bottom of top rail shall be 80"

F. Technical Data:

1. Solid Plastics Products to be independently certified in writing by the manufacturer indicating compliance to appropriate building codes governing the project as it applies to the use of plastic in a commercial building.

G. Manufacturer to supply a written warranty covering all components and hardware against breakage, corrosion, and delamination for a period of 25 years.

PART IV HARDWARE

A. Door hardware shall be as follows:

1. Hinges 8 inches long, fabricated from heavy-duty extruded aluminum with bright dip anodized finish, wrap-around flanges, adjustable on 30-degree increments, through bolted to doors and pilasters with stainless steel, sex bolts. Hinges operate on field-adjustable nylon cams, field adjustable in 30 degree increments.
2. Each handicapped door to include (1) door pull and (1) wall stop.
3. Door strike and keeper shall be fabricated from heavy aluminum extrusion (6364-T5 Alloy) with clear anodized finish with wraparound flange surface mounted and thrubolted to door with one way de-burred bolts. Size of strike shall be 6" in length.
4. Door latch housing shall be fabricated from heavy aluminum extrusion (6364-T5 alloy) with clear anodized finish, surface mounted, and thru-bolted to door with one way de-burred bolts. Slide to bolt and button shall be heavy aluminum with Tuff-Coat Black anodized finish.

B. Pilaster Sleeves shall be 3 inches high, one-piece molded plastic shoe or stainless steel shoe secured to pilaster with stainless steel tamper resistant sex bolt.
SECTION 10156 - TOILET COMPARTMENTS (Plastic)

C. Provide full length double ear continuous extruded aluminum wall brackets. Brackets shall be used for all panels to pilaster, pilasters to wall, and panel to wall connections. Wall brackets shall be thru-bolted to panels and pilasters with one way de-burred bolts. Attachment of brackets to adjacent wall construction shall be accomplished by 12" #14 stainless steel tamper proof head screws anchored directly behind the vertical edge of panels and pilasters at 13" intervals along with full length of bracket and each 13" interval alternately spaced between anchor connections.

D. Headrail shall be heavy aluminum extrusion (6364-T5 Alloy) clear anodized finish in anti-grip configuration weighing not less than 1.188 lbs per linear foot as manufactured by Santana products, Inc., or approved equal. Headrail shall be fastened to tops of pilasters and headrail brackets by thru-bolting with one way stainless steel de-burred bolts (no cadmium plated bolts allowed).

E. Headrail brackets shall be 18 gauge stainless steel.

F. Hinge hold-open setting shall be 30 degrees for all non-handicapped stall doors. Handicapped doors shall be self closing.

G. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.

H. Urinal screens shall be panelsters design with integrated leg to floor.

SECTION V INSTALLATION

Erection of partitions, etc. shall be in accordance with the manufacturer's standard recommendations and the following:

A. All parts shall be erected in a substantial manner, straight, level and plumb.

B. No evidence of drilling, cutting or patching shall be visible in the finished work.

C. Clearance at vertical edges of doors shall be uniform top to bottom and shall not exceed 1/4".

D. Finish surfaces shall be cleaned after installation and left free of imperfections.

E. Authorized factory installers to be utilized.

F. Adjust doors and latches to operate correctly.

END OF SECTION 10156
PART 1 - GENERAL

1.01 Summary

A. This section includes the following types of wall protection systems:
   1. Wall Accent Rails
   2. Wall Protection Panel
   3. Wall Corner Guard
   4. Rub strips

1.02 References


B. American Society for Testing and Materials (ASTM)

C. Underwriters Laboratories (UL)

1.03 Submittals

A. General: Submit the following in accordance with conditions of contract and Division 1 specification Section 01300 – Submittals.

B. Product data and detailed specifications for each system component and installation accessory required, including installation methods for each type of substrate.

C. Shop drawings showing locations, extent and installation details of accent rails. Show methods of attachment to adjoining construction.

D. Samples for verification purposes: If the Basis of Design product is not being used, the Contractor will be required to submit the samples of each product proposed to be substituted in a mock-up wall.

E. Product test reports from a qualified independent testing laboratory showing compliance of each component with requirements indicated.

F. Provide installer qualification certifications in the Shop Drawing submission. Engage an installer who has no less than 3 years experience in installation of systems similar in complexity to those required for this project.

G. Provide manufacturer’s qualification certifications in the Shop Drawing submission. The manufacturer shall have not less than 5 years experience in the production of specified products and a record of successful in-service performance.

H. Provide manufacturer’s cut sheets or certification for the fire performance characteristics. Provide engineered PETG wall protection system assembled from components that are identical to those tested in accordance with ASTM E84 for Class B/2 characteristics listed below:
SECTION 10260 – WALL PROTECTION

1. Flame spread: 75 or less
2. Smoke developed: 450 or less

I. Provide manufacturer’s cut sheets or certification for the Chemical and stain resistance. Provide wall protection system components with chemical and stain resistance in accordance with ASTM D543.

1.04 Single source responsibility: Provide all components of the wall protection system manufactured by the same company to ensure compatibility of color, texture and physical properties.

1.05 Delivery, Storage and Handling

A. Deliver materials to the project site in unopened original factory packaging clearly labeled to show manufacturer.

B. Store materials in original, undamaged packaging in a clean, dry place out of direct sunlight and exposure to the elements. A minimum room temperature of 40°F (4°C) and a maximum of 100°F (38°C) should be maintained.

C. Materials must be stored flat.

1.06 Project Conditions

A. Materials must be acclimated in an environment of 65-75°F (18-24°C) for at least 24 hours prior to beginning the installation.

B. Installation areas must be enclosed and weatherproofed before installation commences.

PART 2 – PRODUCTS

2.01 Manufacturers

A. Interior surface protection products specified herein and included on the submittal drawings shall be manufactured by Construction Specialties, Inc. or approved equal.

B. Provide wall accent rail (WAR), wall protection panel (WPP) wall corner guard (WCG) wall protection system in locations shown on Drawings A-3 through A-7. Note that there is an Alternate Bid for additional areas also shown on these Drawings. Provide rubstrip (WRS) in every exam room on two (2) walls (the wall opposite the casework and the wall opposite the bed).

2.02 Materials

A. Wall Accent Rail-Chair rail (WAR-X) Colors to be indicated in the finish schedule from one of manufacturer’s available colors and patterns.
1. Medium Density Fiber (MDF): 3/4" (19.05mm) board material with no added urea formaldehyde.
2. Engineered PETG Accent Rails to be CS Acrovyn (or approved equal): Surface mounted assembly consisting of Acrovyn (or approved equal) 4000 sheet formed over shaped MDF board.
3. Model FR-251N 2 1/2" (63.5mm) high engineered PETG contemporary accent rail. Select from one of Acrovyn (or approved equal) solid colors or Chameleon™ simulated patterns.

B. Wall Protection Panel – (WPP-X) Colors to be indicated in the Finish Schedule from one of the manufacturer’s available colors and patterns.

1. Engineered PETG rigid sheet to be CS Acrovyn (or approved equal): Nominal .040" (1.02mm) thick rigid sheet supplied in 4’ x 8’ or 10’ (1.2m x 2.4m or 3.0m) sheet sizes in standard Suede texture. Engineered PETG: Rigid sheet should be high-impact Acrovyn 4000 with standard Suede texture, nominal .040" (1.02mm) thickness. Chemical and stain resistance should be per ASTM D543 standards as established by the manufacturer.
2. Model 4000 .040N Sheet. Select from one of Acrovyn (or approved equal) solid colors or Chameleon™ simulated patterns.

C. Wall Corner Guard- (WCG-X) Colors to be indicated in the Finish Schedule from one of the manufacturer’s available colors and patterns.

1. Engineered PETG: Extruded material should be high-impact Acrovyn (or approved equal) 4000 with Shadowgrain texture. Chemical and stain resistance should be per ASTM D543 standards as established by the manufacturer. Colors to be indicated in the finish schedule from one of manufacturer's available colors and patterns.
2. Engineered PETG Corner Guards to be CS Acrovyn (or approved equal): Surface mounted guards consisting of continuous Acrovyn 4000 cover.
3. Model VA-200N 90° surface mounted corner guard with 1 1/2" (38.0mm) legs self-adhesive tape backing. Select from one of Acrovyn (or approved equal) solid colors. For VA-200 and VA-250 a Chameleon™ (or approved equal) simulated pattern can also be selected

D. Rubstrips – (WRS-X) colors to be indicated on the Finish Schedule from one of the manufacturer’s available colors and patterns.

1. Model RS-40N supplied 6" high cut from nominal .040" (1.02mm) thick sheet with tapered upper and lower edges. Select from one of Acrovyn (or approved equal) solid colors or Chameleon™ simulated patterns.
2. Locations include: All Exam Rooms (2 walls w/rubstrip).
3. Engineered PETG Rubstrip to be CS Acrovyn (or approved equal): Material shall be secured to wall with standard adhesive.
4. Engineered PETG: Material should be high-impact Acrovyn (or approved equal) 4000 with Suede texture. Chemical and stain resistance should be per ASTM D543 standards as established by the manufacturer. Colors to be indicated in the finish schedule from one of manufacturer’s available colors and patterns.
SECTION 10260 – WALL PROTECTION

2.03 Fabrication
   A. General: Fabricate wall protection systems to comply with requirements indicated for design, dimensions, detail, finish and sizes.

2.04 Accessories
   A. Adhesive: Acrovyn wall protection shall be furnished as a complete packaged system, including appropriate standard adhesive.

PART 3 – EXECUTION

3.01 Examination
   A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
      1. Do not proceed until unsatisfactory conditions have been corrected.

3.02 Preparation
   A. Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.
   B. Protection: Take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions.

3.03 Installation
   A. Install the work of this section in strict accordance with the manufacturer's recommendations, using only approved adhesive, and locating all components firmly into position, level and plumb.
   B. Temperature at the time of installation must be between 65-75°F (18-24°C) and be maintained for at least 48 hours after the installation.

3.04 Cleaning
   A. General: Immediately upon completion of installation, clean rails and accessories in accordance with manufacturer's recommended cleaning method.
   B. Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work.

3.05 Protection
   A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION
SECTION 10425 - SIGNS AND PLAQUES

A.1 GENERAL

A. Submittals: Submit the following:

1. Shop Drawings: Provide plans, elevations, and sections showing typical members, anchors, layout, reinforcement, accessories, and installation details. Provide the following:
   a) A signage spread sheet with each door location, room name, room number and detailed layout.
   b) Setting drawings, templates, and directions for installing anchors.
   c) Full-size spacing templates for dimensional letters.
   d) Furnish full-size rubbings for metal plaques.

2. Samples: For initial selection of color, pattern, and surface texture, and for verification of compliance with requirements indicated.
   a) Standard room sign
   b) Standard bathroom sign
   c) Dimensional Letters: Full-size sample of each letter type.

3. Provide an additional ten (10) standard room signs as an allowance.

B. UL and NEMA Compliance: Provide electrical components that are labeled and listed by UL and comply with applicable NEMA standards.

C. Unless indicated otherwise provide two (2) Plaques – one at each building. Location of plaques to be determined by owner.

D. Marking and Identification:

1. At all new or existing firewalls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations within the work area where there is accessible concealed floor, floor-ceiling or attic space provide permanent signage in the concealed space as follows.
   a) Signage to be either signs or stenciled.
   b) Be located within 15 feet of the end of each wall and in intervals not exceeding 30 feet measured horizontally along the wall or partition.
   c) Include lettering not less than 3 inches in height with a minimum 3/8-inch stroke in contracting color.
   d) Wording: “FIRE AND/OR SMOKE BARRIER – PROTECT ALL OPENINGS” or other wording.
   e) Provide shop drawings of concealed space identification

1. Floor plan with all firewalls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations located.

2. Message list for each sign with wording and letter layout.
SECTION 10425 - SIGNS AND PLAQUES

A.2 PRODUCTS

A. Basis of Design: VISTA Sign Systems or approved equal

1. Standard Room Sign: Curved Vista Wall Sign 7.87" x 4.1575" x 0.84" with 1mm Glossy/Non-Glare lens with standard ADA tactile and Braille and digitally printed 10 mil double-sided matte rigid PVC film insert
   a) V200 (200mm/7.87") aluminum sign holder extrusion, Clear Anodized, 4.1575 inch.
   b) CC200 - Clear cover (Glossy/Non-Glare) for V200 extrusion (1mm thick), Glossy/Non-glare, 4 inch.
   c) 2 PEC200 - Plastic (ABS) end caps for V200 extrusion, Black.
   d) CCADA200 - ADA Lens for V200 extrusion (7.8" / 198mm)

2. Standard Room Sign with Slider (Psychology Exam Rooms only): Curved Vista Wall Sign 7.87" x 6.1575" x 0.84" with 1mm Glossy/Non-Glare lens with standard ADA tactile and Braille and digitally printed 10 mil double-sided matte rigid PVC film inserts.
   a) V200 (200mm/7.87") aluminum sign holder extrusion, Clear Anodize, 6.1575 inch.
   b) CC200 - Clear cover (Glossy/Non-Glare) for V200 extrusion (1mm thick), Glossy/Non-glare, 4 inch.
   c) 2 PEC200 - Plastic (ABS) end caps for V200 extrusion, Black.
   d) CCADA200 - ADA Lens for V200 extrusion (7.8" / 198mm)
   e) SLV200-PL-2in - Plastic slider element for V200 sign. 2" height.
   f) PS200B - Black dividing strip

3. Standard Room Sign (Bathrooms) 7.87" x 8" x 0.84" with 1mm Glossy/Non-Glare lens with standard ADA tactile and Braille and digitally printed 10 mil double-sided matte rigid PVC film insert
   a) V200 (200mm/7.87") aluminum sign holder extrusion, Clear Anodized, 8 inch.
   b) CC200 - Clear cover (Glossy/Non-Glare) for V200 extrusion (1mm thick), Glossy/Non-glare, 8 inch.
   c) 2 PEC200 - Plastic (ABS) end caps for V200 extrusion, Black.
   d) CCADA200 - ADA Lens for V200 extrusion (7.8" / 198mm)

4. Bathroom Flag Sign: 2 V200 (200mm/7.87") aluminum sign holder extrusions, Clear anodize, 8 inch non-glare lens with digitally printed 10 mil double-sided matte rigid PVC film inserts (2)
   a) 2 V200 (200mm/7.87") aluminum sign holder extrusions, Clear anodized
   b) 2 CC200 Clear Covers (Glossy/Non-Glare) for V200 extrusion (1mm thick)
   c) 4 PEC200 Plastic ABS end caps for V200 extrusion, Black
SECTION 10425 - SIGNS AND PLAQUES

d) FS20 Flag Sign 200mm Black

5. Office Suspended Sign (three (3) at Workforce building): SUS400 (403.7mm/15.9") aluminum sign suspended extrusions, Clear anodize, 16" x 48" non-glare lens with digitally printed 10 mil double-sided matte rigid PVC film inserts (2)

   a) SUS400 (403.7mm/15.9") aluminum sign suspended extrusions
   b) 2 CC 4 00 Clear Covers (Glossy/Non-Glare) for extrusion (1mm thick)
   c) 4 DSEC400SUS Plastic ABS end caps for, Black
   d) 2 HC100 Stainless steel cable 1.5mm, 3 foot
   e) 8 1MMC cable clamps

B. Window Vinyl Graphics

1. Premium Oracal 951 Cast vinyl or approved equal.

C. Acrylic Sheet: Cast methyl methacrylate monomer plastic sheet with 16,000-psi minimum flexural strength, and minimum allowable continuous service temperature of 176 deg F (80 deg C).

   1. Opaque Sheet: Colored opaque acrylic sheet in colors and finishes indicated.

D. Plastic Laminate: High-pressure plastic laminate engraving stock with face and core plies in contrasting colors.

E. Aluminum Sheet: Alloy and temper with properties specified in ASTM B 209 for 5005-H15.

F. Aluminum Castings: Alloy and temper recommended for the casting process used and for the use and finish indicated.

G. ABS Plastic: Provide high-impact thermoplastic composed of copolymers of acrylonitrile, butadiene, and styrene.

H. Fasteners: Concealed noncorrosive metal.

I. Anchors and Inserts: Nonferrous metal or hot-dipped galvanized. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts for concrete or masonry work.

J. Colored Coatings for Acrylic Plastic Sheet: Nonfading colored coatings, including inks and paints for copy and background colors.

K. Brackets: Fabricate brackets and fittings from extruded aluminum to suit panel construction and mounting conditions. Factory-paint brackets color matching background color of sign panel.

L. Graphic Content and Style: Provide sign copy that complies with size, style, spacing.
content, position, material, finishes, and colors of letters, numbers, and other graphic
devices. Also include braille lettering to meet the handicapped ADA requirements and

M. Raised Copy: Machine-cut copy characters from matte-finished opaque acrylic sheet and
chemically weld onto the acrylic sheet forming sign panel face.

2. Raised Copy Thickness: 1/8 inch.

N. Plaques: Castings shall be free from pits, scale, sand holes, or other defects. Comply
with requirements shown for thickness, size, shape, and copy. Hand-tool and buff
borders and raised copy to produce satin polished finish. Contents of plaques will be
supplied by Owner / Architect and may include logos, County Seals, Building Seals,
Mascots and Owner requested Graphics. Plaque size = 24" x 30"

1. Metal: Bronze.
2. Border Style: Raised flat band.
3. Background Color and Texture: Provide Manufacturer's standard finishes for
Owner's Selection.

O. Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations
and applications recommendations.

1. Aluminum Finishes: Finish designations prefixed by "AA" conform to the
system established by the Aluminum Association.

B. Baked-Enamel Finish: AA-M4xC12C42R1x. Comply with paint
manufacturer's specifications for cleaning, conversion coating, and
painting.

1) Organic Coating: Thermosetting-modified acrylic enamel
primer/topcoat system. Comply with AAMA 603.8 except with
a minimum dry film thickness of 1.5 mils, medium gloss.

a) Color: As selected by the Architect to match the
windows.

2. Bronze Castings: ASTM B 584, lead-free alloy recommended by manufacturer
and finisher for finish indicated.

P. Dimensional Letters:

1. Cast Letters: Individual characters and logo with smooth, flat faces, sharp corners
and precisely formed lines and profiles, free from pits, scale, sand holes, or other
defects. Cast lugs into back of characters and tap to receive threaded mounting
studs.

a. Metal: Aluminum
SECTION 10425 - SIGNS AND PLAQUES

2. Fabricated Letters: Metal, from exposed faces and sides and characters to produce surfaces free from wrap and distortion. Include internal bracing for stability and attachment of mounting accessories.

   a. Aluminum Sheet: Not less than 0.090 inch (2.3 mm) thick for front and not less than 0.063" for returns. Fabricate by heliarc welding process.
   b. Letter Style: Euroroman to match existing college sign. See Drawings.
   c. Illuminated Units: Use manufacturer standard lighting components including G.F.I. transformers, insulators, 277VAC U.L. recognized to GTO cabling, electrobits, insulator boots and other components. Make provisions for servicing and concealed connection to building system. Coordinate electrical characteristics with those of power supply provided.

   1) Backlighted Units: Use concealed white LED of indicated or required by size of characters. Include manufacturer hardware for projection mounting of characters at distance from wall surface indicated.

3. Finishes:

   a. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other appearance characteristics, provide color matches as selected from manufacturer full range, unless otherwise indicated.

   b. Aluminum:

      1) Painted Finish: Modified-acrylic enamel system.
         a) Color: White or as selected by Owner / Architect.

A.3 EXECUTION

A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.

1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Signage Used for Room Identification: Install in locations on walls as indicated and according to ADA accessibility standards.

C. Mounting Methods:
SECTION 10425 - SIGNS AND PLAQUES

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.
   
a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
   
b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in plaque as template. Countersink holes in plaque if required. Place plaque in position and flush to surface. Install through fasteners and tighten.

3. Brackets: Remove loose debris from substrate surface and install bracket supports in position so that plaque is correctly located and aligned.

4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of plaque and of suitable quantity to support weight of plaque after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as plaque is applied and to prevent visibility of cured adhesive at plaque edges. Place plaque in position, and push to engage adhesive. Temporarily support plaque in position until adhesive fully sets.

5. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of plaque and of suitable quantity to support weight of plaque without slippage. Keep strips away from edges to prevent visibility at plaque edges. Place plaque in position, and push to engage tape adhesive.

6. Shim-Plate Mounting: Provide 1/8-inch- (3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate.

A.4 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as plaques are installed.

C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner

END OF SECTION 10425
SECTION 10430 - ILLUMINATED DIMENSIONAL LETTERS / LOGO

Part 1  GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Illuminated dimensional letters.
2. Rowan University Flaming Torch Logo.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, wiring diagrams, and attachments to other Work.

1. Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

C. Samples: For each exposed finish.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

Part 2  PRODUCTS

2.1 MATERIALS

A. Aluminum Sheet: Alloy and temper recommended by manufacturer for use and finish indicated with not less than the strength and durability properties of ASTM B 209, alloy 5005-H15.

B. Aluminum Extrusions: Alloy and temper recommended by manufacturer for use and finish indicated with not less than the strength and durability properties of ASTM B 221, alloy 6063-T5.

C. Aluminum Castings: Alloy and temper recommended by manufacturer for casting process, use, and finish indicated.

D. Fasteners: Use fasteners fabricated from metals that are not corrosive to sign material and mounting surface.
SECTION 10430 - ILLUMINATED DIMENSIONAL LETTERS / LOGO

E. Anchors and Inserts: Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

F. Translucent White Acrylic Push-thru Graphics: Provide per the details on the Drawings.

2.2 DIMENSIONAL LETTERS

A. Cast Letters: Individual characters with smooth, flat faces, sharp corners, and precisely formed lines and profiles, free from pits, scale, sand holes, or other defects. Cast lugs into back of characters and tap to receive threaded mounting studs.

1. Metal: Aluminum

B. Fabricated Letters: Metal, form exposed faces and sides of characters to produce surfaces free from warp and distortion. Include internal bracing for stability and attachment of mounting accessories.

1. Aluminum Sheet: Not less than 0.090 inch (2.3 mm) thick for front and not less than 0.063" for returns. Fabricate by heliarc welding process.
2. Letter Style: See the drawings for Font and Size.
3. Illuminated Units: Use manufacturer's standard lighting components including 13 MM neon tubing G.F.I. transformers, insulators, 277VAC U.L. recognized GTO cabling, electrobits, insulator boots and other components. Make provisions for servicing and concealed connection to building system. Coordinate electrical characteristics with those of power supply provided.
   a. Backlighted Units: Use concealed white LED of indicated or required by size of characters. Include manufacturer's hardware for projection mounting of characters at distance from wall surface indicated.

2.3 ALUMINUM BOX CABINET

A. Provide UL listed 1/8" thick aluminum box cabinet with the cabinet lid mechanically fastened with blind fasteners to the frame in the field so as to be removeable for service. The cabinet shall be backlit with concealed white LED illumination. See drawings for details and locations.

B. Provide ½” translucent white acrylic push-thru panel. The panel shall push-thru 1/8” above the surface of the panel.

2.4 FINISHES

A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other appearance characteristics, provide color matches as selected from manufacturer's full range, unless otherwise indicated.

B. Aluminum:
SECTION 10430 - ILLUMINATED DIMENSIONAL LETTERS / LOGO

1. Painted Finish: Modified-acrylic enamel system.
   a. Custom color required. See drawings for Font and Color.

Part 3 EXECUTION

3.1 INSTALLATION

A. Install signs level, plumb, and at height indicated on the drawings, with sign surfaces free from distortion or other defects in appearance.

B. Dimensional Letters: Mount letters and numbers using standard fastening methods recommended by manufacturer for letter form, type of mounting, wall construction, and condition of exposure indicated. Use heavy paper template to establish letter spacing and to locate holes for fasteners.

1. Projected Mounting: With letter backs separated from wall surface by distance indicated.

END OF SECTION 10430
SECTION 10510 - METAL LOCKERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

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

B. DESCRIPTION: Furnish and install factory-assembled Heavy-Duty All-Welded Metal Lockers, complete, and in accordance with contract documents.

1. 2-Tier – 15” wide x 15” deep x 36” high / 72” overall

1.02 QUALITY ASSURANCE

A. MANUFACTURING STANDARD: Provide metal lockers that are standard products of a single manufacturer, with interchangeable like parts. Include necessary mounting accessories, fittings, and fastenings.

B. FABRICATOR QUALIFICATIONS: Firm experience (minimum 5 years) in successfully producing the type of metal lockers indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.

C. INSTALLER QUALIFICATIONS: Engage an experienced (minimum 5 years) installer who has successfully completed installation of the type of metal lockers and extent to that indicated for this project.

1.03 SUBMITTALS

A. GENERAL: Refer to Section 01300 - SUBMITTALS

B. SHOP DRAWINGS: Submit drawings showing locker types, sizes, quantities, including all necessary details relating to anchoring, trim installation and relationship to adjacent surfaces.

C. COLOR CHARTS: Provide color charts showing manufacturer's available colors (minimum 24). Provide metal samples if requested.

D. NUMBERING: Locker numbering sequence will be provided by the approving authority and noted on approved shop drawings returned to the locker contractor.

1.04 PRODUCT HANDLING

A. GENERAL: All work shall be fabricated in ample time so as to not delay construction process.

B. DELIVERY: All materials shall be delivered to the site at such a time as required for proper coordination of the work. Materials are to be received in the manufacturer's original, unopened packages and shall bear the manufacturer's label.
SECTION 10510 - METAL LOCKERS

C. STORAGE: Store all materials in a dry and well-ventilated place adequately protected from the elements.

1.05 GUARANTEE

A. LIFETIME WARRANTY: Submit upon completion of the work, in the form prescribed under section 01740 - GUARANTEE FORM, covering all defects in materials and workmanship excluding finish, damage resulting from deliberate destruction and vandalism under this section for the lifetime of the facility.

PART 2 - PRODUCTS

2.01 MATERIALS

A. AVAILABLE MANUFACTURERS: Provide all lockers and related accessories through one source from a single manufacturer. Basis of design shall be AMP-1003 Champ Corridor Lockers" as manufactured by Art Metal Products or approved equal. Subject to compliance with the design, material, method of fabrication and installation as required in this specification section or modified as shown on drawings, the following manufacturers products are acceptable.

1. Art Metal Products (Basis of Design)
2. Hallowell
3. DeBourgh Mfg
4. Or approved equal

B. STEEL:

1. Steel Sheet: All sheet steel used in fabrication shall be prime grade free from scale and imperfections and capable of taking a heavy coat of high gloss baked enamel.

C. FASTENERS:

1. General: Cadmium, zinc or nickel plated steel; bolt heads, slotless type; self locking nuts or lock washers. On joining sections only.

D. EQUIPMENT:

1. Hardware: Hooks and hang rods of cadmium plated or zinc plated steel or cast aluminum.
3. Number Plates: To be polished aluminum with not less than 3/8" high etched numbers attached to door with two aluminum rivets.
SECTION 10510 - METAL LOCKERS

2.02 FABRICATION

A. GENERAL: All lockers shall be factory-assembled, of all MIG welded construction, in multiple column units to meet job conditions. Assembly of locker bodies by means of bolts, screws, or rivets will not be permitted. Welding of knockdown locker construction is not acceptable. Grind exposed welds and metal edges flush and make safe to touch.

B. FINISH: All locker parts to be cleaned and coated after fabrication with a seven stage zinc/iron phosphate solution to inhibit corrosion, followed by a coat of high grade enamel electrostatically sprayed and baked at 325 degrees Fahrenheit for a minimum of 30 minutes to provide a tough durable finish. Color to be selected from manufacturer's standard list of colors.

C. LOCKER TYPES - VENTILATION SCHEDULE:
   1. Doors: Wardrobe doors to have standard louvers.
   2. Sides: Locker sides to be 16 gauge solid.
   3. Backs, tops, bottoms, and intermediate shelves shall be solid.

D. WARDROBE DOOR: Outer door to be fabricated from single sheet prime 14 gauge with single bends at top and bottom and double bends at the sides with a 3-1/2" wide 18 gauge full height channel door stiffener spot welded to the inside of door face and MIG welded to the hinge side of the door as well as to the top and bottom door return bends to form a rigid torque-free box reinforcement for the door. All doors shall be right hand side hinged.

E. SEAMLESS DRAWN STAINLESS STEEL RECESSED LOCKER HANDLE: All locker doors shall have a seamless drawn stainless steel recessed handle shaped to receive a padlock or built-in combination lock. The recess pan shall be deep enough to have the lock be completely flush with the outer door face. The pull handle shall be drawn into the left side of the handle for easy opening of the locker door.

F. LATCH ASSEMBLY: The latching mechanism shall be finger lift control type constructed of 14 gauge (minimum) steel with a nylon cover that has a generous finger pull. Spring activated nylon slide latches shall be completely enclosed in the lock channel allowing doors to close with the lock in the locked position. Locking devise shall be designed for use with either built-in combination locks or padlocks. Latch hooks shall be 12 gauge (minimum) and shall be MIG welded to vertical frame member.

G. DOOR HINGES: Hinges for wardrobe and gym doors shall not be less than 16 gauge continuous piano type, securely riveted to frame and welded to the door. All doors shall be right hand side hinged. Lockers without continuous hinges are unacceptable.
SECTION 10510 - METAL LOCKERS

H. TWIN-FRAME / VERTICAL SIDE PANELS: Shall be of integral frame and side wall construction manufactured from 16 gauge sheet steel. The frames shall be formed to provide a continuous door strike on the latch side. An additional continuous vertical door strike shall be achieved at the hinge side by MIG welding a 16 gauge full height channel frame member to the integral locker side producing a rigid torque-free welded locker body.

I. HAT SHELVES, INTERMEDIATE SHELVES AND BOTTOMS: Shall be 16 gauge sheet steel, have double bends at front and shall MIG welded to the side.

J. BACKS: Shall be 18 gauge cold rolled sheet steel, be continuous to cover a multiple framed unit and be welded to each vertical side panel.

K. WELDED MULTIPLE TIER: Shall have a 1 ½" wide 18 gauge full height door stiffener spot welded to the inner door face and MIG welded to the hinge side as well as the top and bottom door flanges providing a rigid and torque-free door.

L. LOCKER ACCESSORIES:

1. Locks: Provide ring in recessed handle to receive padlock.
2. Equipment: Furnish each locker with the following items, unless otherwise shown.
   a. Double tier lockers: Openings 36” high shall include one double prong ceiling hook.
3. Finished End Panels: Shall be "Boxed" type formed from 16 gauge cold rolled steel with 1” O.D. double bends on sides and a single bend at top and bottom with no exposed holes or bolts. Lockers with slope tops will have end panels formed with slope at top to cover the ends of the slope tops. Finish to match lockers. Provide at all exposed ends.
4. Fillers: Provide where indicated, of not less than 16 gauge sheet steel, factory fabricated and finished to match lockers.
5. Continuous Sloped Tops: Provide continuous sloped tops fabricated of 16 gauge (.0598 inch) thick steel sheet. Sloped tops fabricated of 18 gauge (.0478 inch) thick steel sheet will not be accepted.
6. Continuous Metal Base: Provide continuous 4” high metal base for all lockers fabricated of 16 gauge (.0598 inch) thick steel sheet. All corners/edges should be welded.

PART 3 - EXECUTION

3.01 INSTALLATION

A. GENERAL: Installation shall be in strict conformance with referenced standards, the manufacturer's written directions, as shown on the drawings and as herein specified.
SECTION 10510 - METAL LOCKERS

B. PLACEMENT: Lockers shall be set in place, plumb, level, rigid, flush and securely attached to the wall (or bolted together if back-to-back) and anchored to the floor or base according to manufacturer's specifications.

C. ANCHORAGE: About 48" o.c., unless otherwise recommended by manufacturer, and apply where necessary to avoid metal distortion, using concealed fasteners. Friction cups are not acceptable.

D. TRIM: Sloping tops, metal fillers and boxed end panels shall be installed using concealed fasteners. Provide flush, hairline joints against adjacent surfaces.

3.02 ADJUSTMENT

A. GENERAL: Upon completion of installation, inspect lockers and adjust as necessary for proper door operation. Touch-up scratches and abrasions to match original finish.

END OF SECTION
SECTION 10522 - FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

1.1 GENERAL

A. Submittals: Submit the following:

1. Product Data: Include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials.

2. Samples for Initial Selection: Manufacturer's color charts showing full range of colors, textures, and patterns available for each finish indicated or exposed to view.

B. Coordination: Verify that cabinets are sized to accommodate type and capacity of extinguishers indicated.

C. UL-Listed Products: Fire extinguishers shall be UL listed with UL listing mark for type, rating, and classification of extinguisher.

D. FM-Listed Products: Fire extinguishers approved by Factory Mutual Research Corporation for type, rating, and classification of extinguisher with FM marking.

1.2 PRODUCTS

A. Fire Extinguishers: Provide fire extinguishers for each cabinet and for other locations indicated.

1. In the Wet Research Lab and the Hazardous Materials Waste Storage Provide Multipurpose Dry Chemical Type: Type MP-10, UL-rated 4-A:60-B:C, 10 lb nominal capacity, in enameled steel container.

2. In the Lobby Café provide Class "K" high hazard dry chemical 4-A, 60:B:C, 10 lb. capacity in enameled steel container.

3. As indicated on the drawings, provide Multipurpose Dry Chemical Type: UL-rated 2-A:10:B:C, 5 pound nominal capacity in steel container to hang on bracket or in a cabinet.

B. Cabinet Construction: Box with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.

1. Fire-Rated Cabinets: UL listed with UL listing mark with fire-resistance rating of wall where it is installed.

2. Cabinet Type: Suitable for containing the following:
   a. Fire extinguisher.

3. Cabinet Mounting: Suitable for the mounting indicated:
   a. Semirecessed: Partially recessed in walls of shallow depth.

4. Trim Style: One piece with corners mitered, welded, and ground smooth.
   a. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge.

1) Rolled-edge with 2-1/2-inch backbend depth.
2) Metal: Same metal and finish as door.

C. Door Material and Construction: Manufacturer's standard of material indicated, coordinated with cabinet types and trim styles selected.

1. Enameled Steel: Hollow construction with tubular stiles and rails.
2. Door Glazing: Fully tempered float glass complying with ASTM C 1048, Condition A, Type I, Quality q3, Kind FT, and Class as follows:
   a. Class 1 (clear).
3. Identify fire extinguisher in cabinet with FIRE EXTINGUISHER lettering applied to door. Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location.

D. Door Style: Manufacturer's standard design.

1. Full-Glass Panel: Fully tempered, Float glass, 1/8 inch thick.

E. Door Hardware: Provide door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

F. Cabinet Finishes: Comply with NAAMM "Metal Finishes Manual." Protect exposed finishes from damage by application of temporary strippable covering prior to shipment.

G. Steel Cabinet Finishes: Solvent-clean surfaces to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust from uncoated steel.

1. Baked-Enamel Finish: Immediately after cleaning and pretreatment, apply a two-coat baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's instructions for application and baking to achieve a minimum dry film thickness of 2.0 mils.
   a. Color and Gloss: As selected from manufacturer's standard choices for color and gloss. Paint the following:
      1) Exterior of cabinet except for surfaces indicated to receive another finish.
      2) Interior of cabinet.

1.3 EXECUTION

A. Installation: Follow manufacturer's printed instructions.

B. Install at heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities and meet State and handicapped codes and ADA requirements.

1. Prepare wall recesses for cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.
SECTION 10522 - FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

2. Fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb.

END OF SECTION 10522
SECTION 10650 - OPERABLE PARTITIONS

PART 1 – GENERAL

1.01 DESCRIPTION

A. General

1. Furnish and install operable partitions and suspension system. Provide all labor, materials, tools, equipment, and services for operable walls in accordance with provisions of contract documents.

1.02 RELATED WORK BY OTHERS

A. Preparation of opening will be by General Contractor. Any deviation of site conditions contrary to approved shop drawings must be called to the attention of the architect.

B. All header, blocking, support structures, jambs, track enclosures, surrounding insulation, and sound baffles as required in 1.04 Quality Assurance.

C. Prepunching of support structure in accordance with approved shop drawings.

D. Paint or otherwise finishing all trim and other materials adjoining head and jamb of operable partitions.

1.03 SUBMITTALS

A. Complete shop drawings are to be provided prior to fabrication indicating construction and installation details. Shop drawings must be submitted within 60 days after receipt of signed contract.

1.04 QUALITY ASSURANCE

A. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions

B. The partition STC (Sound Transmission Classification) shall be achieved per the standard test methods ASTM E90.

C. Noise isolation classifications shall be achieved per the standard test methods ASTM E336 and ASTM E413.

D. Noise Reduction Coefficient (NRC) ratings shall be per ASTM C423.

E. Rack testing for 10 years. (tensional strength stress test)

F. The manufacturer shall have a quality system that is registered to the ISO 9001 standards.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Proper storage of partitions before installation and continued protection during and after installation will be the responsibility of the General Contractor.
SECTION 10650 - OPERABLE PARTITIONS

1.06 WARRANTY

A. Partition system shall be guaranteed for a period of two years against defects in material and workmanship, excluding abuse.

PART 2 - PRODUCTS

2.02 MATERIALS

A. Product to be top supported Series 631 individual, omni-directional panels as manufactured by Hufcor Inc. or approved equal.

1. Panels shall be nominally 3" [76] thick and to 48" [1219] in width.
2. Panel faces shall be laminated to appropriate substrate to meet the STC requirement in 2.04 Acoustical Performance.
3. Frames shall be of 16 gauge [1.42mm] painted steel with integral factory applied aluminum vertical edge and face protection. Panels without vertical trim are unacceptable.
4. Vertical sound seals shall be of tongue and groove configuration, ensure panel-to-panel alignment and prevent sound leaks between panels.
5. Horizontal top seals shall be fixed continuous contact dual 4-finger vinyl.
6. Horizontal bottom seals shall be retractable, provide up to 2" [50] nominal operating clearance, and exert downward force when extended. Automatic and protruding bottom seals are unacceptable.
7. Horizontal trim shall be of aluminum.

B. Weight of the panels shall be 8.9 lbs. per sq. ft.

C. Suspension system type 26 dual puck track:

1. Track shall be of clear anodized architectural grade extruded aluminum alloy 6063-T6. Track design shall provide precise alignment at the trolley running surfaces and provide integral support for adjoining ceiling, soffit, or plenum sound barrier. Track shall be connected to the structural support by pairs of minimum 3/8" [10] dia. threaded steel hanger rods. Pairs of rods are directly attached to the track, no single point attachment allowed. L, T, or X intersections shall be factory assembled and welded.

a. Each panel shall be supported by two 2-wheeled counter-rotating horizontal carriers. Wheels to be of precision ground steel ball bearings with heat treated and hardened races encased with molded polymer tires. Panels using single pucks are unacceptable. Steel track is unacceptable.

D. Finishes

1. Face finish shall be:

a. Factory applied reinforced vinyl fabric with woven backing, weighing not less than 15 oz. per lineal yard [465 g/m]. Color shall be selected from manufacturer’s standard color selectors.
SECTION 10650 - OPERABLE PARTITIONS

2. Exposed metal trim and seal color shall be, trimless panels are unacceptable:
   a. Lamb’s Wool (standard)
   b. Brown (standard)
   c. Gray (standard)

3. Aluminum track shall be clear anodized, painted steel tracks are unacceptable.

2.03 OPERATION

A. Panels are manually moved from the storage area, positioned in the opening, and seals set.

B. Retractable Horizontal Seals

1. Retractable horizontal seals shall be activated by a removable quick-set operating handle located approximately 42” [1067] from the floor in the panel edge. Seal activation requires approximately 15 lbs. [6.8 kg] of force per panel and approximately a 190 degree turn of the removable handle.

D. Final partition closure to be by (select one):

1. Lever closure panel with expanding jamb which compensates for minor wall irregularities and provides a minimum of 250 lbs. [113.4 kg] seal force against the adjacent wall for optimum sound control. The jamb activator shall be located approximately 45” [1143] from the floor in the panel face and be accessed from either side of the panel. The jamb is equipped with a mechanical rack and pinion gear drive mechanism and shall extend 4”-6” [100-152] by turning the removable operating handle.

2.04 ACOUSTICAL PERFORMANCE

A. Acoustical performance shall be tested at a laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) and in accordance with ASTM E90 Test Standards. Standard panel construction shall have obtained an STC rating of 50.

1. Complete, unaltered written test report is to be made available upon request.

PART 3 – EXECUTION

A. Installation. The complete installation of the operable wall system shall be by an authorized factory-trained installer and be in strict accordance with the approved shop drawings and manufacturer’s standard printed specifications, instructions, and recommendations.

B. Cleaning

1. All track and panel surfaces shall be wiped clean and free of handprints, grease, and soil.
2. Cartoning and other installation debris shall be removed to onsite waste collection area, provided by others.

C. Training
SECTION 10650 - OPERABLE PARTITIONS

1. Installer shall demonstrate proper operation and maintenance procedures to owner's representative.
2. Operating handle and owner's manuals shall be provided to owner's representative.

END OF SECTION
SECTION 10800 - TOILET AND BATH ACCESSORIES - ECONOMIC DEVELOPMENT CENTER

1.1 GENERAL

A. Submittals: Manufacturer's product data for each toilet accessory item specified, including details of construction relative to materials, dimensions, gages, profiles, mounting methods, specified options, and finishes.

B. Samples: Full-size samples of the following toilet accessory items to verify design, operation, and finish requirements. Acceptable samples will be returned and may be used in the Work:

1. Paper Towel Dispenser
2. Stainless steel framed mirror unit
3. Toilet tissue dispenser
4. Soap Dispenser
5. Grab Bar
6. Waste Receptacle
7. Sanitary Napkin Disposal
8. Napkin/Tampon Vendor
9. Trash Container
10. Toilet seat cover dispenser
11. Horizontal recessed mounted stainless steel finish Baby Changing Station
12. Lavatory Shield

1.2 PRODUCTS

A. Manufacturers: Subject to compliance with requirements, all items shown in this section are Bobrick Products. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following or approved equal:

1. A & J Washroom Accessories
2. American Specialties, Inc.
4. Bradley Corporation
5. General Accessory Manufacturing Co.
6. McKinney/Parker
7. Kimberly/Clark
8. Georgia Pacific

B. Materials, General: Fabricate toilet accessory items from the following materials and according to requirements specified for individual accessory items:

1. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 0.034-inch (22-gage) minimum thickness, unless otherwise indicated.
2. Brass: Leaded and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16; Castings, ASTM B 30.
3. Sheet Steel: Cold-rolled, commercial quality ASTM A 366, 0.04-inch (20-gage) minimum thickness, unless otherwise indicated. Surface preparation and metal pretreatment as required for applied finish.
4. Galvanized Steel Sheet: ASTM A 527, G60.
7. Mirror Glass: Tempered Glass Nominal 6.0-mm (0.23-inch) thick, conforming to ASTM C 1036, Type I, Class 1, Quality q2, and with silvering, electro-plated copper coating, and protective organic coating.
9. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.
10. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply, etc. Provide a minimum of six keys to Owner's representative.

C. Paper Towel Dispense: Provided by the Owner to be installed by the Contractor.
D. Mirror Units: Provided by the Owner to be installed by the Contractor.
E. Toilet Tissue Dispenser: Provided by the Owner to be installed by the Contractor.
F. Soap Dispenser: Provided by the Owner to be installed by the Contractor.
G. Stainless Steel Grab Bars: Provided by the Owner to be installed by the Contractor.
H. Waste Receptacle: Provided by the Owner to be installed by the Contractor.
I. Sanitary Napkin Disposal: Provided by the Owner to be installed by the Contractor.
J. Surface-Mounted Napkin/Tampon Vendor: Provided by the Owner to be installed by the Contractor.
K. Trash Container in Single User Toilets: Provided by the Owner to be installed by the Contractor.
L. Toilet Seat Cover Dispenser: Provided by the Owner to be installed by the Contractor.
M. Horizontal Recessed Mounted Stainless Steel Finish Baby Changing Station: Provide and install Model KB110-SSRE by Koala Kare or approved equal.
N. Lavatory Shield: Provide and install Lav Shield Model 2018-AS-L by TRUBRO or approved equal on all wall hung china lavatories.
P. Fabrication: Only a maximum 1-1/2-inch diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of toilet or bath accessory units. On either interior surface not exposed to view or back surface, provide additional identification by means of either a waterproof, printed label or a stamped nameplate, indicating manufacturer's name and product model number.
SECTION 10800 - TOILET AND BATH ACCESSORIES - ECONOMIC DEVELOPMENT CENTER

Q. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.

R. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamperproof glass installation and prevent moisture accumulation, as follows:

1. Provide galvanized steel backing sheet, not less than 0.034 inch (22 gage) and full mirror size, with non-absorptive filler material. Corrugated cardboard is not an acceptable filler material.

S. Mirror Unit Hangers: Provide system of mounting mirror units that will permit rigid, tamperproof, and theft-proof installation, as follows:

1. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

1.3 EXECUTION

A. Installation: Install toilet accessory units according to manufacturers' printed installation instructions, using fasteners appropriate to substrate as recommended by unit manufacturer. Install units plumb and level, firmly anchored in locations and at heights indicated.

1. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set the units plumb, level, and square at locations indicated, in accordance with manufacturer's instructions for type of substrate involved.

2. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

3. Clean and polish all exposed surfaces strictly according to manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION 10800
SECTION 10805 - TOILET AND BATH ACCESSORIES - ROWAN MEDICINE

1.1 GENERAL

A. Submittals: Manufacturer's product data for each toilet accessory item specified, including details of construction relative to materials, dimensions, gages, profiles, mounting methods, specified options, and finishes.

B. Samples: Full-size samples of the following toilet accessory items to verify design, operation, and finish requirements. Acceptable samples will be returned and may be used in the Work:

1. Stainless Steel Horizontal Grab Bar (42” x 1 ½” diameter)
2. Waste Receptacle
3. Horizontal Recessed Mounted Stainless Steel Finish Baby Changing Station
4. Special Needs Stainless Steel Diaper Changing Station
5. Mirror (24” x 60”) with Stainless Steel Frame
6. Paper Towel Dispenser
7. Stainless Steel Vertical Grab Bar (18” x 1 ½” diameter)
8. Commercial High Capacity Soap Dispenser
9. Stainless Steel Vertical or Horizontal Grab Bar (24” x 1 ½” diameter)
10. Surface Mounted Napkin/Tampon Vendor
11. Surface Mounted Sanitary Napkin Disposal
12. 3-Roll Toilet Tissue Dispenser
13. Stainless Steel Horizontal Grab Bar (36” x 1 ½” diameter)
14. Toilet Seat Cover Dispenser
15. Vanity Length with Mirror
16. Lavatory Shield
17. Recessed Specimen Pass-Thru Cabinet
18. Mirror (18” x 60”) with Stainless Steel Frame
19. Foam Hand Dispenser
20. Wall Mounted Gym Wipes Dispenser

1.2 PRODUCTS

A. Manufacturers: Subject to compliance with requirements, all items shown in this section are Bobrick Products. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following or approved equal:

1. A & J Washroom Accessories
2. American Specialties, Inc.
4. Bradley Corporation
5. General Accessory Manufacturing Co.
6. McKinney/Parker
7. Kimberly/Clark
8. Georgia Pacific

B. Materials, General: Fabricate toilet accessory items from the following materials and according to requirements specified for individual accessory items:
SECTION 10805 - TOILET AND BATH ACCESSORIES - ROWAN MEDICINE

1. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 0.034-inch (22-gage) minimum thickness, unless otherwise indicated.
2. Brass: Lead and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16; Castings, ASTM B 30.
3. Sheet Steel: Cold-rolled, commercial quality ASTM A 366, 0.04-inch (20-gage) minimum thickness, unless otherwise indicated. Surface preparation and metal pretreatment as required for applied finish.
4. Galvanized Steel Sheet: ASTM A 527, G60.
7. Mirror Glass: Tempered Glass Nominal 6.0-mm (0.23-inch) thick, conforming to ASTM C 1036, Type I, Class 1, Quality Q2, and with silvering, electro-plated copper coating, and protective organic coating.
9. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.
10. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply, etc. Provide a minimum of six keys to Owner's representative.

C. Stainless Steel Horizontal Grab Bar (42” x 1 ½” diameter) with satin finish: Provide and install Model B-6806-42 by Bobrick or approved equal.

D. Waste Receptacle: Provided by the Owner to be installed by the Contractor.

E. Horizontal Recessed Mounted Stainless Steel Finish Baby Changing Station: Provide and install Model KB110-SSRE by Koala Kare or approved equal.

F. Special Needs Stainless Steel Diaper Changing Station: Provide and install Model 100-SSE-SM by Foundations Worldwide, Inc. or approved equal.

G. Mirror (24” x 60”) with Stainless Steel Frame: Provide and install Model B-165 2460 by Bobrick or approved equal.

H. Paper Towel Dispenser: In all Exam Rooms, Kitchen Sinks and two (2) in the Wet Research Lab provide and install Model RENO5153 by Renown or approved equal. In all Restrooms provide and install Model KCC09990 by Supply Works or approved equal.

I. Stainless Steel Vertical Grab Bar (18” x 1 ½” diameter) with satin finish: Provide and install Model B-6806-18 by Bobrick or approved equal.

J. Commercial High Capacity Soap Dispenser: Outside all Exam Rooms, Kitchen Sinks and one (1) in the Wet Research Lab provide and install Purell ADX-12 Hand Sanitizer Dispenser Model GOJ8820-06 by GOJO or approved equal.

K. Stainless Steel Vertical or Horizontal Grab Bar (24” x 1 ½” diameter) with satin finish: Provide and install Model B-6806-24 by Bobrick or approved equal.
L. Surface Mounted Napkin/Tampon Vendor: Provide and install Model B-2706 25 by Bobrick or approved equal.

M. Surface Mounted Sanitary Napkin Disposal: In all Restrooms provide and install Model B-270 by Bobrick or approved equal.

N. 3-Roll Toilet Tissue Dispenser: In all Restrooms Provide and install Model RENO5161-WB by Renown or approved equal. The Color shall be black.

O. Stainless Steel Horizontal Grab Bar (36” x 1 ½” diameter) with satin finish: Provide and install Model B-6806 x 36 by Bobrick or approved equal.

P. Toilet Seat Cover Dispenser: In all Restrooms provide and install Model NS-FH33-PC by Neatseal or approved equal.

Q. Vanity Length Mirror: Provide and install 4’ High x Vanity Length Wall. See the drawings for the length.

R. Lavatory Shield: Provide and install Lav Shield Model 2018-AS-L by TRUBRO or approved equal on all wall hung china lavatories

S. Recessed Specimen Pass-Thru Cabinet: Provide and install Model B-50517 by Bobrick or approved equal.

T. Mirror (18” x 60”) with Stainless Steel Frame: Provide and install Model B-165 1860 by Bobrick or approved equal.

U. Foam Hand Dispenser: In all Exam Rooms, Kitchen Sinks, Restrooms and two (2) in the Wet Research Lab provide and install Model RENO2517 by Renown or approved equal. The unit shall be Gray-White in color and have a capacity of 1,250 ML.

V. Wall Mounted Gym Wipes Dispenser: In the OMM Lab provide and install two (2) Model XLC80 by Supplyworks or approved equal.

W. Fabrication: Only a maximum 1-1/2-inch diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of toilet or bath accessory units. On either interior surface not exposed to view or back surface, provide additional identification by means of either a waterproof, printed label or a stamped nameplate, indicating manufacturer's name and product model number.

X. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.

Y. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamperproof glass installation and prevent moisture accumulation, as follows:
1. Provide galvanized steel backing sheet, not less than 0.034 inch (22 gage) and full mirror size, with non-absorptive filler material. Corrugated cardboard is not an acceptable filler material.

2. Mirror Unit Hangers: Provide system of mounting mirror units that will permit rigid, tamperproof, and theft-proof installation, as follows:

1. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

1.3 EXECUTION

A. Installation: Install toilet accessory units according to manufacturers' printed installation instructions, using fasteners appropriate to substrate as recommended by unit manufacturer. Install units plumb and level, firmly anchored in locations and at heights indicated.

1. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set the units plumb, level, and square at locations indicated, in accordance with manufacturer's instructions for type of substrate involved.

2. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

3. Clean and polish all exposed surfaces strictly according to manufacturer’s recommendations after removing temporary labels and protective coatings.

END OF SECTION 10805
SECTION 10820 – LOUVERED ROOF TOP EQUIPMENT SCREENS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvered roof top equipment screens

1.2 PERFORMANCE REQUIREMENTS

A. Design: Design louvers, including comprehensive engineering analysis by a qualified engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.

1. Wind Loads: Determine loads based on a uniform pressure of 30 lb./sq. ft. (1435 Pa), acting inward or outward.

1.3 SUBMITTALS

A. Product Data: Provide product data for the type of product indicated.

B. Shop Drawings: Provide a complete set of Engineered, Signed and Sealed by a NJ Professional Engineer, drawings and calculations for the equipment screens and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1.4 WARRANTY

A. Provide a Manufacturer’s Standard Warranty for one (1) year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221M, Alloy 6063-T5.

B. Aluminum Sheet: ASTM B 209M, Alloy 3003 with temper as required for forming.
SECTION 10820 – LOUVERED ROOF TOP EQUIPMENT SCREENS

C.  Fasteners: Use types and sizes to suit unit installation conditions.
   1.  For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

2.2  FABRICATION, GENERAL

A.  Join concealed frame members to each other and to fixed louver blades with fillet welds concealed from view welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3  EXTRUDED-ALUMINUM ROOF TOP EQUIPMENT SCREEN

A.  Direct Mount Horizontal Blade Louvered Roof Top Equipment Screen

1.  Basis-of-Design Product: Architectural Louvers Co. (Harray, LLC); Model V4JSD. Subject to compliance with requirements, provide the specified product or comparable product by one of the following:
   a.  Manufacturers of products submitted and approved in accordance with Section 01300 - Submittals.

2.  Louver Blade Depth: 4 inches (100 mm)
3.  Blade Profile: Plain blade without center baffle.
4.  Blade and Frame Nominal Thickness: Not less than 0.080 inch (2.03 mm).
5.  Framing Support: Modular aluminum tube framing, not less than 0.140 inch thickness. Design and construction of framing and connections to handle design wind loads. Framing to mount directly to air handling unit as shown on drawings.
6.  Hinge: 0.120" thickness aluminum heavy-duty hinge. Each louver panel to be hinged for full access to the air handling unit.
7.  Latch: top and bottom slam latch (provided)
8.  Louver Performance Requirements:
   a.  Free Area: Not less than 8.0 sq. ft. (0.74 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver assembly.
   b.  Horizontal Drag Coefficient: Not greater than 0.63 on a cross sectional profile, allowing for a 37% reduction in wind load imposed horizontally upon supporting structural framing.

2.4  ALUMINUM FINISHES

A.  High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1.  Color and Gloss: As selected by Architect from manufacturer's full range.
SECTION 10820 – LOUVERED ROOF TOP EQUIPMENT SCREENS

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place equipment screens level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.

C. Provide perimeter reveals and openings of uniform width to allow for thermal expansion, as indicated.

D. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.

END OF SECTION 10820
SECTION 11131-PROJECTION SCREENS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrically operated, ceiling recessed, front projection screens.
B. Manually operated, wall mounted project screens.

1.2 RELATED DOCUMENTS

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

1.3 SUBMITTALS

A. Submit under provisions of Section 01300 - Submittals.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
C. Wiring diagram for electrically operated units.
D. Shop Drawings: Shop drawings showing layout and types of projection screens. Show the following:
   1. Location of screen centerline.
   2. Location of wiring connections.
   4. Detailed drawings for concealed mounting.
   5. Connections to suspension systems.
   6. Anchorage details.
   7. Accessories.
   8. Frame details.
E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain each type of projection screen required from a single manufacturer as a complete unit, including necessary mounting hardware and accessories.
B. Coordination of Work: Coordinate layout and installation of projection screens with other construction supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system, and partitions. Provide and coordinate the electrical requirements and voltage.
SECTION 11131-PROJECTION SCREENS

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed and other construction where screens will be installed is substantially complete.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Protect screens from damage during delivery, handling, storage, and installation.

1.6 COORDINATION

A. Coordinate work with installation of ceilings, walls, electric service power characteristics, and location.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Draper, Inc., which is located at: 411 S. Pearl P. O. Box 425; Spiceland, IN 47385-0425; Toll Free Tel: 800-238-7999; Tel: 765-987-7999; Email: drapercontract@draperinc.com; Web: www.draperinc.com

B. Or approved equal.

2.2 MOTORIZED, CEILING RECESSED, FRONT PROJECTION SCREENS

A. Access/Series E: Electric motor operated, extruded aluminum case. Ceiling-recessed, extruded aluminum headbox 9 inches (229 mm) deep and 7 inches (178 mm) wide. Extruded aluminum housing with white paint finish and stamped steel end caps. UL approved "Suitable for use in environmental air space." Bottom closure panel forms slot for passage of viewing surface and is removable for access to operating mechanism and viewing surface. Bottom perimeter flange provides support and trim for acoustical ceiling panels and trim for gypsum board ceiling. The Access case may be ordered in advance and the screen installed later to eliminate field damage. The screen installs in minutes. Housing is symmetrical allowing for left and right hand motor locations and for viewing surface to unroll off front or back of roller. Housing designed with internal junction box and plug-in wiring connections to allow housing to be installed and connected to building power supply separately from motor and viewing surface.

1. Motor mounted inside screen roller on rubber isolation insulators. Motor UL certified, rated 110-120V AC, 60 Hz, three wire, instantly reversible, lifetime lubricated with pre-set accessible limit switches. Motor with overload protection and electric brake.

   a. Single station control rated 115V AC, 60 Hz with 3-position rocker switch with cover plate to stop or reverse screen at any point.

2. Projection Viewing Surface:

   a. Matt white, washable surface. For use with any type projector where light can be controlled. GREENGUARD® (or approved equal) for Children and Schools certified.
SECTION 11131-PROJECTION SCREENS

3. Viewing Area:
      1) 120 inches wide x 96 inches high or as noted on the drawings.
      2) Manual screens are 96 inches wide x 96 inches high or as noted on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION
   A. Do not begin installation until substrates have been properly prepared.
   B. Verify rough-in openings are properly prepared.

3.2 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.

3.3 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Install projection screens with screen cases in position and relationship to adjoining construction as indicated, securely anchored to supporting substrate, and in manner that produces a smoothly operating screen with plumb and straight vertical edges and plumb and flat viewing surfaces when screen is lowered.
   C. Test electrically operated units to verify that screen, controls, limit switches, closure and other operating components are in optimum functioning condition.

3.4 PROTECTION
   A. Protect installed products until completion of project.
   B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION
SECTION 12345 – STEEL LABORATORY CASEWORK

PART 1 GENERAL

1.00 SUMMARY

A. Section Includes:
   1. Steel Casework – Painted and Stainless Steel
   2. Work Surfaces
   3. Table Frames
   4. Sinks
   5. Special Purpose Storage Cabinets
   6. Fume Hoods
   7. Flexcore Adjustable Shelving System
   8. Fixtures & safety shower
   9. Equipment

B. “American Made” – Casework wholly manufactured and assembled in USA

1.01 CASEWORK DESIGN REQUIREMENTS

A. Flush Front Construction: Surface of doors, drawers and panel faces shall align with cabinet fronts without overlap of case ends. Vertical case shell members shall meet in the same plane without overlap, crack or crevices. Maintain the following reveals:
   Steel fronts - 1/8” (3 mm) horizontally and vertically between door and drawer fronts,
   7/64” (2.8 mm) vertical side reveals at end of cabinet
   1. Steel front option: 20 gauge interior and 18 gauge exterior panels; interior with sound deadening material; 20 gauge horizontal reinforcement channel, one each door.

B. Field convertible design allows for conversion of cabinet door and drawer front styles, drawer body suspension and cabinet horizontal and vertical rails with the use of simple hands tools.

C. Slimline styling: Front width of end panels 3/4" and front height of top members 1".

D. Self-supporting units: Completely welded shell assembly so that cases can be used interchangeably or as a single, stand-alone unit.

E. Interior of case units: Easily cleanable, flush interior. Base cabinets, 30"- 48” wide, with double swinging doors shall provide full access to complete interior without center vertical post.

F. Drawers: Sized on a modular basis for interchange to meet varying storage needs, and designed to be easily removable in field with the use of simple hand tools.

G. Framed glazed doors: Identical in construction, hardware and installation to solid panel doors. Design framed glazed doors to be removable for glass replacement.
1.02 CASEWORK PERFORMANCE REQUIREMENTS

A. Structural Performance Requirements: Casework components have been tested in conformance with SEFA 8 M-2010 Recommended Practice and shall withstand the following maximum static load capacity, without damage to the component or to the casework operation, when properly leveled, supported and the load evenly distributed:

1. Steel base units: 500 lbs. per lineal ft.
2. Suspended units: 300 lbs.
3. Drawers in a cabinet: 100 or 150 lbs. per drawer (select)
5. Hanging wall cases: 300 lbs.
6. Shelves (base, wall, tall units): 40 lbs./sq.ft. up to 200 lbs.

B. Metal Finish Performance Requirements: Coatings on Casework components have been tested in conformance with the full requirements of SEFA 8 M-2010 Recommended Practice. See Section 2.07 for test procedures, acceptance levels and results for each criteria listed below from SEFA 8 M-2010 Section 8:

1. Chemical Spot Test – Section 8.1
2. Hot Water Test – Section 8.2
3. Finish Impact Test – Section 8.3
4. Paint Adhesion on Steel – Section 8.4
5. Paint Hardness on Steel – Section 8.5

1.03 REFERENCE STANDARDS

A. Scientific Equipment & Furniture Association (SEFA)

1. SEFA 1 Laboratory Fume Hoods
2. SEFA 2 Installation
3. SEFA 3 Work Surfaces
4. SEFA 7 Laboratory and Hospital Fixtures
5. SEFA 8 Laboratory Furniture-Casework-Shelving and Tables (Metal, Phenolic resin, Plastic laminate, Polypropylene, Wood)
6. SEFA 9 Ductless Enclosures
7. SEFA 10 Adaptable Furniture Systems
8. SEFA 11 Liquid Chemical Storage

B. Builders Hardware Manufacturers Association (BHMA)

C. National Electrical Manufacturers Association (NEMA)

D. National Fire Protection Association (NFPA) 30 Flammable Liquid Storage

E. National Fire Protection Association (NFPA) 70 Electrical Components, Devices and Accessories.

F. National Particleboard Association (NPA) 8-Voluntary Standard for Formaldehyde Emission from Particleboard
1.04 SUBMITTALS

A. Refer to submittal section of the General and Supplementary Specifications in Division 1 for requirements and procedures. Fabrication or purchase of any items prior to approval will be at the manufacturer’s risk.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For metal laboratory casework. Include plans, elevations, sections, details, and attachments to other work.
   1. Indicate locations of blocking and reinforcements required for installing laboratory casework. Indicate locations and types of service fittings, together with associated service supply connection required. Include details of utility spaces showing supports for conduits and piping. Include details of support framing system. Include details of exposed conduits, if required, for service fittings.
   2. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment. Include coordinated dimensions for laboratory equipment specified in other sections.

D. Samples for Initial Selection: For factory-applied finishes

E. Samples for Verification: Unless otherwise directed, approved sample units will be retained by the Owner’s Representative.
   1. 6-inch- (150-mm-) square Samples of the countertop material.

F. Qualification Data:
   1. Provide “American Made” certification. The casework shall be manufactured and assembled in the USA.
   2. Provide “SEFA” certification. Based on evaluation of comprehensive SEFA tests performed by a SEFA qualified testing agency, indicating total compliance of laboratory casework finishes and countertops with requirements specified for chemical and physical resistance.
   3. Provide installers qualifications statement and a letter from the manufacturer certifying the installer.

1.05 WORK SURFACE PERFORMANCE REQUIREMENTS

A. Epoxy Work Surface Performance Requirements:
   1. Test procedure: Apply five drops of each reagent to surface and cover with 25mm watch glass, convex side down; test volatiles using one ounce bottle stuffed with saturated cotton. After 1 hour exposure flush surface, clean, rinse and wipe dry. Evaluate after 24 hours at 73°F, and 50°F at 5% relative humidity.
   2. Evaluation ratings: Change in surface finish and function shall be described by the following ratings:
      a. No Effect: No detectable change in surface material.
      b. Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material.
c. Good: Clearly discernible change in color or gloss, but no significant impairment of work surface function or life.

d. Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period.

e. Failure: Pitting, cratering or erosion of work surface material; obvious and significant deterioration.

3. Test Results - Epoxy Resin Work Surface:

<table>
<thead>
<tr>
<th>REAGENT</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hydrochloric Acid, 37%</td>
<td>Excellent</td>
</tr>
<tr>
<td>2. Sulfuric Acid, 33%</td>
<td>No Effect</td>
</tr>
<tr>
<td>3. Sulfuric Acid, 77%</td>
<td>No Effect</td>
</tr>
<tr>
<td>4. Sulfuric Acid, 96%</td>
<td>Failure</td>
</tr>
<tr>
<td>5. Formic Acid, 90%</td>
<td>Excellent</td>
</tr>
<tr>
<td>6. Nitric Acid, 20%</td>
<td>Excellent</td>
</tr>
<tr>
<td>7. Nitric Acid, 30%</td>
<td>Excellent</td>
</tr>
<tr>
<td>8. Nitric Acid, 70%</td>
<td>Good</td>
</tr>
<tr>
<td>9. Hydrofluoric Acid, 48%</td>
<td>Fair</td>
</tr>
<tr>
<td>10. Phosphoric Acid, 85%</td>
<td>No Effect</td>
</tr>
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<td>11. Chromic Acid, 60%</td>
<td>Failure</td>
</tr>
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<td>12. Acetic Acid, 98%</td>
<td>Excellent</td>
</tr>
<tr>
<td>13. 3 &amp; 8 Equal Parts</td>
<td>Excellent</td>
</tr>
<tr>
<td>14. Ammonium Hydroxide, 28%</td>
<td>No Effect</td>
</tr>
<tr>
<td>15. Sodium Hydroxide, 10%</td>
<td>No Effect</td>
</tr>
<tr>
<td>16. Sodium Hydroxide, 20%</td>
<td>No Effect</td>
</tr>
<tr>
<td>17. Sodium Hydroxide, 40%</td>
<td>No Effect</td>
</tr>
<tr>
<td>18. Sodium Hydroxide Flake</td>
<td>No Effect</td>
</tr>
<tr>
<td>19. Sodium Sulfide</td>
<td>Excellent</td>
</tr>
<tr>
<td>20. Zinc Chloride</td>
<td>No Effect</td>
</tr>
<tr>
<td>21. Tincture of Iodine</td>
<td>Excellent</td>
</tr>
<tr>
<td>22. Silver Nitrate</td>
<td>No Effect</td>
</tr>
<tr>
<td>23. Methyl Alcohol</td>
<td>No Effect</td>
</tr>
<tr>
<td>24. Ethyl Alcohol</td>
<td>No Effect</td>
</tr>
<tr>
<td>25. Butyl Alcohol</td>
<td>No Effect</td>
</tr>
<tr>
<td>26. Benzene</td>
<td>Excellent</td>
</tr>
<tr>
<td>27. Xylene</td>
<td>No Effect</td>
</tr>
<tr>
<td>28. Toluene</td>
<td>Excellent</td>
</tr>
<tr>
<td>29. Gasoline</td>
<td>No Effect</td>
</tr>
<tr>
<td>30. Dichlor Acetic Acid</td>
<td>Good</td>
</tr>
<tr>
<td>31. Di Methyl Formamide</td>
<td>Excellent</td>
</tr>
<tr>
<td>32. Ethyl Acetate</td>
<td>No Effect</td>
</tr>
<tr>
<td>33. Amyl Acetate</td>
<td>Excellent</td>
</tr>
<tr>
<td>34. Acetone</td>
<td>Excellent</td>
</tr>
<tr>
<td>35. Chloroform</td>
<td>Excellent</td>
</tr>
<tr>
<td>36. Carbon Tetrachloride</td>
<td>No Effect</td>
</tr>
</tbody>
</table>
SECTION 12345 – STEEL LABORATORY CASEWORK

37. Phenol
38. Cresol
39. Formaldehyde
40. Trichlorethylene
41. Ethyl Ether
42. Furfural
43. Methylene Chloride
44. Mono Chlor Benzene
45. Dioxane
46. Methyl Ethyl Ketone
47. Acid Dichromate
48. Hydrogen Peroxide
49. Naphthalene

Excellent
Excellent
No Effect
Excellent
Excellent
Good
Excellent
Good
Excellent
Fair
No Effect
Excellent

PART 2 PRODUCTS

2.00 MANUFACTURER

A. “American Made” – Casework wholly manufactured and assembled in the USA.

B. General: Assemble and finish units at point of manufacture. Use precision dies for interchangeability of like-size drawers, doors, and similar parts. Perform assembly on precision jigs to provide units that are square. Reinforce units with angles, gussets, and channels. Integally frame and weld to form a dirt and vermin-resistant enclosure. Where applicable, reinforce base cabinets for sink support. Maintain 1/8” (3 mm) horizontally and vertically between door and drawer fronts. Vertical side reveals between the door/drawer and end of cabinet: Flush overlay steel fronts 5/32” (4 mm); Inset steel fronts 3/32” (2.4 mm); flush overlay wood fronts and flush overly steel fronts with five knuckle hinges 1/16”

C. Acceptable Manufacturers: (must provide current SEFA compliance test results)
   2. Fisher Scientific
   3. VWR
   4. Sheldon Laboratory
   5. Or approved equal

2.01 MATERIALS

A. Typical sheet steel used in the construction of cases and related products:
   1. Mild carbon, cold rolled and leveled unfinished steel, ASTM A 1008
   2. Stainless steel, #4 finish one side, ASTM A 666
   3. Mild carbon, cold rolled and hot dipped galvanized steel

B. Unless otherwise noted, the typical gauge of steel used in the construction of cases and related products shall be 18 GA. Exceptions listed below:
   1. 11 GA – table leg stretcher and leg rail support brackets
SECTION 12345 – STEEL LABORATORY CASEWORK

2. 11 GA – Top & bottom corner gussets
3. 16 GA – table cross rails, apron rails and end rails
4. 20 GA – inner door panels, filler stiles, fixed back panels, drawer bodies
5. 20 GA – removable back panels

C. Glass for glazed swinging, sliding and frameless doors as follows:
1. 6mm Tempered Glass per ASTM C 1048 – standard for swinging & sliding doors

D. Steel Doors: Outer and inner pans that nest into box formation, with horizontal channel reinforcements within the door. Doors with sound-deadening material.
1. Glazed Steel Doors: Hollow-metal stiles and rails of similar construction as flush doors, with glass held in resilient channels of gasket material.
2. Steel Drawers: Fronts made from outer and inner pans that nest into box formation, with no raw metal edges at top. Sides, back, and bottom fabricated in one piece with rolled or formed top of sides for stiffening and comfortable grasp for drawer removal. Fasten drawer front to sides and bottom to form a single, integral unit. Provide drawers with ball-bearing slides and positive stops to prevent metal-to-metal contact or accidental removal.
3. Adjustable Shelves: 1” front, back, and ends formed down, with edges returned horizontally at front and back to form reinforcing channels.
   i. Adjustable shelves shall be mounted to surface type steel standards (wall condition) or slotted studs (above peninsula benches). Adjustable shelves shall be supported by steel shelf brackets. Brackets shall be cold rolled steel with epoxy powder coated finish, complying with BHMA A156.9, Types B04102 and B04112. Shelves shall be fastened to brackets with two stainless steel screws per bracket.
   ii. Wall mounted adjustable shelves mounted on slotted studs shall be supplied with a continuous 2” (50.8mm) high band to create a 1” (25.4mm) high curb at rear of shelf. The curb along the back shall be of similar material as the shelf.
4. Toe Space: Fully enclosed with flush overlay heads (per NIH vermin control requirements), 4 inches (100 mm) high by 2.500” inches (63.5 mm) deep, with no open gaps
5. Table Legs: Welded tubing, 2.125 inches (75 mm) nominal, square with stretchers where needed to comply with product standard. Weld or bolt leg stretchers to legs and cross-stretchers and bolt legs to table aprons. Provide leveling device welded to bottom of each leg.
7. Utilities: Provide space, cutouts, and holes for pipes, conduits, and fittings in cabinet bodies to accommodate utility services and their support-strut assemblies.
8. Utility-Space Framing: Laboratory casework manufacturer's standard steel framing units consisting of 2 steel slotted channels complying with MFMA-2, not less than 1-5/8 inches (41 mm) square by 0.0966 inch (2.5 mm) thick, and connected together at top and bottom by U-shaped brackets made from 1-1/4-by-1-1/4-inch (32-by-6-mm) steel flat bars. Framing units may be made by welding specified channel material into rectangular frames instead of using U-shaped brackets.
9. Filler Strips [and Utility-Space Closure Panels]: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets and with hemmed or flanged edges.

2.02 CASEWORK SYSTEM

A. General: Provide casework manufacturer's standard integrated system that includes support framing, suspended modular cabinets, filler and closure panels, wall panels, countertops, and fittings needed to assemble system. System includes hardware and fasteners for securing support framing to permanent construction.

1. Minimum height, including corner gussets, leveler fully retracted:
   - i. Base Standing 35.125”
   - ii. Base Sitting 27.565”
   - iii. Base ADA 32.605”
   - iv. Tall 83.750”

2. Cabinets shall be fabricated as sectional units and be capable of being removed and reinstalled without use of special tools for relocation within system. Component parts of the unit shall be manufactured ensuring uniformity, interchangeability and accurate alignment. All base cabinets shall have integral enclosed bases.

3. Base cabinets allow for field conversion of cabinet door and drawer front styles, drawer body suspension systems and cabinet horizontal and vertical support rails with the use of simple hands tools.

4. Suspended cabinets can be removed without removing or providing temporary support for countertops.

5. Sinks (drop in) shall be supported independent of base cabinets.

6. Support framing has provision for fastening pipe supports at utility space in not more than 1-inch (25-mm) increments.

7. System includes filler and closure panels to close spaces between support framing, cabinets, shelves, countertops, floors, and walls, unless otherwise indicated. Fabricate panels from same material and with same finish as cabinets and with hemmed or flanged edges.

8. System includes wall-mounted casework that matches all other laboratory casework in design and material.

9. Support Framing: Casework manufacturer's standard system consisting of vertical supports and connecting braces and rails as follows:

10. Cabinets, shelves, and countertops are supported from vertical supports [except where floor-supported base cabinets are indicated]. Vertical positioning of supported cabinets, shelves, and countertops can be varied in 1-inch (25-mm) increments through full height of supports.

11. Vertical supports rest on adjustable leveling bases and are secured to floor with optional metal clips fastened to floor.

12. Vertical supports are installed with braces and rails connecting them to each other and to permanent building walls to create a stable, rigid structure with framed utility spaces where indicated.

13. Vertical supports are braced at floor with cantilevered horizontal leg members where indicated.
SECTION 12345 – STEEL LABORATORY CASEWORK

B. Hardware:
1. Wire pulls: Modern design, offering a comfortable hand grip, and be securely fastened to doors and drawers. Two pulls shall be required on all drawers 30" and longer. (Type W3 by ICI or approved equal) Finger holes or slots machined into doors are not acceptable.
2. Hinges: Brushed stainless steel type, 5-knuckle, frictionless, not less than 2" long with fast pin and rounded ends. Hinges are attached to both door and case with three (2) screws through each leaf. Doors over 36" in height shall be hung using 3 hinges.
3. Extension Slides
   a. Soft close, full extension – rated 100 lbs.
   b. Type: Slide 1 by ICI or approved equal

2.03 WORK SURFACES

A. Epoxy Resin: Chemical and abrasion resistant, durable 1" thick cast material of epoxy resins and inert products, cast flat, with a uniform low-sheen black surface. Backsplash curb shall be the same material as the top, but provided separate for field installation. Provide where indicated on drawings or as required where tops abut wall surfaces and at reagent ledges. Include end curb where top abuts end wall as specified. Reagent ledges shall be the same material as the top. Ledge face shall permit installation of service fixtures and top shall be removable for access to service utilities.

2.04 SINKS

A. Epoxy resin “drop in” type sinks. Each sink to include polypropylene sink outlet and strainer.

B. Color: Black

C. Model numbers:
   1. 9730 D- located where shown on plans
   2. 9734D- located where shown on plans
   3. 9688 SPBL at all locations
   4. 9617- located where shown on plans

2.06 SPECIAL PURPOSE STORAGE CABINETS

A. Acid/Corrosive Storage Cabinets: Shall employ the same materials, hardware and construction methods as standard base and tall cabinets with the following exceptions:
   1. Case: Model # 110867ACID (or approved equal)
      a. Double-walled 18 GA steel (back and sides), provides internal backing surface for corrosion resistant inner liner.
      b. No penetration of liner. No venting.
   2. Liner: One-piece molded polypropylene, secured to case with nylon screws. Includes 1" lip along at door opening for spill containment.
3. **Doors:** Polypropylene lined with louvers for ventilation.
4. **Shelves:** 3/4-depth, 1” thick phenolic resin with 1” high, adjustable (two levels).
5. **Labels:** “ACID” shall be silk-screened onto the door. “ACID” appears as red lettering on blue background.

B. **Flammable Storage Cabinets:** Model # 110867 (or approved equal)
The following requirements cover cabinets intended to be used to provide a storage area for limited quantities of flammable and combustible liquids stored in containers in compliance with ANSI/NFPA 30. Construction and performance requirements for these cabinets are primarily based on ANSI/NFPA 30. A storage cabinet may have a maximum total storage capacity of not more than 120 gallons of Class I, Class II or Class IIIA flammable and combustible liquids. Of this total, not more than 60 gallons shall be of Class I or Class II liquids, or a combination thereof.

In addition, all standard cabinets shall be constructed, tested and listed in accordance with UL 1275 “Standards for Flammable Liquid Storage Cabinets”. All UL 1275 approved cabinets will bear a label from the manufacturer stating such, including the company name, model number, and cabinet capacity.

Flammable Storage Cabinets shall employ the same materials, hardware and construction methods as standard base and tall cabinets with the following exceptions:

1. **Case:**
   a. Double-walled 18 GA steel with 1-1/2” air space between panels on top, bottom, sides, back and door.
   b. Air spaces shall be filled with a 1” thick blanket of High-Temp Fiberglass.
   c. The cabinet is not vented. The vent openings shall be sealed with plugs provided by the manufacturer.
   d. Bottom Floor Pan shall provide a 2” deep liquid tight pan to contain liquid spills and prevent leaks.
   e. Provisions for attaching grounding wire at the base of the cabinet on the outside, rear panel.

2. **Doors:**
   a. Provided with a three-point locking mechanism (Up-and-Down bolt type).
   b. Provided with full length stainless steel piano hinge.

3. **Labels:** “FLAMMABLE – KEEP FIRE AWAY” shall be silk-screened onto the door, appearing as red lettering on a bright yellow background.

2.07 **FUME HOOD**

A. JMP Fume Hood (Model # 100-48-G5) at Room D203, or approved equal

B. JMP ADA Fume Hood (Model # F-100-48) at Room D203 or approved equal
   1. Include Base 48” wide (model #40587004A or approved equal)

C. All fume hoods covered in this section are Isolator Series with a top and bottom airfoil and aerodynamically shaped fascia posts to minimize turbulence.
1. VAV (Variable Air Volume) type: Design uses a “restricted by-pass design. Maximum air is exhausted when the sash is open, minimum air is exhausted when the sash is closed. A minimum flow of 25 CFM/sq ft of surface area, as stated by NFPA 45, should be maintained to achieve optimum containment and satisfactory dilution when the sash is closed.

2. Fume hoods shall be designed for consistent and safe air flow through the hood face. Negative variations of face velocity shall not exceed 20% of the average face velocity at any designated measuring point as defined in this section.

3. Average illumination of work area: minimum 80 foot-candles. Work area shall be defined as the area inside the superstructure from side to side and from face of baffle to the inside face of the sash, and from the working surface to a height of 48 inches.

4. Fume hood shall be designed to minimize static pressure loss with stainless steel round duct collar configuration. Maximum average static pressure loss readings taken three diameters above the hood outlet from four points, 90 degrees apart, shall not exceed the following maximums:

5. Face Velocity at sash full open- CAV design - measured S.P.L. (W.G.)
   a. 75 F.P.M. .30 inches
   b. 100 F.P.M. .50 inches
   c. 125 F.P.M. .80 inches
   d. 150 F.P.M. 1.16 inches

6. Fume hood shall maintain essentially constant exhaust volume at any baffle position for safety. Maximum variation in exhaust CFM, static pressure and average face velocity as a result of baffle adjustment shall not exceed 5% for any baffle position at the specified face velocity.

D. MATERIALS
1. Typical sheet steel used in the construction of fume hoods:
   a. Mild carbon, cold rolled and leveled unfinished steel, ASTM A 1008
   b. Type 304 or 316 stainless steel, #4 finish one side, ASTM A 666
   c. Mild carbon, cold rolled and hot dipped galvanized steel

2. Typical gauges:
   a. Stainless steel: 12, 14, 16, 18 and 20 GA
   b. Mild Steel: 18 GA
   c. Galvanized steel: 18 GA

3. Sash glass:
   a. ¼” Tempered Glass per ASTM C 1048 (standard)

4. Sash tracks: Corrosion-resistant polyvinyl chloride (PVC).

5. Fastening devices:
   a. Interior surfaces: Nylon bolts, PVC fasteners, PVC-capped 410 stainless screws
   b. Exterior structural members: 410 stainless steel screws
   c. Exterior panel members: #8-32 zinc plated screws

6. Interior liners: The liner consists of all interior surfaces, including sides, top, back and baffles. Standard: Fiberglass reinforced polyester material (polyglass), 3/16” nominal thickness, white
E. FUME HOOD CONSTRUCTION

1. Superstructure: Shall consist of 18 GA mild steel side pans, painted neutral color grey, maximum 4-3/4" thick, holding side and rear liner panels, and fastened together with pinions and screws so that the entire structure is secure and rigid. Any framing system not providing structural support is unacceptable. Front and both sides of the superstructure are aligned and precision fit, eliminating the need for exterior gaskets.

2. Airfoils:
   a. Lower airfoil shall be constructed of 16 GA mild steel and painted and be equipped with power cord/tube pass-throughs 3" square near each side post. These pass-throughs shall allow sash handle to seal against airfoil without running cords and tubes under the airfoil, but by simply resting cords and tubes into the pass-through cavity. It is also flush with the work surface and has an integral drip trough.
   b. Upper airfoil 18 GA mild steel and painted (standard)

3. Sash: Provide a frameless vertical sash containing a 1/4" (6 mm) tempered glass panel and a full width painted steel sash handle connected to a steel rear-hung counterweight system insuring non-tilting, non-binding, and non-creeping sash performance. Rear-mounted counterweight shall be connected to a #35 case-hardened steel chain engaging a twin sprocket axle system with positive master link connection points both front and rear. Sash systems utilizing cables and pulleys are not acceptable. Painted steel parts in the sash are not acceptable. Note: Sash interlock system utilized on double sided pass-through hoods.

4. Baffles: Control air vectors into and through the fume hood, and shall be fabricated of the same material as the liner. Provide three fixed baffles and one adjustable baffle at bottom.

5. Baffle attachment: Baffles are secured to the superstructure using non-metallic, corrosion resistant baffle stand-offs.

6. Bypass: Isolator View pass system consisting of a 1/4" thick tempered glass panel allowing complete visual display of fume hood interior. --Clear

7. Duct collars: Standard 10" or 12" round exhaust outlet collar(s), fabricated of 20 gauge Type 304 stainless steel. Coated steel collars are not acceptable.

8. Fascia posts 18 GA mild steel and painted

9. Exterior end panels18 GA mild steel and painted (standard)

10. Interior clearance: All bench type fume hoods are designed to have an interior vertical clearance of not less than 47" in the front twelve inches of the hood depth. Internal dimensions may be affected by accessories or options.

11. Interior lighting: Standard configurations for fluorescent light fixtures are: 36" hood (1-24" fixture); 48" hood (1-36" fixture);
   a. Standard non-hinged fluorescent light fixture configured for T-8 lamp tubes shall be provided and installed on the exterior of the fume hood roof. A tempered glass panel is provided and has a vapor-tight seal to isolate the fluorescent fixture from the hood interior. The largest possible double tube UL approved fixture is provided for each hood.
12. Service Fittings and Fixtures:
   a. All laboratory service fittings and fixtures shall be as manufactured by the Water Saver Fixture Company or an approved equal. Fixtures, including handles, shall be color coded to indicate the proper service. Color code requirements for indexing service fixtures shall be as follows:
      
      | Service         | Index Color |
      |-----------------|-------------|
      | Gas             | Blue        |
      | Air             | Orange      |
      | Vacuum          | Yellow      |
      | Cold Water      | Green       |
      | Hot Water       | Red         |
      | Deionized Water | White       |
   b. Finish of Service Fixtures:
      1. Laboratory service fixtures (except fittings inside the fume hood) shall have
      a. A polished chrome finish with clear epoxy coating
         Fittings inside the fume hood shall have an epoxy finish color-coded to match the fixture service index color.

13. Electrical services: Specified electrical services are prewired to a junction box located on the roof of the fume hood for field connection by the electrical contractor. All electrical receptacles are 3-wire, 20-amp duplex, 120/277VAC or as specified. Light switch shall be 3-wire polarized grounded, 15 amp, 125VAC or as specified. Face plates are stainless steel.

14. Work surfaces
   a. Epoxy resin, 1-1/4" thick, molded top made in the form of a watertight pan, not less than 1/4" deep to contain spillage. Work surfaces are non-glaring finish and black, grey or white in color.

15. Instruction Plate: Corrosion resistant or plastic plate attached to the fume hood exterior with condensed information covering recommended locations for apparatus and accessories, use of sash and recommended safe operating procedures.

2.08 FLEXCORE SHELVING SYSTEM
   A. Island Flexicore Upright (model # PC424812-A)
   B. Flexicore shelf brackets (model # PSB09) modified to 6”
   C. Flexicore inner shelf (model # PS4212-a)
   D. Flexcore outshelves 6”
   E. End panels closure modified to accept pegboards to frame
   F. Include finished back of flex cores
   G. Flex Wall adjustable shelving system (model # JTP24836)
   H. Or approved equal

2.09 FIXTURES
   A. Vacuum & Gas (model # 9404 WS)
   B. Deck mounted Hot and Cold Faucet (model # 9500 WSBH)
   C. Pure Water (model # L7833)
   D. Hot and Cold Single handle faucet (model # 9516)
E. Safety Shower (Model # 9617WS)
F. Or approved equal

2.10 EQUIPMENT
A. Pegboard (model #6674)
B. Pegboards (model 6674-m)
C. Drip trough (model # 6679-a)
D. Fire Extinguisher (model # 9964)
E. Fire Blanket (model # 9930)
F. First Aid (model # 9962)
G. Spill control station (model # 117211)
H. Or approved equal

2.11 METAL FINISH (Painted Series)
A. Preparation: Metal shall be treated with a heated alkaline based acid solution, rinsed with water, and a coat of epoxy-link applied; immediately dried in heated ovens, then gradually cool prior to application of finish.

B. Application: Electrostatically apply epoxy powder coat of selected color and bake in controlled high temperature oven to assure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thicknesses:
   1. Exterior and interior surfaces exposed to view: 1.8 – 3 mils.
   2. Backs of cabinets and other surfaces not exposed to view: 1.8 mils minimum.

C. Chemical Spot Test:
   1. Test procedure: Place test panel on a flat surface, clean with soap and water and blot dry. Condition the test panel for 48 hours at 73°F ± 3°F and 50% ± 5% relative humidity. Panel will be subjected to chemical reagents according to SEFA 8 M-2010 Recommended Practice using one of the following two test methods:
      a. Method A – Test volatile chemicals by placing a cotton ball saturated with reagent in the mouth of a 1-oz. bottle and inverting the bottle on the surface of the panel.
      b. Method B – Test non-volatile chemicals by placing five drops of the reagent on the surface of the panel and covering with a 24 mm watch glass, convex side down.
      c. For both test methods, leave the reagents on the panel for a period of one hour. Wash off the panel with water, clean with detergent and naptha, and rinse with deionized water. Dry with a towel and evaluate after 24 hours at 73°F ± 3°F and 50% ± 5% relative humidity using the following rating system.
   2. Evaluation ratings:
      a. Level 0 – No detectable change.
b. Level 1 – Slight change in color or gloss.
c. Level 2 – Slight surface etching or severe staining.
d. Level 3 – Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.

3. **Acceptance level:** No more than four (4) level 3 conditions
4. **Test results:** Two (2) level 3 conditions exist. See data below.

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<th>REAGENT</th>
<th>METHOD</th>
<th>RATING</th>
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<td>Acetate, Amyl</td>
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</table>

**D. Hot Water Test**

1. **Test procedure:** Hot water (100°C±3%) shall be allowed to trickle (with a steady stream and at a rate of not less than 6 ounces [177.44cc] per minute) on a finished surface, which shall be set at an angle of 45-degrees, for a period of five minutes.

2. **Acceptance level:** After cooling and wiping dry, the finish shall show no visible effects from the hot water.

3. **Test results:** The finish shows no visible effect due to the hot water.

**E. Finish Impact Test:**

1. **Test procedure:** Position the 18 GA CRS test panel with nominal paint thickness of 3 mils on a smooth concrete floor. A one-pound ball (approximately 2” in diameter) shall be dropped from a distance of 12” onto a flat horizontal surface.

2. **Acceptance level:** There shall be no visual evidence to the naked eye of cracks or checks in the finish due to impact.

3. **Test results:** There is no visual evidence of any cracks or checks due to impact.

**F. Paint Adhesion on Steel:**

1. **Test procedure:** This test is based on ASTM D3359-02 “Standard Test Methods for Measuring Adhesion by Tape Test 1 – Test Method B”. Two sets of six parallel lines 2mm apart shall be cut with a razor blade to intersect at right angles thus forming a grid of 25 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. Brush the grid area lightly with a soft brush, and then place a piece of tape over the grid. Rub the tape firmly with the eraser of a pencil to ensure good contact. Remove the tape by rapidly pulling it back upon itself as close to an angle of 180° as possible.

2. **Acceptance level:** A 4B rating or better (ninety-five percent or more of the grid area shall show finish intact.

3. **Test results:** 100% of the squares remained intact after the test.
G. Paint Hardness on Steel:

1. Test procedure: This test is based on ASTM D3363-01 “Standard Test Method for Film Hardness by Pencil Test”. Clip a corner of the sample at 45° exposing a raw metal edge. Place the sample on a raw metal base plate so that the exposed metal edge of the sample makes contact with the turned up side of the base plate.

Remove approximately 6mm of wood from a 4H pencil, being careful to leave an undisturbed smooth cylinder of lead. Holding the pencil at an angle of 90° to an abrasive paper, rub the lead against the paper maintaining an exact angle of 90° section until a flat smooth and circular cross section is obtained. On the other end of the pencil remove approximately 13mm of wood from on half of the pencil.

Install the pencil into a Sheen model 720N Pencil Scratch Hardness Tester. Connect a continuity meter to the base plate and to the top of the pencil, being sure to make good contact with the exposed portion of the lead.

Follow the manufacturer’s instructions place the tester on the surface of the test sample and push it forward approximately 13mm. Rotate the pencil 90° in the holder and repeat the test to one side of the first test. Repeat this two more times for a total of four test, each with a different quadrant of the pencil lead.

2. Acceptance level: The paint finish shall withstand the abrasion of a 4H pencil without penetrating through to the substrate and completing a continuous circuit.

3. Test results: The 4H pencil did not penetrate the substrate during the test.

Note: manufacturer shall provide independent SEFA certified test report on chemical resistance of finish if requested.

2.12 QUALITY ASSURANCE

A. Single source responsibility: Casework, work surfaces, laboratory fume hoods, equipment and accessories shall be manufactured or furnished by a single laboratory furniture company.

1. “American Made” – Casework wholly manufactured and assembled in USA.

B. Manufacturer's qualifications: Modern plant with proper tools, dies, fixtures and skilled workmen to produce high quality laboratory casework and equipment, and shall meet the following minimum requirements:

1. Five years or more experience in manufacture of laboratory casework and equipment of type specified.
2. Ten installations of equal or larger size and requirements.
3. “American Made” – Casework wholly manufactured and assembled in USA.

C. Installer's qualifications: Factory trained and/or certified by the manufacturer.
D. Cabinet identification: Cabinets are identified on drawings by manufacturer's catalog numbers. Unless otherwise modified on drawings or in specifications, catalog description constitutes specific requirements for each type of cabinet.

PART 3 EXECUTION

3.00 INSTALLATION - REFER TO INSTRUCTION AND INSTALLATION MANUAL

A. Casework installation:
1. Set casework components plumb, square, and straight with no distortion and securely anchored to building structure. Shim as necessary using concealed shims.
2. Bolt continuous cabinets together with joints flush, tight and uniform, and with alignment of adjacent units within 1/16" tolerance.
3. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board.
4. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8" between top units.
5. Remove and discard shipping clip and associated screws from top of shelf, (thin galvanized angle) install 4 shelf clips into integral standard and set shelf. Check for level and adjust clips as required.

B. Work surface installation:
1. Where required due to field conditions, scribe to abutting surfaces.
2. Only factory prepared field joints, located per approved shop drawings, shall be permitted. Secure joints in field, where practicable, in the same manner as in factory, with dowels, splines, adhesive or fasteners recommended by manufacturer.
3. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.

C. Sink installation: Sinks which were not factory installed shall be set in chemical resistant sealing compound and secured and supported per manufacturer's recommendations.

D. Accessory installation: Install accessories and fittings in accordance with manufacturer's recommendations. Turn screws to seat flat; do not drive.

3.01 ADJUSTING

A. Repair or remove and replace defective work, as directed by [Architect] [Owner] upon completion of installation.

B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.02 CLEANING

A. Clean shop finished casework, touch up as required.
SECTION 12345 – STEEL LABORATORY CASEWORK

B. Clean counter tops with diluted dishwashing liquid and water leaving tops free of all grease and streaks. Use no wax or oils.

3.03 PROTECTION OF FINISHED WORK

A. Take protective measures to prevent exposure of casework and equipment from exposure to other construction activity.

B. Advise contractor of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

3.04 DELIVERY, STORAGE AND HANDLING

A. Schedule delivery of casework and equipment so that spaces are sufficiently complete that material can be installed immediately following delivery.

B. Protect finished surfaces from soiling or damage during handling and installation. Keep covered with polyethylene film or other protective coating.

C. Protect all work surfaces throughout construction period with 1/4" corrugated cardboard completely covering the top and securely taped to edges. Mark cardboard in large lettering "NO STANDING".

3.05 PROJECT CONDITIONS

A. Do not deliver or install equipment until the following conditions have been met:
   1. Windows and doors are installed and the building is secure and weather tight.

END OF SECTION
SECTION 12400 – PLASTIC LAMINATE CASEWORK

PART 1 GENERAL

1.01 GENERAL PROVISIONS

A. Applicable provisions of General Conditions, Special Conditions, and General Requirements shall apply to this section as if repeated in full herein. Reference other Sections and Divisions for work in connection with this section.

1.02 SCOPE OF WORK

A. Cabinets: Furnish prefabricated cabinetry and related components as specified herein. Refer to plans and equipment lists for details and requirements. Cabinetry shall include all fillers, scribes, finish ends, finish backs, laminate and solid polymer countertops. Locks to be provided where shown on casework drawings or described in equipment lists.

B. Sinks and Fixtures: Provide sinks, fixtures, electrical outlets, and fittings specified as part of complete model numbered units. Provide materials to appropriate trades for final hook ups and installation.

1.03 RELATED WORK NOT INCLUDED

A. Sinks and Fittings: Sinks and fittings, connection, piping, traps, supplies, shut offs, and special plumbing applicable to codes. Electrical fittings, devices, conduit, wiring, fans, blowers, motors, ductwork, and special grills not specified as part of furnishings. (Specified in electrical, plumbing, and heating/ventilation/air conditioning sections)

B. Blocking, Framing and Reinforcements: In walls, ceilings, and floors for cabinetry anchorage and mountings, SHALL BE COORDINATED DURING SHOP DRAWING SUBMITTALS & CONSTRUCTION AND PROVIDED BY GENERAL CONTRACTOR AS NEEDED.

C. Locks: Master keyed to room doors or specialty locking systems. (Specified in lock section)

D. Vinyl Base Molding: (Specified in resilient flooring section)

1.04 QUALIFICATION

A. Casework Standards: Casework is based on Stevens Industries model numbers. Cabinet Construction options are as specified in this section and on Contract drawings. The manufacturers listed below will vary somewhat in exact construction methods included in their base or standard designs. Accordingly, any acceptable manufacturer must include the options and/or customized materials and construction methods to meet or exceed the specified design criteria.

1. Stevens Industries 1200 Series
2. Case Systems
3. Or Approved Equal

B. Substitutions:
1. Substitutions will be approved in accordance with Specification Section 01300.
SECTION 12400 – PLASTIC LAMINATE CASEWORK

2. Contractor shall state in writing any deviations from requirements and specifications. The casework shall conform to the configuration, arrangement, design, material quality, joinery, panel thickness, and surfacing of that specified and shown on drawings.

3. Manufacturers requesting approval shall submit samples with cut-aways showing cabinet construction, joinery, drawer and door construction, hardware, and materials, along with catalogs and specification, in order that accurate evaluations can be made. Manufacturers shall show full sized working samples. Catalogs and specifications shall be submitted with written request, along with detailed list of compliance and deviations from these documents for approval. Samples may be impounded by owner and retained until completion of job for verification and compliance of specifications.


1.05 SUBMITTALS

A. Shop Drawings: Shall be submitted for approval after formal notification of award of contract. Drawings shall consist of floor plans indicating arrangement and relation to adjacent work and equipment and complete elevations of casework. Centerline of service requirements shall be noted for use by other trades. A schedule of all sinks, fittings, and accessories that are part of this contract shall be provided.

B. Color Samples: Shall be submitted for selection and coordination at time of shop drawing submittals. Samples of actual materials and color shall be available as required.

C. Catalog Cuts: Additional catalog cuts, details, and samples as requested by architect for evaluation and coordination.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect casework and related materials during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration.

B. Storage: Store casework and related materials at project site in installation and storage areas with similar ambient conditions as final installation. Storage areas must be kept dry, heated with low relative humidity, and away from construction work such as painting, wet work, grinding, and similar operations.

C. Site Conditions: In accordance with AWI’s Quality Standards Illustrated (current edition) and Stevens Industries, Inc.’s Site Conditions.

1.07 WARRANTY

A. Casework manufacturer shall warrant for a period of three (3) years that its manufactured product is free from defects in materials and workmanship when properly installed and under normal use and conditions.

B. Accessory equipment (sinks, fittings, etc.) shall be warranted by appropriate manufacturer’s guarantee to the limit of that manufacturer’s standard warranties.
PART 2 PRODUCTS

2.01 SURFACE MATERIAL

A. Cabinet:
   1. Exposed finish ends, fronts, modesty panels, and finish backs shall be faced with vertical grade
      (.028") High Pressure Laminate (HPL), tested under National Electrical Manufacturers
      Association (NEMA) LD3-2005.
   2. Panels with exterior .028 HPL surfaces shall have Cabinet Liner Surface (CLS) (.020") white
      interior cabinet liner.

B. Semi-Exposed Interior: Surfaces exposed when doors and drawers are open, but not exposed when
   door and drawers are closed shall be Cabinet Liner Surface (CLS) (.020") white interior.

C. Exposed Interior: Surfaces not concealed by doors and drawers (open shelving, lockers, etc.) and
   surfaces visible thru transparent (glass) doors exposed when doors shall be faced with vertical grade
   (.028") High Pressure Laminate (HPL), tested under National Electrical Manufacturers Association
   (NEMA) LD3-2005.

D. Drawers: Sides, back and sub front shall be constructed of ½" thick particleboard laminated with
   white melamine. Drawer bottom shall be ½" thick particleboard laminated in white melamine and
   screwed directly to the bottom of the drawer box. Cabinet with less than ½" thick bottom or painted
   drawer bottoms will not be acceptable.

E. Concealed Backs: Shall be ¼" thick white hardboard to match interior of cabinet

2.02 CORE MATERIALS

A. Particleboard: Shall be high performance industrial grade core. Particleboard shall be 45# - 48#
   density 3-ply type formation conforming to American National Standards Institute (ANSI) A208.1

B. Medium Density Fiberboard: Core shall be minimum 48# density conforming to ANSI A208.1 MD-
   130 standards.

2.03 EDGINGS

A. Door and Drawer Fronts: Edges shall have 3mm radius extrusion banding. 3mm pattern selection
   Fronts shall have radius edges and corners utilizing automated hot melt adhesive application and
   trimming.

B. Cabinet Edges: Cabinet sides, top, bottom, adjustable shelves, and other interior components shall be
   edged with (.020") flat edge extrusion. Automated hot melt adhesive application and trimming.

C. Drawer Components: 3/4" sides shall be edged with (.020") flat edge extrusion. Automated hot melt
   adhesive application and trimming.
SECTION 12400 – PLASTIC LAMINATE CASEWORK

D. Selections: Edgebanding to match laminate selections based on standard offerings and commercially available stock patterns.

2.04 SELECTIONS AND APPLICATIONS

A. Exposed: Cabinet finish ends, fronts, modesty panels, and finish back HPL .028 thickness shall be selected from Wilsonart Design Group I patterns or approved equal.

B. Interior of Exposed Cabinets shall be High Pressure Laminate to match the exterior

C. Semi-exposed Surfaces: are to be white .020 cabinet liner

D. Drawers: Are to be white

E. Backs: Shall be matching to Interior of cabinet (White .020 cabinet liner)

F. Laminate Countertops: Selected from Wilsonart Design Group I patterns or approved equal.

2.05 HARDWARE

A. 5-Knuckle Hinges: Shall be heavy duty 5-knuckle 270 degree pivot reveal overlay style. Hinges shall have interlaying leaves 270 degree swing constructed of (.090") thickness steel. Hinges shall be (Grade 1) with hospital ground tips and non-removable pin. 5-knuckle hinges shall be available in minimum five (4) standard finishes. Doors less than 47" shall have two (2) hinges per door. Doors exceeding 47" shall have three (3) hinges per door:

B. Door Catches: Shall be 7lb pull magnetic with screws slotted for adjustment

C. Pulls: Shall be offered in easy grip 4” metal wire type pulls in offered in matching colors to 5 knuckle hinges

D. Full Extension Slides: Full extension ball bearing slides to be an option feature available for all cabinet drawers if selected in specification options. Slides shall be side mounted with profile to not reduce interior drawer space normally provided. Ball bearing slides to be tested under The Business and Institutional Furniture Manufacturer’s Association (BIFMA) X5.5 Section 7. Slides shall pass both 50,000 and 100,000 cycle test with a 120# load rating.

E. Shelf Supports: Adjustable shelf supports shall be injection molded clear polycarbonate. Supports shall incorporate integral molded lock tabs to retain shelf from tipping or inadvertent lift out. Supports shall have 5mm diameter double pin engagement into precision bored cabinet vertical hole patterns. Adjustment shall be (32mm) 1 1/4” spacings. Supports shall have a compression ridge effecting force against shelf edge to maintain positive pin engagement. Supports shall have molded-in screw attachment feature. Static test load shall exceed 200# per clip. Shelf spans above 27" shall have 5-point support with backs drilled to receive a mid-span shelf support, further reducing deflection. Shelf spans below 27" shall have end 4-point support.

F. Locks: shall be 5 pin by National lock or approved equal.

2.05 COMPONENT DETAILS AND CONSTRUCTION
SECTION 12400 – PLASTIC LAMINATE CASEWORK

A. Fronts: Door and drawer fronts shall be 3/4" thick. Fronts shall be edged with 3mm radius edge extrusion with face laminate as described 2.01.A. Automated hot melt adhesive application and trimming.

B. Wall Cabinets: Components shall be 3/4" thick members throughout. Wall cabinet tops and bottoms shall include back groove and minimum four (4) dowel pins per joint for insertion into cabinet ends. Wall cabinet ends shall be 3/4" thick with back groove and precision Computer Numerical Control (CNC) drill pattern for accurate location of fixed members, hardware, and shelf supports. Wall cabinet tops and bottoms to be 1” thick

C. Mounting Frames: Incorporated in wall units, tall units, and base units, shall be 3/4" thick with minimum two (2) dowel pins per mounting frame end joint for wall and tall units. Base units shall have a minimum of three (3) dowel pins per mounting frame end joint.

D. Tall Cabinets: Components shall be 3/4" thick members throughout. Tall cabinet tops and bottoms shall include back groove and up to eight (8) total dowels per end joint (based on cabinet depth). Tall cabinet ends shall be 3/4" thick with back groove and precision CNC drill pattern for accurate location of fixed members, hardware, and shelf supports. Tall cabinets to have two (2) integral (dowel into end) mounting frames. (Designs with simple spacer rails or rails without dowel pin engagement into ends are not acceptable.)

E. Base Cabinets: Components shall be 3/4" members throughout. Base unit bottoms shall incorporate back groove and up to dowel pins per end joint (based on cabinet depth). Base units shall have a full ½” sub top. Cabinets with top frame will not be acceptable

F. Toe Kicks: Bases shall be separate ladder base design using water resistant exterior grade plywood & concealed fastening. No cabinet sides or body to touch floor. Individual bases constructed of the water resistant exterior grade plywood will be acceptable.

G. Cabinet Backs: Shall be in an integrated system of a "prefinished Medium Density Fiberboard (MDF) back captured in side and horizontal grooves. Unit back to be further integrated with attachment to 3/4" doweled-in mounting frames. Fixed backs are mechanically fastened into grooves and sealed with hot melt adhesive. Removable backs shall be set in groove and attached with screws. On cabinets with exposed back a ¾” High Pressure overlay panel will be used in colors to match exposed casework

H. Adjustable Shelves: All Shelves shall be 1” thick to match the color of interior of cabinet. If cabinet interior is exposed then shelves are to be laminated with .028 HPL to match.

I. Drawers: Four (4) sided full box design with separate attached front shall be provided. Drawer members shall be ½” thick for back, subfront, sides and bottom.

2.07 LAMINATE TOPS

A. Decorative laminate shall meet NEMA LD3-2005 PF-42 (.042") specification standards. Patterns chosen from Wilsonart standard selections
SECTION 12400 – PLASTIC LAMINATE CASEWORK

B. Laminate tops shall be 1 1/16" thick with solid moisture resistant particleboard core and laminated with backer sheet edges are to be provided 3mm PVC. Countertops are to be provided with 4" back and side splash. Edged backsplash to match front edge.

PART 3 EXECUTION

3.01 INSTALLATION

A. The installer must examine the job site and the conditions under which the work in this section is to be performed and notify the contractor in writing of any unsatisfactory conditions. Do not proceed with work under this section until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Casework, countertops, and related materials to be conditioned to average prevailing humidity condition in installation areas prior to start of work.

C. Install casework and countertops with factory-trained supervision, authorized by manufacturer. Casework shall be installed plumb, level, true, and straight with no distortions (shim as required). Casework shall be securely attached to building structure with anchorage devices of appropriate type, size, and quantity to meet applicable codes, specifications, and safety conditions. Where casework and countertops abut other finished work, scribe and trim to accurate fit, and caulk as required.

D. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware.

E. Repair, or remove and replace, defective work as directed upon completion of installation.

F. Advise project site superintendent of problems and precautions for protection of casework and countertops from damage by other trades until acceptance of the work by the owner.

G. Cover casework with 4-mil polyethylene film for protection against soiling and deterioration during remainder of construction period.

END OF SECTION
SECTION 12511 - HORIZONTAL LOUVER BLINDS

1.1 GENERAL

A. Product Standard: Comply with AWCMA Document 1029 for each horizontal louver blind unit.

B. Submittals: Submit product data for each type of blind and the following:

1. Shop drawings showing location and extent of blinds. Show installation details. Include elevations indicating blind units. Indicate location of blind controls.
2. Samples for initial selection showing the full range of colors available for each type of blind indicated.
3. Samples for verification of the following products showing the full range of color variations expected. Prepare samples from the same material to be used for the Work.
   a. Louver: Manufacturer's standard-size unit, not less than 12 inches (300 mm) long.

4. Every window and storefront inside office spaces shall have blinds.
5. Maintenance data to include in the operation and maintenance manual.

C. Fire-Test-Response Characteristics: Provide blinds identical to those tested for the following fire-test-response characteristics as determined by UL or another testing agency acceptable to authorities having jurisdiction.


D. Space Enclosure and Environmental Limitations: Do not install blinds until space is enclosed and weatherproof, wet-work is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be maintained at values near those indicated for final occupancy.

1.2 PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

1. Horizontal Louver Blinds:
   b. Levolor Corp.
   c. Springs Window Fashions Division, Inc.; (Bali-Graber)
   d. or approved equal.
SECTION 12511 - HORIZONTAL LOUVER BLINDS

B. Horizontal Louver Blinds: Manufacturer's standard as follows:

1. Louvers: Steel.
   a. Nominal Louver Width: 1-inch x 0.008" thick (miniblinds).

   a. Length of Tilt Control: Full length of blind.
   b. Position of Tilt Control: Right side.
   c. Tilt: Full.

3. Cord-Lock Operation: Cord lock; locks pull cord to stop blind at any position in ascending or descending travel.

6. Colors: Where manufacturer's standard products are indicated, comply with the following requirements:
   a. Match colors indicated by referencing manufacturer's standard designations for these characteristics.

C. Horizontal Louver Blind Fabrication: Manufacturer's standard as follows:

2. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
   a. Blind Units Installed Between (Inside) Jambs: Width equal to ¼ inch (6 mm) per side, plus or minus 1/8 inch (3 mm), less than jamb to jamb dimension of opening. Length equal to ¾ inch (6 mm), plus or minus 1/8 inch (3 mm), less than head to sill dimension of opening.

3. Installation Fasteners: Not less than 2 fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; support blind units under conditions of normal use.

1.3 EXECUTION

A. Examination: Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Do not proceed until unsatisfactory conditions have been corrected.
SECTION 12511 - HORIZONTAL LOUVER BLINDS

B. Installation: Install blinds level, plumb, and located so exterior louver edges in any position are not closer than 1 inch (25 mm) to interior face of glass lites.

1. Head Mounted: Install headrail on face of opening head.

C. Adjust components and accessories for proper operation.

D. Clean blind surfaces, according to manufacturer's instructions, after installation.

E. Remove surplus materials, packaging, and debris resulting from installation. Leave installation areas clean and ready for use.

F. Protection: Protect and maintain conditions in a manner acceptable to manufacturer and Installer. Ensure that blinds are without damage or deterioration at the time of Substantial Completion.

G. Lifetime Warranty for control mechanism for normal operation by manufacturer.

H. Provide horizontal louver blind unit for each window or fixed glass section. Do not cross multi-mullions for one blind unit and control.

END OF SECTION 12511
SECTION 13423 ENTRANCE CANOPY STRUCTURE AND ROOF SYSTEM

PART 1 - GENERAL

1.1 STRUCTURE DESCRIPTION

A. Entry canopy including AESS steel frame, foundations, footings and glazed roofing system.

B. The work includes the following:

1. A Design / Build Engineered System of insulated translucent single panel system roof, AESS steel frame, foundations, footings and accessory parts including Signed and Sealed by a New Jersey Professional Engineer structural calculation submittals.

2. Fabrication, packaging and delivery to job site for erection as a complete Design / Build System not requiring field welding or painting.

1.2 DESIGN REQUIREMENTS

A. Structure shall be designed by a qualified Professional Engineer. A complete set of calculations and drawings, sealed in New Jersey, shall be submitted for approval by the owner's representative prior to the erection of the canopy structure.

B. Provide complete canopy structure, including foundations, framing, and roof panels, capable of withstanding the effects of the following:

1. Dead Load: Account for frame weight along with any material supported by the frame.
2. Roof Live Load: 20 psf area load.
3. Wind load: Account for design wind speed required by the applicable building code (IBC 2015 New Jersey Edition), including uplift on roof panels.

C. Where structural bolts are required at framing member connections, all bolts and nuts shall be concealed.

D. Column anchorage shall include four (4) bolts in compliance with OSHA 1926.755(a)(1).

E. No field welding permitted.

F. Exposed structural steel elements shall arrive to the site with a manufacturer-applied powder coat finish. Field painting of canopy components is not permitted. The product shall be a complete manufactured system that bolts together on site.

1.3 SUBMITTALS

A. Manufacturer of canopy structure shall provide drawings and calculations sealed by a New Jersey Professional Engineer.

B. Manufacturer shall provide appropriate laboratory test results for the following:
1. Frame finish requirements listed in PART 2 of this specification.

C. The manufacturer shall submit certified test reports made by an independent organization for each type and class of panel system. Reports shall verify that the material will meet all performance requirements of this specification. Previously completed test reports will be acceptable if they are indicative of products used on this project. Test reports required are:

1. Self-Ignition Temperature per (ASTM 1929-3)
2. Smoke Density per (ASTM D-2843)
3. Burning Extent per(ASTM D-635)
4. Interior Flame Spread per (ASTM E-84)
6. Weathering (ASTM D-4364)
7. Weathering Evaluation before and after 25 minute exposure to 300°F, for Light Transmission and Color Change, per ASTM E-1175, ASTM D-2244
8. Large Missile Test - Impact Resistance per SFBC PA 201-94
9. Impact loading per ASTM E 695
11. Insulation “U” Factor per NFRC 100 test methods & procedures.
12. Solar Heat Gain Coefficient (SHGC) per methods and procedures given in the NFRC Calorimeter Standard. Independent Test Reports or calculations based on this test standard are acceptable.
13. Visible light Transmission (VT) per ASTM E972 & ASTM E1084
14. Water Penetration per (AAMA 501.2)
16. ICC evaluation service report for compliance with IBC building code as an approved light transmission plastic with a CCl rating

1.4 TECHNICAL SUPPORT

A. Manufacturer of canopy structure shall provide technical support for questions and issues pertaining to the fabricated structure by in-house, licensed engineering staff.

1.5 QUALITY ASSURANCE – Provide Certification of these requirements as part of a Shop Drawing.

A. General

1. Fabrication procedures shall comply with applicable codes and local regulations.

B. Manufacturer qualifications

1. Must have a minimum (10) years’ experience engineering and fabricating pre-engineered structures
2. Manufacturer owned and operated powder coat paint finish system
3. All welders must be AWS certified
4. Full-time New Jersey licensed Professional Engineer on staff
5. Full-time AWS certified associate welding inspector on staff

C. Manufacturer certifications

1. PCI-4000 certification through Powder Coating Institute (PCI)

D. Roof installation shall be by a factory-approved installer who has been in the business of
installing similar material for at least five (5) consecutive years and can show evidence of
satisfactory completion of projects of similar size, scope and type.

1.6 SUBMITTALS: Provide Certification letters for quality assurance as above noted.

1. Structural Calculations: Prior to fabrication of the canopy system, submit calculations
prepared in accordance with current applicable codes as called for by the Project Engineer.
Include analysis and engineering for all combinations of load cases such as live, dead, wind,
thermal, snow, seismic, etc.
2. Supply calculations for support and other details as necessary.

B. Engineered Drawings: Submit complete shop drawings including polycarbonate panel and
support steel layouts and details.

1. Identify all materials, attachments devices and accessories.

C. Installation Drawings: After approval of engineered drawings, provide a detailed set of field
installation drawings and a written installation procedure. Identify each part by size and number.

D. The manufacturer shall submit certified test reports made by an independent organization for each
type and class of panel system. Reports shall verify that the glazing material will meet all
performance requirements of this specification. Previously completed test reports will be
acceptable if they are current and indicative of products used on this project. Test reports
required are:

1. Self-ignition Temperature (ASTM 1929-3)
2. Smoke Density (ASTM D-2843)
3. Burning Extent (ASTM D-635)
4. Interior Flame Spread per (ASTM E-84)
5. Water Penetration per (AAMA 501.2)
6. Large Missile Test – Impact Resistance per TAS 201-94
8. Concentrated Load per ASTM E661
9. Concentrated Load per OSHA and California Code of Regulations for 600 Ft-Lbs
1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All polycarbonate and steel shall be manufactured, stored, handled and shipped in a manner that will provide unscratched and undamaged units delivered to the site.
B. Time the delivery of materials to the site to ensure uninterrupted progress of the installation work.

1.8 PROJECT CONDITIONS

A. Field Verifications: Polycarbonate and support steel shall be fabricated in accordance with approved shop drawings which shall include dimensional approval from the Architect and General Contractor.

1.9 MANUFACTURER WARRANTY

A. Manufacturer shall provide a minimum (10) year limited warranty on steel frame members.
B. Manufacturer shall provide a minimum (10) year limited warranty on paint system.
C. Provide a single source Skylight system manufacturer warranty against defective materials and fabrication. Submit manufacturer’s written warranty agreeing to repair Skylight system work, which fails in materials within two (2) years of Substantial Completion.
D. Provide single source structure & skylight manufacturer 10 year glazing panel warranty. Third party warranty for glazing panels shall not be acceptable. Glazing warranty to include:

1. Change in light transmission of no more than 6% per ASTM D-1003.
2. No delamination of panel affecting appearance, performance or structural integrity of the panel or the system.
3. Thermal aging - the light transmission and the color shall not change after exposure to heat of 300°F for 25 minutes. (When measured per ASTM D-1003 and ASTM D-2244 respectively)

E. In addition, submit installer’s written warranty agreeing to repair installation workmanship, defects and leaks within one year of the date of delivery.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Basis of Engineered System Products: CEAS+, a division of PorterCorp.

2. The local sales representative is CBG Associates, Inc. Email Dave Coffey at dcoffeycbg@comcast.net or call 215-641-9360.
3. Or approved equal manufacturer’s will be considered in accordance with Specification Section 01300 – Submittals.

2.2 FRAME
A. Materials

1. Anchor bolts
   a. Anchor bolts shall comply with ASTM F1554

2. Structural steel
   a. Steel structural members shall comply with ASTM A500

3. Structural bolts
   a. Bolts utilized for structural connections shall comply with ASTM A325

B. Finish

1. Frame finish: Manufacturer-applied Super Durable TGIC powder coat. No field painting permitted.
   a. Powder coat finish to be applied in a PCI-4000 certified facility.
   b. Components shall be cleaned, pre-treated, and finished prior to application of the powder coat finish. Transportation of components between cleaning and finish application will not be permitted unless approved by manufacturer and owner.
   c. Components shall be shot blasted to SSPC-SP10 near-white condition. SSPC-SP2 hand tool cleaning will not be an acceptable alternative.
   d. Components shall be pretreated in a (3) stage iron phosphate or equal washer.
   e. Components shall receive epoxy primer coat for superior corrosion protection.
   f. Components shall receive top coat of Super Durable TGIC powder coat.
   g. Finish shall not have any VOC emissions.
   h. Manufacturer shall be able to produce documentation stating sample production components have been tested to meet the following:
      i. Salt spray resistance per ASTM B 117/ ASTM D 1654 to 10,000 hours with no creep from scribe line and rating of 10.
      ii. Humidity resistance per ASTM D2247-02 to 5,000 hours with no loss of adhesion or blistering.
      iii. Color/UV resistance per ASTM G154-04 to 2,000 hours exposure, alternate cycles with results of no chalking, 75% color retention, color variation maximum 3.0 E variation CIE formula (before and after 2,000 hours exposure).

2. Frame color: Color to be selected and verified by owner prior to fabrication of structural components.

C. Fabrication
1. Structural components shall be fabricated to allow for bolted field connections. All welded connections shall be performed prior to the application of the final powder coat finish. Field welds are not permitted.

2. Individual structural components shall be labeled with a unique part identifier prior to delivery to the site.

2.3 ROOF

A. Materials

1. Nano-Cell® Panel Technology (or approved equal) – Longevity and Resistance to Buckling and Pressure:

   a. Translucent Panels must be of Nano-Cell® (or approved equal) technology (cell sizes less than 0.18”). Wide Cell technology (cell size exceeding 0.18”) shall not be acceptable.

   b. The translucent panel shall include an integral extruded Nano-Cell® (or approved equal) structural core. The panel’s exterior skins shall be connected with supporting continuous ribs, perpendicular to the skins, at a spacing not to exceed 0.18” (truss-like construction). In addition, the space between the two exterior skins shall be divided by multiple parallel horizontal surfaces, at a spacing not to exceed 0.18”.

2. Appearance

   a. Single Panel assembly thickness shall be standard 0.47” (12mm) with exposed interlocking U battens to the exterior (standing seam look from exterior)

   b. Panel Width: Shall not exceed 2’ to ensure best performance for wind uplift, vibration, oil canning and visual appearance. Panels over 2’ wide will not be approved.

3. Thermal and Solar Performance:

   a. Insulation Value (“U”) per NFRC 100 test methods & procedures center of glass:

   b. U Factor: 0.48, Visible Light Transmission (VT. %) per ASTM E972, E1175

   c. Solar Heat Gain Coefficient (SHGC) independently tested or calculated based on testing per methods and procedures given in the NFRC Calorimeter Standard

4. Translucent Panel Joint System:

   a. Panel shall be extruded in one single formable length. Transverse connections are not acceptable.

   b. The panels should be manufactured with grip-lock double tooth up stands that are integral to the unit. The up stands shall be 90 degrees to the panel face (standing seam dry glazed concept). Welding or gluing of up stands or standing seam is not acceptable.
c. The U battens shall have a grip-lock double tooth locking mechanism to ensure maximum uplift capability.

d. The metal retention clip shall be configured with a 0.4" wide top flange that extends continuously across the web from end to end and from side to side. To allow a safety factor, the clip must be tested to meet a wind uplift standard of 90 psf. per ASTM E330

e. Water Penetration: No water penetration of the panel U joint connection length at test pressure of 6.24 PSF per ASTM E-331

f. Free movement of the panels shall be allowed to occur without damage to the weather tightness of the completed system.

5. Flammability

a. The exterior and interior faces shall be an approved light transmitting panel with a CC1 fire rating classification per ASTM D-635. Flame spread no greater than 25 per ASTM E-84. Smoke density no greater than 75 per ASTM D2843 and a minimum self-ignition temperature of 1000°F per ASTM 1929. The panel shall be self-extinguishing.

b. Interior flame spread classification of Class ‘A’ per ASTM E84.

6. Impact Resistance-the panels shall meet the following test requirements:


b. ASTM E 695 - Impact loading per for 500 ft.-lbs.

c. Impact resistance per ASTM 1886 & ASTM E1996 level D.

7. Weatherability

a. The light transmission as measured by ASTM D1003 shall not decrease more than 6% over 10 years, or after exposure to temperature of 300°F for 25 minutes (thermal aging).

b. The panel shall be tested by recognized laboratory for weathering evaluation per ASTM D4364-84 (EMMAQUA, UNBACKED), after exposure to minimum concentrated natural sunlight radiation of 56000 MJ/M (1540 MJ/M of UV, 200 - 385 N.M). The panel shall not change in color more than 4.0 units Delta E, 4.0 units Delta L and Delta B.

c. The panel shall not change color more than 4.0 units (DELTA-E by ASTM D2244) after 60 months outdoor weathering in Arizona determined by an average of at least two samples.

d. Thermal aging - the interior and exterior faces shall not change color in excess of 0.75 Delta E by ASTM D2244 and shall not darken more than 0.3 units (Delta L by ASTM D2244) and shall not show cracking or crazing when exposed to 300°F for 25 minutes.

e. The faces shall not become readily detached when exposed to temp of 300°F and 0°F for 25 minutes.

f. Panels shall consist of a polycarbonate resin with a permanent, co-extruded, ultra-violet protective layer. Post-applied coating or films of dissimilar materials are unacceptable. Fiberglass skins are unacceptable.
g. UV Maintenance: The system shall require no scheduled re-coating to maintain its performance or for UV protection.

h. Panel shall be factory sealed at the sill to restrict dirt ingress.

A. Finish

1. Roof trim finish: Kynar 500 (or approved equal) high-performance resin-based paint

2. Roof color: determined by owner.

2.4 MISCELLANEOUS

A. Materials

1. Concrete shall be a minimum strength of 4,000 psi or as specified in the engineered canopy drawings. All concrete materials shall conform to the requirements of division 3. Where discrepancies exist, the more stringent of requirements shall govern. Concrete materials not provided by steel canopy manufacturer.

PART 3 – EXECUTION

3.1 STORAGE AND HANDLING

A. Protect material after delivery from weather, sunlight, and damage.

B. Stored materials shall be elevated to allow circulation and reduce mold, fungi decay, and insect infestation.

C. Handle material with protective straps or padded forklift. Handling material with chain or cable will not be accepted and may void manufacturer’s warranty.

D. To prevent moisture damage to any wood material, keep wood packaged before installation and cover immediately with any secondary roof material.

3.2 ERECTION

A. Installation of canopy components shall comply with manufacturer’s installation drawings and these specifications.

B. Layout and positioning of anchor bolts shall comply with manufacturer’s installation drawings.

C. No field slotting or opening of holes will be allowed. Tolerances on steel structural members are set according to AISC construction practices, followed during fabrication, and cannot be increased.
D. Any damage to manufacturer-applied powder coat finish shall be restored to original condition using manufacturer-supplied touch-up paint. Finish repairs are subject to owner approval. Rejected repairs shall be remedied by replacement of damaged components and materials at no cost to owner.

E. Assembly and erection shall be coordinated with other disciplines (electrical, plumbing, etc.).

F. Erection of canopy structure shall comply with all applicable OSHA requirements.

3.3 REPAIR

A. Changes or modifications to the structure are prohibited except where approved in advance by the manufacturer.

END OF SECTION
SECTION 14210 - ELECTRIC TRACTION ELEVATORS

PART 1  GENERAL

1.01  SUMMARY

A. Section Includes: Electric Traction Elevators.

B. Products Supplied But Not Installed Under this Section:
   1. Hoist Beam
   2. Pit Ladder
   3. Inserts mounted in block walls for rail attachments

C. Work Supplied Under Other Sections:
   1. Temporary lighting, including temporary lighting in hoistway for machine space with
      switch located in hoistway on the strike jamb side of top landing door.
   2. Main line disconnects for each elevator.
      a. One fused three phase permanent power in building electrical distribution room
      b. One non fused three phase permanent power in hoist way at top landing
   3. Hoistway ventilation shall be in accordance with local and national building code
      requirements.
   4. Guide Rail Support shall be structurally adequate to extend from pit floor to top of
      hoistway, with spans in accordance with requirements of authority having jurisdiction
      and final layouts.
   5. Removable barricades at all hoistway openings, in compliance with OSHA 29 CFR
      1926.502 in addition to any local code requirements.
   6. Lifeline attachments capable of withstanding 5000 lb load in accordance with OSHA
      29 CFR 1926.502. Provide a minimum of 2 at the top, front of each hoistway.
   7. Pit lighting: Fixture with switch and guards. Provide illumination level equal to or
      greater than that required by ASME A17.1/CSA B44 2000, or applicable version.
   8. Control space lighting with switch. Coordinate switch with lighting for machine space
      as allowable by code.

D. Industry and government standards:
   1. ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities
   2. ADAAG - Accessibility Guidelines for Buildings and Facilities
   3. ANSI/NFPA 70, National Electrical Code
   4. ANSI/NFPA 80, Standard for Fire Doors and Fire Windows
   6. IBC 2015 New Jersey Addition

1.02  DESCRIPTION OF ELEVATOR

A. Elevator Equipment: The Basis of Design is KONE EcoSpace™ gearless traction elevator
   or approved equal by Otis or Thyssen Krupp or other Approved equal manufacturer/
   installer.

B. Equipment Control: KCM831 or approved equal control
SECTION 14210 - ELECTRIC TRACTION ELEVATORS

C. Drive: Non Regenerative
D. Quantity of Elevators: 1
E. Landings: 2
F. Openings: 2 Front Openings, 0 Back Openings
G. Travel: 14’ 0”
H. Rated Capacity: 4000lbs.
I. Rated Speed: 150fpm
J. Clear Inside Dimensions (7’ 5” W x 5’ 6”D):
K. Cab Height: 8’ 0”
L. Clear height under suspended ceiling: 7’ 4”
M. Entrance Width and Type: 4’ 0” Wide Center
N. Entrance Height: 7’ 0”
O. Main Power Supply: 480 Volts ± 5%, three-phase
P. Operation: Simplex
Q. Machine Location: Inside the hoistway mounted on car guide rail
R. Control Space Location: Integrated Controller inside hoistway at top landing
S. Elevator Equipment shall conform to the requirements of seismic zone: non-seismic
T. Maintenance Service Period: 24 months

1.03 PERFORMANCE REQUIREMENTS

A. Car Performance
   1. Car Speed ± 5% of contract speed under any loading condition or direction of travel.
   2. Car Capacity: Safely lower, stop and hold (per code) up to 125% of rated load.

B. System Performance
   1. Vertical Vibration (maximum): 25 mg
   2. Horizontal Vibration (maximum): 25 mg
   3. Jerk Rate (maximum): 3.3 ft/sec³
   4. Acceleration (maximum) 1.3 ft/sec²
   5. In Car Noise: ≤ 55 dB(A)
6. Leveling Accuracy: ±0.2 inches
7. Starts per hour (maximum): 120

1.04 SUBMITTALS

A. Comply with Specification Section 01300 - Submittals.

B. Product Data: Submit manufacturer's product literature for each proposed system.
   1. Cab design, dimensions and layout.
   2. Layout, finishes, and accessories and available options.
   3. Controls, signals and operating system.

C. Shop Drawings:
   1. Clearances and travel of car.
   2. Clear inside hoistway and pit dimensions.
   3. Location and layout of equipment and signals.
   4. Car, guide rails, buffers and other components in hoistway.
   5. Maximum rail bracket spacing.
   7. Hoist beam requirements.
   8. Location and sizes of access doors.
   9. Location and details of hoistway door and frames.
   10. Electrical characteristics and connection requirements.

D. Operation and maintenance data:
   1. Provide manufacturer's standard maintenance and operation manual.

E. Diagnostic Tools

1. Prior to seeking final acceptance for the completed project as specified by the Contract Documents, the Elevator Subcontractor shall deliver to the Owner any specialized tool(s) that may be required to perform diagnostic evaluations, adjustments, and/or parametric software changes and/or test and inspections on any piece of control or monitoring equipment installed. This shall include any specialized tool(s) required for monitoring, inspection and/or maintenance where the means of suspension other than conventional wire ropes are furnished and installed by the Elevator Subcontractor. Any and all such tool(s) shall become property of the Owner. Any diagnostic tool provided to the Owner by the Elevator Subcontractor shall be configured to perform all levels of diagnostics, systems adjustment and parametric software changes which are available to the Elevator Subcontractor. In those cases where diagnostic tools provided to the Owner require periodic recalibration/or re-initiation, the Elevator Subcontractor shall perform such tasks at no additional cost to the Owner for a period equal to the term of the maintenance agreement from the date of final acceptance of the competed project. During those intervals in which the Owner might find it necessary to surrender a diagnostic tool for re-calibration, re-initiation, or repair, the Elevator Subcontractor shall provide a temporary replacement for the tool at no additional cost to the Owner.
The Elevator Subcontractor shall deliver to the Owner, printed instructions for the proper use of any tool that may be necessary to perform diagnostic evaluations, system adjustment, and/or parametric software changes on any unit of microprocessor-based elevator control equipment and means of suspension other than standard elevator steel cables furnished and install by the Elevator Subcontractor. Accompanying the printed instructions shall be any and all access codes, password, or other proprietary information that is necessary to interface with the microprocessor-control equipment.

1.05 QUALITY ASSURANCE

A. Manufacturer: Minimum of fifteen years experience in the fabrication, installation and service of elevators of the type and performance of the specified. The manufacturer shall have a documented quality assurance program.

B. Installer: The equipment manufacturer shall install the elevator.

C. Inspection and Testing: In accordance with requirements of local jurisdiction, obtain required permits, inspections and tests.

1.06 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer’s recommendations for delivery, storage and handling.

B. If the construction site is not prepared to receive the elevator equipment at the agreed ship date, the General Contractor shall be responsible to provide a safe, dry, and easily accessible storage area on or off the premises. Additional labor costs for double handling will be the responsibility of the general contractor.

C. Delivered elevator materials shall be stored in a protected environment in accordance with manufacturer recommendations. A minimum storage area of 10 feet by 20 feet is required adjacent to the hoistway.

1.07 WARRANTY

A. Provide manufacturer warranty for a period of two (2) years. The warranty period is to begin upon Substantial Completion of the Contract. Warranty covers defects in materials and workmanship. Damage due to ordinary use, vandalism, improper or insufficient maintenance, misuse, or neglect do not constitute defective material or workmanship.

1.08 MAINTENANCE SERVICE

A. The elevator manufacturer shall provide maintenance service consisting of regular examinations and adjustments of the elevator equipment for a period of 24 months after date of substantial completion. Replacement parts shall be produced by the original equipment manufacturer.

B. Maintenance service be performed during regular working hours of regular working days and shall include regular time call back service emergency 24-hour call back service.

C. Maintenance service shall not include adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents.
PART 2

2.01 MANUFACTURER

A. Provide AC gearless machine room-less elevator systems subject to compliance with the design and performance requirements of this specification. Elevator manufacturers may include but are not limited to one of the following:

2. Other acceptable machine room-less products: manufacturer with minimum 15 years experience in manufacturing, installing, and servicing elevators of the type required for the project.
3. Approved equal manufacturers will be considered in accordance with Specification Section 01300 – Submittals.

2.02 EQUIPMENT: CONTROL COMPONENTS AND CONTROL SPACE

A. Controller: Provide microcomputer based control system to perform all of the functions.

1. All high voltage (110V or above) contact points inside the controller cabinet shall be protected from accidental contact in a situation where the controller doors are open.
2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed and physically segregated from the rest of the controller.
3. Provide a serial cardrack and main CPU board containing a non-erasable EPROM and operating system firmware.
4. Variable field parameters and adjustments shall be contained in a non-volatile memory module.

B. Drive: Provide Variable Voltage Variable Frequency AC drive system to develop high starting torque with low starting current.

C. Controller Location: Locate controller{s} in the front wall integrated with the top landing entrance frame, machine side of the elevator. A separate control space should not be required.

2.03 EQUIPMENT: HOISTWAY COMPONENTS

A. Machine: AC gearless machine, with permanent magnet synchronous motor, direct current electro-mechanical disc brakes and integral traction drive sheave, mounted to the car guide rail at the top of the hoistway.

B. Governor: Friction type over-speed governor rated for the duty of the elevator specified.

C. Buffers, Car and Counterweight: Polyurethane buffer.

D. Hoistway Operating Devices:

1. Emergency stop switch in the pit
2. Terminal stopping switches.
SECTION 14210 - ELECTRIC TRACTION ELEVATORS

3. Emergency stop switch on the machine

E. Positioning System: System consisting of magnets and proximity switches.

F. Guide Rails and Attachments: Steel rails with brackets and fasteners.

2.04 EQUIPMENT: HOISTWAY ENTRANCES

A. Hoistway Entrances

1. Sills: extruded aluminum
2. Doors: Hollow metal construction with vertical internal channel reinforcements.
3. Fire Rating: Entrance and doors shall be UL fire-rated for 1-1/2 hour.
4. Entrance Finish: Brushed Stainless Steel.
5. Entrance Markings Jamb Plates: Provide standard entrance jamb tactile markings on both jambs, at all floors. Plate Mounting: Refer to manufacturer drawings.

2.05 EQUIPMENT: CAR COMPONENTS

A. Car Frame: Provide car frame with adequate bracing to support the platform and car enclosure.

B. Platform: Platform shall be all steel construction.

C. Car Guides: Provide guide-shoes mounted to top and bottom of both car and counterweight frame. Each guide-shoe assembly shall be arranged to maintain constant contact on the rail surfaces. Provide retainers in areas with Seismic design requirements.

D. Steel Cab Finish: Kone Plastic Laminate Series or other Approved Manufacturers Plastic Laminate Series.

1. Car Wall Panels: Non-removable vertical panels plastic laminate: Wilsonart Amber Cherry #7918K-78 or approved equal, selected from standard manufacturer's catalog of choices.

4. Ceiling:

   a. Round LED Down Light Drop Ceiling - LF-88: Satin Finished Stainless Steel three panel suspended ceiling with three holes per panel for Round LED lights.

5. Handrail:

   a. Rails to be located on side and back wall of car enclosure.

7. Threshold: Aluminum
8. Provide protective pad hooks and quilted fire retardant protective pads. Pads should be hung from the suspended ceiling.
E. Emergency Car Signals

1. Emergency Siren: Siren mounted on top of cab that is activated when the alarm button in the car operating panel is engaged. Siren shall have rated sound pressure level of 80 dB(A) at a distance of three feet from device. Siren shall respond with a delay of not more than one second after activation of alarm button.

2. Emergency Car Lighting: Provide emergency power unit employing a 12-volt sealed rechargeable battery and totally static circuits shall illuminate the elevator car and provide current to the alarm bell in the event of building power failure.

3. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.

4. Ventilation: Fan

2.06 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

A. Car Operating Panel: Provide car operating panel with all card access, key switches, and message indicators for elevator operation. Fixture finish to be: Textured Stainless Steel.

1. Flush mounted car operating panel shall contain a bank of round, mechanical, illuminated buttons marked to correspond to landings served, emergency call button, door open button, door close button, and key switches for lights, inspection, and exhaust fan. The car operating display panel shall be blue DOT-matrix. All texts, when illuminated, shall be blue. The car operating panel shall have a brushed stainless steel finish.

2. Additional features of car operating panel shall include:

   a. Car Position Indicator within operating panel blue.
   b. Elevator Data Plate marked with elevator capacity and car number on car top.
   c. Help buttons with raised markings.
   d. In car stop switch per local code.
   e. Firefighter's hat.
   f. Firefighter's Phase II Key-switch.
   g. Call Cancel Button.
   h. Pre-programmed integrated ADA phone (complete description of krms features included as standard)
   i. Help Button/Communicator. Activation of help button will initiate two-way communication between car and the security desk inside the building, switching over to “911” if call is unanswered, where personnel are available to take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
   j. Firefighter's Phase II emergency in-car operating instructions.
   k. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.

B. Hall Fixtures: Wall mounted hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Wall mounted hall fixtures shall have a brushed stainless steel finish.
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1. Hall fixtures shall feature round, mechanical, buttons in applied mount face frame. Hall fixtures shall correspond to options available from that landing. Buttons shall be in a vertically mounted fixture. Hall fixtures shall not be jamb-mounted. Hall lanterns shall feature blue illumination.

C. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound. The chime will sound once for up and twice for down. The car riding lantern face plate shall have a brushed Steel finish.

2.07 EQUIPMENT: ELEVATOR OPERATION AND CONTROLLER

A. Elevator Operation

1. Simplex Collective Operation: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
2. Zoned Car Parking.

B. Standard Operating Features to include:

1. Full Collective Operation
2. Fan and Light Control
3. Load Weighing Bypass
4. Ascending Car Uncontrolled Movement Protection
5. Top of Car Inspection Station

C. Additional Operating Features to include:

1. Independent Service
2. Hoistway Access Bottom Landing
3. Hoistway Access Top Landing
4. Car Secure Access
5. Provision for Card Reader in Car (Card Reader provided and installed by others)
6. Provide provisions for coaxial cable for CCTV. CCTV by others.
7. Emergency Battery Power Supply

   a. When the main line power is lost for longer than 5 seconds the emergency battery power supply provides power automatically to the elevator controller. The elevator will rise or lower to the first available landing, open the doors, and shut down. The elevator will return to service upon the return of normal main line power. An auxiliary contact on the main line disconnect and shunt trip breaker (if used) will be provided by others.

D. Elevator Control System for Inspections and Emergency

1. Provide devices within controller to run the elevator in inspection operation.
2. Provide devices on car top to run the elevator in inspection operation.
3. Provide within controller an emergency stop switch to disconnect power from the brake and prevents motor from running.
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4. Provide the means from the controller to mechanically lift and control the elevator brake to safely bring car to nearest available landing when power is interrupted.
5. Provide the means from the controller to reset the governor over speed switch and also trip the governor.
6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.
7. Provide the means for the control to reset elevator earthquake operation.

2.07 EQUIPMENT: DOOR OPERATOR AND CONTROL

A. Door Operator: A closed loop permanent magnet VVVF high-performance door operator shall be provided to open and close the car and hoistway doors simultaneously. Door movement shall be cushioned at both limits of travel. Electro-mechanical interlock shall be provided at each hoistway entrance to prevent operation of the elevator unless all doors are closed and locked. An electric contact shall be provided on the car at each car entrance to prevent the operation of the elevator unless the car door is closed.

B. The door operator shall be arranged so that, in case of interruption or failure of electric power, the doors can be readily opened by hand from within the car, in accordance with applicable code. Emergency devices and keys for opening doors from the landing shall be provided as required by local code.

C. Doors shall open automatically when the car has arrived at or is leveling at the respective landings. Doors shall close after a predetermined time interval or immediately upon pressing of a car button. A door open button shall be provided in the car. Momentary pressing of this button shall reopen the doors and reset the time interval.

D. Door hangers and tracks shall be provided for each car and hoistway door. Tracks shall be contoured to match the hanger sheaves. The hangers shall be designed for power operation with provisions for vertical and lateral adjustment. Hanger sheaves shall have polyurethane tires and pre-lubricated sealed-for-life bearings.

E. Electronic Door Safety Device. The elevator car shall be equipped with an electronic protective device extending the full height of the car. When activated, this sensor shall prevent the doors from closing or cause them to stop and reopen if they are in the process of closing. The doors shall remain open as long as the flow of traffic continues and shall close shortly after the last person passes through the door opening.

PART 3 EXECUTION

3.01 EXAMINATION

A. Field measure and examine substrates, supports, and other conditions under which elevator work is to be performed.

B. Do not proceed with work until unsatisfactory conditions are corrected.

C. Prior to start of Work, verify hoistway is in accordance with shop drawings. Dimensional tolerance of hoistway from shop drawings: ±0 inches ±2 inches. Do not begin work of this section until dimensions are within tolerances.
D. Prior to start of Work, verify projections greater then 2 inches (4 inches if ASME A17.1/CSA B44 2000 applies) must be beveled not less then 75 degrees from horizontal.

E. Prior to start of Work, verify landings have been prepared for entrance sill installation. Traditional sill angle or concrete sill support shall not be required.

F. Prior to start of Work, verify elevator pit has been constructed in accordance with requirements, is dry and reinforced to sustain vertical forces, as indicated in approved submittal. Verify that sumps or sump pumps located within pit will not interfere with installed elevator equipment.

G. Prior to start of Work, verify control space has been constructed in accordance with requirements, with access coordinated with elevator shop drawings, including Sleeves and penetrations.

H. Verify installation of GFCI protected 20-amp in pit and adjacent to each signal control cabinet in control space.

3.02 PREPARATION

A. Coordinate installation of anchors, bearing plates, brackets and other related accessories.

3.03 INSTALLATION

A. Install equipment, guides, controls, car and accessories in accordance with manufacturer installation methods and recommended practices.

B. Properly locate guide rails and related supports at locations in accordance with manufacturer’s recommendations and approved shop drawings. Anchor to building structure using isolation system to minimize transmission of vibration to structure.

C. All hoistway frames shall be securely fastened to fixing angles mounted in the hoistway. Coordinate installation of sills and frames with other trades.

D. Lubricate operating system components in accordance with manufacturer recommendations.

E. Perform final adjustments, and necessary service prior to substantial completion.

3.04 CONSTRUCTION

A. Interface with Other Work:

1. Guide rail brackets attached to steel shall be installed prior to application of fireproofing.

2. Coordinate construction of entrance walls with installation of door frames and sills. Maintain front wall opening until elevator equipment has been installed.

   a. Ensure adequate support for entrance attachment points at all landings.
   b. Coordinate wall openings for hall push buttons, signal fixtures and sleeves. Each elevator requires sleeves within the hoistway wall.
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c. Coordinate emergency power transfer switch and power change pending signals as required for termination at the primary elevator signal control cabinet in each group.
d. Coordinate interface of elevators and fire alarm system.
e. Coordinate interface of dedicated telephone line.

3.05 TESTING AND INSPECTION

A. Perform recommended and required testing in accordance with authority having jurisdiction.

B. Obtain required permits and provide originals to Owner’s Representative.

3.06 DEMONSTRATION

A. Prior to substantial completion, instruct Owner’s Representative on the proper function and required daily maintenance of elevators. Instruct personnel on emergency procedures.

END OF SECTION
SECTION 15010 – GENERAL REQUIREMENTS

PART 1  GENERAL

1.01  SCOPE

1.    The General, Supplementary, and Special Conditions, applicable portions of all divisions and the addenda thereto, are made a part of this Contract.

2.    Provide all work described in Division 15 “Mechanical” section of the specifications for the mechanical systems. This work shall be the responsibility of the mechanical prime subcontractor.

3.    It is the intent of these specifications to include all material, service and labor necessary to form a complete and properly operating whole.

1.02  CONTRACT DRAWINGS

1.    Examine all drawings and specifications and visit the site to become acquainted with the construction and the extent of the work.

2.    In referring to drawings, figured dimensions take precedence over scale measurements. Discrepancies must be referred to the Architect for decision. Each Contractor shall certify and verify all dimensions before ordering material or commencing work.

3.    Any work called for in the specifications, but not mentioned or shown on the drawings, or called for on the drawings, but not mentioned in the specifications, shall be furnished as though called for in both. When there is a discrepancy between drawings and specifications, the most considerable shall apply.

4.    When any device or part of equipment is herein referred to in to singular number, such as "the pump" such reference shall be deemed to apply to as many such devices as required to complete the installation.

5.    The term "provide" shall mean "furnish and install". Neither term will be used generally in these specifications but will be assumed. The term "furnish" shall mean to obtain and deliver on the job for installation by other trades.

1.03  CODES AND STANDARDS

1.    All work shall comply with all regulations and latest edition of applicable codes and be subject to inspection and approval of authorities having jurisdiction.

2.    All electrical work shall comply with latest edition of the NEC National Electrical Code.

3.    Where items indicated on contract documents differ from code requirements, contractor shall inform Architect prior to installation. Any construction installed by contractor that is not in compliance with applicable codes, shall be removed, modified, and/or replaced at not additional cost.

4.    All equipment shall be labeled by an applicable approved agency.

5.    Contractor shall give all notices, obtain and pay for all permits, deposits, and fees necessary.
SECTION 15010 – GENERAL REQUIREMENTS

6. Manufacturer's published data is made a part of these specifications.

7. Wherever a recognized national organization has published standards these shall be complied with (such as ASA Z 21.30 for gas piping).

1.04 SCOPE OF WORK

1. It is the intent of these specifications to include all material, service and labor necessary to form a complete and properly operating whole system.

2. See Specification Section 01010 – Summary of Work, for a full list of Owner Furnished Equipment.

1.05 PROGRESS

1. See “General Conditions”.

1.06 SHOP DRAWINGS AND SUBMITTALS

1. See “General Conditions”.

2. Ductwork and piping shop drawings shall be prepared using Auto Cad 2000 or latest edition of Auto Cad @ ¼"scale (minimum).

3. Equipment Manufacturers are required to provide a written report stating whether or NOT any equipment furnished by the Manufacturer qualifies for a Program Incentive payment through the NJ Clean Energy Commercial and Industrial Program (New Jersey SmartStart Buildings®). The report is to be submitted with original shop drawing submittal. Report shall include all supporting equipment specification sheets, applicable AHRI Certificate and any other certifications required. (Note: a negative report MUST be submitted where applicable) Listed below are the types of qualifying equipment & approved technologies listed by New Jersey SmartStart Buildings® that require the above specified report. Note: a report shall be submitted from each Equipment Manufacturer for each equipment item submitted.

**Gas Heating**
- Gas furnaces

**Electric Unitary HVAC**
- Unitary HVAC and split systems
- Central DX AC systems
- Dual enthalpy economizer
- controls
- Occupancy controlled
- A/C Economizing Controls
- Thermostats

**Variable Frequency Drives**
- Variable air volume

**Gas Water Heating**
- Water heaters
- Booster heaters

GENERAL REQUIREMENTS 15010 - 2
SECTION 15010 – GENERAL REQUIREMENTS

1.07 EQUIPMENT DEVIATIONS

1. The material and products mentioned in these specifications are given to establish a standard of quality, design and performance. The phrases "equivalent", "acceptable", "or equal" and "equal to" shall be used to indicate that other similar products may be used and provided in accordance with "General Conditions", where applicable, such substitutes are accepted by the Architect as meeting all standards necessary to perform the function intended. Specific products listed without reference to equals or substitutions shall be provided as specified.

2. Where this Contractor proposes to use methods and/or manufacturer other than that specified or detailed on drawings, that will require any changes of the structure, partitions, foundations, piping, wiring or any other part of the design documents, all design, engineering and any new drawings and detailing required by other contractors and/or professionals shall be paid by this Contractor at no additional cost to Owner.

3. Where such deviation requires a different quantity and/or arrangement of duct work, piping, electrical work, wiring conduit and/or equipment that would have been required for equipment specified or indicated on the drawings, that Contractor shall, with the approval of the Architect, provide all material, equipment and labor required by the change at no additional cost to the Owner.

4. Where such approved deviation requires a change to the structure, electrical, plumbing or any other Contractor's or Sub-Contractor's work, or any change to the construction as indicated on the design documents. This Contractor shall pay for all costs incurred due to such deviations at no additional cost to the Owner.

1.08 REJECTED MATERIALS

1. See “General Conditions”.

1.09 WORKMANSHP

1. See “General Conditions”.

1.10 WARRANTY

1. Provide as part of contract, all belts and other normally replaceable items found defective at start up and/or for a period of 60 days operation equivalent run time. Owner is responsible for normal belt and filter replacement after initial 60 day breaking in period. This does not relieve contractor for replacement of damaged equipment, belts, etc. which are not a result of normal usage.

2. See “General Conditions”.

3. At the expiration of the Factory Warranty period, provide a Factory Warranty agreement, to include full coverage, parts and labor, plus emergency service for the new packaged rooftop air conditioning units, specified under Section 15650, for an additional three (3) year period for a total of five (5) years of Factory Warranty.
SECTION 15010 – GENERAL REQUIREMENTS

4. Filter Change - See Specification Section 15010 “FILTER CHANGES”.

1.11 AS-BUILT DRAWINGS

1. See “General Conditions”.

1.12 FIRE RATING

1. All materials used anywhere in the work must have N.F.P.A. rating and be in accordance with ASTM-E-84 as follows:

   A. Flame Spread - Not Over 25
   B. Smoke Developed - Not Over 50
   C. Fuel Contributed - Not Over 25

2. All materials shall be "Self Extinguishing”.

1.13 EQUIPMENT SELECTION AND SERVICEABILITY

1. All equipment shall be located and installed so that it may be serviced. Demonstrate to Owner as part of instructions that there is room to remove all coils, tube bundles, filters, motor and similar equipment. Equipment which is too large or poorly located to permit servicing shall be replaced or repositioned or modifications made to allow for proper servicing at no additional cost to the Owner.

2. Where piping, control diagrams and/or sequencing differ from the recommended piping arrangements of the equipment manufacturer, and will directly affect the equipment performance, the manufacturer's recommendations shall be submitted in writing to the Architect/Engineer for approval, prior to purchasing the equipment involved and piping arrangement, control, etc., as recommended by manufacturer shall be used. This Contractor shall be responsible for obtaining such recommendations from the manufacturers in order to effect correct and proper operation of the equipment at the capacities and temperatures indicated.

1.14 FACTORY TESTING (BY UNIT MANUFACTURER)

1. All factory assembled packaged equipment shall be factory tested including helium leak testing of the coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. A certified factory Run test report shall be provided for each unit. The “Run Test Report” shall be submitted to Owner for approval, prior to acceptance of unit for payment.

1.15 EQUIPMENT FURNISHED BY OTHER TRADES

1. All equipment furnished and/or installed by other trades requiring connections and services by this Contractor shall have such services provided by this Contractor.

2. This Contractor shall verify exact requirements with approved shop drawings supplied by the Equipment Contractor and/or Supplier prior to construction.
SECTION 15010 – GENERAL REQUIREMENTS

3. This Contractor shall verify locations, sizes and requirements of all services to equipment, in field with the Equipment Contractor prior to construction.

1.16 EQUIPMENT TO BE FURNISHED BY OWNER

1. All equipment which shall be furnished by the Owner will be identified throughout the plans and specifications as FURNISHED BY OWNER.

2. The Owner shall be responsible for furnishing the following:
   • Purchasing the Specified Equipment and/or Contractor Services indicated on plans and specifications as “FURNISHED BY OWNER”. Refer to plans and specifications for FURNISHED BY OWNER equipment submittals submitted by the Equipment Manufacturers. Refer to plans and specifications for additional FURNISHED BY OWNER scope of work provided by the design team as required to provide further clarity or provide corrections due to omissions or errors by the Equipment Manufacturer’s submittals.
   • Purchased Factory Start Up and Warranty Services from the Equipment Manufacturer.
   • Purchased Automatic Temperature Control Integration from the Equipment Manufacturer.
   • Mounting and wiring of sensors
   • Owner to purchase factory warranty service for warranty period.
   • Purchased Extra (Spare) Parts (Filters, belts, etc.) from the Equipment Manufacturers.
   • Owner’s option to Purchased Maintenance Contract.

3. For equipment FURNISHED BY OWNER this CONTRACTOR shall be responsible (in all aspects) for providing the following. The following list is a guide and reference exclusion of any item does not relieve contractor from providing a fully functional and operational system. Commissioning, balancing and installation per the specifications.
   • Reviewing & coordinating shipping status once the equipment is ordered
   • Receiving, unloading, storing and inspecting the equipment.
   • Confirm equipment has “Run Test Report” from the Equipment Manufacturer certifying the equipment has been “FACTORY TESTED”.
   • Coordinating all aspects of the equipment delivery with the trucker.
   • Accepting, safeguarding and secure storage any accessory shipped separately from the main unit.
   • Provide all Receiving and unloading of all material.
   • Provide All Rigging and permits
   • Inspect all material upon arrival.
   • Coordinating, filing, and processing of any damage claims with the responsible shipping and delivery vendor.
   • Before lifting the unit, verifying that the unit has the proper voltage, gas connections and model numbers.
   • Provide secured storage required with protection from weather, vandalism and any other potentially damaging conditions.
   • Provide long term storage for any applicable project phasing,
   • Review equipment for compliance with plans and specifications
   • Reviewing and complying with all manufacturer’s recommendations
SECTION 15010 – GENERAL REQUIREMENTS

- Coordinating all aspects of equipment’s installation, including but not limited to: layout, code compliance, roof penetrations, electrical requirements and protection from weather.
- Provide all temporary and/or permanent protection of building construction and/or building’s occupants required due the temporary and/or permanent installation of the equipment.
- This contractor is responsible for all installation of all equipment and accessories furnished by Owner and/or by this Contractor.
- Furnish and install all specified Vibration / Seismic Isolation equipment and devices.
- Furnish and install all specified Power Wiring and other pertinent Electrical work unless noted otherwise to be done by others.
- Furnish and install all specified Ductwork as indicated on plans and specifications.
- Furnish and install all specified all Gas Piping and Specialties (booster, regulator, etc.) as indicated on plans and specifications.
- Provide coordination, as indicated on plans and specifications, with the Automatic Temperature Controls (ATC) Contractor. Note: ATC Contractor and ATC control scope of work to be provided by the Owner. Refer to specifications section 15930.
- Installation of any ATC parts listed as field installed (sensors, valves, actuators, etc)
- Provide Cleaning of equipment.
- Provision of all Balancing and Belt/Sheave Changes required for Balancing
- Provide all specified Commissioning of equipment installed by this Contractor.
- Provide all Extra Parts (Filters, belts, etc.) as indicated on plans and specifications.
- Provide all specified owner’s training as indicated on plans and specifications.
- Provide all other pertinent services required for proper operation of the above specified equipment installed by this contractor.
- Provide Testing and Balancing (TAB), Belt or Sheave Change required for Balancing of the above specified equipment installed by this contractor.
- Furnish and install return air duct Smoke Detector.
- Furnish and install interlock wiring between Smoke Detector and existing Fire Alarm System. NOTE: Smoke Detector’s interlock wiring with HVAC equipment to be FURNISHED BY OWNER via ATC Contractor. Refer to specifications section 15930.
- This Contractor shall verify exact requirements with approved shop drawings supplied by the Equipment Contractor and/or Supplier prior to construction.
- This Contractor shall verify locations, sizes and requirements of all services to equipment, in field with the Equipment Contractor prior to construction.

PART 2 PRODUCTS

2.01 ELECTRICAL EQUIPMENT

1. This Contractor shall furnish all his equipment complete with motor, controllers, capacitors and starting equipment.

2. Electric motors shall be premium high efficiency (refer to table below for minimum efficiency), open, drip proof induction motors premium high efficiency rated for continuous duty at 15% overload with 40°C rise; single phase motor shall be capacitor start-induction run. Motors one-half and larger shall be polyphase, motors smaller than one-half horse power shall be single phase, unless otherwise noted (see Division 16). Starting equipment shall consist of magnetic across-the line starters equal to Furnas Bulletin 14, or approved equal, unless otherwise
SECTION 15010 – GENERAL REQUIREMENTS

specified. Thermal overload type, motor rated manual switches shall be furnished for motors ¾ HP and less which do not require magnetic starters for control purposes.

Premium high efficiency motors shall have efficiencies equal to or greater than listed below.

<table>
<thead>
<tr>
<th>SIZE/HP</th>
<th>1800 RPM ODP NEMA NOMINAL EFFICIENCY</th>
<th>1800 RPM TEFC NEMA NOMINAL EFFICIENCY</th>
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<tr>
<td>1</td>
<td>85.5%</td>
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<td>93.0%</td>
</tr>
<tr>
<td>25</td>
<td>93.6%</td>
<td>93.6%</td>
</tr>
</tbody>
</table>

3. Provide FPE/CDE Type 1C Power Factor correction capacitors size to increase full load power factor to 95%. Capacitors shall be fused, in NEMA enclosure, connected between safety switch and motor starter.

4. Where apparatus is specified as "Packaged", all electrical equipment shall be furnished, set and wired to a single point of connection for apparatus as a unit.

5. This Contractor shall set all electrical equipment furnished by him unless same is to be mounted on an electrical panelboard, junction box or similar piece of electrical equipment and is to be wired by others.

6. Where electrical characteristics are not shown, all electrical characteristics shall be as indicated on electrical plans. Where there is a conflict between Model Numbers which indicate electrical characteristics and electrical drawings, the electrical drawings shall take precedent.

7. This Contractor shall verify all electrical characteristics of all equipment with the Electrical Contractor. This Contractor shall submit to Electrical Contractor location of all motors, starters, all other electrical equipment, voltage and phase required prior to submission of this Contractor's and/or Electrical Contractor's shop drawings or start of construction. This Contractor shall submit to the electrical contractor all equipment requiring electrical services and obtain the review of the shop drawings for correct electrical characteristics for the electrical contractor prior to submission for review.

8. Should this Contractor change type of equipment which results in change to electrical characteristics, then this Contractor will be responsible to coordinate these changes with all other trades and pay for all costs required as a result of changes.

9. Should this Contractor change electrical characteristics of equipment from that shown on electrical drawings or does not submit shop drawings to the electrical contractor for his review, he is responsible for all cost required, resulting from such change or failure to submit shop drawings.

GENERAL REQUIREMENTS
SECTION 15010 – GENERAL REQUIREMENTS

2.02 ELECTRICAL WIRING

1. This Contractor shall furnish and install all electric power wiring required for his contract, with the exception of certain wiring shown under Electrical Contract. This contractor shall furnish and install all control wiring required for his contract including power wiring to all ATC devices, panels, etc.

PART 3 EXECUTION

3.01 METHOD OF PROCEDURE

1. The drawings accompanying these specifications are diagrammatic and intended to cover the approximate and relative locations of the systems. Where FMCS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

2. Installation, connection and interconnection of all components of these systems shall be complete and made in accordance with the manufacturers instructions and best trade practices. This Contractor shall erect all parts of equipment to be furnished by him under his contract in such time and in such a manner as not to delay or interfere with other Contractors work.

3. This Contractor shall lay out his work and be responsible for the establishment of heights, grades, etc., for all interior and exterior piping, equipment, conduit, duct work etc., included in Contract Documents, in strict accordance with the intent expressed thereby. The establishment of the location of all work shall be performed in consideration of the finished work. In case of conflict, equipment and/or materials shall be relocated without additional cost to the Owner, as directed by the Architect, regardless of which equipment was installed first.

4. Each contractor shall cooperate with other Contractors for the proper securing and anchoring of all work included within these specifications. Extraordinary care shall be used in the erection and installation of all equipment and materials to avoid marring surfaces of the work of other Contractors, as each Contractor will be held financially responsible for all such damage caused by the lack of precaution and due to negligence on the part of his workmen.

5. Do not run pipe or conduit for Mechanical Systems in any concrete slab three inches (3") or less in thickness. Do not place any pipe or conduit in any slab where the outside diameter of the pipe or conduit is more than one-quarter the thickness of the slab.

6. All duct work, conduit and other mechanical materials and equipment shown to be mounted below ceilings are to be kept as close to ceiling areas as possible unless otherwise noted.

7. All items such as dampers, equipment, controllers, starters, ATC panels, etc., that will be concealed in construction shall be installed and so arranged as to be fully accessible for adjustment, service and maintenance by use of access doors.

8. Where these devices are above suspended ceiling, colored indications mounted on ceiling, markings on suspended ceiling grid, shall be provided.
SECTION 15010 – GENERAL REQUIREMENTS

3.02 EQUIPMENT IDENTIFICATION

1. All HVAC equipment, control panels and starters shall engrave plastic equipment tags. Tags shall be 1/16" plastic with mounting holes or adhesive backing to allow tags to be permanently mounted to equipment. Indication shall be for the equipment number, usage and location and where applicable circuit numbers and panel for electrical feed served. Equipment number shall be per the contract documents or where different numbering system is used by the contractor, the number system be per as-builds, O & M manuals and/or control drawings. Areas served shall be per room name and number (if applicable) based on architectural plans; contractor to verify prior to submittal. If different room designations and number system is used by Owner/contractor, these shall be used.

2. Size of equipment tags shall be minimum 1"x3". Larger sizes shall be used, 1-1/2" x 4", for equipment requiring additional information.

3. Colors shall be to the extent practical and possible; match duct and pipe marker color.

4. For equipment not ducted or piped, provide same color as adjacent equipment. Engraved plastic equipment tags shall be manufactured by MSI.

5. Equipment location tags shall be used for equipment located above acoustical ceiling and shall be MSI Model 35550 or approved equal. Color coding shall be per Owner. Tags shall be 7/8” dia. with heads that can be written on with a marking pen.

3.03 VISIT TO SITE

1. Due to the nature of the work involved under this Contract, all bidders are required to thoroughly examine the site. Bidding contractors shall thoroughly review Contract Documents prior to visiting the site, take Contract Documents to site and thoroughly explore to any extent necessary, the existing conditions as relating to fulfilling the requirements of this Contract.

2. If discrepancies are noted between requirements of Contract Documents and existing conditions, this Contractor shall so indicate to architect during bidding period and receive clarification before bidding. Failure to comply with this requirement will result in Architect's interpretation during the construction period and architect's decision will be final and binding as the sole interpreter of the Contract requirements.

3. Extras will not be considered for any work relating to connections with existing systems or adaptability of new systems to existing conditions.

3.04 CLEANING

1. Upon completion of the work, this Contractor shall remove all excess material, debris, tools and equipment from the site, and leave the premises in a broom clean condition.

2. Flush out all piping systems with proper solvents to insure removal of all foreign materials. Clean equipment, piping and other surfaces soiled by the work. Remove debris and rubbish on a daily basis.
SECTION 15010 – GENERAL REQUIREMENTS

3. Disposal of all materials shall be this Contractor's responsibility. All solvents and other chemicals, and materials used, shall be disposed of in strict accordance with all applicable environmental codes.

3.05 START-UP AND ADJUSTMENTS

1. Equipment Start-UP

   A. The equipment manufacturer shall provide all start-up. Start-up shall be provided by the equipment supplier for all equipment.

   B. As part of start up, the equipment manufacturer shall provide a complete checklist of all start up requirements for each piece of equipment. This checklist, when completed, shall be provided to the architect/owner indicating that the equipment has been started up, adjusted, balanced, tested and installed in strict accordance with the equipment manufacturer's requirements and is functioning per specification.

   C. This written confirmation shall be the equipment manufacturer's standard checklist for start up. All start up, adjustments, replacement of equipment, rebalancing, installation, and any other modification to the equipment or system required to provide the correct and/or specified performance shall be made at no additional cost to owner. Any of the above items needed shall be indicated as part of this start up.

   D. All equipment startup provided by the equipment manufacturer shall have written confirmation as specified above and shall be submitted to owner/architect prior to contractor submission of payment for substantial completion. Failure to provide start up reports will result in non-payment of billing for substantial completion.

   E. Where any modifications and/or reinstallation is required as specified above and results in additional work to any other contractors or subcontractors work, this work shall be the responsibility of the HVAC contractor and shall be done at no additional cost to owner/architect.

   F. Where start up is not completed in a timely manner and results in additional cost to other contractors, regardless of cause, these additional costs will be the responsibility of the HVAC contractor. These costs shall result in no additional cost to owner.

   G. The equipment manufacturer personnel who will do the start-up and provide report shall be a certified factory trained representative(s) whose primary function is starting up of equipment. Qualifications of the start up representative shall be provided as part of the report or inspection.

   H. As part of startup, the Owner shall be provided operation and maintenance manuals.

   I. As part of start up and/or inspection services after startup has been performed, the same factory trained representative shall be available for a period of classroom instruction to instruct the Owners' personnel in the proper maintenance equipment.
J. This Contractor shall supply the owner with the following literature as furnished by the manufacturer, four (4) weeks prior to start up, and have equipment manufacturer representative available for any questions.

- Three (3) complete sets of installation drawings.
- Field wiring diagrams.
- Installation instructions.
- Start up operation and maintenance instructions.

K. Where start up results in performance which is not in accordance with contract documents or manufacturers’ specifications, this Contractor shall submit architect the discrepancies prior to commissioning of work. Any discrepancies shall be the responsibility of the HVAC contractor and be corrected by this Contractor at no additional cost to Owner.

L. All of the work in this section must be completed and accepted by the Architect as a condition for issuing a substantial completion letter.

2. Upon completion of initial testing and prior to final balance, this Contractor, the Owners’ ATC subcontractor and sheet metal sub-contractor shall perform a survey and testing of the entire system. The testing shall be done with the commissioning agent and/or Owner. Contractor shall include the services of a minimum of three (3) personnel; not to include control personnel and equipment start-up personnel. This work to be done in accordance with this section prior to commission by Owners’ commissioning agent.

A. This Contractor shall perform, but not limited to, the following.

B. Each individual thermostat and/or sensor shall be tested in presence with the Owners’ representative for proper operation and setpoint. Adjustments shall be made to setpoints, calibration, repairs, and/or replacement of defective equipment.

F. Each and every new control device and damper, and controller shall be tested, adjusted, repaired, and/or replaced if found defective. All wiring associated with the control system shall be tested. This shall include control transformers, wiring, electronic devices, and all equipment associated with the control system. (Also see Specification Section 15010, Factory Testing.)

G. Each piece of packaged equipment shall be tested with the factory representative present as part of their start-up and shall be tested and operated up to its full capacity. All tests of packaged equipment shall be done before and after equipment has been integrated with the remainder of the system.

H. Each fan shall be tested, adjusted, repaired, and/or replaced and made ready for final air balance performed. Fan shall be tested before and after it has been installed and integrated into the remainder of the system.
SECTION 15010 – GENERAL REQUIREMENTS

I. The Contractor shall test the entire automatic control system. First, each component shall be tested to determine proper operation, calibration, performance and sequence prior to installation and/or integration into the remainder of the system. After the initial test, the equipment shall be installed and integrated into the system. After this is done, the entire system shall be tested and adjusted for proper sequence of operation, performance, function and capacity of the entire system. This equipment shall be tested from computer program and verified for operation in field using 2-way communication.

J. When delivered to the job site, all new equipment in need of repair and/or replacement shall not be installed until the necessary repairs have been made. In the event equipment is required to be repaired for whatever reason, it shall be repaired and/or replaced by the equipment manufacturer at no additional cost to Owner, and with no interruption of service or extension of contract time.

K. All tests, adjustments, repair, and/or replacement of all the mechanical system shall be completed at least three (3) weeks prior to the scheduled date of substantial completion and/or commissioning agent. No extension of time will be given for contractors’ failure to perform the above. No extra compensation will be given due to the “overtime” hours implicated on the requirements of this section.

L. Upon completion of all tests, this Contractor shall prepare a written report for submission to the Architect for his review. This report shall indicate the activity, time performed, results, initial balance points, final balance points, initial and final control settings, repair, and/or remedial work required and performed.

M. This Contractor shall schedule (submit schedule as part of shop drawing for review) all his work and testing, so that in the event there is replacement, repair, and/or adjustment to system and equipment, it shall be completed, so as not to delay substantial completion.

As a result of test, adjustments, and work necessary to perform the above, this Contractor shall, at his own expense, remove and replace any construction, either his or of other contractors. It is incumbent upon this Contractor to schedule the required work so as to not affect other trades or progress of other contractors’ work.

3.06 OPERATING AND MAINTENANCE INSTRUCTIONS

1. This Contractor and equipment manufacturer shall furnish qualified personnel to instruct the Owner's employees in the operation of the system and must request from the Owner, in writing, a date for such instruction to begin. Contractor's personnel shall remain until such instruction is complete to Owner's satisfaction. This Contractor shall receive from Owner written verification that the Owner's personnel have been thoroughly instructed in the operation, maintenance, and all facets of the system operation.

2. This Contractor shall provide to engineer for approval a report indicating the itinerary of this instruction complete with duration of instructions location, time, and all other pertinent data.

3. This Contractor shall have manufacturers’ representatives, as part of their start-up, provide instruction on equipment.
SECTION 15010 – GENERAL REQUIREMENTS

4. Manuals shall include all equipment, equipment parts lists, complete oiling, recommend spare parts, and complete coiling, cleaning and servicing data compiled in a clearly indexed and easily understood form. The contractor shall obtain this information from the equipment supplier and include in the O & M manuals. The data shall indicate the serial numbers of each piece of equipment and provide complete lists of replacement parts, motor parts, ratings and actual loads.

5. Provide list of any special emergency operating instructions and a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to the various parts of the system.

6. Certified log of air quantities at all air supply, return and exhaust openings by Owners’ balancing contractor.

7. Provide list of all motor data, including standard and actual operating in service data.

8. Provide all manufacturer's equipment guarantees and warranties.

9. Provide a list of units, filter sizes, quantities and recommended changes. For each piece of equipment, locate filter and demonstrate filter change.

3.07 TRAINING AND INSTRUCTION

1. Provide operating instructions shall include wiring and control diagrams showing complete lay out of each system. These instruction periods shall be a minimum of:

   Filter Changing       8 Hours/Building
   General System        8 Hours/Building

   In addition, contractor shall have each equipment supplier and start-up personnel for each type of equipment on site for the above minimum times.

2. The control manufacturer and this Contractor shall provide separate instruction periods for control system as indicated below:

   On Site - 8 hours to consist of minimum two (2) 4-hour sessions or broken into segments as determined by Owner. This instruction period is in addition to the hours specified for maintenance service.

3.08 PAINTING AND FINISHING

1. All painting is to be done in accordance to Rust-Oleum Corporations printed instructions. All surfaces to receive two (2) coats of primer, exposed surfaces one (1) finished coat, color selected. Aluminum or galvanized metal surfaces are considered finished where concealed.

2. All surfaces to be carefully cleaned and/or pickled and filled as required to provide a proper uniform surface. Factory finished equipment shall be touched up or refinished where required.

GENERAL REQUIREMENTS

15010 - 13
SECTION 15010 – GENERAL REQUIREMENTS

3. Where equipment is provided as factory painted and is visible on roofs from grade (as determined by construction manager), exposed in space or otherwise not concealed behind finished surfaces, equipment shall be factory painted in accordance with manufacturers standard painting procedures. The color shall be selected by architect and a color chart shall be submitted for review.

4. All duct exposed and all other exposed equipment, pipe and appurtenances in all other areas unless specifically indicated to be painted by general contractor, to be painted by this Contractor color as selected. Submit for approval. All surfaces shall be prepared for painting and/or constructed of materials suitable to be painted.

3.09 CONSTRUCTION SAFETY

1. All work shall be done in accordance with the following Federal regulations:
   
   A. Williams-Steiger Occupational Safety and Health Standards, Chapter XVII of Title 29, Codes of Federal Regulations.

2. Comply with local Health and Safety Regulations.

3.10 ENERGY CONSERVATION CODES

1. It is the intent of this specification that all equipment and materials furnished meet the latest enforced edition of the ASHRAE 90.1-2015 or such code as locally applicable, if more restrictive.

3.11 FLASHINGS

1. All ducts penetrating roof shall be provided with curbs, flashing, counterflashing and flashing collar welded to duct. Coordinate exact requirements with Roofing Contractor or Roof Bonding Agent.

3.12 EQUIPMENT INSTALLATION

1. Rooftop equipment installed within 10' of edge of roof shall have a painted guard, provided by this Contractor, at edge of roof, top of guard to be minimum 42" above roof surface, constructed to prevent passage of 2" diameter sphere.

2. Mounting, details, color, and arrangement of guard shall be submitted for review. Coordinate all details with all other contractors.

3.13 EQUIPMENT LIST

Refer to general conditions. Exclusion of items on list does not relieve Contractor of the responsibility of providing equipment as specified, required to complete work or shown on drawings to be provided by this Contractor.
SECTION 15010 – GENERAL REQUIREMENTS

MANUFACTURERS

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<th>EQUIPMENT</th>
<th>NUMBER 1</th>
<th>NUMBER 2</th>
<th>NUMBER 3</th>
<th>NUMBER 4</th>
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<td>Chromolox</td>
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3.14 SCHEDULE OF WORK AND COMPLETION DATES

1. The exact times and dates and schedules that the projects will be available for this Contractor to do work, shall be as indicated in General Conditions. Refer to general conditions for completion dates.

3.14 DELIVERY AND STORAGE OF EQUIPMENT

1. This Contractor shall store, take deliveries and install all equipment in accordance with manufacturers’ requirements (see “General Conditions”).

3.15 ALLOWANCE

1. See Specification Section 01210 - Allowances.

3.16 FILTER CHANGES

1. Contractor to be responsible for four (4) sets of filters. One set installed on equipment from factory by equipment manufacturer. Install a second set of filters prior to balancing by contractor. Install a third set of filters following substantial completion at the start of the two (2) year warranty period by contractor. The fourth set of filters is to be provided to the Owner as attic stock by contractor.

END OF SECTION
15010.5801
SECTION 15110 - BASIC MATERIALS AND METHODS

PART 1 GENERAL

1.01 MATERIALS AND EQUIPMENT

1. All material and equipment used for this contract shall be unused and of the latest model or design available. Equipment shall be installed in strict accordance with manufacturer's recommendations and details.

2. Materials not specifically described but indicated or incidentally required shall be acceptable to the Architect and/or Engineer. Submit shop drawings. Materials shall be delivered, stored and handled so as to preclude injury by weather, dirt or abrasion.

3. This Contractor shall use only specifically assigned areas for storage of materials and construction operation, unless other areas are authorized by the Owner. Such areas will be identified after the award of Contract by Owner. Comply with local municipal regulations regarding use of and parking on public streets.

4. This Contractor shall repair streets, drives, curbs, sidewalks and any existing surface where disturbed by construction operations and leave them in as good condition after completion of the work as before operations started.

1.02 PROTECTION

1. All equipment shall be covered to protect it from damage; all damage is the responsibility of this Contractor.

PART 2 PRODUCTS

2.01 CONDENSATE REMOVAL

1. All condensate pipe shall be installed at a minimum of ¾" dia. and a constant slope and uniform alignment.

2. All connections to units shall have traps and trap depth equal to operating static pressure of unit (i.e. unit with 2" static pressure, minimum depth of water in trap 2").

3. All condensate connections to units less than 15 tons shall be EZ Trap Series 100 (or approved equal) cleanable condensate trap kits consisting of ¾" dia. trap inlet cross and outlet tee with closure cap. Provide for each five (5) traps installed, one (1) brush (minimum 2 brushes).

4. Condensate pipe shall discharge to leaching wells or as indicated on plans per local codes and/or site conditions.

5. Condensate pipe from rooftop units shall not dump on roof but shall extend to closest roof drain and/or gutter. Where roof drain and/or gutter is greater than 25' from unit discharge, condensate shall discharge to roof with splash block. Splash block to be located where roof pooling, due to drain location, will not occur. Condensate discharging to roof shall be piped to a location where it will drain away from unit or low points on roof.
SECTION 15110 - BASIC MATERIALS AND METHODS

6. Where condensate pipe discharges to french drain, it shall be a pit minimum 24" dia. x 24" deep, completely filled with coarse gravel. The drain pipe shall extend into pit not less than 6" below grade. Pit shall be covered only after inspection by authorities having jurisdiction.

2.02 LINTELS

1. The General Contractor will furnish and install all lintels required for the installation and completion of all work of this Contractor, provided that the General Contractor is advised in advance of such requirements.

2. Failure to give proper notice and/or to comply with the above requires this Contractor involved to be financially liable for all work and material necessary for the completion of work to install lintels. Submit shop drawings of all openings requiring lintels to general contractor.

2.03 AUXILIARY DRAIN PANS

1. Provide auxiliary drain pans under units containing cooling coils where units are located above suspended ceiling or furred space and where there is a blockage of condensate system resulting in overflow which will cause damage.

2. Drain pans shall be constructed of galvanized metal, minimum .0276" and minimum 1½" deep, extending 3" beyond unit. Non-metallic pans may be used and shall be constructed of approved corrosion resistant material minimum .0625" except in plenums.

4. For all equipment above finished spaces provide a water level detector in auxiliary drain pan which shall automatically de-energize unit upon detection of water. Overflow cut-off switch shall be EZ Trap Model EZT-225 (or approved equal) suitable for vertical and horizontal installation. This Contractor shall be responsible for all wiring.

5. On secondary drain lines, provide a water level detector in overflow line which shall automatically de-energize unit upon detection of water. Overflow cut-off switch shall be EZ Trap Model EZT-225 (or approved equal) suitable for vertical and/or horizontal installation. This Contractor shall provide all wiring.

PART 3 EXECUTION

3.01 FOUNDATIONS

1. Foundations shall be provided by this Contractor for all equipment mounted on concrete floors and shall be of concrete construction not less than 6" high unless otherwise shown. Details of all foundations shall be submitted for approval.

2. Foundations or footings for structural steel supports shall be carried to a point not less than 12" below the underside of the floor slab, except where rock is encountered at less depth, and then foundation may set on the rock. All foundations shall be built to templates and reinforced as required by the load to be imposed upon them.
SECTION 15110 - BASIC MATERIALS AND METHODS

3.02 STRUCTURAL STEEL

1. This Contractor shall furnish and install all structural steel, supports, braces, hangers, etc., required for his contract unless shown as being furnished and/or supplied by others.


3. All structural steel design for support of HVAC system shall be the responsibilities of this Contractor. The design shall be prepared by a Registered Professional Engineer licensed in the state where work is being performed, who's seal should be affixed to plans.

3.03 PLENUM AREAS

1. Any duct plenum area, ceiling or room plenum shall not contain any combustible material, and all wiring and/or piping shall be suitable and approved by local authorities for plenum installation.

END OF SECTION
15110.5801
SECTION 15180 - INSULATION

PART 1 GENERAL

1.01 SCOPE

1. All surfaces throughout the work shall be insulated with fiberglass insulation as indicated in applicable section.

2. All insulation thickness and R Value shall be installed in accordance with ASRAE 90.1 latest edition.

PART 2 PRODUCTS

2.01 DUCT INSULATION

1. All ducts in unconditioned spaces shall be insulated with 1-1/2" thick high-density fiberglass blanket insulation, UL labeled, faced with aluminum foil covered, glass reinforced, flameproof, and Kraft paper. Where internal lining is specified or shown, the external insulation may be deleted, only if internal insulation provides same insulation value as external insulation and vapor barrier.

2. Duct insulation and linings shall not glow, flame or smolder when tested at their rated temperatures in accordance with ASTM-C-411, test temperature 250° F. or greater.

3. Duct coverings shall not penetrate fire resistance rated enclosures nor partitions required to be fire rated.

4. All duct insulation located inside of building shall be plenum rated.

5. All exposed duct in finished spaces to have rigid insulation of same thickness. Paint all duct, insulation and hangers.

2.02 INSULATION AT ROOFTOP UNITS

1. Insulate space between bottom of rooftop unit and deck with insulation.

2. Decking shall be maintained inside the rooftop unit roof curb to a clearance of 1/4” maximum around all duct drops, but never contact the duct.

   A. Pack all air gaps around duct drops for return and supply with HUSH BATT and seal with HUSH SEALAMT HSAC-100 (or approved equal).

3. HUSHCORE Model DS-52 (or approved equal) In-Curb Composite Acoustical Treatment Performance

   A. The combination of all layers shall be tested for Sound Transmission Loss in accordance with procedure ASTM E-90-10. The assembly shall be rated at not less than STC-52 with 1/3 octave performance values as listed below for sound radiation thru the deck inside the curb.
SECTION 15180 - INSULATION

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<th>Freq. (Hz)</th>
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4. The basis of design for the products referenced in this section are manufactured by BRD Noise & Vibration Control, Inc., Wind Gap, PA, 610-863-6300, infor@brd-noise.com. Approved equal manufacturer’s will be reviewed in accordance with Specification Section 01300 – Submittals.

PART 3 EXECUTION

3.01 INSTALLATION OF DUCT INSULATION

1. Insulation shall be pasted to the duct using "3M" EC-321 (or approved equal) with joints butted and taped with "Scotch No. 47A (or approved equal) Flame-Resistant Vinyl baked tape and dry dust free surface using nylon sealing tool. Tape to be used to seal joints only, NOT TO HOLD INSULATION TO DUCT.

2. In lieu of pasting insulation to duct it may be impaled on 12-gauge mechanical fasteners welded or glued on 12 to 18" centers with minimum of two (2) rows, per side-Seal protruding pin with mastic and secure with metal cap.

3. Duct coverings shall not penetrate fire resistance rated enclosures nor partitions required to be fire rated.

4. Insulation shall fit between seams and stiffeners. All joints tightly butted.

5. All duct insulation shall be installed per manufactures’ requirements.

END OF SECTION
15180.5801
SECTION 15605 - TERMINAL UNITS, ELECTRIC

PART 1 GENERAL

1.01 SCOPE

1. Furnish and install all equipment and leave all equipment completely installed so that only the connection of auxiliary services is required for start up.

1.02 CERTIFICATION

1. Units shall be listed by Underwriters Laboratories for 0 clearance.

2. Guarantee - Motors and elements shall be guaranteed for five (5) years.

PART 2 PRODUCTS

2.01 BASEBOARD RADIATION

1. Casing shall be fabricated from 16-gauge zinc coated steel. All exterior parts shall be painted and baked with acrylic enamel color as directed by the Architect. Enclosures shall be ribbed longitudinally for strength and have center reinforcement to resist impact.

2. Provide tubular prewired wireways matching terminal boxes with separate covers in which thermostats and relays can be mounted to each end of the heater. Elements shall consist of nickel chromium alloy resistance wire embedded in magnesium oxide, enclosed in corrosion resistance finned sheaths.

3. Thermal Overload - Full length hydraulic tubular type, automatic reset.

4. Where indicated, provide room thermostat.

5. Provide interface capability for DDC system to monitor and schedule for occupied/unoccupied.

2.02 UNIT HEATERS

1. Enclosures shall be fabricated from heavy gauge zinc coated steel, finished in high gloss beige enamel. Air shall be discharged through independently adjustable horizontal louvers.

2. Elements shall consist of nickel chromium alloy resistance wire embedded in magnesium oxide, enclosed in corrosion - resistant finned sheaths. Element assemblies shall be arranged to insure uniform air flow.

3. Motor shall be totally enclosed permanently lubricated and equipped with automatic reset thermal overload protection. Fan blade shall be of the axial flow type designed for quiet operation. Fan speed shall not exceed 1,600 RPM.

SECTION 15605 - TERMINAL UNITS, ELECTRIC

5. Units shall be factory assembled and wired so that only electrical supply and thermostat connections are required in the field. Thermostats shall be wall mounted and tamper-proof. Contractor shall furnish and install all wiring between thermostat and units.

6. Where indicated, provide room thermostat.

7. Provide interface capability for DDC system to monitor and schedule for occupied/unoccupied.

2.03 INSERT HEATERS

1. Heaters shall be of the forced air type with non-glowing elements, arranged so that air is drawn in at the center and discharged at each side. Heaters shall be semi-recessed to extend not more than 1½" from the wall unless otherwise approved.

2. Enclosures shall be of impact resistant construction, incorporating a chrome-plated welded steel wire guard and an underguard of perforated metal with openings no greater than ¼" x ¼". Enclosure shall be finished in a high gloss baked enamel with semi-gloss black perforated underguard.

3. Motor shall be permanently lubricated, totally enclosed, with automatic reset thermal overload protection, 1,100 RPM maximum. Elements shall consist of nickel chromium alloy resistance wire embedded in magnesium oxide, enclosed in corrosion-resistant finned sheaths. Provide automatic reset thermal overload protection.

4. Built-In Controls - Built-in thermostat on-off switch. Controls shall be operated from vandal proof knobs.

5. Where indicated, provide room thermostat.

6. Provide interface capability for DDC system to monitor and schedule for occupied/unoccupied.

2.04 DUCT HEATERS

1. Heaters shall be slip-in type with terminal boxes suitable for the installation.

2. Heaters shall have nickel-chromium resistance coils, insulated by floating bushings supported in aluminized steel frames.

3. All heaters shall be furnished with thermal cutouts for primary and secondary protection. Primary automatic reset, secondary manual. All internal wiring shall be suitable for 105°F.

4. Control Circuit - Heaters shall be supplied "packaged" with thermal cut-outs, magnetic contactors, fuse blocks, airflow switches and disconnect switches.
SECTION 15605 - TERMINAL UNITS, ELECTRIC

PART 3 EXECUTION

3.01 INSTALLATION

1. Provide all materials and hanging materials necessary for installation, verify supports prior to installation.

3.02 WIRING

1. Heaters shall be installed and wired according to the manufacturers' recommendations and applicable national and local codes.

END OF SECTION
15605.5801
PART 1 GENERAL

1.01 SCOPE

1. Equipment is to be furnished by Owner. Contractor is responsible for taking delivery of unit, verifying that it is operational, storing and rigging unit and setting unit and curb in place, providing all materials and work, whether specified or not to install unit in accordance with manufacturers’ requirements and in accordance with specifications.

2. Contractor shall, along with equipment manufacturer, commission system.

3. Contractor shall have certified report from the factory indicating unit has been tested. After installation and start-up, any problems shall be the responsibility of the contractor.

4. Leave equipment completely installed so that only the connection of auxiliary services is required to make ready for start up.

5. Provide all materials, miscellaneous equipment and interconnecting piping required for the proper functioning of the work.

1.02 APPROVALS

1. Unit shall be rated in accordance with ARI Standards 210/240 or 360 and 270. Designed in accordance with UL Standard 1995. Unit shall be designed to conform to ANSI/ASHRAE 15, latest revision. Unit shall be UL tested and certified in accordance with ANSI Z21.47 Standards. Unit casing shall be capable of withstanding Federal test method Standard No. 141 (Method 6061) 500-hour salt spray test.

1.03 ENERGY EFFICIENCY

1. Units shall have minimum efficiency per ASHRAE 90.1-2007 and be tested in accordance with applicable ARI requirements.

1.04 FILTERS

1. Provide spare filters per specification 15010-3.22

2. Provide 4” & 2” thick fiberglass pleated filters with an ASHRAE efficiency of 30% and a MERV rating of 7. Clogged filter switch installed at factory. Provide interface to DDC system.

3. Provide 1” aluminum mesh pre-filters mounted over the outside air opening.

1.05 SHOP DRAWINGS

1. Shop drawings of the rooftop unit shall be prepared by the manufacturer. They shall be first submitted to the Owner for their review and then submitted to the architect/engineer for their review.
SECTION 15651 – ROOFTOP PACKAGED AIR-CONDITIONING UNITS
FURNISHED BY OWNER

2. After architect/engineer review, the shop drawings shall be submitted to the mechanical contractor and electric contractor for their approval.

3. Copy of reviewed submittals are attached to specifications for use by bidding contractors.

4. Any revisions to equipment submittals must be reviewed by Owner, Architect/Engineer prior to acceptance of equipment by Owner.

5. Provide sloped roof curb. Roof curb to be coordinated with equipment supplied by Owner.

PART 2 PRODUCTS

2.01 AIR CONDITIONING UNITS (FURNISHED BY OWNER)

1. See the “Owner Furnished Equipment” for the Packaged Rooftop unit submittals.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

1. All units shall be supported on supporting steel and roof curb as indicated on plans. Where units are supported on steel, main supporting steel to be provided by the structural steel contractor, refer to structural plans. This Contractor to provide all additional steel required to support the units. The structural steel layout as shown on the plans is for the specified basis of design equipment. Where equipment other than the specified equipment is to be provided, this Contractor, for review and approval prior to shop drawing submitted shall submit the substituted equipment to the architect, structural engineer and steel contractor. Alternate design will be prepared, and this Contractor shall assume additional cost for design and modifications at no additional cost to Owner.

2. Where specified equipment locations differ due to field conditions from what is shown on plans, this Contractor to provide alternate layout and submit to architect and structural engineer and provide all modifications and additional costs associated with field conditions at no additional cost to Owner.

3. Submit supports and weights to Structural Engineer and/or Steel Fabricator for approval and/or coordination. Relocate and provide all additional steel for units at no additional cost.

4. Units shall be painted color selected. Provide color chart for review and approval.

5. All disconnects and electrical devices that are installed externally on the unit by contractor are to be set at a maximum dimension of 6'-0" above roof deck. Contactor is cautioned that the units are to be installed on sloped curbs which are to match the new and/or existing roof slope. Contractor is to verify exact slope of roof prior to equipment purchase.
6. Roof curbs shall include an insulated panel under compressor section. Curb design shall comply with NEC Association requirements. Provide sound insulating material between roof deck and bottom of unit. Continue roof deck under unit and cut roofing as required for duct and connections. Where roof deck can not be continued, provide sheet metal same or heavier gauge than roof deck. Space between sheet metal and bottom of unit shall be filled with medium weight acoustical insulation (see Section 15180). Provide additional vibration isolation curb where internal vibration is not provided. Provide sloped roof curbs for all units.

END OF SECTION
15651.5801
SECTION 15656 - DUCTLESS SPLIT SYSTEMS

PART 1 GENERAL

1.01 SCOPE

1. Install all ductless split system air-conditioning system.

2. Leave equipment completely installed so that only the connection of auxiliary services is required to make ready for start up.

3. Provide all materials, miscellaneous equipment and interconnecting piping required for the proper functioning of the work.

1.02 APPROVALS

1. Equipment shall be installed, constructed and rated in accordance with all applicable ARI Standards and bear U.L. label.

1.03 ENERGY EFFICIENCY

1. Units 65,000 BTU/hr or less total cooling capacity shall have SEER of 10.0 at standard ratings. Units 65,000 BTU/hr to 135,000 BTU/hr total cooling capacity shall have SEER of 10.3 at standard conditions.

PART 2 PRODUCTS

2.01 OUTDOOR UNITS (FURNISHED BY OWNER)

1. The unit shall be properly assembled and tested at the factory.

2. Performance - Cooling capacity shall be rated with air entering condenser at 95°F. and a saturated suction temperature at compressor of 40°F. Saturated condensing temperature shall not exceed 117°F.

3. Outdoor coil shall be of nonferrous construction. Coil shall have aluminum plate fins, mechanically bonded to seamless copper tubes. Coil shall be circuited for subcooling.

4. Condenser fans and motors - Unit shall be furnished with direct-driven, propeller-type fans arranged for vertical discharge. Condenser fan motors shall have Class B motor insulation, inherent protection, and shall be of the permanently lubricated type, resiliently mounted. Each fan shall have a safety guard. Thru-wall units shall have centrifugal fans, horizontal discharge.

5. Compressors - Each shall be of serviceable hermetic design with external spring isolators and shall have an automatically reversible oil pump. Compressor shall be located in a section separated from condenser fans and coil. Multiple compressor units shall be step-start.
SECTION 15656 - DUCTLESS SPLIT SYSTEMS

6. Controls shall be factory wired and located in a separate enclosure. Safety devices shall consist of high- and low-pressure switches and compressor overload devices. Unit wiring shall incorporate a positive acting timer to prevent short-cycling of compressor if power is interrupted. Timer shall prevent compressor from restarting for a five (5) minute period. Provide reduced current starters where required.

7. Casing shall make unit full weatherproof for outdoor installation. Casing shall be of galvanized steel, zinc phosphatized and finished with baked enamel. Openings shall be removable to provide access of servicing. Units shall have as access door on the control panel.

8. Connections - Only refrigerant piping and one (1) power supply connection shall be required for each unit.

9. Arrangement - Unit shall be arranged for pad, wall or roof mounting as noted on drawings.

2.02 INDOOR UNITS (FURNISHED BY OWNER)

1. Indoor unit shall be wall mounted. Controls shall be remote type with IC thermostat and settings for two fan speeds, plus fan only operation with operation indicator lamp. Cooling and heating capacities as well as electrical characteristics shall be shown on the plan.

2. Locate unit as indicated on drawings. All refrigerant pipe and wiring shall be in construction, furred-in and/or concealed in finished areas.

3. Provide condensate drain line to closest drain point. Where gravity flow is not possible, provide little giant condensate pump of suitable capacity. Mount pump out of finished space.

4. Control shall be permanent with all wiring concealed.

2.03 REFRIGERANT PIPE (BY HVAC SUBCONTRACTOR)

1. Split system units are specifically designated as packaged equipment and as such, the manufacturer shall provide a complete design of the interconnecting piping and controls. As part of the submission of equipment, provide a complete refrigerant pipe design to include all pipe lengths, maximum pipe elevations and distances, as well as all other appurtenances. Equipment manufacturer shall be responsible to provide all refrigerant charge. Equipment manufacturer shall review the location and travel distances of refrigerant pipe and point out where there are problems prior to installation. All modifications of the system design shall be the responsibility of the HVAC subcontractor.

2. Refrigerant pipe shall be type "K" copper located within finished walls or furred-in or concealed in finished areas. All refrigerant pipe shall be properly supported, insulated and installed in accordance with manufacturers requirements.

3. Furnish complete refrigerant piping packaged pre-charged with fillings thermal expansion valve.
SECTION 15656 - DUCTLESS SPLIT SYSTEMS

4. Furnish and install at each evaporator or liquid connection an externally equalized thermal expansion valve. Valve shall be capable of being serviced with the body flange in line.

5. Provide at each evaporator liquid solenoid valve with moisture resistant coil, manual operating stem and solder or flanged connectors with maximum one psi or less pressure drop at maximum design loading.

6. Insulate all refrigerant pipe per Section 15180.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

1. Provide necessary supporting steel and verify weight and mountings with Structural Engineer.

2. Contractor to provide refrigerant pipe shall be type "K" copper and shall be properly supported and insulated per manufacturers requirements. Maximum length, minimum size supports and insulated in accordance with manufacturers requirements.

END OF SECTION
15656.5801
SECTION 15659 - VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 SCOPE

1. Furnish and install variable frequency drives to control the speed of all equipment as specified.

2. Leave equipment completely installed so that only the connection of auxiliary services is required to make ready for startup.

3. Provide all materials, miscellaneous equipment and duct pressure sensors required for the proper functioning of the work.

4. Variable frequency drives for rooftop unit supply fan shall be provided per Trane.

1.02 APPROVALS

1. Equipment shall meet the standards of CSA, ETL (UL 508), NEMA and NEC.

PART 2 PRODUCTS

2.01 VARIABLE FREQUENCY DRIVES

1. Variable frequency drives (VFD) shall be of a Pulse Width Modulated (PWM) design with input displacement power factor of > 0.95 at all operating speeds and loads. They shall be microprocessor based and utilize digital input for parameter adjustments. Use of potentiometer is not acceptable.

2. VFD's shall automatically attempt to restart after a malfunction or an interruption of power. The number of restart attempts shall be user selectable (0 to 5). If restart is not successful, the restart circuit shall lock out and provide contact annunciation.

3. A current limit circuit shall limit motor current to a preset adjustable maximum level. Range of adjustment shall be 50% to 110%. A main logic board shall include a digital display and digital input programming capability. The display shall indicate output speed in RPM, frequency or percent of base speed, motor amps, output motor volts and output load.

4. VFD's shall provide a minimum of four (4) selectable frequency jump points to be used to avoid critical resonance frequencies of the mechanical system.

5. The input signal follower circuit shall have selectable differential inputs and accept an electrical speed command from an external source. A +/- 10V bipolar input shall be standard.

6. Electronic motor protection shall be provided that predicts motor winding temperature from input of specific motor parameters and provides an orderly shutdown should the motor's thermal capabilities be exceeded.
7. Each VFD shall include three (3) open collector outputs to indicate drive run, drive fault and drive ready. It shall also include analog output signals for output load, output speed and motor voltage.

8. VFD's shall provide up to eight (8) selectable V/Hz profiles. VFD stopping mode functions shall be selectable for either coast-to-stop or stopping at a programmed decel rate.

9. In the event of a loss of signal, VFD shall, by user selection, go to either an adjustable preset speed or to hold speed based on the last reference received and provide a signal to indicate loss of reference.

10. VFD's shall be provided with the following protective features:
    A. Power circuit shall be fused and isolated internally with respect to ground. Fuses shall be rated minimally at 200,000 A interrupting capacity.
    B. Power units' logic common shall be at ground potential.
    C. Phase loss protection shall be provided to prevent single phasing of the VFD input.
    D. Each VFD shall be capable of continued operation during an intermittent loss of power for 15 ms. Opening a VFD input and/or output line switch while operating shall not damage power system components.
    E. An instantaneous electric trip circuit shall protect from line-to-line or line-to-ground short circuits. An instantaneous overcurrent trip shall not allow a restart after a trip until reset through the run/stop circuit or unless the auto restart function is operating.
    F. VFD's shall start into a rotating motor (any speed or direction) and accelerate or decelerate without tripping or component loss.
    G. All control circuit voltages shall be physically and electrically isolated from power circuit voltages to insure safety to maintenance personnel.

11. Each VFD shall be provided with an alphanumeric diagnostic display with fault indications including: bus overvoltage, bus undervoltage, overcurrent, ground fault, timed overload and drive fault.

12. All printed circuit boards shall utilize quick disconnect plugs and/or pull-apart terminal blocks to facilitate maintenance by providing quick change-out without disconnecting terminal strip connections.

13. VFD's shall be capable of starting and operating without a motor connected.

14. All setup and operating parameters shall be stored in non-volatile memory. The static memory module shall be removable so that it can be reinstalled in a replacement logic board with all setup and operating parameters intact requiring no adjustment boards.

15. Provide a softouch operator panel meeting NEMA 4 and NEMA 12 requirements with the following functions and features:
SECTION 15659 - VARIABLE FREQUENCY DRIVES

A. Digitally display motor speed, load, amps and output volts.

B. Eight (8) LED's for indicating drive run, drive ready, drive fault and operator status/function indications such as auto speed reference and auto restart.

C. Selection for Hand-Off-Auto control. In Hand mode the VFD shall be started from the operator's panel. In Auto mode the VFD shall be stopped and started by remote contact closure. In Off mode the VFD is locked out.

D. Selection for Manual Ref./Auto Ref. In Manual Ref. mode the VFD speed reference shall be set from the operator's panel. In Auto Ref. mode the VFD speed reference shall be set by the external (duct static pressure sensor) instrument signal.

E. Large (½" min.) easily readable displays with mnemonics displayed in English.

F. Electric lock-out feature to prevent unauthorized personnel from parameter access.

16. Bypass control circuitry shall be mounted integrally to the VFD enclosure. The bypass shall utilize an input circuit breaker to feed both the VFD and the bypass starter. An input contactor shall be utilized to feed the VFD and isolate the VFD for trouble shooting. An output contactor which is electrically and mechanically interlocked with the bypass starter shall be utilized on the VFD to provide a positive disconnect between the VFD and the motor.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

1. Install VFD's and duct and/or pipe pressure sensors where indicated on plans or as required to guarantee proper system operation.

2. Coordinate with Electrical Contractor to provide adequate access for making required connections between VFD's and air conditioning and/or pump units.

3. Interface with building's automatic temperature control system to provide operating sequence.

4. Provide NEMA "3R" enclosure.

END OF SECTION
15659.5801
SECTION 15810 - AIR HANDLING EQUIPMENT

PART 1 GENERAL

1.01 SCOPE

1. Furnish and install all fans and air handling units. Leave equipment completely installed so that only the connection of auxiliary services is required to make ready for start up. Provide all materials, miscellaneous equipment and interconnecting piping required for the proper function of the work.

1.02 CERTIFICATION

1. All fans shall have AMCA Certified ratings for sound and performance and bear UL label and manufacturer be 150 9001 certified facility.

1.03 ENERGY EFFICIENCY

1. All motors shall be premium high efficiency type.

1.04 BALANCING

1. Balance all equipment per manufacturer requirements and Section 15190.

1.05 CONTROL INTERFACE

1. Where units serve as exhaust or intake with remote automatic dampers that are required for the proper operation of the system the fan serves, the remote dampers and/or associated dampers with fans shall be interlocked with fan. Provide all wiring.

PART 2 PRODUCTS

2.01 FANS

1. All fans to be manufacturer type, size, quantity and capacity shown on drawings. All rooftop fans shall have self-flashing Sonotrol roof curbs and disconnect switch. All fan motors shall be premium high efficiency.

2. Ceiling exhaust fans shall have acoustically insulated housings, maximum sound level rating of 4.6. Terminal box with cord, plug and receptacle inside the housing. Entire fan, motor and wheel assembly shall be removable from the housing. Motor speeds shall not exceed 1050 RPM and all fan motors shall be suitably grounded and mounted on rubber-in-shear vibration isolators. Provide insulation on all discharge duct where required to prevent condensation. Units shall have metal face grille, sound block to attenuate 50% of operational sound level. Provide reinforced aluminum damper with continuous aluminum hinge rod and brass bushings. Pressure drops, fan speeds and horsepowers to be adjusted for sound block. Units to have wall caps, brick vents and roof caps, where required and/or shown. Painted color selected. Controls to be Solid State control, unless otherwise indicated. Where units are used for inline applications, provide inlet duct collar and delete face grille.
SECTION 15810 - AIR HANDLING EQUIPMENT

3. In-line centrifugal fans shall be constructed of steel. The fan wheels shall be the backward curved centrifugal type with non-overloading characteristics.

4. Centrifugal roof intake fans shall be direct or V-belt drive with louvered side panels, removable permanent washable filters, an internally wired disconnect device and automatic damper and damper motor interlocked with fan motor. Belt driven models shall be provided with adjustable pulleys. Provide self-flashing aluminum Sonotrol curb.

2.02 UPBLAST CENTRIFUGAL FAN ROOF EXHAUST FAN (FUME HOOD APPLICATIONS)

1. Fan shall be a spun aluminum, roof mounted, belt driven, upblast centrifugal exhaust ventilator.

2. Fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. Provide Aluminum structural components shall be constructed of minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have a one-piece inlet spinning and continuously welded curb, cap corners. Two-piece top cap shall have stainless steel quick release latches to provide motor compartment access. An external wiring compartment with integral conduit chase shall be provided. The motor, bearings and drives shall be mounted on a minimum 14-gauge steel power assembly, isolated from the unit structure with solid vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust air stream. Lifting lugs shall be provided. Unit shall bear an engraved nameplate which shall indicate design CFM, static pressure and maximum fan RPM. Unit shall be shipped in ISTA certified transit tested packaging.

3. Wheel shall be centrifugal backward inclined, constructed of 100% aluminum and cast aluminum hub. Wheel inlet shall overlap aluminum inlet cone. Wheel shall be balanced.

4. Motor shall be heavy duty premium efficiency type with permanently lubricated sealed ball bearings.

5. Bearings shall be heavy duty re-greasable ball type in a cast iron pillowblock housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

6. Belts shall be oil and heat resistant, static dissipating type. Drives shall be precision machined cast iron type, keyed and securely attached. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

PART 3 EXECUTION

1. Provide all hanging materials and vibration isolation prior to hanging any unit, verify supports with Structural Engineer.

2. Provide prefabricated roof curbs for all roof mounted equipment. Unibeam Sonotrol type, minimum 12", all aluminum continuously welded construction with integral cant. Minimum 2" thick walls filled with insulation. Provide additional wood nailers so that fan bases rest level on curbs.

3. Provide wall caps or roof caps for ceiling fans flashed and secured as required.
SECTION 15810 - AIR HANDLING EQUIPMENT

4. All rooftop fans and utility sets shall be factory painted color selected.

5. All fans with duct connections or connections to building construction shall have flexible connections as specified in Section 15860.

END OF SECTION
15810.5801
SECTION 15860 - DUCT SYSTEMS

PART 1 GENERAL

1.01 SCOPE

1. The work under this heading shall include the furnishing and installation of:

   A. All sheet metal work required for the various systems, including installation of control devices and connections to equipment and all materials and specialties required for the proper functioning of the work.

   B. All acoustical treatment required for the work as hereinafter specified.

1.02 CONSTRUCTION

1. All ducts shall be constructed of prime quality, resquared, galvanized steel sheets in accordance with "Duct Manual and Sheet Metal Construction for Ventilating and Air Conditioning Systems" of the "Sheet Metal and Air Conditioning Contractors National Association", (SMACNA) Sections 1 and 2.

2. Gauges shall be as recommended for the use intended in the applicable SMACNA Manuals. All ductwork and other sheet metal shall be properly stiffened and supported as per the applicable recommendations of SMACNA Manuals. Only first quality, smooth, cold rolled sheets of the best grade steel shall be used and shall be guaranteed to double seam without showing fracture.

3. All fume hood exhaust duct shall be stainless steel.

3. "High" Velocity Ductwork: Defined as ducts with velocities in excess of 2,500 FPM or 2" static pressure.

1.03 FLEXIBLE DUCTS

1. Use canvas flexible duct for inlet connection to air control devices as V.A.V. boxes. Use Fabric covered duct for connections on outlet-side of air control devices and low velocity run-outs.

2. Ducts must be suitable for the service of acceptable fire rating and shall be insulated as specified for duct work.

3. Flexible ducts shall be run in the most direct manner and shall be hung so that no bend has a centerline radius less than three times its diameter, maximum 12' +/- . Duct found not in compliance shall be removed and installed to comply with this Section at no additional cost.

4. Substitution of flexible ducts for run-outs shown as sheet metal or vice versa is acceptable but must be submitted for approval.

5. Flexible duct shall not pass through any wall, draftstopping wall, floor, ceiling or fire resistance rated assembly. Where flexible duct is shown thru these, provide sheet metal collar thru wall and minimum 6" either side.
SECTION 15860 - DUCT SYSTEMS

Note - It is the intention of the design that the flexible duct runouts thru existing roof to
diffusers be allowed. This is to minimize the demolition of existing ceiling construction which is
shown to remain.

6. Flexible duct on inlet to VAV boxes shall have minimum straight run of duct as required and
recommended by the VAV box manufacturer.

7. Where flexible ducts are shown to be connected to return air or supply air plenum boxes, the
duct connections shall be made to allow for installation of plenum boxes thru ceiling and/or
down from roof.

1.04 DIMENSIONS

1. Duct dimensions are INSIDE CLEAR DIMENSIONS: Increase metal duct size to allow for
thickness of inside insulation.

1.05 BALANCING AND TESTING

1. See Section 15190.

PART 2 PRODUCTS

2.01 FITTINGS

1. Round elbows shall be formed or stamped type; use five- piece construction where stamped
fittings are available, centerline radius equal to 1.5 times the duct diameter minimum.

2. All round take offs to be expanded to 90-degree conical type of 45-degree branches.

3. Obstructions: Where possible, avoid locating any pipe, wire or structural member in a duct.
Where such obstructions cannot be avoided, duct shall be eased, split or transformed as the
Engineer may direct.

4. Transformation: Where changes result in an increase of area slope shall not exceed one (1) in
seven (7); where areas remain constant or decrease, slope shall not exceed one (1) in four (4), but
one (1) in seven (7) is preferable.

5. Changes in direction: Changes in direction shall be made with elbows or tees as conditions
necessitate in the following order or preference:

A. Unvanned ell, centerline radius equal to 1.5 times duct width.
B. 6" throat radius with full radius vanes and heel radius.
C. 3" throat radius with full radius vanes and heel radius.
D. 3" throat radius with 3" heel radius, double thickness vanes.
E. No square elbows without turning vanes allowed.

6. Branch Takeoffs: Made, in order of preference, with radius elbow, radius tap-in or suitable
vanes in a square takeoff.
SECTION 15860 - DUCT SYSTEMS

2.02 JOINTS

1. All connections of duct shall be installed in strict accordance with SMACNA standards, except that all exposed non-spiral duct with design pressure less than 2" W.C. or 2,500 fpm velocity in finished areas shall use streamline joints.

2. Mechanical joint fasteners, such as "Ductmate", will be allowed and shall be installed in strict accordance with manufacturers’ requirements. Where mechanical fasteners are used, contractor shall coordinate joint locations with all other trades for clearances. Where use of mechanical fasteners result in an increased requirement for space and clearance and results in modification, removal, replacement, or new work for this Contractor or other contractors work; the work shall be done at this Contractors expense and with no additional cost to Owner. These joints shall not be used for exposed duct in furnished areas.

3. Where any joint is installed in any duct below 7'0", installation shall have protection as specified under ductwork installation.

4. All joints shall be sealed as specified for air tightness.

5. Hazardous Exhaust Duct joints shall be made tight with lap joints having a minimum lap of 1 inch.

2.03 DAMPERS

1. Furnish and install all dampers. Dampers for automatic operation shall be minimum leakage, multi-opposed type with neoprene balloon edge and snap steel side.

2.04 VOLUME DAMPERS, SPLITTERS AND ADJUSTABLE DEFLECTORS

1. Volume dampers in ducts shall be opposed blade type, slide rod operated. Adjusting quadrants shall be as manufactured by Ventfabrics or Parker and Young.

2. Volume dampers shall be installed in all of the trunk and branch ducts, no exceptions. The balancing trade shall not depend upon register shutters or dampers for balancing. The sheet metal contractor shall submit shop drawings to the balancing contractor for his review of location, type, size, and quantity of balancing dampers. Where additional control devices or alternate methods of duct installation are suggested and/or required, these shall be provided, and all modifications made at no additional cost to Owner.

3. Splitter dampers shall be installed where shown on drawings. Splitters shall be made of 18-gauge galvanized steel or heavier and shall be cross broken and flanged or hemmed for rigidity. Splitters shall be made easily adjustable and readily accessible for adjustment.

4. Adjustable deflectors and adjustable turning-vane devices for diverting air flow from a duct main into a branch duct shall be multi-blade assembly hinged at one end and so constructed that, as it is closed, the air passage between the blades narrows until no air passage remains when the assembly is in the fully-closed position.
SECTION 15860 - DUCT SYSTEMS

2.05 LOCKING TYPE MANUAL VOLUME DAMPERS

1. Provide manual Everlock locking dampers as manufactured by Rossi HVAC Hardware (www.RossiHardware.com – info@rossihardware.com – (818) 252-3811) or approved equal.

2. Bracket – Cold rolled Steel (ASTM A-1008), 18-gauge nominal thickness of 0.0478 with tolerance range of 0.0438 to 0.0518, single cut and formed bracket for use with 1.5” or 2.0” insulation wrapping or any other such stand-off applications, finished with a white Chromate plating.


5. Blades
   
   A. 4” to 14” dia. single blade (or disc). ASTM-A527 LFO G90, 20-gauge reinforced to equal strength of 18-gauge material.

   B. 3/8” full length bar fits through formed channel in center of damper blade.


7. Bearings
   
   A. Snap-in bearings for medium and low-pressure systems. Polyamide 66 (PA66), flame retardant, glass reinforced, “Zytel”.

   B. B-lined bearings for lined duct. Polyamide 66 (PA66), flame retardant, glass reinforced, “Zytel”.

2.06 FIRE DAMPERS

1. Fire dampers shall be provided and installed at all places where duct passes through a floor, fire wall, fire rated ceiling or other fire division, or as required by applicable codes.

2. Steel curtain dampers may be used in any system but are required 100% free area.

3. Fire dampers shall comply with UL-555 and shall bear the label of an approved agency. Fire dampers shall be installed in accordance with manufacturer's installation instructions.

4. Provide access doors at all fire dampers.

5. This Contractor shall, prior to shop drawing preparation, coordinate with general contractor, the location of all fire dampers based on architectural plans and/or existing construction. Where access doors are required behind any inaccessible area, this Contractor shall furnish and install access panels in general construction which shall be suitable for servicing of dampers.
SECTION 15860 - DUCT SYSTEMS

6. Where due to existing and/or new construction of any trades, access to fire dampers are not possible prior to duct installation. This Contractor shall notify the Architect.

7. Mark locations of fire dampers and access panels with approved methods.

2.07 DOORS

1. Access doors of suitable sizes minimum 18"x18" shall be provided for access to all coils, dampers, controls, etc.; in insulated duct, door shall be double panel, insulated type.

2.08 FLEXIBLE CONNECTIONS

1. Flexible connections shall be provided to motorized equipment, made with at least 3" of neoprene coated fiberglass cloth with 1" slack material (except kitchen hood exhaust and hazardous exhaust ducts).

2.09 LOUVERS AND SCREENS

1. Louvers shall be extruded aluminum, factory anodized, color selected by architect (submit color chart for selection by architect) equal to Air Balance Model 102 or Krueger XAL-3.

2. An aluminum screen (½" mesh) in an aluminum frame shall be provided over the louver in such a way as to be easily removable for maintenance.

3. Where air intakes or relief discharges occur on roofs, prefabricated aluminum curbs (maximum height 12"; minimum height 4") shall be provided one inch higher than gravel stop or parapet scuppers and properly flashed. Aluminum rain hoods or goosenecks, unless otherwise shown, shall be provided thereon, so designed as to prevent rain entrance, provide low frictional resistance and have rigid construction, each provided with removable screen.

2.10 FAN DISCHARGE, BACK DRAFT AND RELIEF DAMPERS

1. Air/Dynamic as manufactured "Air Balance".

2.11 DUCT HANGERS

1. All horizontal ducts and connections shall be securely hung in position be solid galvanized steel bands not lighter than #12 gauge or carried on suitable angle iron, or Unistrut type cradles as best suited to the location. All hangers for ducts shall be securely fastened to the basic building structure and not the ceiling construction or metal roof decking.

2. Duct hangers and supports will normally not be shown on the drawings, however, must be installed at the proper intervals according to the appropriate SMACNA Manuals by this trade.

3. Where ducts and hangers are to be installed in building areas with exposed steel structural members, they shall be securely clamped to structural members using C clamps which have a locknut and retaining strap.
SECTION 15860 - DUCT SYSTEMS

4. Where ducts and hangers are to be installed in building areas with concrete decks, they shall be securely attached to the concrete structure by means of concrete inserts cast in the original pours of the slabs. Where required, inserts are omitted or where hangers are to be installed in existing concrete decks, this trace may use drill-in type expansion bolts with rods of the proper diameter.

5. Exposed duct in finished areas shall be painted and finished as specified for duct.

6. Hazardous Exhaust Duct supports must be supported at intervals not exceeding 10 feet and constructed of noncombustible material.

2.12 “HIGH VELOCITY” FITTINGS

1. Fittings shall be formed or stamped type. Use five-piece construction where stamped fittings are unavailable.

2.13 DUCT IDENTIFICATION

1. Provide for all concealed insulated and non-insulated duct and duct exposed in non-finished areas; self-adhesive color-coded labels for identification of air flow and equipment.

2. Markers shall be installed at every turn in direction and minimum every 25’.

3. Markers shall have color coding per the manufacturer. In addition to marking, the duct shall have flow directions located next to duct markers.

4. Flow directional tape shall be completely around all visible portions of duct and termination shall be 1’ +/- past visible corner. Flow directional tape shall be ASME A13.1 color coding. Color to match duct markers. Arrows shall be white on green, red or blue and black on yellow, green or orange.

5. The duct shall have flow direction located next to flow direction. Indication shall be MS900 flow directional tape; 2” wide for duct up to 12’ +/- AFF and 4” wide for duct above 12’ +/- AFF.

6. Markers shall have color coding and lettering per the manufacturer and meet ASME A13.1 Standards.

7. Duct markers shall be; duct up to 12’ +/- AFF – 2-1/4” x 13” and duct above 12’ +/- AFF – 4” x 24”.

8. Duct markers shall be MSI MS-900 or approved equal.

PART 3 EXECUTION

3.01 AIR DELIVERY AND NOISE

1. This Contractor shall guarantee that all equipment shall operate without objectionable noise or vibration; that all ductwork shall be free from pulsation or objectionable noises; that the volume of air specified will be delivered to all points of supply and exhaust.
SECTION 15860 - DUCT SYSTEMS

2. After this system is in operation, should the ductwork be found to vibrate or chatter, Contractor will be required to eliminate same.

3.02 TESTING OF AIR DISTRIBUTION SYSTEM

1. The volume and velocities of air at all terminals, outlets and inlets, shall be tested.

2. The volume dampers, splitters and deflectors shall be adjusted so that the air velocities and volume will be as specified.

3. Provide “Duct Leak Test” per code officials requirements.

3.03 DUCTWORK INSTALLATION

1. All ductwork shall generally be installed in the location and manner shown and detailed on the drawings with all fittings and connections made in accordance with the applicable SMACNA Manuals. Duct shown on drawings are diagrammatic. Contractor to determine in field exact routing, size and configuration. All modifications or deviations required by job conditions must be approved prior to any fabrication.

2. Prepare all duct work and set it in place before furring begins. Extend all damper operators and serviceable or adjustable devices to accessible locations.

3. All connections from sheet metal assemblies such as ductwork, plenums, etc., to operating machines and/or mechanisms such as fans, air conditioners, etc., shall have flexible connections.

4. Where any ductwork is mounted lower than 7'-0" above a finished floor line, all seams in ducts shall be flattened and filed so that no standing seams or angle bracing protrudes from the duct in any manner which could cause injury to personnel. Covering of standing seams with an approved flexible bumper material, like split Armaflex pipe insulation, is acceptable.

5. Coordinate exact location of all duct in field with existing construction. Coordinate location of all duct with truss manufacturer.

6. All ductwork shall be delivered and sealed in accordance with SMACNA requirements and sealing shall only be removed prior to installing duct. After installation, duct shall still be protected from water damage.

7. Duct shall be supported with seismic supports where required by IBC.

3.05 ROOF PENETRATIONS

1. All roof penetrations shall have roof curb minimum 12" high with cant strip, flashing collars, flashing and counterflashing.

2. Provide sloped roof curbs at sloped roofs. Verify all curbs with roof conditions prior to shop drawing submission.

3. All roof curbs shall be installed per SMACNA requirements.
SECTION 15860 - DUCT SYSTEMS

4. Where reroofing work requires higher curbs due to new insulation, these shall be used. Coordinate with general contractor for exact location.

3.06 FAN DUCT CONNECTION

1. All duct connections to fans and/or equipment with fans shall be installed in strict accordance with fan manufacturer's requirements. Ducts shall be installed to eliminate any system effects pressure losses. Where ducts are shown or are required to be installed that are not in compliance with manufacturers requirement, the additional pressure losses due to the system effect shall be added to the fans specified static pressure and fan size increased accordingly. All work shall be done at no additional cost.

2. Where elbows are required at discharge, they shall be full radius elbow R/W = 1.5 or greater.

3. All discharge dampers shall be arranged and installed in accordance with manufacturer's requirements and to avoid any system effects.

END OF SECTION
15860.5801
SECTION 15870 - TEMPERED AIR TERMINAL UNITS

PART 1 GENERAL

1.01 SCOPE

1. Furnish and install all air terminal devices in sizes, types and capacities shown on the drawings.

1.02 RATINGS

1. Manufacturer shall rate all terminals in accordance with Air Diffusion Council (where applicable).

PART 2 PRODUCTS

2.01 REGISTERS AND GRILLES

1. All supply air registers shall be METAL*AIRE Model V4004D-1 or approved equal consisting of two (2) banks of fins, front bank vertical, second bank horizontal, with one (1) bank of multi-opposed damper blades operated by a concealed screwdriver operator.

2. All return and exhaust air registers shall be METAL*AIRE Model RHD-1 or approved equal consisting of one (1) bank of horizontal fins fixed at a 45-degree angle with one (1) bank of multi-opposed damper blades operated by a concealed screwdriver operator.

3. Where grilles are shown, omit the damper.

4. All filter return air grilles shall be METAL*AIRE Model RHF-1 or approved equal consisting of one (1) bank of horizontal fins fixed at a 45-degree angle with one (1) bank of multi-opposed damper blades operated by a concealed screwdriver operator.

5. All registers and grilles shall be of aluminum construction with baked white enamel finish.

2.02 DIFFUSERS

1. All ceiling diffusers shall distribute air in a horizontal pattern parallel to the ceiling.

2. All diffusers shall be equipped with opposed blade dampers operated from the diffuser face by unobtrusive screw operator.

3. Variable Air Volume Square Diffusers (CD-1 thru CD-4) - Install, where shown on plans, METAL*AIR Model 5750-6 as Unit-Flow plaque ceiling diffusers or approved equal. The diffuser sizes shall be nominal 24"x24" as scheduled, with minimum 18" square flat appearance panels. The diffusers shall be either aluminized steel or aluminum construction and shall be designed to integrate with the specified ceiling system type (refer to architectural reflected ceiling plan). The diffuser shall consist of a back pan and a removable heavy gauge appearance panel attached to the back pan via four (4) latch tabs. The appearance panel shall have aerodynamic, rigid, hemmed edges around the perimeter and shall be a single piece construction. The panel shall be flat and smooth and shall be free of any welding or forming blemishes. The horizontal air discharge pattern shall be 360-degree type. Baffles shall be proved for directional control as scheduled on shown on the
drawings. Diffusers that meet the performance requirements are acceptable. Diffuser finish shall be #01 white. Provide published performance data determined in accordance with the latest ANSI-ASHRAE standard for throw, pressure and sound.

2.03 LINEAR DIFFUSERS

1. For installation in solid surfaces (i.e. drywall, plaster, etc.), all continuous linear diffusers shall be Anemostat TL Series or approved equal, with total length and number of slots as indicated on plans or be of size recommended by diffuser manufacturer.

2. Furnish insulated plenums for active lengths with collar sizes as shown.

3. For installation in T-bar ceilings, furnish plenum slot diffusers. All plenum slot diffusers must be as indicated on plans or be of size recommended by the diffuser manufacturer.

4. Linear diffusers shall be provided with continuous plenum behind diffuser plate. Plenum size shall be as indicated on plans or be of size recommend by diffuser manufacturer.

5. Where plenums cannot be continuous due to general construction, provide non-continuous plenums with separate feeds to main duct. Face plate of diffuser shall be continuous and be cut where it is located in front of construction.

6. Provide connections from plenum to main duct. Connections shall be to plenum on side adjacent to diffuser. Where not possible, provide diffuser plate in front of opening (supply air not to blow directly into diffuser).

2.04 LINEAR DIFFUSERS LID-1 & LID-2

1. Units shall be constructed of 24-gauge galvanized steel. The face of the diffuser shall have a double metal thickness, rigid hemmed edge.

2. Each slot shall be provided with a two element patterns controller, capable of not only a 180° air pattern adjustment, but also air volume.

3. Provide plenum slot diffuser nominal length as indicated on plans.

4. Plenums shall be internally insulated with ½” thickness of acoustical insulation. Note – Provide external end cap insulation.

5. Plenum slot diffusers shall have 1” slot width, not of slots as indicated on plans.

2.04 VARIABLE VOLUME CONTROL DEVICES (FURNISHED BY OWNER)

1. Control box shall be factory assembled pressure independent variable-air-volume boxes, factory preset, and maximum and minimum air flow rates. Maximum and minimum air flow rates to be field adjustable.

2. Box shall control air flow rate based on thermostat demand from minimum static pressure up to 4” S.P. with +/- 5% of control volume. Inlet of box is to be equipped with an Air Lens
which will limit volume variation due to inlet duct configuration to a minimal deviation with a flexible duct 90% bend at the inlet.

3. Unit shall be provided with a damper having a neoprene lip seal and capable of shut-off with leakage less than 2% of nominal box rating at 4" S.P.

4. Box to be constructed of minimum 20 heavy gauge galvanized steel (meeting UL 1995 requirements) and internally lined with minimum 1/2" dual density fiberglass insulation with a Permacote acrylic coating formulated with a anti-microbial agent to protect the coating from microbial growth. Insulation shall meet NFPA 90A & B, UL181, ASTM C, 1338, G 21 & 22, AND ASTM C 1071.

5. Air distribution manifold (octopus) shall be factory installed on the base control box as required with locking butterfly balancing damper. Manifold shall be insulated as specified for box.

6. Box identification for each box shall be marked with identification label and airflow indicator.

7. Electronic controls shall consist of electronic pressure independent controller averaging differential pressure sensor, pressure independent thermostat with exposed setpoints, air valve actuator, transformer, air pressure switch, duct sensor and all wiring.

8. Electric heating coils shall have the capacity scheduled on the drawings and be installed per Section 15605. They shall be U.L. or E.T.L. listed and meet all N.E.C. requirements. Entire assembly (fan section and heater) shall be listed by U.L. or E.T.L. for zero clearance. An automatic reset thermal cutout shall be provided as primary over-temperature protection. A one-time replaceable thermal cutout shall interrupt current flow to the heater element in the event of an over-temperature condition. All over-temperature safety devices shall be replaceable without removing the heater from the duct. A non-fused disconnect switch shall be provided as an integral component of the heater. Provide access panels for access to coil.

9. Provide controllers and sensors to allow for measurement of air flow for purposes of allowing for recording and billing for energy (air/electric usage), see Section 15930.

2.05 FAN POWERED VARIABLE AIR VOLUME BOXES (FURNISHED BY OWNER)

1. Furnish and install fan powered variable air volume control boxes. Units shall be parallel, or series flow size and capacity as indicated on plans.

2. Casing shall be 20-gauge galvanized steel with rectangular discharge. One-piece aluminum backdraft damper on fan discharge, factory set and aligned for leak rate of 2% at 0.5 S.P. Interior surface of casing shall be acoustically and thermally lined with ¾" thick, 4-pound dual density glass fiber insulation with high density facing. Insulation shall conform to UL 181 and NFPA 90.

3. Air valve shall be die cast aluminum airflow control device with integral actuator. Integral sensor with taps and calibration chart to measure airflow within +/- 5% for 1½" diameters of straight duct. Leak rate 4% at 3" S.P.
SECTION 15870 - TEMPERED AIR TERMINAL UNITS

4. Volume damper shall be factory installed extruded aluminum air modulating device. Movement of gate damper is linear with actuator stroke and perpendicular to airflow. Leak rate 6% at 3" SP.

5. Minimum Limiter shall be factory mounted and wired to actuator to provide a minimum cfm stop on unit.

6. Volume regulator shall be a thermostatically reset velocity controller which provides constant delivery air control within +/- 5% of rated from and down to 25% of unit rated cfm, independent of changes in system static pressure. Factory calibrated field adjustable setpoints provided to set maximum and minimum cfm.

7. Fan shall be a FC style galvanized steel wheel. Housing is 18-gauge steel.

8. Electronic controls shall consist of electronic pressure independent controller averaging differential pressure sensor, pressure independent thermostat with exposed setpoints, air valve actuator, transformer, air pressure switch, duct sensor and all wiring.

9. Fan motor shall be high efficiency permanently lubricated sleeve bearing, permanent split-capacitor type with thermal overload protection and multi-tap capability. A three tap motor switch and an electronic speed controller. Fan controller shall include a voltage limiting circuit. Fan plenum induction port shall include a radiated sound damper. Fan motor, where required due to voltage supplied, shall have transformer.

10. Electric heating coils shall have the capacity scheduled on the drawings and be installed per Section 15605. They shall be U.L. or E.T.L. listed and meet all N.E.C. requirements. Entire assembly (fan section and heater) shall be listed by U.L. or E.T.L. for zero clearance. An automatic reset thermal cutout shall be provided as primary over-temperature protection. A one-time replaceable thermal cutout shall interrupt current flow to the heater element in the event of an over-temperature condition. All over-temperature safety devices shall be replaceable without removing the heater from the duct. A non-fused disconnect switch shall be provided as an integral component of the heater. Provide access panels for access to coil.

11. Attenuator shall be 26-gauge galvanized steel with high density, mat faced insulation, UL listed and meets NFPA 90A requirements.

12. Provide octopus duct connection with each outlet having a balancing damper.

13. Provide controllers and sensors to allow for measurement of air flow for purposes of allowing for recording and billing for energy (air/electric usage), see Section 15930.

PART 3 EXECUTION

3.01 INSTALLATION

1. All devices shall be mounted true and square, pulled up tightly without distortion.

2. Provide equalizing deflectors and/or air extractors where required to achieve proper air distribution.
SECTION 15870 - TEMPERED AIR TERMINAL UNITS

3.02 FIRE RATED CONSTRUCTION

1. All devices in fire rated construction shall be provided with approved fire dampers, "tents", or other devices as required to conform to applicable regulations.

3.03 VISIBILITY

1. Where registers and grilles are at floor level and inside duct is visible, provide acoustic insulation (black) or where insulation is not specified or required, paint all visible inside surfaces of duct flat black.

END OF SECTION
15870.5801
PART 1 GENERAL

1.01 SCOPE – DDC SYSTEM WILL BE FURNISHED AND INSTALLED BY OWNERS DDC CONTRACTOR

1. The work under this heading shall include the furnishing and installation of:
   
   A. A direct digital electronic control system which shall be complete and consist of the CPU, network controllers, local controllers, unitary stand-alone controllers, sensors, safety thermostats, control valves, unit mounted controllers, damper actuators, relays, transformers, fuses, terminal strips, control panels, position switches, pilot lights, all appurtenances and all software necessary to provide the sequence of operation. System shall be connected, controlled and monitored by the existing Trane Tracer Control System.
   
   B. Connections to all equipment requiring connections to the control medium whether furnished under this Section or not.
   
   C. The system shall use the latest technologies available from Trane in the implementation of Direct Digital Electronic Control for the HVAC system and its management.
   
   D. The systems shall be installed by Trane factory trained technicians, regularly employed by the manufacturer and factory trained in the installation and calibration of the product.
   
   E. ATC Contractor shall be responsible for all software, programming, calibration, the proper operation and adjustment of all controls, dampers and appurtenances to provide required sequence of operations and protection against freeze-ups.
   
   F. All equipment provided by this Contractor and required to be controlled, shall be capable of being controlled and monitored from this DDC system.
   
   G. All training and instruction per Section 15010.
   
   H. All software, equipment, training and all work shall be of the same manufacturer and/or ATC subcontractor. Independent ATC companies and/or contractors owned by or represented by, or in any manner associated with the specified manufacturers are not considered to be the specified manufacturer, and as such, are not acceptable.
   
   I. Tozour Trane is the only control company that will be accepted or approved. No substitutions shall be acceptable.
   
   J. The control equipment programming, software, instruction to Owner, and all commissioning and integration of new controls into existing control system are to be purchased by the school.

1.02 WARRANTY

1. Labor and materials for the control system specified shall be warranted free from defects for a period as indicated in "General Conditions". Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner.
This Contractor shall respond to the Owner's request for warranty service with 24 hours during normal business hours.

2. At the end of the final startup, testing and commissioning phase, if equipment and systems are operating satisfactorily to the Owner, Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification.

3. At the expiration of the warranty period, provide a proposal for an additional service agreement, to include full overage, parts and labor, plus emergency service for the new system for an additional one (1) year period.

1.03 BASE BID

1. This project is to represent an expansion to the existing Trane Tracer Building Automation/Energy Management System in the Gloucester County Community College. The new work is to include modifications of existing on-site computers with all controllers tied into the existing application Data Server. All cable and wiring for on-site computer to Data Server by this Contractor. Tie-in to existing on-site computer by this Contractor.

2. All points on the new DDC system shall be mapped back and viewable at the existing front-end PC workstations currently connected to the College campus network. There are currently four (4) existing workstations and the new graphics will be added to all of the existing Summit licensed work stations.

3. The ATC control manufacturer is Trane Tracer, which shall include all work as specified and/or required to provide a complete operation DDC System. All software for the new DDC system shall be installed on existing computer (final location to be determined in field) of the Gloucester County Community College.

3. All points on the new DDC system shall be mapped back and viewable at the existing front end PC workstation currently connected to the College campus network.

1.04 SUBMITTALS

1. Product Data and Shop Drawings: Meet requirements of Shop Drawings, Product Data, and Samples specification requirements as specified in Section 15010, General Conditions. In addition, Contractor shall provide shop drawings or other submittals on all hardware, software, and installation to be provided. No work may begin on any segment of this project until submittals have been reviewed and approved for conformity with the design intent. Six copies are required. All drawings shall be done in DXF format and provided on magnetic/optical disk and as full-size Mylar drawings. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Submittals shall be provided within 12 weeks of contract award. Submittals shall include:
A. Direct Digital Control System Hardware:

1. A complete bill of materials of equipment to be used shall be listed indicating quantity, manufacturer, model number, and other relevant technical data.

2. Manufacturer's description and technical data, such as performance curves, product specification sheets, and installation/maintenance instructions for the items listed below and other relevant items not listed below:

   a. Direct Digital Controller (controller panels)
   b. Transducers/Transmitters
   c. Sensors (including accuracy data)
   d. Actuators
   e. Valves
   f. Relays/Switches
   g. Control Panels
   h. Power Supply
   i. Wiring

3. Wiring diagrams and layouts for each control panel. Show all termination numbers.

4. Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware

5. “Control System Demonstration and Acceptance.”

6. For each BACnet device, a BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and operator interface included in the submittal. PICS to include for each project, as a minimum, a list of BACnet functional groups supported, BACnet services supported, BACnet data link options a available and BACnet objects provided.

7. For each LonWorks device that does not have LonMark certifications, the device supplier must provide an XIF file and a resource file for the device.

1.05 SCHEDULES

A. Within one month of contract award, provide a schedule of the work indicating the following.

1. Intended sequence of work items
2. Start dates of individual work items.
3. Duration of individual work items
4. Planned delivery dates for major material and equipment, and expected lead times
5. Milestones indicating possible restraints on work by other trades or situations.

Provide monthly written status reports indicating work completed, revisions to expected delivery dates, etc. An updated project schedule shall be included.
1.06 PROJECT RECORD DOCUMENTS

1. Project Record Documents: Upon completion of installation, submit three copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and shall include:

A. Project Record Drawings. These shall be as-built versions of the submittal shop drawings. One set of magnetic media including DXF drawing files also shall be provided.

B. Testing and Commissioning Reports and Checklists. Completed versions of all reports and checklists, along with all trend logs, used to meet the requirements of Part 3: “Control System Demonstration and Acceptance.”

C. Operation and Maintenance (O & M) Manual. This shall include as-built versions of the submittal product data. In addition to the information required for submittals, the O & M manual shall include:

1. Names, addresses, and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representatives of each.

2. Operators Manual with procedures for operating the control systems, including logging on/off, alarm handling, producing point/object reports, trending data, overriding computer control, and changing setpoints and other variables.

3. One set of Programming Manuals with a description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point/object database creation and modification, program creation and modification, and use of the editor.

4. Engineering, Installation, and Maintenance Manual(s) that explain how to design and install new points/objects, panels, and other hardware; preventive maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.

5. A listing and documentation of all custom software created using the programming language, including the setpoints, tuning parameters, and object database. One set of magnetic/optical media containing files of the software and database also shall be provided.

6. One set of magnetic/optical media containing files of all color graphic screens created for the project.

7. A list of recommended spare parts with part numbers and suppliers.

8. Complete original issue documentation, installation, and maintenance information for all third-party hardware provided, including computer equipment and sensors.
9. Complete original issue diskettes for all software provided, including operating systems, programming language, operator workstation software, and graphics software.

10. Licenses, guarantee, and warranty documents for all equipment and systems.

11. Recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.

1.07 ATC RELATED WORK COORDINATION SCHEDULE

1. "ATC Coordination Schedule" developed for reference only. The Contractor (G.C.) is responsible for providing all coordination required to provide a complete and fully operational DDC system.

2. "ATC Coordination Schedule" must be completed by the G.C. before the first payment will be issued.

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<th>ATC Related Work Coordination Schedule</th>
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<td>DESCRIPTION</td>
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<tr>
<td>Duct Smoke Detector</td>
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<td>Furnishes Duct Smoke Detector</td>
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<tr>
<td>Installs Detector in Return Duct</td>
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<td>Wires to Fire Alarm System</td>
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<tr>
<td>Hard Wire to Air Handler's Supply Fan</td>
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<td>Duct Smoke Damper W/Actuator</td>
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<td>Furnishes Duct Smoke Damper w/Actuator</td>
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<td>Furnishes Duct Smoke Damper at HVAC Equipment w/Actuator</td>
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<td>Installs in Duct</td>
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<tr>
<td>Wire Actuator</td>
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<tr>
<td>Wires to Smoke Detector</td>
</tr>
<tr>
<td>Wires to Fire Alarm System</td>
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<tr>
<td>ATC Panels</td>
</tr>
<tr>
<td>Furnishes &amp; Installs ATC workstation</td>
</tr>
<tr>
<td>with all specified Software &amp; Hardware</td>
</tr>
<tr>
<td>Mapping System Points to existing front-end PC workstations currently connected to the College campus network</td>
</tr>
<tr>
<td>Furnishes ATC Panel</td>
</tr>
<tr>
<td>Installs Panel and all pertinent ATC wiring</td>
</tr>
<tr>
<td>Provides 120-volt branch circuit to ATC Panel(s)</td>
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<tr>
<td>Provides Ethernet Network drop at ATC Panel(s)</td>
</tr>
<tr>
<td>Reviews and approves final location</td>
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<tr>
<td>X</td>
</tr>
<tr>
<td>Space Pressure Sensor Tubing</td>
</tr>
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ELECTRONIC DIRECT DIGITAL CONTROL SYSTEM 15930 - 5
### ATC Related Work Coordination Schedule

<table>
<thead>
<tr>
<th>Location Confirmation</th>
<th>M.C.</th>
<th>ATC</th>
<th>E.C.</th>
<th>MFG</th>
<th>G.C.</th>
<th>CX/Owner</th>
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<td>ATC Sensor Wells</td>
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<tr>
<td>Provide ATC sensor wells</td>
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<tr>
<td>Provide ATC sensors, Install and wire ATC sensors</td>
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<td>Install ATC sensor wells</td>
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<tr>
<td>ATC Dampers External Equipment- Provide</td>
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<td>ATC Damper Actuators in Equipment- Provide &amp; Install</td>
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<tr>
<td>Provide and Install network lighting panels</td>
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<td>Provide and Install lighting control devices per design</td>
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<tr>
<td>Provide and install lighting fixtures per design</td>
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<td>Provide dedicated power circuit to network lighting panels</td>
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<tr>
<td>Interconnect lighting control devices to HVAC equipment controllers per design per zone</td>
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### Matrix Key

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<tr>
<th>M.C.</th>
<th>ATC</th>
<th>E.C.</th>
<th>MFG</th>
<th>G.C.</th>
<th>CX/Owner</th>
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</tr>
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<td>ATC</td>
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<td>Agent/Owner</td>
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1.08 TRAINING MANUALS

1. The Contractor shall provide a course outline and training manuals for all training classes at least six weeks prior to the first class.
PART 2  PRODUCTS

2.01  GENERAL

1. The ATC system shall be furnished by the Tozour Trane Company who has a separate contract with the Owner.

2. It is the intent of this project is to provide seamless integration of the new control system into the existing Trane system. All point information in the system will be provided to the existing Trane front end system. HVAC sub-contractor shall contact Tozour Trane prior to bid to coordinate the integration of the system. The final result shall be one complete control system allowing access of the new system through the existing system. The use of third-party drives and interface devices or additional system servers shall not be accepted.

3. Refer to the “Owner Furnished Equipment” for a copy of DDC CONTROL SYSTEM.

2.02  ELECTRONIC OPERATORS

1. Size electronic actuators to operate their appropriate dampers or valves with sufficient reserve power to provide smooth modulating action or two (2) position action as specified.

2. Provide unit outside air damper motors with adjustable minimum settings so that ventilation requirements may be adjusted for each space or room.

3. Provide spring return for outside air dampers.

2.03  ROOM SENSORS

1. Room sensors shall be electronic and provided with override buttons. Sensors are not adjustable from rooms. All sensors in non-supervised areas (locker rooms, gym and corridors) shall have lockable metal covers. For sensors on exterior walls, provide insulation (minimum 2" thick R=8.0).

2.04  DAMPERS

1. Modulating dampers shall be opposed blade type. Air handling unit outdoor, relief and return air dampers shall be parallel blade type arranged to combat stratification. Two (2) position dampers shall be parallel blade type. Damper frames shall be not less than 13-gauge galvanized steel. Damper blade shall not be over 8" in width and 48" in length.

2. Blade edges shall have inflatable seal edging rated for less than 10 CFM per square foot of damper area. Damper hardware shall be zinc plated; bearings shall be nylon, Teflon, Oilite or approved equal.

3. Damper operators shall be mounted outside of duct on device unless factory installed or internally mounted with access panels.

4. Damper operators shall be mounted outside of duct unless factory installed or internally mounted with access panels. All dampers on equipment exposed in finished spaces shall have internal
mounted operators, increase duct size accordingly.
5. Damper end switches shall sense blade position and not controller output.

2.05 PROTECTIVE FREEZESTATS, FIRESTATS AND SMOKE DETECTORS

1. Provide for all new air handling systems, freezestats located on the suction side of the fan. When its setting is exceeded, perform the following:

   A. Open control valve on heating coil to full heating and/or close outside air damper and stop fans.

   B. All protective devices shall be manually reset and shall send an alarm signal to DDC system.

2. Smoke detector in system greater than 2,000 cfm shall have smoke detector installed in return downstream of filters.

3. Smoke detector well, interlock and control wiring and all appurtenances shall be by this Contractor.

4. Upon activation, the smoke detectors shall shut down the air distribution system.

5. Smoke detectors shall be supplied by electrical contractor and wired to fire alarm panel by electrical contractor. Smoke detectors shall be installed by HVAC contractor.

6. The electrical contractor shall verify smoke detector auxiliary contacts.

7. The interlocking of smoke detectors with HVAC equipment shall be by ATC Contractor.

2.06 SYSTEM POINTS

System points are shown as a guide and reference only. Provide all point lists required for proper operation, monitoring, and function ability of system. Exclusion of required points as specified below does not relieve contractor of responsibility to provide all work required. Contractor shall provide these requirements at no additional cost to Owner. All points required by equipment manufacturer shall be provided whether indicated or not.

A. Rooftop Packaged Air-Conditioning Units with factory provided and mounted microprocessor controls

1. ATC contractor to be responsible for binding the following points list.

   Analog Input/Output - Outdoor Air Temperature
   Analog Input/Output - Return Air Temperature
   Analog Input/Output - Mixed Air Temperature
   Analog Input/Output - Supply Air Temperature
   Analog Input/Output - Outdoor Air Humidity
   Analog Input/Output - Duct Static Pressure
   Analog Input/Output - Space Static Pressure
   Analog Input/Output - Supply VFD
Analog Input/Output - Cooling Demand (Digital Compressor Control)
Analog Input/Output - Heating Demand (Modulating Gas Heat Control)
Analog Input/Output - Outside Air Damper Control
Digital Input/Output - Supply Fans Status
Digital Input/Output - Supply Fans S/S
Digital Input/Output - Compressor S/S
  Gas Heat Operation
  Gas Heat Stages
  Gas Heat Discharge Air Adjustment
  Gas Heat Gas Pressure

2. Exhaust Fan (EF)
   - Fan Start/Stop
   - Supply Fan Status - Current Transducer

3. VAV Boxes
   - Supply Air Temperature
   - Supply air volume (CFM)
   - Space Temperature
   - Adjustment Room Temperature
   - Adjustment Primary Air Volume (CFM)
   - Room CO2 (ppm)
   - Electric Heat Operation
   - Fan Operation, Speed Fan Powered Boxes

4. Ductless Split Systems

5. Vacuum Pumps (by PC) (Provide all wiring and contact points along with all sensors.)
   - Vacuum Pressure
   - Vacuum Pump Operation

6. Fume Hoods (by GC) (Provide all wiring and contact points along with all sensors.)
   - Analog Input/Output - Exhaust Air Volume (CFM)
   - Analog Input/Output - Adjustment Primary Exhaust Air Volume (CFM)

7. Emergency Generator (by EC) (Provide all wiring and contact points along with all sensors.)
   - Tank (generator) Level
   - Generator Operation
2.07 UTILITY METERS

1. GAS METER

A. Gas meter and all required appurtenances to be furnished by this contractor. Gas meter to be installed onto gas piping system by Plumbing Contractor. All associated electrical wiring and control wiring by this Contractor.

B. Provide a Thermal Mass Flow Meter, complete with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter shall be hand-insertable up to 250 psi. Materials of construction for wetted metal components shall be 316 SS. The flow meter shall provide SFPM flow readings from a pair of encapsulated platinum sensors and shall not require additional temperature or pressure compensation. In addition, the meter shall continuously display information that can be used to validate the calibration of the meter. Each flow meter shall be individually wet-calibrated against a standard that is directly traceable to NIST*. A certificate of calibration shall be provided with each flow meter.

C. Accuracy shall be within ± 1% of rate from 500-7000 SFPM and ± 2% of rate from 100-500 SFPM. Overall turndown shall exceed 1000:1. Output signals shall consist of the following: (1) analog 4-20mA output and (1) scalable pulse output for totalization. The meter shall be equipped with an integrally mounted graphical display that may be optionally remote mounted up to 1000’ from the sensor. Each flow meter shall be covered by the manufacturer’s one-year warranty.

D. Optional Flow Display: Provide a D-100 Series Display Module for local or remote indication of flow rate and total. Output signals shall be either serial network (protocol conforming to BACnet® MS/TP, BACnet/IP, LONWORKS®, MODBUS RTU RS485, MODBUS RTU TCP) or via individual analog and pulse outputs.

2. ELECTRIC METER

A. Electric meter and all required appurtenances to be furnished by this contractor. Electric Meter to be installed onto electrical distribution system by Electrical Contractor, refer to specification 16000 sections. All associated control wiring by this contractor.

B. Energy Meters shall be E-Mon D-Mon Class 3000 kWh/Demand Meter, or approved equal, and shall contain the following options:

1. Industrial Grade JIC Steel Enclosure with padlocking hasp and mounting flanges for indoor installation.

2. Easy to read LCD Display showing:
   a. Total Energy Consumption (kWh)
   b. Current Load (Real Time KW)
   c. KW with Peak Date & Time
d. Power Factor  
e. Amps per Phase  
f. Volts per Phase

3. Meet ANSI C12 National Accuracy Standards.

4. Record kWh & kVARH for two channels at 15-minute intervals for 36 days and maintain 36 days of data in a “first-in/first-out” format.

5. 0-2 Volts Split Core Current Sensors allowing for remote mounting of sensors from meter without power interruptions.

6. BACnet/IP Communication Gateway with the capability of providing 38 points to the Building Automation System. Modbus points to be provided are as follows:

a. Energy Delivered (kWh)  
b. Energy Received (kWh)  
c. Reactive Energy Delivered (kVARH)  
d. Reactive Energy Received (kVARH)  
e. Real Power (kW)  
f. Reactive Power (kVAR)  
g. Apparent Power (kVA)  
h. Power Factor (%)  
i. Current Total (Amps)  
j. Current Average (Amps)  
k. Voltage Line-Neutral (Volts)  
l. Voltage Line-Line (Volts)  
m. Frequency (Hz)  
n. Phase Angle (Degree)  
o. Real Power Phase A (kW)  
p. Real Power Phase B (kW)  
q. Real Power Phase C (kW)  
r. Reactive Power Phase A (kVAR)  
s. Reactive Power Phase B (kVAR)  
t. Reactive Power Phase C (kVAR)  
u. Apparent Power Phase A (kVA)  
v. Apparent Power Phase B (kVA)  
w. Apparent Power Phase C (kVA)  
x. Power Factor Phase A (%PF)  
y. Power Factor Phase B (%PF)  
z. Power Factor Phase C (%PF)  
aa. Current Phase A (Amps)  
bb. Current Phase B (Amps)  
cc. Current Phase C (Amps)  
dd. Voltage, Line-Neutral Phase A-N (Volts)  
ee. Voltage, Line-Neutral Phase B-N (Volts)  
ff. Voltage, Line-Neutral Phase C-N (Volts)  
gg. Voltage, Line-Line Phase A-B (Volts)
hh. Voltage, Line-Line Phase B-C (Volts)
ii. Voltage, Line-Line Phase C-A (Volts)
jj. Phase Angle Phase A (Degree)
kk. Phase Angle Phase B (Degree)
ll. Phase Angle Phase C (Degree)

3. WATER METER

A. Water meter and all required appurtenances to be furnished by this contractor. Water meter to be installed onto water distribution system by Plumbing Contractor. All associated electrical wiring and control wiring by this Contractor.

B. Standard Transmitter version (0.4% of rate accuracy) - Provide an ONICON F-3100 Series Electromagnetic Flow Meter complete with integral or remote electronics module. The electronics module shall include a backlit LCD and internal keypad. The principle of operation shall be based of Faraday's Law of Electromagnetic Induction. The flow meter shall be installed either in the supply or return pipe of the system to be measured following the manufacturer’s instructions. Connections to the piping shall be ANSI class 150 flanges (ANSI class 300 where required). The installing contractor is responsible for providing suitable mating flanges and any required reducer/expander. The flow tube shall be epoxy coated steel; the sensing electrodes shall be 316SS; the liner shall be polypropylene or ebonite for low temperature service, PFTE for hot water service (302 F maximum). Each flow meter shall be individually wet-calibrated and accurate to within ±0.4% of reading from 3.3 to 33 feet per second velocity. A certificate of calibration shall be provided with each flow meter. Output signals shall be 4-20 mA and programmable pulse. The flow meter shall be capable of measuring bi-directional flow. For installations in non-metallic pipe, install grounding rings between flanges. Each flow meter shall be factory programmed for its specific application and shall be re-programmable using the integral keypad on the electronics module (no special interface device or computer required).

4. ENERGY STANDARD REPORTS

A. The following standard system reports shall be provided for this project. Provide ability for the Owner to readily customize these reports for this project.

1. Electrical Meter Report - Provide a monthly report showing the daily electrical consumption and peak electrical demand for the building.

2. Gas Meter Report - Provide a monthly report showing the daily natural gas consumption for each meter. Provide an annual (12-month) report that shows the monthly consumption for the building.

3. Water Meter Report - Provide a monthly report showing the daily potable water consumption for the building. Provide an annual (12-month) report that shows the monthly consumption for the building.
PART 3 EXECUTION

3.01 ELECTRIC WIRING

1. All power and control wiring in connection with the temperature control system shall be furnished under this contract and shall be per N.E.C.

2. All electrical controls and switches shall be suitable either for 120 volts, 60 Hz or 24 VAC.

3. For control circuits of 115 volts and above, all wire shall be rated for 600 volts and may be either single or multi-conductor cable.

4. For control circuits below 30 volts, all wire shall be rated for 300 volts and may be either single or multi-conductor cable.

5. All electrical sensing element wire shall be in accordance with manufacturers' recommendation with the proper number of conductors, equivalent to Beldon No. 8770 and installed in "EMT" conduit in mechanical room. This cable shall not be installed in the same conduit with any conductors for voltages of 115 or above.

6. Electrical work provided shall include, but not limited to:

   A. Wiring from all control devices furnished to the respective equipment being controlled.

   B. Furnishing and installation of all necessary conduit and wire.

   C. Interlocking wiring between rooftop units, exhaust fans and radiation as specified in the sequence of operations, shown on the drawings or otherwise required.

   D. Installation of smoke detectors and wiring to fan starter.

   E. Wiring of flow switches, sequence relays, thermostats and permissive circuits to boilers.

7. Metal raceways shall be installed where pipe can not be installed in construction and shall be stamped one-piece metal minimum 18-gauge, factory painted color selected and secured to prevent vandalism.

8. In locations where wire cannot be installed above ceiling, wire shall be run in metal raceways.


3.02 ROOM SENSORS

1. Sensors shall be located so that they will not be influenced by the mechanical system or heat producing equipment. Sensors installed not in accordance with above shall be relocated and construction repaired at no additional cost to Owner.
2. Mount all sensors as required by ADA unless otherwise directed or required by code.

3. The exact location of sensors and/or thermostats to be determined in field with Owner and be coordinated with the final furniture layout. Submit location for review with shop drawings. As part of bid, contractor to include sufficient wire to relocate sensor 5' ± from location shown and where interference occurs, sensors shall be relocated (after final installation) at no additional cost to Owner.

4. As part of bid, contractor to include sufficient wire to relocate sensor 5' ± from location shown and where interference occurs, sensors shall be relocated (after final installation) at no additional cost to Owner. Contractor shall also include as part of bid, two (2) additional space wires to each space temperature sensor for future use. All spare wires shall be clearly identified and mark at the controller and sensor locations.

5. Where sensors are shown to be located behind grilles, provide hinged access and mark location.

3.03 DRAWINGS AND LAYOUT

1. This Contractor shall provide diagrams of the automatic temperature control system, which shall show all control equipment, and the function of each item.

2. The following data/information shall be submitted in accordance with general conditions:
   
   A. Complete sequence of operation.

   B. Color coded control system CAD generated drawings including all pertinent data to provide a functional operating system.

   C. Valve and damper schedules showing size, configuration, pressure losses, capacity and location of all equipment.

   D. A description of the installation materials including conduit, wire flex, etc.

3.04 ECONOMIZERS

1. All economizers shall be dual enthalpy type.

3.05 CO2 SENSORS

1. Rooftop units shall have CO2 sensors provided by the equipment manufacturer. CO2 sensors to be located in return air to modulate outside air dampers from closed to minimum position. Note – CO2 sensors shall be overridden by the lab exhaust system.
PART 4 SEQUENCE OF OPERATIONS

4.01 SPACE SETPOINTS

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<td>Occupied Heating</td>
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<tr>
<td>Morning Warm-up</td>
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<tr>
<td>Unoccupied Heating</td>
<td>60°F.</td>
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<tr>
<td>Occupied Cooling</td>
<td>74°F.</td>
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<td>Cool Down</td>
<td>74°F.</td>
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<td>Unoccupied Cooling</td>
<td>80°F.</td>
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<td>Relative Humidity</td>
<td>55% RH</td>
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Note: All setpoints to be adjustable by Owner via BAS (DDC).

4.02 HVAC SYSTEM EMERGENCY SHUT-DOWN SWITCH

1. Upon manual operation of switch, shut down all HVAC equipment that uses outside air for ventilation, combustion air or any other purpose which may cause outside air to enter building by equipment use or causing building to become negative. Locate switch per Owner and also have ability from central computer.

4.03 VENTILATION FANS

1. Provide room thermostat, energize fan. Upon a rise above setpoint, open dampers on inlet where applicable.

4.04 ROOFTOP UNITS - VAV

1. The units shall be sequenced from occupied/unoccupied warm-up/cool-down modes.

2. Provide the ability to override the control and energize system to occupied mode. Provide ability to have more than one override. Record time used and time and date of override events.

3. Heating Unoccupied Mode - When indexed to unoccupied mode by central computer or by manual override, all associated exhaust fans shall be de-energized, 100% return air, outside air damper shall be closed, VAV box heat de-energized, and VAV box sequenced to night heat. Upon a fall below night unoccupied space temperature as sensed by DDC system external zone sensors. VAV rooftop unit shall be energized. Supply air volume to minimum required for gas heat. Modulate gas heat and sequence dampers on VAV unit to allow for flow. Fan powered VAV’s shall be operated in a similar manner.

4. Heating Warm-Up Mode - When indexed to occupied mode (warm-up cycle), outside air damper closed, exhaust fans energized, unit gas heat energized and supply fan ramped up to preset minimum supply air flow, 100% return air, minimum air flow to be per manufacturer for minimum required for gas heat operation, until building is satisfied as sensed by central return air
sensor. VAV boxes shall be indexed to warm-up mode. VAV box primary dampers open and boxes under control of space sensor. Maintain mode until room sensors reach occupied heating setpoint, after which sequence to occupied heating mode.

5. Occupied Heating Mode - After warm-up is complete, the outside air dampers shall be allowed to operate. Discharge air set point shall be reset based on outdoor temperature 55°F - 50°F, 62°F - 10°F. VAV boxes shall, upon a fall below setpoint, modulate primary dampers closed until minimum position. Note – Sequence electric heat in stages.

6. Cooling Unoccupied Mode - When indexed to unoccupied mode by central control or by manual override; all associated exhaust fans to be de-energized, relief and outside air dampers closed. VAV box de-energized and VAV sequenced to unoccupied mode cooling. Upon a rise above night sensor, unoccupied cooling space temperature as sensed by ATC system, external zone sensors and interior enthalpy is above outside exterior enthalpy; energize unit economizer system to 100% outside air and 100% exhaust air to provide purge mode, open room VAV primary dampers. Provide purge mode until all zones have been satisfied. Provide time delay minimum 30-minute run time. Provide space low limit temperature and space high humidity thru DDC system shall override purge mode upon a fall below or rise above setpoints.

7. Cooling Occupied Mode - When indexed to cooling occupied mode from central computer, system shall first go to cool-down. Energize supply air fan. Close outside air dampers. System shall either provide refrigeration or economizer operation. Discharge air temperature control shall maintain desired reset discharge air control which shall be based on return air temperature and outside air temperature fully adjustable summer 55°F. ± and winter 62°F. ±. Upon a fall below setpoint of discharge air control, modulate closed outside air damper and operate enthalpy economizer with refrigeration to maintain desired setpoint. Upon a continued fall below setpoint, de-energize refrigeration and operate enthalpy economizer cycle per manufacturers’ requirements. Upon a continued fall; reset outside air dampers to minimum. Upon a further fall below set point; go to occupied heating mode.

8. Discharge Duct Static Pressure Setpoint - Duct pressure sensor located @ ¼ of the total duct length located shall maintain desired duct static pressure by modulating VFD drive on supply fan. The control bands, setpoint increment values, setpoint decrement values and adjustment frequencies shall be adjusted to maintain maximum static pressure optimization with stable system control and maximum comfort control.

9. Outside Air - The minimum outside air quantity shall remain constant during all modes regardless of supply air quantity, except for economizer operation and unoccupied cycles. To maintain compensated outdoor air control (IAQ), factory installed CO2 sensors shall reset minimum outside air quantities minimum based on return air CO2 levels, but outside air quantities shall not be allowed to fall below point where building is under negative pressure as sensed by pressure differential control between outdoors and indoors.

10. Start-Up Purge Cycle

A. The normal start up shall be as indicated above. The DDC system and unit control shall have a separate start up purge cycle which shall only be used if desired by Owner. The control logic sequence of operations shall be provided.
B. The sequencing of the system from normal start up to purge cycle start up shall be automatically initiated. The DDC system shall, during the normal operation, track and trend the conditions at start up, and if determined after a period of normal operation, that a purge startup cycle is required, then the system shall initiate a purge condition. This shall also alert operation and allow for manual override. Purge cycle shall only be initiated under outside conditions where economizer operation allows for free cooling.

C. When the unit starts, the outdoor air damper shall open and exhaust fan to track supply fan, initiating a timed purge cycle. The outdoor air damper shall modulate to maintain the mixed airflow at 30% outdoor air. The purge period shall be adjustable and shall initially be set for 30 minutes.

D. The unit shall modulate its preheat control to maintain the discharge air temperature set point if the mixed air temperature falls below the AHU discharge air temperature falls below the unit discharge air temperature set point. At the conclusion of the timed cycle, the outdoor air damper shall modulate closed and exhaust fan speed reset to maintain the base ventilation rate of outdoor air, and the demand-controlled ventilation control algorithm shall be enabled.

4.05 VAV UNITS

1. Minimum air quantities shall be heating 40%, cooling mode 15% (adj.). This Contractor shall include as part of his bid, adjustment of minimum air quantities after initial settings based on space and comfort conditions.

2. Each VAV zone controller shall monitor primary air flow, space temperature, air handler status and mode, supply air temperature and shall position its terminal damper-based unit's (PID) temperature control algorithm to maintain the desired zone temperature set point. Each zone controller shall include the inherent ability to override the temperature control loop and modulate the terminal's damper with (PI) loop. The zone controller shall be capable of maintaining a ventilation set point through a demand-controlled ventilation (DCV) algorithm in conjunction with the unit to fulfill the requirements of ASHRAE standard, 62-189 "Ventilation for Acceptable Indoor Air Quality" and 2009 IBC.

3. Whenever the system unit is operating the system controller shall maintain the Base Ventilation Rate, unless overridden by a pre-occupancy purge sequence or the DCV function.

4. The system controller shall maintain the discharge air temperature setpoint if the mixed air temperature falls below the discharge air temperature setpoint. The outside air damper position shall close with a decreasing CO₂ sensor signal down to the Base Ventilation Rate. The zone controller (VAV Box) shall contain a provision to operate modulating type heat to maintain the space temperature at the midpoint between the heating and cooling setpoints during DCV operation. The zone controller shall have the capability to define a maximum primary airflow limit (ventilation) to protect the zone from overcooling for those units that do not include reheat coils. DCV control shall be automatically suspended if the space temperature falls below the heating setpoint and the outdoor air damper shall return to the base ventilation position.
5. Operation shall be dependent upon the equipment mode of operation, so that the DCV function will only operate during occupied periods when the outdoor air damper is actively providing ventilation. DCV control shall be disabled if the CO₂ sensor fails.

4.06 EMERGENCY EXHAUST FAN

1. Provide manual red push-button switch. When engaged, shall open damper on grille that is served by switch and energize fan. All other dampers closed unless switch in another room is energized per deactivation. Plunger return to normal, close damper and de-energize fan.

4.07 FUME HOOD EXHAUST FAN

1. Provide switch on fume hood to energize fan on roof. Switch location and operation per fume hood manufacturers' requirements.

4.08 AIR CURTAIN

1. Provide room control which shall be located at the control desk. Final location to be verified. Sensor for door activation shall be furnished by equipment manufacturer and installed by DDC contractor.

2. Provide all wiring between controller door switch and unit.

4.09 MEDICAL WASTE

1. Fan shall run continuously. Provide override switch with label in room "fan control".

END OF SECTION
15930.5801
RC@GC MEDICINE CENTER
OWNER FURNISHED EQUIPMENT
Tag Data - Architectural Electric Wall Heaters (Qty: 8)

<table>
<thead>
<tr>
<th>Item</th>
<th>Tag(s)</th>
<th>Qty</th>
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<td>A1</td>
<td>EH-1</td>
<td>8</td>
<td>Architectural Wall Heaters</td>
<td>UHAA041CTA</td>
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</table>

Product Data - Architectural Electric Wall Heaters

Item: A1 Qty: 8 Tag(s): EH-1
- 4.0 kW unit capacity
- 1 phase/60 cycle
- 277 element and motor voltage
- Unit mounted tamperproof thermostat
- Unit mounted tamper resistant manual disconnect switch
- Unit mounted day/night relay
- 3320EX33 surface mounting adapter

Warranty
- 2 year whole unit warranty – parts and labor
Tag Data - Electric Ceiling Mounted Heaters (Qty: 1)

<table>
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Product Data - Electric Ceiling Mounted Heaters

Item: B1  Qty: 1  Tag(s): EH-2
5 kW Unit Size
1 Phase
277 Volt, Element & Motor
Recess Mounted (Series 80)
Unit mounted thermostat, single pole
Unit Mounted Disconnect Switch
Plaster Trim (Flf)

Warranty
2 year whole unit warranty – parts and labor
Tag Data - Electric Wall Fin Units  (Qty: 14)

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<td>C2</td>
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Product Data - Electric Wall Fin Units

Item: C1  Qty: 9  Tag(s): EH-3
2 Total length of enclosure w/element

Item: C2  Qty: 5  Tag(s): EH-5
3 Total length of enclosure w/element

All Units
- Production unit - Standard Finish
- DBF enclosure with front louver 6" (153 mm) high X 3-1/2" in (89 mm) deep
- 250 Watts per foot
- 277 volt
- Unit mounted thermostat single pole
- 1 Total quantity thermostats
- Unit mounted disconnect switch
- 1 Total quantity unit mounted disconnects
- 12" (305mm) RH extended enclosure
- 1 Quantity RH extensions
- 12" (305 mm) control section
- 1 Total quantity of control sections
- Power relay 277/24 volt
- 1 Total quantity of relays
- DBF 6" (153 mm) X 3-1/2" (89 mm) blank enclosure with front louver
- 1 Total length of blank enclosure
- Driftwood grey finish
- Driftwood grey back panel
- 4 Total length of finished back panels
- 1 Left end cap quantity (FId)
- 1 Right end cap quantity (FId)
Unit Dimensions - Electric Wall Fin Units
Item: C1, C2  Qty: 14  Tag(s): EH-3, EH-5

Extended Enclosure Adds 2.0 lbs [0.91 Kg]

Weight - 4.0 lbs [1.8 kg]

Pedestal Height Adjusts from 2" [51 mm] to 3-1/4" [83 mm]

Allow 3" [76 mm] Clearance Between Bottom of Heater and Finished Floor
Accessory - Electric Wall Fin Units

Item: C1, C2  Qty: 14  Tag(s): EH-3, EH-5
Accessory - Electric Wall Fin Units
Item: C1, C2  Qty: 14  Tag(s): EH-3, EH-5
Unit Dimensions - Electric Ceiling Mounted Heaters

Item: B1  Qty: 1  Tag(s): EH-2

NOTE:
1. ARROW INDICATES THE DIRECTION OF AIRFLOW.

| SHIPPING |
| WEIGHT |
| 36.0 lb |

LEFT VIEW

BACK VIEW

FRONT VIEW

RIGHT VIEW
Accessory - Electric Ceiling Mounted Heaters
Item: B1 Qty: 1 Tag(s): EH-2

USE PLASTER TRIM IN A HARD FINISHED CEILING
Unit Dimensions - Architectural Electric Wall Heaters

Item: A1  Qty: 8  Tag(s): EH-1

TOP VIEW

NOTE:
1. ARROWS INDICATE THE DIRECTION OF AIRFLOW.

WEIGHT

| 22.0 lb |

BOTTOM VIEW

ISO1 VIEW

1/2" KNOCKOUT FOR ELECTRICAL CONN

RIGHT VIEW
### Tag Data - Electric Unit Heaters (Qty: 1)

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</table>

### Product Data - Electric Unit Heaters

**Item: D1  Qty: 1  Tag(s): EH-4**
- Electric Unit Heater
- 5.0 kW Unit Capacity
- 3 Phase 60 Cycle
- 480 Volt Element and Motor
- 24 Volt Control Transformer
- Contactor
- Stratification Low Voltage 24 Volt Duty Thermostat (Fid)
- Wall Mounted Thermostat Low Voltage with Summer Fan Switch (Fid)
- Unit Mounted in Field Disconnect Switch 3 Pole for 3 Phase (Fid)
- Mounting Bracket - Horizontal Discharge (Fid)
- Dust Shield (Horizontal Discharge) (Fid)
- OSHA Fan Guard 3-5 kW (Fid)

**Warranty**
- 2 year whole unit warranty – parts and labor
HORIZONTAL DISCHARGE BRACKET

LOCATION OF BRACKET FOR CEILING MOUNTED UNITS

LOCATION OF BRACKET FOR WALL MOUNTED UNITS

ISOMETRIC VIEW

SIDE VIEW

21 3/8"
Weight, Clearance & Rigging Diagram - Electric Unit Heaters
Item: D1  Qty: 1  Tag(s): EH-4

Isometric View

Top View

Front View

Dust Shield
## Field Installed Options - Part/Order Number Summary

This is a report to help you locate field installed options that arrive at the jobsite. This report provides part or order numbers for each field installed option, and references it to a specific product tag. It is NOT intended as a bill of material for the job.

### Product Family - Electric Ceiling Mounted Heaters

<table>
<thead>
<tr>
<th>Item</th>
<th>Tag(s)</th>
<th>Qty</th>
<th>Description</th>
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### Field Installed Option Description

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### Product Family - Electric Wall Fin Units

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<tbody>
<tr>
<td>C1</td>
<td>EH-3</td>
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<td>Electric Wall Fin</td>
<td>EWFB</td>
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<tr>
<td>C2</td>
<td>EH-5</td>
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### Product Family - Electric Unit Heaters

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<tr>
<td>Dust Shield ( Horizontal Discharge )</td>
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</table>
INDOOR UNIT FEATURES

- Space-efficient ductless installation
- Equipped with 3D i-see Sensor™ for enhanced comfort and energy efficiency
- Airflow settings for high and low ceiling applications
- Individual vane settings for direct/indirect airflow control or variable airflow patterns
- Knockouts for outside-air intake and branch-duct run
- Filter indicator signal
- Easy-to-clean, washable filter (optional high-efficiency filter available - requires multi-function casement)
- Built-in condensate lift mechanism
- Ideal for retail shops, classrooms, office spaces, conference centers, building lobbies, and more

OUTDOOR UNIT FEATURES

- Variable speed INVERTER-driven compressor
- Suction accumulator pre-charged with refrigerant volume for piping length up to 100 ft (70 ft. for A12/18/24/30)
- 24-hour continuous operation (cooling mode)
- High pressure protection
- Fast restart due to bypass valve make it ideal for equipment cooling applications, such as data centers
- Superior energy and operational efficiency

Specifications are subject to change without notice.

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## SPECIFICATIONS: PLA-A42EA7 & PUZ-A42NKA7(-BS)

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Indoor Unit</th>
<th>PLA-A42EA7</th>
<th>PUZ-A42NKA7</th>
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<table>
<thead>
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<th>Model Number</th>
<th>Indoor Unit</th>
<th>PLU-A42EA7</th>
<th>PUZ-A42NK7</th>
<th>PUZ-A42NK7-BS</th>
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<tr>
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<td></td>
<td>External Finish Color</td>
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<tr>
<td></td>
<td>Unit Dimensions // Grille Dimensions</td>
<td>W: In. (mm)</td>
<td>33-1/16 (840) // 37-13/32 (950)</td>
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<td>D: In. (mm)</td>
<td>33-1/16 (840) // 37-13/32 (950)</td>
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<td>H: In. (mm)</td>
<td>11-3/4 (298) // 1-9/16 (40)</td>
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<tr>
<td></td>
<td>Package Dimensions // Grille Dimensions</td>
<td>W: In. (mm)</td>
<td>35-9/16 // 39-6/16</td>
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<tr>
<td></td>
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<td>D: In. (mm)</td>
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<td>H: In. (mm)</td>
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<tr>
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<td>Unit Weight // Grille Weight</td>
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<td>56 (25) // 11 (5)</td>
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<td>D: In. (mm)</td>
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<td>H: In. (mm)</td>
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<td>Package Dimensions</td>
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<td>D: In. (mm)</td>
<td>17-11/16</td>
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<td></td>
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<td>H: In. (mm)</td>
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<td>Unit Weight</td>
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<td></td>
<td>Package Weight</td>
<td>Lbs. (kg)</td>
<td>245 (111)</td>
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## SPECIFICATIONS: PLA-A42EA7 & PUZ-A42NKA7(-BS)

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<th>Model Number</th>
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<th>Outdoor Unit</th>
<th>PLA-A42EA7</th>
<th>PUZ-A42NKA7</th>
<th>PUZ-A42NKA7-BS</th>
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<td><strong>Outdoor Unit Operating Temperature Range</strong></td>
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<tr>
<td>Heating Intake Air Temp (Maximum / Minimum)</td>
<td>°F</td>
<td>70 DB, 59 WB / -4 DB, -4 WB</td>
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<td>Thermal Lock-out / Re-start Temperatures**</td>
<td>°F</td>
<td>-8 / -4 DB</td>
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<td>Lbs, oz</td>
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<td>Gas Pipe Size O.D. (Flared)</td>
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<td>Liquid Pipe Size O.D. (Flared)</td>
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<td>Maximum Number of Bends</td>
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<td>15</td>
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</table>

### Notes

**AHRI Rated Conditions**

1. Cooling (Indoor // Outdoor) °F 80 DB, 67 WB // 95 DB, 75 WB
2. Heating at 47°F (Indoor // Outdoor) °F 70 DB, 60 WB // 47 DB, 43 WB
3. Heating at 17°F (Indoor // Outdoor) °F 70 DB, 60 WB // 17 DB, 15 WB
4. Heating at 5°F (Indoor // Outdoor) °F 70 DB, 60 WB // -4 DB, -6 WB

*Wind baffles required to operate below 23°F DB in cooling mode. PUZ with wind baffle: 0°F - 115°F.*

**System cuts out in heating mode to avoid thermistor error and automatically restarts at these temperatures.

### SEACOAST PROTECTION

- External Outer Panel: Phosphate coating + Acrylic-Enamel coating
- Fan Motor Support: Epoxy resin coating (at edge face)
- Separator Assembly; Valve Bed: Epoxy resin coating (at edge face)
- "Blue Fin" treatment is an anti-corrosion treatment that is applied to the condenser coil to protect it against airborne contaminants.

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INDOOR UNIT FEATURES
- Sleek, compact design
- Simple installation
- Vane setting for air flow direction control
- Auto fan speed mode
- Ideal for spaces such as server rooms, daycare centers, classrooms, churches, small offices, and more

OUTDOOR UNIT FEATURES
- Variable speed INVERTER-driven compressor
- Suction accumulator pre-charged with refrigerant volume for piping length up to 100 ft (70 ft. for A12/18/24/30)
- 24-hour continuous operation (cooling mode)
- High pressure protection
- Fast restart due to bypass valve make it ideal for equipment cooling applications, such as data centers
- Superior energy and operational efficiency
<table>
<thead>
<tr>
<th>Model Number</th>
<th>Indoor Unit</th>
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<th>Outdoor Unit</th>
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### SPECIFICATIONS: PKA-A36KA7 & PUZ-A36NKA7(-BS)

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<td>H: In. (mm)</td>
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<td>H: In.</td>
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</table>

#### Indoor Unit Operating Temperature Range

| **Cooling Intake Air Temp (Maximum / Minimum)** | °F | 90 DB, 73 W6 / 66 DB, 59 WB |
| **Heating Intake Air Temp (Maximum / Minimum)** | °F | 82 DB / 50 DB |

#### Outdoor Unit

| **MCA** | A | 25 |
| **MOCP** | A | 31 |
| **Fan Motor Full Load Amperage** | A | 0.5 + 0.5 |
| **Fan Motor Output** | W | 74 + 74 |
| **Airflow Rate** | CFM | 3,880 |
| **Refrigerant Control** | Electronic Expansion Valve |
| **Defrost Method** | Reverse Cycle |
| **Heat Exchanger Type** | Cross fin |
| **Sound Pressure Level, Cooling** | dB(A) | 52 |
| **Sound Pressure Level, Heating** | dB(A) | 53 |
| **Compressor Type** | INVERTER-driven twin rotary |
| **Compressor Model** | MNB33FBRMC-L |
| **Compressor Rated Load Amps** | A | 8 |
| **Compressor Locked Rotor Amps** | A | 13 |
| **Compressor Oil Type / Charge** | oz. | FV50S / 46 |
| **External Finish Color** | Ivory Munsell 3Y 7.8/1.1 |
| **Base Pan Heater** | n/a |
| **Unit Dimensions** | W: In. (mm) | 1050 [41-5/16] |
| **Package Dimensions** | W: In. | 42-15/16 |
| **Unit Weight** | Lbs. (kg) | 214 (97) |
| **Package Weight** | Lbs. (kg) | 245 (111) |

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## SPECIFICATIONS: PKA-A36KA7 & PUZ-A36NKA7(-BS)

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Indoor Unit</th>
<th>Outdoor Unit</th>
<th>PKA-A36KA7</th>
<th>PUZ-A36NKA7</th>
<th>PUZ-A36NKA7-BS</th>
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<tbody>
<tr>
<td>Outdoor Unit Operating Temperature Range</td>
<td>Cooling Intake Air Temp (Maximum / Minimum)</td>
<td>°F</td>
<td>115 DB / 0° DB</td>
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<td>Heating Intake Air Temp (Maximum / Minimum)</td>
<td>°F</td>
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<td>Thermal Lock-out / Re-start Temperatures**</td>
<td>°F</td>
<td>-8 / -4 DB</td>
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<td>Refrigerant Type</td>
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<td>Maximum Piping Length</td>
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<td>Maximum Height Difference</td>
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<td>Maximum Number of Bends</td>
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</tbody>
</table>

**Notes**

AHRI Rated Conditions
(Rated data is determined at a fixed compressor speed)

1. Cooling (Indoor // Outdoor) | °F | 80 DB, 67 WB // 95 DB, 75 WB |
2. Heating at 47°F (Indoor // Outdoor) | °F | 70 DB, 60 WB // 47 DB, 43 WB |
3. Heating at 17°F (Indoor // Outdoor) | °F | 70 DB, 60 WB // 17 DB, 15 WB |
4. Heating at 5°F (Indoor // Outdoor) | °F | 70 DB, 60 WB // -4 DB, -5 WB |

*Wind baffles required to operate below 23°F DB in cooling mode. PUZ with wind baffle: 0°F - 115°F.*

**System cuts out in heating mode to avoid thermistor error and automatically restarts at these temperatures.

SEACOAST PROTECTION
- External Outer Panel: Phosphate coating + Acrylic-Enamel coating
- Fan Motor Support: Epoxy resin coating (at edge face)
- Separator Assembly; Valve Bed: Epoxy resin coating (at edge face)
- “Blue Fin” treatment is an anti-corrosion treatment that is applied to the condenser coil to protect it against airborne contaminants.

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INDOOR UNIT FEATURES

- Sleek, compact design
- Simple installation
- Vane setting for airflow direction control
- Auto fan speed mode
- Ideal for spaces such as server rooms, daycare centers, classrooms, churches, small offices, and more

OUTDOOR UNIT FEATURES

- Variable speed INVERTER-driven compressor
- Suction accumulator pre-charged with refrigerant volume for piping length up to 100 ft (70 ft. for A12/18/24/30)
- Low ambient cooling down to -20°F providing 100% capacity (only for PUY models with wind baffles installed)
- 24-hour continuous operation (cooling mode)
- High pressure protection
- Fast restart due to bypass valve make it ideal for equipment cooling applications, such as data centers
- Superior energy and operational efficiency

Specifications are subject to change without notice.
<table>
<thead>
<tr>
<th>Model Number</th>
<th>Indoor Unit</th>
<th>PKA-A36KA7</th>
<th>PUY-A36NKA7</th>
<th>PUY-A36NKA7-BS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum Capacity</td>
<td>Btu/h</td>
<td>36,000</td>
<td>36,000</td>
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<td></td>
<td>Rated Capacity</td>
<td>Btu/h</td>
<td>16,000</td>
<td>3,330</td>
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<tr>
<td></td>
<td>Minimum Capacity</td>
<td>Btu/h</td>
<td>16,000</td>
<td>3,330</td>
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<tr>
<td></td>
<td>Maximum Power Input</td>
<td>W</td>
<td>208 / 230V, 1-phase, 60 Hz</td>
<td>198 - 253</td>
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<tr>
<td></td>
<td>Rated Power Input</td>
<td>W</td>
<td>24</td>
<td>12</td>
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<tr>
<td></td>
<td>Moisture Removal</td>
<td>Pints/h</td>
<td>9.7</td>
<td>9.7</td>
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<tr>
<td></td>
<td>Sensible Heat Factor</td>
<td>%</td>
<td>0.70</td>
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<td></td>
<td>Power Factor</td>
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<td>Efficiency</td>
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<td>208 / 230V, 1-phase, 60 Hz</td>
<td>198 - 253</td>
<td>208 / 230</td>
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<td></td>
<td>EER¹</td>
<td>208 / 230V, 1-phase, 60 Hz</td>
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<td>208 / 230</td>
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<tr>
<td>Electrical</td>
<td>Voltage, Phase, Frequency</td>
<td>V AC</td>
<td>208 / 230</td>
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<td>Guaranteed Voltage Range</td>
<td>V AC</td>
<td>208 / 230</td>
<td>208 / 230</td>
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<td>Voltage: Indoor - Outdoor, S1-S2</td>
<td>V DC</td>
<td>24</td>
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<td>Voltage: Indoor - Outdoor, S2-S3</td>
<td>V DC</td>
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<td>Voltage: Indoor - Remote controller</td>
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<td>Recommended Fuse/Breaker Size</td>
<td>A</td>
<td>30</td>
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<td>Recommended Wire Size (Indoor - Outdoor)</td>
<td>AWG</td>
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<td>14</td>
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<tr>
<td></td>
<td>MCA</td>
<td>A</td>
<td>1</td>
<td>1</td>
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<tr>
<td></td>
<td>Fan Motor Full Load Amperage</td>
<td>A</td>
<td>0.57</td>
<td>0.57</td>
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<tr>
<td></td>
<td>Fan Motor Output</td>
<td>W</td>
<td>56</td>
<td>56</td>
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<tr>
<td></td>
<td>Airflow Rate, Dry</td>
<td>CFM</td>
<td>705-810-920</td>
<td>705-810-920</td>
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<tr>
<td></td>
<td>Airflow Rate, Wet</td>
<td>CFM</td>
<td>635-730-830</td>
<td>635-730-830</td>
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<td>External Static Pressure</td>
<td>in.WG</td>
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<td>n/a</td>
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<td>Sound Pressure Level</td>
<td>dB(A)</td>
<td>43-46-49</td>
<td>43-46-49</td>
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<td></td>
<td>Drain Pipe Size</td>
<td>in. (mm)</td>
<td>5/8 (16)</td>
<td>5/8 (16)</td>
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<tr>
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<td>Condensate Lift Mechanism, Max. Distance</td>
<td>in. (mm)</td>
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<td>n/a</td>
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<tr>
<td></td>
<td>Heat Exchanger Type</td>
<td>Plate fin coil</td>
<td>White Munsell 1.0Y 8.2/0.2</td>
<td>White Munsell 1.0Y 8.2/0.2</td>
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<tr>
<td></td>
<td>External Finish Color</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Unit Dimensions</td>
<td>W: In. (mm)</td>
<td>46-1/16 (1170)</td>
<td>46-1/16 (1170)</td>
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<td></td>
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<td>D: In. (mm)</td>
<td>11-5/8 (295)</td>
<td>11-5/8 (295)</td>
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<tr>
<td></td>
<td></td>
<td>H: In. (mm)</td>
<td>14-3/8 (365)</td>
<td>14-3/8 (365)</td>
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<td></td>
<td>Package Dimensions</td>
<td>W: In.</td>
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<td>51</td>
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<td></td>
<td>D: In.</td>
<td>18-8/16</td>
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<tr>
<td></td>
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<td>H: In.</td>
<td>14-4/16</td>
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<td></td>
<td>Unit Weight</td>
<td>Lbs. (kg)</td>
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<td>Package Weight</td>
<td>Lbs.</td>
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<table>
<thead>
<tr>
<th>Model Number</th>
<th>Indoor Unit</th>
<th>PUA-A36KA7</th>
<th>PUY-A36NKA7</th>
<th>PUY-A36NKA7-BS</th>
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<tr>
<td>MCA</td>
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<td>Fan Motor Output</td>
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<td>Airflow Rate</td>
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<td>Heat Exchanger Type</td>
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<td>Cross fin</td>
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<td>Sound Pressure Level, Cooling</td>
<td>dB(A)</td>
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<td>INVERTER-driven twin rotary</td>
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<tr>
<td>Compressor Locked Rotor Amps</td>
<td>A</td>
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<tr>
<td>Compressor Oil Type // Charge</td>
<td>oz.</td>
<td>FV50S // 45</td>
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<tr>
<td>External Finish Color</td>
<td></td>
<td>Ivory Munsell 3Y 7.8/1.1</td>
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<tr>
<td>Base Pan Heater</td>
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<tr>
<td>Unit Dimensions</td>
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<td>W: In. (mm)</td>
<td>1050 [41-5/16]</td>
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<tr>
<td></td>
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<td>D: In. (mm)</td>
<td>13 + 1-3/16 (330 + 30)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>H: In. (mm)</td>
<td>52-11/16 (1338)</td>
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<td>Package Dimensions</td>
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<td>W: In.</td>
<td>42-15/16</td>
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</tr>
<tr>
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<td>D: In.</td>
<td>17-11/16</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>H: In.</td>
<td>56-4/16</td>
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<td>Unit Weight</td>
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<td>211 (95)</td>
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</tr>
<tr>
<td>Package Weight</td>
<td>Lbs. (kg)</td>
<td>243 (110)</td>
<td></td>
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</tr>
<tr>
<td>Outdoor Unit Operating Temperature Range</td>
<td>Cooling Intake Air Temp (Maximum / Minimum)</td>
<td>°F</td>
<td>115 DB / -20° DB</td>
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</tr>
<tr>
<td>Refrigerant</td>
<td>Type</td>
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<tr>
<td>Charge</td>
<td>Lbs. oz</td>
<td>10 lbs, 6 oz</td>
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<tr>
<td>Piping</td>
<td>Gas Pipe Size O.D. (Flared)</td>
<td>in.(mm)</td>
<td>5/8 (15.88)</td>
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<td></td>
<td>Liquid Pipe Size O.D. (Flared)</td>
<td>in.(mm)</td>
<td>3/8 (9.52)</td>
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<tr>
<td></td>
<td>Maximum Piping Length</td>
<td>Ft. (m)</td>
<td>225 (69)</td>
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<tr>
<td></td>
<td>Maximum Height Difference</td>
<td>Ft. (m)</td>
<td>100 (30)</td>
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<tr>
<td></td>
<td>Maximum Number of Bends</td>
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<td>15</td>
<td></td>
</tr>
</tbody>
</table>

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**Notes**

<table>
<thead>
<tr>
<th>AHRI Rated Conditions (Rated data is determined at a fixed compressor speed)</th>
<th>Cooling (Indoor // Outdoor)</th>
<th>³F</th>
<th>80 DB, 67 WB // 95 DB, 75 WB</th>
</tr>
</thead>
</table>

³Wind baffles required to operate below 23°F DB in cooling mode. PUY with wind baffle: -20°F - 115°F. Refer to wind baffle documentation for further information.

**System cuts out in heating mode to avoid thermistor error and automatically restarts at these temperatures.**

**SEACOAST PROTECTION**
- External Outer Panel: Phosphate coating + Acrylic-Enamel coating
- Fan Motor Support: Epoxy resin coating (at edge face)
- Separator Assembly, Valve Bed: Epoxy resin coating (at edge face)
- "Blue Fin" treatment is an anti-corrosion treatment that is applied to the condenser coil to protect it against airborne contaminants.
CAPABILITIES

- Basic Operations
  - On/Off
  - Operation Mode: Cool, Dry, Fan, Heat, Auto (Dual or Single set point)
  - Set Temperature
  - Fan Speed
  - Daylight Savings Time (DST)
- Vane setting: Auto, Step 1-5, Swing
- Louver: Off, Swing On
- Vent. (Lossnay): Off, Low, High
  - Manual vane angle: No Setting, Step 1-5, Draft reduction, All outlet
  - Draft reduction mode keeps the vane angle more horizontal than the angle of Step 1
- Restriction
  - Set Temperature range limit
  - Operation lock: On/Off, Mode, Set Temp, Vane
- High power
  - Operate at higher-than-normal capacity to bring room to set temperature quickly for up to 30 minutes
- No Occupancy Auto-OFF
  - 3D i-See sensor required
- On/Off timer
  - Set On Time in 5-minute increments
  - Set Off Time in 5-minute increments
  - Repeat daily
  - Home screen display icon
- Auto-Off timer
  - Automatically turns unit off after preset time
  - Time range of 30 to 240 minutes in 10-minute increments
  - Home screen display icon
- Weekly timer
  - Set each day Monday through Sunday
  - 1 to 4 time periods per day in 5-minute increments
  - Set Mode: On/Off/Auto (Dual set point)
  - On/Off/Auto
  - Set Temperature
- Outdoor Unit silent mode
  - Schedule: Mon, Tue, Wed, Thu, Fri, Sat, Sun
  - Start/Stop times in 5-minute increments
  - Silent Levels: Normal, Middle, Quiet
- Energy saving features:
  - Automatic return to preset temperature setpoint if set point is changed from the remote controller after a preset time range
  - Cool preset temp: Cool, Dry, Auto-Cool
  - Heat preset temp: Heat, Auto-Heat
  - Range of 30 to 120 minutes in 10-minute increments
  - Energy-saving Operation Schedule
    - Operation schedule
    - Four daily patterns with time periods in 5-minute increments and energy-saving rate 0% to 90%
    - 7 day programming
- Night setback
  - Starts Heat/Cool operation when room temperature exceeds preset temperature range
  - Adjustable time range in 5-minute increments
- Main display
  - Full: Shows all icons and values
  - Basic: Limited to Mode, Set Temp., Fan, Time & Day
  - Backlight Display
  - Adjustable Contrast Level
    - Language: English, French, Spanish, Italian, Portuguese, Greek, Turkish, Swedish
  - CITYMULTI® Function setting
  - Filter maintenance notification
  - Error code notification

*(All Capabilities are dependent on the model connected)*
### SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Unit(s)</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product size</td>
<td>In. (mm)</td>
<td>4 1/2 x 4 3/4 x 3/4 (120 x 120 x 19)</td>
</tr>
<tr>
<td>Net weight</td>
<td>Lbs. (kg)</td>
<td>9/16 (0.25)</td>
</tr>
<tr>
<td>Rated power supply voltage</td>
<td>VDC</td>
<td>12 (supplied from indoor units)</td>
</tr>
<tr>
<td>Power consumption</td>
<td>W</td>
<td>0.3</td>
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<tr>
<td>Usage environment</td>
<td></td>
<td>Temperature: 0 to 40°C (32 to 104°F)</td>
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<tr>
<td></td>
<td></td>
<td>Humidity: 30 to 90%RH (without condensation)</td>
</tr>
<tr>
<td>Material</td>
<td>Panel</td>
<td>PMMA</td>
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<tr>
<td></td>
<td>Main body</td>
<td>PC + ABS</td>
</tr>
<tr>
<td>Sound Pressure Level</td>
<td>dB(A)</td>
<td>&lt;70 [A-weighted sound pressure level]1</td>
</tr>
</tbody>
</table>

1. Per Machinery Directive 2009/42/EC

### DIMENSIONS

(Front view)

(Side view)

Notes:
Unit Dimensions - Variable Air Volume Single Duct Terminal Units

Item: A1, A2, A4, A5, A20  Qty: 5  Tag(s): VAV-1, VAV-2, VAV-4, VAV-5, VAV-20

Customer Notes

1. Air Inlet is centered in unit front panel.
2. Slip & Drive discharge outlet standard.
3. Minimum of 1.5 times duct diameter of straight duct at inlet for proper flow reading.
4. For electric heater access, side hinged door must have minimum distance per NEC or local code.
5. Allow 48" of straight duct downstream of unit before first runout & inside of the duct should be equal discharge size (A & B)
6. Left-hand orientation shown. (Facing discharge) Unit can be flipped to right-hand orientation

Approximate Dry Weight
36.0 lb

Weight reflected may vary
5 lb (2.2 kg) based upon options selected.
Unit Dimensions - Variable Air Volume Single Duct Terminal Units

Item: A3, A6, A7, A9, A14, A19, A21, A31, A33, A34, A37, A40  Qty: 12  Tag(s): VAV-3, VAV-6, VAV-7, VAV-9, VAV-14, VAV-19, VAV-21, VAV-31, VAV-33, VAV-34, VAV-37, VAV-40

Customer Notes
1. Air Inlet is centered in unit front panel.
2. Slip & Drive discharge outlet standard.
3. Minimum of 1.5 times duct diameter of straight duct at inlet for proper flow reading.
4. For electric heater access, side hinged door must have minimum distance per NEC or local code.
5. Allow 48" of straight duct downstream of unit before first runout & inside of the duct should be equal discharge size. (A & B)
6. Left-hand orientation shown. (Facing discharge) Unit can be flipped to right-hand orientation

Approximate Dry Weight
38.0 lb

Weight reflected may vary 5 lbs(2.27kg) based upon options selected
Unit Dimensions - Variable Air Volume Single Duct Terminal Units
Item: A8, A18  Qty: 2  Tag(s): VAV-8, VAV-18

Customer Notes
1. Air inlet is centered in unit front panel.
2. Slip & Drive discharge outlet standard.
3. Minimum of 1.5 times duct diameter of straight duct at inlet for proper flow reading.
4. For electric heater access, side hinged door must have minimum distance per NEC or local code.
5. Allow 48" of straight duct downstream of unit before first runout & inside of the duct should be equal discharge size. (A & B)
6. Left-hand orientation shown. (Facing discharge) Unit can be flipped to right-hand orientation

Approximate
Dry Weight
38.0 lb

Weight reflected may vary
5 lbs (2.27kgs) based upon options selected.
Unit Dimensions - Variable Air Volume Single Duct Terminal Units


Customer Notes
1. Air inlet is centered in unit front panel.
2. Slip & Drive discharge outlet standard.
3. Minimum of 1.5 times duct diameter of straight duct at inlet for proper flow reading.
4. For electric heater access, side hinged door must have minimum distance per NEC or local code.
5. Allow 48" of straight duct downstream of unit before first runout & inside of the duct should be equal discharge size. (A & B)
6. Left-hand orientation shown. (Facing discharge) Unit can be flipped to right-hand orientation.

Approximate Dry Weight

Weights reflected may vary ±5.0 lb based upon options selected.
**Unit Dimensions - Variable Air Volume Single Duct Terminal Units**

**Item:** A12, A28, A29  
**Qty:** 3  
**Tag(s):** VAV-12, VAV-28, VAV-29

---

**TOP VIEW**

- **2 3/4"**
- **10"**
- **45°**
- **31"**
- **42 1/2"**
- **SLIP & DRIVE CONNECTION**

**BACK VIEW**

- **11 1/2"**
- **12"**
- **13 1/2"**
- **3"**
- **14"**
- **15 1/2"**

**Customer Notes**

1. Air Inlet is centered in unit front panel.
2. Slip & Drive discharge outlet standard.
3. Minimum of 1.5 times duct diameter of straight duct at inlet for proper flow reading.
4. For electric heater access, side hinged door must have minimum distance per NEC or local code.
5. Allow 48" of straight duct downstream of unit before first turnout & inside of the duct should be equal discharge size. (A & B)
6. Left-hand orientation shown. (Facing discharge) Unit can be flipped to right-hand orientation

**Approximate Dry Weight**

- **48.0 lb**

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Single Duct Terminal Units

Item: A22  Qty: 1  Tag(s): VAV-22

Customer Notes

1. Air inlet is centered in unit front panel.
2. Slip & Drive discharge outlet standard.
3. Minimum of 1.5 times duct diameter of straight duct at inlet for proper flow reading.
4. For electric heater access, side hinged door must have minimum distance per NEC or local code.
5. Allow 48" of straight duct downstream of unit before first runout & inside of the duct should be equal discharge size (A & B)
6. Left-hand orientation shown. (Facing discharge)
   Unit can be flipped to right-hand orientation

Approximate Dry Weight  52.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Single Duct Terminal Units

Item: A39  Qty: 1  Tag(s): VAV-39

TOP VIEW

BACK VIEW

Customer Notes:
1. Air inlet is centered in unit front panel.
2. Slip & Drive discharge outlet standard.
3. Minimum of 1.5 times duct diameter of straight duct at inlet for proper flow reading.
4. For electric heater access, side hinged door must have minimum distance per NEC or local code.
5. Allow 48" of straight duct downstream of unit before first runout & inside of the duct should be equal discharge size (A & B)
6. Left-hand orientation shown. (Facing discharge) Unit can be flipped to right-hand orientation.

Approximate
Dry Weight
90.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Accessory - Variable Air Volume Single Duct Terminal Units


Air-Fi™ WIRELESS COMMUNICATIONS INTERFACE (Air-Fi™ WCI)
(INSTALLLED, WIRED & TESTED ON UNIT)

Wireless specifications
Air-Fi™ WCI works with other Air-Fi™ WCI's for wireless communications and optionally with wireless communications sensor.
(Does not work with non-Air-Fi™ Wireless Zone Sensors)

- WCI operating temperature: -40 to 150°F (-40 to 70°C)
- Storage temperature: -40 to 150°F (-40 to 70°C)
- Storage and operating humidity range: 5% to 95% relative humidity (RH), non-condensing
- Resolution: ±0.125°F over a range of 60 to 0°F
  (15.66 to 26.8°C) ±0.25°F when outside this range
- Receiver voltage: 9V nominal output ± 10%
- Receiver power consumption: <2.5VA
- Housing material: Polycarbonate/NB blend, suitable for plemum
  mounting, UV protected, UL 94: 5 VA flammability rating
- Mounting: Factory mounted on exterior of control box
- Range(s): Open range - 2,500 ft (762m) w/ packet error rate of 2%
  Indoor: Typical range is 200 ft (61m); actual range is dependent on the environment.
- Output power: 100 mW - North America
- Radio frequency: 2.4 GHz (IEEE 802.15.4-2003 compliant)
  (2400-2483 MHz, 5 MHz spacing)
- Radio channels: 16
- Address range: 00-99
- RoHS compliance: Yes
- Agency Listing: UL Listed: UL94, V-0 flammability rating and UL61006.
  CSA - C22.3 No. 225-M1609 Signal Equipment

(*) Range values are estimated transmission distances for satisfactory operation of the 100 mW version. Estimated transmission distance for the 10 mW version will be less. Actual distance is job specific and must be determined during site evaluation.

Placement of the receiver and the sensor is critical to proper system operation. In most general office space installations, distance is not the limiting factor for proper radio signal quality. It is more greatly affected by walls, barriers, and general clutter. In perimeter, stairwells, walls and ceiling plate offer some restriction to the propagation of the radio signal throughout the building or opposed to concrete or metal barriers.
Accessory - Variable Air Volume Single Duct Terminal Units

Air-Fi™ WIRELESS COMMUNICATIONS CO₂ / OCCUPANCY SENSOR (WCS-S CO₂)

Measures temperature, optional humidity (with optional WCS-DH). CO₂ levels in parts per million, and occupancy. All sensing values are displayed in an internal facing LCD display, which prevents public viewing. This sensor is typically used on demand - control ventilation applications. An LED indicates when movement is observed for proper sensor positioning during installation. Sensor works with Air-Fi™ Wireless Communications interface.

Specifications

- Sensor operating temperature: 32 to 122°F (0 to 50°C)
- Storage temperature: 40 to 158°F (40 to 70°C)
- Storage and humidity range: 5% to 95%, non-condensing
- Range: Open range - 2,500 ft (pocket error rate = 2 % indoor typical range - 200 ft (61 m)
- Actual range is dependent on the environment
- Output power: 120 mW - North America
- Radio frequency: 2.4 GHz (IEEE 802.15.4-2003 compliant)
- (2405-2480 MHz, 9 MHz spacing)
- Radio channels: 16
- Mounting: Plug a standard 2" x 4" junction box (vertical mount only). Mounting bolts are spaced 3.2" (81 mm) apart on a vertical center line. Includes mounting screw and junction box and wall anchors for sheet metal walls. Overall dimensions: 2.5" (63.5 mm) x 4.7" (119 mm)
- Ambient Light: Required for Occupancy Detection
- From 2.5 to 430 foot candles
- CO₂ range: 0 - 1,000 ppm
- CO₂ Accuracy at 25 °C: ± 3 % of reading (includes repeatability)
- CO₂ Pressure dependence of output: Built-in pressure sensor eliminates inaccuracy due to altitude
- CO₂ Recommended calibration interval: None (auto-calibrated)
- CO₂ Response resolution: 60 ppm change or 15 minute heartbeat
- Housing Material: Polycarbonate/ABS blend (wall)
- Address range: 000-999
- Minimum time between transmissions: 30 seconds
- Maximum time between transmissions: 15 minutes
- cETLus compliance: Yes
- Agency Listing: UL316 Energy Management Equipment
- CSA - cETLus No. 206-M1683 Signal Equipment

(1) Range values are estimated transmission distances for satisfactory operation of the 100 mW version. Estimated transmission distance for the 10 mW version will be less. Actual distance is job specific and must be determined during site evaluation.

Placement of the receiver and the sensor is critical to proper system operation. In most general office space installations, distance is the key limiting factor for proper radio signal quality. It is more greatly affected by walls, barriers, and general clutter. In general, indoor walls and ceiling tiles offer wide resistance to the propagation of the radio signal throughout the building as opposed to concrete or metal barriers.

FLD = Furnished by Trane U.S. Inc. / Installed by Others
Field Wiring - Variable Air Volume Single Duct Terminal Units

NOTE:

1. FACTORY WIRING
   FIELD WIRING
   OPTIONAL OR ALTERNATE WIRING

2. BASE WIRE SIZES 18-24 AWG shall connect terminals required for all field connections.

3. ZONE SENSOR TERMINALS 1-8 1-5 AND 2-4 REQUIRE SHIELDED TWISTED PAIR WIRING FOR COMMUNICATIONS JACk EQUIPPED DUCT ZONE SENSOR OPTION.

4. NO ADDITIONAL WIRING REQUIRED FOR NIGHT SETBACK Override (continues)

5. IF UNIT MOUNTED TRANSFORMER IS NOT PROVIDED. POLARITY FROM UNIT TO UNIT MUST BE MAINTAINED TO PREVENT PERMANENT DAMAGE TO CONTROLS. IF ZONE LED OF 24VAC SUPPLY IS GROUND, THEN ZONE LEAD MUST BE CONNECTED TO J6.

6. CONTACTORS ARE 24VAC 12VDC Max. (MERCURY CONTACTORS) 12VDC Max. (MAGNETIC CONTACTORS)

7. OPTIONAL FUSE, DISCONNECT SWITCH & TRANSFORMER LOCATED IN CONTROL BOX FOR COOLING & HEATING UNITS LOCATED IN HEATING ELECTRIC HEAT UNITS. TRANSFORMER WIRE COLORS:
   8. BLEED TERMINAL ADAPTERS REQUIRED FOR BD1. BD1, BD2 INCL.

9. TO USE AUG W/ AIR SENSOR FOR AUTO CHANGEOVER.
   REASSIGNMENT OF AUG TO AUTO WITH ZONE MODIFIED

10. ZONE SENSOR TERMINALS 6 AND 7 REQUIRE SHIELDED TWISTED WIRING FOR OPTIONAL USE OF COMMUNICATIONS JACK.

11. 24VAC REQUIRED FOR TRANE SCR ELECTRIC HEAT MODULE.
## ELECTRICAL / GENERAL DATA

### UNIT
- **Model [Tonnage]**: YCD360 (30.0)
- **Operating voltage range**: 414 - 506
- **Primary voltage**: 460
- **Hertz**: 60
- **Phase**: 3
- **EER / IEEER**: 10.0 EER/13.3 EER

### HEATING - PERFORMANCE
- **Heat**: High Modulating
- **Heating Input (Btu/h)**: 600,000
- **First Stage (Btu/h)**: 70,000
- **Heating Output (Btu/h)**: 480,000
- **First Stage (Btu/h)**: 56,700
- **No. Burners**: 2
- **No. Stages / Turn Down Rate**: 5:1
- **Gas Supply Pressure (in w.c.)**: 2.5/14.0
- **Gas Connection Pipe Size**: 1"

### COMPRESSOR
- **Number**: 1.0
- **Tons**: 6.0/10.0
- **Compressor Rated Load Amps**: 14.5/18.6
- **Locked Rotor Amps**: 58.0/71.0

### ELECTRIC HEATER
- **Electric Heater kW**: N/A
- **Electric Heater Full Load Amps**: N/A

### INDOOR MOTOR SUPPLY FAN
- **Horsepower**: 1.0
- **Motor speed (rpm)**: 1,800
- **Indoor motor full load amps**: 1.0

### OUTDOOR MOTOR
- **Number**: 3
- **Horsepower**: 1.1
- **Phase**: 1
- **Outdoor motor full load amps**: 3.5

### EXHAUST MOTOR
- **Number**: 2
- **Horsepower**: 1.0
- **Phase**: 3
- **Exhaust motor full load amps**: 1.8

### FILTERS (7)
- **Type**: Throwaway
- **Furnished**: Yes
- **Number**: 18
- **Recommended size**: 16"x20"x2"

### REFRIGERANT TYPE
- **Type**: R-410A
- **Factory Charge (Circuit #1)**: 37.8 lb
- **Factory Charge (Circuit #2)**: Not Available

### COOLING MCA
- **MCA = (1.25 x Load 1) + Load 2 + Load 4**

### COOLING MOP
- **MOP = (2.25 x Load 1) + Load 2 + Load 4**

**Notes:**
1. LOAD 1 = Current of the largest motor (Compressor or Fan Motor); LOAD 2 = Sum of the currents of all remaining motors.
2. LOAD 3 = FLA (Full Load Amps) of the electric heater; LOAD 4 = Any other load rated at 1 amp or more.
3. For Electric Heat MCA, MOP, RDE values, calculate for both cooling and heating modes.
4. If selected Max Over Cut is less than the Min Cut Amp, then select the lowest maximum fuse size which is equal to or larger than the Min Cut Amp, provided the selected fuse size does not exceed 800 amps.
5. The use of Liquid Propane (LP) requires unit modification. Contact a Trane salesman for information.
6. Refrigerant charge is an approx. value. For a more precise value, see unit nameplate and service instructions.
7. Filter dimension are actual. Nominal filter size 16"x20"
### ELECTRICAL / GENERAL DATA

<table>
<thead>
<tr>
<th>UNIT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Model (Tonnage)</td>
<td>YCD330 (27.5)</td>
</tr>
<tr>
<td>Operating voltage range</td>
<td>414 - 500</td>
</tr>
<tr>
<td>Primary voltage</td>
<td>480</td>
</tr>
<tr>
<td>Herzt</td>
<td>60</td>
</tr>
<tr>
<td>Phase</td>
<td>3</td>
</tr>
<tr>
<td>EER / IEER</td>
<td>11.0 EER/13.6 EER</td>
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</table>

<table>
<thead>
<tr>
<th>HEATING - PERFORMANCE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat:</td>
<td>High Modulating</td>
</tr>
<tr>
<td>Heating Input (Btu/h)</td>
<td>600,000</td>
</tr>
<tr>
<td>First Stage (Btu/h)</td>
<td>70,000</td>
</tr>
<tr>
<td>Heating Output (Btu/h)</td>
<td>480,000</td>
</tr>
<tr>
<td>First Stage (Btu/h)</td>
<td>58,700</td>
</tr>
<tr>
<td>No Burners</td>
<td>2</td>
</tr>
<tr>
<td>No, Stages / Turn Down Rate</td>
<td>5:1</td>
</tr>
<tr>
<td>Gas Supply Pressure (in w.c.)</td>
<td>25/14.0</td>
</tr>
<tr>
<td>Gas Connection Pipe Size</td>
<td>1&quot;</td>
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<tr>
<th>COMPRESSOR</th>
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<tbody>
<tr>
<td>Number</td>
<td>1/2</td>
</tr>
<tr>
<td>Compressor Rated Load Amps</td>
<td>6.0/8.0</td>
</tr>
<tr>
<td>Locked Rotor Amps</td>
<td>14.7/15.8</td>
</tr>
<tr>
<td>ELECTRIC HEATER</td>
<td></td>
</tr>
<tr>
<td>Electric Heater kw</td>
<td>N/A</td>
</tr>
<tr>
<td>Electric Heater Full Load Amps</td>
<td>N/A</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>INDOOR MOTOR SUPPLY FAN</th>
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</thead>
<tbody>
<tr>
<td>Horsepower</td>
<td>10.0</td>
</tr>
<tr>
<td>Motor speed (rpm)</td>
<td>1,760</td>
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<tr>
<td>Indoor motor full load amps</td>
<td>12.6</td>
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<tr>
<th>OUTDOOR MOTOR</th>
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<tbody>
<tr>
<td>Number</td>
<td>3</td>
</tr>
<tr>
<td>Horsepower</td>
<td>1.1</td>
</tr>
<tr>
<td>Phase</td>
<td>1</td>
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<tr>
<td>Outdoor motor full load amps</td>
<td>3.6</td>
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<table>
<thead>
<tr>
<th>EXHAUST MOTOR</th>
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<tbody>
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<td>Number</td>
<td>2</td>
</tr>
<tr>
<td>Horsepower</td>
<td>1.0</td>
</tr>
<tr>
<td>Phase</td>
<td>3</td>
</tr>
<tr>
<td>Exhaust motor full load amps</td>
<td>1.8</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>FILTERS (7)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Thrownaway</td>
</tr>
<tr>
<td>Furnished</td>
<td>Yes</td>
</tr>
<tr>
<td>Number</td>
<td>16</td>
</tr>
<tr>
<td>Recommended size</td>
<td>16&quot;x20&quot;x2&quot;</td>
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</table>

<table>
<thead>
<tr>
<th>REFRIGERANT TYPE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>R-410A</td>
</tr>
<tr>
<td>Factory Charge (Circuit #1)</td>
<td>37.9 lb</td>
</tr>
<tr>
<td>Factory Charge (Circuit #2)</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

Cooling MCA = (1.25 x Load 1) + Load 2 + Load 4

Notes:
1. LOAD 1= Current of the largest motor (Compressor or Fan Motor); LOAD 2=Sum of the currents of all remaining motors
2. For Electric Heat MCA, MOP, RDE values, calculate for both cooling and heating modes.
3. If selected Max Over Cur is less than the Min Cir Amp, then select the lowest maximum fuse size which is equal to or larger than the Min Cir Amp, provided the selected fuse size does not exceed 800 amps.
4. The use of Liquid Propane (LP) requires unit modification. Contact a Trane salesman for information.
5. Compressor kw at AHRI rating conditions of 80/67 -05
6. Refrigerant charge is an approx. value. For a more precise value, see unit nameplate and service instructions.
7. Filter dimension are actual. Nominal filter size 16"x20"
### ELECTRICAL / GENERAL DATA

#### UNIT
- **Model (Tonnage):** YCD460 (40.0)
- **Operating voltage range:** 414 - 506
- **Primary voltage:** 460
- **Hertz:** 60
- **Phase:** 3
- **EER / IEER:** 11.0 EER/14.7 EER

#### HEATING - PERFORMANCE
- **Heat:** High Modulating
- **Heating Input (Btu/h):** 750,000
- **First Stage (Btu/h):** 70,000
- **Heating Output (Btu/h):** 620,000
- **First Stage (Btu/h):** 58,700
- **No Burners:** 2
- **No. Stages / Turn Down Rate:** 5:1
- **Gas Supply Pressure (in w.c.)**
  - Natural or LP: 2.5/14.0
- **Gas Connection Pipe Size:** 1"

#### COMPRESSOR
- **Number:** 3
- **Tons:** 813/13
- **Compressor Rated Load Amps:** 14,103/923
- **Locked Rotor Amps:** 98/156/158

#### ELECTRIC HEATER
- **Electric Heater kW:** N/A
- **Electric Heater Full Load Amps:** N/A

#### INDOOR MOTOR SUPPLY FAN
- **Horsepower:** 15.0
- **Motor speed (rpm):** 1,760
- **Indoor motor full load amps:** 18.9

#### OUTDOOR MOTOR
- **Number:** 4
- **Horsepower:** 1.1
- **Phase:** 1
- **Outdoor motor full load amps:** 3.5

#### EXHAUST MOTOR
- **Number:** 2
- **Horsepower:** 1.5
- **Phase:** 3
- **Exhaust motor full load amps:** 2.7

#### FILTERS (7)
- **Type:** Throwaway
- **Furnished:** Yes
- **Number:** 17
- **Recommended size:** 16"x20"x2"

#### REFRIGERANT TYPE (6)
- **Type:** R-410A
- **Factory Charge (Circuit #1):** 61.0 lb
- **Factory Charge (Circuit #2):** Not Available

#### Notes:
1. LOAD 1 = Current of the largest motor (Compressor or Fan Motor); LOAD 2= Sum of the currents of all remaining motors; LOAD 3= Full Load Amps of the electric heater; LOAD 4= Any other load rated at 1 amp or more.
2. For Electric Heat MCA, MOP, RDE values, calculate for both cooling and heating modes.
3. If selected Max Over Cur Is less than the Min Cur Amp, then select the lowest minimum fuse size which is equal to or larger than the Min Cur Amp, provided the selected fuse size does not exceed 800 amps.
4. The use of Liquid Propane (LP) requires unit modification. Contact a Trane salesman for information.
5. Compressor KW at AHRI rating conditions of 80/67 -95
6. Refrigerant charge is an approx. value. For a more precise value, see unit nameplate and service instructions.
7. Filter dimension are actual. Nominal filter size 16"x20"
NOTES:
1. SEE ROOF CURB DRAWING FOR DETAILS ON FIELD DUCT FITUP AND CONNECTIONS
2. SEE DETAIL HOOD DRAWING FOR HORIZONTAL/ DOWNSPOUT UNITS FOR ADDITIONAL DIMENSION AND LOCATION.
3. THREAD THE BASE ELECTRICAL IS NOT STANDARD ON ALL UNITS.

PLAN VIEW

DOWNFLOWS SUPPLY AND UPFLOWS RETURN CONFIGURATION
DIMENSIONAL DRAWING
Unit Dimensions - Packaged Rooftop, Cooling / Heating Units

NOTES:
1. THRU-THE-BASE ELECTRICAL IS NOT STANDARD ON ALL UNITS.
2. VERIFY ALL DIMENSIONS WITH INSTALLER DOCUMENTS BEFORE INSTALLATION.

THRU-THE-BASE ELECTRICAL PROVISION

PLAN VIEW
NOTES:
1. SEE ROOF CURB DRAWING FOR DETAILS ON FIELD DUCT FIT UP AND CONNECTIONS
2. SEE DETAIL HOOD DRAWING FOR HORIZONTAL / DOWNFLOW UNITS FOR ADDITIONAL DIMENSION AND LOCATION
3. THRU-THE-BASE ELECTRICAL IS NOT STANDARD ON ALL UNITS.

SEE NOTE 2

1 1/4" FEMALE PVC PIPE

GAS INLET

CUSTOMER CONNECTION POINT

PLAN VIEW

DOWNFLOW SUPPLY AND UPFLOW RETURN CONFIGURATION

DIMENSIONAL DRAWING

60 5/8"
232 3/4"
3 1/4"
7 1/8"
7 1/8"
31 1/8"
53 9/16"
64 1/8"
7 9/16"
5 5/16"
93 3/8"
49 9/16"
49 15/16"
4 3/4"
60 1/16"
NOTES:
1. THRU-THE-BASE ELECTRICAL IS NOT STANDARD ON ALL UNITS.
2. VERIFY ALL DIMENSIONS WITH INSTALLER DOCUMENTS BEFORE INSTALLATION.

THRU-THE-BASE ELECTRICAL PROVISION

PLAN VIEW
Clearence Notes:
1. Horizontal and downflow units, all sizes.
2. Condenser coil is located at the end and side of the unit.
3. Clearances on multiple unit installations are distances between units.
4. Econo / exhaust end multiple units 144°.
5. Condenser coil ends side 192° to 90°.
6. Service side access 90°.

Estimated Operating Weight

<table>
<thead>
<tr>
<th>Operation Weight: 5578.0 lb</th>
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</table>

Center of Gravity

<table>
<thead>
<tr>
<th>Corner Loading Percentages</th>
<th>X</th>
<th>Y</th>
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<tbody>
<tr>
<td>A</td>
<td>40%</td>
<td>16%</td>
</tr>
<tr>
<td>B</td>
<td>16%</td>
<td>16%</td>
</tr>
<tr>
<td>C</td>
<td>17%</td>
<td>14%</td>
</tr>
<tr>
<td>D</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>E</td>
<td>14%</td>
<td>14%</td>
</tr>
<tr>
<td>F</td>
<td>13%</td>
<td>13%</td>
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Optional Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Exhaust</td>
<td>165.0 lb</td>
</tr>
<tr>
<td>Baro. Relief</td>
<td>N/A</td>
</tr>
<tr>
<td>Thru-Base Electrical</td>
<td>0.0 lb</td>
</tr>
<tr>
<td>Disc. Switch</td>
<td>N/A</td>
</tr>
<tr>
<td>Manual Dampers</td>
<td>N/A</td>
</tr>
<tr>
<td>GFI with Discon. Switch</td>
<td>95.0 lb</td>
</tr>
<tr>
<td>VFD</td>
<td>95.0 lb</td>
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<tr>
<td>Ultra Low Leak Exh.</td>
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</tr>
<tr>
<td>Ultra Low Leak Econ</td>
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<tr>
<td>Coil Hail Guard</td>
<td>105.0 lb</td>
</tr>
<tr>
<td>Mod. Hot Gas Reheat</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Weight Notes:
1. The weight shown represents the typical unit operating weight for the configuration selected. Estimated at +/- 10% of the nameplate weight.
2. The actual weight is stamped on the unit nameplate.
CLEARANCE NOTES:
1. HORIZONTAL AND DOWFLOW UNITS, ALL SIZES.
2. CONDENSER COIL IS LOCATED AT THE END AND SIDES OF THE UNIT.
3. CLEARANCES ON MULTIPLE UNIT INSTALLATIONS ARE DISTANCES BETWEEN UNITS.
4. ECONO / EXHAUST END MULTIPLE UNITS 114".
5. CONDENSER COIL END SIDE 192" TO 96".
6. SERVICE SIDE ACCESS 96".

<table>
<thead>
<tr>
<th>CENTER OF GRAVITY</th>
<th>OPTIONAL COMPONENTS</th>
</tr>
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<tbody>
<tr>
<td>POWER EXHAUST</td>
<td>105.0 lb</td>
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<tr>
<td>ECONOMIZER</td>
<td>200.0 lb</td>
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<tr>
<td>BARO. RELIEF</td>
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<tr>
<td>THRU-BASE ELECTRICAL</td>
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<tr>
<td>DISC. SWITCH</td>
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<tr>
<td>MANUAL DAMPERS</td>
<td>N/A</td>
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<tr>
<td>GFI WITH DISCON. SWITCH</td>
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<tr>
<td>VFD</td>
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<td>ULTRA LOW LEAK EXH</td>
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<tr>
<td>ULTRA LOW LEAK ECON</td>
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<tr>
<td>COIL HAIL GUARD</td>
<td>105.0 lb</td>
</tr>
<tr>
<td>MOD. HOT GAS REHEAT</td>
<td>N/A</td>
</tr>
</tbody>
</table>

WEIGHT NOTES:
1. THE WEIGHT SHOWN REPRESENTS THE TYPICAL UNIT OPERATING WEIGHT FOR THE CONFIGURATION SELECTED. ESTIMATED AT 4%-10% OF THE NAMEPLATE WEIGHT.
2. THE ACTUAL WEIGHT IS STAMPED ON THE UNIT NAMEPLATE.
**CLEARANCE NOTES:**
1. HORIZONTAL AND DOWNFLOW UNITS, ALL SIZES.
2. CONDENSER COIL IS LOCATED AT THE END AND SIDE OF THE UNIT.
3. CLEARANCES ON MULTIPLE UNIT INSTALLATIONS ARE DISTANCES BETWEEN UNITS.
4. ECONO / EXHAUST END MULTIPLE UNITS 144".
5. CONDENSER COIL ENDSIDE 122" TO 96".
6. SERVICE SIDE ACCESS 96".

---

**ESTIMATED OPERATING WEIGHT**

<table>
<thead>
<tr>
<th>CENTER OF GRAVITY</th>
<th>POWER EXHAUST</th>
<th>BARO. RELIEF</th>
<th>ECONOMIZER</th>
<th>THRU-BASE ELECTRICAL</th>
<th>MANUAL DAMPERS</th>
<th>O/F WITH DISCON. SWITCH</th>
<th>ULTRA LOW LEAK EXH</th>
<th>ULTRA LOW LEAK ECON</th>
<th>COIL HAIL GUARD</th>
<th>MOD. HOT GAS REHEAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>X 42&quot; Y 111&quot;</td>
<td>165.0 lb</td>
<td>N/A</td>
<td>200.0 lb</td>
<td>8.0 lb</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>130.0 lb</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**WEIGHT NOTES:**
1. THE WEIGHT SHOWN REPRESENTS THE TYPICAL UNIT OPERATING WEIGHT FOR THE CONFIGURATION SELECTED. ESTIMATED AT 4% 10% OF THE NAMEPLATE WEIGHT.
2. THE ACTUAL WEIGHT IS STAMPED ON THE UNIT NAMEPLATE.
Accessory - Packaged Rooftop, Cooling / Heating Units

FRESH AIR HOOD

POWER EXHAUST HOOD

FRESH AIR AND POWER EXHAUST HOODS FOR DOWNFLOW RETURN
UNIT DETAIL
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units

- Item: A1, A2, A44, A45
- Qty: 4
- Tag(s): FVAV-01A, FVAV-01B, FVAV-47, FVAV-48

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>VSEF120X60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size &amp; Depth</td>
<td>12&quot; Dia x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>0650 Fm</td>
</tr>
<tr>
<td>Filter Size</td>
<td>20&quot; x 20&quot; x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

Low Voltage Control Box

Airflow

Attenuator Field Installed

Top View

Terminal Box

Electric Heater

Airflow Discharge Outlet

Discharge View

NOTES:
1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
2. Filter is secured in filter frame and located on attenuator Airflow Plenum Inlet.
3. Attenuator is factory assembled, field installed.
4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
5. See Installation Documents for exact hanger bracket location.
6. Air valve centered between top & bottom panel.
7. Heating Coil un-insulated. External insulation may be field supplied and installed as required.
8. All high & low voltage controls have semi-side NEC jumpback clearance.
9. Allow 48" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.
10. Terminal box access door is side hinged. Allow for clearance.
11. A 4 wire power supply required for 480V & 575V single point connection units.

Approximate Dry Weight: 190.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units


<table>
<thead>
<tr>
<th>Unit Size</th>
<th>VSEF0303SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size &amp; Depth</td>
<td>8&quot; Dia. x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>03SQ Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>16&quot; x 20&quot; x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

TOP VIEW

LOW VOLTAGE CONTROL BOX

16 1/2"

18 1/2"

12"

9 3/4"

AIRFLOW

AIRFLOW PLENUM INLET

FILTER

REMOVE PANEL FOR MOTOR ACCESS

TERMINAL BOX

ELECTRIC HEATER

AIRFLOW DISCHARGE OUTLET

NOTES:

1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
2. Filter is secured in filter frame and located on attenuator Airflow Plenum Inlet.
3. Attenuator is factory assembled, field installed.
4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
5. See Installation Documents for exact hanger bracket location.
6. Air valve centered between top & bottom panel.
7. Heating coil un-insulated. External insulation may be field supplied and installed as required.
8. All high & low voltage controls have same-side NEC jumpback clearance.
9. Allow 48" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.
10. Terminal box access door is side hinged. Allow for clearance.
11. A 4 wire power supply required for 4503 & 5753 single point connection units.

DISCHARGE VIEW

154.0 lb

Approximate Dry Weight

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units

<table>
<thead>
<tr>
<th>Item</th>
<th>Tag(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A6, A8 - A13, A17, A20, A34, A36, A37</td>
<td>FVAV-05, FVAV-07, FVAV-08, FVAV-09, FVAV-10, FVAV-11, FVAV-13, FVAV-17, FVAV-20, FVAV-35, FVAV-38, FVAV-39</td>
</tr>
</tbody>
</table>

### Unit Size

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size &amp; Depth</td>
<td>6&quot; Dia. x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>03SQ Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>18&quot; x 20&quot; x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

#### TOP VIEW

NOTES:

1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
2. Filter is secured in filter frame and located on attenuator Airflow Plenum Inlet.
3. Attenuator is factory assembled, field installed.
4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
5. See Installation Documents for exact hanger bracket location.
6. Air valve centered between top & bottom panel.
7. Heating coil un-insulated. External insulation may be field supplied and installed as required.
8. All high & low voltage controls have same-side NEC jumpback clearance.
9. Allow 48" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.
10. Terminal box access door is side hinged. Allow for clearance.
11. A 4 wire power supply required for 4803 & 5703 single point connection units.

#### DISCHARGE VIEW

Approximate Dry Weight: 153.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units
Item: A21, A23  Qty: 2  Tag(s): FVAV-21, FVAV-23

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>VSEF1004SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size &amp; Depth</td>
<td>10&quot; Dia. x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>04SQ Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>50&quot; x 20&quot; x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

**TOP VIEW**

- Notes:
  1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
  2. Filter is secured in filter frame and located on attenuator Airflow Plenum inlet.
  3. Attenuator is factory assembled, field installed.
  4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
  5. See Installation Documents for exact hanger bracket location.
  6. Air valve centered between top & bottom panel.
  7. Heating coil un-insulated. External insulation may be field supplied and installed as required.
  8. All high & low voltage controls have same-side NEC jumpback clearance.
  9. Allow 48" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.
  10. Terminal box access door is side hinged. Allow for clearance.
  11. A 4 wire power supply required for 4643 & 6753 single point connection units.

**DISCHARGE VIEW**

Approximate Dry Weight 120.0 lb
Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units
Item: A22, A24, A39, A41  Qty: 4  Tag(s): FVAV-22, FVAV-24, FVAV-41, FVAV-43

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>VSEF100SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size &amp; Depth</td>
<td>10&quot; Dia x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>0SQ Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>16&quot; x 20&quot; x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

**TOP VIEW**

**DISCHARGE VIEW**

**NOTES:**

1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
2. Filter is secured in filter frame and located on attenuator Airflow Plenum inlet.
3. Attenuator is factory assembled, field installed.
4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
5. See Installation Documents for exact hanger bracket location.
6. Air valve centered between top & bottom panel.
7. Heating coil un-insulated. External insulation may be field supplied and installed as required.
8. All high & low voltage controls have same side NEC jumpback clearance.
9. Allow 48" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.
10. Terminal box access door is side hinged. Allow for clearance.
11. A 4 wire power supply required for 4603 & 5703 single point connection units.

**Approximate Dry Weight:** 157.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units
Item: A28  Qty: 1  Tag(s): FVAV-28

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>VSEF140XSG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size &amp; Depth</td>
<td>1-1/2&quot; Dia x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>06SQ Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>20' x 20' x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

**Notes:**
1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
2. Filter is secured in filter frame and located on attenuator airflow plenum inlet.
3. Attenuator is factory assembled, field installed.
4. For motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
5. See Installation Documents for exact hanger bracket location.
6. Air valve centered between top & bottom panel.
7. Heating coil un-insulated. External insulation may be field supplied and installed as required.
8. All high & low voltage controls have same-side NEC jumpback clearance.
9. Allow 60" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.
10. Terminal box access door is side hinged. Allow for clearance.
11. A 4-wire power supply required for 480A & 208V single point connection units.

**Approximate Dry Weight:** 191.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units

Item: A29  Qty: 1  Tag(s): FVAV-30

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>VSEF1407SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size &amp; Depth</td>
<td>14&quot; Dia x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>07SQ Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>20&quot; x 20&quot; x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

**NOTES:**

1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
2. Filter is secured in filter frame and located on attenuator Airflow Plenum inlet.
3. Attenuator is factory assembled, field installed.
4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
5. See Installation Documents for exact hanger bracket location.
6. Air valve centered between top & bottom panel.
7. Heating coil un-insulated. External insulation may be field supplied and installed as required.
8. All high & low voltage controls have same-side NEC jumpback clearance.
9. Allow 48" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.
10. Terminal box access door is side hinged. Allow for clearance.
11. A-4 wire power supply required for 4803 & 5763 single point connection units.

**Approximate Dry Weight**: 204.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>V8EF120SSQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size</td>
<td>12&quot; Dia. x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>0SSQ Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>16&quot; x 20&quot; x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

**NOTES:**

1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.

2. Filter is secured in filter frame and located on attenuator Airflow Plenum Inlet.

3. Attenuator is factory assembled, field installed.

4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.

5. See Installation Documents for exact hanger bracket location.

6. Air valve centered between top & bottom panel.

7. Heating coil uninsulated. External insulation may be field supplied and installed as required.

8. All high & low voltage controls have same-side NEC jumpback clearance.

9. Allow 48" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.

10. Terminal box access door is side hinged. Allow for clearance.

11. 4 wire power supply required for 4803 & 5793 single point connection units.

**Approximate Dry Weight:** 171.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Accessory - Variable Air Volume Fan Powered Terminal Units

Item: A1 - A45  Qty: 45  Tag(s): FVAV-01A, FVAV-01B, FVAV-02, FVAV-03, FVAV-04, FVAV-05, FVAV-06, FVAV-07, FVAV-08, FVAV-09, FVAV-10, FVAV-11, FVAV-13, FVAV-14, FVAV-15, FVAV-16, FVAV-17, FVAV-18, FVAV-19, FVAV-20, FVAV-21, FVAV-22, FVAV-23, FVAV-24, FVAV-25, FVAV-26, FVAV-27, FVAV-28, FVAV-30, FVAV-31, FVAV-32, FVAV-33, FVAV-34, FVAV-35, FVAV-37, FVAV-38, FVAV-39, ...

Air-Fi™ WIRELESS COMMUNICATIONS INTERFACE (Air-Fi™ WCI)
(INSTALLED, WIRED & TESTED ON UNIT)

Wireless specifications
AirFi™ WCI works with other Air-Fi™ WCI's for wireless communications and optionally with wireless communications sensor.
(Does not work with non-Air-Fi™ Wireless Zone Sensors)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>WCI operating temperature</td>
<td>-40 to 158°F (-40 to 70°C)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 to 158°F (-40 to 65°C)</td>
</tr>
<tr>
<td>Storage and operating humidity range</td>
<td>5% to 95% relative humidity (RH), non-condensing</td>
</tr>
<tr>
<td>Resolution</td>
<td>±0.125°F over a range of 50 to 100°F (15.6°C to 37.8°C) ±0.25°F when outside this range</td>
</tr>
<tr>
<td>Receiver voltage</td>
<td>24 V nominal ac/dc ±10%</td>
</tr>
<tr>
<td>Receiver power consumption</td>
<td>&lt;2.8W</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Polycarbonate/ABS blend, suitable for plenum mounting, UV protected, UL 94: V-0 flameability rating</td>
</tr>
<tr>
<td>Mounting</td>
<td>Factory mounted on exterior of control box.</td>
</tr>
<tr>
<td>Range[]</td>
<td>Open range - 2,000 ft (610m) w/ worst error rate of 2%</td>
</tr>
<tr>
<td>Output power</td>
<td>100 mW - North America</td>
</tr>
<tr>
<td>Radio frequency</td>
<td>2.4 GHz (IEEE Std 802.15.4-2003 compliant) (2400-2480 MHz, 8 MHz spacing)</td>
</tr>
<tr>
<td>Radio channels</td>
<td>16</td>
</tr>
<tr>
<td>Address range</td>
<td>00-99</td>
</tr>
<tr>
<td>RoHS compliance</td>
<td>Yes</td>
</tr>
<tr>
<td>Agency Listing</td>
<td>UL Listed: UL94, S1A flameability rating and UL916.</td>
</tr>
<tr>
<td>CBA - 22.2 No. 200-M-1903 Signal Equipment</td>
<td></td>
</tr>
</tbody>
</table>

(1) Range values are estimated unobstructed distances for satisfactory operation of the 100 mW version. Estimated transmission distance for the 10 mW version will be less. Adjust distance is job specific and must be determined during site evaluation.

Placement of the receiver and the sensor is critical to proper system operation. In most general office space installations, distance is the limiting factor for proper radio signal quality. It is more greatly affected by walls, barriers, and general obstructions. In general, sheetrock walls and barriers offer little restriction to the propagation of the radio signal throughout the building as opposed to concrete or metal barriers.
## Accessory - Variable Air Volume Fan Powered Terminal Units

**Item:** A1 - A45  **Qty:** 45  **Tag(s):** FVAV-01A, FVAV-01B, FVAV-02, FVAV-03, FVAV-04, FVAV-05, FVAV-06, FVAV-07, FVAV-08, FVAV-09, FVAV-10, FVAV-11, FVAV-13, FVAV-14, FVAV-15, FVAV-16, FVAV-17, FVAV-18, FVAV-19, FVAV-20, FVAV-21, FVAV-22, FVAV-23, FVAV-24, FVAV-25, FVAV-26, FVAV-27, FVAV-28, FVAV-30, FVAV-31, FVAV-32, FVAV-33, FVAV-34, FVAV-35, FVAV-37, FVAV-38, FVAV-39, ...

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### Air-Fi™ Wireless Communications

**WCS-S CO₂**

Measures temperature, optional humidity (with optional WCS-BH), CO₂ levels in parts per million, and occupancy. All sensing values are displayed in an internal facing LCD display, which prevents public viewing. This sensor is typically used on demand - control ventilation applications. An LED indicates when movement is observed for proper sensor positioning during installation. Sensor works with Air-Fi™ Wireless Communications Interface.

### Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor operating temperature</td>
<td>32 to 122°F (0 to 50°C)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 to 185°F (-40 to 85°C)</td>
</tr>
<tr>
<td>Storage and humidity range</td>
<td>5% to 95%, non-condensing</td>
</tr>
<tr>
<td>Range(s)</td>
<td>Open range - 2,500 ft (gauged error rate ± 2% indoor typical range - 200 ft (61 m)) Actual range is dependent on the environment</td>
</tr>
<tr>
<td>Output power</td>
<td>15W max - North America</td>
</tr>
<tr>
<td>Radio frequency</td>
<td>24 GHz (IEEE 802.16-2003 compliant)</td>
</tr>
<tr>
<td>Radio channels</td>
<td>16</td>
</tr>
<tr>
<td>Mounting</td>
<td>Fix a standard 2&quot; by 4&quot; junction box (vertical mount only). Mounting holes are spaced 3.2&quot; (80mm) apart on vertical center line, includes mounting screws/screw junct box and wall anchors for sheet-rock walls. Overall dimensions: 2.6&quot; (66mm) by 4.7&quot; (118mm)</td>
</tr>
<tr>
<td>Ambient Light Required for Occupancy Detection</td>
<td>From 2.5 to 450 foot candle</td>
</tr>
<tr>
<td>CO₂ range</td>
<td>0 - 10,000 ppm CO₂</td>
</tr>
<tr>
<td>CO₂ Accuracy at 25 °C</td>
<td>40 ppm CO₂ ± 3% of reading (includes repeatability)</td>
</tr>
<tr>
<td>CO₂ Pressure dependence of output</td>
<td>Built-in pressure sensor simulates accuracy due to altitude</td>
</tr>
<tr>
<td>CO₂ Recommended calibration interval</td>
<td>None (auto-calibrated)</td>
</tr>
<tr>
<td>CO₂ Response resolution</td>
<td>60ppm change or 15 minute heartbeat</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Polycarbonate/ABS blend (wall)</td>
</tr>
<tr>
<td>Address range</td>
<td>000-999</td>
</tr>
<tr>
<td>Minimum time between transmissions</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Maximum time between transmissions</td>
<td>15 minutes</td>
</tr>
<tr>
<td>UL® Compliance</td>
<td>Yes</td>
</tr>
<tr>
<td>Agency Listing</td>
<td>UL936 Energy Management Equipment</td>
</tr>
</tbody>
</table>

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(i) Range values are estimated transmission distances for satisfactory operation of the 100 mW version. Estimated transmission distance for the 15 W version will be less. Actual distance is job specific and must be determined during site evaluation.

Placement of the receiver and the sensor is critical to proper system operation. In most general office space installations, distance is the limiting factor for proper radio signal quality. It is more greatly affected by walls, barriers, and general clutter. In general, line of sight installations are best for minimizing the propagation of the radio signal throughout the building as opposed to concrete or metal barriers.
Field Wiring - Variable Air Volume Fan Powered Terminal Units

Item: A1 - A45 Qty: 45 Tag(s): FVAV-01A, FVAV-01B, FVAV-02, FVAV-03, FVAV-04, FVAV-05, FVAV-06, FVAV-07, FVAV-08, FVAV-09, FVAV-10, FVAV-11, FVAV-13, FVAV-14, FVAV-15, FVAV-16, FVAV-17, FVAV-18, FVAV-19, FVAV-20, FVAV-21, FVAV-22, FVAV-23, FVAV-24, FVAV-25, FVAV-26, FVAV-27, FVAV-28, FVAV-30, FVAV-31, FVAV-32, FVAV-33, FVAV-34, FVAV-35, FVAV-37, FVAV-38, FVAV-39, ...

480 Volt, 3 Phase, 4 wire

L1  L2  L3  N

480 Volt, 3 Phase, 4 wire

Heater Control Wiring

⚠️ WARNING
HAZARDOUS VOLTAGE!
DISCONNECT ALL ELECTRIC POWER
INCLUDING REMOTE DISCONNECTS
BEFORE SERVICING.
FAILURE TO DISCONNECT POWER
BEFORE SERVICING CAN CAUSE
SEVERE PERSONAL INJURY OR DEATH

⚠️ CAUTION
USE COPPER CONDUCTORS ONLY!
UNIT TERMINALS ARE NOT DESIGNED
TO ACCEPT OTHER TYPES OF
CONDUCTORS.
FAILURE TO DO SO MAY CAUSE
DAMAGE TO THE EQUIPMENT.

Customer Notes:
1. Factory installed.
2. Optional or installed by others.
Customer Notes

1. Air inlet is centered in unit front panel.
2. Slip & Drive discharge outlet standard.
3. Minimum of 1.5 times duct diameter of straight duct at inlet for proper flow reading.
4. For electric heater access, sides hinged door must have minimum distance per NEC or local code.
5. Allow 48” of straight duct downstream of unit before first runout & inside of the duct should be equal discharge size. (A & B)
6. Left-hand orientation shown. (Facing discharge)
   Unit can be flipped to right-hand orientation.

Approximate Dry Weight

<table>
<thead>
<tr>
<th></th>
<th>60.0 lb</th>
</tr>
</thead>
</table>

Weights reflected may vary ±5.0 lb based upon options selected.
Customer Notes
1. Air inlet is centered in unit front panel.
2. Slip & Drive discharge outlet standard.
3. Minimum of 1.5 times duct diameter of straight duct at inlet for proper airflow reading.
4. For electric heater access, side hinged door must have minimum distance per NEC or local code.
5. Allow 45° of straight duct downstream of unit before first runout & inside of the duct should be equal discharge size. (A & B)
6. Left-hand orientation shown. (Facing discharge) Unit can be flipped to right-hand orientation

Approximate Dry Weight
46.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Single Duct Terminal Units
Item: A3   Qty: 1   Tag(s): VAV-3

Customer Notes
1. Air inlet is centered in unit front panel.
2. Slip & Drive discharge outlet standard.
3. Minimum of 1.5 times duct diameter of straight duct at inlet for proper flow reading.
4. For electric heater access, side hinged door must have minimum distance per NEC or local code.
5. Allow 48" of straight duct downstream of unit before first runout & inside of the duct should be equal discharge size (A & B)
6. Left-hand orientation shown. (Facing discharge)
    Unit can be flipped to right-hand orientation

Approximate Dry Weight
<table>
<thead>
<tr>
<th></th>
<th>38.0 lb</th>
</tr>
</thead>
</table>

Weight reflected may vary
5 lb(2.27kg) based upon options selected.
**Unit Dimensions - Variable Air Volume Single Duct Terminal Units**

**Item:** A4  **Qty:** 1  **Tag(s):** VAV-4

**Customer Notes**

1. Air Inlet is centered in unit front panel.
2. Slip & Drive discharge outlet standard.
3. Minimum of 1.5 times duct diameter of straight duct at inlet for proper flow reading.
4. For electric heater access, side hinged door must have minimum distance per NEC or local codes.
5. Allow 48" of straight duct downstream of unit before first runout & insides of the duct should be equal discharge size (A & B)
6. Left-hand orientation shown. (Facing discharge)
   Unit can be flipped to right-hand orientation

**Approximate Dry Weight**

| Weight | 36.0 lb |

Weight reflected may vary
5 lb (2.27kgs) based upon options selected.
Unit Dimensions - Variable Air Volume Single Duct Terminal Units
Item: A7, A8  Qty: 2  Tag(s): VAV-7, VAV-8

Customer Notes
1. Air Inlet is centered in unit front panel.
2. Slip & Drive discharge outlet standard.
3. Minimum of 1.5 times duct diameter of straight duct at inlet for proper flow reading.
4. For electric heater access, side hinged door must have minimum distance per NEC or local code.
5. Allow 45° of straight duct downstream of unit before first runout & inside of the duct should be equal discharge size (A & B)
6. Left-hand orientation shown. (Facing discharge) Unit can be flipped to right-hand orientation

Approximate Dry Weight 52.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Air-Fi™ WIRELESS COMMUNICATIONS INTERFACE (Air-Fi™ WCI)
(INSTALLED, WIRED & TESTED ON UNIT)

Wireless specifications
Air-Fi™ WCI works with other Air-Fi™ WCI’s for wireless communications and optionally with wireless communications sensor.
(Does not work with non-Air-Fi™ Wireless Zone Sensors)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WCI operating temperature</td>
<td>-40 to 159°F (-40 to 70°C)</td>
</tr>
<tr>
<td>Storage and operating humidity</td>
<td>5% to 95% relative humidity (RH), non-condensing</td>
</tr>
<tr>
<td>Resolution</td>
<td>±0.125F over a range of 60 to 60°F</td>
</tr>
<tr>
<td></td>
<td>(15.66 to 26.67°C) ±0.25°F when outside this range</td>
</tr>
<tr>
<td>Receiver voltage</td>
<td>24 V nominal ac/dc ± 10%</td>
</tr>
<tr>
<td>Receiver power consumption</td>
<td>&lt;0.5W</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Polycarbonate/ABS blend, suitable for plenum mounting, UV protected,</td>
</tr>
<tr>
<td></td>
<td>UL 94: V-0 Flammability rating</td>
</tr>
<tr>
<td>Mounting</td>
<td>Factory mounted external of control box</td>
</tr>
<tr>
<td>Range(s)</td>
<td>Open range - 2,000 ft (610m) with no error rate of 2%</td>
</tr>
<tr>
<td>Indoor: Typical range is 2000 ft (600m)</td>
<td>Actual range is dependent on the environment.</td>
</tr>
<tr>
<td>Output power</td>
<td>100 mW - North America</td>
</tr>
<tr>
<td>Radio frequency</td>
<td>2.4 GHz (IEEE Std 802.15.4-2003 compliant)</td>
</tr>
<tr>
<td></td>
<td>(2405-2480 MHz, 5 MHz spacing)</td>
</tr>
<tr>
<td>Radio channels</td>
<td>16</td>
</tr>
<tr>
<td>Address range</td>
<td>10-99</td>
</tr>
<tr>
<td>RoHS compliance</td>
<td>Yes</td>
</tr>
<tr>
<td>Agency Listing</td>
<td>UL Listed: E1,94, IEC Flammability rating and UL94.</td>
</tr>
<tr>
<td></td>
<td>C6A - C22.2 No, 205-M1983 Signal Equipment</td>
</tr>
</tbody>
</table>

(i) Range values are estimated transmit/receive distances for satisfactory operation of the 100 mW version. Estimated
information distance for the 10 mW version will be less. Actual distance is job specific and must be determined
during site evaluation.

Placement of the receiver and the sensor is critical to proper system operation. In most general office space
installations, distance is not the limiting factor for proper radio signal quality. It is more greatly affected by walls,
toys, and general clutter. In general, sheet rock walls and ceiling tiles offer little restriction to the propagation
of the radio signal throughout the building as opposed to concrete or metal barriers.
Air-Fi™ WIRELESS COMMUNICATIONS CO₂/OCCUPANCY SENSOR (WCS-S CO₂)

Measures temperature, optional humidity (with option WCS-SH), CO₂ levels in parts per million, and occupancy. All sensing values are displayed in an internal LCD display, which prevents public viewing. This sensor is typically used in demand-controlled ventilation applications. An LED indicates when movement is observed for proper sensor positioning during installation. Sensor works with Air-Fi™ Wireless Communications Interface.

Specifications

Sensor operating temperature
32 to 122°F (0 to 50°C)

Storage temperature
-40 to 160°F (-40 to 70°C)

Storage and humidity range
5% to 95%, non-condensing

Range(s)
Open range - 2,500 ft (packet error rate = 2 %) Indoor typical range - 200 ft (61 m)

Actual range is dependent on the environment

Output power
100 mW - North America

Radio frequency
3.4 GHz (IEEE Std 802.15.4-2003 compliant)

(2405-2480 MHz, 6 MHz spacing)

Radio channels
16

Mounting
Horizontal or vertical (surface or flush)

Ambient Light Required for Occupancy Detection
From 2.5 to 450 foot candles

CO₂ range
0 - 10,000 ppm CO₂

CO₂ Accuracy at 25°C
± 40 ppm CO₂ ± 3 % of reading (includes repeatability)

CO₂ Pressure dependence of output
Built-in pressure sensor eliminates inaccuracy due to altitude

CO₂ Recommended calibration interval
None (auto-calibrated)

CO₂ Response resolution
50 ppm change or 15 minute heartbeat

Housing Material
Polycarbonate/ABS blend (well)

Address range
600-999

Minimum time between transmissions
26 seconds

Maximum time between transmissions
15 minutes

RoHS compliance
Yes

Agency Listing
UL 61016 Energy Management Equipment

CSA - C22.2 No. 205-M1993 Signal Equipment

()<sup>(1)</sup> Range values are estimated transmission distances for satisfactory operation of the 100 mW version. Estimated transmission distance for the 10 mW version will be less. Actual distance is job specific and must be determined during site evaluation.

Placement of the receiver and the sensor is critical to proper system operation. In most general office space installations, distance is not the limiting factor for proper radio signal quality. It is more greatly affected by walls, barriers, and general clutter. In general, sheetstock walls and ceiling tiles offer little restriction to the propagation of the radio signal throughout the building as opposed to concrete or metal barriers.
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units

Item: A1, A3, A6, A7, A10, A11, A15, A16  Qty: 8  Tag(s): FVAV 1, FVAV 3, FVAV 6, FVAV 7, FVAV 10, FVAV 11, FVAV 15, FVAV 17

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>V8EF1003SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size</td>
<td>10&quot; Dia. x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>03SQ Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>18&quot; x 20&quot; x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

**TOP VIEW**

**LOW VOLTAGE CONTROL BOX**

**AIRFLOW**

**AIRFLOW PLENUM INLET**

**FILTER**

**REMOVE PANEL FOR MOTOR ACCESS**

**ELECTRIC HEATER**

**AIRFLOW DISCHARGE OUTLET**

**NOTES:**

1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
2. Filter is secured in filter frame and located on attenuator Airflow Plenum Inlet.
3. Attenuator is factory assembled, field installed.
4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
5. See Installation Documents for exact hanger bracket location.
6. Air valve centered between top & bottom panel.
7. Heating coil un-insulated. External insulation may be field supplied and installed as required.
8. All high & low voltage controls have same-side NEC jumpback clearance.
9. Allow 48" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.
10. Terminal box access door is side hinged. Allow for clearance.
11. A 4 wire power supply required for 4803 & 57013 single point connection units.

**DISCHARGE VIEW**

**APPROXIMATE DRY WEIGHT**

157.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units
Item: A2  Qty: 1  Tag(s): FVAV 2

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>VSEF1204SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size &amp; Depth</td>
<td>12&quot; Dia. x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>04SQ Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>50&quot; x 20&quot; x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

**TOP VIEW**

**NOTES:**
1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
2. Filter is secured in filter frame and located on attenuator Airflow Plenum inlet.
3. Attenuator is factory assembled, field installed.
4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
5. See Installation Documents for exact hanger bracket location.
6. Air valve centered between top & bottom panel.
7. Heating coil un-insulated. External insulation may be field supplied and installed as required.
8. All high & low voltage controls have same-side NEC jumpback clearance.
9. Allow 48" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.
10. Terminal box access door is side hinged. Allow for clearance.
11. A 4 wire power supply required for 4803 & 5703 single point connection units.

**DISCHARGE VIEW**

Approximate Dry Weight: 169.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units
Item: A4   Qty: 1   Tag(s): FAV 4

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>VSEF1400S4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size</td>
<td>4&quot; Dia. x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>06S9 Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>30&quot; x 30&quot; x 1&quot; (qty 1)</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
2. Filter is secured in filter frame and located on attenuator Airflow Plenum inlet.
3. Attenuator is factory assembled, field installed.
4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
5. See Installation Documents for exact hanger bracket location.
6. Air valve centered between top & bottom panel.
7. Heating coil un-insulated. External insulation may be field supplied and installed as required.
8. All high & low voltage controls have same-side NEC jumpback clearance.
9. Allow 45" of straight duct downstream of unit before final runout and inside of the duct should be equal discharge size.
10. Terminal box access door is side hinged. Allow for clearance.
11. A 4 wire power supply required for 480V & 575V single point connection units.

Approximate Dry Weight: 191.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units

Item: A5  Qty: 1  Tag(s): FVAV 5

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>VSEF1205SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size</td>
<td>12&quot; Dia. x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>055Q Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>16&quot; x 20&quot; x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

NOTES:
1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
2. Filter is secured in filter frame and located on attenuator Airflow Plenum inlet.
3. Attenuator is factory assembled, field installed.
4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
5. See Installation Documents for exact hanger bracket location.
6. Air valve centered between top & bottom panel.
7. Heating coil un-insulated. External insulation may be field supplied and installed as required.
8. All high & low voltage controls have same-side NEC Jumperback clearance.
9. Allow 48" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.
10. Terminal box access door is side hinged. Allow for clearance.
11. A 4 wire power supply required for 480/3 & 575/3 single point connection units.

Approximate Dry Weight: 171.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
### Unit Dimensions - Variable Air Volume Fan Powered Terminal Units

**Item:** A8  **Qty:** 1  **Tag(s):** FVAV 8

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>VSEF0603SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size &amp; Depth</td>
<td>6&quot; Dia. x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>03SQ Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>16&quot; x 20&quot; x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

---

**NOTES:**

1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
2. Filter is secured in filter frame and located on attenuator Airflow Plenum inlet.
3. Attenuator Airflow Plenum inlet Installed.
4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
5. See Installation Documents for exact hanger bracket location.
6. Air valve centered between top & bottom panel.
7. Heating coil un-insulated. External insulation may be field supplied and installed as required.
8. All high & low voltage controls have same-side NEC jumpback clearance.
9. Allow 48" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.
10. Terminal box access door is side hinged, allow for clearance.
11. A 4 wire power supply required for 48003 & 57003 single point connection units.

**Approximate Dry Weight:** 150.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units
Item: A9, A12, A14  Qty: 3  Tag(s): FVAV 9, FVAV 12, FVAV 14

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>V8EF080GSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size &amp; Depth</td>
<td>8&quot; Dia. x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>G3SQ Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>15&quot; x 20&quot; x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
2. Filter is secured in filter frame and located on attenuator Airflow Plenum Inlet.
3. Attenuator is factory assembled, field installed.
4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
5. See Installation Documents for exact hanger bracket location.
6. Air valve centered between top & bottom panel.
7. Heating coil un-insulated. External insulation may be field supplied and installed as required.
8. All high & low voltage controls have same-side NEC jumpback clearance.
9. Allow 48" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.
10. Terminal box access door is side hinged. Allow for clearance.
11. A 4 wire power supply required for 480/3 & 575/3 single point connection units.

**DISCHARGE VIEW**

Approximate Dry Weight: 154.0 lb

Weights reflected may vary ±5.0 lb based upon options selected.
Unit Dimensions - Variable Air Volume Fan Powered Terminal Units

Item: A13  Qty: 1  Tag(s): FVAV 13

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>VSEF1203SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Valve Size &amp; Depth</td>
<td>12&quot; Dia. x 4&quot; Depth</td>
</tr>
<tr>
<td>Nominal Fan Size</td>
<td>03SQ Fan</td>
</tr>
<tr>
<td>Filter Size</td>
<td>16&quot; x 20&quot; x 1&quot; (QTY 1)</td>
</tr>
</tbody>
</table>

**TOP VIEW**

- LOW VOLTAGE CONTROL BOX
- AIRFLOW
- AIRFLOW PLENUM INLET
- FILTER
- ELECTRIC HEATER
- TERMINAL BOX
- AIRFLOW DISCHARGE OUTLET
- REMOVE PANEL FOR MOTOR ACCESS

**NOTES:**
1. Allow a minimum 6" plenum inlet clearance for un-ducted installations.
2. Filter is secured in filter frame and located on attenuator Airflow Plenum inlet.
3. Attenuator is factory assembled, field installed.
4. For Motor access, remove bottom screws on hanger brackets to slide panel as shown in drawing.
5. See Installation Documents for exact hanger bracket location.
6. Air valve centered between top & bottom panel.
7. Heating coil un-insulated. External insulation may be field supplied and installed as required.
8. All high & low voltage controls have same-side NEC jumpback clearance.
9. Allow 48" of straight duct downstream of unit before first runout and inside of the duct should be equal discharge size.
10. Terminal box access door is side hinged. Allow for clearance.
11. A 4 wire power supply required for 4603 & 5753 single point connection units.

**DISCHARGE VIEW**

**Approximate Dry Weight**

<table>
<thead>
<tr>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>169.0 lb</td>
</tr>
</tbody>
</table>

Weights reflected may vary ±5.0 lb based upon options selected.
Air-Fi™ WIRELESS COMMUNICATIONS INTERFACE (Air-Fi™ WCI)
(INSTALLED, WIRED & TESTED ON UNIT)

Wireless specifications

Air-Fi™ WCI works with other Air-Fi™ WCI's for wireless communications and optionally with wireless communications sensor.
(Does not work with non-Air-Fi™ Wireless Zone Sensors)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>WCI operating temperature</td>
<td>-40 to 158°F (-40 to 70°C)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 to 185°F (-40 to 85°C)</td>
</tr>
<tr>
<td>Storage and operating humidity range</td>
<td>5% to 95% relative humidity (99%), non-condensing</td>
</tr>
<tr>
<td>Resolution</td>
<td>±0.12°F over a range of 60 to 90°F (15.6°C to 32.2°C) ±0.25°F when outside this range</td>
</tr>
<tr>
<td>Receiver voltage</td>
<td>24 V nominal ac/dc ±10%</td>
</tr>
<tr>
<td>Receiver power consumption</td>
<td>&lt;2.5W</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Polycarbonate/ABS blend, suitable for plenum mounting, UV protected; UL, 94: V-0 Flammability rating</td>
</tr>
<tr>
<td>Mounting</td>
<td>Factory mounted on exterior of control box.</td>
</tr>
<tr>
<td>Range(s)</td>
<td>Open range - 2,500 ft (762m) or packet error rate of 2% Indoor: Typical range is 200 ft (61m); actual range is dependent on the environment</td>
</tr>
<tr>
<td>Output power</td>
<td>100 mW - North America</td>
</tr>
<tr>
<td>Radio frequency</td>
<td>2.4 GHz (IEEE Std 802.15.4-2003 compliant) (2400-2480 MHz, 5 MHz spacing)</td>
</tr>
<tr>
<td>Radio channels</td>
<td>16</td>
</tr>
<tr>
<td>Address range</td>
<td>60-99</td>
</tr>
<tr>
<td>RoHS compliance</td>
<td>Yes</td>
</tr>
<tr>
<td>Agency Listing</td>
<td>UL Listed: UL94, 6V flat flammability rating and UL916. C0A - C02.2 No. 206-M1993 Signal Equipment</td>
</tr>
</tbody>
</table>

(i) Range values are estimated transmission distances for satisfactory operation of the 100 mW version. Estimated transmission distance for the 10 mW version will be less. Actual distance is job specific and must be determined during site evaluation.

Placement of the receiver and the sensor is critical to proper system operation. In most-panel office space installations, distance is not the limiting factor for proper radio signal quality. It is more greatly affected by walls, barriers, and general clutter. In general, sheetrock walls and ceiling tiles offer little resistance to the propagation of the radio signal throughout the building as opposed to concrete or metal barriers.
Air-Fi™ WIRELESS COMMUNICATIONS CO₂/OCCUPANCY SENSOR (WCS-S C0₂)

Measures temperature, optional humidity (with optional WCS-SH), CO₂ levels in parts per million, and occupancy. All sensing values are displayed in an internal facing LCD display, which prevents public viewing. This sensor is typically used on demand - control ventilation applications. An LED indicates when movement is observed for proper sensor positioning during installation. Sensor works with Air-Fi™ Wireless Communications Interface.

**Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor operating temperature</td>
<td>32 to 122°F (0 to 50°C)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 to 185°F (-40 to 85°C)</td>
</tr>
<tr>
<td>Storage and humidity range</td>
<td>5% to 95%, non-condensing</td>
</tr>
<tr>
<td>Range(1)</td>
<td>Open range - 2,500 ft (painted or metal + 2 % indoor typical range - 200 ft (61 m) Actual range is dependent on the environment</td>
</tr>
<tr>
<td>Output power</td>
<td>150 mW - miliWatts</td>
</tr>
<tr>
<td>Radio frequency</td>
<td>2.4 GHz (IEEE Std 802.15.4-2003 compliant)</td>
</tr>
<tr>
<td></td>
<td>(2402-2480 MHz, 5 MHz spacing)</td>
</tr>
<tr>
<td>Radio channels</td>
<td>26</td>
</tr>
<tr>
<td>Mounting</td>
<td>Plastered 2&quot; by 4&quot; junction box (vertical mount only). Mounting holes are spaced 2.2&quot; (85mm) apart on vertical center line. Includes a mounting screw, a junction box and wall anchors for sheet steels. Overall dimensions: 2.5&quot; (74mm) by 4.7&quot; (119mm)</td>
</tr>
<tr>
<td>Ambient Light</td>
<td>Required for Occupancy Detection</td>
</tr>
<tr>
<td>CO₂ range</td>
<td>0 - 10,000 ppm CO₂</td>
</tr>
<tr>
<td>CO₂ Accuracy at 25 °C</td>
<td>40 ppm CO₂ ± 3 % of reading (includes repeatability)</td>
</tr>
<tr>
<td>CO₂ Pressure dependence of output</td>
<td>Built-in pressure sensor eliminates inaccuracy due to altitude</td>
</tr>
<tr>
<td>CO₂ Recommended calibration interval</td>
<td>None (auto-calibrated)</td>
</tr>
<tr>
<td>CO₂ Response resolution</td>
<td>50ppm change or 10 minute haestest</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Polycarbonate/ABS blend (exterior)</td>
</tr>
<tr>
<td>Address range</td>
<td>000-999</td>
</tr>
<tr>
<td>Minimum time between transmissions</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Maximum time between transmittions</td>
<td>15 minutes</td>
</tr>
<tr>
<td>RoHS compliance</td>
<td>Yes</td>
</tr>
<tr>
<td>Agency Listing</td>
<td>UL315 Energy Management Equipment</td>
</tr>
<tr>
<td></td>
<td>CSA - C22.2 No. 205-M1993 Signal Equipment</td>
</tr>
</tbody>
</table>

(1) Range values are estimated transmission distances for satisfactory operation of the 100 mV version. Estimated transmission distance for the 10 mV version will be lower. Actual distance is dependent on specific building and must be determined during site evaluation.

Placement of the sensor and the sensor's interference to proper system operation. In most general office space installations, distance is not the limiting factor for proper radio signal quality, but more generally affected by walls, barriers, and general clutter. In general, skylights walls and ceiling tiles offer little restriction to the propagation of the radio signal through the building as exposed to concrete or metal barriers.
**UNIT**
- Model (Tonnage): YCD360 (30.0)
- Operating Voltage Range: 187 - 229
- Primary Voltage: 208
- Hertz: 60
- Phase: 3
- EER / IEER: 10.6 EER/13.3 EER

**HEATING - PERFORMANCE**
- Heat: Low Modulating
- Heating Input (Btu/h): 350,000
- First Stage Heating (Btu/h): 70,000
- Heating Output (Btu/h): 260,000
- First Stage Heating (Btu/h): 62,000
- No Burners: 1
- No. Stages / Turn Down Rate: 2.5:1
- Gas Supply Pressure (in w.c.): 2.514.0
- Gas Connection Pipe Size: 3/4" in

**COMPRESSOR**
- Number: 1/2
- Tons: 6.0/10.0
- Compressor Rated Load Amps: 203,067.0
- Locked Rotor Amps: 203,067.0

**ELECTRIC HEATER**
- Electric Heater kw: N/A
- Electric Heater Full Load Amps: N/A

**INDOOR MOTOR SUPPLY FAN**
- Horsepower: 7.5
- Motor speed (rpm): 1,760
- Indoor motor full load amps: 21.5

**OUTDOOR MOTOR**
- Number: 3
- Horsepower: 1.0
- Phase: 1
- Outdoor motor full load amps: 7.0

**EXHAUST MOTOR**
- Number: 2
- Horsepower: 1.0
- Phase: 3
- Exhaust motor full load amps: 4.1

**FILTERS**
- Type: Throwaway
- Furnished: Yes
- Number: 16
- Recommended size: 16"x20"x2"

**REFRIGERANT TYPE**
- Type: R-410A
- Factory Charge (Circuit #1): 3.8 lb
- Factory Charge (Circuit #2): Not Available

Cooling MCA = (1.25 x Load 1) + Load 2 + Load 4

Cooling MOP = (2.25 x Load 1) + Load 2 + Load 4

Notes:
1. LOAD 1= Current of the largest motor (Compressor or Fan Motor); LOAD 2=Sum of the currents of all remaining motors
   LOAD 3= FLA(Full Load Amps) of the electric heater; LOAD 4= Any other load rated at 1 amp or more.
2. For Electric Heat MCA, MOP, RDE values, calculate for both cooling and heating modes.
3. If selected Max Over Cur is less than the Min Cir Amp, then select the lowest maximum fuse size which is equal to or larger
   than the Min Cir Amp, provided the selected fuse size does not exceed 800 amps.
4. The use of Liquid Propane (LP) requires unit modification. Contact a Trane salesman for information.
5. Compressor KW at AHRI rating conditions of 80/67.65
6. Refrigerant charge is an approx. value. For a more precise value, see unit nameplate and service instructions.
7. Filter dimension are actual. Nominal filter size: 16"x20"

FLD = Furnished by Trane U.S. Inc / Installed by Others
Equipment Submittal
Unit Dimensions - Packaged Rooftop, Cooling / Heating Units
Item: A1, A2  Qty: 2  Tag(s): WD-AC-1, WD-AC-2

NOTES:
1. SEE ROOF CURB DRAWING FOR DETAILS ON FIELD DUCT FITUP AND CONNECTIONS
2. SEE DETAIL HOOD DRAWING FOR HORIZONTAL / DOWNFLOW UNITS FOR ADDITIONAL DIMENSION AND LOCATION
3. THRU-THE-BASE ELECTRICAL IS NOT STANDARD ON ALL UNITS.

SEE NOTE 2

1 1/4" FEMALE
PVC PIPE

GAS INLET

CUSTOMER CONNECTION POINT

PLAN VIEW

DOWNFLOW SUPPLY AND UPFLOW CONFIGURATION

DIMENSIONAL DRAWING
NOTES:
1. THRU-THE-BASE ELECTRICAL IS NOT STANDARD ON ALL UNITS.
2. VERIFY ALL DIMENSIONS WITH INSTALLER DOCUMENTS BEFORE INSTALLATION.
CLEARED NOTES:
1. HORIZONTAL AND DOWFLOW UNITS, ALL SIZES.
2. CONDENSER COIL IS LOCATED AT THE END AND SIDE OF THE UNIT.
3. CLEARANCES ON MULTIPLE UNIT INSTALLATIONS ARE DISTANCES BETWEEN UNITS.
4. ECONO / EXHAD END MULTIPLE UNITS 144°.
5. CONDENSER COIL END / SIDE 192° TO 90°.
6. SERVICE SIDE ACCESS 90°.

ESTIMATED OPERATING WEIGHT

<table>
<thead>
<tr>
<th>CENTER OF GRAVITY</th>
<th>OPTIONAL COMPONENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>X 43° Y 77°</td>
<td>POWER EXHAUST 165.0 lb</td>
</tr>
<tr>
<td>CORNER LOADING PERCENTS</td>
<td>ECONOMIZER 290.0 lb</td>
</tr>
<tr>
<td>A 16% B 16% C 17% D 14% E 15%</td>
<td>MANUAL DAMPERS N/A</td>
</tr>
<tr>
<td>21%</td>
<td>ULTRA LOW LEAK EXH N/A</td>
</tr>
<tr>
<td></td>
<td>COIL HAIL GUARD 105.0 lb</td>
</tr>
</tbody>
</table>

WEIGHT NOTES:
1. THE WEIGHT SHOWN REPRESENTS THE TYPICAL UNIT OPERATING WEIGHT FOR THE CONFIGURATION SELECTED. ESTIMATED AT +10% OF THE NAMEPLATE WEIGHT.
2. THE ACTUAL WEIGHT IS STAMPED ON THE UNIT NAMEPLATE.
Accessory - Packaged Rooftop, Cooling / Heating Units
Item: A1, A2  Qty: 2  Tag(s): WD-AC-1, WD-AC-2

END OF UNIT

FRESH AIR HOOD

POWER EXHAUST HOOD

2 13/16'
32 1/8'
37 3/4'

FRESH AIR AND POWER EXHAUST HOODS FOR DOWNFLOW RETURN
UNIT DETAIL
Accessory - Packaged Rooftop, Cooling / Heating Units
Item: A1, A2  Qty: 2  Tag(s): WD-AC-1, WD-AC-2
INDOOR UNIT FEATURES
- Sleek, compact design
- Simple installation
- Vane setting for air flow direction control
- Auto fan speed mode
- Ideal for spaces such as server rooms, daycare centers, classrooms, churches, small offices, and more

OUTDOOR UNIT FEATURES
- Variable speed INVERTER-driven compressor
- Suction accumulator pre-charged with refrigerant volume for piping length up to 100 ft (70 ft. for A12/18/24/30)
- Low ambient cooling down to -20°F providing 100% capacity (only for PUY models with wind baffles installed)
- 24-hour continuous operation (cooling mode)
- High pressure protection
- Fast restart due to bypass valve make it ideal for equipment cooling applications, such as data centers
- Superior energy and operational efficiency
# SPECIFICATIONS: PKA-A24KA7 & PUY-A24NHA7(-BS)

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Indoor Unit</th>
<th>PKA-A24KA7</th>
<th>PUY-A24NHA7</th>
<th>PUY-A24NHA7-BS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Cooling

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Maximum Capacity</td>
<td>Btu/h</td>
<td>24,000</td>
<td></td>
</tr>
<tr>
<td>Rated Capacity</td>
<td>Btu/h</td>
<td>24,000</td>
<td></td>
</tr>
<tr>
<td>Minimum Capacity</td>
<td>Btu/h</td>
<td>10,000</td>
<td></td>
</tr>
<tr>
<td>Maximum Power Input</td>
<td>W</td>
<td>1,960</td>
<td></td>
</tr>
<tr>
<td>Rated Power Input</td>
<td>W</td>
<td>1,960</td>
<td></td>
</tr>
<tr>
<td>Moisture Removal</td>
<td>Pints/h</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>Sensible Heat Factor</td>
<td></td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td>Power Factor</td>
<td>%</td>
<td>95.7</td>
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## Efficiency

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<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>SEER</td>
<td></td>
<td>21.4</td>
<td></td>
</tr>
<tr>
<td>EER (^1)</td>
<td></td>
<td>12.2</td>
<td></td>
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</table>

## Electrical

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Voltage, Phase, Frequency</td>
<td>208 / 230V, 1-phase, 60 Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guaranteed Voltage Range</td>
<td>V AC</td>
<td>198 – 253</td>
<td></td>
</tr>
<tr>
<td>Voltage: Indoor - Outdoor, S1-S2</td>
<td>V AC</td>
<td>208 / 230</td>
<td></td>
</tr>
<tr>
<td>Voltage: Indoor - Outdoor, S2-S3</td>
<td>V DC</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Voltage: Indoor - Remote controller</td>
<td>V DC</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Recommended Fuse/Breaker Size</td>
<td>A</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Recommended Wire Size (Indoor - Outdoor)</td>
<td>AWG</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>MCA</td>
<td>A</td>
<td>0.36</td>
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</tr>
<tr>
<td>Fan Motor Full Load Amperage</td>
<td>A</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>Fan Motor Output</td>
<td>W</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>Airflow Rate, Dry</td>
<td>CFM</td>
<td>635-705-775</td>
<td></td>
</tr>
<tr>
<td>Airflow Rate, Wet</td>
<td>CFM</td>
<td>570-635-700</td>
<td></td>
</tr>
<tr>
<td>External Static Pressure</td>
<td>in.WG</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Sound Pressure Level</td>
<td>dB(A)</td>
<td>39-42-45</td>
<td></td>
</tr>
<tr>
<td>Drain Pipe Size</td>
<td>In. (mm)</td>
<td>5/8 (16)</td>
<td></td>
</tr>
<tr>
<td>Condensate Lift Mechanism, Max. Distance</td>
<td>In. (mm)</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Heat Exchanger Type</td>
<td>Plate fin coil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Finish Color</td>
<td>White Munsell 1.0Y 9.2/0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit Dimensions</td>
<td>W: In. (mm)</td>
<td>46-1/16 (1170)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D: In. (mm)</td>
<td>11-5/8 (295)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>H: In. (mm)</td>
<td>14-3/8 (365)</td>
<td></td>
</tr>
<tr>
<td>Package Dimensions</td>
<td>W: In.</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D: In.</td>
<td>16-8/16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>H: In.</td>
<td>14-4/16</td>
<td></td>
</tr>
<tr>
<td>Unit Weight</td>
<td>Lbs. (kg)</td>
<td>46 (21)</td>
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</tr>
<tr>
<td>Package Weight</td>
<td>Lbs.</td>
<td>53</td>
<td></td>
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</table>

## Indoor Unit Operating Temperature range

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling Intake Air Temp (Maximum / Minimum)</td>
<td>°F</td>
<td>90 DB, 73 WB / 66 DB, 59 WB</td>
<td></td>
</tr>
</tbody>
</table>

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## SPECIFICATIONS: PKA-A24KA7 & PUY-A24NHA7(-BS)

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Indoor Unit</th>
<th>PKA-A24KA7</th>
<th>PUY-A24NHA7</th>
<th>PUY-A24NHA7-BS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Outdoor Unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCA</td>
<td>A</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOCP</td>
<td>A</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan Motor Full Load Amperage</td>
<td>A</td>
<td>0.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan Motor Output</td>
<td>W</td>
<td>86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airflow Rate</td>
<td>CFM</td>
<td>1,940</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refrigerant Control</td>
<td></td>
<td>Electronic Expansion Valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Exchanger Type</td>
<td></td>
<td>Cross fin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sound Pressure Level, Cooling¹</td>
<td>dB(A)</td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressor Type</td>
<td></td>
<td>INVERTER-driven twin rotary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressor Model</td>
<td></td>
<td>SNB172FWMH1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressor Rated Load Amps</td>
<td>A</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressor Locked Rotor Amps</td>
<td>A</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressor Oil Type // Charge</td>
<td>oz.</td>
<td>FV50S // 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Finish Color</td>
<td></td>
<td>Ivory Munsell 3Y 7.8/1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base Pan Heater</td>
<td></td>
<td>n/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit Dimensions</td>
<td>W: In. (mm)</td>
<td>37-13/32 (950)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D: In. (mm)</td>
<td>13 + 1-3/16 (330 + 30)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>H: In. (mm)</td>
<td>37-1/8 (943)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Package Dimensions</td>
<td>W: In.</td>
<td>40-15/16</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D: In.</td>
<td>17-11/16</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>H: In.</td>
<td>40-11/16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit Weight</td>
<td>Lbs. (kg)</td>
<td>151 (68)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Package Weight</td>
<td>Lbs. (kg)</td>
<td>176 (80)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoor Unit Operating Temperature Range</td>
<td>Cooling Intake Air Temp (Maximum / Minimum)</td>
<td>°F</td>
<td>115 DB / -20° DB</td>
<td></td>
</tr>
<tr>
<td>Refrigerant</td>
<td>Type</td>
<td>R410A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charge</td>
<td>Lbs, oz</td>
<td>7 lbs, 11 oz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piping</td>
<td>Gas Pipe Size O.D. (Flared)</td>
<td>In.(mm)</td>
<td>5/8 (15.88)</td>
<td></td>
</tr>
<tr>
<td>Liquid Pipe Size O.D. (Flared)</td>
<td>In.(mm)</td>
<td>3/8 (9.52)</td>
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<td></td>
</tr>
<tr>
<td>Maximum Piping Length</td>
<td>Ft. (m)</td>
<td>225 (69)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Height Difference</td>
<td>Ft. (m)</td>
<td>100 (30)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Number of Bends</td>
<td></td>
<td>15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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## SPECIFICATIONS: PKA-A24KA7 & PUY-A24NHA7(-BS)

### Notes

<table>
<thead>
<tr>
<th>AHRI Rated Conditions (Rated data is determined at a fixed compressor speed)</th>
<th>¹Cooling (Indoor // Outdoor)</th>
<th>⁰F</th>
<th>80 DB, 67 WB // 95 DB, 75 WB</th>
</tr>
</thead>
</table>

¹Wind baffles required to operate below 23°F DB in cooling mode. PUY with wind baffle: -20°F - 115°F. Refer to wind baffle documentation for further information.

**System cuts out in heating mode to avoid thermistor error and automatically restarts at these temperatures.**

---

### SEACOAST PROTECTION

- External Outer Panel: Phosphate coating + Acrylic-Enamel coating
- Fan Motor Support: Epoxy resin coating (at edge face)
- Separator Assembly, Valve Bed: Epoxy resin coating (at edge face)
- "Blue Fin" treatment is an anti-corrosion treatment that is applied to the condenser coil to protect it against airborne contaminants.
Tag Data - Electric Unit Heaters (Qty: 1)

<table>
<thead>
<tr>
<th>Item</th>
<th>Tag(s)</th>
<th>Qty</th>
<th>Description</th>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>EH-1</td>
<td>1</td>
<td>Electric Unit Heaters</td>
<td>UHEC052AACA</td>
</tr>
</tbody>
</table>

Product Data - Electric Unit Heaters

Item: A1  Qty: 1  Tag(s): EH-1
- Electric Unit Heater
- 5.0 kW Unit Capacity
- 1 or 3 Phase Field Convertible 60 Cycle
- 208 Volt Element and Motor
- 24 Volt Control Transformer
- Contactor
- Stratification Line Voltage Thermostat Single Pole (Fld)
- Wall Mounted Thermostat Low Voltage with Summer Fan Switch (Fld)
- Unit Mounted in Field Disconnect Switch 3 Pole for 3 Phase (Fld)
- Mounting Bracket - Horizontal Discharge (Fld)
- Dust Shield (Horizontal Discharge) (Fld)
- OSHA Fan Guard 3-5 kW (Fld)

Warranty
- 2 year whole unit warranty – parts and labor
Unit Dimensions - Electric Unit Heaters
Item: A1  Qty: 1  Tag(s): EH-1

NET WEIGHT 35.0 lb
MINIMUM RECOMMENDED MOUNTING HEIGHT 108" ABOVE FLOOR
VERTICAL ARRANGEMENT - 108"

11'-0" 5'-7½"

KNOCKOUTS FOR ELECTRICAL CONNECTIONS

AIR FLOW

MOUNTING HOLES 5¼" - 19

FLD = Furnished by Trane U.S. Inc. / Installed by Others
Equipment Submittal
Accessory - Electric Unit Heaters
Item: A1  Qty: 1  Tag(s): EH-1

OSHA FAN GUARD
SECTION 15015 – GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

1. The General, Supplementary, and Special Conditions, Applicable portions of all divisions and the addenda thereto, are made a part of this Contract.

2. All work described in these specifications shall be the responsibility of the plumbing contractor unless otherwise indicated.

3. It is the intent of these specifications to include all material, service and labor necessary to form a complete and properly operating whole.

1.02 CONTRACT DRAWINGS

1. Examine all drawings and specifications and visit the site to become acquainted with the construction and the extent of the work.

2. In referring to drawings, figured dimensions take precedence over scale measurements. Discrepancies must be referred to the Engineer for decision. Each Contractor shall certify and verify all dimensions before ordering material or commencing work.

3. Any work called for in the specifications, but not mentioned or shown on the drawings, or called for on the drawings, but not mentioned in the specifications, shall be furnished as though called for in both.

4. When any device or part of equipment is herein referred to in to singular number, such as "the pump" such reference shall be deemed to apply to as many such devices as required to complete the installation.

5. The term "provide" shall mean "furnish and install". Neither term will be used generally in these specifications but will be assumed. The term "furnish" shall mean to obtain and deliver on the job for installation by other trades.

1.03 CODES AND STANDARDS

1. All work shall comply with all regulations and be subject to inspection and approval of authorities having jurisdiction.

2. Where items indicated on contract documents differ from code requirements, contractor shall inform engineer prior to installation. Any construction installed by contractor that is not in compliance with applicable codes, shall be removed, modified, and/or replaced at not additional cost.

3. All equipment shall be labeled by an approved agency.

4. Contractor shall give all notices, obtain and pay for all permits, deposits, and fees necessary.

5. Manufacturer's published data is made a part of these specifications.
SECTION 15015 – GENERAL REQUIREMENTS

6. Wherever a recognized national organization has published standards these shall be complied with (such as ASA Z 21.30 for gas piping).

1.04 REJECTED MATERIALS

1. See "General Conditions".

1.05 WORKMANSHIP

1. All work and the execution of same shall be completed in a first class, workmanlike manner and shall conform to the best mechanical practice.

1.06 SHOP DRAWINGS

1. See "General Conditions".

1.07 AS-BUILT DRAWINGS

1. See "General Conditions".

1.08 WARRANTY

1. See "General Conditions".

1.09 FIRE RATING

1. All materials used anywhere in the work must have N.F.P.A. rating as follows:

   A. Flame Spread - Not Over 25
   B. Smoke Developed - Not Over 50
   C. Fuel Contributed - Not Over 25

2. All materials shall be "Self Extinguishing".

1.10 EQUIPMENT SELECTION AND SERVICEABILITY

1. All equipment shall be located and installed so that it may be serviced. Demonstrate that there is room to remove all tube bundles, motor and similar equipment. Equipment which is too large or poorly located to permit servicing shall be replaced or repositioned at no additional cost to the Owner.

2. Where piping or control diagrams or sequencing differ from the recommended piping arrangements of the equipment manufacturer, and will directly affect the equipment performance, the manufacturer's recommendations shall be submitted in writing to the Architect/Engineer for approval, prior to purchasing the equipment involved. This Contractor shall be responsible for obtaining such recommendations from the manufacturers in order to effect correct and perfect operation of the equipment at the capacities and temperatures indicated.
SECTION 15015 – GENERAL REQUIREMENTS

1.11 EQUIPMENT FURNISHED BY OTHER TRADES

1. All equipment furnished and/of installed by other trades requiring connections and services by this Contractor shall have such services provided.

2. This Contractor shall verify exact requirements with shop drawings.

3. This Contractor shall verify all locations, sizes, requirements of services required for equipment in field with Contractor furnishing equipment.

1.12 FIRE SAFING

1. Provide fire safing and duct safing per 1996 Boca Code, Section 714. Proseal Systems - Proseal plug device per 93 UL Directory, No 545, F rating for precast concrete. 3M Brand Fire Barrier CP25WB and caulk CAJ 1044 and CAJ 5001, WL1003, WL5011 or approved equal.

PART 2 PRODUCTS

2.01 ELECTRICAL EQUIPMENT

1. This Contractor shall furnish all his equipment complete with motor, controllers, capacitors and starting equipment.

2. Electric motors shall be premium high efficiency (refer to table below for minimum efficiency), open, drip proof induction motors premium high efficiency rated for continuous duty at 15% overload with 40° C. rise; single phase motor shall be capacitor start-induction run. Motors one-half and larger shall be polyphase, motors smaller than one-half horse power shall be single phase, unless otherwise noted (see Division 16). Starting equipment shall consist of magnetic across-the line starters equal to Furnas Bulletin 14, or approved equal, unless otherwise specified. Thermal overload type motor rated manual switches shall be furnished for fractional HP motors which do not require magnetic starters for control purposes.

3. Provide FPE/CDE Type 1C Power Factor correction capacitors size to increase full load power factor to 95%. Capacitors shall be fused, in NEMA enclosure, connected between safety switch and motor starter.

4. Where apparatus is specified as "Packaged", all electrical equipment shall be furnished, set and wired to a single point of connection for apparatus as a unit.

5. This Contractor shall set all electrical equipment furnished by him unless same is to be mounted on an electrical panel board, junction box or similar piece of electrical equipment and is to be wired by others.

6. Where electrical characteristics are not shown, all electrical characteristics shall be as indicated on electrical plans. Where there is a conflict between model numbers which indicate electrical characteristics and electrical drawings, the electrical drawings shall take precedent.
7. This Contractor shall verify all electrical characteristics of all equipment with electrical contractor. This Contractor shall submit to electrical contractor location of all motor, starters, other electrical equipment voltage and phase required prior to submission of this Contractor's and electrical contractor's shop drawings.

8. Should this Contractor change type of equipment which results in change to electrical characteristics, then this Contractor will be responsible to coordinate these changes with all other trades and pay for all required changes.

9. Should this Contractor change electrical characteristics of equipment from that shown on electrical drawings, he is responsible for any extra cost resulting from such change.

2.02 ELECTRICAL WIRING

1. This Contractor shall furnish and install all electric power wiring required for his contract, with the exception of specified wiring shown to be under the electrical contract.

2.03 RELIEF VALVES

1. Provide ASME labeled relief valve on each closed fluid system, set to relieve full code capacity at design pressure. Pipe discharge to closed drain or approved receptor.

2.04 THERMOMETERS

1. Thermometers shall be 5" diameter dial type with stainless steel cases and separate wells. Ashcroft T-7173T or approved equal, adjustable to any angle.

2.05 TAGS

1. This Contractor shall provide a 2" diameter brass tag with stamped service designation and numbers, fastened to each valve with brass chain and "S" hook.

2. Each control, starter, disconnect switch, etc., shall be provided with 0.75" x 2.5" metal name tag securely fastened to device.

3. Omit name tags on controls exposed in finished spaces.

PART 3 EXECUTION

3.01 METHOD OF PROCEDURE

1. The drawings accompanying these specifications are diagrammatic and intended to cover the approximate and relative locations of the system.

2. Installation, connection and interconnection of all components of these systems shall be complete and made in accordance with the manufacturer's instructions and best trade practices. This Contractor shall erect all parts of equipment to be furnished by him under his Contract at such time and in such manner as not to delay or interfere with other Contractors.
SECTION 15015 – GENERAL REQUIREMENTS

3. This Contractor shall lay out his work and be responsible for the establishment of heights, grades, etc., for all interior and exterior piping, drains, fixtures, conduit, etc., included in Contract Documents, in strict accordance with the intent expressed thereby; and all the physical conditions to be met at the building and finished grade, and shall be responsible for accuracy thereof. The establishment of the location of all work shall be performed in consideration of the finished work. In case of conflict, equipment and/or materials shall be relocated without cost to the Owner, as directed by the Architect, regardless of which equipment was installed first.

4. This Contractor shall cooperate with other Contractors for the proper securing and anchoring of all work included within these specifications. Extraordinary care shall be used in the erection and installation of all equipment and materials to avoid marring surfaces of the work of other trades, as this Contractor will be held financially responsible for all such damage caused by the lack of precaution and due to negligence on the part of his workmen.

5. Do not run pipe or conduit for Plumbing Systems in any concrete slab three inches (3") or less in thickness. Do not place any pipe or conduit in any slab where the outside diameter of the pipe or conduit is more than one-quarter the thickness of the slab.

6. All piping, conduit and other Plumbing materials and equipment shown to be mounted below ceilings are to be kept as close to ceiling areas as possible unless otherwise noted.

7. Items such as valves, cleanouts, etc., that will be concealed in construction shall be installed and so arranged as to be fully accessible for adjustment, service and maintenance.

3.02 CLEANING

1. Upon completion of the work, this Contractor shall remove all excess material, debris, tools and equipment from the site, and leave the premises in a broom clean condition.

2. Flush out all piping systems with proper solvents to insure removal of all foreign materials. Clean fixtures, equipment, piping and other surfaces soiled by the work. Remove debris and rubbish on a daily basis.

3.03 START-UP AND ADJUSTMENTS

1. After all testing is complete, start each system and make final adjustments for proper flow, temperature and quietness of operation. Record all final results including flows, balance settings, temperature adjustments, pertinent notes and recommendations. Furnish copies of report for review and record.

2. Report shall show actual data as recorded. Variations are expected due both to "normal" variations in field readings and to settings deliberately made to achieve proper operating conditions rather than design guidelines. Correct operation and maintained conditions will be sufficient evidence of proper setting.

3.04 OPERATING AND MAINTENANCE INSTRUCTIONS

1. This Contractor shall provide a complete set of bound operating and maintenance instructions.
SECTION 15015 — GENERAL REQUIREMENTS

The instructions prepared shall be black on white and shall be complete enough so that personnel generally familiar with the type of system will need no further data to properly perform the indicated procedures.

2. Manuals shall include all equipment, equipment parts lists, complete oiling, recommend spare parts, complete coiling, cleaning and servicing data compiled in a clearly indexed and easily understood form the data shall indicate the serial numbers of each piece of equipment and provide complete lists of replacement parts motor parts ratings and actual loads.

3. Operating instructions shall include wiring and control diagrams showing a complete layout of each system.

4. Any special emergency operating instructions and a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to the various parts of the system.

5. ASME and State pressure vessel inspection forms, all motor data, including standard and actual operating in service data and copies of all manufacturer's equipment, guarantees and warranties.

3.05 PAINTING AND FINISHING

1. All painting is to be done in accordance with Rust-Oleum Corporations printed instructions. All surfaces to receive two (2) coats of primer, exposed surfaces one (1) finished coat, color selected. Aluminum or galvanized metal surfaces are considered finished where concealed.

2. All surfaces to be carefully cleaned and/or pickled and filled as required to provide a proper uniform surface. Factory finished equipment shall be touched up or refinished where required.

3.06 CONSTRUCTION SAFETY

1. All work shall be done in accordance with the following Federal regulations:

A. Williams-Steiger Occupational Safety and Health Standards, Chapter XVII of Title 29, Codes of Federal Regulations.

2. Comply with local Health and Safety Regulations.

3.07 ENERGY CONSERVATION CODES

1. It is the intent of this specification that all equipment and materials furnished meet the latest enforced edition of the ASHRAE 90.1-2004 or such code as locally applicable, if more restrictive.

3.08 FLASHINGS

1. All piping passing through roofs shall be provided with Stoneman "Stormtite" seamless lead flashing (or approved equal).
SECTION 15015 – GENERAL REQUIREMENTS

3.09 DELIVERY AND STORAGE OF EQUIPMENT

1. This Contractor shall store, take deliveries and install all equipment in accordance with manufacturers' requirements (see general conditions).

3.10 STERILIZATION

1. After final testing for leaks, all new potable water lines shall be thoroughly flushed, by plumbing contractor, to remove foreign material. Before placing the system in service, Contractor shall engage a qualified service organization to sterilize the new water lines in accordance with the following procedure:

   A. Through a hose connection in the main entering the building, pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 100 PPM.

   B. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident.

   C. When chlorinated water has been brought to every faucet and tap with a minimum concentration of 100 PPM chlorine, retain this water in the system for at least two (2) hours.

   D. At the end of the retention period, no less than 10 PPM of chlorine shall be present at the extreme end of the system.

   E. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 PPM.

   F. Obtain representative water samples from the system for analysis by a recognized Bacteriological Laboratory.

   G. If all samples tested for coliform organisms are negative, a letter and laboratory reports shall be submitted by the service organization to the Contractor, certifying successful completion of the sterilization.

   H. If any samples tested indicate the presence of coliform organisms, the entire sterilization procedure shall be repeated.

3.11 PLENUM AREAS

1. Any plenum area, duct plenum, ceiling plenum or room plenum shall not contain any combustible material, and all insulation, wiring and/or piping shall be suitable and approved by local authorities for plenum installation.

3.12 SCHEDULE OF WORK

1. The exact times and dates and schedules that the schools will be available for contractor to do work, shall be as indicated in General Conditions.
SECTION 15015 – GENERAL REQUIREMENTS

3.13 PROTECTION OF SERVICES DURING CONSTRUCTION AND DEMOLITION

1. This Contractor shall repair, replace, and maintain in service any utilities, facilities or services (in existing areas where demolition is to occur) which are damaged, broken, or otherwise rendered inoperative during the course of demolition.

2. This Contractor shall effectually protect, at his own expense, such of his work, materials or equipment that may be subject to damage during the construction period.

3. All openings must be securely covered, or otherwise protected.

4. This Contractor shall be held responsible for all damage so done until his work is fully done and finally accepted.

5. It shall be the responsibility of this Contractor to protect existing and new motors, pumps, electrical equipment, plumbing fixtures and all phases of construction.

3.14 EQUIPMENT LIST

1. Refer to General Conditions. Exclusion of items on list does not relieve Contractor of the responsibility from providing equipment as specified, required to complete work as shown on drawings that is to be provided by this Contractor.

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<thead>
<tr>
<th>EQUIPMENT</th>
<th>MANUFACTURER</th>
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<tr>
<td>Valves</td>
<td>number 1</td>
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<td>Insulation</td>
<td>number 2</td>
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<td>number 3</td>
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<td>Plumbing Specialties</td>
<td>number 4</td>
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<td>Floor Drains</td>
<td>Mueller</td>
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<td>Trap Primers</td>
<td>Stokham</td>
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<td>Lavatory Fittings</td>
<td>Owens/Corning</td>
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<td>Emergency Shower</td>
<td>Johns Manville</td>
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<tr>
<td>Vacuum Pumps</td>
<td>Josam</td>
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<tr>
<td>Domestic Hot Water Heater</td>
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3.16 UNIT PRICES

1. See “General Conditions”.

3.17 ALTERNATE BIDS

1. See “General Conditions”. Refer to drawings and specifications for extent of work.
SECTION 15015 – GENERAL REQUIREMENTS

3.18 CONSTRUCTION SEQUENCING

1. Refer to General Conditions for the overall contract staging. However, specific items for HVAC contractor should be noted. The following are suggested methods of staging of construction. Alternate methods to achieve the intent of these specifications will be allowed, however, they must be coordinated with other trades and submitted for review and approval.

2. The sequence of construction shall be as indicated in the General Conditions of the specifications.

3. Where work is shown on mechanical plans where it is outside the phase areas indicated or specified in the General Conditions, this work shall be done at any time. All work shall be done so not to interfere with normal school operations. Where work is done outside normal school occupied areas (boiler room, roof area), this work may proceed at contractor’s option. All work, regardless of the location of work, type of work, or extent of work, shall be done with the approval of the School District.

4. Where work in a particular phase requires work to be done outside that phase’s construction boundaries, this Contractor shall locate all new duct, pipe, and equipment to allow for new construction and/or to integrate with existing building construction.

5. All new ductwork and piping shall be installed and coordinated with proposed new work.

6. All work required to be modified due to non-compliance with this section, General Conditions or Construction Sequencing, shall be removed, replaced and/or modified at no additional cost to Owner.

7. Where pipe is shown to serve future phases, provide capped outlet suitable for connection when phase is completed. Provide valves for isolation and draining lines without affecting the work installed in earlier phase.

END OF SECTION
15015.5801
SECTION 15115 - BASIC MATERIALS AND METHODS

PART 1 GENERAL

1.01 MATERIALS AND EQUIPMENT

1. All material and equipment used for this contract shall be unused and of the latest model or design available. Equipment shall be installed in strict accordance with manufacturer's recommendations and details.

2. Materials not specifically described but indicated or incidentally required shall be acceptable to the Architect and/or Engineer. Submit shop drawings. Materials shall be delivered, stored and handled so as to preclude injury by weather, dirt or abrasion.

3. This Contractor shall use only specifically assigned areas for storage of materials and construction operation, unless other areas are authorized by the Owner. Such areas will be identified after the award of Contract by Owner. Comply with local municipal regulation regarding use of and parking on public streets.

4. This Contractor shall repair streets, drives, curbs, sidewalks and any existing surface where disturbed by construction operations and leave them in as good condition after completion of the work as before operations started.

1.02 PROTECTION

1. No pipe shall be left open any longer than is required to affix the next piece. If pipe ends are to be left for a protracted period, they shall be closed with approved plugs or caps.

2. All equipment shall be covered to protect it from damage; all damage is the responsibility of this Contractor.

3. Any pipe, equipment or construction in existing building shall be done in such a manner to prevent injury to building personnel. Particular care must be taken for any work which will be done during building's normal operation.

1.03 IDENTIFICATION OF PIPING

1. Use color scheme for painting listed in "Scheme for Identification of Piping System", ANSI A-13 and Rust-Oleum Corporation Form # 117. Paint identifying bank of color near each valve and fitting, on both sides of pipes passing through wall, and on long pipe runs approximately every 30' (closer when directed), throughout building. Exposed piping in mechanical rooms and all other areas including insulation, hangers, supports, valves and all appurtenances shall be painted color selected.

<table>
<thead>
<tr>
<th>Fire Protection Pipe</th>
<th>Fire Engine Red</th>
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<tbody>
<tr>
<td>Gas Pipe</td>
<td>Yellow</td>
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<tr>
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<td>Sanitary Vent</td>
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<tr>
<td>Storm</td>
<td>Dark Green</td>
</tr>
<tr>
<td>Domestic Cold Water</td>
<td>Dark Blue</td>
</tr>
<tr>
<td>Domestic Hot Water</td>
<td>Red</td>
</tr>
</tbody>
</table>
SECTION 15115 - BASIC MATERIALS AND METHODS

2. Stencil on pipe, near each valve, name of pipe contents in abbreviated form, size of pipe, and arrow indicating direction of flow. Place legend in such location that it can be read from floor. Size of stencil letters shall vary with the size of pipe.

3. Seaton "SETMARK" (or approved equal) pipe markers are acceptable.

1.04 TESTING

1. At the completion of all work, and before any covering is applied, all piping except drainage shall be tested hydrostatically at a pressure equal to 150% of the working pressure or to material test pressure, if lower. All piping concealed in any manner shall be tested before being concealed. Maximum drop in pressure permissible shall be two (2) psi in 24 hours.

2. The drainage system shall have openings plugged and be filled with water to the level of the main gutter or top of vent pipes and allowed to stand at least thirty minutes. Each stack may be tested separately.

3. Testing shall be in accordance with ANSI B31.1 in all test gauges, traps and all other apparatus which may be damaged by the test pressure shall be removed or valved off from the system before tests are made.

4. In existing building all required tests on new and/or existing systems shall only be done after normal working hours. All tests done in building shall be done in such a manner as to avoid injury to building personnel and damage to existing and/or new construction. Protect all new and existing construction from damage which may occur as a result of the test or failure of test material.

5. This Contractor shall be responsible for all costs associated with damage to materials or liability due to injury to personnel, as a result of tests or failure of tests.

1.05 PRESSURE RATINGS

1. All equipment and materials shall have a working pressure as determined by A.S.M.E. (or similar body), of not less than 125 psi.

1.06 SLEEVES

1. All pipes passing through construction shall be fitted with flush sleeves of sufficient diameter to pass the insulation. Sleeves shall be 20 USG galvanized iron, except in masonry, where steel pipe sleeves shall be used. Sleeves in waterproof construction shall be steel pipe, waterproofed with modular mechanical synthetic rubber seals equal to "Link Seals" (Thunderline), or approved equal. In floors they shall extend on inch above the floor.

2. In fire divisions, sleeves shall be constructed of fire-retardant material and shall be installed to maintain the fire integrity of the fire division.

3. All materials and construction methods shall be installed in accordance with the manufacturer recommendations and the requirements of the IBC Code or any other applicable codes.
SECTION 15115 - BASIC MATERIALS AND METHODS

1.07 Fire Safing

1. Provide fire safing per 2009 IMC. Proseal Systems - Proseal plug device per 93 UL Directory, No 545, F rating for precast concrete. 3M Brand Fire Barrier CP25WB and caulk CAJ 1044 and CAJ 5001, WL1003, WL5011 or approved equal.

PART 2 PRODUCTS

2.01 PIPE

1. Steel pipe shall be Schedule 40, electric welded, ASTM-A53, Grade A, plain or galvanized as specified under applicable system.

2. Copper tubing shall be hard temper "Type L" except that all piping underground shall be "Type K", conforming to ASTM-B-88.

3. Cast iron soil pipe shall be extra heavy Bell and Spigot spun type conforming to ASTM-A-74. Standard or medium weights may be used, if permissible under local code.

4. Acid Resistant Piping

   A. Non-Plenum Installation - Shall be polypropylene piping made from Type 1 polypropylene plastic as defined in ASTM-D-2146.

   B. Plenum Installation - Shall be polyvinylidene fluoride (PVDF) piping confirming to ASTM-D3222 Standard. The PVDF material shall meet UL-723 requirements for flame spread rating less than 25 and smoke developed less than 50.

5. PVC pipe (Radon System) – Note-No PVC pipe in return air plenums. Polyvinyl chloride pipe (PVC) shall be Schedule 40 conforming to ASTM-D-2241.

6. PVC Pipe

   A. Polyvinyl chloride pipe (PVC) shall be Schedule 40 conforming to ASTM-D-2241.

   B. Sound rating exposed PVC pipe in finished areas shall have sound rating equal to or less than the sound radiated from cast iron pipe (25-30 DB).

   C. Where sound ratings are greater, contractor shall install insulation wrap to reduce the radiated sound to less than the sound radiated for cast iron pipe.

   D. Contractor to install PVC pipe with supports at intervals required by the applicable plumbing code.

   E. Provide fire listed fire stop devices or collars in accordance with ASTM E814 on both sides of pipe penetrations of fire rated assembly temperature.

   F. PVC pipe shall not be used where temperatures exceed 140°F.
SECTION 15115 - BASIC MATERIALS AND METHODS

G. All underground pipe to be installed in accordance with ASTM D2321.

2.02 PIPE FITTINGS

1. All welded fittings shall be of the same thickness and material as the pipe meeting ASTM-A234. Branch connections shall be made with Weldolets or welding fittings.

2. All flanges shall conform to A.S.A. B-16 using gaskets suitable for the service.

3. Cast iron drainage fittings shall be standard weight galvanized cast iron, banded and recessed.


5. Fittings for copper tubing shall be wrought copper of the solder Type conforming to A.S.A. B16.22.

6. Radon System - Fittings for polyvinyl chloride (PVC) shall be socket fittings or solvent welded.

7. Fittings for polyvinyl chloride (PVC) shall be socket fittings or solvent welded.

6. Fittings for polypropylene piping shall be flanged, thermal fusion or threaded, made from polypropylene plastic ASTM-D2146.

7. Fittings for PVDF piping shall be flanged, thermal fusion or threaded, made from polyvinylidene fluoride material conforming to ASTM-D32222 Standard.

2.03 GATE, GLOBE AND CHECK VALVES

1. All valves 2" or smaller shall be ball valves; bronze solder end valves in copper tubing and screwed end in other lines.

2. Gate valves shall be 125 psi WSP, 200 psi WOG union bonnet, silicon bronze, rising stem, inside screw, wedge gates provided with back seat to enable packing under line pressure. Globe and swing check valves shall be of similar construction with renewable composition disc underground, AWWA standard iron body, double disc. and gate valves shall be used.

3. All valves 2½" dia. or larger shall be 125 psi WSP, 200 psi WOG bronze mounted, silicon bronze stem, outside screw and yoke, blotted bonnet and follower gland, iron body, flanged end, wedge gate valves. Valves shall be provided with back seat to permit packing under line pressure. Globe and Swing check valves shall be of similar construction with renewable, regrinding, bronze disc and seat.

4. All valves in deionized water shall be PVC ball valves.

2.04 PLUG AND BALL VALVES

1. All valves 2" dia. and smaller shall be 150 psi WOG ball valves with full port. Valves to be lever operated, screwed or solder end in sizes up to 2" dia. Valves used for balancing shall have infinite throttling handle and adjustable stops. All valves bubble tight shut-off.
SECTION 15115 - BASIC MATERIALS AND METHODS

2. Plug and Ball Valves shall be 150 psi WOG with full port. Valves to be lever operated, screwed or solder end in sizes up 2" dia., flanged end in 2 ½" dia. to 6" dia. size.

2.05 UNIONS

1. Unions shall be installed where needed to facilitate the removal of equipment.

2. Unions 2" dia. and smaller in copper tubing shall be all brass, ground joint, solder end. In other lines, screw end, malleable iron, 125 psi WSP, 300 psi WOG of the ground type.

3. Unions 2 ½" dia. and larger in copper tubing shall be flanged pattern, all brass, solder end. In other lines; 125 psi WPS-175 psi WOG, cast iron flanged pattern, black or galvanized to match piping.

2.06 ESCUTCHEON PLATES

1. Where any pipe passes into a finished space, there shall be provided a solid brass, chrome plated, escutcheon plate held to the pipe mechanically or fastened to the building construction.

2.07 ANCHORS

1. Anchors of approved design shall be provided where shown or required for the proper control of the stress due to expansion. Anchors shall be heavy metal sections securely fastened to the building construction.

2.08 DRIP PANS

1. Provide drip pans for all pipes and equipment carrying liquid or, liquid vapors where pipes pass over areas or electrical equipment. Drip pans shall be constructed of galvanized metal. Provide drain line to closest sanitary line.

2.09 ACCESS PANELS

1. Furnish and install access panels not smaller than 18”x18”, for access to all concealed valves, and equipment, accessories, etc.

2. Access panels shall be all steel construction with a 16-gauge wall or ceiling frame and a No. 16-gauge wall or ceiling frame and a 14-gauge panel door with not less than 1/8" insulation secured to inside of door.

3. Doors shall have concealed hinges and cylinder lock except doors for wall panels may be secured with suitable clips and countersunk screws.

4. Access panels shall be flush with finished wall or ceiling and shall be painted to match adjacent surfaces. Access panels behind finished surfaces shall have color coded marking on finished surface to indicate location of doors and type of equipment.

5. Access panels in fire rated construction shall be fire rated.
SECTION 15115 - BASIC MATERIALS AND METHODS

2.10 ANCHOR BOLTS

1. Contractor shall furnish and install anchor bolts as required for the equipment. Anchor bolts shall be DECO's standard anchor with floating nut, adjustable ½" in any direction. Grout all bases.

2.11 HANGERS

1. All piping shall be supported by hangers, concrete inserts, and insulation saddles conforming to MSS-SP-58.
2. Hangers for cast iron pipe shall be spaced at least one per length, but not more than 7’ apart. Steel and copper pipe shall be spaced not over 8’ apart.
3. Vertical runs of pipe shall be supported by riser clamps except that pipe 1¼" and smaller may be braced by galvanized malleable iron fasteners.
4. Hangers for copper tubing shall be copper plated, and completely encircle the tubing. A hanger shall be placed no further than 24" from each change in direction of piping.
5. Hangers shall not be connected to or supported from other pipe, conduit or equipment, but shall be supported from building structure.

PART 3 EXECUTION

3.01 INSTALLATION OF PIPING

1. All fittings, offsets, etc., may not be shown. Contractor shall determine their necessity by investigating conditions at the site.
2. Contractor shall use shop drawings for exact locations.
3. All piping above ground shall be run parallel with the lines of the building in the most direct manner, concealed in furred spaces where possible.
4. Pipes shall be cut accurately and placed without springing or forcing all burrs removed.
5. All water piping inside the building shall be properly graded to drain ½", hose outlet, angle drain valves.
6. All changes in size of piping shall be made by reducing fittings; no bushing will be permitted unless approved.
7. This Contractor shall determine, with approval, where expansion joints, loops or anchors will be required due to space restrictions prohibiting proper run-out flexibility.
8. Valves, air vents, balancing cocks, etc., shall be placed in accessible positions, and flush metal access doors, (12"x12" minimum size), with necessary lintels, etc., provided where they are concealed.
SECTION 15115 - BASIC MATERIALS AND METHODS

9. All piping shall be located to prevent freezing. Where pipe is located in areas subject to freezing, provide freeze protection and insulation. Refer to Section 15185.

3.02 DRAINAGE PIPING

1. All vent piping may not be shown. This Contractor shall install all vents that may be required by local authorities.

2. All piping shall be so installed that any point in the system can be cleaned by a standard-length snake.

3. It is intended that no horizontal pipe be built into masonry.

4. Vent piping shall be extended full size (minimum 3") above the roof. Offset vents at roof to clear structure.

5. Provide cleanouts at all traps, the bases of all stacks and rain conductors, changes of direction greater than 45 degrees and other points shown on drawings or required by authorities having jurisdiction, minimum 50' intervals. Cleanouts in buried piping shall be brought up flush to finished floors, outside to 18" below finished grade. Cleanout shall be full size in pipe up to 4", and 4" in larger pipes.

6. Interior cleanouts shall be similar with polished nickel bronze access cover for flush mounting.

7. In concrete floors cleanouts shall be cast brass countersunk plug type with nickel bronze adjustable head and heavy duty scoriated cover.

8. Coordinate locations of all cleanouts with other trades. Relocate or add cleanouts when interferences occur at no additional cost to Owner.

3.03 JOINING PIPE

1. Steel piping shall be of welded or flanged construction in sizes 2½" dia. and larger; screwed or welded construction in sizes 2" dia. and smaller. All screwed fittings to be cast iron unless otherwise specified. All threads shall be conformity with A.S.A. B-21.

2. All screwed pipe joints shall be made with Teflon Dry Thread Sealer (3M-#48) applied to male threads only.

3. Soldered joints shall be made with non-acid flux and lead-free solder. (ASTM 32-60AT). Fluxes shall be used sparingly, and excess wiped from copper.

4. For domestic hot and cold water pipe branches 1½" below, contractor may use Pro-Press system.

3.04 JOINING DISSIMILAR METALS

1. Where copper is jointed to steel, joints shall be made by means of brass or bronze adapter in a cast iron fitting or by means of an electrochemically insulated union.
SECTION 15115 - BASIC MATERIALS AND METHODS

2. Hangers supporting copper tubing shall be copper, or copperized. Copper tubing lines shall not be, even temporarily supported or secured to ferrous metals.

3.05 ERECTION AND RIGGING

1. This Contractor shall do all rigging, hoisting and setting-in place of all equipment furnished by him or as shown on drawings or as specified herein.

3.06 NATURAL GAS

1. The gas piping system shall be installed, and final connections made as part of the section titled "GAS PIPING".

2. Any contractor supplying gas-fired equipment shall leave such equipment complete and ready to operate so that only the final connection of gas piping will be required.

3.07 CLEANING OF GRAVITY SYSTEMS – FINAL CLEANING

1. At completion of project, prior to owner occupancy, this Contractor shall provide a hydro-jet cleaning and a video inspection of the newly installed gravity sanitary systems and storm/sewer system. The scope of work is all gravity systems installed in building and outside building to connection of gravity sewer systems and to main storm system as shown on site plans.

2. This Contractor is responsible for all work and all cost of work. This contractor shall utilize a certified independent sub-contractor using the latest technology to perform the hydro-jet cleaning and video inspection.

3. Work shall be done so that any debris and blockages encountered shall be removed. Take proper cautions (i.e. screening, etc.) to prevent the debris and material from entering the municipal sewer system.

4. Any blockages due to new construction work which cannot be removed by this hydro-jet cleaning shall be the responsibility of this Contractor to remove. Remove and replace all existing construction, pipe and equipment necessary to access pipe system to clean pipes and clean system to the satisfaction of the owner, engineer and local authorities having jurisdiction.

5. Any leaks due to new construction and/or renovation work shall be the responsibility of this Contractor to repair to the satisfaction of the Owner, engineer and local authorities having jurisdiction.

6. At the completion provide video with a written test report to Owner.

7. Sanitary cleaning shall be to the main in rear of building.

8. Storm line shall be to the storm main at rear and to first manhole for storm lines in front of building.

END OF SECTION
15115.5801
SECTION 15185 - INSULATION

PART 1 GENERAL

1.01 SCOPE

1. All surfaces throughout the work shall be insulated with fiberglass insulation as indicated in applicable section.

1.02 SURFACE TEMPERATURE

1. Where surface temperature can exceed 350° F. substitute calcium silicate insulation.

PART 2 PRODUCTS

2.01 PIPE INSULATION

1. All piping throughout the work shall be insulated with fiberglass pipe insulation in thickness, indicated in 3.04, of high density and with jacket indicated in the applicable section. (Except that outside thickness shall be doubled.) Vapor barrier jackets shall have self-sealing lap joint, and joints between sections shall be covered with a 4" wide strip to self-sealing vapor barrier materials.

2. Aluminum bands shall be applied, two to a section on all indoor insulation.

3. On outdoor installations, double insulation thickness and provide metal jacket banded or with sheet metal screws.

4. All pipe exposed in finished areas shall be painted color selected. Where insulation is subject to damage or is located below 7'-0" AFF, insulation shall have painted metal jacket as indicated for outdoor pipe, except no exposed joints or seams.

5. All insulation shall be "plenum rated".

6. Provide 1 ½" thickness pipe insulation for storm lines above or within noise sensitive areas.

PART 3 EXECUTION

3.01 INSTALLATION OF PIPE INSULATION

1. All pipe insulation shall be applied over dry, clean surface with joints tightly butted and jacket firmly and securely attached and smoothed. Insulation shall be continuous through wall, floor or ceiling openings and sleeves.

2. All valve bodies and fittings shall be insulated with preformed fittings of thickness equal to adjacent insulation and jacketed with same material. At Contractor's option, except in plenums, outdoors and where not permitted by code; provide precut fiberglass insulation blanket of same insulation thickness as adjacent insulation with a preformed snap on type molded PVC jacket, cover edges with vapor barrier adhesive or vapor barrier tape.

3. Provide metal shields under all hangers or pipe supports on outside of insulation; on roller supports provide pipe shoe cavity with insulation. Provide insert between support shield and
SECTION 15185 - INSULATION

piping on piping 1 1/2" dia. and larger. Insulation inserts shall be heavy duty insulation material length 12" up to 6" dia. pipe 16" long on 8" & 10" pipe, and 22" long on 12" pipe and larger. HANGERS SHALL NOT PENETRATE PIPE INSULATION.

4. On outdoor insulation, double insulation thickness, provide metal jacket; and prefabricated, removable and replaceable metal jacket at fitting and valves.

5. Locate insulation and cover seams in least visible locations, neatly finish insulation at supports, protrusions and interruptions.

3.02 EQUIPMENT INSULATION

1. All equipment containing fluids whose piping is specified to be insulated or whose surface temperatures will be low enough to cause condensation (60°F.), or high enough to burn persons touching same (110°F.), shall be insulated with a minimum of 1-1/2" thick fiberglass block firmly butted and wired in place, and covered with 1/2" thick coat of insulating cement troweled over one inch galvanized hexagonal wire mesh and finished cement troweled smooth. Metal corners beads shall be applied to protect corners.

3.03 INSULATION THICKNESS

1. Minimum pipe insulation thickness shall be in accordance with the ASHRAE 90.1-2007, local requirements, or the following table:

<table>
<thead>
<tr>
<th>PIPING SYSTEM CLASSIFICATION</th>
<th>FLUID TEMP. RANGE, F.</th>
<th>INSULATION THICKNESS IN INCHES FOR PIPE SIZES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Hot Water Supply and Return</td>
<td>120-200</td>
<td>1&quot; and LESS to 2</td>
</tr>
<tr>
<td>Domestic Cold Water</td>
<td>40-60</td>
<td>1&quot;</td>
</tr>
<tr>
<td>Horizontal Storm Lines</td>
<td></td>
<td>1&quot;</td>
</tr>
</tbody>
</table>

2. Where piping runs outdoors, double insulation thickness.

3. This Contractor shall provide heat tape (electric) to prevent freezing of outdoor piping and all other piping subject to freezing. Electric heat tape to be Chromalox Type M1 (or approved equal) cable, furnished with all controls, power wiring and appurtenances. Size and capacity per manufacturer's requirements.

END OF SECTION 15185.5801

INSULATION 15185 - 2
SECTION 15410 - WATER SUPPLY SYSTEMS (INTERIOR)

PART 1 GENERAL

1.01 SCOPE

1. The work under this heading shall include furnishing and installation of:

   A. All domestic water piping, insulation, plumbing material and specialties required for the proper functioning of the work. Connections to all equipment requiring domestic water connections whether furnished under this section or not. Sloped piping and valves to permit drainage of entire system.

PART 2 PRODUCTS

2.01 PIPING MATERIAL

1. Water Services - Copper Tubing Type "L", Type "K" underground. All exposed piping under and adjacent to fixtures shall be chrome plated brass pipe. All pipe shall have lead-free solder.

2.02 HOT WATER RECIRCULATION PUMP

1. (Small Systems) Hot water recirculating pumps shall be centrifugal pumps especially designed for domestic water service, B&G model NBF-9U/LW; 41 watts, 2,300 rpm, 1" dia. flange size, bronze fitted (or approved equal).

2. Provide B&G timer model 113210 and B&G Aquastat Model AQS-1/2 (3/4) (or approved equal), to de-energize pump for all recirculation pumps. Pump shall have check valve and shutoff valve on pump discharge and shutoff valve on pump suction, all valves same size as recirculation line.

2.03 STORAGE WATER HEATER

1. Furnish and install domestic hot water heaters as shown on plans. Heaters shall have pressure temperature relief valve piped to receptor. Insulate in accordance with ASHRAE-90 requirements.

2. Ceiling mounted units shall have auxiliary sheet metal drain pan under units with drain to floor or closest sanitary line. Where located above fixtures, provide vacuum breaker.

3. Fuel fired units shall have breeching and flues as required and as specified in Section 15860.

4. Provide emergency shutoff switches with all wiring per code.

5. Provide combustion air and interlock with combustion air to allow for operation of combustion air only during periods of use.

2.04 STORAGE WATER HEATER EXPANSION TANK

1. Provide expansion tank on domestic hot water heaters where required and where heaters are installed with check valve on cold water and/or on installations with backflow preventers on main water service.
SECTION 15410 - WATER SUPPLY SYSTEMS (INTERIOR)

2. Expansion tank to be installed on cold water inlet to storage heater.

3. Tank shall be equipped with air inlet and water drain off and shall be diaphragm type tanks (Amtrol Therm-X-Trol Model ST or approved equal), where required provide ASME tanks.

4. Minimum tank volume shall either be as required by Amtrol Form ST-8-89 or .11 gallons expansion tank per gallon of storage tank capacity, whichever is greater. Volumes based on 140 degrees F. water temperature, for higher temperatures adjust volumes accordingly.

2.05 WATER METER

1. Provide water meter and all appurtenances. Meter to be installed in strict accordance with local water company requirements.

2. Contractor shall coordinate requirements for all work with the water company.

3. Where backflow preventers are required, these shall be installed, see Section 15450.

4. Provide additional meter, see Section 15930.

PART 3 EXECUTION

3.01 MINIMUM COVER FOR EXTERIOR LINES

1. Water Lines – 3’-6”.

3.02 INSULATION

1. See Section titled "INSULATION".

2. Domestic Cold Water, Hot Water and Hot Water Recirculating Line - Fiberglass with all service jacket.

3.03 BALANCE COCKS AND RECIRCULATION SYSTEM

1. Balancing plug valves shall be installed in each branch of the recirculating system. Install thermometer in each branch of recirculating system near plug valve to facilitate balancing.

3.04 STERILIZATION

1. After the tests have been completed, and before the system is put into operation, the entire water system shall be sterilized as required in Section 15010.

3.05 EXPOSED LINES

1. All domestic water pipe in finished areas shall be concealed in drywall and/or concrete block walls. Where installed in concrete block walls, pipe to be installed within cores and done without cutting block. Where it is not possible to locate in wall without removing block, this
 SECTION 15410 - WATER SUPPLY SYSTEMS (INTERIOR)

Contractor shall coordinate with general contractor location and sizes required. This Contractor shall cut and repair block. Finishing of block shall be suitable for painting.

2. Where is determined by construction manager and/or architects that pipe must be exposed in finished area, it shall be enclosed in sheet metal chase constructed per architectural details by this Contractor.

3. No pipe shall be allowed in finished areas, except where specifically indicated (backflow preventers, etc.) Pipe shall be insulated and protected per Section 15185. Exposed pipe runnouts to fixtures shall be chrome plated.

3.06 COMBUSTION AIR

1. Fuel fired units shall have adequate combustion air. Natural gas-fired units shall have combustion air installed per 2015 International Fuel Gas Code, Latest Edition.

3.07 IRRIGATION SYSTEM

1. Where indicated on plans, provide capped connections thru foundation wall below grade, location as indicated on plans, exact location per site irrigation contractor. Provide backflow preventer for each service. Provide water meter per MUA requirements. Locate backflow preventer per code.

END OF SECTION
15410.5801
SECTION 15415 - DEIONIZED WATER SYSTEM

PART 1 GENERAL

1.01 SCOPE

1. The work under this heading shall include furnishing and installation of:

A. All deionized water piping and insulation thereof.

B. All material and specialties required for the proper functioning of the work. Connections to all equipment requiring demineralized water connections whether furnished under this Section or not.

C. Valves and sloped piping, to permit drainage of entire system.

PART 2 PRODUCTS

2.01 PIPING MATERIAL

1. PVC Schedule 40 pipe.

2.02 PIPING FITTINGS & JOINING PIPES

1. See Section 15115.

2.04 PIPE INSULATION

1. 1” thick with all service jacket.

PART 3 EXECUTION

3.01 STERILIZATION

1. After the tests have been completed, and before the system is put into operation, the entire new system shall be filled with a solution containing not less than 50 parts per million of available chlorine and allowed to stand six (6) hours before flushing. During the period, a pressure of not less than 150 psi shall be maintained on the system and all valves shall be opened and closed several times.

2. Chlorinate sterilization and flush with demineralized water to verify system cleanliness to required parts per million.

3. System hydrostatic test requirements shall be in accordance with Section 15110.

END OF SECTION
15415.5801
SECTION 15420 - SOIL AND WASTE SYSTEM

PART 1  GENERAL

1.01  SCOPE

1. The work under this heading shall include the furnishing and installation of:

   A. All soil, waste and vent piping, including connections to sewers. All materials and specialties required for the proper functioning of the work. Connections to all equipment requiring soil, waste or vent connections whether furnished by this Contractor or not.

   B. Connection to sanitary sewer at a point 5'-0" from building. All sanitary sewer from 5' outside of building by general contractor.

PART 2  PRODUCTS

2.01  PIPING MATERIALS

1. Drainage Systems - Cast iron soil pipe. Galvanized steel, copper tube, etc., may be acceptable if locally approved.

2. PVC pipe may be used as permitted by code.

3. PVC pipe shall be for sanitary and/or vent systems and shall not be used in plenums. Contractor shall be cautioned that both buildings have ceiling return air plenums.

2.02  JOINTS

1. Neoprene gasket joints may be acceptable if locally approved.

2. "No Hub" pipe, fitting and joint material may be acceptable if locally approved.

PART 3  EXECUTION

3.01  MINIMUM COVER FOR EXTERIOR LINES

1. Soil Lines – 3’

3.02  PIPE INSTALLATION

1. Provide minimum slope of 1/8" per foot or as required by local code. Install cleanouts at lower ends of stacks, at each change of direction, where indicated, or required by local code. Support cast iron pipe risers at base of stack and at hubs.

2. Offset vent lines through roof to obtain minimum visibility from front of the building. Extend vents a minimum of 2’ above roof line.
SECTION 15420 - SOIL AND WASTE SYSTEM

3. Flash vents passing through roof with sheet lead (6 pounds per square foot). Extend lead vertically up pipe and turn down into bore 2" or terminate in special flashing collar. See Section titled "General Requirements - Flashings".

END OF SECTION
15420.5801
SECTION 15430 - ROOF DRAINAGE SYSTEM

PART 1 GENERAL

1.01 SCOPE

1. The work under this heading shall include the furnishing and installation of:

A. All rain water piping except sheet metal rain leaders including connections to sewers. All materials and specialties required for the proper functioning of the work. Connections to all equipment requiring rain water connections whether furnished by this Section or not.

B. Connection to storm sewer 5'-0" +/- outside of building.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

1. Drainage Systems - Cast iron soil pipe. Galvanized steel, copper tube, etc., may be acceptable if locally approved.

2. PVC pipe shall not be used for any pipe above ceiling of occupied areas or is not enclosed, contractor is cautioned that the ceilings in both buildings are return air plenums.

2.02 ROOF DRAINS

1. Cast iron roof drains with large sump, removable metal large dome and flashing clamp integral with gravel stops; with deck clamp and receivers where required.

2. Drains to be Josam 21500 Series (or approved equal) with expansion joints Josam 26200 at each roof drain.

3. Provide overflow pipe where required by local code.

PART 3 EXECUTION

3.01 MINIMUM COVER FOR EXTERIOR LINES

1. Rain Water – 2'-6"

3.02 INSULATION

1. Rain water conductors - 1" thick with all Service Jacket on horizontal lines and bottom of roof drains. ½" thickness for pipes above or within occupied (not enclosed in) occupied space.

3.03 FLASHINGS

1. All roof drains shall be flashed and counterflashed in such a way as to permit roofer to bond roof (whether specified or not) for 20 years.

END OF SECTION
SECTION 15440 - GAS PIPING SYSTEM

PART 1 GENERAL

1.01 SCOPE

1. The work under this heading shall include the furnishing and installation of:

   A. All gas piping including all materials and specialties required for the proper functioning of the work. Connections to all equipment requiring gas connections whether furnished by this Section or not.

   B. Gas service in accordance with local regulations including meter pits if required or shown.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

1. Steel pipe with malleable iron fittings unless otherwise required by local authorities. All underground piping shall be coated in accordance with the recommendations of the local utility. Use approved connectors and/or connection details for all equipment. All pipe above 2” dia. Shall be welded.

2. All gas pipe shall be painted “yellow” including but not limited to pipe on roof and above ceilings.

3. Label all gas pipes with “GAS - Pressure”.

2.02 UNDERGROUND PIPE WITHIN BUILDING

1. All underground pipe within building shall be installed in an approved conduit system. Conduit shall be of a size that will allow for pipe to be installed without penetration of conduit. Conduit shall be made air tight. All end connections shall be sealed. Connection to existing pipe trench shall be sealed. Extend conduit outdoors as indicated on plans. Conduit shall be installed in accordance with gas company requirements.

2. Provide separate test of gas pipe within conduit as well as pressure test of conduit system. All testing shall be in accordance with gas company and International Fuel Gas Code.

2.03 GAS EMERGENCY SHUTOFF

1. Provide a complete gas emergency shutoff system. The system shall consist of;

   A. Control Station

      1. Surface mounted (only allowed on existing masonry walls), ASCO Model 173A20 (or approved equal). All other applications; recessed mounted ASCO Model 173A19. Units shall have momentary mushroom push button labeled "Emergency Gas Stop". Upon activation, power to valves is shut off and valves close in .1 seconds.
SECTION 15440 - GAS PIPING SYSTEM

2. Quantity of stations shall be as indicated on plans where more than one station closes solenoid valve. The units shall be controlled so any valve closes solenoid.

2.03 GAS EMERGENCY SHUTOFF

1. Provide a complete gas emergency shutoff system. The system shall consist of;

A. Control Station

   1. Surface mounted (only allowed on existing masonry walls), ASCO Model 173A20 (or approved equal). All other applications; recessed mounted ASCO Model 173A19. Units shall have momentary mushroom push button labeled "Emergency Gas Stop". Upon activation, power to valves is shut off and valves close in .1 seconds.

   2. Quantity of stations shall be as indicated on plans where more than one station closes solenoid valve. The units shall be controlled so any valve closes solenoid.

B. Solenoid Valve

   1. ASCO Series 8215 (or approved equal) (size to match line size) 2-way normally closed, explosion proof, low pressure gas control, 120V voltage.

C. AC Relay Control Panel

   1. ASCO Catalog 108D90C (or approved equal) recessed mounted, key operated switch with manual on/off buttons, surface mounted on existing masonry walls (Provide additional metal to over sides and wiring).

D. Master Control Station

   1. ASCO 216C89 key-operated, normally open switch and a normally closed pushbutton mounted in a stainless-steel faceplate for flush installation labeled "Gas Valve Control" on the faceplate, and the switches are labeled "Open" over the key switch and "Shut" over the pushbutton with wall box.

E. All wiring per manufacturer's requirements.

PART 3 EXECUTION

3.01 MINIMUM COVER FOR EXTERIOR LINES

1. Gas - Three feet six inches (3'6").

3.02 PIPE INSTALLATION

1. All gas piping shall be installed in accordance with the International Fuel Gas Code, NFPA-54 and the recommendations of the local utility including coating, ventilation and/or protection.
SECTION 15440 - GAS PIPING SYSTEM

2. All gas pipe shall be painted “yellow” including but not limited to pipe on roof and above ceilings.

3. Label all gas pipes with “GAS - ___ Pressure”.

3.03 CONNECTIONS TO EQUIPMENT

1. All connections to equipment shall have shut-offs and drip legs and shall be in accordance with equipment manufacturer's requirements. All shutoff valves shall have 1/2" NPT plugged tapping for pressure testing. Verify final location and type of connection in field.

2. All connections to movable equipment shall have flexible connections, quick disconnects. All kitchen equipment shall have stainless steel flexible connections.

3.04 GAS SERVICE AND METERS

1. Coordinate all requirements for metering with local gas company. All new meters are to be installed in accordance with gas company's requirements.

2. The size and capacity of the new gas service and meter to be coordinated with gas

3. Where required by local code, provide a label at service entrance - Natural Gas - CAS-74-82-8.

4. Provide additional meter, see Section 15930 with interface to DDC system. Meter to be furnished by control contractor and installed by this Contractor.

3.05 COMBUSTION AIR

1. All-natural gas-fired appliances located indoors shall have adequate provisions for combustion air. All combustion air installations shall be installed per NFPA-54/ANSI-Z-223.1, National Fuel Gas Code latest edition, and per local gas company requirements.

3.06 GAS PRESSURE

1. All gas-fired equipment furnished under this Contract shall be rated to operate at minimum 5.0" w.c. gas operating pressure, unless otherwise noted.

2. Prior to installation of gas pipe, this Contractor shall verify the pressure requirement of all gas-fired equipment furnished under this contract or under other contracts.

3. Where gas pressure exceeds 6.0" WC or where high pressure in excess of 14" WC is utilized, provide pressure regulators in all gas lines where appliances are not rated for higher gas pressure. Pressure regulators shall be sized and installed per manufacturers’ requirement. All regulators installed indoors shall be vented outdoors.

3.07 EXPANSION LOOPS

1. Provide expansion loops for all rooftop mounted pipe.
SECTION 15440 - GAS PIPING SYSTEM

3.08 ROOFTOP PIPE

1. Provide roof supports per details and gas company requirements.

END OF SECTION - 15440.5801
SECTION 15450 - PLUMBING FIXTURES AND EQUIPMENT

PART 1 GENERAL

1.01 SCOPE

1. Furnish and install complete with all necessary trim, hangers, etc., all plumbing fixtures and equipment required for the Contract.

2. All handicapped fixtures shall be installed per American Disabilities Act (ADA) and applicable guidelines.

3. Install all fixtures at heights indicated on architectural plans.

4. Provide all offset piping and special tail pieces per manufacturer requirements to comply with clearances per ADA.

5. Adjust heights of carriers due to depressed floors in toilet rooms.

6. Where fixture manufacturers are specified, approved or equal substitution shall be applicable.

PART 2 PRODUCTS

2.01 SUPPLIES, TRAPS, CARRIERS, ETC.

1. Provide chrome plated supplies with screw driver stops for all fixtures.

2. Provide traps, deep seal where required, for all fixtures, chrome plated where exposed.

3. Provide Josam carriers for all wall hung fixtures. All bases, where required, to be block type.

2.02 P-1 - WATER CLOSETS

1. American Standard "Afwall", elongated rim, wall mounted bowl, siphon jet with 1 1/2" dia. top spud. Aquameter 2257.103 with Sloan #111-SMO battery powered sensor operated flush valve, 1.5 gal./flush (or approved equal). Note: Flush valve requires 25 psi minimum working pressure.

2.03 P-2 - HANDICAPPED WATER CLOSETS

1. Wall mounted fixtures to be mounted so that height of water closet shall be 17" to 19" above finished floor to top of seat.

2. Seats shall not be sprung to return to a lifted position.

3. Flush valves and controls shall be installed in accordance with ADA guidelines Section 4.16.5 and 4.27.4.

2.04 URINALS

1. P-3 - American Standard "Lynnbrook" 6601.012 (or approved equal); vitreous china blowout urinal, wall hung, 1 1/4" top spud with Sloan #180-SMO battery powered sensor operated flush valve, 1.0 gallon/flush.
SECTION 15450 - PLUMBING FIXTURES AND EQUIPMENT

2. P-4 - Handicapped - Mount as required for handicapped. For battery operated flush valves, use Sloan 180-SMO BD (beam deflector) (or approved equal).

2.05 CLOSET SEATS

1. Heavy duty, open front, cut out back, seat no cover, stainless steel check hinge, solid section, high impact polystyrene white seats.

2. Handicapped Applications - Provide seat cover where required to meet requirements of ADA, Section 4.16.5 and 4.27.4.

2.06 P-5/6 - COUNTERTOP LAVATORIES

1. Oval Lavatories — Corian one-piece counter and bowls by general contractor.

2.07 LAVATORY TRIM

1. P-5 - Sloan BASYS sensor metering solar powered with battery power hand washing faucet, sensor operated pedestal, Model EFX-375.100.0100 with below deck Model 170LF thermostatic (or approved equal) lead-free mixing valve and faucet and brass grid strainer.

2. P-6 - "Handicapped Installation" - Insulate waste and hot water pipes under sink.

2.08 P-7 - MOP SERVICE BASINS

1. Fiat molded stone mop service basin with #830-A supply fitting and #889CC Mop Hanger (or approved equal).

2.09 P-9 - EXAM ROOM SINKS

1. 18-gauge, countertop mounted, self-rimming Elkay Model LFAD2522-5½; 25"x22"x5½” deep with sound deadener, battery power hand washing faucet, 3½” all brass C.P. strainer with crumb cup with offset drain and fitting (or approved equal).

2.10 P-10 - STAINLESS STEEL SINK

1. 18-gauge, countertop mounted, self-rimming Elkay Model LFAD2522-5½; 25"x22"x5½” deep with sound deadener, battery power hand washing faucet, 3½” all brass C.P. strainer with crumb cup with offset drain and fitting (or approved equal).

2.11 P-13 - ELECTRIC WATER COOLERS

1. Halsey Taylor HTHB-HAC8WF and HTHB-HACDBLWF bi-level filtered cooler with hydroboost bottle filler, double water cooler with stainless steel panels, bottle filler and filter (or approved equal).

2.12 P-14 - FLOOR DRAINS

1. Finished Spaces - Josam 30000-S (or approved equal) with round nickaloy strainer of recommended size with auxiliary inlet for trap primer.
A. Floor drains installed in tiled floors shall be Josam 30000A with square nickaloy strainer of recommended size and installed and coordinated with tile layout, so drains are located within the tile pattern in a manner to minimize cutting of tile.

2. Provide deep seal traps on ALL floor drains and JR Smith 2699 trap primer with ½” dia. Type K copper under slab to auxiliary inlet.

2.13 P-15 – STAINLESS STEEL SINK

1. Double bowl, 18-gauge, countertop mounted, self-rimming Elkay Model LFAD2522-5½; 25”x22”x5½” deep with sound deadener, battery power hand washing faucet, 3½” all brass C.P. strainer with crumb cup with offset drain and fitting (or approved equal).

2.14 P-16 - LAB STATION

1. This Contractor to provide all domestic hot and cold water and waste piping, vacuum and gas pipe (where indicated). Sink to be furnished and installed by general contractor. Faucets, vacuum tirrits and outlets to be furnished by general contractor and installed by this Contractor, see Section 15015.

2.15 P-17 – ADA SAFETY CENTER

1. Showerhead with shower valve and pull chain, eye wash bowl, eyewash valve, pipe and fittings to be furnished and installed by general contractor. This Contractor shall provide all domestic water and waste piping.

2. This Contractor shall furnish and install mixing valve Bradley Model EFX8 (or approved equal) with ½" inlet and ½" outlet for emergency eye wash. Mixing valve to meet or exceed ANSI Z358.1 requirement. Where feasible the mixing valve is to be installed in the furniture and is to be accessible. If unable to install the mixing valve in the furniture, the mixing valve is to be installed above ceiling and to be accessible. This Contractor shall verify exact location of mixing valve in field with furniture and new construction.

3. This Contractor shall furnish and install mixing valve Bradley Model EFX60 (or approved equal) with 1¼” inlet and 1¼” outlet for emergency shower. Mixing valve to meet or exceed ANSI Z358.1 requirement. Where feasible; the mixing valve is to be installed in the furniture and is to be accessible. If unable to install the mixing valve in the furniture, the mixing valve is to be installed above ceiling and to be accessible. This Contractor shall verify exact location of mixing valve in field with furniture and new construction.

2.16 P-18 – FUME HOOD

1. This Contractor to provide all domestic water and waste piping, compressed air and gas (where indicated). Fume hood to be furnished and installed by general contractor. Faucet to be furnished by general contractor and installed by this Contractor, see Section 15015.

2. Provide acid pipe per Section 15115 and 15475.
2.17 **P-19 – ICE MACHINE**

1. Provide water filter per manufacturers’ requirements and indirect waste to floor sink.

2.18 **P-20 - ELEVATOR SUMP PUMP**

1. Enpo-Cornell (or approved equal) submersible, automatically controlled sump pump (50 GPM at 15’ head - ½ HP) in terra cotta sump. Provide discharge check and shut-off valve.

2. Unless otherwise noted, sump pump shall be installed in elevator pit and/or in other location as indicated on plans.

3. Sump pump installed in elevator pit shall have 2” dia. discharge piped to the outdoors.

4. Contractor shall furnish and install See Water Oil Smart® Pump Controller and Alarm Panel Pump System or an approved equal. Sump Pump System shall be capable of pumping water without the risk of pumping oil. The system shall automatically function as Oil Containment system relying on no moving parts. Pump Control shall automatically control pump to discharge water without pumping oil, while separate alarm on independent 120 VAC alarm circuit shall alarm and differentiate in the event of high oil or high-water condition.

2.19 **P-21 – 3-COMPARTMENT SINK**

1. Tabco Model 93-3-54 or approved equal; 16-gauge, 304 stainless steel, welded side, cross brace, stainless steel legs, 8” backsplash, 12” deep bowls, three (3) 16”x20” bowls with K1 12” swing faucet, faucet mounting kit, 3 twist handle operated drain.

2.20 **P-22 – HAND WASH SINK**

1. Tabco Model 7-PS60 or approved equal; 14”x10”x5” with Model K-59 splash mounted faucet, 3½” basket drain and wall bracket.

**PART 3 EXECUTION**

3.01 **INSTALLATION**

1. All fixtures shall be installed after finished surfaces are complete; they shall be set neat and flush without damage to adjacent surface.

2. All equipment shall be installed in a neat workmanlike manner.

3. All floor mounted fixtures to be set on silicone caulking as further waterproofing.

**END OF SECTION**

15450.5801
SECTION 15460 – VACUUM SYSTEMS

PART 1 GENERAL

1.01 SCOPE

1. The work under this heading shall include the furnishing and installation of:

   A. All medical gas piping and connections to all equipment requiring compressed air and vacuum whether furnished by this Section or not.

   B. All air compressors.

   C. All materials, piping, specialties and control wiring required for the proper function of the work.

   D. Pipeline system, testing, checkout and report as required by NFPA.

1.02 APPROVALS

1. All medical gas piping shall be installed in accordance with all applicable NFPA and NSPC and IBC codes.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

1. Vacuum - Type "M" copper or PVC. PVC pipe not in plenum.

2. Brazing Alloy - Aircosil 45 silver brazing alloy or approved equal (at least 1,000 degrees), melting point and physical properties.

2.02 VACUUM PUMP

1. Provide Fisherbrand Maxma C Plus vacuum pump or approved equal.

2. Pump shall be 12 ¼"x7 ¼"x10.75" rated at 320 L/minute.

3. Pump shall have all appurtenances ¾ HP and 1,725 rpm.

2.04 VALVES

1. Valves shall be bronze-bodied, double-sealed, full-flow, ball type with neoprene seat seals and O-ring packing designed for working pressure to 300 psi, chrome-plated bronze ball which seals in both directions, and adjustable Teflon steam seals and bearings, self-compensating. The valves shall be so designed that only a quarter turn of the lever-type handle is necessary between the open and closed positions. Gas service labels shall be provided for each service as required.
SECTION 15460 – VACUUM SYSTEMS

PART 3 EXECUTION

3.01 INSTALLATION

1. All vacuum pumps shall be installed in accordance with NFPA Codes and the standards for medical-surgical vacuum systems in hospitals, Compressed Gas Association (CGA) pamphlet #P2.1.

2. Systems shall be blown clear using compressed air or nitrogen.

3. Systems shall be tested for 24 hours at 1-1/2 times the working pressure.

4. All lines to be verified to assure proper gas to outlets.

END OF SECTION
15460.5801

VACUUM SYSTEMS 15460-2
SECTION 15475 - ACID RESISTANT WASTE VENT & NEUTRALIZING SYSTEM

PART 1 GENERAL

1.01 SCOPE

1. Furnish and install complete acid resistant waste and acid neutralizing tank system as shown on the drawings.

2. Leave equipment completely installed so that only the connection of auxiliary services is required to make ready for start up.

3. Provide all materials, miscellaneous equipment and interconnecting piping required for the proper functioning of the work.

4. Provide rough-in for connection to fixed equipment as specified in Section 15015.

1.02 ACID NEUTRALIZING INTERCEPTOR

1. Furnish and install where indicated on drawings, an acid neutralizing tank. Unit shall have bolted cover and shall have a vent opening.

2. Connections to tank may be either hub end with caulked joint or threaded.

3. The neutralizing medium with each tank is filled up to the invert of the inlet, should be marble or limestone in pieces of not less than 1" and not more than 3" in size.

4. Materials shall be either calcium or magnesium carbonate or both with a calcium carbonate equivalent of at least 90%. Agricultural limestone meets this specification.

5. Acid neutralizer tank size shall be as indicated on plans and Orion Style 4 or approved equal; 15-gallon capacity, 3" inlet and outlet vent, 16 ¼" high x 11"x3".

1.03 PIPING MATERIALS

1. Piping material to be as specified in Section 15115.

2. Joints for all piping in easily accessible spaces up to 3" diameter shall be mechanical type or heat fusion.

3. Joints for all piping in accessible spaces 4" dia. and over shall be made by heat fusion only.

4. Joints for all piping in concealed spaces shall be made by heat fusion only.

1.04 EXECUTION

1. Provide acid resistant cleanouts at lower ends of stacks at each change of direction where indicated or where required by local code.

2. Provide minimum slope 1/8"/ft. and minimum 2" diameter on all underslab pipe, or as required by code.
SELECTION 15475 - ACID RESISTANT WASTE VENT & NEUTRALIZING SYSTEM

3. Locate neutralizing sump in pit (pit by general contractor). Provide shop drawing and information on sump and piping to general contractor. Coordinate sleeves, pit depth, and all details with general contractor.

END OF SECTION
15475.5801
SECTION 15560 - FIRE PROTECTION SYSTEMS (INTERIOR)

PART 1  GENERAL

1.01  SCOPE

1.  The work under this heading shall include the furnishing and installation of:

   A.  All piping, equipment and materials necessary, including connections to all equipment
       required for the proper functioning of the work.

1.02  CODES AND REGULATIONS

1.  All work done, all equipment and materials used and all tests shall be done to meet the
    approval of the insurer as well as local authorities having jurisdiction.

1.03  INSPECTION

1.  All work shall be inspected by the Insurer and any local authorities having jurisdiction;
    certified copies of these approvals shall be delivered to the Owner before final payment.

1.04  SHOP DRAWINGS

1.  This Contractor shall prepare shop drawings showing all runs of piping and necessary details
    and elevations.

2.  Shop drawings shall be prepared and sealed by a registered Professional Engineer and shall
    be submitted and approved by the inspecting authorities before submission to the Architect
    and/or Engineer for record only.  Architect and Engineer will not review shop drawings.

3.  This Contractor shall submit along with shop drawing the calculations required for
    engineering of the system.

4.  Shop drawings shall be submitted to all Contractors, Sub-Contractors and/or any other entity
    which require drawings for coordination of their work with the fire protection.  The drawings
    shall be submitted in a timely manner so as to impede the progress of any other trades.

5.  If shop drawings are submitted for coordination prior to approvals and there is a change to the
    system required due to the approvals; this Contractor shall pay for all cost incurred by other
    Contractors, Sub-Contractors and/or Suppliers incurred due to changes.

1.05  QUALIFICATIONS

1.  This Contractor shall be licensed to install sprinkler systems and be experienced in
    installation of sprinkler systems.

1.06  APPROVALS

1.  This Contractor shall prepare and be responsible for all drawings, documents and work
    required, etc., to obtain State and Local approvals.  Copies of the above shall be submitted to
    the Architect and/or Engineer after approvals are obtained.
SECTION 15560 - FIRE PROTECTION SYSTEMS (INTERIOR)

PART 2 PRODUCTS

2.01 FIRE DEPARTMENT CONNECTION

1. Where Fire Department connections are shown in walls, they shall be 4" storz; Guardian Model 6624 with cap (or approved equal). Alternate manufacturers will be accepted but must be approved by Fire Marshall. Remote fire department connection shall be 4" storz; Guardian Model 6634 (or approved equal). All connections shall be polished brass and shall be installed with rubber seated check valve and ball drip. The final location and thread type shall be per local authorities.

2.02 PIPING MATERIALS

1. All piping above ground to be black steel, all dry sprinkler pipe, Schedule 40, with screwed or flanged joints; all fittings to be cast iron - 175 psi W.W.P. approved type. Victaulic or similar grooved piping may be used, provide separate price and submit for approval, if locally acceptable (except for in exposed pipe in finished areas).

2. All piping underground shall be cast iron water pipe. Alternate materials may be acceptable if locally approved.

3. All valves, checks, etc., shall be of the approved type, designed for not less than 175 psi W.W.P.

4. Use of unions is prohibited unless specifically approved by the Owner, the Architect and/or the Engineer, and the inspecting authority all in writing.

2.03 ELECTRIC HEAT TAPE

1. Provide electric heat trace tape for those portions of fire protection system subject to freezing.

2. This Contractor shall be responsible for all electrical wiring outlets, etc., as required for the proper functioning of the work.

2.04 BACKFLOW PREVENTORS

1. Provide as indicated or as required by local codes, and/or approving agency (on the plans) packaged, double check valve backflow preventers for protection against backflow of pollutants through cross connections due to back pressure or back siphonage.

2. Units shall have two counter-weighted check valves which will maintain 1 psi back pressure. Check valve body and trim shall be iron. Units shall have OS & Y indicating type gate valves on inlet and outlet. Provide 4 corporation stops, air vents, galvanized check valve bodies and cover. All valves shall be supervised.

3. System shall be ASSE, FM approved UL classified rated at 175 psi WWP. Viking Model A-1 or approved equal, size as required by NFPA or approved equal.
SECTION 15560 - FIRE PROTECTION SYSTEMS (INTERIOR)

2.05 WATER METER

1. Provide water meter per MUA requirements on incoming fire service.

PART 3 EXECUTION

3.01 MINIMUM COVER

1. Minimum cover for underground lines shall be as required by the inspecting authorities, but not less than 3’6”.

3.02 APPURtenANCES

1. Contractor shall furnish all appurtenances as required for the proper operation of the system in accordance with NFPA local codes and insuring agency requirements including, but not limited to field tests, painting disinfections identification signs.

3.03 WIRING

1. All control wiring, interlocking wiring, wiring between valves, sensors, panels and alarms shall be by this Contractor. All work per National Electrical Code.

END OF SECTION
15560.5112
SECTION 15570 - AUTOMATIC SPRINKLER SYSTEM

PART 1  GENERAL

1.01  SCOPE

1.  Provide all piping for full sprinkler protection of the building, or those areas shown. Provide all pipe, equipment, material and appurtenances necessary for the proper functioning of the work as hereinafter specified.

2.  Provide required zoning of system including indication.

1.02  CODES AND REGULATIONS

1.  All work done, all equipment and material used and all tests shall be done to meet the approval of the NFPA, local codes and insurer as well as local authorities having jurisdiction.

1.03  INSPECTION

1.  All work shall be inspected by the insurer and any local authorities having jurisdiction; certified copies of these approvals shall be delivered to the Owner before final payment.

1.04  SHOP DRAWINGS

1.  This Contractor shall prepare shop drawings showing all runs of piping and necessary details and elevations.

2.  Shop drawings shall be prepared and sealed by a registered Professional Engineer and shall be submitted and approved by the inspecting authorities before submission to the Architect and/or Engineer for record only. Architect Engineer will not review shop drawings.

3.  This Contractor shall submit along with shop drawing the calculations required for engineering of the system.

4.  Shop drawings shall be submitted to all Contractors, Sub-Contractors and/or any other entity which require drawings for coordination of their work with the fire protection. The drawings shall be submitted in a timely manner so as to impede the progress of any other trades.

5.  If shop drawings are submitted for coordination prior to approvals and there is a change to the system required due to the approvals, this Contractor shall pay for all cost incurred by other Contractors, Sub-Contractors and/or Suppliers incurred due to changes.

1.05  DESIGN

1.  Contractor shall use hydraulically designed sprinkler system, calculations shall be based upon NFPA and shall have a minimum of 15% safety factor between required system pressure and actual pressure available. Submit calculations for approval to Inspecting Authorities before submission to the Architect and/or Engineer for record.
SECTION 15570 - AUTOMATIC SPRINKLER SYSTEM

1.06 FLOW TEST

1. This Contractor shall obtain in writing from local utility company results of latest flow test for use in preparing hydraulic calculations. Flow test should include all pertinent data and dates when test was conducted along with any anticipated seasonal variations. The lowest flow and pressure shall be used in system design.

2. If no flow test data is available, this Contractor shall either make arrangements with local utility company to perform flow test or perform his own flow test, either to be done at no additional cost to Owner.

PART 2 PRODUCTS

2.01 FIRE DEPARTMENT CONNECTION

1. See section titled "Fire Protection Systems (Interior)".

2.03 ALARMS

1. Provide approved variable pressure type alarm valves and water motor alarms for each wet system. Valves shall be designed to prevent false alarm due to pressure surges. Water motor alarm shall be mounted on outside wall of building, and the name of any manufacturer or contractor appearing thereon shall be painted out before installation. For pre-action, dry system, deluge or special type system as shown or required, provide type alarm valve suitable for use with that system.

2. Provide electric flow switches on each zone and in each branch of the zone. Flow switches shall be wired by this Contractor to a separate annunciator panel. The panel shall indicate flow switch activation and location. Provide an auxiliary contact which can be used by alarm company.

3. Provide electric "tell-tale", switch on each valve controlling sprinkler system water, so arranged that if any valve is shut light will flash and alarm will ring. Light and alarm horn shall be in separate annunciator panel, (located as directed, with separate pilot light to indicate which valve has been tampered with. Provide horn silencer at panel, a ring back feature shall be provided with a silence normal two position switch.

4. Provide strobe light and motor alarm at front and rear (near siamese connection on front).

2.04 SPRINKLER HEADS

1. All sprinkler heads shall be of the approved type of sidewall, upright or pendant installation with temperature rating required. Sprinkler heads in the pendant or sidewall position shall be chrome plated and provided with chrome plated escutcheon. Provide upright heads with guards under equipment, ducts over 48 inches etc., as required.

2. Sprinkler heads in suspended finished ceilings shall be fully recessed and concealed with coverplate painted color selected. Heads shall be located in center of ceiling tile.

3. Quick response EFSR or other types of heads shall be used as required for service.
SECTION 15570 - AUTOMATIC SPRINKLER SYSTEM

4. In security areas, provide vandal-proof institutional type heads and separate branch pipe with separate shut-off valve for these areas.

5. Sprinkler heads in skylight shall be high-temperature sidewall type.

2.05 PRESSURE GAUGES

1. Pressure gauges shall be installed where required on all sprinkler risers, one on each side of alarm check valve. Gauges shall have a brass case, nickel plated ring, 5" dial with pressure reading from 0 to 150 pounds per square inch. Gauges shall be located for convenient observation and shall be equipped with brass cocks for control and test purposes.

2. Pipe and fittings between gauge and standpipes shall be unfinished brass (ASTM Specification B-4-3042).

2.06 TOOLS AND SPARE HEADS

1. A set of tools required to remove or replace sprinkler heads or to make adjustment in water alarm valves shall be furnished. Tools and heads shall be provided in a metal box with hasp, lock and two keys capable of containing all items, provided with brass plated riveted on, engraved, "Sprinkler Tools", in block letters no less than 3/4" high. Twenty-four (24) spare sprinkler heads shall also be furnished.

PART 3 EXECUTION

3.01 PIPING INSTALLATION

1. In general, all piping shall be run near the roof, hung from overhead, and above suspended ceiling. All piping shall be graded and drain valves with plug type discs provided to permit complete drawings.

2. Sprinkler heads on exposed piping shall be upright, on concealed piping pendant type.

3. Provide 2" drain on each sprinkler riser with slight glass.

4. Provide Inspector's Test Connections for each system. Line shall be installed with valve located so that it can be reached from the floor and shall terminate in a brass outlet giving the flow equivalent of one sprinkler. Drain to splash block located outside of building or floor drain.

3.02 WIRING

1. All control wiring, interlocking wiring, wiring between valves, any and all wiring required for the work, sensors, panels and alarms shall be by this Contractor. All work per National Electrical Code.

END OF SECTION
15570.5801
SECTION 16100 - GENERAL ELECTRICAL

1. GENERAL PROVISIONS

1.1 The applicable provisions of the Division 1 General Conditions, Supplemental Conditions, Special Contract Requirements, Amendments and Additions to the General Conditions, and all project addenda are hereby made an integral part of this section.

1.2 These specifications apply to all electrical work performed.

1.3 When apparent conflict exists between these specifications and the contract drawings, within the specifications, or within the drawings, the engineer will determine the intent.

1.4 The term "provide" means "furnish and install". The terms "contractor" and "E.C." mean "electrical contractor", unless otherwise noted. All work indicated in specifications division 16000 and on the electrical drawings is by the electrical contractor, unless otherwise noted.

1.5 The terms "unless otherwise noted" or "unless otherwise indicated" in any form of wording mean "unless specifically indicated otherwise on the electrical drawings, in the electrical specifications, or in the General Conditions and Requirements to the specifications and/or contract". These terms do not mean "unless indicated otherwise on the general construction, mechanical construction, or other disciplines' drawings or specifications", except where specifically so worded on the electrical drawings or electrical specifications.

1.6 Materials and equipment manufacturers and catalog numbers specified constitute the type and quality of design, material, workmanship, ruggedness of construction, resistance to vandalism, exact operating and performance characteristics, features, configuration, dimensions, etc.. Where multiple manufacturers are shown in the drawings and/or specifications, not all manufacturers shown may be capable of providing materials and equipment meeting the specifications, field conditions, etc.. Manufacturers not specifically shown on the drawings or specifications shall be considered, provided the products equal or exceed the requirements of the drawings and specifications (including equaling or exceeding products and/or manufacturers specifically shown on drawings and specifications). Manufacturers, whether shown on the drawings or specifications or not, are acceptable only if they can meet the specifications, conditions, and requirements specific to this project. Provide materials and equipment as required (include all costs in bid).

1.7 For any equipment indicated on the drawings or specifications as furnished by the owner (or furnished by any other party, including other contractors, subcontractors, or third parties), contact the furnishing party prior to submitting bid to obtain all requirements of such equipment as necessary to provide a complete installation. Provide all ancillary equipment as necessary which is not furnished but which is required for a complete installation of owner furnished equipment.

2. SCOPE OF WORK

2.1 The work governed by these specifications consists of providing all labor, materials, equipment, services, and related items/work necessary to complete all the electrical work as indicated and described in the drawings and specifications.
SECTION 16100 - GENERAL ELECTRICAL

2.2 Electrical work includes but is not limited to:

A. Electric service and service equipment
B. Power distribution and wiring
C. Interior and exterior lighting
D. Emergency power and lighting
E. Utilization equipment connections
F. Fire alarm system
G. Data/Telephone/Security raceway/pathway system
H. Temporary power and lighting
I. Select wiring for low voltage systems

3. CONTRACT DRAWINGS AND SPECIFICATIONS

3.1 Drawings are diagrammatic and indicate the general arrangement of the various systems and approximate and relative locations of the materials and equipment defined by the specifications. Coordinate with and obtain the approval of the owner, architect, and engineer for the exact locations of all materials and equipment. Check the drawings, specifications, and all fabrication and shop drawings (including fabrication and shop drawings of other trades) to verify space conditions, headroom requirements, characteristics, and for coordination. Where space conditions and headroom requirements appear inadequate, notify the engineer before submitting a bid. No consideration or allowance will be granted for failure to notify the engineer, or for any alleged misunderstanding of the requirements above. Completely furnish, install, connect, and interconnect all components of all systems in accordance with contract requirements, manufacturer's instructions, applicable codes and standards, and best practices of the trade.

3.2 Minor deviations, variations, changes, and corrections from layouts shown on the drawings (based on coordination, conditions, manufacturer's instructions, codes and standards, shop drawings, and verification of measurements and conditions) are permitted to facilitate construction provided the changes do not represent potential changes in scope of work (see the section of these specifications "Changes to the Scope of Work") and provided the changes are acceptable to the owner, architect, and engineer.

3.3 Before submitting bid, examine and check all drawings and specifications relating to all work, including electrical, mechanical, plumbing, general construction, fire protection, and any other trades' drawings and specifications (as well as Division 1 General Conditions) and become fully informed as to the extent and character of work required and its relation to the work of other trades. No consideration, claims, charges, or compensation will be granted for any alleged misunderstanding of the work to be performed, or the force and intent of these specifications.

3.4 Fully coordinate (prior to releasing doors and hardware) with the general contractor to ensure that all doors to rooms housing new large electrical equipment swing open in the direction of egress and are equipped with proper "panic" hardware (as per NEC Articles 110.26(C)(3) and 110.33(A)(3), where applicable).
SECTION 16100 - GENERAL ELECTRICAL

4. VISIT TO SITE

4.1 Before estimating work, visit the project site and verify all measurements and field conditions affecting the work. The contractor is fully responsible for the correctness of all measurements and for any connections to existing work. Submission of bid is considered evidence that this contractor has visited and examined the site. No consideration, claims, charges, or compensation will be granted for extra work as a result of the contractor's failure to visit the site or verify conditions and measurements.

5. VERIFICATION OF MEASUREMENTS AND CONDITIONS

5.1 The electrical contractor is solely responsible for verifying field measurements, conditions, and drawing and specifications information (for all trades) before ordering materials and equipment and before commencing work. The electrical contractor is solely responsible for verifying shop drawings (including shop drawings of other trades) before releasing related materials and equipment and before rough in. No consideration, claims, charges, or compensation will be granted due to any differences between the actual dimensions and any dimensions indicated on the drawings.

5.2 Report any apparent discrepancies or conflicts found at once to the engineer for consideration and wait for a decision before proceeding with any work in the affected area.

5.3 The engineer's decisions in cases of discrepancies, conflicts, and related to verification of measurements and conditions are final and binding upon the contractor, make all installation accordingly.

6. EXISTING CONDITIONS AND UTILITIES

6.1 Information and data indicated on the drawings regarding existing conditions (including underground utilities) is from the best available sources. However, no assurance is made as to completeness and/or accuracy.

6.2 Contact all utility companies operating in the project vicinity (water, gas, sewage, electric, telephone, cable television, etc.) and the owner's maintenance department (where applicable) and verify all existing underground systems before any excavation commences. Utilize applicable "one-call" or "before you dig" utilities marking services, including paying all associated fees.

6.3 Relocate any existing underground electrical feeders and wiring in areas of construction and around proposed foundations as required. Include all costs in bid. If any third-party owned wiring or equipment interferes with construction, notify the engineer.

7. ITEMS NOT SHOWN OR SPECIFIED

7.1 Provide any items of material not indicated on the drawings and/or not specified, but which are required for the complete and proper installation and/or operation of any part of the work, as if indicated and specified.
7.2 Provide any work not indicated on the drawings and/or not specified, but which is required for compliance with applicable codes and regulations, as if indicated and specified.

7.3 No consideration, claims, charges, or compensation will be granted for performing work required for complete and proper installation/operation or required for compliance with applicable codes and regulations.

8. REGULATIONS AND CODES

8.1 Perform work in accordance with all respective requirements of the latest adopted editions (as of the date of electrical construction permit approval) of all applicable federal, state, and local codes, standards, regulations, ordinances, laws, etc. and industry standards. This includes applicable requirements of the National Electrical Code (NEC), National Fire Protection Association (NFPA), American National Standards Institute (ANSI), Americans with Disabilities Act (ADA) (as well as all related state disabled access and/or barrier free codes and standards and ANSI A117.1), International Building Code (IBC), International Energy Conservation Code (IECC), International Residential Code (IRC), Factory Mutual (FM), Illuminating Engineering Society of North America (IES, IESNA), Institute of Electrical and Electronic Engineers (IEEE), Insulated Power Cable Engineer's Association, National Electrical Contractors' Association (NECA) "Standard of Installation", National Electrical Manufacturer's Association (NEMA), National Electrical Safety Code (N.E.S.C.), Underwriter's Laboratories (UL), United States Department of Labor Occupational Safety and Health Administration (OSHA), utility companies requirements, etc..

8.2 Where listing or labeling (in any form, i.e. UL, CSA, ETL, etc.) is indicated in the drawings or specifications or is otherwise required by the NEC or other applicable code, provide equipment and materials as either listed or labeled by a qualified product evaluating organization (UL, CSA, ETL, or approved equal) acceptable to the local authority having jurisdiction. Include all costs in bid. No extra claims or compensation shall be granted under any circumstance associated with providing listed equipment.

A. The electrical contractor is fully responsible for verifying (before submitting bid) the applicability and extent of code required listing with the local authority. Specifically verify if the municipality has any requirements that "listable" (capable of being listed) products must be "listed". Provide accordingly where applicable.

B. Submission and/or approval of shop drawings (which may or may not show listing) do not relieve the contractor of the responsibility to meet listing requirements.

C. Where products required (by specifications/code) as listed are installed without listing or as non-listed (without prior written approval), the contractor shall remove the products and install listed products at no cost to the owner. Written approval will only be considered if all of the following are satisfied:
SECTION 16100 - GENERAL ELECTRICAL

1) The contractor is fully responsible for (including all costs) and must prepare and submit any and all information necessary for review and evaluation of products (by the authority having jurisdiction, engineer, architect, and owner). This includes all processing costs for all parties involved and costs for any special or independent third party inspections, investigations, evaluations, engineering services (including sealing by a registered professional engineer), etc. which may be required or requested in conjunction with approval. In the absence of listing, the contractor is fully responsible for proving that products are acceptable.

2) The contractor must show one (1) or more of the following:
   a) That listed products are not available.
   b) That providing available listed products involves excessive costs or hardships.
   c) That listing of products involves requirements that unreasonably exceed the requirements of the specifications, codes, and project conditions.

3) Products must meet or exceed all specified requirements, industry standards, code requirements, and conditions specific to the project.

4) There must be no change in contract price (except that the owner reserves the right to require credit pricing).

5) Where acceptable to the owner.

8.3 Where NEC article numbers are referenced in the drawings and specifications, they apply to the latest edition. Where the authority having jurisdiction has not adopted the latest edition, refer to the equivalent applicable code requirement article.

9. PERMITS, CERTIFICATES, AND FEES

9.1 Apply for, obtain, pick-up, and pay for (pay all costs associate with) all permits, licenses, certificates, etc., required for execution of the project. Procure all permits immediately upon notice to proceed with the contract. The contractor is fully responsible for verifying all permits, licenses, certificates, etc. which are required. Submit (see the section of these specifications "Summary of Submissions") copies of all permits, licenses, certificates, etc. in conjunction with this project for record. If requested by the Local Code Official, prepare all information and data for submittal to any authority as required to obtain permits and certification of compliance for the permits. This specifically includes this contractor reproducing contract drawings for permit submission, which shall be sealed by an electrical engineer if required by the Local Code Official.

9.2 Obtain and submit (see the section of these specifications "Summary of Submissions") six (6) copies of inspection certificate(s) from authorities having jurisdiction indicating approval of the electrical installation. Arrange and pay for all electrical inspections (performed by an approved Underwriters Inspection Agency) associated with inspection certificate(s).
SECTION 16100 - GENERAL ELECTRICAL

9.3 Applicable utility service charges will be paid directly by the owner. Obtain and submit (see the section of these specifications "Summary of Submissions") written estimates from all respective utility companies prior to utilities performing work.

9.4 If and when requested by the owner or owner's representative, the electrical contractor shall submit to the owner any information necessary as part of the owner's application or submission for applicable grants, rebate programs, reimbursement programs (including, but not limited to, energy rebate programs such as "smart start" or "clean energy"), or other similar/related programs. Submit all required documentation, including, but not limited to, detailed pricing information on materials and/or labor, bills of materials, invoices, receipts, counts, take-offs, other related cost information, submittals, shop drawings, etc.. Compile information in format as required for submission as directed by the owner or owner's representative including tables and other formats as requested.

10. GUARANTEE AND WARRANTIES

10.1 The electrical contractor is fully responsible to guarantee all electrical equipment and work (applies to all materials and equipment, including lamps for luminaires) and is fully responsible for all manufacturers' warranties from material purchase (by the contractor), through the date of final acceptance by the owner, to the expiration date(s) of the guarantee and warranties. Guarantee and provide warranties for a period after the date of final acceptance by the owner as per Division 1 General Conditions, unless longer periods are specifically indicated otherwise on the electrical drawings or specifications. Guarantee/warranty periods of less than two (2) years after date of final acceptance are not permitted under any circumstance.

10.2 Wherever "warranties" are indicated elsewhere in the specifications, provide and submit (see the section of these specifications "Summary of Submissions") written manufacturers' warranties for equipment. Include all costs in bid associated with providing specified warranties periods (including purchasing any required extended or special warranties to meet the specified periods). Submission of written warranties showing periods, conditions, or coverage of less than the periods, conditions, and coverage specified does not relieve the contractor or manufacturers' of the responsibility to provide warranties with periods, conditions, or coverage as specified. Manufacturers' warranties do not relieve the contractor of any responsibility associated with the electrical contractor's guarantee.

10.3 The electrical contractor shall guarantee and respective manufacturers shall warranty equipment and materials from defects in workmanship, materials, and operation. Provide guarantee/warranties including all service, maintenance (excluding routine maintenance), materials, labor, travel, all other work, and all expenses required as part of guarantee/warranties. Provide all guarantee/warranties service at no extra cost to the owner under any circumstance. Provide all guarantee/warranties service in timely manner.

10.4 Completely replace or repair, to the satisfaction of the owner, any equipment (as part of this project) improperly installed or damaged before or after installation until expiration of the guarantee period. Completely replace or repair, to the satisfaction of the owner, any equipment (including existing equipment and equipment installed by any other contractor or party) damaged by the electrical contractor (or any subcontractor thereof).
11. SEQUENCE OF WORK

11.1 Perform work in areas or general sequences (including applicable project phasing) as determined and directed by the owner and architect. Submit (see the section of these specifications "Summary of Submissions") a complete schedule of construction for approval, showing delivery of equipment, erection of equipment, pertinent work related to installation, and when equipment will be placed in operation. Fully coordinate exact sequencing, phasing, and scheduling with all contractors, the architect, and the owner in detail and obtain approval of sequencing, phasing, and scheduling before starting work.

11.2 Perform all work in such a manner and associated with sequencing, phasing, and scheduling as required and include all costs and manpower allocations in bid. For example, to complete a particular sequence or phase of the work, it may be necessary to perform work in physical areas of the project areas which are covered by and/or part of prior phases or subsequent phases of work (i.e. work in initial phases of the project may involve installing the electrical service and electrical distribution equipment in areas which are proposed for renovation as part of a later phase; this would require installing the electrical service and electrical distribution equipment as part of the initial phase). Verify all such conditions, implications, requirements and include costs in bid. No consideration, claims, charges, or compensation will be granted under any circumstance for sequencing, phasing, and scheduling.

11.3 Maintain service at all times (except as provided elsewhere in the drawings and specifications for shutdowns) and minimize disruptions to all active areas, activities, and operations in and around the scope of work. This specifically includes activities and operations of the owner, third parties in the vicinity of the project, roads and highways surrounding the project, and utility companies serving the project. Coordinate specific requirements with the owner before submitting bids.

11.4 Maintain service of life safety systems (specifically emergency lighting and fire alarm) at all times.

A. As a minimum, maintain the following during construction (except brief periods, not exceeding one (1) working day, while making connections to or transitions between existing, proposed, and temporary systems [where applicable]):

1) Maintain code compliant emergency lighting in all occupied areas of the building. Emergency lighting is not required in unoccupied areas and other areas closed to use by building occupants.

2) Maintain manual fire alarm operation throughout the entire building (including areas under construction). This includes manual pull stations (existing, proposed, and/or temporary) at all active building means of egress exits (i.e. exits from each floor to stairwells or the exterior). This includes audible signaling devices to adequately warn building occupants and construction personnel (visual signaling is not required and signaling is not required to comply with the ADA during construction).
SECTION 16100 - GENERAL ELECTRICAL

3) Maintain supervision of all active sprinklers in the building. This includes monitoring flow, tamper, and pressure switches.

4) Maintain service to automatic fire detection as much as practical. Automatic fire detection is not required to operate in areas of construction at times when construction personnel are present (who can activate manual fire alarms). Other shutdowns of automatic fire detection may be considered, if approved in writing by the owner.

4) Whenever ADA approved signaling is not operational during construction, the electrical contractor's construction personnel shall be instructed with and shall carry out procedures to manually notify any disabled building occupants of fire emergencies (this provision does not apply if the existing fire alarm system is not ADA compliant or is not present).

5) Whenever HVAC duct smoke detection systems are not operational during construction, the electrical contractor is responsible for maintaining clear and unobstructed access to HVAC controls and/or disconnecting means (to facilitate manual operation in the event of a fire).

B. To satisfy requirements above, any existing and proposed life safety systems may be used as much as practical. Where requirements cannot be satisfied using existing/proposed systems, provide suitable temporary life safety systems (including all associated temporary wiring) as required.

C. Whenever unable to meet the above requirements, the electrical contractor (at the electrical contractor's expense) shall provide continuous fire watch.

12. CHANGES TO THE SCOPE OF WORK

12.1 Changes to the scope of work include any change effecting the overall nature or cost of the project. Examples of changes to the scope of work include, but are not limited to, additions or deletions of equipment or items of work, substitutions not equivalent or superior to equipment specified, substitutions with characteristics or operation varying from equipment specified, changes which effect the ultimate use or functioning of equipment or areas of the building, changes considered to be "substantial", any change which any party (contractors, sub-contractors, owner, architect, engineers, etc.) believes may involve a possible change in contract price, etc..

12.2 Make all changes to the scope of work in complete accordance with the general conditions of the specifications. Submit (see the section of these specifications "Summary of Submissions") changes to the scope of work immediately upon proposal of changes. Do not proceed with any work associated with or affected by changes to the scope of work unless the owner approves changes in writing or authorizes proceeding in writing.

12.3 All applicable provisions of the contract drawings and specifications, including addenda and prior changes, apply to all changes to the scope of work, unless specifically indicated otherwise.
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12.4 In addition to all requirements of the general conditions, submit all pricing related to changes to the scope of work as indicated below. Pricing will not be reviewed until the required breakdowns (summarized below) are submitted.

12.5 Submit pricing for a proposed change to the scope of work with detailed breakdown as follows.

A. Submit a complete detailed breakdown of all material associated with the proposed change in scope of work. Itemize each unit of material and the respective cost.

B. Submit a complete detailed breakdown of all labor associated with each respective item of the above material breakdown. Itemize labor hours and classification for each item of material. Summarize total labor costs, broken down by worker classification and/or billing rate.

12.6 Where instructed to proceed with a change to the scope of work on a time-and-material (T&M) basis, submit pricing with detailed breakdown as follows.

A. Submit a complete detailed breakdown of all material. Submit copies of all receipts, invoices, and stock material lists.

B. Submit a complete detailed breakdown of all actual labor hours. Submit copies of time sheets. Summarize total labor costs, broken down by worker classification and/or billing rate.

13. TEMPORARY POWER AND LIGHTING

13.1 For this specification section only, the term "responsible" (in any form) means "responsible to pay all costs (pay to the electrical contractor) to erect the described work". For this specification section only, the term "erect" (in any form) means "furnish, install, maintain, and remove".

13.2 The electrical contractor is responsible for temporary power and lighting service/source and distribution during construction. Provide service capacity as required for construction. Provide service including any required utility or private metering.

13.3 The electrical contractor is responsible for all temporary lighting, all 120 V power for small construction tools, and all other temporary power not exceeding 120 V or 20 A. Power for large tools and equipment exceeding 120 V or 20 A (including arc welders, etc.) is the responsibility of the contractor requesting such power. Temporary power during construction (exceeding 120 V or 20 A) to permanent equipment installed as part of this project (for installing, testing, operating, etc., including mechanical equipment, elevators, etc.) is the responsibility of the contractor requesting such power.

13.4 Where a general contractor's construction trailer is present, the electrical contractor is responsible for a minimum 60 A, maximum 200 A single phase service to the trailer. Provide service including any required utility or private metering. Temporary service to any other contractor or subcontractor trailer is the responsibility of the contractor requesting such service.
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13.5 Where utility power is not available and during shutdowns of utility power, the contractor requesting power under these conditions is responsible for providing portable generator(s), associated temporary wiring, and fuel (as required to meet power requirements during these conditions). Generator power to owner loads during construction is not required (unless specifically indicated on the drawings).

13.6 The electrical contractor is responsible for temporary power to existing and/or other owner loads, equipment, and wiring as indicated on the drawings.

13.7 The electrical contractor shall erect all temporary power equipment and wiring as required for complete temporary power installation, regardless of the contractor who is responsible for the temporary power.

13.8 Erect all temporary power and lighting during construction in accordance with OSHA and the NEC. This includes required ground fault circuit interrupter (GFCI) protection for personnel and "assured grounding program".

14. TESTING

14.1 After completing installation of equipment and wiring and prior to energizing or placing in service, test all electrical equipment, conductors, systems, and each and every part thereof to insure continuity, proper splicing, freedom from unwanted grounds, acceptable insulation values, proper operation and functioning, and a complete workmanlike installation to the satisfaction of the engineer and owner.

14.2 Completely test all equipment installed. This includes all equipment furnished and installed by the electrical contractor as well as equipment furnished by others and installed by the electrical contractor and equipment furnished and installed by others and wired by the electrical contractor.

A. Electrical tests of panels, switches, and circuit breakers rated 800 A and less and 600 V and less are not required, except that meg-ohm meter testing is required.

B. Electrical tests of motors 75 kW (100 hp) and less are not required.

C. Electrical tests of individual motor starters are not required. This does not apply to motor control centers (where applicable), where complete testing is required.

D. Visual and mechanical checks are required for all equipment (including all panels, switches, circuit breakers, motors, motor starters, and all other equipment) without exception.

14.3 Test all equipment and wiring as per the latest edition of InterNational Electrical Testing Association (NETA) standards (Acceptance Testing Specifications (NETA-ATS) for new equipment/wiring and Maintenance Testing Specifications (NETA-MTS) for existing equipment/wiring), unless indicated otherwise. For each piece of equipment, perform testing as shown for that equipment in respective NETA standards. Where equipment is not specifically shown in NETA standards, perform testing as shown for equipment most closely resembling the equipment to be tested. Perform all tests shown in respective NETA standards, unless indicated otherwise. Tests shown as "optional" in NETA standards are
not required unless specifically indicated otherwise on the drawings or specifications. Utilize suitable instruments in making all tests, as per NETA standards. Battery, magneto, or similar hand-held testers may be used for preliminary conductor continuity checking but are not acceptable for final results, which must be obtained utilizing proper equipment only (i.e. meg-ohm meter, etc.).

14.4 Provide all testing performed by a NETA accredited independent testing firm employed by the electrical contractor, unless indicated otherwise. Provide visual and mechanical checks shown in the NETA standards, testing of transformers 225 kVA and less (with primary and secondary voltages 600 V and less only), and testing of panels, switches, and circuit breakers 1,200 A and less and 600 V and less performed by the electrical contractor's direct employees or by the independent testing firm (at the contractor's option). Provide continuity and insulation resistance meg-ohm meter testing of 600 V and less conductors performed by the electrical contractor's direct employees only.

14.5 If requested by the owner or engineer, utilize a recording type (i.e. "Dranetz") meter to measure phase-to-phase voltage, phase to neutral voltage, phase currents, harmonic content, and surges in the system. Perform testing for a period of one (1) week. Completely set up and take down meter and submit printout tapes formal test results.

14.6 For all testing performed, submit (see the section of these specifications "Summary of Submissions") complete typewritten and tabulated test results for review and approval by the engineer and owner. Submit test result bound together in a single three-ring binder (one (1) binder per set of test results) including a table of contents. Submit quantity of sets as directed in the General Construction specifications, but in no case less than three (3) sets. Submit results upon project completion, except under conditions below.

14.7 Where any abnormal, questionable, "failing", or "borderline" test results are encountered or where discrepancies are noted during testing, submit results immediately to the engineer before energizing equipment. Do not energize until authorized in writing by the engineer. Test results submitted under these circumstances are not required to be bound or complete.

14.8 Where connecting to or otherwise modifying existing wiring, test wiring as follows.

A. Test existing wiring before performing work to confirm integrity (where testing is performed, the electrical contractor is not responsible for the prior existing condition of wiring).

B. Test new wiring before connecting to existing wiring.

C. Test connections of new to existing wiring (test new wiring and existing wiring together) and modified existing wiring after performing work.

Where this testing is not performed, the condition of existing wiring will be assumed to be a direct and sole result of work preformed and the electrical contractor will be held fully responsible for the condition of existing wiring. Where this testing is not performed and where existing wiring is not in acceptable condition for maintained use or service, the electrical contractor shall repair or replace wiring to the satisfaction of the owner at no cost to the owner.
14.9 Provide oscilloscope testing of all variable frequency drives (VFD's) installed as part of this project (with power wiring installed by the electrical contractor), including VFD's furnished by the mechanical contractor, other contractors, or the owner and including VFD's in motor control centers (where applicable). Perform oscilloscope testing to determine the presence/magnitude of voltage surges (at the VFD carrier frequency level, approximately 15 kHz to 25 kHz) associated with reflected wave phenomenon. Perform testing by making oscilloscope measurements at the VFD load terminals and at the motor line terminals (or at the disconnecting means local to the motor where motor terminals are not practical). Record oscilloscope readings with a suitable oscilloscope type "Polaroid" camera (or other recording means which accurately displays equivalent graphic information) and compare readings at the VFD with readings at the motor. Submit photographs with test results. Oscilloscope testing is not required for a VFD located directly adjacent to the motor served, provided the VFD and motor manufacturers submit written certification showing that the complete motor/VFD installation is fully coordinated (including considering reflected wave phenomenon); the electrical contractor is responsible for obtaining this written certification.

15. SUBSTITUTIONS
15.1 Materials and equipment manufacturers and catalog numbers specified constitute the type and quality of design, material, workmanship, ruggedness of construction, resistance to vandalism, exact operating and performance characteristics, features, configuration, dimensions, etc. The engineer will consider substitutions of similar equipment superior to specified equipment (meeting or exceeding all characteristics of the specified equipment).

15.2 Submit shop drawings associated with substitutions complete with documentation necessary to establish compliance with the specifications (see the sections of these specifications "Shop Drawings" and "Summary of Submissions"). Submit samples of substitutions where requested (see the sections of these specifications "Samples" and "Summary of Submissions"). If documentation and/or samples are not submitted when required, the request for substitution will be denied.

15.3 Determination of compliance with specifications rests with the engineer. When a request for substitution is denied, furnish the equipment specified. The engineer's decisions in cases of substitutions are final and binding upon the contractor, provide equipment accordingly.

15.4 Pay all costs associated with a substitution where granted. For the provisions of this section, "substitutions" includes equipment where characteristics or operation vary significantly from equipment specified (including equipment of the specified manufacturer). This includes costs incurred by any party (electrical contractor, other contractors, sub-contractors, owner, architect, engineers, etc.), costs resulting from differences of details, configuration, ratings, operation, characteristics, and dimensions between the specified and substituted equipment, costs to provide features of the specified equipment which may be manufacturer's options of the substituted equipment, and costs to remove and replace work already installed and any other remedial work as a result of substitutions. Approval of substitutions is conditional upon there being no cost change to the contract, unless specifically indicated on the shop drawings submittal and corresponding approval. The electrical contractor is fully responsible for coordinating with the owner, architect, and other trades to identify all possible cost impacts associated with any substitution before releasing equipment and before any party proceeds with work effected by the substitution.
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15.5 Submit bid based on the items as specified. Substitutions will be considered only after a contract has been awarded.

16. SHOP DRAWINGS

16.1 Submit a product list indicating all proposed items of products, materials, and equipment as directed in the general construction specifications.

16.2 Submit (see the section of these specifications "Summary of Submissions") shop drawings of all equipment and materials proposed to be furnished for review and approval by the engineer. Submit quantity of sets as directed in the general construction specifications, but in no case less than ten (10) sets.

16.3 Submit shop drawings for all equipment and materials including, but not limited to luminaires, solid state energy saving ballasts, raceways, conductors, cable, termination methods, grounding, wiring devices, safety switches, enclosed circuit breakers, branch and distribution panels, transformers, contactors, time clocks, photocells, fire alarm system, emergency power and lighting system equipment, engraved plastic nameplates, and any other items requested by the owner, architect, any code official, or engineer.

16.4 Stamp or mark shop drawings with the contractor's approval, as evidence that they were checked for accuracy and that all dimensions, characteristics, ratings, operation, features, data, relation to existing conditions, and coordination with work and shop drawings of other trades were completely verified before submission. Approval of shop drawings by the engineer does not relieve the contractor of responsibilities to review shop drawings in detail, to comply with drawings and specifications, for errors contained in shop drawings, for coordination, and to provide equipment as listed.

16.5 Where any characteristics, ratings, operations, or features differ from the specified equipment (where not equal to or superior to the characteristics, ratings, operations, and features of the specifications and specified equipment), circle, highlight, or otherwise clearly designate and identify the specific differences.

16.6 In the event that shop drawings are not acceptable to the engineer (including as provided below for conditional approval), submit acceptable shop drawings within seven (7) days of notification.

16.7 Approval of shop drawings, including approval of substitutions, is conditional that there is no cost change to the contract, unless specifically indicated on the shop drawings submittal and corresponding approval.

16.8 Approval of shop drawings is conditional upon the contractor fully and completely complying with all review comments by the owner, architect, and engineer. Where the contractor fails to or is unable to fully and completely comply with every review comment, then the shop drawings are disapproved (whether or not they are stamped or noted as "approved" in any manner in any review comment) and must be resubmitted as within seven (7) days (as indicated above). Immediately upon receipt of shop drawing review comments, the contractor is responsible for carefully reviewing all comments in detail and for complying with comments. Where unable to fully satisfy any comment or where the
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contractor takes exception to any comment, revise and resubmit acceptable shop drawings (or, where taking exception, notify the engineer in writing) within seven (7) days. Where the contractor fails to comply with these requirements (including resubmitting/notifying within the seven (7) day period specified), the contractor shall provide acceptable equipment meeting all specified requirements and all review comments (including removing unacceptable equipment [if installed] and replacing with acceptable equipment) at no cost to the owner.

16.9 Do not release equipment until shop drawings are approved. The electrical contractor is responsible for all changes where equipment is released before approval and/or where equipment does not comply with all approval conditions.

16.10 In addition to the quantity of shop drawings submitted for approval (see above), submit one (1) copy of approved shop drawings to the general contractor, the mechanical contractor, and each other contractor and trade for review and coordination. The electrical contractor is not required to submit copies direct to subcontractors or vendors to other contractors (this is the other contractors' responsibility). The electrical contractor is responsible for all changes and other costs where the electrical contractor fails to submit shop drawings to other parties for coordination.

16.11 Obtain copies of all shop drawings relating in any way to electrical work from all other contractors, subcontractors, and trades. Review shop drawings and coordinate with electrical work. Notify the architect and engineer immediately where discrepancies are found. The electrical contractor is responsible for all changes and other costs where the electrical contractor fails to obtain shop drawings or fails to coordinate shop drawing information. Approval of other trades submittals by the architect or engineers (or lack of review by the architect or engineers) does not relieve the electrical contractor of the responsibility to review other trades shop drawings in detail and for coordination.

16.12 No extra claims or compensation shall be granted under any circumstance associated with any party's failure or delay in properly submitting, transmitting, obtaining, reviewing, and/or coordinating shop drawings.

17. SAMPLES

17.1 Submit (see the section of these specifications "Summary of Submissions") samples of materials and equipment for approval only where specifically requested by the owner, architect, or engineer. Submit samples along with complete catalog data, installation instructions, operating and maintenance (O&M) information, etc. specifically applying to the samples submitted, to facilitate proper evaluate the quality of the sample. Specifically designate and identify each sample as to the service and location where each sample is to be used on the project.

17.2 Submit samples within 30 days of the engineer's request, except where the sample is ancillary to a substitution. Where samples are ancillary to a substitution, submit samples within seven (7) days of the engineer's request.

18. AS-BUILT DRAWINGS, MANUALS, AND DEMONSTRATION
18.1 Prepare and submit (see the section of these specifications "Summary of Submissions") as-built record drawings showing conditions exactly as installed.

A. Indicate the exact locations and elevations of all equipment and devices and underground, concealed, and hidden work (including raceways, junction and pull boxes, etc.).

B. Indicate exact layout, connections, and conductor routing for all grounding.

C. Indicate all substitutions, including marked-up lighting fixture/luminaire schedule and symbol list as required.

D. For underground work, specifically indicate exact conditions accurately. Where underground wiring does not run straight and direct between visible and obvious equipment, objects, or markers (i.e. markers specifically placed to identify underground work [specifically note the presence and approximate location of all markers on as-built drawings]), clearly, accurately, and exactly mark and dimension exact underground work (including all bends) from visible permanent landmarks. Acceptable visible permanent landmarks include building walls, retaining walls, curbs, foundations, pole bases, etc.. Lines, joints, and markings on pavements are not considered permanent (since they would be covered by re-paving). Acceptable markers for placement to identify underground work include a 0.9 m (3'0") long piece of 102 mm (4") conduit installed vertically in the ground (top flush with grade) completely filled with concrete (or other similar means providing equivalent visibility, durability, and permanence approved by the engineer). Where the contractor does not include this exact marking/dimensions on as-built drawings or where marking/dimensions are inaccurate (allowing for a tolerance of not greater than 0.6 m (2'0") away from actual locations), the electrical contractor will be held responsible if underground facilities are damaged in the future (where due to lack of or inaccurate marking/dimensioning).

18.2 During the progress of work, maintain an accurate record of all deviations, variations, changes, and corrections from the layouts shown on the drawings. Maintain this information on a "record working" set of drawings and specifications kept at the job site.

18.3 Upon completion of work, incorporate all information from the "record working" drawings onto a "marked-up as-built" set of drawings. Submit the "marked-up as-built" drawings to the engineer for review, comment, and approval.

18.4 Following approval of "marked-up as-built" drawings, prepare "final as-built" drawings utilizing the latest version of Autocad (or compatible) software. Submit one (1) set of "final as-built" drawing originals, sets of "final as-built" blueprint drawings as directed in the general construction specifications (but in no case less than three (3) sets), and "final as-built" drawings in disk format. Submit photocopies of all panel circuit directories with "final as-built" drawings.

18.5 Upon completion of work and following approval of "marked-up as-built" drawings, incorporate all information from the "record working" specifications onto "final (marked-up) as-built" specifications. Submit sets of "final as-built" specifications as directed in the general construction specifications (but in no case less than three (3) sets).
18.6 Submit operating and maintenance (O&M) manuals for all new equipment furnished as part of this contract. Provide O&M manuals including installation, operating, and maintenance instructions for the equipment. Wherever "proof-of-purchase" is required as part of any manufacturer's warranty (whether manufacturer's warranty is specified or not), submit with O&M manuals. Where any proof-of-purchase is required but not submitted (or where insufficient information is submitted), the electrical contractor is fully responsible and liable for providing the warranty. Submit all O&M manuals bound together in a single three-ring binder (one binder per set of manuals) including a table of contents. Submit quantity of sets as directed in the general construction specifications, but in no case less than three (3) sets.

18.7 Explain and demonstrate the complete electrical system and all work installed by the electrical contractor to the owner's operating and maintenance personnel. Demonstration is to instruct owner's personnel in the operation and maintenance of systems as well as to prove to the owner correct and adequate operation of all parts of the electrical system. Provide a demonstration period of one (1) full working day for the general electrical installation (including, but not limited to, contactors, time clocks, customer metering equipment, lighting controllers, dimming cabinets, motor controls [where furnished by the electrical contractor], transformer fan controls, generators, transfer switches, key interlocking schemes, and similar equipment, where applicable). Wherever demonstrations are indicated elsewhere in the specifications for equipment furnished by the electrical contractor (i.e. for fire alarm, dimming, sports lighting, stage lighting, UPS units, MCC's, VFD's, metal clad switchgear, power management, sound/paging, security, CCTV, and similar systems, where applicable), provide the specified additional demonstrations during additional periods of time (above and beyond the period above for the general electrical demonstration). Conduct all demonstrations at the project site and after all systems are fully operational.

19. SUMMARY OF SUBMISSIONS

19.1 Submit items as indicated elsewhere in the specifications (applicable sections are shown for convenience) and as summarized as follows. Information below indicates relative schedule of submission.

19.2 Submit upon commencement of construction (as per general construction specifications); resubmit within seven (7) days of notification:

A. Permits, licenses, certificates (see 16100-9)
B. Schedule of work (see 16100-10)
C. Product list (see 16100-17)
D. Shop drawings (see 16100-17)

19.3 Submit within 30 days of request (within seven (7) days for substitutions):

A. Samples (see 16100-18)

19.4 Submit during the project as applicable (refer to respective specifications sections for conditions and schedule of submission):
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A. Utility service charge estimates (see 16100-9)
B. Scope of work changes, w/ breakdowns (see 16100-11)
C. Test results, abnormal/failing only (16100-15)
D. Short circuit and coordination report (where specified for adjustable circuit breakers)

19.5 Submit upon substantial completion of the project:
A. Approved inspection certificate(s) (see 16100-9)
B. Written manufacturers' warranties (see 16100-14)
C. Test results (see 16100-15)
D. As-built drawings (see 16100-19)
E. O&M manuals (see 16100-19)
F. Spare parts (where specified elsewhere)

20. SAFETY

20.1 Perform all work and work practices in strict accordance with all applicable local, state, and federal codes, standards, regulations, and requirements including OSHA (including the proper use and maintenance of personal protective equipment (PPE) and clothing), state labor and industry, the NEC, ASTM, the National Electrical Safety Code, NFPA, etc..

20.2 The term "live" means "energized or capable of being energized at any time for any reason, either intentionally or accidentally".

20.3 Suitably protect all live equipment against accidental contact at all times. Install and maintain covers on all live equipment. Where covers are not installed, provide suitable insulating barriers at all live parts. Suitable barriers include arc-resistant NEMA GPO-2 or GPO-3 and UL 94 V-0 electrical grade fiberglass reinforced epoxy compound sheets, rubber insulating blankets, suitable thermoplastic insulating materials, etc. as per OSHA, ASTM, and the NEC. Cardboard and similar materials are not acceptable. Provide listed OSHA approved signs reading "Danger: High Voltage" at locations of live parts and on doors/gates leading to rooms/fences/areas containing the equipment and keep doors/gates locked at all times.

20.4 Protect and enclose equipment operating at over 600 V at all times. Equipment is considered adequately protected where all requirements of NEC Articles 110.26 through 110.34 (including all other articles and codes referenced therein) are satisfied at all times. Where equipment must be exposed for work, or where work is to be performed around normally exposed live parts, provide suitable insulating barriers (suitable for the voltage involved), listed warning signs, and door/gate locking, etc. as required above. Provide listed OSHA approved warning tape (reading "Danger: High Voltage") around the equipment and all code required working spaces at equipment.

20.5 When working on equipment or wiring, properly identify and use lockout devices and tags (in accordance with OSHA requirements) to prevent unauthorized or accidental energizing of equipment and wiring.
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20.6 Perform all work in or associated with confined spaces (including manholes, hand holes, vaults, crawl spaces, etc.) in accordance with all safety codes referenced above. Obtain appropriate permits where required by the above codes and/or the owner.

20.7 Perform all excavation and work in and associated with excavation in accordance with all safety codes referenced above (include all required sloping, benching, shoring, bracing, supporting, shields, protective systems [fall protection, protection of personnel in excavation, protection of structures, etc.], ramps, access/egress, warning systems, rescue equipment, etc.). Provide suitable barricades and safety procedures to restrict pedestrian and vehicular access to areas where work is being performed (including open excavations, lay-down areas, clearance space around operating excavation equipment, etc.). Do not leave excavations open when not actually performing associated work (including at night, during weekends, or when working away from excavations). Leaving excavations open for short periods of time will be considered only when approved in writing by the owner and only where suitably protected. Any request for owner's approval must include a written plan on proposed protection and safety procedures. No consideration, claims, charges, or compensation will be granted for any multiple excavations and backfilling needed to satisfy safety requirements.

20.8 When working in, on, or near areas subject to vehicular traffic (including public and private roadways, driveways, parking lots, etc. and including loading and unloading equipment/materials in the vicinity of traffic), perform all work and provide appropriate work zone traffic control in accordance with all safety codes referenced above as well as state department of transportation regulations, requirements, and recommendations. Where requested by the owner, architect, or engineer, submit a traffic control plan detailing proposed work zone traffic control and associated safety procedures.

21. HAZARDOUS MATERIALS

21.1 The electrical contractor is not responsible for and is not required to remove equipment contaminated by hazardous materials, except as indicated below. For this specification section, the term "hazardous material(s)" applies to any materials classified by federal, state, or local authorities as environmental or health hazards (including, but not limited to, polychlorinated biphenyls (PCB's), asbestos, mercury, radioactive materials, etc.). For this specification section, the term "contaminated" (in any form) means "contains or is contaminated by hazardous material(s)".

21.2 The electrical contractor (and all applicable subcontractors) shall be fully insured for performing all work related to, on, and around contaminated equipment and for all work specifically shown in this specifications section as by the electrical contractor. Submit proof of insurance to the owner as part of or along with other applicable insurance submittals (as per Division 1 General Conditions, Supplemental Conditions, and Special Contract Requirements).

21.3 Immediately notify the owner if any electrical equipment or wiring to be removed or modified as part of this project is contaminated or suspected as contaminated. Identify all areas where disruptive work is proposed (including, but not limited to, excavation, cutting, penetration, drilling, etc.) in advance of performing work so the owner can arrange to have any necessary abatement completed, include all costs and schedule time accordingly. No consideration, claims, charges, or compensation will be granted under any circumstance for
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any delays resulting from abatement of hazardous materials.

21.4 When performing work with, on, and around equipment contaminated or suspected as contaminated, assume that the equipment is contaminated until/unless proven otherwise by testing. Exercise care and suitably guard and protect equipment at all times from the start of work until the equipment is either proven by testing as not contaminated or is removed from the project site.

21.5 Where existing equipment is specifically shown on the drawings as containing or filled with electrical insulating fluid ("oil", including transformers marked "OA") and where the equipment is specifically indicated on the drawings as being removed, utilize the services of a qualified testing agency (see the section of these specifications "Testing") to sample and test the oil. Test only for content of PCB's in the oil, unless indicated otherwise. Test a sample from each separate tank/compartment containing oil. Verify exact conditions (including the quantity and arrangement of tanks, compartments, and enclosures, the presence of sampling, drain, or fill valves or plugs, removable covers or access panels, etc.) in field prior to submitting bid. Submit written certified test results to the owner.

21.6 Where equipment is proven by testing as contaminated or is indicated on the drawings as contaminated, perform work as follows:

A. Completely de-energize, disconnect, and make the equipment electrically safe.

B. The owner, at the owner's discretion, shall perform one (1) of the following two (2) options:
   1) Completely remove and dispose of the contaminated equipment.
   2) Completely "abate" the contaminated equipment by removing hazardous materials from the equipment in complete accordance with all applicable federal, state, and local laws, ordinances, and regulations.

C. Once equipment is abated of hazardous materials by the owner and certified by the abating vendor as no longer contaminated, the electrical contractor shall then remove the equipment as if the equipment was never contaminated.

21.7 When removing existing luminaires containing ballasts (fluorescent, H.I.D., etc.), consider all ballasts as being contaminated by PCB's, unless ballast factory nameplate specifically indicates that the ballast does not contain PCB's. The electrical contractor shall completely disconnect, remove, and dispose of all ballasts not contaminated by PCB's. For ballasts considered as contaminated by PCB's, remove ballasts from luminaires, cut all ballast wiring leads within 51 mm (2") of the ballasts, and neatly place ballasts in owner furnished drum containers (i.e. 55-gallon). The owner shall dispose of PCB contaminated ballasts in drum containers. For luminaries (with ballasts considered as contaminated by PCB's) where there are signs of ballast rupture or leakage, carefully remove the entire luminaire and turn over to the owner (owner shall dispose of luminaires where PCB leakage is suspected).

END OF SECTION
SECTION 16200 - ELECTRICAL WORK PRACTICES

1. GENERAL PROVISIONS

1.1 The applicable requirements and conditions of specifications section "General Provisions" of specifications division 16100, General Electrical, are hereby made an integral part of this section.

1.2 The work governed by these specifications includes but is not limited to that as defined in specifications section "Scope of Work" of specifications division 16100, General Electrical.

2. INSTALLATION

2.1 Provide all equipment and materials in accordance with the recommendations and instructions of the respective manufacturers. This includes recommendations and instructions for equipment furnished by other trades or the owner and installed or connected by the electrical contractor.

2.2 Perform all work in an approved first class and workmanlike manner and conform to the best practices of the trade and to all requirements of the NEC.

2.3 Protect and preserve all existing, new and proposed raceways, wiring, materials, devices, luminaires, and equipment from corrosion, dirt, paint, building materials, acid, solvents, chemicals, water, ice, tools, overload, freezing, heat, combustion, theft, damage, abrasion, inadvertent removal, improper installation (including where installation has not been completely or properly coordinated), conflicts, interference, vandalism, etc. at all times. Repair or replace all equipment and materials lost or damaged as the result of inadequate protection. Cap and plug open ends of raceways and equipment during construction until wiring is ready to be installed.

2.4 Coordinate with and obtain approval of the owner and architect for all exact locations of all outlets, raceways, materials, and equipment. Where requested by the owner, architect, or engineer, submit sketches/drawings of proposed raceway routing, equipment locations, and any other details of installation specifically requested.

2.5 Completely coordinate installation and routing of all wiring, materials, and equipment in the field and with shop drawing information of all trades prior to rough in of wiring or releasing equipment. Completely inspect equipment and materials upon receiving in the field (including equipment received by other trades where installed or connected to by the electrical contractor) and verify exact installation requirements and details (compare to installation and routing as coordinated above) prior to installing, preparing installation, modifying, or handling in any manner which would restrict the ability to return material or equipment in the event of potential installation complications.

2.6 Cooperate and fully coordinate all work with the work of all other trades, contractors, subcontractors, and the owner, including work as part of other contracts and projects related to and/or in the vicinity of the specified work. Coordinate the locations of pipes, ducts, structure, reinforcement, foundation components, floor/wall/ceiling construction, raceways, branch and distribution panels, luminaires, devices, electrical outlets, air outlets, motor controls, and all other equipment in order to avoid conflicts, interference, or placing services at the wrong locations. Coordinate all demolition, disconnection, removals, relocations, extension, and re-feeding associated with existing equipment and wiring.
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Coordinate with shop drawings of all trades. Install all wiring and equipment in such a way to maintain clearance and clear access to all equipment requiring access by code or for operating, servicing, maintaining, replacing, examining, etc.. This includes access to electrical equipment and devices as well as mechanical, architectural, and other equipment including, but not limited to, valves, dampers, sensors, meters, gauges, clean-outs, access doors and panels, operating mechanisms, motors, pumps, fans, air handling and other mechanical equipment, etc.. This specifically includes coordinating wall mounted electrical devices and outlets with wall mounted HVAC equipment (including baseboard, radiation, cabinets, etc.).

2.7 Provide all work indicated on the electrical drawings and electrical specifications but involving disciplines of other trades performed by the electrical contractor (or applicable sub-contractors to the electrical contractor), unless specifically indicated otherwise. Perform work in complete accordance with all general construction specifications applicable to the work. This applies to all work including, but not limited to, cutting and patching, excavation, backfill, surface restoration (including paving), concrete, metal fabrication, fire stopping and sealing, painting, etc..

2.8 Properly isolate all materials and equipment against the transmission of vibration or noise to, from, or between any parts of the building.

2.9 The electrical contractor is fully responsible for determining and verifying all exact details of installation. Where installation details or similar information is shown on the drawings or is otherwise forwarded to the contractor (including during construction), the information represents the minimum criteria required and serves as a guide to the contractor but does not relieve the contractor of the responsibility for determining and verifying installation details.

3. GROUNDING

3.1 Completely ground and bond all equipment (specifically including all metallic raceways, cable armor, cladding, and shielding, supports, transformers, cabinets, cable trays, service equipment, and the neutral conductor) in strict and complete accordance with all applicable requirements of the NEC.

3.2 Provide insulated grounding conductors run with all wiring (not applicable to "BX" armored cable [type "AC"] where permitted elsewhere in this specification).

3.3 Install all metallic raceways in such a way to provide a continuous grounding path without the use of the insulated grounding conductor required above. Include all bonding jumpers and conductors (in addition to the insulated conductor required above) as required for flexible conduit, loosely jointed raceways, etc.. Provide suitable raceway/conduit fittings for a completely grounded raceway system as required, including the use of fittings approved and/or listed for grounding, grounding bushings, grounding lock nuts, etc..

3.4 Provide all grounding and bonding materials and connections as per specifications section "Grounding Materials" of specifications division 16300, Electrical Materials.

3.5 Wherever connections to grounding electrodes or electrode systems are required by code, connect and bond to and interconnect the following.
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A. Provide new driven (made) grounding rod electrodes, for all services and where equipment is located on or below the second floor of a building.

B. Connect to the domestic cold water piping system and any other metal piping system where required by the NEC (excluding piping prohibited from bonding/grounding by the NEC).

C. Connect to the structural steel and/or metal building frame, where applicable.

D. Connect to all existing grounding electrode systems, where applicable.

3.6 Wherever the following is installed as part of this project (including where installed by other contractors), connect and bond to the grounding electrode system.

A. Ground new metal piping systems where required by the NEC.

B. Ground new structural steel and/or metal building framing.

C. Wherever any new foundation and/or footing is installed with continuous length of 3.0 m (10'0") or more or covering area of 3.3 m² (36 sq. ft.) or more, provide concrete-encased electrode(s) as per NEC Article 250.52(A)(3). Provide consisting of not less than 6.0 m (20'0") of #4 AWG bare copper conductor encased in not less than 50 mm (2") of the foundation/footing concrete, except that concrete reinforcement may be substituted for the copper conductor where the size, length, type, and installation of reinforcement complies with NEC Article 250.52(A)(3) for use as a grounding electrode.

D. Ground existing or new computer room style raised floors where within the project scope. In addition, connect to grounding for all panels and electrical equipment serving the raised floor area.

3.7 Where driven (made) grounding rod electrodes are installed, provide grounding resistance not exceeding 1.0 ohm (maximum). Verify proper ground resistance by testing as per the section "Testing" of this specifications division 16100. Where the measured resistance exceeds the maximum value, install additional ground rod(s) at the location and/or set ground rods in suitable listed and NEC approved chemical ground enhancement material as required to obtain proper values, include all costs in bid.

3.8 Detail all grounding on as-built record documents.

3.9 Wherever new wiring or equipment is installed at or near roofs of buildings with lightning protection system(s), bond wiring/equipment to the lightning protection system(s) as required by lightning protection codes and standards.

4. WIRING METHODS

4.1 The wiring methods in this section apply to all systems (including power, lighting, emergency, over 600 V, control, telecommunications, data, fire alarm, sound, security, CCTV, and any other system), unless specifically indicated otherwise.
4.2 In finished areas, run all wiring hidden or concealed in/behind ceilings, walls, and floors, include all cutting and patching as required. In unfinished areas, wiring may run exposed. Run exposed wiring following building lines.

4.3 Utilize steel rigid metal conduit (RMC) for all wiring unless indicated otherwise. Utilize only steel RMC for all exposed visible exterior raceways, for raceways in wet locations above ground, for exposed visible raceways in damp locations, and for all raceways in NEC Hazardous Classified Locations (NEC Chapter 5). Utilize only steel RMC (encase in a 76 mm (3") 20 MPa (3,000 p.s.i.) concrete envelope) for raceways in or below grade that are subject to vehicular traffic (except that reinforced concrete encased PVC RNC or concrete encased steel IMC may be utilized as indicated below). Utilize only steel RMC for all wiring over 600 V (except that PVC RNC may be utilized for underground wiring over 600 V as indicated below). Utilize only steel RMC (with concrete encasement where required by code) where field conditions do not facilitate maintaining NEC required minimum cover for underground PVC RNC. For conduits 53 mm (2") and larger, where concrete encasement is not required above, embed all underground 45 degree or greater conduit bends (field fabricated or factory elbows) in a 155 mm (6") 20 MPa (3,000 p.s.i.) concrete envelope.

4.4 Steel intermediate metal conduit (IMC) may be utilized for all wiring except conditions indicated above as requiring only steel RMC. Steel IMC may be utilized in any condition where PVC RNC is permitted by these specifications. As an alternate to steel RMC, steel IMC (encase in a 76 mm (3") 20 MPa (3,000 p.s.i.) concrete envelope) is permitted under roadways, parking lots, and other areas subject to vehicular traffic. For conduits 53 mm (2") and larger, where concrete encasement is not required above, embed all underground 45 degree or greater conduit bends (field fabricated or factory elbows) in a 155 mm (6") 20 MPa (3,000 p.s.i.) concrete envelope.

4.5 Where permitted by code, schedule 40 or schedule 80 polyvinyl chloride rigid nonmetallic conduit (PVC RNC) may be used underground. Changing PVC RNC thickness (i.e. from schedule 40 to schedule 80 or vice versa) in the middle of any run of PVC RNC is not permitted. Encase all PVC RNC in a 76 mm (3") 20 MPa (3,000 p.s.i.) concrete envelope, unless indicated otherwise. As an alternate to steel RMC, PVC RNC encased in steel reinforced 76 mm (3") 20 MPa (3,000 p.s.i.) concrete envelope is permitted under roadways, parking lots, and other areas subject to vehicular traffic. Provide steel reinforcement consisting of a 12.7 mm (#4) reinforcing rod at each of four (4) "corners" around each conduit in cross section (where encasement includes more than one (1) conduit, rods located between conduits may be "shared"). Provide reinforcing rods continuous for the entire length of the reinforced encasement, join rods where required by overlapping not less than 155 mm (6") and wrapping with suitable reinforcing tie wire. In unpaved areas not subject to vehicular traffic, schedule 80 PVC RNC may be installed without concrete encasement. In unpaved areas not subject to vehicular traffic, schedule 40 PVC RNC 27 mm (1") and smaller may be installed without concrete encasement. For conduits 41 mm (1.5") and larger, where concrete encasement is not required by these specifications, embed all underground 45 degree or greater conduit bends (field fabricated or factory elbows) in a 155 mm (6") 20 MPa (3,000 p.s.i.) concrete envelope.
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4.6 Where runs of PVC RNC protrude exposed and visible above grade or floors, in indoor or outdoor locations, utilize steel RMC for the portions above grade/floor to a minimum depth of 155 mm (6") below finished grade/floor. This requirement does not apply where protruding PVC RNC is completely concealed/hidden within equipment enclosures, walls, or ceilings. Where exposed visible runs of PVC RNC are installed by the contractor (without prior written approval) the contractor shall remove the PVC RNC and install new steel RMC (including cutting and patching to a minimum 155 mm (6") depth and including replacing or reInstalling conductors) at no cost to the owner.

4.7 Where permitted by code, electrical metallic tubing (EMT) may be used for interior feeder and branch wiring in locations not subject to abuse or injury. Utilize steel RMC for conditions indicated above as requiring only steel RMC.

4.8 Utilize flexible conduit for flexible connections to motors, equipment requiring flexibility, equipment subject to vibration (including transformers), and where required for adjustment, in lengths not to exceed 1.8 m (60'). Flexible conduit may be utilized for flexible connections to luminaires only where wiring is concealed or located above accessible ceilings (in lengths not to exceed 1.8 m (60')). Exposed visible flexible conduit is not permitted for luminaires, except adjustable luminaires. Flexible conduit may be used where existing walls are fished in lengths not to exceed the portion in the wall plus 0.9 m (30'). Utilize liquidtight flexible metal conduit (LFMC, "sealtite"), unless indicated otherwise. Utilize only LFMC in damp, wet, and outdoor locations, mechanical rooms, and for NEC Hazardous Classified Locations (except as indicated below). Utilize flexible metal conduit (FMC, "greenfield") in dry locations only (except conditions indicated above as requiring only LFMC). Where flexible connections are required in NEC Class I, Division 1 Hazardous Classified Locations, utilize only flexible unions listed as suitable for the application. Flexible conduit/fittings of any type are not permitted as a substitute for conduit bends or offsets under any circumstance.

4.9 Where permitted by Code and approved by local authorities and the owner, armored cable (type "AC", i.e. "BX") and metal clad cable (type "MC") may be used for interior branch wiring concealed in walls/ceilings and hidden above accessible ceilings in dry locations only. Where applicable, comply with NEC Article 518 "Assembly Occupancies". Utilize raceway for all feeder wiring (#4 AWG and larger). Types "AC" and "MC" cables are not permitted in wet, damp, or exterior locations. Types "AC" and "MC" cables are not permitted in exposed visible locations. Type "AC" cable is not permitted for use on circuits exceeding 250 V or for use on DC circuits. Hide cables at panels in electrical rooms and electrical closets as per the section "Branch Panels" of specifications division 16300, Electrical Material.

4.10 Provide surface raceway with integral wiring devices (including receptacles, power outlets, telephone/data outlets, switches, etc.) and/or surface raceway plug-in strips where specifically indicated on the drawings.

4.11 Surface raceway without integral wiring devices is permitted only where all of the following conditions are met or where specifically indicated on the drawings. Surface raceway without integral wiring devices is permitted where physically impossible to run wiring hidden or concealed, where impossible to hide or conceal wiring by cutting, patching, and painting, where approved by code, in dry locations only, and where specifically approved by the owner and architect in writing. Permission to use surface
raceway without integral wiring devices is conditional upon there being no cost change to the contract, unless specifically indicated on the written approval.

4.12 Nonmetallic-sheathed cable (types "NM", "NMC", and "NMS", i.e. "romex") is not permitted under any circumstance. Electrical nonmetallic tubing (ENT), liquidtight flexible nonmetallic conduit (types LFNC-A and LFNC-B), high-density polyethylene (HDPE) conduit, type "A" nonmetallic conduit, and type "EB" nonmetallic conduit are not permitted under any circumstance.

4.13 Provide all wiring within air handling plenum spaces in complete accordance with the NEC. Provide wiring methods utilizing metal conduit raceways (as permitted by the specifications) only. Type "MC" cable, where otherwise permitted, may be utilized in plenum ceilings (but not other plenum spaces). Type "AC" cable is not acceptable in plenum ceilings or other plenum spaces.

4.14 Provide all wiring in Hazardous Classified Locations or similar locations as defined by the NEC (where applicable) in strict accordance with all applicable requirements of NEC Chapter 5. Utilize wiring methods specified above, installed according to the NEC. Provide a complete installation including all required fittings, all required conduit and cable seals, etc. as indicated in the NEC. The applicable scope of Hazardous Classified Locations shall be as indicated on the drawings.

4.15 Provide conduit and cable seals (utilize a NEC Hazardous Classified Locations type, even if location is not classified) for all wiring within or passing through walk-in refrigerators/freezers, cold rooms, other refrigerated spaces, and any other location where wiring is exposed to widely different temperatures, in accordance with NEC Article 300.7(A). Consider these areas as wet locations and utilize aluminum RMC or PVC coated steel RMC for all wiring within or passing through these areas.

4.16 Provide all systems wiring (including only fire alarm, telecommunications, data, sound, security, and CCTV, where applicable) in complete accordance with all requirements of other sections of the electrical specifications, except as modified below. Where permitted by Code and approved by local authorities and the owner, suitable code approved systems type cables (without conduit) may be used for interior branch wiring concealed in walls/ceilings and hidden above accessible ceilings in dry locations only. Systems type cables without conduit are not permitted in wet, damp, or exterior locations. Systems type cables without conduit are not permitted in exposed visible locations. Run wiring in pathways as indicated on the drawings and specifications.

A. Provide wiring as directed, recommended, and approved by the respective system manufacturer/utility company and meeting all minimum requirements of the system manufacturer/utility (including where manufacturer/utility requirements exceed the requirements of the specifications and the NEC).

B. Provide all cables as multi-conductor style having an overall jacket (of a color other than red; red is reserved for fire alarm) and utilize only cables approved by the NEC for use with the system.
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C. Provide all wiring in plenum spaces in complete accordance with the NEC. In dry location plenum ceilings, utilize only plenum rated cables. For damp and wet location plenum ceilings and in all other duct and plenum spaces, run wiring (utilize a non-plenum type suitable for the damp/wet location) in metal conduit. Plenum rated cables may be utilized for other (i.e. non-plenum) applications, but only in dry locations. Plenum cables, even when installed in conduit, are prohibited in damp and wet locations.

D. In damp locations, utilize only cables specifically listed and identified for use in damp or wet locations. Provide all cables in wet locations (including underground and embedded in concrete slabs at or below grade, whether in conduit or direct buried) specifically designed for outdoor and submerged use and specifically listed and identified for use in wet locations.

4.17 Except as indicated otherwise on the drawings, 21 mm (3/4") raceways are the minimum permitted. No raceway smaller than 21 mm (3/4") is permitted under any circumstance (except where specifically approved in writing by the owner and engineer for the individual condition encountered). Where luminaires, devices, or equipment have factory knockouts or hubs smaller than 21 mm (3/4") size (or smaller than conduit sizes specified on the drawings), provide suitable reducing conduit fittings or provide field knockouts at equipment to match conduit size.

4.18 Except as indicated otherwise on the drawings, #12 AWG conductors are the minimum permitted for power and lighting and #14 AWG conductors are the minimum permitted for control and signal systems. #10 AWG conductors are the minimum permitted for outdoor wiring, night lighting circuit wiring, and emergency power and lighting wiring. #10 AWG conductors are the minimum permitted where circuits exceed 23 m (75'0") for 120/208/240 V circuits or exceed 46 m (150'0") for 277/480 V circuits, measured to the center of the load.

4.19 Provide a separate neutral conductor with each branch circuit where a neutral is required or indicated on the drawings. Multi-wire branch circuits with a shared common neutral are not permitted, unless specifically indicated otherwise on the drawings. Utilize multi-wire branch circuits with a shared common neutral conductor for lighting controlled by "dual switching" where the lighting is connected to two (2) circuits.

4.20 Multiple branch circuits may be installed in the same raceway (including surface raceways) where permitted by code and provided all of the following conditions (A through D below) are met.

A. Apply appropriate NEC de-rating factors and adjust conductor sizes accordingly. Wiring sizes indicated on the drawings are based on each circuit run in an individual raceway (and are not adjusted for de-rating factors), except where multiple branch circuits in a common raceway are specifically indicated on the drawings (wiring is adjusted for applicable de-rating factors in this case, but only for the specific wiring combination shown on the drawings).

B. Provide no conductor (after de-rating adjustment) exceeding #10 AWG, except grounding conductors as provided below (or as otherwise specifically approved in writing by the engineer).
C. Common equipment grounding conductors are permitted in lieu of individual equipment grounding conductors for each individual circuit. Provide minimum single equipment grounding conductor size two (2) standard wire sizes larger than the size as determined in accordance with the NEC. Provide isolated grounding conductors (where required) individually for each circuit and in addition to common equipment grounding conductors.

D. Provide raceway fill (after de-rating adjustment) not exceeding 30% (provide maximum number of conductors permitted not exceeding 75% of the maximum number allowed by Code [i.e. refer to NEC Chapter 9 and Annex C] to allow for future wiring). Adjust minimum conduit size to maintain 30% maximum fill.

4.21 Minimum raceway sizes indicated in the specifications and on the drawings are applicable to all conduit types specified, except schedule 80 PVC RNC (unless the drawings specifically indicate schedule 80 PVC RNC). Where schedule 80 PVC RNC is utilized and the specified conduit size is 63 mm (2.5") and smaller, increase conduit to the next higher trade size. Where schedule 80 PVC RNC is proposed and the specified conduit size is 78 mm (3") and larger, submit raceway fill calculations; where raceway fill with the specified conduit size exceeds 40%, increase conduit to the next higher trade size.

5. WIRING INSTALLATION

5.1 Securely support and fasten all raceways, cables, outlets, boxes, equipment, etc. in place as required by the NEC. Support at intervals as required by the NEC, but in no case exceeding 3.0 m (10'0"). Refer to the section of this specification "Fastenings, Supports, and Hangers" for information.

5.2 Where any run of wiring passes vertically through more than one (1) floor level (including where installed in open vertical chases), support at every floor level. For conduits 63 mm (2.5") and larger, utilize only suitable pipe riser clamps (B-Line #B3373 series or approved equal), suitable wall bracket offset pipe clamps (NPHC-National Pipe Hanger Corp. figure #430 series or approved equal), or engineer approved heavy duty steel brackets (fabricated of not less than 6.5 mm (1/4") thick steel and of type, design, and arrangement suitable for the specific application and weights involved) for these floor level supports. Conduit clamps and strut type supports are not acceptable for this application.

5.3 Make all changes in direction of 27 mm (1") and larger conduits with standard elbows or case metal fittings. Fabricate field-made bends and offsets in conduit with suitable hickey/conduit-bending machine. Make conduit bends of the long radius type without kinks, flattening or crushing. Do not install crushed or deformed raceways. Avoid trapped raceways in damp and wet locations. Exercise care to prevent the accumulation of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Entirely free clogged or obstructed raceways or replace raceways.

5.4 Provide raceway ends cut squarely and reamed. Provide raceway installation (including pull boxes as required) so there is no more than a total of 360 degrees of bends in any run of raceway. Provide pull boxes at intervals not greater than every 30 m (100'0"), unless otherwise indicated on drawings.
5.5 Maintain a separation of not less than 155 mm (6") between all raceways and hot water lines, steam lines, and any other surface with temperature exceeding 104 degrees F (40 degrees C), whenever possible. When not possible to maintain the 155 mm (6") separation, provide insulation pipe covering on the electrical raceways.

5.6 Provide a suitable insulating or grounding type (as required) bushing on each conduit terminating in a pressed steel box and for each conduit stub. Bushing is not required where conduit terminates in a suitable conduit connector/termination fitting which includes an integral bushing or which provides smoothly rounded surface suitable and approved for use without a bushing.

5.7 Wherever raceways pass across structure expansion joints, provide suitable conduit expansion fittings. Where expansion fittings are not listed for grounding, provide external flexible copper grounding strap. Wherever expansion fittings are installed, provide a suitable junction box located not farther than 7.6 m (25'0") from the expansion fitting location. Coil suitable slack conductors in this junction box to allow functioning of expansion fittings. For continuous runs of PVC RNC exceeding 27 m (90'0"), provide expansion fittings at intervals not exceeding 15 m (50'0") as required to compensate for linear thermal expansion and contraction.

5.8 Where metal raceway is installed in contact with or entering earth or concrete in outdoor, wet, or damp locations, coat raceway with engineer approved coal tar or epoxy based corrosion resistant coating (3M, Benjamin Moore, Carboline, or approved equal).

5.9 Running threads are not permitted.

5.10 Do not run wiring horizontally across floors or the ground, to avoid tripping hazards and facilitate cleaning floors.

5.11 Horizontal runs of raceway at rooftops are not permitted (to facilitate future roofing repairs/replacement), except where specifically approved in writing by the architect and owner. Horizontal runs may not exceed 2.4 m (8'0") length. Horizontal runs of any length are not permitted within 4.5 m (15'0") of any edge of any roof under any circumstance, to avoid tripping hazards. Support raceways at roofs in a manner to avoid harming, impacting, or compromising the roofing weatherproof integrity (fully coordinate requirement with roofing contractor/supplier [where present], architect, and owner). Where wiring is installed atop roofing material, utilize only pre-cast concrete paving units measuring not less than 12" x 12" x 2" (300 mm x 300 mm x 51 mm) thick laid on the roof and bonded to the roof using suitable roofing adhesive. Running rooftop wiring on wood blocks or bricks is not permitted under any circumstance.

5.12 In all kitchens, food preparation, and similar areas, run wiring concealed as much as possible. Where necessary to run wiring exposed, maintain space between raceways and building surfaces and run raceways vertically only in such a way to facilitate cleaning walls, ceilings, and floors and to avoid accumulation of foreign materials.

5.13 Install wiring in such a manner to avoid infiltrating water into the wiring system (during or after construction). Install wiring in such a manner so any water which does infiltrate cannot become trapped or accumulate and cannot drain into electrical or other equipment.
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5.14 Install exposed wiring (including visible wiring and wiring in accessible ceiling spaces or other accessible locations) parallel or perpendicular to walls, structural members, or intersections of vertical planes and floors or ceilings.

5.15 Install concealed wiring (except as provided above for wiring in accessible spaces) as straight and direct as possible. Detail routing of all concealed wiring on record (as-built) documents.

5.16 Space raceways embedded in concrete slabs, walls, beams, etc. or run underground not closer than 76 mm (3") between outsides of raceways and install as to avoid changing the locations of reinforcement.

5.17 Except when plans of raceways are approved by the engineer, provide embedded raceways, other than those merely passing through, not larger in outside diameter than one-third the thickness of the slab, wall, beam, etc. in which they are embedded.

5.18 Embedded raceways are not permitted to cross, except where the 76 mm (3") spacing and one-third thickness provisions above are maintained or exceeded.

5.19 Provide all splices only in suitable code-sized junction or outlet boxes. Splices are not permitted in any type of conduit body under any circumstance.

5.20 Do not install any wires in raceways until all raceway work is completed and closed in such a manner as to prevent the possibility of water or other foreign matter entering raceways.

5.21 Wherever empty or spare raceways are installed, provide suitable pull wires with identification tags securely attached to each end. Where empty or spare raceways do not terminate in boxes or enclosures, provide suitable conduit caps. Utilize only conduit fitting type caps appropriate for the conduit involved. Rubber and plastic conduit plugs, duct sealing compounds, and tape are not acceptable.

6. FASTENERS, SUPPORTS, AND HANGERS

6.1 Provide all fastenings, supports, hangers, clamps, and anchors of the type made for the specific purpose for which they are used.

A. Utilize wood screws for fastening to wood.
B. Utilize toggle bolts or bolt fastenings for fastening to hollow tile, terra cotta, hollow masonry units, lath, and similar construction.
C. Utilize machine screws/bolts with nuts for fastening to structural steel.
D. Utilize metallic expansion shield anchors and machine screws/bolts for fastening to concrete, brick, and solid masonry. Wooden plugs with screws and plastic expansion shield anchors are not acceptable.
E. Threaded studs driven in by a powder charge and provided with washers and nuts may be used in lieu of expansion anchors, machine screws, and wood screws under the applications indicated above.
F. Utilize engineer approved adhesive fastening on roofing areas (mechanical fasteners are not be permitted to be driven into roofing surfaces).
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G. Threaded C-clamps are not permitted.
H. Additional acceptable supports for a single 21 mm (3/4") EMT only include common nails for wood, spring-tension clamps for steel and nail-type nylon anchors for masonry.
I. Additional acceptable supports for not more than two (2) cables (where cable wiring methods are permitted elsewhere in this specification) only include nails for wood, spring-tension clamps for steel, and nail-type nylon anchors for masonry. A single cable only may be secured directly to wood with NEC approved cable staples.

6.2 To prevent swaying, vibrating and/or sagging, rigidly and firmly install raceway and cable (where cable wiring methods are permitted elsewhere in this specification).

A. Support with malleable or wrought steel clamps, hangers, or with fabricated strut type supports. Provide strut type supports as B-Line, Kindorf, Power-Strut, Unistrut, or approved equal (steel only, aluminum is not acceptable unless specifically indicated on the drawings).
B. Stamped metal one-hole and two-hole straps are permitted to secure EMT and cable wiring methods permitted by the specifications in exposed and concealed dry indoor locations not subject to abuse or injury only.
C. Stamped metal wrap around "mineralax" type hangers are permitted to secure EMT and cable wiring methods permitted by the specifications in hidden and concealed dry indoor locations not subject to abuse or injury only. Stamped metal wrap around type hangers are not permitted for visible exposed wiring.
D. Additional manufactured fastening systems specifically designed for the purpose shall be considered to secure cable wiring methods permitted by the specifications, but only where submitted for review and approval before commencing work.
E. Do not weld raceways, clamps, hangers, or straps to steel structure.
F. Wire (including ceiling support wires), perforated pipe straps, plastic ties, "J" hooks, and bridle rings are not acceptable.

6.3 Provide all supports and fasteners of the following materials, unless indicated otherwise.

A. Utilize stainless steel for all applications, unless indicated otherwise. Utilize stainless steel only when underground or in contact with earth or floors in outdoor areas, mechanical rooms, kitchens, and other areas subject to the possible presence of water on the floor/ground.
B. Steel protected by hot-dip or mechanical galvanizing after fabrication may be utilized for all conditions except conditions indicated above as requiring only stainless steel. Clean areas where galvanizing is cut or damaged and touch-up with suitable zinc dust/zinc oxide paint.
C. Steel protected by pre-galvanizing before fabrication, epoxy coating, zinc electrolytic plating, or other engineer approved corrosion resistant coating may be utilized for interior locations not subject to abuse or injury.
D. Other materials providing equivalent strength and corrosion resistance to the above shall be considered.
E. Supports and fasteners without corrosion protection, protected only by painting, or protected only by oil coating are not acceptable under any circumstances.
F. For electrical fasteners (at conductors and all current-carrying parts), utilize only materials and types approved by the NEC and listed for the application.
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6.4 Provide all fastening, supports, wall brackets, ceiling trapeze, and hangers as required for the installation of all equipment and wiring. Install all fastenings, supports and hangers in such a way and at such intervals as required by Code or otherwise required to support the equipment. The electrical contractor is responsible for verifying that supports are adequate for the load supported, based upon weight, stresses which may be applied to the support (including when installing equipment, pulling wiring, physical impacts to equipment, and seismic/earthquake loads as per IBC Section 1613), vibration, etc. Submit calculations for any supports where requested by the engineer.

6.5 In new concrete structure, engineer approved cast-in-place type inserts (furnished and installed by the electrical contractor and coordinated with and under the direct supervision of the general contractor) may be utilized in concealed locations, unfinished spaces, and other locations where approved by the architect and owner. Inserts may be of the spot or continuous types. Continuous type may be used to directly support raceways.

6.6 For all telephone and equipment backboards indicated on the drawings and wherever plywood backboards are installed to support and/or mount electrical equipment, utilize only fire resistant plywood.

6.7 Where the contractor installs fasteners or supports not meeting specified requirements (without prior written approval) the contractor shall remove the fasteners and supports and install new fasteners and supports as specified at no cost to the owner.

7. CHASES, RECESSES, AND OPENINGS

7.1 Provide, including all excavation, cutting, patching, fire stopping, sealing, backfill, surface restoration, and painting, all required openings, chases, and recesses in the construction for all work.

7.2 Where openings are required in new or modified structure, furnish the exact location, size, and other necessary information to the contractor installing or modifying the structure in ample time to have them incorporated during construction as approved by the architect and engineer. If the electrical contractor fails to comply with these information requirements, then the electrical contractor shall perform the necessary cutting and patching at his own expense under the direct supervision of the general contractor.

7.3 Where openings in masonry are required, make by coring only.

7.4 Locate and provide all openings (including openings for junction and outlet boxes and luminaires) in such a manner to maintain any required fire/smoke rating, waterproof, and sound transmission integrity in accordance with all applicable codes and standards (including, but not limited to IBC/BOCA, NFPA, and UL). Where boxes are located in opposite sides of fire/smoke/sound rated walls, maintain minimum spacing between boxes as required. The general contractor shall provide fire/smoke rated enclosures around luminaires and boxes where required to comply with fire/smoke ratings.

8. CUTTING, PATCHING, FIRE STOPPING, AND PAINTING
SECTION 16200 - ELECTRICAL WORK PRACTICES

8.1 Perform all required excavation, cutting, patching, fire stopping, sealing, backfill, surface restoration, and painting associated with the electrical installation. Perform in accordance with general construction specifications and as indicated elsewhere in this specification. Coordinate all requirements with the general contractor. This includes cutting and patching associated with suspended ceiling tiles and grid.

8.2 Completely restore (including painting where applicable) all surfaces to match existing condition as directed and approved by the owner, architect, and engineer.

8.3 Completely seal and fire stop all penetrations of all fire and/or smoke rated walls, floors, ceilings and any other construction (including all construction required to be rated by any code) to a rating matching or exceeding the fire rating of the construction. Refer to architectural drawings and specifications for information on fire ratings of building construction and include all costs in bid. Provide the complete installation (including fire stopping methods and materials) complying with all applicable fire rating codes and standards (including the NEC, NFPA, IBC/BOCA, and UL (including the UL "Fire Resistance Directory").

8.4 Completely seal and weatherproof all penetrations of exterior, at or below grade, and wet location walls and floors and roof penetrations.

8.5 Paint all exposed raceways, boxes, enclosures, etc. as directed by the owner and architect.

8.6 Provide baked enamel painted finish for all equipment and materials as directed by the owner and architect. Wherever finish colors are indicated on the drawings (including symbol list and luminaire schedule) as being selected by the architect ("as per architect", etc.), include costs in bid to utilize any of the available standard and/or optional colors listed in manufacturers' catalogs (excluding any colors identified in manufacturers' catalogs as "custom" or "premium").

8.7 Touch up damages to prime and/or finished paint coats on equipment. This includes touching-up stainless steel surfaces to avoid superficial surface rust (i.e. at cut surfaces and welds).

9. SLEEVES

9.1 Provide sleeves in all construction. Provide sleeves of minimum 0.85 mm (22 ga.) galvanized steel, sized for passing raceway/cable, and of the proper design for sealing and flashing around the sleeves where required. Locate and set sleeves extending approximately 51 mm (2") above floor in concealed locations, unfinished rooms, and mechanical spaces. Locate and set all sleeves flush with finished surfaces in finished areas unless otherwise directed by the owner and architect.

9.2 Seal the space between the raceway/cable and sleeve and between the sleeve and structure in an engineer and code approved manner. Seal and fire-stop all penetrations to a fire rating not less than the wall, ceiling, floor, or member penetrated. Completely seal and waterproof all penetrations of exterior walls, roofs, mechanical room floors, or any other area subject to weather or water.
10. FLASHING AND ACCESS PANELS

10.1 Where a general contractor is present, base flashing is by the general contractor, otherwise base flashing is by the electrical contractor. Counter flashing (provide of 0.47 mm (28 ga.) copper) is by the electrical contractor under all circumstances.

10.2 Provide access panels for all items requiring accessibility for operation and maintenance or where required by code. Provide access panels of not less than 1.6 mm (16 ga.) steel frame and not less than 1.9 mm (14 ga.) steel panel, with tamper-proof fasteners, and compatible with the type of construction in which they are installed.

10.3 Where a general contractor is present, the electrical contractor shall furnish all access panels and the general contractor shall install access panels under the direction of the electrical contractor.

11. LOCATIONS AND MOUNTING HEIGHTS

11.1 The approximate locations of luminaires, pipes, switches, radiation, receptacles, outlets and other equipment and materials are indicated on the drawings. Provide actual locations and mounting heights as determined by, confirmed with, and approved by the owner and architect during field construction (prior to rough-in). Where equipment or devices are installed without prior approval/confirmation or without prior written notification (see below) and the location or mounting height is not acceptable to the owner and architect, relocate the equipment and all associated wiring as directed by the owner and architect at no cost to the owner.

11.2 Provide mounting heights complying with all applicable federal, state, and local disabled ("handicapped") access codes, standards, and requirements, including the Americans with Disabilities Act (ADA).

11.3 Provide mounting heights for all equipment as follows. Utilize standard mounting heights indicated below for all equipment, unless indicated otherwise on the drawings or otherwise directed by the owner and architect. Where installation conditions and/or obstructions make it impossible to install equipment at the standard height, the mounting height may be adjusted as required by conditions, provided the mounting height falls within the listed maximum and minimum heights. Notify the architect and engineer in writing of all conditions where deviating from standard mounting heights. Provide mounting heights not greater than the maximum mounting height and not less than the minimum mounting height under any circumstance, unless specifically approved in writing by the owner, architect, and engineer.

11.4 All mounting heights listed below are above finished floor, unless indicated otherwise. Mounting heights listed as "to bottom" are measured to the lowest operable part of the equipment or the lowest visual indicating device on the equipment. Mounting heights listed as "to top" are measured to the highest operable part of the equipment or the highest visual indicating device on the equipment.
### Control Devices

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall switches &amp; lighting controls</td>
<td>46&quot; (1.17m) to ctr. 15&quot; (0.38m) to bot.</td>
<td>48&quot; (1.22m) to top</td>
<td></td>
</tr>
<tr>
<td>Thermostats &amp; other controls</td>
<td>46&quot; (1.17m) to ctr. 15&quot; (0.38m) to bot.</td>
<td>48&quot; (1.22m) to top</td>
<td></td>
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</tbody>
</table>

### Receptacles and Outlets

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptacles, tele/data, &amp; similar *</td>
<td>18&quot; (0.46m) to ctr. 15&quot; (0.38m) to bot.</td>
<td>48&quot; (1.22m) to top</td>
<td></td>
</tr>
<tr>
<td>Wall mounted telephones</td>
<td>46&quot; (1.17m) to top 27&quot; (0.69m) to bot.</td>
<td>48&quot; (1.22m) to top</td>
<td></td>
</tr>
</tbody>
</table>

### Electrical Equipment

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety switches **</td>
<td>See max./min. 15&quot; (0.38m) to bot.</td>
<td>48&quot; (1.22m) to top</td>
<td></td>
</tr>
<tr>
<td>Enclosed circuit breakers **</td>
<td>See max./min. 15&quot; (0.38m) to bot.</td>
<td>48&quot; (1.22m) to top</td>
<td></td>
</tr>
<tr>
<td>Devices with fuses/breakers **</td>
<td>See max./min. 15&quot; (0.38m) to bot.</td>
<td>48&quot; (1.22m) to top</td>
<td></td>
</tr>
<tr>
<td>Contactors **</td>
<td>See max./min. 15&quot; (0.38m) to bot.</td>
<td>48&quot; (1.22m) to top</td>
<td></td>
</tr>
<tr>
<td>Transfer Switches **</td>
<td>See max./min. 15&quot; (0.38m) to bot.</td>
<td>48&quot; (1.22m) to top</td>
<td></td>
</tr>
<tr>
<td>Time clocks, individual **</td>
<td>See max./min. 15&quot; (0.38m) to bot.</td>
<td>48&quot; (1.22m) to top</td>
<td></td>
</tr>
<tr>
<td>Annunciators and displays</td>
<td>46&quot; (1.17m) to ctr. 15&quot; (0.38m) to bot.</td>
<td>48&quot; (1.22m) to top</td>
<td></td>
</tr>
</tbody>
</table>

### Equip. indicated with (**) where group mounted

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equip. indicated with (**) where too large to mount at above heights</td>
<td>15&quot; (0.38m) to 48&quot; (1.22m)</td>
<td>None</td>
<td>78&quot; (1.98m) to top</td>
</tr>
</tbody>
</table>

### Branch panels

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall mounted distribution panels</td>
<td>15&quot; (0.38m) to 48&quot; (1.22m)</td>
<td>None</td>
<td>78&quot; (1.98m) to top</td>
</tr>
<tr>
<td>Controllers &amp; grouped controls</td>
<td>15&quot; (0.38m) to 48&quot; (1.22m)</td>
<td>None</td>
<td>78&quot; (1.98m) to top</td>
</tr>
<tr>
<td>Individual meter sockets ***</td>
<td>48&quot; (1.22m) to ctr. 36&quot; (0.92m) to ctr.</td>
<td>60&quot; (1.52m) to ctr.</td>
<td>Contact engineer</td>
</tr>
<tr>
<td>Meter centers ***</td>
<td>48&quot; (1.22m) to 48&quot; (1.22m)</td>
<td>None</td>
<td>78&quot; (1.98m) to top</td>
</tr>
</tbody>
</table>

### Fire Alarm Equipment

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire alarm controls</td>
<td>15&quot; (0.38m) to 48&quot; (1.22m)</td>
<td>None</td>
<td>78&quot; (1.98m) to top</td>
</tr>
<tr>
<td>Pull stations</td>
<td>48&quot; (1.22m) to top 42&quot; (1.07m) to bot.</td>
<td>48&quot; (1.22m) to top</td>
<td>48&quot; (1.22m) to top</td>
</tr>
<tr>
<td>Horns/speakers/strobes/bells ****</td>
<td>80&quot; (2.03m) to bot. 80&quot; (2.03m) to bot.</td>
<td>96&quot; (2.43m) to bot.</td>
<td></td>
</tr>
</tbody>
</table>

### All equipment mounted above counters

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>***** All equipment mounted above counters</td>
<td>15&quot; (0.38m) to bot.</td>
<td>46&quot; (1.17m) to top</td>
<td></td>
</tr>
</tbody>
</table>

### Other Equipment

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other equipment mounted on standard</td>
<td>46&quot; (1.17m) to ctr. 15&quot; (0.38m) to bot.</td>
<td>48&quot; (1.22m) to top</td>
<td></td>
</tr>
</tbody>
</table>

Contact the engineer for any equipment not listed or similar to equipment above.

* Specifically coordinate with any wall-mounted radiation, if present

** Applies where equipment is mounted individually, see below for group mounted equipment.

*** Provide metering equipment mounting heights conforming to utility company requirements, where applicable, regardless of mounting heights indicated above.

**** For ceilings lower than 90" (2.29m), mount fire alarm signaling devices 6" (0.15m) below the ceiling. Fire alarm signaling devices may be ceiling mounted if mounted on the lowest portion of the ceiling, if mounted not higher than 9.14 m (30'-0") above the lowest floor level in the room and if located and spaced in accordance with NFPA requirements.

***** Standard mounting height for above counter equipment is 6" (0.16m) above back splash or 8" (0.20m) above counter where no back splash is present.

#### 11.5 Where any equipment or device protrudes more than 100 mm (4") from the finished wall surface, mount at height conforming with the ADA and in accordance with the following.
SECTION 16200 - ELECTRICAL WORK PRACTICES

Contact the engineer where maximum and minimum heights listed above conflict with mounting requirements summarized below.

A. Mount so the bottom of equipment/device is 0.68 m (2'3'') AFF or less.

B. Mount so the bottom of equipment/device is 2.0 m (6'8'') AFF or greater.

C. Projecting equipment/devices are permitted mounted with the bottom between 0.68 m (2'3'') and 2.0 m (6'8'') AFF where protected with a suitable warning barrier in accordance with ADA requirements.

D. Projecting equipment/devices are permitted mounted with the bottom between 0.68 m (2'3'') and 2.0 m (6'8'') AFF without warning barrier protection only where specifically approved in writing by the engineer.

12. ELECTRIC SERVICE

12.1 Perform all electrical service work complying with applicable electric utility company standards and requirements, including metering equipment locations, equipment specifications, inspections, notification, scheduling, and service pole/manhole.

12.2 Submit to utility company all required service/meter application forms. Obtain written approval from utility company prior to commencing service related work. Utility service-related work shown on the drawings is approximate as a guide to pricing only and is not fully coordinated with respective utility companies. Fully coordinate all service-related work in detail with utility companies before releasing equipment and before associated rough-in of work. No consideration, claims, charges, or compensation will be granted under any circumstance associated with failure to coordinate with utility companies.

12.3 Reference single line diagram for a complete description of the proposed electrical system.

12.4 Where pole risers are indicated on the drawings, provide a complete riser in accordance with all applicable utility company requirements. Verify exact riser requirements with utility company prior to submitting bid (include all costs in bid). Provide riser including all ancillary equipment as directed by the utility company, including (but not limited to) raceways stubbed and/or run up pole, molding, grounding, suitable slack conductors, location of riser around circumference of pole, etc.

12.5 Provide protective bollards for all pad mounted outdoor equipment. Provide quantity and location as per utility company standards (for both utility and customer owned equipment) unless otherwise indicated on the drawings. Provide consisting of not smaller than 102 mm (4'') steel RMC filled with concrete, protruding at least 1.2 m (4'0'') above finished grade, set in not less than 0.3 m (1'0'') diameter x 0.9 m (3'0'') deep concrete base, and in no case less than the minimum construction required by utility company standards. Provide bollards even if not shown on electrical drawings.

13. UTILIZATION EQUIPMENT CONNECTIONS
13.1 Provide complete power wiring and final connections for utilization equipment as indicated on the drawings. This includes, but is not limited to, all mechanical, kitchen, manufacturing, computer, medical, office, copier, fixed, and portable equipment and apparatus. Coordinate all requirements with the contractor supplying the equipment (the supplying contractor).

13.2 Provide connections complete and including power wiring from the electrical contractor provided local disconnecting means to each piece of equipment. If required, pass power wiring through supplying contractor furnished control equipment (including thermostats, relays, timers, integrated controllers, starters, contactors, VFD's, etc.). Provide a single point connection or multiple-point connections (by separating one larger circuit into smaller circuits at controller and/or equipment) as required (include all costs in bid). The electrical contractor is responsible for taking deliveries of all control equipment (which power wiring passes through) from the supplying contractor and for mounting and passing power wiring through this control equipment. Locate control equipment as indicated on mechanical or other trades documents or as otherwise coordinated with and approved by the owner, architect, mechanical engineer, and the supplying contractor.

13.3 All control wiring and associated raceway is by the supplying contractor, unless specifically indicated on the drawings. All central/common control panels are by the supplying contractor (power wiring is by the electrical contractor), unless specifically indicated on the drawings.

13.4 Provide safety switches as local disconnecting means at all equipment. Provide switches regardless of whether shown on the drawings or not. Provide switches regardless of whether or not the equipment includes integral unit switches or circuit breakers. Provide outdoor switches as NEMA-3R and indoor switches as NEMA-1.

13.5 For all equipment rated 120 V or 277 V and 20 A or less, provide either direct connection, including thermal overload switch where disconnecting means is required, or suitable receptacle where equipment is supplied with cord and plug (combination of plug and receptacle serves as disconnecting means), include all costs in bid.

13.6 Prior to rough in of raceway or purchasing any associated electrical equipment, obtain shop drawings from the supplying contractor and verify all requirements. The electrical contractor is fully responsible for contacting and obtaining copies of approved shop drawings from the supplying contractor. This includes fully coordinating the locations of all equipment and wiring in/serwing elevator shafts, pits, and machine rooms.

13.7 Where equipment is served by variable frequency drives (VFD's), other solid-state controllers, or other special starters or controllers, wiring indicated on the drawings is as a guide to pricing only. Prior to rough in of raceway or purchasing associated electrical equipment, verify all requirements in writing with the supplying contractor. Provide exact circuit breaker trip amperes (or fuse amperes, where applicable) for circuits feeding this equipment as coordinated with and directed and approved by the manufacturer, include all costs in bid. Where the required circuit breaker/fuse amperes exceed the ampacity of the specified wiring, notify the engineer in writing. Provide all safety switches connected on the load side of VFD's with auxiliary contacts and interconnect (including providing all required wiring in separate 21 mm (3/4") raceway from power wiring) with VFD controls (to prevent and stop operating VFD with load disconnected). Provide all power wiring on
the load side of any VFD as a dedicated circuit (from individual VFD to motor served) with no other circuit or wiring (of any kind) in the same raceway.

13.8 Where heat tracing, control power transformers and control power supplies (rated 500 VA and less), electric alarm bells, plug-in condensate pumps, ultraviolet germicidal lamps in HVAC equipment, electrically operated security devices, door hardware, dampers, and valves (including sinks/toilets/urinals), switchgear/switchboard strip/space heaters, etc. are specified on mechanical, plumbing, fire protection, electrical, or architectural drawings or specifications, provide appropriate wiring and power connections (whether shown on electrical drawings or not). Verify and coordinate voltage and wattage/amperes in field and provide wiring accordingly. Obtain power from a suitable nearby branch circuit. Include all disconnecting means switches, junction boxes, receptacles, and other equipment as required by code or manufacturer recommendations. Provide ground fault protection (utilizing protective devices complying with the NEC) for all heat tracing.

14. DEMOLITION, REMOVAL, RELOCATION, AND RE-FEEDING

14.1 Disconnect, remove, relocate, and/or re-feed existing wiring and electrical equipment as indicated on the drawings (including, but not limited to, as indicated in electrical notes on the drawings) and otherwise provided in contract documents. Assume that all demolition and new construction requires disconnecting, removing, relocating, and re-feeding unless verified otherwise in the field. No consideration, claims, charges, or compensation will be granted for any alleged misunderstanding of the scope of disconnecting, removing, relocating, and re-feeding or as a result of failure to verify existing conditions.

14.2 Fully verify all requirements associated in any way with demolition, removals, relocations, and re-feeding and include all costs in bid. Visit site prior to submitting bid and investigate and verify all existing conditions (including verifying conditions above all accessible "drop" ceilings and in accessible chases).

14.3 Prior to commencing any removals, completely verify all conditions and exact requirements related to re-feeding, maintaining, or affecting service to existing electrical equipment, devices, and wiring and mechanical, architectural, and other equipment and system in the field during construction. Where equipment or wiring is removed which is required to re-feed equipment, maintain service, or effects systems to remain, replace or reinstall the equipment and wiring as required. No extra claims or compensation shall be granted to re-feed, reinstall, replace, reconfigure, etc. wiring and equipment where removed without first verifying all conditions.

14.4 Wherever electrical equipment and wiring is removed from visible finished surfaces, patch and restore the surface to the original condition matching existing adjacent surfaces. This includes all required painting, filling all openings (including channels and filling holes left from supports), etc..

14.5 Where existing ceilings are removed and reinstalled (either partly or entirely), remove all existing electrical equipment (including lighting fixtures, fire alarm devices [including, but not limited to, smoke and heat detectors, signaling devices, indicators, etc.], security/CCTV cameras, motion detectors, speakers, and all other electrical devices, equipment, and apparatus) from the ceiling grid and ceiling tiles. Leave in place at the ceiling and
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temporarily support (in a code approved and local code official approved manner) as required to facilitate ceiling removal. Once ceiling is reinstalled, permanently reinstall all electrical equipment in the ceiling. Where new equipment is shown on the drawings, completely disconnect and remove existing equipment (being replaced) and all associated wiring and provide all new equipment and associated wiring as shown on the drawings. Ceilings may be left open for a long period of time (i.e. there may be several months or more between the time of removal and the time of reinstalling ceilings). When ceilings are not in place, maintain (as operational) all fire alarm devices and equipment and normal and emergency lighting as required (temporarily install fire alarm devices, supported from structure and provide temporary lighting or temporarily support existing lighting from structure as required). When ceilings are not in place, safely secure everything which is exposed by the absence of ceilings (new and existing) and keep all areas clean when occupied. This ceiling work is not shown on electrical plans (see architectural drawings and ceiling plans and other trades drawings for information). This ceiling work applies regardless of the party removing the ceiling and regardless of whether or not ceiling removal is shown on drawings. Coordinate with all contractors and trades to confirm the extent of ceiling work and include all costs in bid. This ceiling work also applies where any contractor chooses to install new ceiling in lieu of reinstalling the existing ceiling.

14.6 Where existing ceilings are removed and new ceilings are installed (either partly or entirely), remove all existing electrical equipment (including lighting fixtures, fire alarm devices [including, but not limited to, smoke and heat detectors, signaling devices, indicators, etc.], security/CCTV cameras, motion detectors, speakers, and all other electrical devices, equipment, and apparatus) from the ceiling grid and ceiling tiles. Leave in place at the ceiling and temporarily support (in a code approved and local code official approved manner) as required to facilitate ceiling removal. Once new ceiling is installed, permanently reinstall all electrical equipment in the ceiling. Where new equipment is shown on the drawings, completely disconnect and remove existing equipment (being replaced) and all associated wiring and provide all new equipment and associated wiring as shown on the drawings. Ceilings may be left open for a long period of time (i.e. there may be several months or more between the time of removal and the time of installing new ceilings). When ceilings are not in place, maintain (as operational) all fire alarm devices and equipment and normal and emergency lighting as required (temporarily install fire alarm devices, supported from structure and provide temporary lighting or temporarily support new or existing lighting from structure as required). When ceilings are not in place, safely secure everything which is exposed by the absence of ceilings (new and existing) and keep all areas clean when occupied. This ceiling work is not shown on electrical plans (see architectural drawings and ceiling plans for information).

14.7 Where electrical work involves removal and reinstallation of existing ceilings, removal and relocation is the responsibility of the electrical contractor. As an alternative (at the electrical contractor's option) to reinstalling ceilings removed to facilitate electrical work, the electrical contractor may install a new ceiling of a type matching the existing ceiling provided there is no cost change to the contract (wherever new ceiling involves additional cost to the contract, new ceiling is not acceptable).

15. EXCAVATION, BACK-FILLING, AND RESTORATION
SECTION 16200 - ELECTRICAL WORK PRACTICES

15.1 Perform all required excavation, cutting, patching, backfill, surface restoration, and painting associated with the electrical installation, perform in accordance with general construction specifications. Coordinate all requirements with the general contractor. Refer to the section of this specification "Cutting, Patching, Fire-Stopping, and Painting" for additional information.

15.2 Install all underground wiring to maintain a minimum cover of 0.8 m (2'7") to top of raceways. Where field obstructions do not facilitate the above minimum cover, minimum cover as indicated in NEC Article 300.5 is permitted.

15.3 Perform all excavation and work in and associated with excavation in accordance with all applicable safety codes, standards, regulations, and requirements (refer to specifications section "Safety" of specifications division 16100, General Electrical).

15.4 Completely restore all surfaces to a condition matching or exceeding the original condition to the satisfaction of the owner, architect, and engineer. Backfilling and restoration below does not supersede or serve as a substitute for concrete encasement of raceways specified elsewhere.

A. **Earth (and other unpaved surfaces) excavation:** Backfill with suitable on-site material, preferably utilizing excavated material, and compact during backfill. Provide additional material as required to provide a flush surface after compacting or settlement. Provide seeding (as directed by the owner and architect) to restore grass surfaces.

B. **Sidewalk (and other paved surfaces not subject to vehicular traffic) excavation:** Where pavement construction joints are spaced not greater than 1.8m (6'0") apart, remove complete blocks of paving to the construction joints to facilitate excavation. Where construction joint spacing exceeds 1.8 m (6'0"), either saw cut pavement at a convenient location or remove to construction joints to facilitate excavation. Backfill with suitable on-site material, preferably utilizing excavated material and compact during backfill. Replace pavement sub-base with new materials to match existing sub-base materials. Replace pavement with new materials to match existing pavement.

C. **Roadway and parking lot (and other surfaces subject to vehicular traffic) excavation:** Saw cut pavement 76 mm (3") deep prior to excavation. Remove pavement 300 mm (1'0") beyond the edges of below grade excavation ("cut-back" pavement 300 mm (1'0") on both sides of trench). Backfill with suitable on-site material, preferably utilizing excavated material and compact during backfill. Replace pavement sub-base with new materials to match existing sub-base materials. Replace pavement with new materials to match existing pavement, filling the entire width of the excavation with "cut-backs".

D. **Optional roadway and parking lot (and other surfaces subject to vehicular traffic) excavation:** The following may be substituted for the methods indicated in item "C" above at the contractor's option. Saw cut pavement 76 mm (3") deep prior to excavation. Remove pavement to the same width as the edges of below grade excavation (without any "cut-back"). Back fill with concrete only to the bottom of the sub-base. Replace pavement sub-base with new materials to match existing sub-base.
SECTION 16200 - ELECTRICAL WORK PRACTICES

base materials. Replace pavement with new materials to match existing pavement.

15.5 Completely remove and properly dispose of any material excavated and not utilized for backfill, include all costs in bid.

16. HOUSEKEEPING AND EQUIPMENT PADS

16.1 Mount all fully or partially freestanding electrical equipment on pads as follows. Where equipment is installed without pad (without prior written approval) the contractor shall remove the equipment, provide a suitable approved pad, and reinstall the equipment (including providing temporary power [including the use and cost of a generator if required] to maintain service) at no cost to the owner.

16.2 Provide all floor and roof mounted equipment on a 100 mm (4") concrete housekeeping pad.

16.3 Provide all outdoor ground mounted equipment on a suitable pad. Level grade around pad. Provide top of pad 155 mm (6") nominal above finished grade (100 mm (4") minimum at any point).

16.4 Provide all housekeeping and equipment pads in complete accordance with equipment manufacturer's requirements and recommendations. This includes, but is not limited to anchor bolts, reinforcement, minimum thickness, pad openings and cutouts, raceway stubs, overall dimensions and shape, steel leveling channels, concrete characteristics, grounding (including grounding grids and loops), and structural details. Where applicable, provide pads as per utility company standards.

16.5 Where approved by the manufacturer, engineer, and utility company (where applicable), pre-cast concrete pads and foundations may be utilized for outdoor installation. Install and set all pre-cast concrete pads on a smooth, compacted, and level base of not less than 155 mm (6") of crushed stone (or sand, for manhole style vault foundations 1.2 m (40") or deeper) according to manufacturer's (and utility company, where applicable) recommendations.

16.6 Where the project schedule, shutdown considerations, or other project conditions do not allow the time required for a cast-in-place indoor housekeeping pad, utilize a suitable custom pre-cast housekeeping pad (include all costs in bid). Pre-cast housekeeping pads may also be used under other conditions where approved in writing by the engineer and owner. Submit shop drawings for review and approval. Provide complete with openings pre-cast or cored in advance as required to facilitate conduit stub-ups (where applicable). Secure pad to the floor utilizing suitable concrete anchors. Set pad on wet bed of grout/mortar (to provide a firm and level surface regardless of floor surface conditions/irregularities) and utilize shims as required (to level pad and avoid pad settling before/while grout/mortar cures). Where a new cast-in-place pad will be poured adjacent to a new pre-cast pad, provide 10 mm (3/8") (minimum) reinforcement cast into and stubbed out from the pre-cast pad (extending at least 230 mm (9") and spaced not farther than 230 mm (9") on center) in the direction of proposed poured pad.

END OF SECTION
SECTION 16300 - ELECTRICAL MATERIALS

1. GENERAL PROVISIONS

1.1 The applicable requirements and conditions of specifications section "General Provisions" of specifications division 16100, General Electrical, are hereby made an integral part of this section.

1.2 The work governed by these specifications includes but is not limited to that as defined in specifications section "Scope of Work" of specifications division 16100, General Electrical.

1.3 Provide all materials and equipment (products) as new, the best in grade and quality, and manufactured in the United States of America with standards and ratings as specified herein. No substitution or deviation from the materials and equipment specified is permitted except by written permission from the engineer. Provide all materials and equipment as listed and/or labeled where applicable.

1.4 Replace or repair, to the satisfaction of the owner, any materials and equipment damaged before or after installation.

1.5 Materials and equipment manufacturers and catalog numbers specified constitute the type and quality of design, material, workmanship, ruggedness of construction, resistance to vandalism, exact operating and performance characteristics, features, configuration, dimensions, etc.. Where multiple acceptable manufacturers are shown in the drawings and/or specifications, not all manufacturers shown may be capable of providing materials and equipment meeting the specifications, field conditions, etc.. Showing acceptable manufacturers indicates that the manufacturer is acceptable only if they can meet the specifications, conditions, and requirements specific to this project. Provide materials and equipment as required (include all costs in bid).

2. RACEWAYS

2.1 Steel Rigid Metal Conduit (RMC) and Steel Intermediate Metal Conduit (IMC)

A. Provide steel RMC as full weight, heavy wall, mild steel pipe, galvanized inside and outside.

B. Provide steel IMC as standard wall steel pipe; otherwise the same as steel RMC.

C. Provide fittings for steel RMC and steel IMC of high grade steel, having rust resistant finish, providing ample wiring space, having smooth round edges, and having full threaded hubs.

D. Utilize only fully threaded screw-on fittings with steel RMC and steel IMC (coat field-cut threads as per NEC Article 300.6(A)). Compression, set screw, bolt on, or other thread-less fittings are not permitted.

2.2 Electrical Metallic Tubing (EMT)

A. Provide EMT of high grade steel and galvanized inside and outside. Enamel coating only is not acceptable.
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B. Provide fittings for EMT of high-grade steel, having rust resistant finish, providing ample wiring space, and having smooth round edges. For EMT in damp locations (i.e. concealed), utilize only fittings of the thread-less compression type without set screws. For EMT in dry locations only, thread-less set screw steel type fittings are permitted. Die cast, set screw, and indenter fittings are not permitted.

2.3 Flexible Metal Conduit (FMC) and Liquidtight Flexible Metal Conduit (LFMC)

A. Provide FMC ("greenfield") of high-grade steel, galvanized inside and outside, having a smooth interior, and providing a continuously effective ground. Provide fittings for FMC of high grade steel, having rust resistant finish, providing ample wiring space, having smooth round edges, of the two (2) screw type, listed and NEC approved for grounding.

B. Provide LFMC ("sealtite") with an overall PVC sheath; otherwise the same as FMC. Provide fittings for LFMC of high grade steel, having rust resistant finish, providing ample wiring space, having smooth round edges, listed and NEC approved for grounding, and of the sealing compression gland type.

C. Where applicable, provide FMC and LFMC manufactured to comply with NEC Article "Places of Public Assembly".

2.4 Polyvinyl Chloride Rigid Nonmetallic Conduit (PVC RNC)

A. Provide PVC RNC of virgin PVC (or material reground from the manufacturer's own products), heavy wall, schedule 40 or schedule 80.

B. Provide fittings for PVC RNC of schedule 40 virgin PVC, providing ample wiring space, and having smooth round edges. Make all interfaces between PVC RNC and raceways, enclosures, boxes, other conduit types, etc., utilizing adapter fittings designed for the purpose.

C. Make all joints utilizing solvent welding method, installed to be completely watertight and pressure-tight to 172 kPa (25 p.s.i.).

D. High density polyethylene (HDPE) conduit and type "EB" encased burial and type "A" PVC conduits are not permitted under any circumstance.

2.5 Surface Raceway

A. Surface raceway with integral wiring devices: Provide steel or aluminum type as indicated on the drawings. Utilize one (1), two (2), or three (3) compartment types (with dividers as required) as indicated on the drawings.

B. Surface raceway without integral wiring devices: Provide steel type. Utilize Wiremold types #V700, #V2000, #V2100, or #V2400 (or approved equals) as required by the number of conductors to be run in the raceway. Utilize the smallest size raceway facilitating conductors. Raceway smaller than #V700 type is not acceptable.
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C. Surface raceway plug-in strips: Provide steel type, Wiremold #V2000 series or approved equal. Provide with #12 AWG through wiring suitable for use on 20 A branch circuits. Provide with 15 A, 120 V single receptacles 300 mm (12") on center, unless indicated otherwise. Provide one (1) or two (2) circuit type as indicated on the drawings.

D. Provide all steel surface raceways in factory ivory finish. Provide final painting (over the ivory factory finish) as directed by the owner and architect in the field. Provide all aluminum surface raceways in natural brushed aluminum finish.

E. Nonmetallic surface raceways are not permitted, unless specifically indicated otherwise on the drawings.

F. Provide all installations of surface raceways complete including all required fittings, accessories, details of installation, etc.. Include costs in bid for installing surface raceways around all obstructions encountered.

G. Provide fittings for surface raceways manufactured by the surface raceway manufacturer and specifically designed to be used with and compatible with the surface raceway and the actual installation conditions encountered. Provide fittings for surface raceways having rust resistant finish, providing ample wiring space, and having smooth round edges. Provide device box type fittings as per the section of this specification "Outlet, Switch, and Junction Boxes".

H. Perform all cutting, bending, and offsetting of surface raceways and components utilizing tools specifically designed and manufactured for the purpose by the surface raceway manufacturer. Cutting with hacksaws and bending/offsetting with standard conduit benders is not acceptable. Where the manufacturer does not manufacture or supply tools to perform work required (as indicated in manufacturer's standard catalogs), use only tools specifically recommended and approved for the purpose by the manufacturer.

I. Fasten and secure all surface raceways utilizing hardware concealed by the surface raceway. Visible securing and fastening hardware is not acceptable except that Wiremold #V5703 (or approved equal) supporting "back clip" type fasteners are permitted with #V700 style surface raceway without integral wiring devices only. One (1) or two (2) hole straps over the raceway are not acceptable.

J. Specifications are based on equipment as manufactured by Wiremold. Equipment as manufactured by Hubbell, Mono-Systems, or approved equal shall be considered.

3. OUTLET, SWITCH, PULL, AND JUNCTION BOXES

3.1 Provide boxes of proper types and sizes as required at all outlets and junctions indicated on the drawings and as otherwise required.

3.2 In unfinished areas, mount boxes flush or exposed. In finished areas, mount boxes flush in ceilings, walls, and floors, include all cutting and patching as required. Where impossible to mount flush in finished areas or where surface wiring is required to serve equipment in finished areas, finished style (Wiremold #V5730 to #V5760 series or approved equal)
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Surface boxes are permitted. Standard style pressed steel boxes are not permitted in finished areas. Where the contractor installs improper boxes in finished locations (without prior written approval), the contractor shall remove the boxes and install new boxes flush mounted (including cutting and patching to flush mount boxes and wiring and including replacing or reinstalling wiring) at no cost to the owner.

3.3 Utilize boxes of either unit or ganged construction and sized as required for devices and wiring installed and not smaller than the minimum sizes as per the drawings and specifications (and in no case smaller than the minimum size permitted by the NEC). Provide boxes as galvanized pressed steel (unless indicated otherwise), not less than 4" square, and with the proper size knockouts to facilitate wiring.

3.4 For flush mounted boxes, provide box shape permitting surfacing materials to be on straight lines and to fit closely around the box. Provide boxes in plastered, drywall (GWB), and similar walls, partitions, and ceilings with suitable plastering rings.

3.5 Utilize cast and/or malleable rust-resisting steel boxes for wiring in exterior, wet, or damp locations and for exposed visible steel RMC and IMC runs. Utilize aluminum or alloy boxes only where aluminum conduit is permitted by the specifications and used.

3.6 For all boxes in floors, utilize only boxes specifically designed, NEC approved, and listed for floor installation. Provide as required to maintain fire rating of the floor.

3.7 Provide all boxes for lighting outlets with studs of a size suitable for the weight of the luminaire supported (in no case less than 10 mm (3/8")) . Provide the stud of integral construction with the box or of the type inserted from the back of the box. Studs held to the box with bolts to support luminaire weight are not permitted.

3.8 100 mm (4") diameter "octagon" boxes are not acceptable, except under the following conditions. Octagon boxes are permitted in conjunction with luminaire mounting studs where studs are required above. Octagon boxes are permitted where required to mount equipment where equipment is not compatible with square or ganged type boxes (including the use of adapter rings on square boxes).

3.9 Secure boxes firmly in place and set true, square, and flat or flush (as applicable) with finished surfaces. Keep all unused knockouts closed or close with suitable threaded plugs (for threaded knockouts or hubs) or knockout seals (for unthreaded knockouts). Install flush mounted boxes so the covers are flush with the finished surface.

3.10 Provide all boxes with cover plates as specified below.

4. COVER PLATES

4.1 Provide cover plates for switches, receptacles, outlet and junction boxes, and other devices of 1.0 mm (0.04") thick metal with paint finish or of stainless steel (as directed by the owner and architect, include costs in bid for painted or non-magnetic stainless steel), unless indicated otherwise.
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4.2 Utilize suitable pressed galvanized steel code gauge raised covers for exposed wiring methods in unfinished areas and accessible hidden locations. Flat pressed galvanized steel code gauge covers may be utilized on junction boxes (where devices are not installed) or for ganged devices (three (3) gang or greater only). Tile and/or plastering rings style covers are not permitted for exposed wiring methods under any circumstance.

4.3 Utilize cast rust-resisting steel or #302 stainless steel covers with gaskets for boxes in wet, damp, or exterior locations or other locations where cast steel boxes are utilized.

4.4 Provide suitable blank covers on all unused boxes and boxes for future use (including boxes where devices are not installed at the time that electrical work is completed; specifically including telephone/data outlets where jacks and covers are not installed).

5. CONDUCTORS AND CABLE (600 V)

5.1 Provide all wiring (for all systems) utilizing multiple single conductors in raceway, unless indicated otherwise. Conductor sizes indicated in the specifications and on the drawings are the minimum that will be accepted (conductor sizes are identified based on the NEC, as either American Wire Gauge [AWG] or thousands of circular mils [MCM equivalent to kcmil]). Where the contractor installs conductors smaller than the minimum size, the contractor shall remove conductors and install new conductors of the specified size at no cost to the owner.

5.2 Provide all conductors (including conductors in cables, where permitted) as 600 V, having flame retardant, heat resistant, and moisture resistant insulation, and listed and marked in accordance with industry standards and the NEC. Unless indicated otherwise, provide all conductors identified both as type "THHN" and as type "THWN" ("THHN/THWN"), rated 90 degrees C for dry and damp locations and rated 75 degrees C for wet locations. Conductors identified as type "XHHW" (in lieu of type "THHN/THWN") are permitted only where conductors are of the compact stranded type (type "XHHW" is not permitted for solid conductors or for standard concentric or compressed stranded conductors). Provide all conductors for all systems of a type suitable for installing in dry, damp and wet locations. Conductors suitable for dry locations only and conductors suitable for dry and damp locations only are not acceptable (except as specifically otherwise provided for plenum rated systems cables).

5.3 Provide all conductors of soft drawn copper (Cu, CU) wire of 98% conductivity. Aluminum (Al, AL) conductors are not acceptable, unless specifically indicated otherwise on the drawings.

5.4 For wiring installed in high temperature locations subject to temperature exceeding 60 degrees C (140 degrees F), utilize conductors with special heat resistant insulation based on exact temperature conditions and location classifications encountered (consult engineer for exact conductor type; include costs in bid to utilize any of types "FEPB" (glass braid type only), "MI", "PFA", "SA", "THWN-2", "Z", and "ZW"). Install wiring in high temperature locations in conduit raceways (surface raceways and cable wiring methods without conduit are not permitted, except type "MI" cable); provide respective conduit sizes in accordance with NEC raceway fill requirements. Transition to standard conductor types are permitted (in a suitable junction box) beyond the minimum distance as per NEC Article 310.15(A)(2). Exception, measured from the first point where normal ambient temperature occurs.
5.5 Where permitted elsewhere in this specification, provide metal clad cable (type "MC") having interlocked steel or aluminum cladding and having conductors as specified above, including an insulated grounding conductor. Provide conductors #10 AWG and smaller as solid and conductors #6 A.W.G and larger as stranded. Conductors #8 AWG may be solid or stranded. Provide type "MC" cable listed and NEC approved to provide an acceptable grounding path. Provide fittings for type "MC" cable of suitable pressure pad/clamp type, high grade steel, having rust resistant finish, providing ample wiring space, having smooth round edges, and having full threaded hubs. Fittings utilizing set screws are not acceptable. "Snap-in" fittings of any kind (including, but not limited to, fittings designed to fasten in knockouts or hold cable with spring tension, fittings without treaded hubs, and fittings designed to be installed without the use of tools) are not acceptable. Install type "MC" cable in complete accordance with NEC Article 330. Where permitted by the NEC (including Article 604), listed manufactured wiring systems consisting of cables identified as type "MC" may be utilized wherever specifications allow the use of type "MC" cables.

5.6 Where permitted elsewhere in this specification, provide armored cable (type "AC") having interlocked steel or aluminum armor and having conductors as specified above along with a code sized copper or aluminum (compatible with armor material) armor bonding wire. Provide conductors #10 AWG and smaller as solid and conductors #6 A.W.G and larger as stranded. Conductors #8 AWG may be solid or stranded. Provide type "AC" cable listed and NEC approved to provide an acceptable grounding path. Provide fittings for type "AC" cable of suitable pressure pad/clamp type, high grade steel, having rust resistant finish, providing ample wiring space, having smooth round edges, and having full threaded hubs. Fittings utilizing set screws are not acceptable. "Snap-in" fittings of any kind (including, but not limited to, fittings designed to fasten in knockouts or hold cable with spring tension, fittings without treaded hubs, and fittings designed to be installed without the use of tools) are not acceptable. Install type "AC" cable in complete accordance with NEC Article 320. Where permitted by the NEC (including Article 604), listed manufactured wiring systems consisting of cables identified as type "AC" may be utilized wherever specifications allow the use of type "AC" cables.

5.7 Where direct buried cables/conductors are specifically indicated on the drawings, provide conductors as 600 V, having flame retardant, heat resistant, moisture resistant, and sunlight resistant insulation and identified as types "RHH/RHW-2/USE-2". Where messenger supported aerial multiplex cables are specifically indicated on the drawings, provide conductors as 600 V (with flame retardant, heat resistant, moisture resistant, and sunlight resistant insulation of a type in accordance with the NEC) with bare messenger as required to support the cable (hard drawn for copper conductors or ASCR for aluminum conductors).

6. SPLICES, TAPS, AND CONNECTIONS

6.1 Make all splices, taps, and connections at locations indoor and above ground only. Splices, taps, and connections are not permitted below grade (including below any floor level where the floor is in direct contact with earth, i.e. basement slabs, slabs on grade, etc.), or where subject to being submerged (except as specifically provided as follows). Route raceways and wiring as required and include all costs in bid. Where physically impossible to install wiring to make splices/taps above grade, splices/taps below grade shall be considered where specifically requested in writing in advance (prior to installing conductors) by the contractor and where approved in writing by the engineer. Specifically and individually
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identify each and every case involved for below grade splices/taps in the request(s) and submit shop drawings for splices/taps (as indicated below). Where below grade splices/taps are installed by the contractor (without prior written approval) the contractor shall remove the raceways, wiring, splices, and taps and install new raceways and wiring in such a manner to completely avoid below grade splices/taps at no cost to the owner.

6.2 Perform all splices/taps in suitable code sized outlet and junction boxes only, not in raceways, conduit bodies, or equipment cabinets. Clean each strand of conductors carefully before connecting.

6.3 Where aluminum wiring is permitted elsewhere in this specification or where connecting to existing aluminum wiring, utilize only suitable crimp-on compression connectors/lugs. Bolted pressure type connectors/lugs are not acceptable under any circumstance. Where aluminum wiring terminates in factory installed bolted pressure lugs at equipment, utilize suitable crimp-on compression adapters (ILSCO #CPM, #ACM, and #ACO types or approved equal).

6.4 Insulation piercing type splices, taps, and connections of any kind are not permitted under any circumstance (including where applied after removing insulation).

6.5 Provide connections at equipment, apparatus, and devices as required for a complete installation and as follows. Coordinate all requirements with equipment to connect.

A. Where equipment includes factory "pig tails" for connections, make connections as specified above for splices and taps.

B. For stranded wiring #10 AWG and smaller, utilize suitable crimp-on "stacon" type terminals. Where equipment terminals include pressure pads, wiring may terminate directly at equipment without crimp-on terminals. Connecting stranded wiring directly at wire binding screw terminals (i.e. wrapped around screw) is not permitted under any circumstance.

C. For solid wiring #8 AWG and smaller, provide wiring connecting directly at terminals.

D. For wiring #6 AWG and larger and #8 AWG stranded wiring, utilize suitable crimp-on compression lugs. Where equipment is provided with factory-installed lugs, wiring may connect directly at factory lugs.

6.6 Where equipment (including equipment furnished by other contractors or the owner) is provided with factory installed lugs and the factory-installed lugs do not facilitate the specified wiring sizes, provide complete connections as required and as summarized for the following options. Options "A" and "B" apply where the specified conductors are either larger than the maximum conductor for the lug or smaller than the minimum conductor for the lug. Option "C" applies where the specified conductors are larger than the maximum conductor for the lug.

A. Remove factory lugs and provide new suitable field-installed lugs. This option is not permitted where removal and replacement of lugs would violate equipment listing or where factory lugs are not removable.
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B. Utilize suitable crimp-on compression reducing adapters to splice between specified conductors and conductors compatible with factory lugs. Perform this splice within the equipment enclosure containing the factory lugs (where there is sufficient NEC required space for splices) or in a code sized junction box outside of the equipment enclosure (where sufficient space is not available). Install splices as indicated above for splices and taps. Provide conductors between the reducing adapters and the factory lugs insulated, as short as practical, and sized as per the NEC and the factory lugs. Utilize Burndy types #YSV, #YRV-L, #Y-R (Cu), and #YRB (Cu/Al) reducing adapters, or approved equal. Coordinate exact types and sizes with actual conductors involved.

C. Utilize suitable crimp-on compression pin type adapters on the end of conductors connecting in the factory-installed lugs. Utilize Burndy types #YE-P, #YE-P-FX (Cu), #AYP, and #AYPO (Al) pin adapters, or approved equal. Coordinate exact types and sizes with actual conductors and factory lug size involved.

6.7 Provide splices and taps at indoor locations and outdoor locations above ground (excluding exposed outdoor splices/taps) as follows.

A. For stranded wiring #10 AWG and smaller and solid wiring #8 AWG and smaller, make splices/taps by twisting conductors together and utilizing suitable pressure type "wire nut" connectors. Tightly over-wrap with vinyl insulating tape. Utilize listed wire nuts with internal coiled square metal binding spring ("all plastic" and porcelain wire nuts are not acceptable under any circumstance). For splices/taps in wet locations, utilize only "self-sealing" wire nuts with integral water repellent non-hardening sealant (Ideal #60 "DB Plus" or approved equal).

B. For wiring #6 AWG and larger and for #8 AWG stranded wiring, make splices/taps utilizing suitable crimp-on compression connectors. Bolted type connectors are not permitted, except where available crimp-on compression connector configurations do not correspond to combinations and arrangement of conductors to be connected. Wrap with rubber insulating tape or vinyl mastic of type, thickness, and insulation level equal to or exceeding the original insulation then tightly over wrap the entire assembly with vinyl insulating tape covering all rubber tape/mastic without gaps or voids.

6.8 Provide all splices and taps underground, below grade, and subject to being submerged (where specifically approved in writing by the engineer) as follows. Provide splices/taps of direct buried and open aerial wiring (where specified elsewhere) as follows. Submit shop drawings for all proposed splice/tap products and methods. Where any splice/tap is installed in any underground, below grade, submerged, or exposed wet or outdoor location for which shop drawings are not previously submitted, the contractor shall disconnect and remove the installed splices/taps and provide new acceptable splices/taps (as directed by the engineer) at no cost to the owner.

A. Utilize manufactured or pre-engineered splices/taps specifically designed and listed for the application, including being suitable for installation underground, direct buried, submerged, and in wet locations. Provide outdoor exposed splices/taps also as sunlight resistant. Pre-molded, heat-shrink, and cold-shrink manufactured kits and engineer approved pre-engineered hand-wrapped tape kits shall be considered.
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B. For underground splices/taps of stranded wiring #10 AWG and smaller and solid wiring #8 AWG and smaller only, splices/taps may be made as follows. Permanently electrically connect conductors by either of the following options:

1) Twist conductors together then solder conductors. Utilize suitable pressure type wire nut connectors with integral water repellent non-hardening sealant (Ideal #60 "DB Plus" or approved equal) to mechanically bind the soldered splice/tap and tightly over wrap with vinyl insulating tape.

2) Splice/tap conductors with suitable insulated crimp-on connectors and tightly over wrap with vinyl insulating tape.

Once electrically connected, embed splices/taps in sealant compound. Utilize only engineer approved hardening flexible sealant (i.e. "bondo" traffic detector loop style sealant; contact the engineer for information and submit shop drawings for approval). Place sealant (uncured liquid) in a suitable container, immerse splices/taps in sealant in the container, and rigidly support splices, taps, and conductors in place until sealant has set.

C. Self-sealing wire nuts (used alone and/or when over wrapped with vinyl insulating tape) are not an acceptable substitute for splices/taps as specified in items "A" and "B" above.

6.9 Splices, taps, and connections (and associated materials) as manufactured by Burndy, Elastimold, G&W, Homac, Ideal, Ilsco, Mac Products, O-Z/Gedney, Plymouth, Raychem, Scotch/3M, Thomas and Betts/Blackburn, and approved equal shall be considered.

7. GROUNDING MATERIALS

7.1 Provide all material used for grounding of non-ferrous copper. Aluminum is not acceptable, unless specifically indicated on the drawings.

7.2 Provide all driven (made) grounding rod electrodes of copper or copper clad steel, minimum 19 mm (3/4") diameter by 3.0 m (10'0") long.

7.3 Provide all grounding conductors in accordance with the section of this specification "Conductors and Cable (600 V)", except as follows. Grounding conductors may be insulated or bare, except as follows. Wherever grounding conductors #6 AWG and smaller are insulated, provide insulation colored green. Provide "isolated" grounding conductors as insulated only (green with yellow tracer). Provide grounding conductors run in raceway/cable with wiring as insulated only (bare conductors are not permitted for grounding conductors run with wiring, except cable wiring methods permitted elsewhere in the specifications where insulated grounding conductors are not available).

7.4 Provide all grounding connections as per the section of this specification "Splices and Taps", except as modified below. Grounding connections do not require insulation.
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7.5 For wiring #4 AWG and larger, provide all grounding connections utilizing exothermic weld process (Erico/Cadweld, Thermoweld, Thomas & Betts, or approved equal). Crimp-on compression type connectors may be used only where available exothermic weld process connection configurations do not correspond to combinations and arrangement of conductors to be connected. Bolted type connectors are not permitted, except where available exothermic weld process and crimp-on compression connector configurations do not correspond to combinations and arrangement of conductors to be connected. Where equipment is provided with factory installed lugs, #4 AWG and larger wiring may terminate directly at factory lugs.

7.6 Utilize only exothermic weld process connections for all concealed grounding connections; compression, mechanical, and other grounding connections are not permitted concealed. Where available exothermic weld process connection configurations do not correspond to combinations and arrangement of conductors to be connected in concealed locations, utilize combinations and arrangement of conductors as required to facilitate exothermic weld process connections and extend from the concealed connection location to an accessible location where crimp-on compression or bolted type connections may be utilized (as permitted above).

7.7 Accessible connections of wiring #6 AWG and smaller to piping and similar materials/equipment may utilize multiple-bolt type ground clamps. Accessible connections of wiring #6 AWG and smaller to driven (made) grounding rod electrodes may utilize one-piece, single bolt "acorn" type ground clamps.

7.8 Provide conduit grounding bushings of galvanized malleable iron with integral screw pressure connector or provisions to accept factory or field installed lug where required.

8. IDENTIFICATION, NAMEPLATES, AND TAGS

8.1 Provide all new electrical equipment with engraved three (3) layer laminated plastic nameplates describing the equipment, load/device served, ratings, circuit(s) feeding the equipment, etc. as indicated below. Provide engraved plastic nameplates for existing electrical equipment where modified or connected to as part of this project or where specifically indicated on the drawings. Provide these engraved plastic nameplates in addition to any code required or manufacturers' standard nameplates.

8.2 Provide engraved plastic nameplates for all electrical equipment, including, but not limited to, safety switches, enclosed circuit breakers, branch panels, distribution panels (including branch circuit breakers and circuit breaker spaces), transformers, any equipment containing fuses, power outlets, thermal overload switches, contactors, time clocks, photocells, meter sockets, modular meter centers, fire alarm equipment and devices, lighting controllers, dimming cabinets, capacitors, snow melting equipment, generators, motor control centers, motor controls (starters, variable frequency drive [VFD] units, etc.) where furnished by the electrical contractor, high voltage equipment, etc. (where applicable). Provide engraved plastic nameplates for all receptacles and switches where dedicated to serving specific equipment. Provide engraved plastic nameplates for convenience receptacles (only where indicated on the drawings).
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8.3 Secure engraved plastic nameplates with suitable screws or rivets, self-adhesive nameplates are not acceptable. Provide engraved plastic nameplates with white letters on black background, unless indicated otherwise. Provide engraved plastic nameplates with 6.5 mm (1/4") minimum lettering, unless indicated otherwise. Provide engraved plastic nameplates on the front and/or cover of the equipment plainly visible when the cover (where applicable) is closed, unless indicated otherwise.

8.4 Submit shop drawings showing proposed sizes (overall and lettering sizes) and exact proposed wording (including exact arrangement of wording) of all engraved plastic nameplates for review and approval.

8.5 Provide all engraved plastic nameplates in accordance with the following example. Equipment names are the alphanumeric designation for equipment indicated on the drawings (i.e. "MDP", "PP1", "EF-1", etc.). Equipment descriptions identify the equipment in "plain English" (see example). Indicate the operating voltage of the equipment, including phase and wires (see example). Where equipment includes overcurrent devices (i.e. main breaker panels, fused switches, enclosed circuit breakers, etc.) show the appropriate amperes on the engraved plastic nameplate. Where equipment does not include overcurrent devices (i.e. main lug panels, unfused switches, contactors, transformers, etc.) show the amperes of the overcurrent device protecting the circuit serving the equipment. Remarks include information as described below.

EXAMPLE ENGRAVED PLASTIC NAMEPLATE WORDING

Equipment Name (use 10 mm (3/8") lettering): PP1
Equipment Description: POWER PANEL
Equipment Voltage, Phase, Amperes: 120/208V-3PH-4W, 100A
Remarks: FED FROM MDP - CCT. 4

A. Branch Panel: Provide engraved plastic nameplate showing panel name and use (description) as indicated on the single line diagram and/or respective panel schedule. Remarks indicate the panel and circuit number or transformer feeding the panel.

B. Distribution Panel: Provide "master" engraved plastic nameplate on the front cover showing information as indicated above for branch panels. For multiple section panels, locate master nameplate on the section containing the main breaker or incoming line main lugs. Remarks indicate the panel and circuit number or transformer feeding the panel (i.e. sub-distribution panel) or indicate "Service Disconnect" if a service entrance distribution panel. Provide additional nameplates for all branch circuit breakers and circuit breaker spaces (see below).

C. Branch Circuit Breaker in Distribution Panel: Provide engraved plastic nameplate for each new circuit breaker within a distribution panel (including breakers in existing panels connected to as part of this project). Show the name and description of equipment/load fed. Voltage and phase are not required on these nameplates. Ampers are not required on these nameplates if the rating is clearly and visibly indicated on the circuit breaker. Where adjustable trip circuit breakers are used, show the proper ampere setting on this nameplate. Remarks indicate the approximate location of the equipment/panel served. Where the distribution panel includes a
hinged overall cover door, provide these nameplates mounted inside the hinged door.

D. Circuit Breaker Space in Distribution Panel: Provide engraved plastic nameplate for each circuit breaker space within a new distribution panel. Show the word "SPACE" and the maximum circuit breaker poles and frame size ampere rating. Equipment name, description, voltage, and remarks are not required on these nameplates. Where the distribution panel includes a hinged overall cover door, provide these nameplates mounted inside the hinged door.

E. Safety Switch/Enclosed Circuit Breaker: Provide engraved plastic nameplate with the name and description of equipment/load fed. Remarks indicate the panel and circuit number or transformer feeding the switch/breaker. Ampere rating may be omitted if the proper rating is clearly indicated on the switch/breaker and is visible with the cover closed. Where fusible switches are used, show the fuse ampere rating. Where adjustable trip circuit breakers are used, show the proper ampere setting.

F. Fusible Device: On the inside cover of each fused device, provide an engraved plastic sign indicating the proper fuse size (as indicated on the drawings or as required). Provide nameplate reading, "USE ___ A FUSE ONLY" (fill in the proper fuse rating).

G. Transformer: Provide engraved plastic nameplate with the name and description of equipment/load fed. Show both the primary and secondary voltages and phase as well as the transformer kVA rating. Ampere ratings are not required. Remarks indicate the panel and circuit number feeding the transformer.

H. Metering: Wherever new metering equipment is installed (including meters, meter sockets, meter boards, digital panel metering units, etc.), provide engraved plastic nameplate showing panel name(s) served by the meter as indicated on the single line diagram and customer buying electricity (description) as verified with the owner. Remarks indicate the panel and circuit number or transformer feeding the panel (or indicate "Fed From Service" if a utility meter). Show service voltage and phase of the metered feeder (not necessarily the meter voltage). For transformer rated metering installations, show current transformer (CT) ratio in place of ampere rating (i.e. "400:5 CT"). For self-contained metering (without CT's), show ampere rating of the metered feeder.

8.6 Provide engraved plastic nameplates for power outlets, thermal overload switches, and for receptacles and switches where dedicated to serving specific equipment. Show the equipment served, the voltage and ampere rating, and the circuit feeding the equipment. Utilize 3.2 mm (1/8") high minimum lettering. Provide as per the following example:

<table>
<thead>
<tr>
<th>Equipment Name and Description:</th>
<th>MO-1 MICROWAVE OVEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Voltage and Amperes:</td>
<td>120V, 20A - PP1-12</td>
</tr>
</tbody>
</table>

8.7 Where specifically indicated on the drawings only, provide engraved plastic nameplates for convenience receptacles showing the voltage and ampere rating and the circuit feeding the receptacle. Utilize 3.2 mm (1/8") high minimum lettering. Provide as per the following example:
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Equipment Voltage and Amperes: 120V, 20A
Equipment Circuit: PP1-14

8.8 Provide engineer approved wrap-around adhesive or tube type wire tags or markers for all conductors, except conductors in feeders tagged as indicated below. Provide tags/markers indicating the panel or device where the wiring originates and the conductor circuit number (or other identifying number/letter/designation unique to the conductor). Tag/mark neutral and grounding conductors with the respective circuit number(s) of the corresponding phase conductor(s).

8.9 Provide engineer approved tags for all panel feeders (regardless of ampere rating) and other circuits (600 V and less) rated 100 A and larger, at both ends and at all intermediate junction and pull boxes. Provide tags indicating the circuit designation or equipment served, panel name and circuit number (or other source of feeder), and stating the voltage, phase, and amperes of the circuit. Provide tag wording and layout similar to engraved plastic nameplates as indicated above.

8.10 Where any conductor size differs from the conductor size normally expected for the respective overcurrent device (for any reason, whether specified or not, including voltage drop consideration, NEC "tap rule" application, ampacity derating considerations, etc.), provide engineer approved tags at the point where the wiring terminates at the overcurrent device reading, "WIRING IS ADJUSTED FOR VOLTAGE DROP/TAP RULE/DERATING, USE MAXIMUM ___ A FUSE/CB" (indicate the proper reason for the adjustment and fill in the proper overcurrent device ampere rating). For feeders, this information may be included on the tags specified above.

8.11 Provide engineer approved plastic tags for all primary feeders (over 600 V) identifying the feeder number/designation and service voltage. Provide feeder numbers and exact tag configuration and information as designated by the owner and/or engineer during construction. Apply tags after applying cable fire protection tape, where applicable.

8.12 Provide all new and existing branch panels (where connected to or modified as part of this project) with accurate and descriptive typewritten circuit directories. For existing panels, provide directories including all modifications as part of this project as well as all previous "penciled in" changes and information. Actual tracing and identifying of existing circuits is not required, unless specifically indicated on the drawings. Submit photocopies of circuit directories at project close out as part of as-built record documents.

8.13 Provide all new electrical equipment with all caution, danger, and warning signs or indications required by any applicable regulation, code, standard, or manufacturer's recommendation (provide as listed where applicable and refer to specifications section "Regulations and Codes" of specifications division 16100, General Electrical). This includes, but is not limited to NEC Articles 100, 110, 200, 230, 250, 450, 490, 504, 513, 516, 550-552, 585, 620, 647, 665, 669, 690, 692, 700, 705, etc., as applicable.

8.14 Identify conductors in complete accordance with the NEC and as indicated below (including identifying "high-leg", grounding, and grounded (i.e. neutral) conductors, where applicable). For conductors #6 and smaller, identify by natural insulation color. For conductors #4 and larger (and for cable wiring methods where applicable colors are not readily available from cable manufacturers), identify by natural insulation color or by a 155
SECTION 16300 - ELECTRICAL MATERIALS

mm (6") long (minimum) band of colored vinyl electrical tape on conductors at all terminations and in all boxes and enclosures. Where "tracers" are required, identify by natural insulation color including narrow stripes of the tracer color. Where conductors including tracer stripes are not readily available, provide a 25 mm (1") band of tape (apply over and in the center of the 55 mm (6") band of tape, where applicable) of the tracer color at all terminations and in all boxes and enclosures.

8.15 Identify phases of all conductors where more than one phase conductor is present (in raceways, cables, boxes, enclosures, etc.) with methods as indicated above. Utilize standard color-coding throughout the project as follows:

120/208/240 V SYSTEM
A-phase Black
B-phase Red (utilize orange if 120/240V-3PH-4W midpoint grounded delta (i.e. "high-leg") system)
C-phase Blue
Neutral White
Ground Green

277/480 V SYSTEM
A-phase Brown
B-phase Orange (utilize purple where orange is used for 120/240V-3PH-4W delta system above)
C-phase Yellow
Neutral White with brown tracer(s)
Ground Green

Isolated ground conductors (any system): Green with yellow tracer(s)

OVER 600 V SYSTEMS
Utilize multiple 51 mm (2") wide bands of colored tape to identify phases. Utilize yellow for 5 kV nominal, red for 15 kV nominal, and orange for 25/35 kV nominal.
A-phase Single band
B-phase Two (2) bands
C-phase Three (3) bands

8.16 The electrical contractor shall provide new OSHA approved "DANGER - HIGH VOLTAGE" signs on all doors which directly enter any room containing exposed live parts or containing new or existing equipment operating at over 600 V (where connected to or modified as part of this project). Provide new signs even if existing signs are present (except that new signs are not required where existing signs are OSHA approved type complying with current OSHA standards).

9. LOCKS AND KEYS

9.1 Provide all locks for lighting and power panels, fire alarm and signaling cabinets and all other electrical systems or locked apparatus with keys which are alike.
10. RECEPCTACLES AND SWITCHES

10.1 Provide all receptacles and switches as industrial and specification grade, totally enclosed in non-flammable and heat resistant heavy-duty thermoset or thermoplastic case, with terminal screws on the side of the case. Pigtail conductor connections are not permitted (except for specialty devices where side terminal screws are not available options in the manufacturer's catalog), unless specifically indicated otherwise. Provide color as selected and approved by the owner and architect.

10.2 Provide receptacles as duplex, parallel blade, side wired, three (3) wire, grounding type, 20 A, 120 V, and listed as "tamper-resistant", unless specifically indicated otherwise on the drawings. Listed combination receptacle and separable snap-in wiring terminal assemblies (Hubbell "SNAPConnect" style, Pass & Seymour "PlugTail" style, or approved equal) may be used and may utilize pigtail connections on the wiring terminal assemblies.

10.3 Provide weatherproof receptacles listed as weather-resistant type and mounted in a weatherproof box with gasket and single spring-hinged weatherproof-while-in-use cover over both receptacle positions.

10.4 Provide receptacles at bathrooms, janitor closets, kitchen/kitchenette counters, outdoors, wet locations, and as indicated on the drawings or required by the NEC with integral ground fault circuit interrupter (GFCI) protection for personnel with trip characteristics as per the NEC and UL standards.

10.5 Where indicated on the drawings, provide isolated ground type receptacles with the receptacle grounding terminal electrically isolated and insulated from the receptacle mounting yoke. Where indicated on the drawings, provide with integral transient voltage surge suppressor (TVSS, with integral light emitting diode (LED) indicating integrity of TVSS protection) with TVSS components rated 150 V, 210 J (at 10 x 1,000 μs), and 13 kA (minimum) and complying with UL-1449. Provide all wiring serving isolated ground receptacles with separate equipment and isolated grounding conductors as per specifications section "Grounding" of specifications division 16200, General Electrical. Where isolated ground type receptacles are shown in nonmetallic raceways or nonmetallic boxes, either ground the metal receptacle yoke (in addition to grounding the receptacle ground terminal) with the equipment (raceway) grounding conductor (utilizing methods approved by the NEC) or substitute a standard (i.e. non-isolated-ground) type receptacle (but with TVSS where specified) so the receptacle yoke is grounded by the isolated ground conductor, at the contractor's option.

10.6 Provide wall switches as single pole, three-way, or four-way as required, heavy duty flux tumbler type, UL "T" rated, specification grade, and rated 20 A, 277 V and 120 V.

10.7 Provide horsepower rated single-pole thermal overload switches (manual motor starters, O/L switches, etc.) with thermal overload heater element coordinated with equipment served. Where overload protection is not required (where the switch acts only as disconnecting means) provide overload heater element rated in excess of the branch circuit breaker amperes.
10.8 For all switches where locking provisions are required by Code or indicated on the drawings and for all thermal overload switches, provide a suitable handle locking guard capable of visibly padlocking in the open or closed position (with switch handle position visible when locked).

10.9 Provide dimmer switches of thin profile slide type ("off" when slider is in the lowest position), Lutron #NT series (Hubbell, Leviton, or approved equal), unless indicated otherwise. Dimmer switches of the rotary type, with raised profile (with raised cooling fins), and/or with on/off toggle separate from slider are not acceptable. Provide with full wattage rating as indicated on the drawings, do not "de-rate" by removing cooling fins or heat sink sections (unless specifically indicated on the drawings). Where multiple dimmer switches or dimmer switch(es) along with standard type switches (single pole, three-way, and four-way) are shown grouped together on the drawings, gang switches together with a single overall cover plate (conform with NEC Article 404.8(B) "Voltage Between Adjacent Switches", where applicable). Utilize special cover plates as required by the combination of switches involved. Where ganged with dimmer switches, utilize single pole, three-way, and four-way switches of the slide type with appearance and manufacturer matching dimmer switches.

10.10 For all receptacles at any location in hospitals and in patient care and/or treatment areas in other occupancies (doctors/nurses offices, athletic training, first aid rooms, etc.) provide receptacles as hospital grade (in addition to requirements above) and provide wiring feeding the receptacles complying with NEC Article 517.13

11. SAFETY SWITCHES

11.1 Provide all safety switches (disconnect switches) of the quick-make and quick-break type, with contacts not marked or shielded, designed to function if the operating spring fails or is removed, with mechanical interlock so operation is impossible when the cover is open (provide means to manually bypass/defeat the interlock), with provisions for padlocking in both the open and closed positions, and of the heavy duty type. Provide switches with voltage ratings equal to or exceeding the operating voltage. Provide indoor switches with NEMA-1 enclosures. Provide outdoor switches with NEMA-3R enclosures. Where NEMA-4X enclosures are specifically indicated on the drawings only, provide of the stainless steel type only.

11.2 Provide fuse clips in fusible switches to facilitate fuses as per the section of this specification "Fuses". Provide suitable "rejection" type clips to prevent replacing fuses with short circuit ratings lower than specified.

11.3 Provide safety switches with ground busses. Where neutral conductor is present, provide safety switches with separate neutral busses (with provisions for bonding, bond where required by the NEC).

11.4 For all safety switches on the load side of variable frequency drive (VFD) units, provide safety switches with integral "electrical interlock" auxiliary contacts (one (1) N.O. and one (1) N.C., minimum) which "break" before safety switch opens. Provide two (2) #14 AWG interlock conductors run (in raceway with line side power conductors) from auxiliary contact to VFD unit. The VFD supplying contractor shall connect interlock wiring at VFD unit to shut down VFD unit if safety switch is opened to prevent operating VFD without load connected.
11.5 For all safety switches serving elevators, provide safety switches with integral "electrical interlock" auxiliary contacts (one (1) N.O. and one (1) N.C., minimum) which "break" before safety switch opens. Provide two (2) #14 AWG interlock conductors run (in raceway with load side power conductors) from auxiliary contact to elevator controller. The elevator contractor shall connect interlock wiring at elevator controls as required.

11.6 Equipment as manufactured by Eaton, General Electric, Siemens, Square-D, and approved equal shall be considered.

12. FUSES

12.1 Provide an NEC cartridge fuse for each fuse-gap in the work. Furnish three (3) spare fuses of the rating installed to the owner for each fused device. Specifications are based on equipment as manufactured by Cooper/Bussman. Equipment as manufactured by Ferraz Shawmut, Littlefuse, or approved equal shall be considered.

12.2 Provide fuses of the dual element time delay, current limiting, and non-renewable type with voltage rating not less than the operating voltage and coordinated with the respective fuse clips and with short circuit rating of 200,000 A. Provide fuses as class "RK1" (600 A and less, Cooper/Bussman #LPN/S-RK series) or class "L" (over 600 A, Cooper/Bussman #KRP-C series). Class "CC" fast acting (Cooper/Bussman #LP-CC series) or time delay (Cooper/Bussman #KTK-R series) fuses, as recommended by manufacturer, are permitted for control applications.

13. CIRCUIT BREAKERS

13.1 This section applies to all circuit breakers installed within or in conjunction with branch and distribution panels, enclosed circuit breakers, contactors, starters, and any other electrical equipment, unless indicated otherwise.

13.2 Provide all circuit breakers of the molded case type unless specifically indicated otherwise. Provide readily removable from the front of panels and equipment without disturbing adjacent units, having quick-make and quick-break toggle mechanisms and non-fusible contacts, having inverse time and short circuit characteristics, which trip free on overload or short circuit so that they cannot be held closed on overload, clearly indicating whether they are in the open, tripped, or closed position. Provide automatic release obtained through the medium of a bimetallic thermal type element (ambient compensated) engaged in the releasing latch of the breaker or mechanism.

13.3 Provide circuit breakers in branch and distribution panels with short circuit ratings as indicated in the respective equipment specifications. Provide circuit breakers as part of enclosed circuit breakers, contactors, starters, and any other electrical equipment with short circuit ratings not less than the short circuit rating of the first overcurrent device on the line side of the breaker, unless indicated otherwise on the drawings.

13.4 Provide field-installed handle locking devices for all circuit breakers not requiring switch control, for all circuit breakers feeding emergency lighting equipment (including battery equipment) and fire alarm controls, and for all circuit breakers fed from an emergency generator system (where applicable).
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13.5 Provide 15 A and 20 A circuit breakers "SWD" and "HID" rated. Provide branch panel (250 V and less) circuit breakers rated 70 A and less as "HACR" rated. Provide enclosed circuit breakers and circuit breakers in distribution panels rated 250 A and less as "HACR" rated.

13.6 For all 120 V, 20 A and 120 V, 15 A circuits (including multi-wire branch circuits feeding 120 V loads) serving any new or existing outlets (receptacle outlets, lighting outlets, fan outlets, equipment outlets, utilization outlets, etc.) in any dwelling unit family room, dining room, living room, parlor, library, den, bedroom, sunroom, recreation room, closet, hallway, or similar room or area, provide branch circuit breakers of the arc fault circuit interrupter (AFCI) type. This does not apply to circuits rated 208 V and greater or circuits rated 30 A and greater. For the purposes of this section, bedrooms include all bedrooms, hotel/motel guest rooms, dormitory rooms, and any other room capable of being converted to or used as a bedroom or for sleeping. Provide as NEC approved and listed for the purpose. Provide whether indicated on the drawings (including panel schedules) or not, include all costs in bid.

13.7 Provide all circuit breakers over 250 A of a type with interchangeable trip units. Provide all circuit breakers rated 1,000 A or larger and operating at over 250 V with integral ground fault protection for equipment.

13.8 Where circuit breakers include or facilitate adjustable settings, adjust and set as follows. Set adjustable continuous current settings (where applicable) to ratings shown on drawings. For adjustable instantaneous, short time, and ground fault settings (where applicable), the electrical contractor is responsible for (include all costs) a basic short circuit and coordination study performed by the respective circuit breaker manufacturer. Set breakers as per this study. Provide study in accordance with applicable ANSI and IEEE standards. Gather all information required by the manufacturer to perform this study. Submit a written report of the study to the engineer for review prior to releasing equipment for manufacture. The basic coordination study may be limited to a minimum of coordinating each adjustable setting circuit breaker with the nearest line side overcurrent device directly feeding the breaker and all nearest load side overcurrent device(s) fed directly by the breaker. The basic short circuit study may be limited to the minimum required to complete the coordination study and confirm proper settings. Setting adjustable circuit breaker settings to the minimum or factory "default" settings (i.e. as shipped from the factory) is not acceptable.

14. ENCLOSED CIRCUIT BREAKERS

14.1 Provide each enclosed circuit breakers consisting of a molded case circuit breaker, with a trip rating as indicated on the drawings, with provisions for padlocking in both the open and closed positions, within a listed enclosure manufactured for the purpose of housing a circuit breaker. Provide indoor breakers with NEMA-1 enclosures. Provide outdoor breakers with NEMA-3R enclosures.

14.2 Provide circuit breakers (including short circuit ratings) as specified elsewhere in this specification. Provide circuit breakers of the bolt-on type.
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14.3 Provide enclosed circuit breakers with ground busses. Where neutral conductor is present, provide safety switches with separate neutral busses. Provide neutral bus with provisions for bonding and bond where required by the NEC.

14.4 Equipment as manufactured by Eaton, General Electric, Siemens, Square-D, and approved equal shall be considered.

15. BRANCH PANELS

15.1 Provide branch panels (panel boards) of dead front completely enclosed safety type construction, listed (with all components bearing labels), of a type suitable for use as service entrance, and containing thermal-magnetic "bolt-on" type circuit breaker branches as per the respective schedules on the drawings.

15.2 Provide circuit breakers as specified elsewhere in this specification.

15.3 Provide cabinets consisting of code gauge galvanized sheet steel boxes of sufficient depth, width, and length to mount the panels as indicated on the drawings and to facilitate wiring, with suitable lugs for mounting panel interiors, and with wiring gutters at top, bottom, and sides of sufficient size to adequately accommodate the raceways, conductors, and cables entering and leaving (provide all gutters at least 100 mm (4"))

15.4 Provide panel faces with adjustable indicating type clamps and of single door construction, with door opening over the circuit breaker section (secured with locks and pulls as specified under paragraph heading "Locks and Keys"), hung with heavy hinges, and with faces and doors not less than 2.7 mm (12 ga.) thick.

15.5 Provide metal frame circuit directory holders welded to the inside of the cabinet doors with transparent covers. Place typewritten directories in these holders.

15.6 Provide bus bars with ampacity as indicated on the drawings (or corresponding to main breaker, where applicable) and with all current carrying parts sized per UL 67 heat rise testing.

15.7 Provide panels with copper or aluminum bus bars.

15.8 Provide panels with separate ground and neutral busses. Provide neutral bus with provisions for bonding and bond where required by the NEC.

15.9 Provide panels with 10,000 A short circuit rating (A.I.C., Iac), unless indicated otherwise on the drawings. Provide panels fully short circuit rated, series short circuit rating of panels are not acceptable (unless specifically indicated otherwise).

15.10 Provide ALL new panels with integral surge suppression as specified elsewhere in this specification.

15.11 Equipment as manufactured by Eaton, General Electric, Siemens, Square-D, and approved equal shall be considered.
15.12 Where branch wiring fed from the panel utilizes cable wiring methods (i.e. types "AC" or "MC" cables, where permitted elsewhere by the specifications) avoid visible exposed cables in electrical closets and electrical rooms by either of the following options:

A. Provide suitable sheet metal panel "skirt" enclosure(s) above and/or below the panel as required to completely enclose cable wiring methods so not more than a 300 mm (12") total length of each cable is visible. Provide skirt enclosures fabricated of galvanized sheet steel not less than 0.55 mm (26 ga.) thick.

B. Provide a nearby junction box for branch wiring as indicated below.

15.13 Where panels are flush mounted, provide an adjacent junction box for branch wiring as indicated below.

16. JUNCTION BOXES FOR BRANCH PANELS

16.1 Provide suitable junction boxes (and/or wiring troughs) for branch wiring at branch panels as follows. The electrical contractor must provide junction boxes for all flush mounted panels. The electrical contractor may utilize junction boxes (as an option to metal panel skirts) to avoid exposed visible cables in electrical closets and electrical rooms. The electrical contractor may utilize junction boxes at other locations and applications if desired, but the boxes and raceways (wherever used) must comply with all of the following requirements.

16.2 Locate each junction box above an accessible drop ceiling (or an access panel if ceiling is inaccessible) directly above or as close as practical to the panel. Where junction box is installed to satisfy requirements to hide cable wiring methods, locate outside of the electrical closet/room or inside the closet/room at a perimeter wall so there are no visible cables in the closet/room (except that not more than 300 mm (12") total visible length of each cable is permitted leaving the junction box).

16.3 Provide junction boxes and raceways between boxes and panel as indicated below.

<table>
<thead>
<tr>
<th>Panel Size</th>
<th>Junction Box</th>
<th>Quantity and Size of Conduits</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Branch Cet. Poles)</td>
<td>Min. Dimensions</td>
<td></td>
</tr>
<tr>
<td>43-Poles &amp; Over (All Double panels)</td>
<td>48&quot;W x 8&quot;H x 8&quot;D (1.2m x 205mm x 205mm)</td>
<td>(8) 53 mm (2&quot;)</td>
</tr>
<tr>
<td>31-to 42-Poles</td>
<td>24&quot;W x 8&quot;H x 8&quot;D (0.6m x 205mm x 205mm)</td>
<td>(4) 53 mm (2&quot;)</td>
</tr>
<tr>
<td>19-to 30-Poles</td>
<td>24&quot;W x 6&quot;H x 6&quot;D (0.6m x 155mm x 155mm)</td>
<td>(3) 53 mm (2&quot;)</td>
</tr>
<tr>
<td>18-Poles and less</td>
<td>18&quot;W x 6&quot;H x 6&quot;D (460mm x 155mm x 155mm)</td>
<td>(2) 53 mm (2&quot;)</td>
</tr>
</tbody>
</table>

* Two (2) 24"W x 8"H x 8"D (0.6 m x 205 mm x 205 mm) junction boxes may be substituted. Provide (2) 78 mm (3") conduit nipples between the junction boxes.

16.4 Adjust wiring sizes between each junction box and panel in accordance with NEC de-rating factors. Utilize #8 AWG wiring for branch circuits rated 25 A or 30 A. Utilize #6 AWG wiring for branch circuits rated over 30 A but less than 60 A. Coordinate routing of wiring between junction box and panel with the engineer during construction for all circuits rated over 30 A. Where wiring sizes change due to de-rating considerations, splice wiring in the junction box as required.
16.5 Do not pass the incoming panel feeder and any branch circuits rated 60 A and larger through junction boxes, run this wiring directly into panels. Do not terminate any branch wiring conductors (including grounding conductors associated with each branch circuit) in junction boxes. Terminate conductors only at circuit breakers, ground bus, and neutral bus in panels. Do not splice conductors in junction boxes, except straight-through splicing of two (2) conductors as provided above for de-rating.

16.6 Bond each junction box to the panel enclosure with a grounding conductor run in one of the raceways between the panel and junction box. Provide bonding conductor not smaller than the grounding conductor for the panel feeder.

17. DISTRIBUTION PANELS

17.1 Distribution panel (distribution panel boards and switchboards) specifications are based on Square-D "I-Line" type. Additional equipment including Square-D #QED type, Eaton "Pow-R-Line" type, General Electric "AV-Line" type and "Spectra" series, Siemens "P-series", and approved equal shall be considered.

17.2 Provide distribution panels of dead front completely enclosed safety type construction, listed (with all components bearing labels), and of a type suitable for use as service entrance.

17.3 Provide thermal-magnetic branch circuit breakers featuring "bolt-on" type modular mounting, facilitating mounting of breakers regardless of breaker frame sizes or poles.

17.4 Provide circuit breakers as specified elsewhere in this specification.

17.5 Where new "spaces" or "provisions" for circuit breakers are indicated on the drawings or specifications, include all circuit breaker mounting brackets, hardware, bus bar straps, screws, and any other material, equipment, and accessories required to install circuit breakers in the future (install in panel spaces). Provide so the only necessary component not furnished as part of provisions is the circuit breaker(s) themselves.

17.6 The quantity of provisions (of each respective frame size) specifically indicated on the drawings is the minimum acceptable. If necessary, provide additional branch distribution sections to provide the specified minimum quantity. After satisfying specified minimums, provide additional provisions (of 100 AF, 225/250 AF, and/or 400 AF frame sizes; in any combinations at the manufacturer's/contractor's discretion) as required so all remaining available circuit branch breaker mounting space in the panel (for the full height of the panel enclosure) consists of provisions.

17.7 Provide all compartments (and all main and branch circuit breakers and other equipment therein) completely accessible from the front, unless otherwise indicated on the drawings (regardless if panels are shown against a wall or free-standing).

17.8 Provide enclosure consisting of code gauge steel box(es) of galvanized sheet steel of sufficient dimensions to mount panels and to facilitate wiring.
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17.9 Provide bus bars with ampacity as indicated on the drawings (or corresponding to main breaker, where applicable) and with all current carrying parts sized per UL 67 heat rise testing.

17.10 Provide panels with copper or aluminum bus bars.

17.11 Provide panels with separate ground and neutral busses. Provide neutral bus with provisions for bonding and bond where required by the NEC.

17.12 Provide bus bars braced to withstand 100,000 A short circuit current. Provide panels with 100,000 A short circuit rating (A.I.C., Iac), unless indicated otherwise on the drawings (rating on drawings does not apply to bus bracing, provide bracing as indicated above). Provide panels fully short circuit rated, series short circuit rating of panels is not acceptable.

17.13 Identify each branch circuit breaker individually with an engraved plastic nameplate as indicated in the section of this specification "Identification, Nameplates and Tags".

17.14 Where indicated on the drawings, provide panels with integral factory fitted electronic metering units with appropriate metering transformers. Provide metering units to meter current (in all three phases), voltages (phase-to-phase and phase-to-neutral/ground in all three phases), power (kW), apparent power (kVA), energy consumption (kWh), power factor, peak demand power (kW peak), and harmonic THD and K-factor, and featuring true RMS metering. Provide meter with communications capability via RS-485 port and via Ethernet (10/100 Base-T UTP) communications card. Provide metering units as Square-D/PowLogic #PM820 (with #PM8ECC communications card, Eaton, General Electric, Siemens, or approved equal.

17.15 Where indicated on the drawings or required by code, provide equipment ground fault protection for main and/or branch circuit breakers.

17.16 Where draw-out construction or draw-out circuit breakers are shown on the drawings or otherwise specifically noted, provide panels accordingly. Refer to the section of this specification "Unit Substation" for information.

18. DRY TYPE TRANSFORMERS

18.1 Provide dry type transformers (indicated "AA" on the drawings) with primary and secondary voltages, connections (i.e. single phase, three-phase wye, three-phase delta, etc.), and kVA rating as indicated on the drawings.

18.2 Provide with 150 degrees C temperature rise above 40 degrees C ambient. Provide all insulating materials in accordance with NEMA St20-1972 standards for a 220 degree C listed component recognized insulation system and provide transformers listed for the specified temperature rise. The maximum temperature of the top of the enclosure may not exceed 50 degrees C rise above 40 degrees C ambient.

18.3 Provide with primary full capacity taps, a minimum of two (2) 2.5% taps above and two (2) 2.5% taps below rated voltage.

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18.4 Provide coils of continuous wound construction impregnated with non-hydroscopic, thermostetting varnish. Provide copper or aluminum coil windings.

18.5 Provide core constructed of high grade, grain oriented, non-aging silicon steel laminations with high magnetic permeability, featuring low hysteresis losses and low eddy current losses, and constructed to maintain magnetic flux densities well below the saturation point. Provide core laminations clamped together with structural steel angles. Provide the core and coil fastened to the enclosure base utilizing an appropriate engineered permanent fastening and vibration isolating/absorbing system (i.e. including rubber mounts). Metal-to-metal contact of any kind between the core and coil and the enclosure is not acceptable. Isolating systems requiring the complete removal of all fastening devices are not acceptable. Provide core and all ferrous parts suitably protected to resist corrosion by painting or plating.

18.6 Provide core visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, IEEE, and ANSI standards.

18.7 Provide transformers mounted in heavy gauge, sheet steel, ventilated enclosures designed for floor mounting. Provide ventilating openings to prevent access to live parts in accordance with UL, NEMA, and NEC standards (specifically including NEC Articles 110.27 and 450.8 [and 110.31(B)(1) if over 600 V]) for ventilated enclosures in locations accessible to unqualified persons (whether installed in such locations or not). Include custom/special enclosures or enclosure modifications as required to satisfy this requirement (where enclosures are installed which not meeting this requirement [without prior written approval], the contractor shall remove the enclosure and provide a new acceptable enclosure at no cost to the owner).

18.8 Provide the entire enclosure degreased, cleaned, phosphatized, primed, and finished with gray baked enamel.

18.9 Provide manufacturer guaranteed sound levels not exceeding 45 dB.

18.10 For transformer coils rated 600 V and less, provide basic impulse level (B.I.L.) rating as per applicable industry standards. For transformer coils rated over 600 V, provide 95 kV B.I.L. rating.

18.11 Provide all transformers rated 15 kVA and larger as energy efficient NEMA TP1 rated. Provide all transformers rated 480V-3PH-3W to 120/208V-3PH-4W and 500 kVA and less with UL K-13 rating, minimum, unless specifically indicated otherwise.

18.12 Where transformers are indicated as part of a unit substation, provide with suitable coordinated flanges for assembly to high voltage and low voltage compartments. Provide all hardware, bus, and connectors as required for complete assembly.

18.13 Where transformers are indicated with forced-air cooling ("AA/FA" on the drawings) provide complete with integral cooling fans, automatic fan controls, and integral control power transformer for fans. Provide forced-air cooling for increased capacity 33.3% above the base (AA) transformer rating. Provide automatic fan controls including over temperature alarm with indicating light and horn and with contacts for external monitoring. Provide nameplate reflecting fan rating.
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18.14 Where transformers are indicated with provisions for future forced air cooling ("AA/FFA" on the drawings) provide with core and coils rated based on future addition of fans, with integral provisions for mounting future cooling fans, with blank plate in enclosure as provisions for mounting future fan controls, and provisions for connecting future control power transformer. Provide all required heat sensing equipment installed in transformer coils. Future forced-air cooling shall provide increased capacity 33.3% above the base (AA) transformer rating once fans are installed. Provide nameplate reflecting future fan rating.

18.15 Equipment as manufactured by Eaton, General Electric, Hevi-Duty, Siemens, Square-D, and approved equal shall be considered.

19. CONTACTORS

19.1 Provide lighting contactors with number of poles and ampere ratings as indicated on the drawings. Provide contactors mechanically held and electrically operated with integral solid-state control modules as required for two (2) wire control, unless indicated otherwise. Utilize electrically held and electrically operated contactors only where specifically indicated on the drawings (and provide with not less than one (1) N.C. and one (1) N.O. auxiliary contacts). Provide contactors with silver alloy double break contacts, with all contacts rated 600 V, and with coil clearing contacts.

19.2 Provide 120 VAC coil voltage, unless indicated otherwise. Provide contactors mounted in NEMA-1 enclosures, unless indicated otherwise. Provide all contacts normally open, unless indicated otherwise.

19.3 Provide contactors rated 20 A as ASCO #918 series, or approved equal. Provide contactors rated 30 A and larger of the non-fusible combination type, with integral disconnect switch, Square-D Class #8903 type "S", or approved equal.

19.4 Equipment as manufactured by ASCO, Eaton, General Electric, Siemens, Square-D, and approved equal shall be considered.

19.5 Provide an engraved laminated plastic nameplate on the front cover (refer to the section of this specification "Identification, Nameplates, and Tags") describing the contactor ("OUTDOOR LIGHTING CONTACTOR - 120V, 5A - CONTROLS FED FROM PP1 - CCT, 4 - SEE INSIDE FOR CONTROLLED LIGHTING CIRCUITS - *"). Describe the device(s) controlling the contactor and controlling device(s) location(s), where applicable. Provide a typewritten circuit directory affixed within the enclosure listing each respective contactor pole, panel, circuit number, and circuit description of each controlled circuit. Nameplate is not required for contactors integral to a lighting controller where the controller includes a similar nameplate.

20. TIME CLOCKS AND PHOTOCELLS

20.1 Provide one (1), two (2), or four (4) channel time clocks, as indicated on the drawings. Provide time clocks with one (1) single pole, double throw (SPDT) contact for each respective channel (to facilitate control of mechanically held, electrically operated contactors), with digital control (electromechanical type is not acceptable), of the seven (7) day type with 365 day single and block holiday scheduling, with astronomic feature,
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indicating "on" or "off" condition with an illuminated light emitting diode (LED) visible with the enclosure cover open, with integral manual override capability, with integral automatically recharging nickel cadmium (NiCd) battery providing minimum 72 hour reserve power.

20.2 Provide coil and contact voltage rated 120 V, unless indicated otherwise. Provide time clock with NEMA-1 metal or NEMA-3 "Noryl" enclosure, unless indicated otherwise. Provide contacts rated 20 A where directly switching branch circuit load or rated 10 A (resistive) minimum where controlling contactor(s).

20.3 Provide Tork #DGLC100A-NC time clocks (or approved equal, having identical functions and characteristics, subject to review by owner).

20.4 Provide an engraved laminated plastic nameplate on the front cover of each time clock (refer to the section of this specification "Identification, Nameplates, and Tags") describing the time clock ("OUTDOOR LIGHTING - 120V, 5A - CONTROLS FED FROM PP1 - CCT. 4 - SEE INSIDE FOR CONTROLLED LIGHTING CIRCUITS - *") Describe the device(s) controlled by the time clock and controlled device(s) location(s), where applicable. Where time clock switches branch circuits directly, provide a typewritten circuit directory affixed within the enclosure listing each respective contact pole, panel, circuit number, and circuit description of each controlled circuit. Nameplate is not required for time clocks integral to a lighting controller where the controller includes a similar nameplate.

20.5 Provide photocells of the twist-lock type with integral time delay feature, with integral utility grade metal oxide varistor (M.O.V.) over-voltage surge protection, arranged to "fail-on", and rated 120-285 V (suitable for 120 V, 208 V, 240 V, and 277 V operation), 1,200-2,850 W, and 1,800-2,800 VA, unless indicated otherwise. Provide a suitable twist-lock photocell receptacle and mount atop a suitable weatherproof box.

20.6 Provide Tork #5007M photocells or approved equal. Provide Tork #2223/4 photocell twist-lock receptacles or approved equal.

20.7 Provide an engraved laminated plastic nameplate at photocell twist-lock receptacles (refer to the section of this specification "Identification, Nameplates, and Tags") describing the device(s) controlled by the photocell and the circuit feeding the photocell ("SEE LIGHTING CONTROLLER IN ELECTRICAL ROOM - 120V, 5A - PP1, CCT. 4"). Nameplate may utilize 3.2 mm (1/8") letters.

20.8 Specifications are based on equipment as manufactured by Tork. Equal equipment as manufactured by Intermatic and Paragon shall be considered. Other Manufacturers shall be considered in accordance with Specification Section 01300 – Submittals.

21. INTEGRATED OUTDOOR LIGHTING CONTROLLER

21.1 Combination Photocell and Time Clock Lighting Controller: Provide combination photocell and time clock controlled integrated outdoor lighting controller including two (2) 20 A, 12-pole lighting contactors (one (1) for photocell and time clock lighting and one (1) for photocell only lighting), an integral one (1) channel digital time clock (utilize specific time clock in specifications section "time clocks and photocells" only), two (2) hand-off-
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auto (HOA) selector switches (one (1) for each lighting contactor above), suitable terminal blocks for all field wiring (including 120 VAC incoming controller power wiring, connections to remote photocell, etc.), fused (rating as per manufacturer) control power circuit, and complete factory internal wiring. Provide all components above enclosed within an overall NEMA-1 enclosure with hinged cover and locking (keyed to match branch panel keys) hasp (provide HOA switches mounted on the front cover). Provide ASCO #641AS outdoor lighting controller, or approved equal (with time clock as specified substituted for normal factory time clock).

21.2 **Lighting Controller Emergency Contactor:** Provide outdoor lighting controller including an electrically held emergency lighting contactor in a separate NEMA-1 enclosure to control emergency outdoor lighting. Maintain complete separation between normal and emergency source wiring as required by code. Provide emergency lighting contactor consisting of a 20 A, 12-pole electrically held and electrically operated (mechanically held contactor of any type is not acceptable for emergency use) lighting contactor with all normally closed (N.C.) contacts so emergency lighting circuits energize upon loss of control voltage to this contactor. Interconnect the emergency contactor with a normally closed auxiliary contact in the normal photocell controlled lighting contactor wired in series with an auxiliary contact in the generator automatic transfer switch (contact opens when generator is in the "emergency" position). Provide all interconnecting field wiring as required.

21.3 Provide an engraved laminated plastic nameplate on the front cover (refer to the section of this specification "Identification, Nameplates, and Tags") describing the controller ("OUTDOOR LIGHTING CONTROLLER - 120V, 5A - CONTROLS FED FROM PP1 - CCT. 4 - SEE INSIDE FOR CONTROLLED LIGHTING CIRCUITS - PHOTOCELL ON ROOF AT NORTH SIDE OF BUILDING"). Describe the location of the remote photocell, where applicable. Provide engraved laminated plastic nameplates at each switch indicating the switch function and respective switch positions. Provide engraved laminated plastic nameplates at each pilot light indicating the light function. Switch and pilot light nameplates may utilize 1/8" letters. Provide a typewritten circuit directory affixed within the enclosure listing each respective contactor pole, panel, circuit number, and circuit description of each controlled circuit.

21.6 Provide lighting contactors, time clocks, fusing, and remote photocells as indicated in respective sections elsewhere in this specification.

21.7 Equipment as manufactured by ASCO, Eaton, General Electric, Siemens, Square-D, and approved equal shall be considered.

END OF SECTION
SECTION 16350 - ADDITIONAL ELECTRICAL MATERIALS

1. GENERAL PROVISIONS

1.1 The applicable requirements and conditions of specifications section "General Provisions" of specifications divisions 16100, General Electrical, and 16300, Electrical Materials, are hereby made an integral part of this section.

2. LIGHTNING PROTECTION SYSTEM

2.1 Drawings indicate relative and approximate quantities and locations of air terminals and driven (made) grounding rod electrodes and approximate general routing of air terminal conductors and down conductors as a guide to pricing and to summarize the general scope of work and lightning protection. Drawings do not indicate exact conductors, exact conductor routing and installation, exact quantities and locations of air terminals, exact quantity of ground rods at each location, bonding to miscellaneous equipment and apparatus, bonding to metal object, equipment, piping, and raceways (including raceways for lightning protection conductors), and equipment at building electrical, telephone, and other services, and interconnection with building electrical, telephone, and other service grounding electrode systems.

2.2 Provide complete lightning protection including listing of the system. Completely coordinate with the lightning protection system supplier and verify all requirements necessary for listing prior to submitting bid. Provide the lightning protection system including and/or meeting all necessary requirements and include all costs in bid. No consideration, claims, charges, or compensation will be granted for any alleged misunderstanding of any proposed or existing conditions or the work to be performed.

   A. Provide a complete detailed review and survey of all project drawings (including the work of other trades, especially architectural and mechanical roof plans and architectural elevations and sections, where applicable), all existing conditions, and all nearby existing buildings which may effect the lightning protection system as part of this project. Visit the site to verify existing and site conditions.

   B. Provide all required overvoltage surge (lightning) arresters throughout the building (including at electrical, telephone, and other services).

   C. Provide exact conductors, exact conductor routing and installation, exact quantities and locations of air terminals, exact quantity of ground rods at each location, bonding to miscellaneous equipment and apparatus, bonding to piping and raceways (including raceways for lightning protection conductors), and interconnection with building electrical, telephone, and other service grounding electrode systems as required.

2.3 Provide lightning protection equipment and installation by a firm certified as a "master installer" by the Lightning Protection Institute (LPI).

2.4 Submit complete shop drawings including all lightning protection equipment, devices, materials, and installation drawings.
2.5 Provide all materials and installation conforming to all applicable requirements of UL, NFPA (including NFPA-780), LPI (including LPI-175 Standard of Installation), the NEC, and all other applicable codes and standards.

2.6 Fully coordinate the entire lightning protection system (including penetrations, running conductors, and all securing and supports), all existing roofing, and all new roofing to maintain full integrity of all roofing systems. Coordinate all work with all other trades, specifically including roofing work and the roofing subcontractor. Utilize only manufacturer’s through-roof connections fully coordinated with and compatible with roofing at roof penetrations.

2.7 Route all conductors as required by UL, NFPA, and LPI to obtain listing.

2.8 Run conductors at roofs exposed. Install in such a manner to be as inconspicuous as possible. Run wiring where not visible to normal building occupants and to people outside of the building as much as possible. Secure exposed conductors utilizing clip cable fasteners spaced not exceeding 0.9 m (3'0") on center.

2.9 Run all down conductors and any conductors not on the roof in 27 mm (1") conduit. Run all conduits concealed or hidden as much as possible.

2.10 Utilize steel RMC for lightning protection wiring unless indicated otherwise (bond raceway to lightning protection conductors at both ends of raceway and at all intermediate pull and junction boxes). Utilize steel RMC only for all exposed exterior raceways, for raceways in or below grade that are subject to vehicular traffic, for all raceways in NEC Hazardous Classified Locations (NEC Chapter 5), and for raceways in plenum spaces. Utilize steel RMC only (with concrete encasement where required by code) where field conditions do not facilitate maintaining NEC required minimum cover for underground PVC RNC.

2.11 Steel IMC may be utilized for lightning protection wiring except conditions indicated above as requiring steel RMC only (bond raceway to lightning protection conductors at both ends of raceway and at all intermediate pull and junction boxes). Steel IMC is permitted for raceways in plenum spaces.

2.12 Where permitted by code, Schedule 40 or schedule 80 PVC RNC may be used for interior and underground lightning protection wiring, except where steel RMC only is indicated above. Encase all underground PVC RNC in a 76 mm (3") 20 MPa (3,000 p.s.i.) concrete envelope.

2.13 Provide lightning protection equipment and wiring of materials as follows as required by conditions encountered. Where conditions require changing lightning protection conductor material (from copper to aluminum and vice versa), utilize only suitable CU/AL dual rated connectors.

A. Provide solid copper air terminals and copper lightning protection conductors for all lightning protection, except as specifically provided below for contact with aluminum building materials. Do not install copper conductors in contact with any aluminum materials. Provide all hardware (of bronze material or as otherwise permitted by UL, NFPA, and LPI) as required to firmly secure air terminals and conductors to the building. Provide conductors of soft drawn copper wire, 98% conductivity, single
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conductor, bare, 28-strand, #14 AWG each strand, weighing 566 g/m (380 lb. per 1,000'), and as otherwise required by UL, NFPA, and LPI. Where specifically indicated on the drawings (i.e. for use in "salt air" environments) utilize only tinned copper conductors.

B. Where in direct contact with aluminum building materials only, provide solid aluminum air terminals and aluminum lightning protection conductors. Do not install aluminum conductors in contact with any copper materials. Completely verify and coordinate building materials with the G.C. (for new materials) or by visiting the project site (for existing materials), include all costs in bid. Provide all hardware (of aluminum material or as otherwise permitted by UL, NFPA, and LPI) as required to firmly secure air terminals and conductors to the building. Provide conductors of soft drawn aluminum wire, 98% conductivity, single conductor, bare, 37-strand, #13 AWG each strand, weighing 283 g/m (190 lb. per 1,000'), and as otherwise required by UL, NFPA, and LPI.

2.14 Provide fasteners and supports for lightning protection air terminals and conductors as per specifications section "Fastenings, Supports, and Hangers" of specifications division 16200, unless indicated otherwise.

2.15 Utilize stainless steel hardware only for securing lightning protection equipment/wiring on roofs and exterior locations.

2.16 Provide all connections in complete accordance with UL, NFPA, and LPI requirements. Exothermic weld process connections are not permitted for connecting to aluminum conductors. Factory installed clamps or lugs may be utilized for connections at air terminals.

2.17 Provide air terminal length as per UL, NFPA, and LPI. Where air terminals are located atop equipment/enclosures, directly connect lightning protection conductors to air terminals (do not depend on equipment/enclosures as a lightning protection conductor).

2.18 To protect personnel from potential impalement hazards, provide air terminals with approved blunt-end protective means or integral blunt-end construction (National Lightning Protection Corp. "Flathead NLP" or approved equal) as follows:

A. Provide all air terminals utilizing impalement protected air terminals, unless specifically indicated otherwise below.

B. Unprotected air terminals are permitted on gable, hip, gambrel, and shed type roofs where there is no equipment located on the roof requiring servicing, maintenance, or inspection from the roof surface.

C. Unprotected air terminals are permitted at the outside edge perimeter (only) of flat type roofs (as well as mansard type roofs where the sloped portion has a pitch rise to run ratio of 1.5:1 or steeper) where there is no parapet or where the parapet is 0.46 m (1'6") high or less (where there is a high fall hazard).
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D. Unprotected air terminals are permitted atop parapet walls, chimneys, and other similar roof equipment provided the top of air terminals is 1.8 m (6'0") or higher above adjacent roof surface.

E. For all air terminals (regardless of roof type) in the vicinity of areas accessible to building occupants or the general public (including, but not limited to, parking garage top levels, decks on roofs, walkways at roofs, any means of egress at roofs, etc.), utilize only impalement protected air terminals.

F. For all air terminals (regardless of roof type) located within 4.5 m (15'0") of any equipment on the roof (which requires servicing, maintenance, or inspection) or within 4.5 m (15'0") of any rooftop walkway or walking surface (including rubber or paver walking surfaces), utilize only impalement protected air terminals.

2.19 At all permanent ladders, hatches, stairs, and doors which lead to any roofs or portion(s) of roofs where air terminals are present, provide suitable OSHA approved warning signs with the wording "DANGER: Lightning Rod Impalement Hazard", or similar approved wording (include costs for custom wording). Provide signs of 255 mm x 180 mm (10" x 7"), minimum, semi-rigid plastic type. Signs are not required where all of the air terminals on the roof involved are provided with blunt-end impalement protection.

2.20 Provide driven (made) grounding rod electrodes, ground rod quantities at each location, lightning protection conductor connections and bonding, grounding testing, and bonding connections to raceways as per specifications section "Grounding" of specifications division 16200, Electrical Work Practices and as per specifications section "Grounding Materials" of specifications division 16300, Electrical Materials, unless indicated otherwise.

2.21 Provide grounding resistance at driven (made) grounding rod electrodes not exceeding one (1) ohm, or the maximum resistance as per UL, NFPA, and LPI requirements, whichever is less.

2.22 Provide a 300 mm x 300 mm x 300 mm (12" x 12" x 12") junction box at all grounding electrodes for access to connections, set flush with finished grade. Provide metal sign on wall near box reading "Lightning Protection Ground". Metal sign is not required where box cover includes prominent and permanent factory cast marking reading, "LIGHTNING GROUND".

2.23 Bond all metal, conductive, and inductive equipment and apparatus to the lightning protection system as required by UL, NFPA, and LPI, including, but not limited to, water, sewer, vent, fire protection, etc. piping systems, metal raceways, cables, mechanical equipment, luminaires, louvers, architectural metal, and other metal objects on the roof (bond whether objects are shown on any drawings or not). Completely bond the lightning protection grounding electrode system to the electrical, telephone, and any other service grounding electrode systems utilizing lightning protection conductors specified above in complete accordance with UL, NFPA, LPI, and NEC requirements. Provide air terminals at metals which are less than 4.8 mm (3/16") thick and which are not in the "zone of protection" as per UL, NFPA, and LPI requirements.
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3. CABLE TRAY

3.1 Provide aluminum cable tray with ladder rungs 230 mm (9") on center and with inside dimensions of 155 mm (6") deep and 0.9 m (30") wide, unless indicated otherwise on the drawings. Tray of the both the outside rail "ladder" and internal "center" spine(s) types are permitted (except where one (1) type is specifically indicated on drawings). Wire mesh and "runway" (without side flanges or rungs) type trays are not permitted.

3.2 Provide all fittings, accessories, hardware, and other materials as required for a complete cable tray installation. Specifically provide the following:

A. At all points where tray routing turns, joins other trays, or changes elevations provide suitable fittings to match tray. Horizontal fittings include elbows (90, 60, 45, and 30 degrees as required), tee fittings, cross ("X") fittings, wye branch fittings, etc.. Vertical fittings include elbows (90, 60, 45, and 30 degrees, inside or outside, as required), tee fittings, cross fittings, etc.. Adjustable angle type fittings are permitted. At the top of all vertical tray runs, provide suitable support elbow fittings with support members to facilitate cable grips to support cables. Wherever tray dimensions change, provide suitable reducer fittings as required.

B. At all junctions between tray sections or between tray sections and fittings, make joints utilizing manufacturer's connector plates and braided copper type ground jumpers (one each per tray rail). For external rail style trays, utilize only eight (8) bolt connector plates (four (4) bolt type is not acceptable).

C. Where specifically indicated on the drawings (only), provide tray with suitable flat and flanged covers. Provide clip type cover connectors to secure covers at intervals not exceeding every 1.2 m (4'0") along the length of the covers.

D. Where conduits interface with the tray, utilize suitable cable tray interface clamps.

3.3 Support cable tray utilizing the following methods only:

A. Install atop suitable strut type trapeze hanging from structural ceiling. Utilize trapeze including minimum 41 mm (1-5/8") steel strut channel supported from continuous threaded rods. Fasten tray to strut with suitable manufacturer's hold down clamps. Where strut trapeze is properly sized for the total weight involved, the strut may support tray and other raceways installed as part of electrical work (supporting other trades systems is not permitted).

B. Install supported directly from structural ceiling utilizing continuous threaded rods and suitable hanger clamps fastened directly to tray. Do not support other raceways from tray supported in this manner.

C. Install on suitable manufacturer approved wall brackets from structural walls. Where of the single strut channel type, brackets may support only the tray. Where of the double strut type and properly sized for the total weight involved, brackets may support tray and other electrical raceways installed as part of electrical work (supporting other trades systems is not permitted).
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3.4 Install cable tray as a complete system. Install in such a manner to maintain electrical and mechanical continuity throughout the complete tray installation. Firmly secure and support in complete accordance with all manufacturer's recommendations and NEC.

3.5 Wherever cable tray passes through fire rated walls, ceilings, or floors, provide suitable manufacturer's frame assembly. Completely fire stop openings in fire rated walls (as indicated elsewhere in these specifications) after installation of cable.

3.6 Cable tray routing indicated on the drawings is approximate as a guide to pricing only. Completely coordinate exact location and installation during construction. Fully coordinate the complete installation with all piping, ductwork, the structure, and all other potential obstructions. Include costs in bid to run tray at varying heights as required to avoid obstructions (coordinate exact heights during construction). Base pricing on a total of ten (10) vertical cable tray offsets (each offset consisting of two (2) vertical 45 degree tray sections with a straight section between as required). These offsets are in addition to any offsets indicated on the drawings.

3.7 Specifications are based on P-W Industries #4F12 series. Equipment as manufactured by B-Line, Mono-Systems, PJ Cope, and approved equal shall be considered.

4. MANHOLES, HAND HOLES, AND TRANSFORMER FOUNDATIONS

4.1 Provide manholes and hand holes of minimum sizes as required by the NEC to facilitate wiring, except where sizes are indicated on the drawings. "Manholes" include underground boxes with any inside dimension (length, width, or depth) 1.2 m (4'0") or larger. "Hand holes" include underground boxes with all inside dimension (length, width, and depth) less than 1.2 m (4'0").

4.2 Provide all manholes of the pre-cast type. Provide all hand holes of the pre-cast type, unless indicated otherwise. Provide all hand holes of only the pre-cast type where located in roadways, parking lots, areas subject to vehicular traffic, and for wiring over 600 V. Hand holes of the composite type are permitted for wiring 600 V and less in paved and unpaved areas not subject to vehicular traffic (except locations indicated above as requiring only the pre-cast type). Hand holes of the composite type are permitted in parking lots (and other locations indicated on the drawings or designated in writing by the engineer as limited to occasional non-deliberate traffic) only where one (1) or more of the following applies:

A. The center of the hand hole is located within 0.6 m (2'0") of a concrete lighting pole base, wall, or similar structure 0.6 m (2'0") or higher (i.e. excluding curbs).
B. Protective bollards installed for the purpose of protecting other equipment or apparatus protect the hand hole (installing bollards for the sole purpose of protecting a hand hole is not permitted).
C. The engineer approved the specific installation in writing.

4.3 Provide all pre-cast manholes as follows. Provide of reinforced pre-cast concrete cast with integral sump pit (slope floor towards pit), ground rod hole, recessed "break-out" wall sections to facilitate raceways, and pulling irons. Provide with at least one (1) pulling iron for each wall (locate at the bottom of the wall), unless indicated otherwise. For with inside height 2.4 m (8'0") or larger, provide with at least two (2) pulling irons for each wall (one
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(1) at the top and one (1) at the bottom of the wall), unless indicated otherwise. Provide with the following:

A. Provide with round 0.75 m (2'6") diameter (minimum inside clear opening), vented (to facilitate escape of pressurized gasses), and heavy-duty AASHTO H20 full traffic loading rated frame and cover (cover weighing 46 kg (100 lb.) or more). In paved areas, set nominally flush with finished grade (set in such a manner to avoid damaging snow plows and other snow removal equipment). In unpaved areas, set 25 to 76 mm (1" to 3") below finished grade to facilitate lawn mowing and to allow for settling. Slope the frame and cover (provide floor as level) if necessary to match grade. Where necessary to facilitate finished grade, provide suitable grade extension ring (of either the pre-cast concrete type or field fabricated utilizing bricks and mortar) between top and cover frame.

B. Provide with at least two (2) cable racks (minimum 0.75 m (2'6") of rack length for every 1.2 m (4'0") of wall height) for each wall, unless indicated otherwise. Provide each rack consisting of a vertical galvanized steel channel rack (McGraw-Edison #DU178 series) secured to the wall, with horizontal galvanized steel support brackets (McGraw-Edison #DU5S series) attached to vertical rack and held in place utilizing locking clips (McGraw-Edison #DU4M1 series), and with porcelain cable support insulators (McGraw-Edison #DE11U1 series) attached to the horizontal brackets. Provide quantities and sizes of horizontal support brackets and porcelain cable support insulators as required to support conductors (provide a minimum of one (1) each per rack, whether or not cables are installed on racks). Support and secure all cables and conductors to racks by laying cables on insulators and securing in place with suitable plastic ties. Specifications are based on equipment as manufactured by McGraw-Edison. Equipment as manufactured by Condux, Hubbell/Chance, Osburn, or approved equal shall be considered.

C. Provide 19 mm (3/4") x 3.0 m (10'0") ground rod driven through floor and #4/0 bare copper ground conductor bus around the perimeter of interior. Bond all metallic objects, racks, ladders, grounding conductors, cable shields, etc. to ground bus utilizing #6 AWG (minimum) copper ground conductors.

D. Provide two (2) signs inside of each cover, plainly visible from grade with the cover removed. Space the two (2) signs 180 degrees apart around the circumference of the cover opening. Provide warning sign as OSHA approved, conforming with CFR1926.21, with the wording "DANGER: Confined Space...", and with additional wording as directed by the owner (include costs for custom wording). Provide signs as 255 mm x 180 mm (10" x 7") minimum, semi-rigid plastic type.

E. Where indicated on the drawings, provide with galvanized steel ladder.

F. Install and set on a smooth, compacted, and level base of not less than 155 mm (6") of sand or crushed stone according to manufacturer's recommendations. Install so all parts of the concrete top (excluding frame, cover, and grade extension ring) are at least 100 mm (4") below final finished grade. Any corner projecting above or within 100 mm (4") below grade is not acceptable.
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4.4 Provide all pre-cast hand holes as follows. Provide of reinforced pre-cast concrete cast with integral sump pit (slope floor towards pit), ground rod hole, recessed "break-out" wall sections to facilitate raceways, and pulling irons. Provide with at least one (1) pulling iron for each wall (locate at the bottom of the wall), unless indicated otherwise. Provide with the following:

A. Provide with round 0.75 m (2'6") diameter (minimum inside clear opening), vented (to facilitate escape of pressurized gasses), and heavy-duty AASHTO H20 full traffic loading rated frame and cover (cover weighing 46 kg (100 lb.) or more). In paved areas, set nominally flush with finished grade (set in such a manner to avoid damaging snow plows and other snow removal equipment). In unpaved areas, set 25 to 76 mm (1" to 3") below finished grade to facilitate lawn mowing and to allow for settling. Slope the frame and cover (provide floor as level) if necessary to match grade. Where necessary to facilitate finished grade, provide suitable grade extension ring (of either the pre-cast concrete type or field fabricated utilizing bricks and mortar) between top and cover frame.

B. Provide 19 mm (3/4") x 3.0 m (10'0") ground rod driven through floor. Bond all metallic objects, grounding conductors, cable shields, etc. to ground rod utilizing #6 AWG (minimum) copper ground conductors.

C. Where the distance from grade level to the floor exceeds 1.8 m (6'0"), provide one (1) sign inside of each cover, plainly visible from grade with the cover removed. Provide warning sign as OSHA approved, conforming with CFR1928.21, with the wording "DANGER: Confined Space...", and with additional wording as directed by the owner (include costs for custom wording). Provide signs as 255 mm x 180 mm (10" x 7") minimum, semi-rigid plastic type.

F. Install and set on a smooth, compacted, and level base of not less than 155 mm (6") of sand or crushed stone according to manufacturer's recommendations. Install so all parts of the concrete top (excluding frame, cover, and grade extension ring) are at least 100 mm (4") below final finished grade. Any corner projecting above or within 100 mm (4") below grade is not acceptable.

4.5 Provide all composite hand holes as follows. Provide of composite fiberglass reinforced polymer concrete construction, heavy-duty open bottom type, capable of being stacked to form an overall deeper box, Hubbell/Quazite #PC* or #PG* series, or approved equal. Fiberglass reinforced polymer and structural plastic construction shall be considered where technical characteristics and structural ratings meet or exceed the specified construction. Provide rectangular (dimensions to match box) locking cover secured with "penta-head" bolts. Provide heavy-duty ANSI/SCTE 77 "Tier 22" loading rated hand hole and cover. Specifications are based on equipment as manufactured by Hubbell/Quazite. Equipment as manufactured by Nordic Fiberglass, PenCell, Synertech, and approved equal shall be considered.

A. Install in complete accordance with manufacturer's recommendations, including gravel/ crushed stone under box (for drainage, as per manufacturer but not less than 155 mm (6") deep below box) for all locations plus concrete encasement ring (as per manufacturer but not less than 255 mm (10") wide and 255 mm (10") deep around box) where located in areas subject to vehicular traffic.
B. Install and set on a smooth, compacted, and level base of not less than 155 mm (6") of crushed stone (for leveling and drainage) according to manufacturer's recommendations. In paved areas, set nominally flush with finished grade (set in such a manner to avoid damaging snow plows and other snow removal equipment). In unpaved areas, set 25 to 76 mm (1" to 3") below finished grade to facilitate lawn mowing and to allow for settling. Slope hand hole if necessary to match grade.

C. Provide all raceways entering the open bottom of the box (locate as required to comply with the NEC), unless indicated otherwise. Where the quantity of bends in a raceway run does not facilitate entering the bottom of the box, raceway may enter the side of the box only where in accordance with NEC Article 314.28.

D. Where a ground rod is indicated on the drawings or otherwise installed, bond all metallic objects, grounding conductors, cable shields, etc. to ground rod utilizing copper ground conductors sized as per the NEC.

4.6 Provide all raceways with suitable bushings or bell fittings. Completely seal around all raceway openings (except raceways entering the open bottom of composite hand holes).

4.7 Utilize steel RMC only for all raceways entering manholes and pre-cast hand holes within 1.5 m (5'0"), except as follows. Where PVC RNC is permitted elsewhere, PVC RNC may directly enter provided the PVC RNC is encased in a steel reinforced concrete envelope within 1.5 m (5'0") and the duct bank reinforcement is tied and interconnected to the manhole or pre-cast hand hole reinforcement.

4.8 Provide all covers with prominent and permanent factory cast marking describing the system use. Coordinate exact wording with the engineer based on the system involved (i.e. "ELECTRIC", "CATV", "COMMUNICATIONS", "CONTROLS", FIBER OPTIC", "HIGH VOLTAGE", "LIGHTING", "STREET LIGHTING", "TELEPHONE", "TRAFFIC", "TRAFFIC SIGNAL", etc.).

4.9 Avoid splices and connections in manholes and hand holes as much as practical. Where splices and connections are necessary (including grounding connections), utilize only methods approved, identified, and listed as suitable for direct burial, underground, and submerged use. Submit shop drawings for all splicing, connecting, and terminating methods and materials to the engineer for review and approval. Where any splices or connections are made utilizing methods or materials which are not approved (in advance) in writing by the engineer, the contractor shall remove splices/connections and install new splices/connections as directed by the engineer (including replacing and/or reinstalling any wiring which is damaged, corroded, must be extended, or does not facilitate the directed splices/connections) at no cost to the owner.

4.10 Pre-Cast Concrete Transformer Foundations: Provide pre-cast concrete transformer foundations (vaults/pads) as indicated above for pre-cast manholes (including sump pit, ground rod hole, recessed "break-out" wall sections, pulling iron, cable racking, ground rod, grounding/bonding, confined space signs, etc.), except as follows:

A. Provide the below grade portion with inside dimensions not smaller than 1.8 m x 1.8 m x 1.2 m high (6'0" x 6'0" x 4'0"), unless otherwise indicated.
B. Provide top with overall dimensions not smaller than 2.1 m (7'0") square (15 kV class) or 2.4 m (8'0") square (35 kV class), unless otherwise indicated.

C. Provide opening in top to facilitate primary and secondary cable access and entry into the foundation, nominal 1.2 m x 0.8 m (4'0" x 2'6") for 15 kV class or 1.5 m x 0.9 m (5'0" x 3'0") for 35 kV class. Coordinate exact opening dimensions with standard transformer terminal cabinet dimensions. Provide heavy-duty galvanized steel diamond plate cover over the portion of the opening not required for cable access (i.e. nominal 1.2 m x 0.3 m (4'0" x 1'0") for 15 kV class or 1.5 m x 0.3 m (5'0" x 1'0") for 35 kV class). Provide top and/or cover with means to ensure that the cover occupies its correct position once installed.

D. Provide foundation designed to support the weight of any standard three-phase pad mounted transformer rating up to a maximum of 2,500 kVA.

E. Install and set on a smooth, compacted, and level base of not less than 155 mm (6") of sand or crushed stone according to manufacturer's recommendations. Provide top of pad 155 mm (6") nominal above finished grade (100 mm (4") minimum at any point).

5. PAD MOUNTED TRANSFORMERS

5.1 Provide each fluid ("oil") immersed self-cooled outdoor pad mounted type transformer ("OA" on the drawings) as indicated on the drawings and as specified herein. Provide with primary and secondary voltages, connections (i.e. three-phase wye, three-phase delta, single-phase, etc.), and kVA rating as indicated on the drawings. Specifications are based on equipment as manufactured by Cooper Power Systems. Additional equipment as manufactured by ABB, Eaton, General Electric, Hevi-Duty, Siemens, and Square-D shall be considered.

5.2 Provide with 65 degrees C temperature rise above 40 degrees C ambient.

5.3 For transformer coils rated 600 V and less, provide basic impulse level (B.I.L.) rating as per applicable industry standards. For transformer coils rated over 600 V, provide 95 kV (15 kV class) B.I.L. rating.

5.4 Provide with primary full capacity taps, a minimum of two (2) 2.5% taps above and two (2) 2.5% taps below rated voltage. Provide externally operable (within transformer terminal compartments) fluid immersed tap changing switch for no-load tap changing.

5.5 Provide of fluid immersed, self-cooled, outdoor pad mounted type construction, designed and manufactured in accordance with ANSI C57.12.00, C57.12.70, C57.12.80, C57.12.90, C57.91, and C57.105 and complying with all applicable ANSI, CEA, IEEE, NEC, and NEMA standards. Provide with fully dead front construction; live front components (over 600 V) of any type are not acceptable.

5.6 Provide coils of continuous wound construction, secured in place with B-stage epoxy pattern paper thermally cured under pressure to ensure bonding of conductor and paper. Provide windings of copper or aluminum. Provide all winding and terminal lead connections welded or crimped; bolted connections are not acceptable (except at bushings).
5.7 Provide core constructed of high grade, grain oriented, non-aging silicon steel laminations with high magnetic permeability, featuring low hysteresis losses and low eddy current losses, and constructed to maintain magnetic flux densities well below the saturation point. Provide core laminations clamped together with structural steel angles. Provide core of the triplex five-legged type or other approved design for three-phase units.

5.8 Provide with core and coils designed and manufactured to meet the requirements of "Distribution and Power Transformers Short Circuit Test Code", ANSI C57.12.90A - IEEE 262A (latest revision). Provide verification from the manufacturer that the design meets or exceeds the short-circuit requirements of ANSI C57.12.90 by submitting copies of short circuit test results on similar designs.

5.9 Provide transformer tank of sealed tank construction with tamper resistant bolted main cover. Provide constructed to withstand pressures in accordance with listing of Factory Mutual (FM) approved and NEC classified "less flammable insulating liquid".

5.10 Internally ground the core to the tank as per applicable ANSI, CEA, IEEE, NEC, and NEMA standards. Include provisions (consisting of 1/2"-13 UNC tapped hole 14 mm (1/2") deep) for tank grounding in each of the primary and secondary cable compartments.

5.11 Provide completely enclosed steel enclosure, including terminal compartments, designed for outdoor pad mounting and of completely weatherproof construction. Provide tamper resistant as defined by Western Underground Committee Guide (WUC 2.13 940279) "Security for Pad Mounted Equipment Enclosures". Provide enclosure with no externally removable screws, bolts, or other fastening devices.

5.12 Provide with full height air filled primary (on left side) and secondary (on right side) terminal compartments with hinged doors located side by side and separated by a steel barrier. Single phase transformers may have combined primary/secondary terminal compartment with single hinged door. Provide removable doors and compartment hoods facilitating making connections and pulling cable. Provide removable door sills facilitating rolling and skidding into place over conduit stubs. Provide all removable and operable components (including fuses, bushings, switches, indicators, valves, drains, fills, etc.) accessible for inspection, operation, and replacement without removing compartment doors, hoods, or sills.

5.13 Provide secondary terminal compartment door with 3-point latching handle (3-point handle not required for top-hinged single phase transformer doors), 1/2" diameter "penta-head" securing bolt, and provisions for padlocking with a single padlock having a maximum 13 mm (1/2") diameter shackle. Provide the "penta-head" bolt within a tamper resistant round shroud blocked when the above padlock is installed. Provide the primary compartment door secured by standard bolts accessible only after the secondary door is opened.

5.14 Provide the entire enclosure degreased, cleaned, phosphatized, and finished with an olive green urethane paint applied over epoxy prime coating. Coat surfaces in contact with the ground with coal tar based compound.
5.15 Provide internal loop-feed, fluid immersed, gang-operated, load break, manually operated switch for sectionalized switching of a "looped" primary cable system (even where utilized on a radial or single transformer application, as provisions for future expansion). Provide hot-stick operable switch handles located in the primary compartment. Provide switch rated 10,000A momentary and rated 15 kV, 300 A, and 95 kV B.L.L. Provide 4-position switch with positions as follows:

A. Source A to coil
B. Source B to coil
C. Sources A and B to coil
D. Sources A and B connected and coil disconnected

5.16 Provide with one (1) load break fluid immersed bayonet expulsion fuse in series with one (1) fluid immersed partial range current limiting fuse for each ungrounded primary conductor. Provide bayonet fuses accessible through the primary compartment and externally removable and field replaceable using a hot stick. Provide a welded-on fluid drip shield located under bayonet fuses to protect primary cable connections from dripping fluid. Provide fluid immersed partial range current limiting fuses located within the transformer tank. Provide three (3) spare bayonet type fuse links for each transformer. Provide fusing sized as recommended by the transformer manufacturer and in accordance with listing of Factory Mutual (FM) approved and NEC classified "less flammable insulating liquid".

5.17 Primary Bushings: Provide each transformer with two (2) primary 200 A, 15 kV class bushing wells per ungrounded primary conductor for loop feed. Provide each normally line-in side bushing well containing a 15 kV class load break feed-through ("double") insert with first position to accept an elbow type lightning arrester and second position to accept a 200 A, 15 kV class load break elbow cable connector. Provide each normally line-out side bushing well containing a 15 kV class load break "single" insert to accept a 200 A, 15 kV class load break cable elbow connector. Where cables are not connected to the line-out side bushings, provide 15 kV, 200 A class fully insulated dead front protective caps (utilizing rubber "shipping" type caps is not acceptable). Provide all items above and complete final connections as required (including load break elbow connectors).

5.18 Provide with a minimum of two (2) factory installed parking stands per ungrounded primary conductor to accept standoff bushings. Provide with one (1) 200 A, 15 kV class insulated standoff bushing per cable connected at the transformer, mount in parking stands. Provide one (1) 200 A, 15 kV class fully insulated dead front protective cap (utilizing rubber "shipping" type caps is not acceptable) on each standoff bushing.

5.19 Provide one (1) dead-front load break elbow type metal oxide varistor (M.O.V.) over-voltage surge (lightning) arrester per ungrounded primary conductor. Provide rating as per drawings [or as recommended by manufacturer and/or utility company and approved by the engineer], include costs in bid for any voltage rating within to the equipment voltage class. Install in the appropriate bushing inserts (see above). Provide an engraved laminated plastic nameplate near the arresters reading, "CAUTION: CLOSE DOORS BEFORE ENERGIZING LIGHTNING ARRESTERS AND ENERGIZE ARRESTERS FROM A REMOTE LOCATION. DO NOT INSERT ARRESTER LOAD BREAK ELBOWS WHEN CIRCUIT IS ENERGIZED. ARRESTERS ARE SUBJECT TO FAILURE UPON ENERGIZING AND MAY EXPLODE." (self-adhesive type may be used where installing
using screws or rivets would potentially damage transformer tank; do not screw or drill into transformer tank).

5.20 Provide with tinned, spade-type secondary 600 V class bushings with 14.29 mm (9/16") holes in NEMA 2-hole spacing in accordance with the latest revisions of ANSI. Provide quantity of sets of holes for each bushing as required for secondary conductors.

5.21 Provide filled with cooling and insulating dielectric fluid less flammable insulating liquid ("oil"). Provide only new fluid meeting the requirements of Table 1, "Functional Property Requirements" of ASTM designation D3487 and ANSI C57.106. Provide fluid containing no polychlorinated biphenyls (PCB's). Submit certification that fluid contains no PCB's. Fill the transformer at the factory under controlled conditions with hot degassed fluid. Provide transformer including Factory Mutual (FM) approved and NEC classified "less flammable insulating liquid" (standard mineral oil type transformer is not acceptable). Provide transformer constructed, with accessories, and protected in accordance with listing of NEC classified "less flammable insulating liquid".

5.22 Provide the following:

A. Corrosion resistant metal diagrammatic nameplate in the secondary terminal compartment where readable with cables in place. Where mounted on a removable part, permanently affix the manufacturer's name and serial number to a non-removable part. Provide nameplate indicating transformer switching.
B. Provisions and base suitable for lifting, jacking, rolling, and skidding.
C. Grounding pad at the secondary compartment.
D. ANSI impedance of 5% minimum.

5.23 Provide the following accessories:

A. 27 mm (1") filling provision
B. 27 mm (1") drain valve with sampling device
C. Liquid level indication
D. Dial type thermometer
E. Vacuum pressure gage
F. Provisions for bushing mounted current transformers in the secondary compartment of the transformer
G. Pressure relief valve in accordance with listing of Factory Mutual (FM) approved and NEC classified "less flammable insulating liquid"

5.24 Provide complete manufacturer testing of transformer in accordance with ANSI C57.12.90 (latest revision). Submit certified test results of all testing to the owner and engineer including transformer serial number. The owner reserves the right to witness all factory testing.

5.25 Completely field test transformer as per the 16100 section of this specification "Testing".

6. PANEL SURGE SUPPRESSION
SECTION 16350 - ADDITIONAL ELECTRICAL MATERIALS

6.1 Provide all new branch panels with integral factory installed transient voltage surge suppression (TVSS). Provide complete panel and TVSS UL 1449 Second Edition listed and providing TVSS protection in accordance with IEEE C62.41 and C62.45. Provide TVSS voltage and phase ratings to match panel and provide short circuit rating of 200,000 A.I.C. (minimum). Provide TVSS connecting directly to panel bus bars (on the load side of panel main circuit breaker, where applicable) and with breaker/fusing (and disconnecting means where required by code) as per the manufacturer (connecting TVSS utilizing branch circuit breakers in the panel is not acceptable). Provide panel enclosure with ample space for TVSS equipment and associated wiring without reducing wiring space/gutters specified above or otherwise required by the NEC. Specifications are based on Advanced Protection Technologies #XDS. Other manufacturers (including Siemens #TPS, Square-D, and approved equal) meeting or exceeding the protection characteristics, ratings, redundancy, and general features of the specified equipment shall be considered.

6.2 Provide all new distribution panels with integral factory installed transient voltage surge suppression (TVSS). Where impossible to mount TVSS integral to panel without adding an additional vertical panel compartment, TVSS in a separate dedicated enclosure mounted directly adjacent to the panel shall be considered. Provide complete panel and TVSS UL 1449 Second Edition listed and providing TVSS protection in accordance with IEEE C62.41 and C62.45. Provide TVSS voltage and phase ratings to match panel and provide short circuit rating of 200,000 A.I.C. (minimum). Provide TVSS connecting directly to panel bus bars (on the load side of panel main circuit breaker, where applicable) and with breaker/fusing (and disconnecting means where required by code) as per the manufacturer. Provide panel enclosure including ample space for TVSS equipment and associated wiring, without reducing wiring space/gutters specified above or otherwise required by the NEC. Specifications are based on Advanced Protection Technologies #XDS. Other manufacturers (including Siemens #TPS, Square-D, and approved equal) meeting or exceeding the protection characteristics, ratings, redundancy, and general features of the specified equipment shall be considered.

6.3 Provide a written warranty (including duration) on TVSS equipment in accordance with "Guarantee and Warranties" in specifications section 16100 "General Electrical", including warranty duration, except that the manufacturer's warranty period shall in no case be less than five (5) years.

END OF SECTION
SECTION 16400 - LIGHTING SYSTEM

1. GENERAL PROVISIONS

1.1 The applicable requirements and conditions of specifications section "General Provisions" of specifications divisions 16100, General Electrical, and 16300, Electrical Materials, are hereby made an integral part of this section.

1.2 Provide lighting systems consisting of all components necessary for a complete installation. Refer to the lighting fixture/luminaire schedule on the drawings for additional information.

1.3 Luminaires including, but not limited to, those manufactured by the following shall be considered: Abolite, Cooper, Columbia, Contech, Elliptipur, Emergylite, General Electric, Hubbell, Insight, Kenall, Kim, Kirlin, Kurt Versen, Light Guard, Lightolier, Lithonia, LSI, Prescolite, Sim-Kar, Sterner, Stonco, Tivoli, Williams, Winona, ZSLI, and approved equal.

2. BALLASTS, DRIVERS, AND WIRING

2.1 Completely coordinate exact lamp types (including configuration, dimensions, bases, pins, etc.), ballasts, drivers, starters, capacitors, sockets, luminaire construction and arrangement (as related to facilitating lamps and related equipment), and all applicable ancillary equipment as required and provide a complete and compatible installation.

2.2 Submit shop drawings of all ballasts/drivers proposed for use (multiple manufacturers and series are permitted, provided all ballasts/drivers conform to the specifications). Where luminaires are installed by the contractor which include ballasts/drivers that do not meet the specifications (without prior written approval) the contractor shall remove ballasts/drivers and provide new ballasts/drivers meeting the specified criteria at no cost to the owner.

2.3 Provide all fluorescent ballasts (including ballasts for compact fluorescent luminaires) of the high power factor solid-state electronic energy saving type, unless indicated otherwise on the drawings. "Hybrid" ballasts or magnetic energy saving ballasts are not permitted unless specifically indicated on the drawings. Low power factor ballasts are not permitted unless specifically indicated on the drawings. Magnetic or any other type ballasts not identified/listed as energy saving type are not permitted under any circumstance.

2.4 Provide all solid-state electronic energy savings ballasts for straight and "U-tube" lamps as follows. Utilize Osram Sylvania (Motorola) "Quicktronic PROStart", General Electric (Ultra Start series), Philips Advance (Mark 5 series), or Universal (Magnetek/Triad series), series ballasts or approved equals. Provide only ballasts meeting or exceeding the criteria specified below (Note: Not all ballasts of the manufacturers' and series' listed above meet the following criteria, only ballasts meeting the criteria are acceptable).

A. Minimum power factor: 0.90
B. Maximum total harmonic distortion (THD): 15%
C. Minimum ballast factor: 0.85
D. Maximum lamp crest factor: 1.5
E. Rating: UL-P, "A" sound rated
F. Provide arranged for rapid starting (or programmed rapid starting) of lamps, instant starting is not acceptable.
G. Maximum input watts shall not exceed the following:
SECTION 16400 - LIGHTING SYSTEM

One (1) 31/32 W T-8 lamp: 32 W
Two (2) 31/32 W T-8 lamps: 61 W
Three (3) 31/32 W T-8 lamps: 88 W
Four (4) 31/32 W T-8 lamps: 112 W
One (1) 25 W T-8 lamp: 26 W
Two (2) 25 W T-8 lamps: 46 W
Three (3) 25 W T-8 lamps: 70 W
Four (4) 25 W T-8 lamps: 86 W
One (1) 17 W T-8 lamp: 19 W
Two (2) 17 W T-8 lamps: 34 W
Three (3) 17 W T-8 lamps: 52 W
Four (4) 17 W T-8 lamps: 62 W

2.5 Provide fluorescent luminaires installed outdoors, in garages, or wherever "cold weather" ballasts are indicated on the drawings with -18 degrees C (0 degrees F) maximum rated cold weather solid state electronic energy savings ballasts, unless indicated otherwise. Provide cold weather ballasts for straight and "U-tube" lamps meeting all criteria specified above for ballasts serving these type lamps, except that cold weather ballasts may utilize instant starting of lamps; utilize Motorola #G1/2-RN-T8 series, Advance (Mark-V series), Magnetek (Triad series), Valmont (Ultra-Miser series), or approved equal.

2.6 Provide quantity of ballasts/drivers in multiple-lamp luminaires as required (i.e. one (1) multiple-lamp ballast or several 1- or 2-lamp ballasts), unless indicated otherwise.

2.7 For lighting controlled by "dual switching", provide with two (2) separate ballasts/drivers to facilitate switching. For "dual switched" three-lamp and four-lamp luminaires, provide internal wiring so the first switch controls inboard lamp(s) and the second switch controls outboard lamps. For "dual switched" two-lamp luminaires, provide internal wiring so the first switch controls the "left side" lamp and the second switch controls the "right side" lamp. For one-lamp luminaires, multiple lamp compact fluorescent and H.I.D. luminaires available only with a single ballast, and other luminaires where unable to wire lamps separately which are controlled by "dual switching", connect to one (1) of the two (2) switches as directed by the engineer during construction (coordinate with the engineer prior to rough-in). Where branch wiring serving lighting controlled by "dual switching" installed by the contractor does not comply with the above, the contractor shall modify or remove and reinstall wiring as required for proper switching at no cost to the owner. Where luminaires controlled by "dual switching" are installed by the contractor and do not have ballasts/drivers and/or internal wiring as required to comply with the above, the contractor shall modify or replace ballasts, drivers, internal wiring, and/or the luminaires as required for proper switching at no cost to the owner.

2.8 Provide H.I.D. lighting with high power factor multiple tap type ballasts, unless indicated otherwise on the drawings.

3. LAMPS

3.1 Completely coordinate exact lamp types (including configuration, dimensions, bases, pins, etc.), ballasts, drivers, starters, capacitors, sockets, luminaire construction and arrangement (as related to facilitating lamps and related equipment), and all applicable ancillary equipment as required and provide a complete and compatible installation.
3.2 Provide lamps for luminaires as indicated on the drawings. Provide all luminaires with lamps (even if lamp types and/or quantities are not shown on drawings) as required for a complete installation.

3.3 Acceptable lamp manufacturers include Osram/Sylvania, General Electric, Philips, and approved equal. For high intensity discharge (H.I.D.) lamps only, lamps as manufactured by Venture are acceptable in addition to the manufacturers listed above. For tungsten halogen T-lamps, utilize only lamps as manufactured by Osram/Sylvania, Ushiu, or approved equal.

3.4 Maintain compatibility and consistency of lamp types and manufacturers (as well as lamp colors, except where different lamp colors are indicated on the drawings) throughout the project as much as possible. Provide luminaires so lamps are completely interchangeable between different luminaire types shown on the luminaire schedule with the same type lamps, wherever possible. For each combination of lamp type and color utilized on the project, provide all lamps of a single manufacturer. Different manufacturers are permitted for different lamp type and color combinations (except that for this provision, all straight and "U-tube" fluorescent lamps are considered as a common type and all compact fluorescent lamps are considered as a common type; i.e. provide all 32 W, 25 W, 17 W, and U31 W T-8 lamps of the same manufacturer). Utilizing more than one (1) manufacturer for any lamp type and color combination is not permitted (except where specifically approved in writing by the engineer and owner).

3.5 Provide all lamps (of all types) of the energy saving type, unless specifically indicated otherwise on the drawings. Lamps which are not energy saving are not permitted (unless specifically approved in writing by the owner, architect, and engineer). Provide all lamps of a type suitable for use ("burning") in any position (unless specific burning positions are indicated on the drawings).

3.6 Provide fluorescent lamps as per the lighting luminaire schedule. Provide lamp color temperature of 3,500 degrees K, unless indicated otherwise on the drawings. Provide straight and "U-tube" lamps of the T-8 type (unless indicated otherwise).

3.7 Provide incandescent lamps as indicated on the drawings and as specified below. Provide all incandescent lamps of the medium base type, unless indicated otherwise.

A. Provide all incandescent A-lamps of the energy saving type (General Electric "Watt-Miser" and "Watt-Miser Plus" series or approved equal).

B. Provide all incandescent PAR-lamps of the energy saving tungsten halogen capsule type. Provide standard flood beam spread ("FL") unless indicated as "NFL" (narrow flood), "SP" (spot), or "NSP" (narrow spot), or as otherwise indicated in the luminaire schedule.

C. Provide all incandescent R-lamps of the energy saving type (General Electric "Watt-Miser" and "Watt-Miser Plus" series or approved equal). Provide standard flood beam spread ("FL") unless indicated as "NFL" (narrow flood), "SP" (spot), or "NSP" (narrow spot), or as otherwise indicated in the luminaire schedule.
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D. Provide all incandescent MR-lamps of the energy saving tungsten halogen capsule type. Provide standard flood beam spread ("FL") unless indicated as "NFL" (narrow flood), "SP" (spot), or "NSP" (narrow spot), or as otherwise indicated in the luminaire schedule. Where luminaires include protective shield/lens, utilize lamps of the type with integral "ultraviolet stop" capsule with average lamp life not less than 4,000 hours. Where luminaires do not include protective shield/lens, utilize lamps of the covered type with average lamp life not less than 3,500 hours.

E. Provide all incandescent quartz halogen T-3 lamps of the double-ended RSC-base type (utilize either T-2.5 or T-3). Provide all incandescent quartz halogen T-4 lamps of the double contact bayonet (DC bay) base type (utilize either T-3.5 or T-4). Screw-in miniature candelabra (mini-can) base is not acceptable (unless luminaire is not available with RSC or DC-bay base). Provide all T-lamps of a type suitable for use ("burning") in any position with average lamp life not less than 2,000 hours.

4. LUMINAIRE

4.1 Provide luminaire types and manufacturers as indicated on the drawings. Where a luminaire type designation (i.e. letter) is not shown at a luminaire symbol, include costs in bid to provide any applicable type of luminaire used for the same symbol anywhere else on the drawings.

4.2 Support all luminaires (including outlet boxes and/or conduits used to support luminaires, where permitted) in complete accordance with all applicable requirements of the NEC (including, but not limited to, code requirements for mounting and support of luminaires, outlet and other boxes, conduits, raceways, and devices). Provide all required mounting hardware, including pendant kits, fasteners, hangers, wall mounted brackets, concrete bases, conduits, supplementary supports, grounding, etc., as required for a complete installation. Support all luminaires completely independent of suspended ceilings and direct from the structure (suspended ceilings are permitted to provide supplemental lateral support to luminaires which are vertically supported direct from the structure), except as follows. Luminaires are permitted to be supported from/by suspended ceilings only where both the general contractor's suspended ceiling installation and the electrical contractor's method of securing luminaires to the suspended ceiling are in complete accordance with NEC requirements for supporting luminaires. Supporting luminaires with or from conduits or raceways is not permitted, except that luminaires specifically designed for conduit support may be supported utilizing only rigid steel conduit (supporting with any other type conduit or raceway, including IMC, EMT, PVC, surface raceway, and flexible conduit, is not permitted under any circumstance). Supporting luminaires from screw shells of lamp holders is not permitted under any circumstance. Supporting luminaires or wiring from trees or vegetation is not permitted under any circumstance.

4.3 Refer to architectural drawings, reflected ceiling plans, and details for exact locations of all luminaires. Verify final location of all luminaires with the owner, architect, and lighting designer (where applicable) prior to rough-in.

4.4 Perform field measurements, verify proper clearances, and verify all exact mounting and installation conditions and requirements prior to ordering luminaires.
SECTION 16400 - LIGHTING SYSTEM

4.5 Provide integral thermal protection for all recessed luminaire housings.

4.6 Perform aiming of all adjustable interior luminaires. Include all costs as required to aim to the satisfaction of the owner, architect, and engineer. This aiming may be performed during normal working hours.

4.7 For surface mounted luminaires wired utilizing surface mounted wiring methods, provide wiring entering the side of luminaires. Where fixtures do not facilitate side entry of wiring, provide fixture with manufacturer's back mounting adapter as required (so wiring enters side of adapter and then enters rear of fixture by passing through adapter). Installing the fixture on surface outlet boxes (in such a way that there is a significant "gap" between the fixture and the wall/ceiling surface) is not acceptable.

4.8 Wherever finish colors are indicated on the drawings (including symbol list and luminaire schedule) as being selected by the architect ("as per architect", etc.), include costs in bid to utilize any of the available standard and/or optional colors listed in manufacturers' catalogs (excluding any colors identified in manufacturers' catalogs as "custom" or "premium").

4.9 Where luminaires are specified or furnished by the contractor with tamper resistant hardware (including, but not limited to, torx, spanner, allen/torx with center reject pin, etc.) which must be removed in order to access lamps or ballasts/drivers for replacing or servicing, furnish and turn over to the owner not less than two (2) tamper resistant screw drivers of each type required.

4.10 Where track lighting, continuous linear lighting, and similar luminaires are indicated on the drawings, provide complete and coordinated installation. Install in continuous lengths with even appearance as shown on the drawings utilizing general sections as shown on the drawings (or if not shown as otherwise required and available from the manufacturer). Include all joining/extension fittings (corners, tees, crosses, straight extensions, etc., with lens and/or louver where applicable), end caps, aligning/attaching hardware, ceiling flanges, grid rails, yokes, etc. (where applicable). For luminaires installed continuous between building members (walls, ceiling soffits, or other architectural structures and details), individually measure exact dimensions at each and every locations and order and install luminaires accordingly. Fully coordinate the installation with the architect and general contractor.

5. EXTERIOR LIGHTING

5.1 All provisions of the section of this specification "General Lighting" apply to exterior lighting as modified herein.

5.2 Provide all pole mounted and "bollard" type ground mounted luminaires with suitable concrete pole bases complete with embedded (during pour) "J-hook" anchor bolts. Anchors installed or set after bases are cast are not acceptable under any circumstance. Notify the owner, architect, and engineer after excavation and prior to pouring bases to facilitate inspection. Provide conduit mounted ground luminaires with conduit secured in minimum 300 mm x 300 mm x 300 mm (12" x 12" x 12") concrete poured below grade and embedding conduit 90 degree bends at luminaire locations. Provide embedded conduit bends, conduit exposed above grade, and conduit between embedded bends and the portion exposed above grade as rigid steel only.
SECTION 16400 - LIGHTING SYSTEM

5.3 Install all luminaire poles and bollard luminaires on bases utilizing leveling nuts (nuts above and below base); shims are not acceptable. Grout between the base and pole/bollard utilizing suitable non-shrink mortar finished vertically to the outside of the pole/bollard, with a drain hole. Where grouting is not required or recommended by the pole/bollard manufacturer, grouting may be omitted where pole base cover or bollard housing completely covers the space between base and pole/bollard. For all concrete pole and bollard bases, submit shop drawings (based on pole bases shown on the drawings) of exact pole base construction, fabrication, and characteristics. This includes sealing (by a registered professional engineer) these shop drawings where requested local authorities for review.

5.4 For all luminaire poles and bollards, provide approved tags for wiring (inside hand holes, where applicable). Provide tags indicating the panel name and circuit number (or other source of feeder), and stating the voltage, phase, and amperes of the feeder. Provide feeder tags wording and layout similar to engraved plastic nameplates (see specifications section "Identification, Nameplates, and Tags" of specifications division 16300, Electrical Materials).

5.5 Perform night aiming of all adjustable exterior luminaires. Include all costs in bid (including overtime costs for work at night) as required to aim to the satisfaction of the owner, architect, and engineer.

6. EMERGENCY AND EXIT LIGHTING

6.1 Provide all emergency and exit lighting as indicated on the drawings.

6.2 Verify exact mounting, quantity of faces, and directional arrows of all exit signs prior to ordering.

6.3 Install all exit signs at general locations as shown on the drawings. Coordinate and obtain approval for exact locations with the architect and local code enforcement officials before installation. Install exit signs as required to ensure they are completely and clearly visible from the entire covered areas and egress paths.

6.4 Perform aiming of all adjustable emergency luminaires. Include all costs as required to aim to the satisfaction of the owner, architect, engineer, and local code officials. This aiming may be performed during normal working hours.

6.5 Wherever any battery units or battery packs are installed (including batteries integral to normal luminaires), connect power to the battery units/packs on the line side of all lighting and other control switches so it is impossible to de-energize by turning any switch off.
6.6 Where indicated on the drawings (see also the luminaire schedule), provide emergency luminaires with integral and/or field-installed ballast generator transfer device (BGTD). Provide as Philips/Bodine #GTD or approved equal. Provide incoming emergency source wiring from emergency panel to light as shown on drawings (3 #10, 3/4" C, unless otherwise noted). Provide incoming normal source wiring (with constantly energized unswitched "constant hot" conductor, switch controlled "switched hot" conductor, neutral conductor, and grounding conductor) run from the normal switch location to the first normal-only light controlled by the switch then to the ballast generator transfer device at emergency luminaires (4 #12, 3/4" C, unless otherwise noted). Provide internal luminaire wiring run from generator transfer device to controlled ballast within each emergency luminaire.

END OF SECTION
SECTION 16550 - SYSTEMS PATHWAYS

1. GENERAL PROVISIONS

1.1 The applicable requirements and conditions of specifications section "General Provisions" of specifications divisions 16100, General Electrical, and 16300, Electrical Materials, are hereby made an integral part of this section.

1.2 This specifications section applies to all pathways and related work for communications systems wiring (including only telecommunications, data, sound, security, and CCTV, where applicable), whether the wiring of each respective system is installed by the electrical contractor, the owner, the owner's vendor(s), or other contractors. The term "wiring installer" applies to the party installing wiring of the respective system. The installer of each system shall be as indicated elsewhere in these specifications and/or the drawings.

1.3 This specifications section does not apply in any way to wiring as part of power, lighting, emergency, over 600 V, control, fire alarm, and any other systems.

2. RACEWAYS AND SLEEVES

2.1 Provide all raceways and sleeves (including all fittings, conduit bodies, boxes, supports, etc.) for communications systems wiring in complete accordance with other sections of this specification except as modified below and unless specifically indicated otherwise.

2.2 Provide minimum sizes for conduits and sleeves as follows, unless indicated otherwise. Provide pull strings in all raceways.

A. 103 mm (4") for main service, trunk line, and primary pathway conduits/sleeves.
B. 21 mm (3/4") for branch secondary pathway conduits.
C. 27 mm (1") for branch secondary sleeves, unless indicated otherwise.

2.3 Install conduits so bends in conduit runs do not exceed a maximum total of 180 degrees between manholes, pull boxes, junctions boxes, conduit bodies, etc..

2.4 Flexible conduit is not permitted for communications systems wiring, unless specifically approved in writing under the following circumstances only. Where flexible conduit is utilized, minimum sizes permitted are 129 mm (5") for main service, trunk line, and primary pathways and 27 mm (1") for branch secondary pathways.

A. Where existing walls are fished.
B. Where physically impossible to install rigid/fixed (non-flexible) conduit.

3. SEALING AND FIRE-STOPPING

3.1 Seal and fire-stop all raceways and sleeves in complete accordance with other sections of this specification and as required by code except as modified below and unless specifically indicated otherwise.

3.2 Seal once wiring is installed. Where wiring is not installed at this time, seal all empty conduits.
3.3 Seal all underground conduits and conduits entering the building with suitable rubber conduit plugs as soon as conduits are installed and prior to installation of wiring in conduits. Once wiring is installed, reseal conduits with suitable rubber conduit plugs, water plugs, or duct sealer as required. Provide all seals water and gas tight.

4. GROUNDING

4.1 Provide all grounding as required by other sections of this specification and by code except as modified below and unless specifically indicated otherwise.

4.2 Provide a ground bus at all communications rooms and backboards. Provide one (1) ground bus assembly for every linear 2.4 m (8') of backboard at each respective location. Provide Ilsco #NB-350-42 ground bus assembly with #R16 mounting block (or approved equal by Burndy, Ideal, or Thomas and Betts/Blackburn). Bond each ground bus to the building electrical service grounding electrode system with #6 A.W.G. minimum conductors. The ground bus facilitates connecting systems cable surge protectors, where used.

4.3 Provide a #4/0 bare copper ground wire the length of all telephone and data risers, bond to the building grounding electrode system.

4.4 Maintain complete mutual separation between the communications systems grounding system, and the electrical power grounding system, except at a single point of connections to the electrical power grounding electrode system as close a possible to the grounding electrode and/or electrical service.

4.5 Bond all raceways, conduits, cable trays, messengers, etc. to the communications systems ground busses or ground wires.

5. RECEPTACLES/LIGHTING/EQUIPMENT IN COMMUNICATIONS ROOMS

5.1 Locate all equipment to avoid conflicts with risers and cabling. Confirm all exact receptacles, luminaires, smoke detectors, and other equipment locations in writing with the owner prior to rough in.

6. OUTLET BOXES

6.1 Provide minimum depth of outlet boxes as 70 mm (2.75") to facilitate terminating category-5 and similar cables. Smaller boxes are permitted only with written approval and only where construction will not allow use of 70 mm (2.75") deep boxes.

7. WIRING ACCESS PATHWAYS

7.1 Provide complete pathways as required for communications systems wiring. This includes all raceways, sleeves, cable trays, and other wiring access as required. Provide pathways as specified below. Provide pathways extending between communications rooms, closets, and backboards and from these locations to each and every communications systems outlet. Refer to the drawings for additional information.

7.2 Prior to rough in, coordinate all proposed cable routing with the owner and wiring installer.
7.3 **Service Pathways:** Provide incoming service wiring access pathways as indicated on the drawings, refer to the riser diagram.

7.4 **Trunk Pathways:** Provide trunk line wiring access pathways between communications closets, rooms, and backboards as indicated on the drawings, refer to the riser diagram.

7.5 **Primary Pathways:** Provide primary wiring access pathways out from communications closets, rooms, and backboards to serve branch outlets as follows:

A. Provide steel strand supporting messengers along all proposed routes of primary wiring access pathways. This includes all corridors used for telephone, data, and security wiring access. Suitably secure messengers at intervals not exceeding 2.4 m (8’0") utilizing "J" clips or other approved hardware. Messenger installation and routing is not shown on the drawings, provide installation and routing as required. Securely support all messenger ends and bends utilizing suitable strain relief clamps. Size messengers as per N.E.C. requirements. Messengers are not required where cable trays and conduits are installed (see below).

B. Provide conduits and cable trays for primary wiring access pathways where indicated on the drawings.

7.6 **Secondary Pathways:** Provide secondary wiring access pathways from each individual branch outlet to the nearest primary pathway as follows:

A. Provide conduits from each respective outlet, from communications compartments of surface raceways, and from communications raceways of modular furniture stubbed and capped into corridor drop ceiling spaces (or other primary pathway locations) or into communications closets, as indicated on the drawings, refer to the symbol list.

B. Conduits are permitted to stub into accessible ceiling spaces in other rooms, away from primary pathway locations. Where conduits do not stub directly into corridors or other primary pathway locations, provide sleeves through all walls and obstructions leading from the conduit stub location to the primary pathway location. Provide sleeve sizes based on the quantity of outlets to be wired as follows. Provide multiple sleeves as required to facilitate the total quantity of outlets.

<table>
<thead>
<tr>
<th>Sleeve Size</th>
<th>Maximum Quantity of Outlets</th>
</tr>
</thead>
<tbody>
<tr>
<td>27 mm (1&quot;)</td>
<td>2</td>
</tr>
<tr>
<td>35 mm (1.25&quot;)</td>
<td>3</td>
</tr>
<tr>
<td>41 mm (1.5&quot;)</td>
<td>5</td>
</tr>
<tr>
<td>53 mm (2&quot;)</td>
<td>9</td>
</tr>
<tr>
<td>63 mm (2.5&quot;)</td>
<td>13</td>
</tr>
<tr>
<td>78 mm (3&quot;)</td>
<td>19</td>
</tr>
<tr>
<td>91 mm (3.5&quot;)</td>
<td>26</td>
</tr>
<tr>
<td>103 mm (4&quot;)</td>
<td>34</td>
</tr>
</tbody>
</table>

C. The wiring installer shall provide support for secondary pathway cable runs, except that where quantity of outlets served exceeds twelve (12), the electrical contractor shall provide supports as indicated above for primary pathways.
8. WIRING

8.1 The wiring installer (the electrical contractor, the owner, the owner's vendor(s), or other contractors as applicable to each respective system) shall provide only wiring complying with all of the following.

8.2 Provide wiring for each respective system as directed, recommended, and approved by the respective system manufacturer and meeting all minimum requirements of the system manufacturer (including where manufacturer's requirements exceed the requirements of the specifications and the N.E.C.).

8.3 Provide all cables as multi-conductor style having an overall jacket (of a color other than red; red is reserved for fire alarm) and utilize only cables approved by the N.E.C. for use with the respective system.

8.4 Provide all wiring in plenum spaces in complete accordance with the N.E.C. In dry location plenum ceilings, utilize only plenum rated cables. For damp and wet location plenum ceilings and in all other duct and plenum spaces, run wiring (utilize a non-plenum type suitable for the damp/wet location) in metal conduit. Plenum rated cables may be utilized for other (i.e. non-plenum) applications, but only in dry locations. Plenum cables, even when installed in conduit, are prohibited in damp and wet locations.

8.5 In damp locations, utilize only cables specifically listed and identified for use in damp or wet locations. Provide all cables in wet locations (including underground and embedded in concrete slabs at or below grade, whether in conduit or direct buried) specifically designed for outdoor and submerged use and specifically listed and identified for use in wet locations.

END OF SECTION
SPECIFICATION SECTION 16555 - TELECOMMUNICATIONS AND LOW VOLTAGE CABBING SYSTEM

Part 1 General

1. Summary
   a. The workstation cabling system scope of work will consist of the following:
      1) Category 6A workstation cabling and components
      2) All necessary cable support hardware, cores, sleeves, firestop, etc.
      3) Installation, termination and testing of all termination equipment including patch panels, wire mangers, racks, etc.

2. References
   a. Install telecommunications cabling system per manufacturer’s requirements and in accordance with NFPA-70 (National Electrical Code®), state codes, local codes, requirements of authorities having jurisdiction, and particularly the following standards:
      1) ANSI/TIA/EIA-568-C Commercial Building Telecommunications Cabling.
      2) ANSI/TIA/EIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces
      3) ANSI/TIA/EIA-606-A The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
      4) ANSI/TIA/EIA-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications
      5) ANSI/IEEE C-2 National Electrical Safety Code
   b. Install cabling in accordance with the most recent edition of BICSI® publications:
      1) BICSI Telecommunications Distribution Methods Manual
      2) BICSI Cabling Installation Manual
   c. Federal, state, and local codes, rules, regulations, and ordinances governing the work, are as fully part of the specifications as if herein repeated or hereto attached. If the Contractor should note items in the drawings or the specifications, construction of which would be code violations, promptly call them to the attention of the Owner’s representative in writing. Where the requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.
   d. Drawings
      Refer to the Electrical Drawings for specific details.

3. Permits, Fees, and Certificates of Approval
   a. The contractor will make application and pay for all required permits.
   b. As prerequisite to final acceptance, supply to the Owner certificates of inspection from an inspection agency acceptable to the Owner and approved by local municipality and utility company serving the project.

4. System Description
a. Category 6A Workstation Cabling

Install, label, terminate and test a complete workstation cabling system providing connectivity from the owners Technology Rooms within each building to the workstation locations. This shall include all necessary patch panels, wire managers, category 6A plenum rated cable, faceplates, jacks, labels, cable support devices, cores, sleeves, firestop, etc. Install 19” equipment racks and necessary overhead ladder racks to support all cables within each Technology Room.

b. Voice and Data Backbone Connectivity – Outside Plant and Fiber between MDF’s and IDF’s

a. Reference the electrical drawings for details on this work.

5. Submittals

a. Submit to the engineer/designer shop drawings, product data (including cut sheets and catalog information), and samples required by the contract documents. Submit shop drawings, product data, and samples with such promptness and in such sequence as to cause no delay in the work or in the activities of separate contractors. The engineer/designer will indicate approval of shop drawings, product data, and samples submitted to the engineer by stamping such submittals “APPROVED” with a stamp. Submitted shop drawings shall be initialed or signed by the contractor, showing the date and the contractor’s legitimate firm name.

1) By submitting shop drawings, product data, and samples, the contractor represents that he or she has carefully reviewed and verified materials, quantities, field measurements, and field construction criteria related thereto. It also represents that the contractor has checked, coordinated, and verified that information contained within shop drawings, product data, and samples conform to the requirements of the work and of the contract documents. The engineer/designer remains responsible for the design concept expressed in the contract documents as defined herein.

2) The engineer’s/designer’s approval of shop drawings, product data, and samples submitted by the contractor shall not relieve the contractor of responsibility for deviations from requirements of the contract documents, unless the contractor has specifically informed the engineer/designer in writing of such deviation at time of submittal, and the engineer/designer has given written approval of the specific deviation. The contractor shall continue to be responsible for deviations from requirements of the contract documents not specifically noted by the contractor in writing, and specifically approved by the engineer in writing.

3) The engineer’s/designer’s approval of shop drawings, product data, and samples shall not relieve the contractor of responsibility for errors or omissions in such shop drawings, product data, and samples.

4) The engineer’s/designer’s review and approval, or other appropriate action upon shop drawings, product data, and samples, is for the limited purpose of checking for conformance with information given and design concept expressed in the contract documents. The engineer’s/designer’s review of such submittals is not conducted for the purpose of determining accuracy and completeness of other details such as dimensions.
and quantities, or for substantiating instructions for installation or performance of
equipment or systems, all of which remain the responsibility of the contractor as required
by the contract documents. The review shall not constitute approval of safety precautions
or of construction means, methods, techniques, sequences, or procedures. The
engineer's/designer's approval of a specific item shall not indicate approval of an
assembly of which the item is a component.

b. Perform no portion of the work requiring submittal and review of shop drawings, product
data, or samples until the respective submittal has been approved by the engineer. Such work
shall be in accordance with approved submittals.

c. Submit shop drawings, product data, and samples as a complete set in a timely fashion.

d. Shop drawings: Submit the following:

1. Technology Room rack elevation diagrams
2. Cable Run List with label information
3. Cable, jacks, cover plates
4. Cable support devices and anchoring methods.
5. Testing Methods.

e. Product Data: Provide catalog cut sheets and information for the following:

1) Category 6A station cable.

2) Patch panels, faceplates, jacks, racks, vertical wire managers, horizontal wire managers,
   etc.

3) Cable support devices.

4) Ground connection devices for racks.

5) Label products.

6) Test methods, test equipment and software for test result documentation.

f. Project record drawings:

1) Submit project record drawings at conclusion of the project and include:

   (a) Approved shop drawings.

   (b) Plan drawings indicating locations and identification of work area outlets,
       numbering, Technology Room layout and general cable pathway notes

   (c) Cable Run List.

   (d) Labeling and administration documentation.
SPECIFICATION SECTION 16555 - TELECOMMUNICATIONS AND LOW VOLTAGE CABLING SYSTEM

(e) Warranty documents for installed cabling system.

(f) Complete as-built drawings in AutoCAD format tailored specifically to each building.

(g) Category 6A link test results.

6. Quality Assurance

a. The contractor shall be an authorized Cabling System installer and certified by the manufacturer for the system being proposed.

b. The contractor shall have worked satisfactorily for a minimum of 5 years on systems of this type and size.

c. Equipment and materials of the type for which there are independent standard testing requirements, listings, and labels, shall be listed and labeled by the independent testing laboratory.

d. Material and equipment shall be new, and conform to grade, quality, and standards specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout.

e. Subcontractors shall assume all rights and obligations toward the contractor that the contractor assumes toward the Owner and engineer.

7. Warranty

All materials, equipment, etc., shall be guaranteed by the Contractor and the Manufacturer for a minimum of 20 years from date of completion of the work. This guarantee shall include all labor and material necessary to remedy any defects in material or craftsmanship.

8. Delivery, Storage, and Handling

Protect equipment during transit, storage, and handling to prevent damage, theft, soiling, and misalignment. Coordinate with the Owner for secure storage of equipment and materials. Do not store equipment where conditions fall outside manufacturer's recommendations for environmental conditions. Do not install damaged equipment; remove from site and replace damaged equipment with new equipment.

9. Sequence and Scheduling

Coordinate schedule for installation of equipment and cabling. Indicate delivery, installation, and testing for conformance to specific job completion dates. Inform Owner of scheduled events so that he may witness certain items of work prior to the work being closed in. For example, the Owner may want to inspect the above ceiling work prior to finished ceiling installation. Inform Owner prior to testing so that the Owner may witness some or all of the testing.

10. Use of the Site
SPECIFICATION SECTION 16555 - TELECOMMUNICATIONS AND LOW VOLTAGE CABLING SYSTEM

a. Use of the site shall be at the Owner’s direction in matters in which the Owner deems it necessary to place restriction.

b. Access to building wherein the work is performed shall be as directed by the Owner.

c. The Owner will occupy the premises during the entire period of construction for conducting his or her normal business operations. Cooperate with the Owner to minimize conflict and to facilitate the Owner’s operations.

d. Schedule necessary shutdowns of plant services with the Owner, and obtain written permission from the Owner.

e. Proceed with the work without interfering with ordinary use of streets, aisles, passages, exits, and operations of the Owner.

11. Continuity of Services

a. Take no action that will interfere with, or interrupt, existing building services unless previous arrangements have been made with the Owner’s representative. Arrange the work to minimize shutdown time.

b. Owner’s personnel will perform shutdown of operating systems. The contractor shall give three (3) days’ advance notice for systems shutdown.

c. Should services be inadvertently interrupted, immediately furnish labor, including overtime, material, and equipment necessary for prompt restoration of interrupted service at no expense to Owner.

B. Part 2 Products

The Contractor shall furnish and install all cables, connectors, and equipment as shown on drawings and as specified below.

1. Category 6A Station Cable
   Cable shall be category 6A, plenum rated 4 pair cable. The cable shall meet the latest standards according to ANSI/TIA/EIA 568-C including addendums. Reference the drawings for cable manufacturers. Approved equal manufacturers will be considered in accordance with Specification Section 01300 – Submittals.

2. Category 6A Connectivity Components
   Patch panels and jacks shall meet the latest standards for category 6A according to ANSI/TIA/EIA 568-C. The connectivity solution shall meet the criteria of the extended warranty program. Outlet jacks, station cable and patch panels shall constitute a “system” and the whole system will be eligible for the extended warranty.

   Reference the drawings for acceptable manufacturers of category 6 connectivity components include but are not limited to Category 6A patch panels, Category 6A jacks and Faceplates:
SPECIFICATION SECTION 16555 - TELECOMMUNICATIONS AND LOW VOLTAGE CABLELING SYSTEM

Use appropriate plate for the number of jacks at each location. Use surface mount boxes for above ceiling locations.

Approved equal manufacturers will be considered in accordance with Specification Section 01300 – Submittals.

3. Category 6A Patch Cables
   All patch cords will be furnished and installed by this Contractor.

4. Above Ceiling Support Devices
   Use appropriately sized cable support devices for the amount of category 6A cables in each bundle. Use appropriate anchoring device for attachment to building structure or deck. Acceptable manufacturers of cable support devices include but are not limited to Caddy and B-Line or approved equal.

5. Firestop
   The contractor is responsible for any penetration he makes through a fire rated wall or floor. An approved, rated firestop system shall be used.

6. Test Equipment
   Contractor shall test all category 6A cables with an approved tester. Test results shall be submitted as part of the final as-built documentation.

7. Telephone Backbone Cable.
   Reference the electrical drawings for details on this work.

8. Conduit between buildings.
   Reference the electrical plans for details on this work

   Reference the electrical plans for details on this work

C. Part 3 Execution

1. Pre-Installation Site Survey
   a. Prior to the start of systems installation, meet at the project site with the Owner’s representative and representatives of trades performing related work to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with the work.
   b. Examine areas and conditions under which the system is to be installed. Do not proceed with the work until satisfactory conditions have been achieved.
   c. Exact location of communications outlets and Technology Room cable terminations shall be field verified with Owner.
2. Handling and Protection of Equipment and Materials
   
a. The contractor shall be responsible for safekeeping own materials and subcontractor’s property, such as equipment and materials, on the job site. The Owner assumes no responsibility for protection of above-named property against fire, theft, and environmental conditions.

3. Protection of Owner’s Facilities
   
a. Effectively protect the Owner’s facilities, equipment, and materials from dust, dirt, and damage during construction.

b. Remove protection at completion of work.

c. Should it be found by the engineer that the materials, or any portion thereof, furnished and installed under this contract fail to comply with the specifications and drawings, with respect or regard to the quality, amount of value of materials, appliances, or labor used in the work, it shall be rejected and replaced by the contractor, and all work distributed by changes necessitated in consequence of said defects or imperfections shall be made good at the contractor’s expense.

4. Installation
   
a. Workstation Cabling
      
1. Furnish and install 19” equipment racks, vertical wire management and overhead ladder rack as required. Furnish and install rack mounted, category 6A patch panels, vertical wire managers and horizontal wire managers. Furnish and install the category 6A cables from the ladder rack through the wall of the Technology Room and into the plenum ceiling. All cables shall be dressed neatly and in accordance with manufacturers’ installation guidelines.

2. The patch panels will be 2 rack units (2U), 48 port panels. For each patch panel, supply one, 2U wire manager. Using the drawings to attain quantity of cables to be serviced by the patch panels, allow for at least 20% growth in the patch panel port count. Prior to cable installation, submit floor plans and cable run details showing j-hook pathways.

3. Station cables will be routed from the Technology Room to the workstations through the ceiling. Cable bundles will be neatly supported to the structure per code and per recommendations from the manufacturer and accepted industry practices. Cable support devices shall be spaced at a maximum of 48” and shall be sized accordingly and rated for use in supporting category 6A cables. Cables shall not be kinked, stressed or otherwise damaged. The contractor shall allow the Owner to inspect the cable pathway and support devices.

4. Cables routed to fixed wall offices will be installed in a conduit stub and outlet box.

5. Cables routed to a floor mounted outlet will be installed in an “in-floor” device.

6. In fixed offices, a single gang communications plate with the appropriate number of category 6 jacks will be used.

7. In floor devices, use appropriate adapter plates as necessary.

8. Above ceiling jacks will be positioned in a surface mount box. All boxes and equipment above the ceilings shall be plenum rated.
SPECIFICATION SECTION 16555 - TELECOMMUNICATIONS AND LOW VOLTAGE CABLELING SYSTEM

9. Label all faceplates, cables and patch panel ports per EIA/TIA 606 recommendations and coordinate label scheme with Owner. Use computer generated, permanent labels.
10. Test all category 6A station cables with a Fluke DTX 1800 or other approved tester. Certify cables to category 6A permanent link standards. Document test results using Fluke LinkWare software or other approved tester manufacturer software. Deliver test results to Owner along with as-built documentation.

5. Labeling
   a. All labeling shall be in accordance with ANSI/TIA/EIA-606 and coordinated with the Owner.
   b. Mark up floor plans showing outlet locations, type, and cable ID numbers. Include costs to create accurate AutoCAD plans. Turn these drawings over to the Owner two (2) weeks prior to move-in.
   c. Three (3) sets of as-built drawings shall be delivered to the Owner within two (2) weeks of acceptance of the project by the Owner. These shall be hard copies as well as the as-built drawings prepared by the Contractor in AutoCAD format.
   d. After as-built drawings are approved, furnish one completed set of 30x42” laminated set of documents for each building.

6. Cooperation

   The contractor shall cooperate with other trades and Owner’s personnel in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided such decision is reached prior to actual installation.

7. Testing

   All category 6A testing shall meet ANSI/TIA/EIA standards. Any testing and reporting of test results to the cable and connectivity manufacturer for warranty purposes is the responsibility of the contractor. Test all installed components and systems as specified in each individual section above and per manufactures requirements.

8. Professional Supervision

   The Contractor shall hire a professional IT designer to perform the final design and prepare submittals for all equipment. Include in bid the following hours and scope of services.

   **Required Hours - Full Design**
   8 Hours – Meeting with the College with IT Systems Designer to review the existing IT infrastructure.
   8 Hours – Prepare submittals
   8 Hours – Supervise the installation
   For pricing, contact Cain Cabling Systems

END OF SECTION
SECTION 16600 - EMERGENCY GENERATOR SYSTEM

1. GENERAL PROVISIONS

1.1 The applicable requirements and conditions of specifications section "General Provisions" of specifications divisions 16100, General Electrical, and 16300, Electrical Materials, are hereby made an integral part of this section.

1.2 Provide a complete emergency power system consisting of generator set with controller, transfer switch, generator annunciator, all ancillary and accessory equipment, emergency power distribution panels, and all related equipment and wiring. Provide power distribution panels, related equipment, and wiring according to other sections of this specification.

1.3 Provide generator system prototype tested, factory built, production tested, site tested, of the latest commercial design, and with all accessories necessary for complete installation as shown on the drawings and specified herein. Provide equipment meeting the requirements of the National Electrical Code (N.E.C.), the Life Safety Code (NFPA-101), and all other applicable codes, standards, and regulations.

1.4 Provide only equipment supplied through a single local manufacturer's representative (distributor) with factory trained and authorized service personnel on staff and single source responsibility for warranty, parts, and service. Submit manufacturer's representative qualifications with shop drawings for review and approval.

1.5 Provide only new equipment of current production of a national firm which manufactures the generator set, generator controls, and transfer switch and assembles the generator sets as a matched unit. The transfer switch (only) may be of a different manufacturer (from the generator set and controls) only where the single manufacturer's representative above is factory authorized by both the generator and transfer switch manufacturers (to provide required single-source responsibility for warranty, parts, and service). Refer also to the sections of this specification "Submittals" and "Warranty" for additional information.

1.6 Specifications are based on equipment as manufactured by Kohler. Equal equipment as manufactured by Caterpillar, Cummins/Onan, and MTU Onsite Energy (Katolight/Detroit-Diesel/MDE) shall be considered. For transfer switches only, equal equipment as manufactured by ASCO and Zenith shall be considered in addition to the manufacturers listed above.

1.7 Provide generator operating on natural gas fuel and configured for outdoor installation. Natural gas generator is ONLY acceptable for use where the natural gas utility company is capable of delivering a flow rate exceeding 125% of the full load fuel consumption of the generator at natural (without the use of pressure boosting devices or pumps) service pressure (on the load side of utility meter and main regulator) of 5 kPa (20 in. H₂O, 0.725 p.s.i.) or greater. Generator operates at slightly lower operating pressure (verify exact operating pressure range with generator manufacturer) via a regulator (if necessary) located at the generator. These service pressure limitations apply even where the actual generator operating pressure range is lower. WHERE AVAILABLE NATURAL GAS UTILITY COMPANY SERVICE PRESSURE DOES NOT MEET THE MINIMUM STANDARDS ABOVE, A NATURAL GAS GENERATOR IS UNACCEPTABLE.
SECTION 16600 - EMERGENCY GENERATOR SYSTEM

2. SUBMITTALS

2.1 Submit shop drawings including catalog cuts and specification sheets showing all standard and optional accessories to be provided, prototype test certification, schematic wiring diagrams, dimension drawings, interconnection diagrams identifying (by terminal number) all interconnections between the generator set, generator controller, transfer switch, and the remote annunciator panel, letter certifying compliance with specifications (see below), and load calculations (see below).

2.2 Submit (along with shop drawings) sufficient information for the mechanical contractor and mechanical engineer to size and confirm proper natural gas fuel piping installation (including sizing of piping and sizing and required operating characteristics for gas regulators). Coordinate the exact information which must be submitted with the mechanical engineer before submitting shop drawings.

2.3 Submit (along with shop drawings) a letter from the manufacturer certifying compliance with all requirements of the specifications. Submit certification identifying equipment by serial number and including no exceptions to the specifications, except those stipulated with the submittal.

2.4 Submit (along with shop drawings) a computer generated load calculation prepared by the manufacturer. Generator and related equipment will not be approved unless calculations are submitted. Based on reviewing electrical drawings, list on the load calculation all loads proposed for connection to the generator. The electrical contractor shall verify and obtain all detailed information on loads as required by the manufacturer to complete the load calculation. Itemize and categorize loads based on operating characteristics. Provide load calculation identifying running and starting loads (including applicable steps of applying loads) and comparing calculated values with generator set maximum ratings. Generator sizing shown on the drawings is based on computerized load calculations performed by the electrical engineer prior to issue of the drawings (based on specified generator system equipment and specified load characteristics) and represents the minimum that will be accepted. Calculations from the manufacturer are required due to variations of standard ratings and electrical characteristics (specifically with respect to motor starting) of generator system equipment available from manufacturers listed in the specifications.

2.5 Submit (along with shop drawings) qualifications of the manufacturer's representative supplying the equipment including factory authorization, summary of warranty coverage, service contacts and procedures (including emergency service telephone numbers), nearest service center location, etc..

2.6 Submit written results for all testing, prior to placing the generator in service.

2.7 Submit complete operation and maintenance (O&M) manuals prior to completion of the project. Submit quantity of sets as indicated elsewhere in the specifications. Submit O&M literature including the following:

A. Installation, operating, & maintenance instructions
B. Overhaul literature
C. General maintenance literature
D. NFPA-101 literature
3. QUALITY ASSURANCE

3.1 To assure the equipment has been designed and built to the highest reliability and quality standards, subject equipment to three (3) separate tests:

A. Design prototype tests
B. Final production tests
C. Site tests

3.2 Design Prototype Tests: Do not subject components of the system (including the generator set, transfer switch, and accessories) to prototype tests since the tests are potentially damaging. Provide prototype tests performed by the manufacturer on similar design prototypes and pre-production models, which will not be sold. Submit certified test data.

A. Generator Set:

1) Maximum power (kW) and apparent power (kVA).
2) Maximum motor starting (kVA) at 30% instantaneous voltage dip.
4) Governor speed regulation under steady state and transient conditions.
5) Voltage regulation and transient response.
6) Fuel consumption at 25%, 50%, 75%, and 100% (full) load.
7) Harmonic analysis, voltage wave form deviation, and telephone influence factor (TIF).
8) Three-phase short-circuit.
9) Alternator cooling air flow.
10) Torsion analysis testing to verify freedom from harmful torsion stresses.
11) Endurance testing.

B. Automatic Transfer Switches:

1) Overload, endurance, and short circuit (withstand and closing) at operating voltage as per UL-1008 when enclosed.
2) Temperature rise after the overload and endurance tests to confirm the ability of the transfer switch to carry rated current within allowable temperature limits of insulation in contact with current-carrying parts.

3.3 Final Production Tests: Test equipment as part of this project at the factory prior to shipping. Submit certified test data. If requested by the owner, make arrangements for the owner to witness testing.

A. Generator Set: Perform the following tests under varying load with guards and exhaust system in place.

1) Single-step load pickup.
2) Transient and steady state governing.
3) Safety shutdown devices testing.
4) Voltage regulation.
SECTION 16600 - EMERGENCY GENERATOR SYSTEM

5) Rated Power.
6) Maximum Power.
7) Rated power factor testing.

B. Automatic Transfer Switches:

1) Ensure proper operation of the individual components, proper overall sequence of operation, and verify that the operating transfer time, voltage, frequency, and the time delay settings comply with the specifications.
2) Perform dielectric strength test per NEMA Standard ICS 1-109.05.
3) Test the control panel for meeting or exceeding the voltage surge withstand capability in accordance with ANSI C37.90a-2978 and the impulse withstand voltage in accordance with NEMA Standard ICS 1-109.

3.4 Site Tests: The electrical contractor is responsible (include costs in bid) for having the manufacturer's local representative perform installation checks, start-up, and load tests at the site. Notify the engineer and owner in advance of the time and date of tests. Perform tests including:

A. Check fuel and fuel system, lubricating oil, coolant and cooling system, exhaust system, generator ventilation, engine electrical system, and heaters (block, generator, and battery) for compliance with manufacturer's recommendations under the environmental conditions present and expected.

B. Adjust all transfer switch and generator timers for proper system coordination before testing.

C. Check accessories that normally function while the set is standing by prior to cranking the engine including block heater(s), battery charger, generator strip heater(s), remote annunciator, etc..

D. Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement and vibration during starting, running, and stopping, normal and generator system voltages, and phase rotation.

E. Confirm proper functioning under loads with the following two (2) tests. For each test, perform the following. Test by simulating power outage to confirm automatic starting of the generator set, transfer of load, retransfer of load, and generator set shutdown. Monitor engine coolant temperature, oil pressure, battery charge level, voltage, amperes, and frequency throughout the test.

1) Test under full (100%) load conditions by connecting the generator set to external load bank(s) as required. Include load bank use in bid. Include installation and removal of temporary wiring to load bank(s) in bid. Where the project utilizes a single transfer switch, connect the load bank on the load side of the transfer switch. Where the project includes multiple transfer switches, connect either multiple load banks (one for each transfer switch, on load sides) or a single load bank (connected directly to the generator), at the contractor's option.
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2) Test under actual building load conditions. Perform this testing when sufficient building load is available. Include costs in bid to perform this testing any time from the date of tests listed above to the date of expiration of project guarantee.

4. WARRANTY

4.1 Provide a written warranty (including duration) on all equipment in accordance with "Guarantee and Warranties" in specifications section 16100 "General Electrical", except that the manufacturer's warranty period shall in no case be less than five (5) years or 1,500 hours of operation (whichever occurs first). Provide warranty complete, comprehensive, and covering all components of the generator system (including engine generator set, controller, annunciator, transfer switch, and all accessories), including parts, labor, and travel, for the entire duration of the warranty. Excluding any component from the warranty is not acceptable. Reducing warranty duration for any component is not acceptable.

4.2 Where the generator set and transfer switch are furnished by separate manufacturers, provide warranties from each manufacturer which are substantially identical, which both meet all provisions of these specifications, and which are both supported by the required single manufacturer's representative. Where warranties substantially differ, do not both meet all provisions of these specifications, are not both supported by the single manufacturer's representative, or where either warranty is voided or restricted based on equipment being furnished by different manufacturers, then provide all equipment as the product of a single manufacturer and covered by a single warranty.

5. ENGINE GENERATOR SET

5.1 Generator Set: Provide engine generator set consisting of engine, generator, controller and indicating panel, and all accessories specified herein. Provide generator set rated as a unit (engine plus generator) for continuous standby duty (defined as continuous for the duration of any power outage). Provide generator set with voltage, phase, and wires (match electrical system ratings) and with minimum kW and kVA ratings as indicated on the drawings. Provide generator set with minimum motor starting kVA rating (at 90% sustained voltage) not less than 400% of the generator kW rating, or as otherwise indicated on the drawings.

5.2 Engine: Provide liquid cooled four (4) stroke cycle natural gas fueled engine, including engine piston displacement (cubic inches/liters), horsepower at governed speed, quantity and arrangement of cylinders, compression ratio, bore, and stroke, as required to drive the generator to obtain ratings indicated on the drawings and specifications. Provide engine naturally aspirated, turbo-charged, or turbo-charged and after-cooled, and with carburetor. Provide engine with the following:

A. Engine speed controlled by an isochronous governor capable of +/-0.25% steady-state frequency regulation.

B. Positive engagement solenoid shift starting motor, voltage as required.

C. Automatic battery charging alternator with solid-state voltage regulation, voltage and ampere rating as required.
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D. Positive displacement full pressure lubrication oil pump, replaceable cartridge oil filters, and dipstick.

E. External oil drain either extending outside of generator frame or which facilitates connecting a drain hose to drain oil into a suitable container outside of the generator frame.

F. Heavy duty dry type replaceable air cleaner elements; air filters containing or utilizing oil are not acceptable.

G. Liquid cooled with unit-mounted high ambient radiator rated 49 degrees C (120 degrees F) or greater, blower fan, coolant pump, thermostat, fan guard, and radiator duct flange to properly cool the engine with up to 120 Pa (0.5" water column) static pressure on the fan.

H. Vibration isolators between the engine-generator and steel base or between the base and the floor.

I. The generator must be capable of operating on the natural gas fuel supply service available at the captioned project. Where the top pressure limit of the generator's rated natural gas pressure operating range (as shown in shop drawings) exceeds 5 kPa (20 in. H₂O, 0.725 p.s.i.) or exceeds the available utility service pressure (on the load side of utility meter and main regulator), the generator is not acceptable under any circumstance.

5.3 Generator: Provide permanent magnet generator (PMG) of the salient-pole brush-less type, 12-lead connectable, self-ventilated of drip-proof construction, with amortisseur rotor windings, and skewed for smooth voltage waveform. Provide insulation meeting NEMA standard (MG1-22.40 and 16.40) for Class H and with epoxy varnish fungus resistant as per MIL 1-24092. Provide temperature rise of the rotor and stator limited to NEMA class F ratings. Provide excitation system of brush-less construction controlled by a solid-state voltage regulator capable of maintaining voltage within +/-2% at any constant load from 0% to 100% of rating. Provide regulator isolated to prevent tracking when connected to SCR loads and provide individual adjustments for voltage range, stability, and volts-per-hertz and protected from the environment by conformal coating. Provide generator with the following:

A. Voltage dip not exceeding 20% and recovering to 2% of rated voltage upon one-step application of any load up to 90% of the rated load at 0.80 power factor.

B. Capable of sustaining at least 250% of rated current for at least 10 seconds under a three-phase symmetrical short by inherent design or by the addition of a current boost system.

C. Factory installed line current sensing line circuit breaker (capable of being manually reset) with inverse time versus current response protecting the generator from damage due to its own high current capability. Mount breaker integral to generator set. Provide circuit breaker rating as indicated on the drawings or as otherwise required to protect the generator. Provide so the breaker will not trip within the 10 seconds at 250% current specified above to allow selective tripping of down-stream overcurrent devices under fault conditions. Automatic resetting breaker is not
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acceptable (to prevent restoring voltage to a fault or if performing maintenance). Field current sensing breaker is not acceptable.

D. With single maintenance-free bearing, directly connected the engine flywheel to the generator rotor with a semi-flexible coupling.

E. "Oversized" if necessary to provide specified starting kVA rating for motors and similar equipment and facilitating large single phase loads.

F. Arranged to provide 1% voltage regulation.

G. Factory provisions for bonding the neutral conductor at the generator set. Bond as a "separately derived system", as per the N.E.C..

6. CONTROLLER AND INDICATING PANEL

6.1 Provide controller with integral indicating panel mounted on or integral to and vibration isolated from the generator set. Provide facing to the rear of the generator set (opposite end from the cooling radiator).

6.2 Provide microprocessor based solid-state logic controller with all control panel circuitry of plug-in design for quick replacement. Utilize relays only in high-current circuits. Provide circuit boards moisture proof and capable of operation from -40 to +85 degrees C (-40 to +185 degrees F).

6.3 Provide NFPA-110 controller with complete diagnostic testing to facilitate owner's maintenance personnel testing controller performance without operating the generator set. Utilize one (1) of the following two (2) options at the manufacturer's discretion:

A. Provide diagnostics utilizing a plug-in diagnostic testing device. Provide controller with suitable connection harness to facilitate plug-in testing device. Furnish and turn over to the owner one (1) plug-in testing device (Kohler "Fast Check" series or approved equal).

B. Provide diagnostic functions accessed directly from the control panel utilizing alphanumeric display (minimum 32 character) with selection push-buttons integral to the controller (Caterpillar "EMCP II" series, Cummins/Onan "PowerCommand" series, or Katolight #MPC 8-32 or #KDGC-2000 series).

6.4 Provide with the following features:

A. Fused DC circuit.

B. Complete two-wire start/stop control operating on closure of remote contact(s).

C. Speed sensing and a second independent starter motor disengagement system protecting starter from engaging with a moving flywheel. Battery charging alternator voltage is not acceptable for this purpose.

D. Starting system designed to restart in the event of a false engine start, by permitting the engine to completely stop and then reengage the starter.
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E. Cranking cycle control with 15-second ON and OFF cranking periods.

F. Over-crank protection to open the cranking circuit after 75 seconds if the engine fails to start.

G. Protection to shut down the engine upon overvoltage (15% or more overvoltage for one (1) second or more), high coolant temperature, low oil pressure, and over-speed. Provide "pre-alarm" signals to warn of impending high coolant temperature and low oil pressure shutdown.

H. All controller accessories to facilitate instrument panel devices and indicators specified below.

I. Switch(es)/push-buttons as required to select from the following minimum functions:
   1) AUTO: Permits normal functioning, generator operates based on remote starting contact position
   2) OFF: Disables operation regardless of the status of remote starting contacts and provides immediate shutdown in case of emergency
   3) RUN: Starts and runs the engine regardless of the status of remote starting contacts
   4) RESET: Resets the controller after any controller or generator fault condition (this function may be combined with the OFF function above)

6.5 Provide instrument panel integral to the controller including:

- Dual range voltmeter 90 mm (3.5"), 2% accuracy *
- Dual range ammeter 90 mm (3.5"), 2% accuracy *
- Voltmeter-ammeter phase selector switch *
- Where dual scale voltmeters or ammeters are used, provide light emitting diode (LED) indicating lights for high or low meter scale
- Frequency meter 3.5", 0.5% accuracy; either direct reading pointer style with 45 to 65 Hz scale or digital reading measuring to 1/100 Hz (i.e. "60.00 Hz") *
- Battery charging voltmeter, 51 mm (2"), 2% accuracy *
- Coolant temperature gauge, 51 mm (2"), 2% accuracy *
- Oil pressure gauge, 51 mm (2"), 2% accuracy *
- Running time meter
- Tachometer *
- Watt meter *
- Panel illuminating light(s)
- Speed potentiometer (in conjunction with isochronous governor)
- Voltage adjust rheostat
- Local emergency stop feature (mushroom style push-button)
- Alarm horn with silencer switch per NFPA 110

* Indicates that where the metered parameter is displayed on an alphanumeric display (minimum 32 character) integral to the controller or where the switch function is replaced by equivalent push-button functions at the alphanumeric display, omitting the instrument will be considered. NOTE: If a device is proposed for omission under this provision, specifically request this on the manufacturer's submittal cover sheet or a manufacturer's letter attached to the submittal; otherwise the omission will not be considered.
6.6 Provide LED indicating lights (incandescent is not acceptable) integral to the controller for each of the following, along with test button for indicating lights:

A. Auxiliary Shutdown (Red) *
B. Auxiliary Pre-alarm (Yellow) *
C. Switch "Not-in-Auto" (Flashing Red)
D. Over-crank (Red) *
E. Emergency Stop (Red)
F. High Coolant Temperature (Red) *
G. Pre-high Coolant Temperature (Yellow) *
H. Over-speed (Red) *
I. Low Oil Pressure (Red) *
J. Pre-low Oil Pressure (Yellow) *
K. Battery Charger Fault (Red) *
L. Low Battery Voltage (Red) *
M. Low Fuel (Red) *
N. System Ready (Green) *
O. Low Coolant Temperature (Red) *

* Indicates that where the condition is displayed on an alphanumeric display (minimum 32 character) integral to the controller, omitting the indicating light will be considered. If any indicating light is omitted, provide a "common pre-alarm" light and a "common alarm" light on the control panel. NOTE: If a light is proposed for omission under this provision, specifically request this on the manufacturer's submittal cover sheet or a manufacturer's letter attached to the submittal; otherwise the omission will not be considered.

6.7 Provide relays/contacts for each indicating light signal above, plus additional relays/contacts for the following:

A. Run relay kit (minimum three (3) SPDT contacts)
B. Common failure relay kit (min. one (1) SPDT contact)
C. Dry contact kit (minimum three (3) SPDT contacts)

7. ACCESSORIES

7.1 Provide the following accessory equipment integral to the generator set:

A. Complete oil drain kit.
B. Engine block/coolant heater, with thermostat control.
C. Battery rack, battery cables, and battery capable of delivering the manufacturer's recommended minimum cold-cranking amperes at -18 degrees C (0 degrees F).
D. Battery heater, with thermostat control.
E. Generator strip heater.
SECTION 16600 - EMERGENCY GENERATOR SYSTEM

F. 10 A (minimum) automatic float and equalize battery charger with +/-2% constant voltage regulation from no load to full load over +/-10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambient from -40 to +50 degrees C (-40 to +122 Degrees F), 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected. Provide optional alarm circuit board to meet the requirements of NFPA 110 for low battery voltage, high battery voltage, and battery charger malfunction. Mount the battery charger integral to generator outdoor enclosure only. Do not mount the battery charger at transfer switches or remote from the generator.

G. The electrical contractor shall furnish and the mechanical contractor shall install gas-proof, seamless, stainless steel, and flexible exhaust connections, exhaust silencer rated for hospital grade (industrial, residential, and critical grade silencers are not acceptable) application (reducing total engine exhaust noise by approximately 32 to 42 dBA), tailpipe/rain cap kit, and insulation blankets on turbocharger (where applicable), exhaust manifold, and factory exhaust elbows.

7.2 The electrical contractor shall furnish and the mechanical contractor shall install the following accessory equipment. The electrical contractor shall wire equipment, including all control wiring interconnections to the generator.

A. Flexible fuel lines, fuel line gas strainer, and NFPA-110 manual valve and gas solenoid bypass.

7.3 Provide the complete generator set (including all accessories) installed within an overall weatherproof housing enclosure. Provide enclosure including ample louvers for generator cooling and with removable, lockable side panels for servicing and to prevent tampering. Provide electrostatic applied powder coat enclosure finish as per architect. Include costs in bid for any standard or optional factory finish or for primer coating only to facilitate final painting in field by the general contractor.

7.4 Provide enclosure as sound attenuating and as follows:

A. Provide to allow the generator set to operate at full rated load in the ambient conditions specified. Provide to reduce the sound level of the generator set operating at full rated load to a maximum of 71.8 dBA at any location 7 m (23'0") from the generator in a free field environment. Housing configuration and materials used may be of any suitable design which meets application needs, (except that acoustical materials shall be oil and water resistant). Foam materials are not permitted unless they are demonstrated to have the same durability and life as fiberglass.

B. Provide the enclosure including hinged doors for access to both sides of the engine, alternator, and control equipment. Provide all doors as stainless steel with key-locking and pad-lockable door latches.

C. Provided the exhaust silencer mounted inside of the enclosure (unless external muffler is specifically approved in writing by the engineer, architect, and owner).
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D. Provide all sheet metal primed for corrosion protection and finish painted with the manufacturer's standard color using a two (2) step electro-coating paint process, or equal meeting the performance requirements specified below. Provide all surfaces of all metal parts primed and painted. Provide a coating meeting or exceeding the following requirements:

1) (0.5-2.0 mils) primer thickness. (0.8-1.2 mils) top coat thickness.
2) Gloss per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year exceeding 50%.
3) Crosshatch adhesion per ASTM D3359-93, 4B-5B.
4) Impact resistance per ASTM D2794-93, (120-160 in. lbs).
5) Salt Spray per ASTM B117-90, 1,000+ hours.
6) Humidity per ASTM D2247-92, 1,000+ hours.
7) Water Soak per ASTM D2247-92, 1,000+ hours.

Do not paint hoses, clamps, wiring harnesses, or other non-metallic service parts. Utilize only corrosion resistant fasteners designed to minimize marring of painted surfaces when removed for normal installation or service work.

8. REMOTE GENERATOR ANNUNCIATOR

8.1 Provide a remote audio-visual generator annunciator (alarm panel) located directly adjacent to the building fire alarm annunciator (or fire alarm control panel where fire alarm system does not include an annunciator), unless another location is shown on the electrical drawings. Provide as Cummins-Onan "Power Command" series (or approved equal) and including the following:

A. Alarm horn with silencing switch sounding for any condition indicated by (*).

B. LED indicating lights (incandescent is not acceptable) for the following, along with a test button for indicating lights:

1) System Ready (Green)
2) Utility Line Power (Green)
3) Generator Supplying Power (Green)
4) Generator Running (Green) - Optional
5) Battery Charger Fault (Red)
6) Low Battery Voltage (Red)
7) High Battery Voltage (Red) - Optional
8) Normal Battery Voltage (Green) - Optional
9) Pre-low Oil Pressure (Yellow) *
10) Low Oil Pressure (Red) *
12) Pre-high Coolant Temperature (Yellow) *
13) High Coolant Temperature (Red) *
14) Low Coolant Temperature (Red) *
15) Low Coolant Level (Red) * - Optional
16) Over-crank (Red) *
17) Over-speed (Red) *
18) Low Fuel (Red) *
19) Pre-auxiliary Alarm (Yellow) *
20) Auxiliary Alarm (Red) *
SECTION 16600 - EMERGENCY GENERATOR SYSTEM

21) Switch "Not-in-Auto" (Flashing Red) *
22) Emergency Stop (Red)

C. For high-rise structures (only), provide controls to manually start the generator and manually transfer/re-transfer each transfer switch individually to/from generator power. Provide integral to or directly adjacent to the annunciator.

9. AUTOMATIC TRANSFER SWITCHES

9.1 Provide automatic transfer switches of the microprocessor logic type featuring both open-transition and delayed-programmed-transition operating modes (field-selectable), Kohler #KCP/KSP series, or approved equal.

9.2 Provide quantity, phase conductor poles, and ampacity as indicated on the drawings. Provide switch rated 600 V with control/operating voltage as required. Provide NEMA-1 enclosure.

9.3 Provide transfer mechanism as a specification grade double-throw switch (single "rocker" switch or two (2) switches positively interlocked by direct connection to in-line solenoid shaft) mechanically held and electrically operated by a single-coil linear solenoid. Provide transfer mechanism main contacts accessible for inspection and servicing (contacts may be located behind removable covers). Transfer mechanism utilizing two (2) mechanically interlocked or linked circuit breakers or molded case switches is not acceptable. Geared operator, motor driven operator, and transfer mechanism utilizing two (2) or more operators are not acceptable.

9.4 Provide with switched neutral pole (in addition to quantity of poles indicated on the drawings) and connect the generator system as a "separately derived system" as defined by the N.E.C.. Provide switched neutral pole of the "overlapping" make-before-break style where available from the manufacturer. Solid neutral bus is not acceptable under any circumstance.

9.5 Provide with the following features:

A. Switch(es)/push-buttons as required to select from the following minimum functions:

1) AUTO: Permits normal functioning
2) TEST: Simulates normal power failure
3) OFF: Disables operation

B. LED indicating lights (incandescent is not acceptable) for the following, along with a test button for indicating lights:

1) Normal power supply (Green)
2) Generator power supply (Red)
3) Test switch not-in-auto (white or amber): Lights if switch(es)/push-buttons select any function other than "AUTO"
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C. Provide voltage monitoring of both normal and generator sources, with differential voltage sensing and adjustable normal source voltage sensing (nominal 72%-100% for pickup, 70%-98% for dropout). Provide three-phase normal source sensing and three phase or single phase generator source sensing.

D. Provide the following adjustable time delay features (except engine starting time delay may be fixed or adjustable) with nominal time/range as shown:

1) Engine starting (3 seconds)
2) Normal to generator transfer (0.6-60 seconds), set not more than 10 seconds
3) Generator to normal retransfer (1-30 minutes)
4) Programmed transition (0-10 seconds)
5) Engine cool-down (1-30 minutes)

E. Main shaft auxiliary contacts (2 N.O. and 2 N.C.).

F. One (1) channel generator exercising time clock, with load/no-load selector switch, with digital control (electromechanical type is not acceptable), of the seven (7) day type, with an illuminated LED visible with the enclosure cover open. Provide coil and contact voltage coordinated with generator and transfer switch controls.

G. Provide with in-phase and frequency monitoring to prevent retransfer unless phase angles and frequencies of the normal and generator sources are within 20 degrees and 2 Hz, respectively.

10. INSTALLATION

10.1 Install the generator set, automatic transfer switch(es), and remote annunciator at respective locations as indicated on the drawings.

10.2 Coordinate exact equipment layout and locations with the architect, owner, and all other trades (including mechanical contractor) as required for a complete installation.

10.3 Mount the generator controller, battery rack, battery cables, battery heater, batteries, and battery charger integral to generator outdoor enclosure only. Do not mount the battery charger at transfer switches or remote from the generator.

10.4 Provide the engine exhaust silencer factory mounted within or atop the generator weatherproof enclosure utilizing flexible exhaust connection and manufacturer brackets and hardware. Provide the exhaust tailpipe/rain cap kit factory mounted atop the generator weatherproof enclosure. Provide the complete exhaust system factory installed by the manufacturer.

10.5 The mechanical contractor shall install electrical contractor furnished mechanical accessories as specified above.
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10.6 The mechanical contractor shall provide the complete fuel system serving the generator (including appropriately sized piping and suitable gas regulator serving the generator; fully coordinate fuel system with the mechanical engineer and mechanical contractor) The gas regulator (if needed) must be dedicated to serving the generator only and must be located at the generator (only). Generator must be supplied directly from the natural gas utility service without any intermediate regulators.

10.7 Provide engraved laminated plastic nameplates at all generator system equipment and equipment fed from the generator system as per specifications section "Identification, Nameplates, and Tags" of specifications division 16300, Electrical Materials, except utilize red nameplates with white letters. This includes nameplates at the generator set, transfer switch, emergency branch/distribution panels, remote mounted generator accessories, switches serving generator set accessories, and related equipment.

A. Provide generator nameplate with wording similar to the following example (fill in the proper ratings):

<table>
<thead>
<tr>
<th>Name (10 mm (3/8&quot;) lettering):</th>
<th>EMERGENCY GENERATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage and Phase:</td>
<td>277/480VV-3PH-4W</td>
</tr>
<tr>
<td>Ratings and circuit breaker amperes:</td>
<td>75KW, 93KVA, 250A</td>
</tr>
<tr>
<td>Fuel Source:</td>
<td>NATURAL GAS</td>
</tr>
<tr>
<td>Remarks (3.2 mm (1/8&quot;) lettering):</td>
<td>(list multiple ATS's) *</td>
</tr>
</tbody>
</table>

* Where the generator serves two (2) or more transfer switches, list locations of transfer switches in the remarks.

B. Provide nameplates for transfer switches similar to nameplates for safety switches and enclosed circuit breakers, except with remarks indicating the panel and circuit number, transformer, or generator feeding both the normal and emergency sources (provide description describing load fed from the transfer switch).

C. Provide nameplates for electrical accessories (block/coolant, generator strip, and battery heaters and battery charger) similar to nameplates for safety switches and enclosed circuit breakers.

D. Provide red engraved laminated plastic nameplates at each of the generator annunciator and the building service disconnect reading, "NATURAL GAS EMERGENCY GENERATOR LOCATED OUTDOORS BEHIND BUILDING", and describe the generator location.

E. The electrical contractor shall provide tags (of an engineer and code approved type) at all fuel line shut-off valves and fuel supply equipment serving the generator reading, "EMERGENCY POWER SUPPLY - NOT TO BE SHUT OFF DURING AN EMERGENCY" or similar wording as directed by local authorities. Coordinate locations and requirements with mechanical contractor and mechanical engineer.

10.8 Provide complete interconnection, control, and intercommunication wiring between all generator system components as required for a complete installation. This includes wiring between any and all of the equipment and components as follows, where applicable: generator set (including engine, generator, controller and indicating panel, and all accessories), transfer switch(es), remote generator annunciator, elevator controls, outdoor
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lighting controls, fuel supply equipment, ventilation louvers, etc. Where the system includes more than one (1) transfer switch, connect generator run contacts in each transfer switch in parallel so activation of any one (1) or more transfer switch operates the generator. Provide all control wiring in complete accordance with the N.E.C. (including maintaining separation from other wiring and systems and fire rating of wiring [including where required for high-rise structures, places of assembly, and fire pump transfer switches], as required).

10.9 Completely connect, ground, and bond the generator set and complete generator power system in accordance with all applicable N.E.C. requirements for a "separately derived system". Include the following:

A. Systems Definitions:

1) **Normal Source System:** The *separately derived* normal (utility) power system fed by the utility electric service and which feeds normal power to the automatic transfer switch.

2) **Generator Source System:** The *separately derived* generator power system originating at the generator and which feeds generator power to the automatic transfer switch.

3) **Emergency Distribution System:** The system originating at the load side of the automatic transfer switch, including all distribution, branch wiring, and equipment as part of the emergency power system (excluding the "Normal Source System" and the "Generator Source System" defined above).

B. **Generator Neutral Bonding:** Provide the generator set with provisions for bonding the neutral conductor and bond in accordance with the N.E.C..

C. **Generator Grounding:** Ground the generator as per specifications section "Grounding" of specifications division 16200, Electrical Work Practices (including using grounding materials as per specifications section "Grounding Materials" of specifications division 16300, Electrical Materials). Provide grounding electrode connections at the generator (including driven (made) grounding electrodes and other applicable connections) as required by the N.E.C. and in addition to all grounding electrode connections as part of the "Normal Source System". Connect the grounding electrode connections at the generator to the grounding electrode system for the "Normal Source System" to form a common and complete grounding electrode system throughout the building.

D. **Switched Neutral at Transfer Switch – 4 Pole Transfer Switches:** Provide the automatic transfer switch with switched neutral pole to facilitate the following:

1) Separating and isolating neutral conductors from each of the "Normal Source System" and the "Generator Source System" (except for brief intervals during transfer or re-transfer).

2) Connecting the "Emergency Distribution System" neutral conductor to either the "Normal Source System" or the "Generator Source System" (along with phase conductors) depending on the transfer switch position.
E. Install wiring of the "Normal Source System", the "Generator Source System", and the "Emergency Distribution System" so the neutral conductors of each respective system do not connect at any point to the any neutral conductor of any other system, except under the following specific conditions:

1) The switched neutral pole of the automatic transfer switch shall connect the neutral conductor of the "Emergency Distribution System" to the neutral conductor of the "Normal Source System" only when the automatic transfer switch is in the "normal" position. No other connection between any "Emergency Distribution System" neutral conductor and any "Normal Source System" neutral conductor is permitted under any circumstance.

2) The switched neutral pole of the automatic transfer switch shall connect the neutral conductor of the "Emergency Distribution System" to the neutral conductor of the "Generator Source System" only when the automatic transfer switch is in the "generator" position. No other connection between any "Emergency Distribution System" neutral conductor and any "Generator Source System" neutral conductor is permitted under any circumstance.

3) No connection between any "Normal Source System" neutral conductor and any "Generator Source System" neutral conductor is permitted under any circumstance (except that both neutral bonding points below shall connect to a common grounding electrode system). Bond the neutral conductor of the "Normal Source System" to the grounding electrode system at the point where the "Normal Source System" originates or receives its supply. Bond the neutral conductor of the "Generator Source System" to the grounding electrode system at the generator.

4) Do not bond or connect the "Emergency Distribution System" neutral conductor to any grounding conductor under any circumstance (neutral is bonded at the sources of the "Normal Source System" and the "Generator Source System" and connected via the transfer switch).

10.10 Completely fill the generator with all fluids as recommended by the manufacturer (including lubricating oil, antifreeze coolant, battery fluid, etc.).

10.11 Set all generator, transfer switch, and load control timers and relays as recommended by the manufacturer (with settings complying with all applicable codes).

10.12 Provide conduit stub-ups at the generator completely enclosed inside of the generator enclosure. Exposed conduits outside of the generator enclosure are permitted only where specifically approved in writing by the engineer before installation and where the generator base does not have any space facilitating enclosing conduit stubs.

END OF SECTION