

PURCHASING DEPARTMENT DIVISION OF BUDGET & FINANCE

PUR-1751 ADDENDUM NO. 2 INVITATION TO BID

HAGERSTOWN REGIONAL AIRPORT EXPAND/REHABILITATE TERMINAL BUILDING EAST

DATE: Tuesday, June 17, 2025

BIDS DUE: Friday, June 27, 2025 2:00 P.M.(EDT/EST)

To Bidders:

This Addendum is hereby made a part of the Contract Documents on which all bids will be based and is issued to correct and clarify the original documents.

Please acknowledge receipt of this Addendum at the appropriate space on the Proposal Form. This Addendum consists of seven (7) pages and twenty-six (26) attachments.

<u>NOTE</u>: All Bidders must enter the Washington County Administration Complex through either the front door at the 100 West Washington Street entrance or through the rear entrance (w/blue canopy roof) which is handicap accessible and must use the elevator to access the Purchasing Department to submit their bid and/or to attend the Pre-Bid Conference. Alternate routes are controlled by a door access system. The general public will be subject to wand search and will be required to remove any unauthorized items from the building prior to entry. Prohibited items include but are not limited to: Weapons of any type; Firearms, ammunition, and explosive devices; Cutting instruments of any type - including knives, scissors, box cutters, work tools, knitting needles, or anything with a cutting edge, etc.; Pepper spray, mace, or any other chemical defense sprays; and Illegal substances.

ITEM NO. 1: <u>Inquiry</u>: Specification 044313.13 – Anchored Stone Masonry Veneer lists Gruber-Latimer Restorations as a Pre-qualified Masonry Contractor. Does this mean they are the only installer we can use?

<u>*Response:*</u> No, other masonry contractors with representative experience in stone masonry will be acceptable.

ITEM NO. 2: <u>Inquiry</u>: Can the AISC certifications for the structural steel fabrication and installation be waived?

Response: No, AISC certifications for structural steel fabrication and installation

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cannot be waived for this project.

ITEM NO. 3: <u>Inquiry</u>: Is the existing roofing under warranty? If so, what type of roofs are they and what subcontractor did the installations?

<u>*Response*</u>: This section of roofing was existing when the 2018 Hold Room was constructed. The Sarnafil membrane on this section of roof would have a 20-year warranty.

ITEM NO. 4: <u>Inquiry</u>: Based on the plans, it is not clear what millwork portions fall under spec sections 06 41 00 – Custom Millwork and 06 42 19 – Manufactured Plastic laminate Clad Casework.

<u>*Response*</u>: Section 06 41 00 applied to 102-Concessions, 111-Coffee Bar, 103 Concessions Exterior Wall, and 113-Breakroom. Section 06 42 19 applied to ticket counters.

ITEM NO. 5: <u>*Inquiry*</u>: With the limited amount of millwork/casework in the project, can local custom millworkers be allowed to provide both 06 41 00 and 06 42 19?

<u>*Response:*</u> The plastic laminate in each section is the same and our local fabricators listed in Section 06 41 00 under products are capable of completing the work with adequate shop drawings.

ITEM NO. 6: <u>Inquiry</u>: Provide sizing/sections/elevations of the 102 Concessions millwork/casework shown on floorplan 1/A1.3 that we are to match existing. The demo/existing plans do not show anything there to match.

<u>*Response*</u>: DELETE Drawing A6.1 and REPLACE with Revised Drawing A6.1 (dated 06.12.2025). The millwork details have been added to this drawing. (Attachment A)

ITEM NO. 7: <u>Inquiry</u>: Provide sizing/sections/elevations for the radius millwork/casework at the 103 Concessions area on floorplan 1/A1.3 unless we are not providing.

<u>*Response*</u>: The radius millwork shown on 103-Concessions is future and Not in Contract (NIC).

ITEM NO. 8: <u>Inquiry</u>: Does section 4/A6.3 apply to this project anywhere?

<u>*Response*</u>: DELETE Drawing A6.3 in its entirety and REPLACE with Revised Drawing A6.3 (dated 06.12.2025). Detail 4 sections of charging stations have been deleted. (Attachment B)

ITEM NO. 9: <u>Inquiry</u>: Does section 5/A6.3 apply to the right side of elevation 2/A6.1?

(NOTE: The wording of all "Inquiries" submitted are displayed exactly as received.)

<u>*Response*</u>: Yes, the detail applies to the 42" high charging counter in 112-Observation Area.

ITEM NO. 10: *Inquiry:* Confirm that section 3/A6.3 does not apply to the project.

<u>*Response*</u>: DELETE Drawing A6.3 in its entirety and REPLACE with Revised Drawing A6.3 (dated 06.12.2025). Detail 3 has been deleted. (Attachment B)

ITEM NO. 11: <u>Inquiry</u>: Please provide better clarification & division of what we are to include in the Base Bid and Alternate # 2.

1. The 1/A1.2 colored floorplan shows doors 115B & 108B and the new wall opening to 104 (E) Tickets as being in the Alternate. Should they be in the Base Bid?

2. Clarify if all the exterior perimeter wall work at 116 (E) Baggage Makeup is in the base bid and only the new 113 Breakroom is in the Alternate.

3. Clarify the break points of what MEP portions are in Base Bid & Alternate since all feed together as shown.

<u>*Response*</u>: Part 1 of Item No. 11 herein: The doors shall be installed under Base Bid. The interior wall shall be constructed under Alternate No. 1.

<u>*Response*</u>: Part 2 of Item No. 11 herein: The revisions to the exterior wall in 116-Baggage Make-Up shall be in Base Bid.

<u>*Response*</u>: Part 3 of Item No. 11 herein: The mechanical work in 116-Baggage Makeup and 113-Breakroom shall be under Alternate No. 1.

ITEM NO. 12: <u>Inquiry</u>: Some of the specification section have numerous pages that the top of the page is covered by the "dark" project description not allowing to read the full spec requirements. The majority of this occurs in the MEP plans. One example is section 28 31 14 – all pages but the first page.

<u>Response</u>:

Remove specification section "220523 – Domestic Water Valves" in its entirety and replace with attached revised specification section "220523 – Domestic Water Valves". (Attachment C)

Remove specification section "220529 – Plumbing Hangers and Supports" in its entirety and replace with attached revised specification section "220529 – Plumbing Hangers and Supports". (Attachment D)

Remove specification section "224000 – Plumbing Fixtures" in its entirety and replace with attached revised specification section "224000 – Plumbing Fixtures". (Attachment E)

Remove specification section "230505 – HVAC Scope" in its entirety and replace with attached revised specification section "230505 – HVAC Scope". (Attachment F)

Remove specification section "230700 - HVAC Insulation" in its entirety and replace with attached revised specification section "230700 - HVAC Insulation". (Attachment G)

Remove specification section "232113 – HVAC Piping" in its entirety and replace with attached revised specification section "232113 – HVAC Piping". (Attachment H)

Remove specification section "233114 – Exterior Ductwork – Manufactured Pre-Insulated" in its entirety and replace with attached revised specification section "233114 – Exterior Ductwork – Manufactured Pre-Insulated". (Attachment I)

Remove specification section "233300 - Duct Accessories" in its entirety and replace with attached revised specification section "233300 - Duct Accessories". (Attachment J)

Remove specification section "237330 Packages Rooftop Units" in its entirety and replace with attached revised specification section "237330 Packaged Rooftop Units". (Attachment K)

Remove specification section "260500 – Common Work Results for Electrical" in its entirety and replace with attached revised specification section "260500 – Common Work Results for Electrical". (Attachment L)

Remove specification section "260553 – Identification for Electrical Systems" in its entirety and replace with attached revised specification section "260553 – Identification for Electrical Systems". (Attachment M)

Remove specification section "262213 – Dry Type Distribution Transformers" in its entirety and replace with attached revised specification section "262213 – Dry Type Distribution Transformers". (Attachment N)

Remove specification section "262416 – Panelboards" in its entirety and replace with attached revised specification section "262416 – Panelboards". (Attachment O)

Remove specification section "262726 - Wiring Devices" in its entirety and replace with attached revised specification section "262726 - Wiring Devices". (Attachment P)

Remove specification section "262816 – Enclosed Switches and Circuits Breakers" in its entirety and replace with attached revised specification section "262816 – Enclosed Switches and Circuits Breakers". (Attachment Q)

Remove specification section "265200 - Solid State Lighting" in its entirety and replace with attached revised specification section "265200 - Solid State Lighting". (Attachment R)

Remove specification section "283111 – Additions to Existing Digital, Addressable, Fire-Alarm System" in its entirety and replace with attached revised specification section "283111 – Additions to Existing Digital, Addressable, Fire-Alarm System". (Attachment S)

ITEM NO. 13: <u>Inquiry</u>: Section 1/A1.8 calls for a composite panel behind the gutter that is flat and does not appear to be panel. Please clarify the intent at this location.

<u>*Response*</u>: The thin 4 mm (1/8") composite metal panel shall be installed as detailed as fascia behind 6" box gutter.

ITEM NO. 14: <u>Inquiry</u>: Section 2/A1.8 shows closed cell foam insulation, but no spec has been provided for this product.

<u>Response</u>: Provide glass fiber insulation in cavity to break conductance.

ITEM NO. 15: <u>Inquiry</u>: Floor Pattern Plan 1/A9.1 shows an F6 type floor that is not identified as existing at the entry vestibule to the 101 Lobby. Confirm this is not in our scope or provide the product to be used.

<u>*Response:*</u> DELETE Drawing A9.1 in its entirety and REPLACE with Revised Drawing A9.1 (dated 06.12.25). The vestibule flooring is existing and not in project. (Attachment T)

ITEM NO. 16: <u>Inquiry</u>: Plan E6.1 - Confirm that the raceway between the existing Panel EL and the 15KVA transformer is to be run overhead in lieu of underground.

<u>*Response*</u>: It is acceptable to run the conduit overhead to Panel EL.

ITEM NO. 17: <u>Inquiry</u>: Plan G2.0 says that the liquidated damages are \$2,000 a day and the ITB & Bid Form say \$2,500 a day. Which is correct?

<u>*Response:*</u> Refer to the bid document, Page BD-18, Supplemental Terms and Conditions, Item No. 16 Liquidated Damages: Liquidated damages shall be applied at the rate of two thousand five hundred (\$2,500.00) dollars per consecutive calendar day for each day the Contractor fails to complete the work as specified herein. This cost includes the 8-hour presence of a Construction Inspector and Engineering support for each additional day.

ITEM NO. 18: *Inquiry*: Clarify the size and type of river rock required on plan G2.0.

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<u>*Response*</u>: The river rock should be ornamental stone that is mostly tan, rounded, and approximately 1"-3" in size.

ITEM NO. 19: <u>Inquiry</u>: Floorplan 1/A1.9 shows 46 total new seats, but the seating legend calls for 39 new seats. Clarify if 46 is correct. Per the site visit, this is to change. Need to confirm count since was originally incorrect.

<u>*Response*</u>: Refer to Revised Drawing A1.9 (dated 06.10.2025) issued in Addendum No.

ITEM NO. 20: <u>Inquiry</u>: Provide additional information on exactly what model & options related to the Herman Miller Eames Tandem Sling Seating we are to provide.

<u>*Response*</u>: Provide padded seats with reinforced vinyl fabric in Black. Supplier: MOI. Contact Person: Candice Davis 240.864.0302, Email: cdavis@moii.com.

ITEM NO. 21: <u>Inquiry</u>: Please provide an exterior elevation of the west side of the new Addition above the existing roof. Appears they are composite panels and a CW4 curtainwall, but an elevation would make things much clearer. Making assumptions with info provided.

<u>*Response*</u>: DELETE Drawing A4.8 in its entirety and REPLACE with Revised Drawing A4.8 (dated 06.12.2025). Showing the east facing elevation with glazing and composite metal panels. (Attachment V)

ITEM NO. 22: <u>Inquiry</u>: Clarify what we are to provide for pipe bollards. The 05 50 00.3.5.A.1 description does not match the 4/CV5.1 plan detail for embedment depth, height above grade or the top of bollard condition. Does the bollard get concrete filled? The structural plans do not provide any information.

<u>*Response:*</u> Spec section 05 50 00.3.5.A.1 has been revised to defer to the Civil drawings for bollard size, heights, embedment, etc. The bollards shall be filled with concrete. (Attachment W)

ITEM NO. 23: <u>Inquiry</u>: The 08 44 33 Sloped Glazed Assemblies specification calls for a mockup. Can this be waived?

<u>*Response*</u>: Delete reference to mockup. We will not require a mock-up for the sloped glazing assembly.

ITEM NO. 24: DIVISION 09 – FINISHES Color Schedule

REVISE: Replace in entirety with attached schedule (Attachment X)

ITEM NO. 25: Sheet No. E3-1 Demolition First Floor Plan

REVISE: Replace sheet in entirety with attached revised sheet (Attachment Y)

(NOTE: The wording of all "Inquiries" submitted are displayed exactly as received.)

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ITEM NO. 26: Sheet No. E1-1 Riser Diagrams

REVISE: Replace sheet in entirety with attached revised sheet (Attachment Z)

ITEM NO. 27: Sheet No. E7-2 Schedules

REVISE: Replace sheet in entirety with attached revised sheet (Attachment AA)

ATTACHMENTS:

- A. Contract Drawings (A4.8, A6.1, A6.3, A9.1, E3-1, E6-1, and E7.2) (7 pages)
- B. Technical Specifications:
 - i. DIVISION 9 FINISHES Color Schedule (4 pages)
 - ii. 22 05 23-DOMESTIC WATER VALVES (5 pages)
 - iii. 22 05 29-PLUMBING HANGERS AND SUPPORTS (5 pages)
 - iv. 22 40 00-PLUMBING FIXTURES (4 pages)
 - v. 23 05 05-HVAC SCOPE (2 pages)
 - vi. 23 07 00-HVAC INSULATION (9 pages)
 - vii. 23 21 13-HVAC PIPING (5 pages)
 - viii. 23 31 14-EXTERIOR DUCTWORK MANUFACTURED PRE-INSULATED (8 pages)
 - ix. 23 33 00-DUCT ACCESSORIES (8 pages)
 - x. 23 73 30-PACKAGED ROOFTOP UNITS (22 pages)
 - xi. 26 05 00-COMMON WORK RESULTS FOR ELECTRICAL (9 pages)
 - xii. 26 05 53- IDENTIFICATION FOR ELECTRICAL SYSTEMS (5 pages)
 - xiii. 26 22 13-DRY TYPE DISTRIBUTION TRANSFORMERS (5 pages)
 - xiv. 26 24 16-PANELBOARDS (4 pages)
 - xv. 26 27 26-WIRING DEVICES (6 pages)
 - xvi. 26 28 16-ENCLOSED SWITCHES AND CIRCUIT BREAKERS (3 pages)
 - xvii. 26 52 00-SOLID STATE LIGHTING (12 pages)
 - xviii. 28 31 11-ADDITIONS TO EXISTING DIGITAL, ADDRESSABLE
 - FIRE-ALARM SYSTEM (21 pages)
 - xix. 05 50 00-METAL FABRICATIONS (4 pages)

By Authority of:

Brandi J.Konther

Brandi J. Kentner, CPPO Director of Purchasing



MICRO. (N.I.C.)







INTERIOR ELEVATION @ 113-BREAK ROOM





A6.1

6011 UNIVERSITY BLVD. SUITE 490 ELLICOTT CITY, MD 21043 PHONE: 410-465-9600 INC. FAX: 410-465-9602 BUSHEY FEIGHT MORIN ARCHITECTS

1/4" = 1'-0"

473 NORTH POTOMAC STREET HAGERSTOWN, MD 21740 301.733.5600 BFM PROJECT # 24043



Professional Certification:	DE
I hereby certify that these documents	
were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland.	DR
	СН

icense No. 615	7
xpiration Date:	09/07/2026

DESIGNED:	RAK	No. Rev 1	DATE 06.12.202
DRAWN:	RAK		
CHECKED:	NEM		
APPROVED:	NEM		





INTERIOR ELEVATION @ 111-COFFEE/112-OBSERVATION 1/4" = 1'-0"





- QUARTZ COUNTERTOP & BACKSPLASH (QZ-2)

13/16"X13/16" SS ANGLE, TYP.







PHONE: 410-465-9600 FAX: 410-465-9602 BUSHEY FEIGHT MORIN ARCHITECTS **473 NORTH POTOMAC STREET** HAGERSTOWN, MD 21740

SUITE 490



Professional Certification:	DESIGNED:	RAK	
I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws	DRAWN:	RAK	
of the State of Maryland.	CHECKED:	NEM	
License No. 6157			

xpiration Date: 09/07/2026

APPROVED: NEM

No.

Rev 1



SECTION @ CHARGING STATION COUNTER 1 1/2" = 1'-0"

6011 UNIVERSITY BLVD.

ELLICOTT CITY, MD 21043

SOUND ATTENUATION INSULATION -FULL HT.		QUARTZ SIDE SPLASH BEYOND
3/4" THK. QUARTZ BACKSPLASH		3/4" THK. QUARTZ SURFACE w/ EASED EDGES ON 3/4" THK. MDF SUBSTRATE
LAGBOLT & FENDER WASHER - TYP.		
6" MTL STUDS @ 16" O/C MAX. SPACING	3/4"	
	2" x 1/4" CONTINUOUS STL. PLATE - WELD TO STUDS & ANGLE SUPPORTS	SUPPORT FRAME
	LAGBOLT & FENDER	
2" x 2" x 1/4" STL. ANGLE SUPPORT FRAME @ 16" O/C SPACING MAX.		
	5/8" THK. GYP. BDPAINT -SEE RM. FIN. SCHED.	
6" METAL STUD TRACK —————	FINISHED WALL BASE -SEE RM. FIN. SCHED.	
FINISHED WALL BASE	2" x 1/4" CONTINUOUS STEEL PLATE	
	1/4" x 2" x 5" STL. PLATE - EXPANSION BOLT TO (E) SLAB	
ELEV 100' - 0" (690'-5" -V.I.F.)		<u> </u>











SECTION 22 05 23: DOMESTIC WATER VALVES

PART 1 - GENERAL

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

1.2 SCOPE

- A. The valves for the domestic water systems shall be as hereinafter described in this section.
- B. <u>Lead Free</u>: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤ 0.25% per Safe Drinking Water Act as amended January 4th 2011 Section 1417. Valve requirements to meet all State and Local requirements.
- C. For fire protection system valves, refer to Section 221420.

1.3 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 for ferrous valve dimensions.
 - 2. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF/ANSI 61 and/or NSF/ANSI 372 for valve materials for potable-water service. Valves for domestic water must be 3rd Party Certified.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.



PART 2 - PRODUCTS

- 2.1 GENERAL USE VALVES
 - A. The domestic water supply system shall be fitted with valves at points specified or indicated on the Drawings. Provide <u>minimum 3/4</u>" hose end drain ball valves with vacuum breakers and threaded caps at all low points of the water system to provide for drainage.
 - B. Lead Free silicon bronze (ASTM listed) valves shall be made with corrosion-resistant materials. Manufacturer shall provide third party certification tested in accordance with EN ISO 6509 regarding dezincification corrosion resistance and stress corrosion cracking.
 - C. Valves 2" and smaller shall be Bronze Valves, ball type, with threaded or solder ends, unless otherwise indicated. Valves 2-1/2" and larger shall be Ferrous Valves, butterfly type, with flanged ends, unless otherwise indicated.
 - D. All valves for general use shall be Victaulic for grooved systems, Nibco Inc., Jomar, Apollo, Viega, Zurn, Wilkins, or Watts. All valves shall be designated for a minimum 125 pounds per square inch (S.W.P.), 200 pounds per square inch (W.O.G.).
 - E. <u>Bronze or brass valves</u>, including check valves and balancing valves, shall be made to be <u>"dezincification resistant</u>", with metal components in the waterway, or not containing more than 15% zinc in their chemical makeup.
 - F. The name or trademark of the manufacturer and the guaranteed working pressure shall be cast or stamped on the body, <u>as well as 'Lead Free' marked handle</u>.
 - G. <u>Valves in Insulated Piping</u>: With 2-inch stem extensions:
 - . Ball Valves: With extended operating handle of non-thermal-conductive material that meets UL 2043 approved for inside air plenum, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO NIB-SEAL (-NS suffix in figure no.), handle extension or approved equal.
 - 2. Butterfly Valves: Shall have 2" extended neck for insulation clearance.
 - H. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Solder Joint: With sockets according to ASME B16.18.
 - 4. Threaded: With threads according to ASME B1.20.1.
 - 5. Copper Press: With sockets according to ASME B16.22/ASTM B75



- I. Bronze Ball Valves
 - 1. Two-piece, full port, silicon bronze ball valves with the capability of accepting extended operating handles. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model T/S/PC-585-80-LF (-NS).
 - a. Standard: MSS SP-110 and ASME A1124.14
 - b. CWP Rating: 600 psig
 - c. Body Design: Two piece bronze with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.
 - d. Body Material: Silicon bronze (ASTM Listed), corrosion resistant.
 - e. Ends: Threaded, soldered or pressed.
 - f. Seats: Reinforced PTFE or TFE.
 - g. Ball & Stem: Silicon Bronze 'Lead Free' Material
 - h. Port: Full.
- J. Drain Valves:
 - 1. Each down fed unit or other equipment shall be provided with drain valves.
 - 2. Drain valves shall be ¹/₂" with hose end and cap similar to NIBCO No. T-585-70-66-HC or S-585-70-66-HC, or approved equivalent.
- K. Vacuum Relief Valve:
 - 1. A Vacuum Relief Valve shall be installed on domestic hot water tanks as indicated on plans. The vacuum relief valve shall be ANSI Z21.22 rated and CSA certified. The vacuum relief valve shall have an all brass body and include a protective cap. Watts Model N36-M1 or approved equal.

2.2 CHECK VALVES AND BACKFLOW PREVENTERS

- A. For <u>condensate drain line "light spring" check valves</u>, refer to Section 221413, "Condensate Drain System".
- B. Silicon Bronze Lift Check Valves
 - 1. 200 CWP, Lift Check Valves with Nonmetallic TFE Disc. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model T/S-480-Y-LF.
 - a. Standard: MSS SP-139
 - b. CWP Rating: 200 psig
 - c. Body Design: Vertical or Horizontal Flow
 - d. Body Material: Silicon Bronze (ASTM Listed), corrosion resistant.
 - e. Ends: Threaded or Soldered.
 - f. Disc: FTE
- C. Silicon Bronze Swing Check Valve
 - 1. 300 CWP, Bronze Swing Check Valves with Nonmetallic TFE Disc. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model T/S-413-Y-LF.
 - a. Standard: MSS SP-139
 - b. CWP Rating: 300 psig
 - c. Body Design: Vertical (flow in upward direction) or Horizontal Flow
 - d. Body Material: Silicon Bronze (ASTM Listed), corrosion resistant.
 - e. Ends: Threaded or Soldered.
 - f. Disc: PTFE or TFE



- D. <u>Hydrants</u>
 - 1. <u>WH-1 Exterior Wall Hydrants</u>: Zurn No. Z1300-CL Series, encased Ecolotrol "anti-siphon" automatic draining wall hydrant for flush installation, Josam, Smith, Wade, or Watts. Complete with non-freeze type integral backflow preventer, bronze casing, all bronze interior parts, non-turning operating rod with free-floating compression closure valve, replaceable bronze seat and seat washer, 3/4" inlet/outlet, and key-operated control valve. Nickel-bronze box and hinged cover with <u>cylinder lock</u> and "WATER" cast on cover. Nickel-bronze cover with polished face. <u>A stainless-steel wall hydrant will not be acceptable</u>. Mount wall hydrants with centerline 2'-0" above finished grade.
 - 2. Furnish six (6) <u>spare</u> operating keys for all hydrants to the Owner.
- E. <u>Vacuum Breakers</u>: For exposed vacuum breakers, 1/2" size, vacuum breaker shall be T&S Brass B-0929-A, wall-mounted elevated atmospheric vacuum breaker with polished chrome plated brass body. For vacuum breakers, 3/4" to 1" size, vacuum breaker shall be Watts Series LF800M4FR, lead free, pressure anti-siphon vacuum breaker, with built-in relief valve.
- F. <u>Vacuum Relief Valve</u>: Vacuum relief valves shall be installed on domestic hot water tanks as indicated on plans. The vacuum relief valve shall be ANSI Z21.22 rated and CSA certified. The vacuum relief valve shall have an all brass body and include a protective cap. Watts Model N36-M1 or approved equal.
- G. <u>Water Dispensing Valves (WDV)</u> shall be Oatey "Moda" Supply Box System Series, PVC body, Guy Gray, Viega. Specific type and version of Box System that is to be installed is to occur during the submittal process. Box shall include quarter turn valve with appropriate fitting connections for application. Provide fire-rated box system where applicable.
- H. <u>Unions</u> shall be wrot copper, ground joints, and solder ends, Nibco, or approved equivalent.

2.3 POINT-OF-USE MIXING VALVES

- A. <u>TMV-1</u> Individual thermostatic point-of-use mixing valves shall be provided at each sink, lavatory, bank of fixtures, or other appliance requiring hot water. Mixing valves shall be Leonard Model 270-LF-BRKT-CP. Valve shall be of brass and bronze body construction, 'Lead Free', minimum flow rate, .5 GPM; brass and stainless steel flow control components, vandal-resistant temperature handle adjustment, integral checks/strainers, rough bronze finish, <u>and wall mounting bracket</u>. Mixing valve shall conform to ASSE 1070. Zurn, Lawler, Acorn, or Symmons, shall also be acceptable, shall also be acceptable. Each valve installed <u>must</u> meet fixtures/equipment's maximum flow rate. Valve shall be required to be chrome-plated <u>ONLY</u> when exposed to view. Coordinate with fixture/equipment supplier prior to submittal.
 - 1. For other locations, set outlet temperatures of mixers as shown or as otherwise directed by the Owner.
 - 2. Furnish and install shutoff valves on inlet and outlet piping of each mixing valve. Refer to the mixing valve schedule and piping schematic shown on the drawings.

2.4 STOPS



A. Each plumbing fixture furnished under this Contract and each piece of special equipment furnished under other contracts or by the Owner shall, <u>unless otherwise shown or specified</u>, be provided with compression stop valves on the water supply piping. On copper or PEX piping, ball valves shall be installed on branch water piping to equipment. Stops shall be finished brass, chrome-plated where exposed and shall be provided with stop control as shown or specified.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. All valves must be <u>accessible</u>.
 - B. Provide a shutoff valve at the base of upfed water risers and at the top of downfed water risers with a <u>minimum 3/4</u>" hose end ball drain valve with vacuum breaker <u>and threaded cap</u> at the base of all water risers.
 - C. Each piece of equipment that may have to be removed from the system for repair shall be connected by union or flange <u>and provided with isolation valves</u>.
 - D. <u>Provide a shutoff valve on water supply to each exterior wall hydrant, regardless of whether shown or not</u>.
 - E. Upon installation, <u>all testable backflow preventers shall be tested under the Plumbing Contract</u>, in accordance with manufacturer's installation standards, or in accordance with local authorities or utility company having jurisdiction over the installations. <u>All testing shall be completed by persons certified in this type of work</u>. All costs, fees, or charges required for testing shall be included in the Contract price.

END OF SECTION 22 05 23

SECTION 22 05 29: PLUMBING HANGERS AND SUPPORTS

PART 1 - GENERAL

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

1.2 SCOPE

- A. The hangers and supports for the various plumbing and fire protection systems shall be as hereinafter described in this section.
- B. Hangers and supports shall be arranged to distribute the weight of the piping and equipment uniformly on the building structure.

PART 2 - PRODUCTS

- 2.1 PIPE HANGERS AND SUPPORTS
 - A. All pipe hangers, riser clamps, and supports shall be as manufactured by The Modern Pipe Supports Corp., Anvil International, Inc., Tolco Co., or Erico Corp. The following catalog numbers are taken from The Modern Pipe Supports Corp. Catalog to indicate the type of installation required.
 - B. Hangers for steel, iron, or plastic piping shall be The Modern Corp. Government ring type hanger, No. 404, complete with band hanger, Fig. No. 540 malleable iron adjuster and rod, or approved equivalent. Hanger bands shall be flat and suitable for <u>application of insulation over the hanger and pipe</u>.
 - C. Hangers for <u>all</u> copper piping shall be The Modern Corp. No. 48, complete with <u>copper-plated band</u>; No. 121 copper plated, malleable iron adjuster, and rod, for pipe sizes 1/2" thru 6", or approved equivalent. PVC coated or epoxy coated hangers will be acceptable. Use The Modern Corp. No. 10, with <u>special PVC coated or padded band</u>, and Fig. No. 540 copper plated, malleable iron adjuster, and rod, for pipe sizes larger than 6".
 - D. Insulation shall be installed over band hangers and all openings shall be sealed.
 - E. Clevis and loop hangers are acceptable, provided that the hangers match the pipe materials. If clevis or loop hanger systems are utilized, insulation shields must be installed to maintain uniform insulation thickness and maintain insulation material characteristics.
 - F. Hanger rods installed in conjunction with hangers shall be not less than 3/8" for pipe sizes 1/2" to 2"; 1/2" for pipe sizes 2 1/2" and 3"; 5/8" for pipe sizes 4" and 5"; 3/4" for 6" pipe; and 7/8" for 8" to 12" pipe sizes. Hanger rods shall be larger where recommended by the hanger manufacturer.

Attachment D

ADCI

SECTION 22 05 29: PLUMBING HANGERS AND SUPPORTS

HAGERSTOWN REGIONAL AIRPORT – RICHARD A. HENSON FIELD | TERMINAL BUILDING EXPANSION AIP 3-24-0019-XXX-2025; MAA-GR-XX-XXX BID NO. PUR – 1751 | DESIGN SET | MAY 2025



- G. Piping 2" and smaller supported on steel joists shall be hung from one joist with beam clamps. Piping over 2" and 3" in diameter shall be suspended from 1 1/4" steel pipe or steel angle, laid in and hook bolted to the web members of the joists. Piping 4" and 5" shall be supported from three joists. Piping 6" and over shall be supported from not less than four joists.
- H. Piping along walls shall be supported on substantial wall hangers securely attached to construction by means of inserts or expansion sleeves and bolts. Wall hangers shall be similar to Modern Corp. Fig. No. 284, or approved equivalent.
- I. All expansion shells shall be of the self drilling types, as manufactured by the Phillips Drill Company, Ramset, Rawlplug, or approved equivalent. Shells shall be hammer installed, special flush or hanger rod types. Shells shall be installed with a drill hammer. Lead expansion shields or lead wedge type shields will not be permitted.
- J. Vertical runs of exposed <u>uninsulated</u> piping shall be supported from walls with sections of Modern Corp. Chan-All channel-strut and strut clamps, or approved equivalent. For all <u>insulated</u> piping, use strut clamps sized to permit a continuous insulation installation.
 - 1. "Klo-Shure" insulation couplings will be acceptable, as represented by Scott Industrial Systems (Tele No. 412-965-3279).
- K. All supports directly in contact with copper piping shall be copper plated, PVC coated, or epoxy coated, or equivalent. Ferrous metals shall not be used in contact with copper piping. <u>Hangers for copper</u> <u>tubing 6" and smaller shall be copper-plated, PVC coated, or epoxy coated as herein specified; PVC</u> <u>coated or padded hangers for larger copper piping</u>.
- L. Hangers for pipe and tubing, **except for fire protection piping**, installed horizontally, shall be spaced, at a <u>maximum</u>, as follows:

PVC AND COPPER PIPE SUPPORT SPACING			
Pipe Size	PVC, FT	Copper, FT	
Cold Water	Cold Water	C.W.	
Up to 1-1/2"	3	6	
2" and Larger	4	8	

STEEL PIPE SUPPORT SPACING				
Pipe Size	Drainage Service, FT	Copper, FT		
1"	7	9		
1-1/2"	9	12		
2" & 2-1/2"	10	13		
3"	12	15		
4" & 5"	14	17		
6"	17	21		
8"	19	24		
10"	22	28		

SECTION 22 05 29: PLUMBING HANGERS AND SUPPORTS

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- M. All vertical runs of piping shall be supported at each floor and/or at specified intervals, by means of riser clamps. Copper tubing shall be protected against electrolysis, such as copper plating, PVC coating, or epoxy coating, or approved equivalent. Supports shall be placed at minimum ten (10) foot intervals for vertical pipe, <u>except</u> as otherwise dictated by NFPA recommendations for **fire protection piping**.
- N. Where concentrated loads of valves, fittings, etc., occur, closer spacing may be necessary. Smaller pipe shall be provided with additional supports to prevent piping from sagging. Hangers must be installed not more than 12" from each change in direction of pipes.
- O. Where cast iron pipe is suspended, a minimum of one (1) hanger shall be provided for each length of pipe at each fitting.
- P. Brass chromium plated pipe shall be supported by suitable cast brass, chromium plated supports. All securing devices shall have all exposed heads, finished chromium plated.

Q. Pipe hangers and <u>hanger</u> spacing for the fire protection systems shall conform to NFPA recommendations. <u>Hangers for the fire protection system shall be UL Listed, FM approved.</u> <u>Hangers shall be adjustable type pattern.</u>

R. For cast iron drainage piping greater than 4", anchorage is to be provided at change in direction locations and at locations of pipe size greater than two pipe sizes. Braces, blocks, rodding, and other suitable methods as recommended or required by the cast iron fitting manufacturer. Coordinate specific anchor requirements and specifics with cast iron manufacturer.

2.2 ROOF BLOCK SUPPORTS

- A. Roof block supports for piping shall be Roof Top Blox system, RTB-01. The support blocks must be designed to eliminate roof penetrations, flashings, or damage to roofing membrane. Support body shall be made of recycled UV-resistant Polypropylene Copolymer. Base platform material shall be 1" thick by 25 psi, type 4 closed cell structural foam to distribute and evenly cushion loads. Block must accept 3/8" and ½" threaded rod using side entry nut slots to allow fast top side assembly and piping height adjustments. Securing brackets (SBC-07) and adhesive (ADH-13) shall be used for permanently securing unit into position.
- B. Also acceptable shall be flexible, closed-cell polyethylene foam, by Erico Pipe Pier Support Systems. <u>Wood blocks shall not be acceptable</u>. Foam blocks shall be standard, Figure 1, Part No. PP50H6, 10-1/2"Lx4"Wx6"H, with chemically bonded 14 gauge solid integral pre-galvanized strut channel; UV resistant, and accommodates expansion and contraction of piping. Load rating – 5 lbs. per linear inch of strut. <u>Confirm</u> exact foam block and pipe load requirements with the equipment supplier <u>prior to</u> <u>ordering</u>. Blocks shall be installed according to manufacturer's recommendations. Block spacing shall conform to industry standards. Blocking shall conform to the Uniform Mechanical Code ('97) 1312.2 for gas piping. <u>Strut clamps and accessories</u> by Plumbing Contractor. <u>Refer to the drawing details</u>.

2.3 PIPE PORTALS



- A. For pipe penetrating the roof, Contractor shall use Pipe Portal from Portals Plus, or approved equivalent. The Pipe Portal shall include an 18 gauge galvanized roof curb Model 32000 series, with integral base plate, continuously welded corner seams, factory-installed wood nailer, and 1.5" 3lb rigid fiberglass insulation.
- B. Pipe Portal shall be furnished with a laminated, acrylic coated, ABS plastic curb cover with prepunched holes and molded sealing ring on an 8" collared opening.
- C. An EPDM compression molded cap model C-212 shall be utilized.
- D. All Caps shall include Portals Plus' stainless steel Snaplock Clamps.
- E. Attachment and installation of the Pipe Portal shall be done in accordance with Portals Plus' instructions and the roofing membrane manufacturer's recommendations.
- 2.4 SEISMIC SUPPORTS
 - A. Being of seismic region, furnish and install all necessary additional bracing, brackets, hangers, and supports to effectively install the piping systems. <u>Refer</u> to Section 226408.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All piping shall be supported from the building construction by the use of fixed or adjustable beam clamps, concrete inserts, lag bolts and lag screws from wood construction, brackets, extension rods, adjustable band ring pipe hangers, or other equipment as dictated by the type of building construction.
- B. The Contractor shall place all hanger and support inserts in concrete. Special studs "shot" into concrete will <u>not</u> be permitted.
- C. Perforated band iron, strap, split ring, wire, chain, or pipe hooks will <u>not</u> be permitted for hangers or supports of pipe.
- D. Piping shall <u>not</u> be supported from any other piping systems, ductwork, conduit, etc. Piping shall only be supported by code approved and manufacturer recommended hanger systems connected directly to the building's structure.
- E. <u>ALL</u> hanger and support locations shall be coordinated and reviewed with the Architect, Structural, HVAC, Electrical **and Fire Protection** Engineer Construction Representatives during construction. If any hanger locations or connection methods are unacceptable to any of the professional team (for example penetrations of pre-cast concrete tees, from piping, uneven spacing or height, etc.), the Contractor shall relocate the support, <u>at his own expense</u>, to an approved location.
- F. Attachments to, and penetrations of new or existing concrete structural tees for hanger connections shall be not be permitted until reviewed and approved by the Architect. The Contractor shall be responsible for the expense of all repairs required as a result of the installation of unauthorized attachments to, or penetrations of new or existing concrete structural tees.

SECTION 22 05 29: PLUMBING HANGERS AND SUPPORTS

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G. Trapeze type hangers may be used for multiple parallel line installations. <u>The Contractor shall submit</u> <u>sketches</u> for the proposed hangers indicating the type of construction, number and size of piping, and maximum spacing to the Architect for approval. Include <u>metal shielding</u> for insulation to rest thereon to avoid crushing. <u>Insulation must be continuous as specified</u>. Electrolysis at pipe/hanger <u>must</u> be prevented.

3.2 UNACCEPTABLE HANGER AND SUPPORT INSTALLATIONS

- A. It is unacceptable to support any pipe(s) or duct(s) from other pipe(s) or duct(s).
- B. If unistrut is used to support piping, strap hangers are unacceptable since they do not allow for continuous insulation.
- C. It is unacceptable for this Contractor to support his work from the hangers of other trades. All trades must install their own hangers.
- D. Unacceptable hanger and support installations shall be corrected as directed by the Architect/Engineer at no cost to the Owner.

END OF SECTION 22 05 29

SECTION 22 40 00: PLUMBING FIXTURES

PART 1 - GENERAL

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

1.2 SCOPE

- A. The plumbing fixtures, trim, accessories, and miscellaneous equipment shall be as shown on the drawings. Additional manufacturer's names of fixtures, trim, and miscellaneous equipment shall be listed herein.
- B. All plumbing fixtures and trim shall be new and of the best quality. All fixtures shall bear the manufacturers' guarantee label or trademark, indicating first quality.
- C. ALL fixtures and associated trim, including traps, stops, faucets, flush valves, etc., shall be 'Lead Free' or 'No Lead' and shall be documented as such as part of the submittal process.
- D. All vitreous china, cast iron, and prefabricated fiberglass, polyethylene, acrylic, or polypropylene fixtures shall be white and all fixtures of all types shall be specially selected, free from cracks, chips, flaws, stains and warping, and other defects. Fixtures shall be replaced by the Contractor, and the guarantee period on such replaced fixtures shall be extended for the full term of the guarantee from the date of replacement.
- E. The Contractor shall refer to the Drawings for the quantities of plumbing fixtures of each kind to be furnished.
- F. Provide adapters on all final piping connections to equipment furnished under other contracts or by the Owner.
- G. All fixtures and trim shall be as listed below. Confirm requirements of all fixtures, trim, and manufacturers with Owner prior to ordering. Trim shall be commercial grade.
 - 1. Lavatories Zurn, American-Standard Brands, Kohler, Bradley or Sloan.
 - 2. Stainless Steel Sinks Just, Advance Tabco, or Elkay.
 - 3. Lavatory / Sink Faucets Bradley. Zurn, Chicago Faucet, Speakman, or T&S Brass.
 - 4. Waste/Trap Assemblies Zurn, McGuire, or Kohler.
 - 5. Water Supplies/Stops Zurn, McGuire, or Kohler.
 - 6. Insulation Kits Zurn, McGuire, or Truebro.
- H. All fixtures and equipment shall be properly trapped in accordance with local code requirements.



- I. <u>All</u> exposed piping to fixtures shall be chrome plated. Chrome traps and chrome tubing shall be 17 gauge minimum. All traps of all types, exposed and accessible concealed, shall each include <u>cleanout</u>. Chrome finishes shall not be required for fixtures that require insulation kits.
- J. All escutcheons shall be chrome, cast brass, set screw type, including on drain assemblies, water supplies at fixtures, and including piping inside fixture cabinets.
- K. Plumbing Contractor shall furnish templates to General Contractor for cut-out work for built-in sinks and lavatories. Confirm available cabinet sizes with the General Contractor or Equipment Supplier <u>prior</u> to ordering counter sinks or counter lavatories of any type.
- L. Supply piping to fixtures, faucets, wall hydrants, and hose bibbs shall be securely anchored to prevent movement.
- M. <u>Contractor shall coordinate all installations with Architectural Drawing elevations and ADA required</u> <u>clearances</u>.
- N. Wiring with conduit from transformers above ceiling to sensor-operated equipment shall be furnished and installed under the Plumbing Contract; refer to Section 220500.

PART 2 - PRODUCTS

- 2.1 FIXTURES
 - A. <u>L-1</u> Wall-Mounted Single Station with *Hard-Wired* Faucet ADA Height
 - 1. Bradley Verge No. LVQD1-WB2-T-5-BS-"STAIN-E"-VS-"S-CHROME" wall hung lavatory, 30" x 21", with WashBar WB1. Mount at ADA Height.
 - 2. Drain shall be Zurn No. Z8746-PC flat perforated strainer drain with 1-1/4" offset tailpiece.
 - 3. P-Trap assembly shall be Zurn No. Z8701-9-PC, 1-1/4" x 1-1/2", with cleanout.
 - 4. Water supplies shall be Zurn Z8800-XL-LRLK-PC. Brass ball valve type "convertible" stops acceptable.
 - 5. Zurn No. Z8946-3-NT ADA compliant insulation kit for waste and hot and cold water assemblies, vandal-resistant; when exposed to users.
 - 6. Bradley Infrared Washbar faucet "WB2" provided with sink.
 - 7. No Soap Dispenser.
 - 8. No Hand Dryer.
 - 9. Finish, material and color provided by architect.
 - B. <u>S-1</u> Drop-In Double Bowl Stainless Steel Sink with Manual Faucet ADA Height
 - 1. Elkay LRAD332250 Lustertone [™] Classic Stainless Steel 33" x 22" x 5" Equal Double Bowl Dropin ADA Sink. Sink is manufactured from 18 gauge 304 Stainless Steel with a Lustrous Satin finish, Rear Center drain placement, and Bottom only pads.
 - 2. Faucet shall be the Zurn No. Z831C4-ICT-XL, 'Lead Free', 8" centers, gooseneck spout, 4" wrist blade handles, and aerator.
 - 3. Elkay LK35 stainless steel drain and tailpiece assembly with 1-1/2" Schedule 40 PVC adjustable P-Trap and waste assembly.



- 4. Water supplies shall be Zurn Z8800-XL-LRLK-PC. Brass ball valve type "convertible" stops acceptable.
- 5. Zurn No. Z8946-3-NT ADA compliant insulation kit for waste and hot and cold water assemblies, vandal-resistant; when exposed to users.
- 6. Sink countertop openings under General Contract. Sink set and sealed by Plumbing Contractor.
- C. <u>S-2</u> Drop In Single Bowl Stainless Steel Sink with *Manual* Faucet ADA Height
 - Elkay LRAD191950 Lustertone [™] Classic Stainless Steel 19-1/2" x 19" x 5" Single Bowl Drop-in ADA Sink. Sink is manufactured from 18 gauge 304 Stainless Steel with a Lustrous Satin finish, Rear Center drain placement, and Bottom only pads.
 - 2. Zurn No. Z831J1-ICT-XL 'Lead Free' *manual* faucet with swing spout, lever handles, and aerator.
 - 3. Just J-35 stainless steel drain and tailpiece assembly with 1-1/2" Schedule 40 PVC adjustable P-Trap and waste assembly.
 - 4. Water supplies shall be Zurn Z8800-XL-LRLK-PC. Brass ball valve type "convertible" stops acceptable.
 - 5. Sink countertop openings by General Contractor. Sink set and sealed by Plumbing Contractor.

2.2 GARBAGE DISPOSERS

- A. In-Sink-Erator Badger 5 garbage disposer, General Electric, Hobart, or approved equivalent. Galvanized steel grinding elements with two (2) stainless steel 360o swivel lugs; continuous feed; one piece, heavy duty stopper; self-service wrench; enamel finish; permanently lubricated upper and lower bearings; overload protector manual reset; dishwasher drain connection; heavy duty motor, 1/2 HP, 1-60-120V. Warranty, two (2) full year parts and in-building service warranty. UL Listed. Plug dishwasher drain connection when not used. All wiring and control switch under the Electrical Contract.
 - 1. Extend waste piping to prevent standing water in disposer motor housing.
 - 2. Provide <u>trap</u> on outlet of disposer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All fixtures, trim, accessories, and equipment shall be assembled and installed according to manufacturers' recommendations in a neat and workmanlike manner.
- B. Thoroughly clean all fixtures, trim, accessories, and equipment installed under this Contract.
- C. Refer to the Architectural and Plumbing Drawings for <u>scheduled mounting heights and clearances for</u> <u>fixtures and equipment</u>. <u>Particular attention</u> is directed to mounting and clearances for ADA fixtures.
- D. Upon completion of this Contract, the Plumbing Contractor shall furnish the Owner's maintenance personnel with a Supplier faucet repair kit furnished by the approved faucet supplier.
- E. Caulk with white silicone sealant caulk on all wall and floor contact edges on all fixtures, or of color caulk selected by the Architect. Caulk shall be of suitable type which can be painted.

PLUMBING FIXTURES

- F. Refer to "Control Wiring" as specified; refer to Section 220500. <u>All costs shall be included under the</u> <u>Plumbing Contract for extending control wiring in conduit (as described) from transformers to hard-</u> <u>wired sensor-operated trim, including final electrical connections of all types.</u> <u>Transformers shall be</u> <u>furnished, installed, and mounted above ceiling by the Plumbing Contractor.</u> <u>Furnish, install, and mount</u> <u>all required solenoid extension nipples</u>.
 - 1. Hardwired power converters for 6 VDC flush valves and faucets shall be the Zurn No. P6000-HW6 Series, or approved equivalent.
- G. <u>Individual mixing valves</u> shall be utilized at certain fixtures and equipment receiving hot water as designated; refer to Section 220523 regarding mixing valve specifications. The Plumbing Contractor shall <u>verify exact requirements</u>, <u>quantities</u>, <u>and locations</u> of mixing valves with the local Plumbing Inspector <u>prior</u> to ordering or installation.

END OF SECTION 22 40 00

SECTION 23 05 05: - HVAC SCOPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 EQUIPMENT AND SYSTEMS PACKAGING

A. Equipment and product manufacturers specified in the Section 23 documents are encouraged to form vendor teams where practical to provide equipment in competitively priced packages.

1.3 DESCRIPTION OF WORK

- A. The work to be performed under these Specifications and the accompanying Drawings comprises the furnishing of the labor, materials, tools, and other services and facilities necessary for the complete installation of, but not necessarily limited to the following:
 - 1. Demolition of HVAC equipment, ductwork, and piping as indicated on the drawings.
 - 2. Rooftop Units
 - 3. Terminal Equipment Fin Tube, Unit Heaters
 - 4. Supply and Exhaust Fans, Miscellaneous Ventilating Systems
 - 5. Air Conditioners and Heat Pumps
 - 6. Piping Refrigerant, Condensate Drain
 - 7. Ductwork Low and Medium Velocity
 - 8. Ductwork Accessories Dampers, Grilles, Diffusers, Supports, Access Doors, and Turning Vanes
 - 9. Insulation Piping, Ductwork
 - 10. Equipment and Piping Identification
 - 11. Testing, Adjusting and Balancing
 - 12. A new DDC Automatic Temperature Control system. The system shall include new control panels, control wiring, control valves, thermostats, switches, relays, controllers, and other accessories herein specified.
 - 13. Furnish combination starter/disconnects, disconnect switches, magnetic motor starters, manual motor starters and fuses to the Electrical Contractor for installation on the HVAC Equipment. Coordinate the electrical requirements with the Electrical Contractor before ordering any such equipment.
 - 14. Install duct-mounted smoke detectors. Furnish and install the control wiring from the duct-mounted smoke detectors to the air handling unit motor starters for unit shutdown. Duct-mounted smoke detectors shall be furnished and connected to the fire alarm system by the Electrical Contractor.



1.4 WORK BY OTHERS

- A. The following construction and equipment related to the work under this Contract will be provided by others:
 - 1. Openings in new roof and roof deck. (General Contractor)
 - 2. Openings in new exterior walls. (General Contractor)
 - 3. Furring around new piping. (General Contractor)
 - 4. Final painting of new interior surfaces. (General Contractor)
 - 5. Recesses and openings in new construction for piping and equipment. (General Contractor)
 - 6. New chases for piping where specifically shown on the drawings. (General Contractor)
 - 7. The removal of existing electrical wiring, conduit and boxes for existing removed heating and ventilating equipment. (Electrical Contractor)
 - 8. The line and load side electric power wiring to the new electrically operated heating, ventilating and air conditioning equipment (Electrical Contractor). The control and interlock wiring, both low and line voltage shall be included under the HVAC Contract as hereinafter specified for the HVAC equipment.
 - 9. The Electrical Contractor shall be responsible for the power wiring and associated terminations to line and load side as well as mounting of the combination starter/disconnects, magnetic starters, VFD's, manual starters, disconnect switches, etc. furnished by the mechanical contractor and external to equipment they are designated to serve. The Electrical Contractor shall make final connections to the equipment as directed by the Mechanical Contractor.
 - 10. Furnishing of duct mounted smoke detectors (Electrical Contractor). Wiring to fire alarm system by Electrical Contractor.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

3.1 NOT APPLICABLE TO THIS SECTION

END OF SECTION 23 05 05



SECTION 23 07 00: - HVAC INSULATION

PART 1 - GENERAL

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

1.2 SCOPE

A. The insulation for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

- 2.1 GENERAL
 - A. Fiberglass insulation shall be as manufactured by Owens Corning, CertainTeed, Johns-Manville, Knauf, or approved equal.
 - B. Manufacturer's names are indicated herein to denote a standard of quality and type only. Products of other manufacturers not mentioned herein will be acceptable providing they meet the requirements of these Specifications in quality and type and are submitted according to Section 23 0506, Paragraph 1.4.
 - C. The materials, finish and adhesive herein specified, shall be listed and inspected by Underwriters Laboratories Incorporated. Covering, vapor barriers, and adhesives used in this application shall have a flame spread classification of not more than 25 and a smoke developed rating of not more than 50, based on tests in accordance with ASTM Standard E84, "Methods of Tests for Surface Burning Characteristics of Building Materials," except as hereinafter specified. Each product shall bear the label Underwriters Laboratories. Products used on this project shall be classified as "non-combustible" by NFPA.

2.2 HOT PIPING SYSTEM INSULATION

- A. Hot piping systems shall include the following:
 - 1. Hot Water Supply and Return (HWS & R)
 - 2. Glycol Hot Water Supply and Return (GHWS & R)
 - 3. High Pressure Steam Supply and Return, HPS & R (100 PSIG)
 - 4. Medium Pressure Steam Supply and Return, MPS & R (60 PSIG)
 - 5. Low Pressure Steam Supply and Return, LPS & R
 - 6. **Pumped Condensate (PC)**



- 7. Boiler Feed Water (BFW)
- 8. Drain piping
- 9. Relief valve piping
- 10. Vent piping
- B. Hot piping system insulation, except where specified otherwise, shall be glass fiber pipe insulation with white Type ASJ jacket, Owens Corning FIBERGLAS[™] pipe insulation or approved equal. End and transverse joints shall be wrapped with factory-furnished sealing strips of same material as jackets. Horizontal laps and end joints shall be sealed down with Foster® 85-20[™] Spark-Fas® Adhesive, non-flammable, vapor barrier adhesive.
- C. Exterior hot piping Insulation shall be the same as specified for hot piping systems. Thickness shall comply with the table in Paragraph 2.4, but shall be no less than 2 inches. Insulation shall be covered with a Type ASJ jacket and a Childers 0.016" smooth aluminum exterior weatherproof jacket neatly banded and sealed in place.
- 2.3 COLD PIPING SYSTEM INSULATION
 - A. Cold piping systems shall include the following:
 - 1. Condensate Drain Lines
 - B. Cold piping system insulation shall be glass fiber pipe insulation with white Type ASJ vapor barrier jacket, Owens Corning FIBERGLAS[™] pipe insulation or approved equal. End and transverse joints shall be wrapped with factory-furnished sealing strips of same material as jackets. All horizontal laps and end joints shall be sealed down with Foster® 85-20[™] Spark-Fas® Adhesive, non-flammable, vapor barrier adhesive.
 - C. Vapor barrier jacket shall have a vapor transmission of approximately 0.02 perms.
 - D. Exterior cold piping insulation shall be the same as specified for cold piping systems. Thickness shall comply with the table in Paragraph 2.4, but shall be no less than 2 inches. Insulation shall be covered with a Type ASJ vapor barrier jacket and a Childers 0.016" smooth aluminum exterior weatherproof jacket neatly banded and sealed in place.
- 2.4 INSULATION THICKNESS AND THERMAL CONDUCTIVITY
 - A. Insulation thickness shall comply with the following table for the pipe service and fluid temperatures indicated:

Minimum Pipe Insulation Thickness, Inches								
Pipe Fluid Designation Range, °F	Elid	Insulation Conductivity		Nominal Pipe or Tube Size, Inches				
	Temperature Range, °F	Conductivity, k, BTU • IN / HR FT ² • °F	Mean Rating Temperature, °F	<1	1 to < 1½	1½ to < 4	4 to < 8	≥ 8
Condensate Drain Lines	40 – 60	0.21 – 0.27	75	1.0	1.0	1.0	1.0	1.0

For piping smaller than 1½ inch and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted, but not to a thickness less than 1 inch.

2.5 COLD PIPING SYSTEM FITTINGS

A. <u>Fittings, Flanges and Valves on Cold Piping Systems</u> shall be insulated with Insul-Coustic Insul-Sure or approved equal pre-molded fiberglass fittings. Pre-molded fittings shall be held in place with glass reinforcing cloth and insulating cement. Cloth shall be covered with a fire-resistant white vapor barrier coating applied in two equal coats in the amount of four gallons per each 100 square feet by brush or spray to the entire surface. Vapor barrier coating shall be Foster® 30-35™ Tite-Fit™ Coating, or approved equal. Coating shall be covered with 8 oz. flameproof canvas jacket sealed in place. It is the intent of these specifications that piping and equipment in contact with the chilled water be insulated for such use. This includes pump casings, valves and any other item where condensation is expected.

2.6 COMMON INSULATION REQUIREMENTS FOR PIPING SYSTEMS

- A. Seams, overlaps and end joints shall be thoroughly sealed down with Foster® 85-20[™] Spark-Fas® Adhesive or Foster® 85-75 Drion® Contact Cement vapor barrier adhesive as required. Ends of pipe insulation shall be sealed off at valves, fittings, flanges and every 20'-0" on straight runs with Foster® 30-35[™] Tite-Fit[™] Coating. The entire installation shall be sealed and free of condensation.
- B. <u>Insulation</u> shall be applied with Bostitch outward clinched staples, one every 3" and four at each butt strap.
- C. In lieu of pre-molded insulation fittings, the Contractor will be permitted to insulate pipe fittings with mitered and segmented fiberglass pipe insulation with elbows and changes of direction mitered, segmented and rounded to a thickness equal to the adjacent insulation, and thoroughly sealed and wrapped. Square cornered mitered joints will <u>not</u> be permitted. Field applied mitered and rounded insulation shall be held in place with reinforced glass cloth and vapor barrier insulating cement applied as specified above for pre-molded fittings. Coating shall be covered with 8 oz. flameproof canvas jacket sealed in place.
- D. <u>Insulation</u> shall be applied over clean dry surfaces with the pipe at approximately room temperature. The installations shall be sealed and shall be free of condensation.
- E. Fittings including tees, 90 degree fittings, 45 degree fittings, etc., shall be covered in strict accordance with the recommendations of the manufacturer of the pre-molded insulators. Joints and overlaps at fittings shall be buttered with fire resistant vapor barrier sealer.

- F. In lieu of the pre-molded fittings previously specified herein, pre-molded one-piece PVC insulated fitting covers, with factory-precut and marked fiberglass All-Temp insulation, Zeston® 2000 PVC, as manufactured by Johns Manville, will be acceptable. Insulation shall fully cover the fitting and the covers shall be stapled and taped in place. Tapes shall be off-white and shall be of the pressure sensitive type furnished by the fitting manufacturer. Bands are <u>not</u> permitted. Ends shall be overlapped. Fittings on cold piping systems shall have all edges sealed with Zeston® Fire-resistant vapor barrier adhesive. The circumferential edges shall be wrapped with Zeston® fire-resistant vapor barrier sensitive Z-tape. The tape shall extend over the adjacent pipe insulation and have an overlap on itself at least 2" on the downward side. <u>Cold pipe system fittings shall have at least two layers of factory-precut All-Temp insulation inserts</u>. Installations shall be sealed and free of condensation. Fittings shall be installed in strict accordance with the fitting manufacturer's recommendations and details. Twine shall be used for securing insulation at chilled water and cold water installations.
- G. Where certain thicknesses of pre-molded fitting insulators are not available from the manufacturer, the fitting insulation shall be one size smaller than the pipe insulation and shall be built up to the correct thickness with vapor barrier cement. Where necessary, fitting shall be mitered and segmented to a thickness equal to the adjacent insulation and shall be sealed and wrapped. Pre-molded fittings shall be installed to the satisfaction of the Professional, and shall be removed and replaced at the direction of the Professional where the installation is not completed in a neat and workmanlike manner. Pre-molded fittings shall have surfaces level, smooth and uniform without bulges, changes in thickness or uniformity.
- H. Pipe covering shall not be installed on flanged or screwed fittings until connections have been tested and are free of leaks.
- I. Insulation on piping shall extend full size through oversized floor, ceiling or wall sleeves. <u>Piping shall be</u> <u>fully insulated except where specifically mentioned otherwise</u>.
- J. Glass cloth, fireproof canvas, vapor barrier sealer and adhesive shall be of types which can suitably be painted.
- K. In lieu of sealing all-service jackets with a field applied vapor barrier adhesive, the Contractor may use factory applied pressure sensitive laps provided the pressure sensitive laps are guaranteed to remain sealed for the life of the insulation. Guarantee letters must be submitted in triplicate from the insulation manufacturer and the Heating Contractor. In lieu of the lifetime guarantee, the Contractor may use factory applied sensitive laps and additionally staple overlaps as hereinbefore specified.

2.7 PIPE HANGERS AND STRUCTURAL MEMBERS

A. <u>Pipe Hangers</u> supporting cold piping systems shall be insulated separately in the same manner as fittings. The insulation shall be applied upward along the vertical hanger rod to a point not less than 6" above the pipe and sealed off in a neat and symmetrical manner. ½" thickness Armaflex FR flexible tubing insulation may be used in lieu of fiberglass at pipe hangers. Riser clamps and other supports directly in contact with chilled water piping shall be thoroughly insulated similar to that specified above.

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- B. Structural members and metal supports or equipment in direct contact with cold piping systems shall be insulated separately with 1-1/2" thick fiberglass blankets with vapor barrier jacket, securely fastened and covered with 8 oz. flameproof canvas. The insulation shall be applied along the members to a point not less than 6" above the pipe and sealed off in a neat and symmetrical manner. Venturi flow stations shall be insulated similar to the above, except at meter connections. Exposed disconnect valves and shutoff valves shall be wrapped with anti-sweat tape and covered with 8 oz. flameproof canvas.
- C. Insulation shall be <u>continuous</u> at hangers and supports on piping. <u>Extend insulation over pipe and hangers</u> and thoroughly seal joint with a permanent pliable vapor barrier sealer such as Foster Elastolar® Sealant 95-44, or approved equal.
- 2.8 REFRIGERANT PIPING INSULATION
 - A. Suction and liquid piping less than or equal to 1-1/2", valves and accessories shall be insulated with 1" thickness Type FR Armaflex, or approved equivalent, flexible tubing insulation. Suction and liquid piping greater than 1-1/2" shall have 1.5" thick insulation. Insulation exposed to weather shall be painted with two coats of Armaflex Finish, or approved equivalent, protective coating.

2.9 INTERIOR DUCT INSULATION (DUCT WRAP)

- A. Supply air and outdoor air ductwork (low and medium velocity) shall be externally wrapped with 2" thick and 1-1/2 lb. density glass fiber insulation with a minimum R-6 value with vapor barrier.
- B. Ductwork, including return air, located in unheated spaces, like vented attics, shall be wrapped with 3" thick insulation with a minimum R-8 value with vapor barrier.
- C. Vapor barrier shall be taped and sealed as required to prevent condensation.
- D. Duct wrap shall be cut to manufacturer's "stretch out" dimensions and a 2" piece of duct wrap removed from the facing at the end of the piece of duct wrap to form an overlapping staple and tape flap.
- E. Seams shall be stapled 6" on center with outward clinching staples.
- F. Where rectangular ducts are 24" in width or greater, duct wrap shall be additionally secured to the bottom of the duct with mechanical fasteners such as pins and speed clip washers, spaced on 18" centers to prevent sagging of insulation.
- G. Return air and exhaust ductwork shall not be insulated, except where specified herein.
- H. Duct wrap shall be as manufactured by Knauf or approved equal.
- 2.10 INTERIOR ROUND SPIRAL DUCT INSULATION (DUCT LINER)
 - A. Round spiral duct, for supply and outdoor air service, shall be insulated with spiral duct liner to control noise and eliminate condensation for both concealed and exposed applications.



- B. Acceptable Manufacturers:
 - 1. Owens Corning QuietZone® Spiral Duct Liner
 - 2. CertainTeed
 - 3. Johns Manville
- C. Spiral duct liner shall be rigid, resin bonded fibrous glass board with a damage-resistant, flame retardant, veil faced airstream surface, and a reinforced aluminum foil (FRK) backing.
- D. Insulation thickness shall be 1.5 inches with a minimum thermal resistance of R-6.5.
- E. Insulation shall be for service at internal air velocities not to exceed 6000 FPM.
- F. Insulation shall be fabricated with a glass mat on the airstream side to resist damage during installation and in service.
- G. Spiral duct liner product shall be UL listed and labeled.
- H. Provide accessories as recommended by the insulation system manufacturer including adhesives.
- I. Fully cover the interior of the duct with insulation. Neatly butt transverse joints without interruptions or gaps.
- J. Install the mat faced surface of the duct liner facing the airstream.
- K. Complying with requirements of ASTM C916, adhere duct liner to the sheet metal with 90% coverage of adhesive.
- L. Coat exposed leading edges and transverse joints during fabrication.
- M. Do not coat the grooved longitudinal edges.
- N. Do not install two layers of duct liner to meet a specified liner thickness.

2.11 EXTERIOR DUCTWORK

- A. Exterior ductwork shall include supply air, return air, exhaust air, relief air and outside air ductwork which is installed outdoors.
- B. Insulate the duct with 2-inch thick minimum, rigid roof insulation board, R-9.1 minimum, composed of a glass mineral wool material with a 6 PCF density and an FSK facing. Insulation shall be Earthwool Insulation Board with ECOSE Technology as manufactured by Knauf or approved equal.
- C. The material flame spread rating shall be 25 or less and the smoke developed rating shall be 50 or less when tested in accordance with the test method for surface burning in ASTM E 84.



- D. Insulation shall be attached to the ductwork with welded insulation pins on the top, sides and bottom of the duct. Pin spacing shall be no less than 12-inches on center for duct dimensions 24-inches and greater and no less than 10.5-inches for duct dimensions less than 24-inches.
- E. The insulation and exterior ductwork surface shall be protected with a 60-mil nominal thickness thermoplastic polyolefin (TPO) membrane as follows:
 - 1. The material shall be resistant to UV, ozone, acid rain, and physical elements produced from outdoor weather per ASTM E 96 Procedure A.
 - 2. The material flame spread rating shall be 25 or less and the smoke developed rating shall be 50 or less when tested in accordance with the test method for surface burning in ASTM E 84.
 - 3. The material shall show no evidence of continued erosion, delaminating, cracking, flaking, or peeling when tested in accordance with the test method for erosion resistance in UL181.
 - 4. The material shall be resistant to mold growth resistance, ASTM G 21/C 1338 resistant to fungi, and resistant to bacteria growth per ASTM G 22.
 - 5. TPO membrane shall be fully adhered to the insulation as recommended by the TPO Membrane manufacturer.
 - 6. The top surface of horizontal exterior ductwork shall be sloped at a minimum 2-degree angle to prevent the accumulation of water on top of the finished insulated duct.
 - 7. Color shall be as selected by the Professional.
 - 8. To prevent "ballooning" of the TPO membrane from duct leakage, the Contractor shall install oneway pressure release valves on the bottom of the ductwork as manufactured by Polyguard (<u>www.polyguardproducts.com</u>). One (1) pressure release valve shall be installed per section between duct seams and as per the manufacturer's instructions.

2.12 SPRAY-ON THERMAL INSULATING COATING (FOR STEAM LINE APPLICATIONS)

- A. Basis of Design:
 - 1. Mascoat Industrial-DTI
- B. Spray-on thermal insulating coating shall be a composite ceramic and silica based insulating coating that provides an insulating barrier, protects personnel and blocks corrosion in one application. The coating is specifically designed to be a multiple purpose coating solving painting and insulating issues.
- C. Expected bare steam line temperature: 350°F
- D. Coat thickness: 20 mils, applied in successive coats
- E. Thermal conductivity: 0.4381 BTU-in/ft²-hr-°F

HVAC INSULATION



- F. Color: As selected by the Owner.
- G. Fire Rating: Class A
- H. Flame Spread: Class A
- I. Smoke Developed: Class A"
- J. Installation shall be per the manufacturer's recommendations.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

- A. Insulation shall be installed by an Insulation Subcontractor responsible to the Heating Contractor. Insulation shall be installed in a neat and workmanlike manner by workmen skilled in the installation and handling of commercial and industrial insulation for piping, ductwork, and equipment.
- B. Insulation shall be installed as recommended by the insulation manufacturer.

3.2 PIPING SYSTEMS

- A. Insulation shall be applied on clean, dry surfaces after pressure testing and approval. Insulation shall be continuous, including through wall and ceiling openings and sleeves. Insulation on piping systems operating at 60 degrees or less shall be maintained with a continuous unbroken vapor seal. Hangers, supports, anchors, guides and equipment shall be insulated and vapor sealed to prevent condensation.
- B. Covered pipe shall be located a sufficient distance from walls, other pipes, ductwork, and other obstacles to permit the application of the full thickness of insulation specified; and if necessary, extra fittings and pipes shall be used.
- C. <u>Fiberglass insulation</u> shall be installed with Bostitch outward clinched staples, one (1) every 3" and four (4) at each butt strap.
- D. Insulation shall not be applied to any piping or equipment until pressure tests have been performed and approved by the Architect. Surfaces shall be clean and dry when insulation is installed.
- E. Piping located in walls, in pipe chases, in crawl spaces, or above ceilings shall be considered as concealed. Other locations shall be considered as exposed unless otherwise specified herein.
- F. Insulated piping (including piping with vapor barrier jacket) shall be wrapped with factory applied ASJ all-service jackets securely sealed in place with Benjamin Foster fire-resistant sealer. All-service jackets shall be heavy density, white, suitable for operating temperatures from –60 degrees F. to +450 degrees F., with vinyl coated and embossed vapor barrier laminate. All-service jackets shall be the Owens-Corning Fiberglass ASJ-25, or approved equal. All-service jackets shall have a vapor transmission rating of approximately .02 perms.



- G. Piping furnished and installed under this Contract shall be insulated unless specifically indicated otherwise.
- H. <u>Water Chiller Unit</u> shall be completely factory insulated as hereinafter specified, however, should any surfaces or piping be exposed and which are subject to sweating, they shall be insulated for chilled water service similar to that herein specified for chilled water equipment and piping, or as included with the package unit.
- I. Exposed hot and chilled water piping in the boiler and chiller rooms shall be provided with PVC covers for a neat and professional appearance.
- J. Pipe insulation inside the custom-built roof top units (RTU's) shall be field installed by this contractor.

END OF SECTION 23 07 00

SECTION 23 21 13: - HVAC PIPING

PART 1 - GENERAL

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

1.2 SCOPE

A. The pipe and fittings for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

- 2.1 REFRIGERATION PIPING
 - A. Furnish and install a complete refrigeration piping system from the air-cooled condensing unit to the DX coil in all split system air conditioning units.
 - B. All refrigeration piping and accessories shall be installed in accordance with the refrigeration equipment manufacturer's recommendations and in accordance with the best standard practice.
 - C. System shall be complete with necessary shutoff valves, purge valves, charging valves, liquid line solenoid valve, sight glasses, dryers, vents, traps, fittings and other accessories required for a complete installation.
 - D. System shall be fully charged with refrigerant in accordance with the manufacturer's recommendations and requirements.
 - E. Refrigerant piping shall be sized as recommended by the equipment manufacturer, and based on total friction loss equivalent to not more 2 degrees F for hot gas line, and 1 degree F for liquid line.
 - F. Refrigeration piping shall be hard temper, or soft annealed, Type L, or ACR copper tubing assembled with long radius wrought copper solder end fittings or SAE fittings.
 - G. The contractor shall properly clean the piping, eliminating all moisture and contaminants, which could harm refrigeration or air conditioning equipment, before charging with refrigerant.
 - H. Refrigeration lines shall be properly supported.
 - I. Refrigeration valves shall be back-seating globe valves of the diaphragm packless type, as manufactured by Alco, Superior or approved equivalent. Shutoff valves shall be furnished and installed on all lines at the condensing unit and at the air-handling unit.
 - J. The Contractor shall include initial startup of the system, final checkout and instruction to the Owner's operating personnel.



- K. Maintenance service for the refrigerant piping system shall also be included in the Contractor's bid for the first year from date of final acceptance by the Owner.
- L. The approximate refrigerant piping arrangement, sizes, etc., are shown on the Drawings. The exact arrangement, sizes and other details shall be in strict accordance with the equipment manufacturer's diagrams, which shall be submitted for approval.
- M. Installation of refrigeration systems shall be by technicians certified to purchase and handle refrigerants. Technicians are required to pass an EPA-approved test given by an EPA-approved certifying organization to become certified.
- N. Apprentices are exempt from certification requirements provided the apprentice is closely and continually supervised by a certified technician.
- O. In lieu of solder connections, the Contractor may furnish and install the following refrigerant press fitting systems:
 - 1. Acceptable Manufacturers:
 - a. Rapid Lock Systems (Basis of Design)
 - b. NIBCO Press ACR
 - c. ZoomLock MAX by Parker Hannifin
 - 2. Product Parameters:
 - a. Continuous Operating Temperature: 250°F
 - b. O-Ring Temperature Rating: -40°F to 300°F
 - c. Maximum Pressure Rating: 700 PSI
 - d. Minimum Burst Pressure: 2,100 PSI
 - e. Vacuum Pressure Capability: <200 Microns
 - f. Vibration Resistance: Conforms to UL109
 - g. Fitting Materials:
 - 1) Fitting Body: Refrigerant Grade Copper per ASTM-B75 or ASTM-B743
 - 2) O-Ring: HNBR (Hydrogenated Nitrile Rubber)
 - h. Press tools, jaws and accessories shall be compatible with the manufacturer's materials.


- i. All materials, fittings, and accessories shall be by a single manufacturer.
- j. Cuts of tubing, across the tube manufacturer's stamp or other tube imperfections, to create an end for a fitting may result in a leak and are not acceptable.

2.2 CONDENSATE DRAIN SYSTEM

- A. All condensate drain piping from HVAC equipment <u>not</u> in return, relief or conditioned air plenum spaces shall be polyvinyl chloride (PVC) Schedule 40 plastic pipe (DWV) ASTM 2665. All condensate drain piping <u>in</u> return, relief, or conditioned air plenum spaces shall be Type "L", hard temper, copper tubing, assembled with cast bronze or wrought copper solder end drainage fittings. PVC fire rated insulated piping systems shall be acceptable, as herein specified.
- B. <u>Direct connection to the sanitary drainage system is prohibited</u>. Provide air gaps in accordance with local prevailing code requirements.
- C. Unless noted otherwise, drain lines shall be sloped at 1%. Minimum drain line size shall be 1-1/4", except as otherwise specifically noted.
- D. Provide a trap in gravity drain line at each piece of equipment. Coordinate depth of trap with equipment manufacturer. <u>Refer to connection details shown on drawings.</u> <u>Traps will not be required on pumped condensate drain lines.</u>
- E. <u>No PVC or plastic piping shall be used in return, relief or conditioned air plenum spaces.</u> Use metallic piping and tubing systems as specified. <u>In lieu of metallic piping, tubing, and fittings, the Contractor may use standard PVC piping and fittings with the addition of flame attenuated fiberglass pipe insulation and fittings or non-combustible ceramic fiber pipe wrap and fittings in these areas, conforming to local fire codes and building codes.</u> Flame-attentuated fiberglass pipe insulation shall be as manufactured by Owens-Corning Company, or approved equivalent; fire retardant fittings by Zeston, Proto, Speedline, or approved equivalent. Ceramic fiber pipe wrap and fittings shall be 3M FireMaster ceramic fiber Plenum Wrap, or approved equivalent. <u>All insulation installations shall be completed by an Insulation Subcontractor responsible to the HVAC Contractor.</u>
- F. Joints in PVC pipe shall be accomplished with socket type fittings and solvent-cement welding for the DWV System.
- G. All joints shall be made permanently gas and water tight.
- H. The use of any of the above joints and connections shall be subject to their acceptability with the prevailing local plumbing codes.
- I. <u>Where condensate drain lines are extended to rain conductors</u>, use <u>bronze ball</u> check valves in the condensate drain lines, the Apollo 61-12X, <u>with light spring</u>, or approved equivalent.

PART 3 – EXECUTION



3.1 PIPING SYSTEM INSTALLATIONS

- A. All piping installations shall be in accordance with American Code for Pressure Piping No. ANSI B31.1. All piping not specifically mentioned herein shall be installed per the manufacturer's recommendations and applicable recognized codes.
- B. All piping and system accessories shall be stored with ends closed tight.
- C. Before installation, each length of pipe, each fitting and each accessory (such as a valve) shall be "bore-sighted", inspected and cleaned if debris or dirt is found.
- D. After installation of piping, but before valves and accessories are installed, a heavy wad of swabbing cloth shall be pulled through the piping and fittings. All loose scale or debris shall be blown or worked free and removed.
- E. After closure, each system shall be flushed clean as herein specified under "Cleaning." Connections shall be installed for this purpose, and all necessary temporary piping shall be furnished, installed and removed after system is approved. The Contractor shall double-check to see that items such as rocks, stones, mud, wood and other debris are not left in the system.
- F. Equipment such as tanks shall be cleaned in the same manner but the procedure shall be varied to suit the specific item being cleaned. Coils shall be absolutely clean inside and outside before closure and after use for temporary heat, etc.
- G. All pipes shall be cut accurately to measurements established at the Building and shall be worked into place without springing or forcing, properly clearing all Building openings. Excessive cutting or other weakening of the Building structure to facilitate piping installation will <u>not</u> be permitted. Threaded pipe shall have full, clean-cut threads. All pipes shall have burrs removed by reaming. All pipes shall be so installed as to provide proper drainage and to permit free expansion and contraction without causing damage. All changes in directions shall be made with fittings.
- H. The ends of piping and associated equipment shall be capped or plugged as construction proceeds to prevent the entrance of dust, dirt, and other foreign matter.
- I. Valves shall be so placed that automatic valves, check valves and equipment may be entirely isolated for repairs while the system is in operation.
- J. All piping run within the Building shall be run concealed in the finished portions of the Building, in pipe spaces, furred ceilings or furred chases and exposed only in unfinished areas, Mechanical Rooms, or specifically where shown on the Drawings. The Heating Contractor shall locate all necessary chases or openings in new construction that are to be provided by the General Contractor. No piping shall be run exposed in finished areas of the Building without the consent and approval of the Professional for each specific installation.



- K. All piping shall be hydrostatically, or air tested to 150 PSIG, or 1.5 times the design pressure, whichever is higher, for a period of two hours. During this period all welds, joints, etc., shall be coated with soap emulsion to test for leaks, which shall be made tight and free from imperfections. Piping joints shall not be insulated until they have been pressure tested and are free of leaks.
- L. All piping shall be cleaned, filled and vented of all air as herein specified.
- M. Due to the small scale of the Drawings, it is not possible to indicate all offsets, fittings, valves or similar items which may be required to make a complete operating system. The Drawings are generally diagrammatic and indicative of the work to be installed. The Heating Contractor shall carefully investigate all conditions affecting his work and shall install his work in such a manner that interferences between pipes, conduit, ducts, equipment, architectural and structural features will be avoided, and shall furnish and install all such offsets or fittings as may be required to meet the conditions at the Building, so as to avoid such interferences without additional cost to the Owner.
- N. Each installation shall be made in a workmanlike manner, according to the best practice of the trade, properly installed and vented to eliminate air pockets or traps and to insure rapid and noiseless circulation throughout.
- O. All pipe work shall run parallel with, or at right angles to Building walls and partitions, and all exposed connections, risers or other piping in such areas shall be erected plumb and straight so as to form parallel lines with walls and floors. These requirements refer to long and short runs alike. Piping shall not be run exposed in finished areas unless specifically shown and prior approval is obtained from the Professional.
- P. Each section of pipe shall be reamed and cleaned before installation. All steel piping 2-1/2" and larger shall be assembled with welded connections. Seamless forged welding fittings of same material as pipe shall be used for all connections, except Weld-O-Lets or Thread-O-Lets may be used where branch line is at least two sizes smaller than main line.
- Q. Welds shall be painted with a primer coat of Rustoleum immediately after metal brush cleaning and the pipe cools.

END OF SECTION 23 21 13

SECTION 23 31 14: - EXTERIOR DUCTWORK - MANUFACTURED PRE-INSULATED

PART 1 – GENERAL

- 1.1 SUMMARY
 - A. Section includes:
 - 1. Exterior ductwork, designed, manufactured, and pre-insulated for thermal efficiency, low leakage, and weather resistance.
 - 2. Pressure Class: 6" w.g. positive and 6" w.g. negative.
 - B. This section does not include:
 - 1. Air passages rated over a continuous internal static pressure of 6" w.g. positive, 6" w.g. negative, or with test pressure rating over: 10" w.g. startup and 10" w.g. negative (as documented on product labeling).

1.2 SUBMITTALS

- A. Product data: For each type of product indicated.
- B. Shop drawings: Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work including.
 - 1. Duct layout indicating sizes and pressure classes.
 - 2. Elevation of top of ducts.
 - 3. Dimensions of main duct runs from building grid lines.
 - 4. Fittings.
 - 5. Penetrations through fire-rated and other partitions.
- C. Coordination Drawings: Plans, drawn to scale, showing coordination general construction, building components, and other building services.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Exterior ductwork can be installed by competent trained field mechanics who demonstrate competence in the HVAC industry.
- 1.4 SPECIFICATION COMPLIANCE



- A. Duct Leakage Class, follow SMACNA Leakage Class 3 or less.
- B. Exterior ductwork shall incorporate a Kingspan KoolDuct fortified inner liner compliant to UL (C-UL) 181 Standard for Safety Listed, Class 1 system, with included testing and passing the following:
 - 1. Test for Surface Burning Characteristics
 - 2. Flame Penetration Test
 - 3. Burning Test
 - 4. Mold Growth and Humidity Test
 - 5. Low Temperature Test and High Temperature Test
 - 6. Puncture Test
 - 7. Static Load Test
 - 8. Impact Test
 - 9. Pressure Test and Collapse (negative pressure) Test
 - 10. High Temperature and Humidity for 90 days
 - 11. Cone Calorimeter
 - 12. ASTM E2257 Standard Test Method for Room Fire Test of Wall and Ceiling Materials and Assemblies
 - 13. ASTM E 84 tested, Tunnel Test, Does not exceed 25 flame spread, 50 smoke developed.
 - 14. DW144, Class B
 - 15. NRTL product approval, (Subpart S of 29 CFR Part 1910, OSHA)
 - 16. ASTM C 423 noise reduction
 - 17. ASTM E 96/E 96M Procedure A for permeability
 - 18. ASTM C 1071 for erosion
 - 19. ASTM C 518: 2004, Standard Test Method for Steady–State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - 20. UL 723, Test for Surface Burning Characteristics of Building Materials

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- 21. NFPA Compliance:
 - a. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems"
 - b. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems"
 - c. NFPA 255, "Standard Method of Test of Surface Burning Characteristics of Building Materials
- C. Exterior ductwork outer shell shall be a UV stable 1000 micron high impact resistant titanium infused vinyl with included testing as following;
 - 1. UL-94 Flammability V-0
 - 2. ASTM D-638 Tensile Strength of 6250 psi
 - 3. ASTM D-790 Flexible Strength of 11,000 psi
 - 4. ASTM D-4226 Drop Impact Resistance
 - 5. ASTM D-4216 Cell Classification
- 1.5 PRODUCT DELIVERY AND STORAGE
 - A. Prevent objectionable aesthetic damage to the outer surface of duct segments during transport and storage.
 - B. Store duct segments under cover and protect from excessive moisture prior to installation.

PART 2 – PRODUCTS

- 2.1 EXTERIOR RECTANGULAR DUCT AND FITTINGS
 - A. Acceptable Manufacturers:
 - 1. Thermaduct with Kingspan Kooltherm thermoset resin insulated core (Basis of Design)
 - 2. Dual-Tech by PTM Manufacturing, LLC
 - 3. Pro-R by Duct & Cleats
 - 4. Tuff Duct
 - 5. No Exceptions
 - B. The panel shall be manufactured of CFC-free closed cell rigid thermoset resin thermally bonded on both sides to a factory applied .001" (25 micron) aluminum foil facing reinforced with a fiberglass scrim. An added UV stable, 1000 micron high impact resistant titanium infused vinyl is factory bonded to the outer surfaces to provide a zero permeability water tight barrier.



- C. The thermal conductivity shall be no greater than 0.13BTU in/Hr •ft2•°F, the thermal conductivity shall be no greater than 0.13BTU in/Hr •ft2•°F
- D. The density of the Kooltherm foam shall not be less than 3.5 PCF with a minimum compressive strength of 28 psi (.2 MPa).
- E. The panel thickness, R-value, and other characteristics shall be as follows:
 - 1. Maximum Temperature: Continuous rating of 185 °F inside ducts or ambient temperature surrounding ducts.
 - 2. Maximum Thermal Conductivity: 0.13 Btu x in./h x sq. ft. x deg F at 75 °F mean temperature.
 - 3. Permeability: 0.00 perms maximum when tested according to ASTM E 96/E 96M, Procedure A.
 - 4. Antimicrobial Agent: Additive for antimicrobial shall not be used but instead, raw product must pass UL bacteria growth testing.
 - 5. Noise-Reduction Coefficient: 0.05 minimum when tested according to ASTM C 423, Mounting A.
 - 6. Required Markings: All interior duct liner shall bear UL label and other markings required by UL 181 on each full sheet of duct panel; UL ratings for internal closure materials.
 - 7. All insulation materials shall be closed cell with a closed cell content of >90%.
 - 8. R-value: 1 ³/₄" Thick Panel: 12 R
- F. Closure Materials:
 - 1. V-Groove Adhesive: Silicone (interior only).
 - 2. UV stable 39 mil high impact resistant titanium infused vinyl (exterior).
 - a. Factory manufactured seamless corners for zero perms.
 - b. Cohesive bonded over-lap at corner seam covers for zero perms.
 - c. Water resistant titanium infused welded vinyl seams.
 - d. Mold and mildew resistant.
 - 3. Polymeric Sealing System:
 - a. Structural Membrane: Aluminum scrim with woven glass fiber with UV stable vinyl clad applied
 - b. Minimum Seam Cover Width: 2 7/8" inches

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- c. Sealant: Low VOC.
- d. Color: As selected by the Professional
- e. Water resistant.
- f. Mold and mildew resistant.
- 4. Duct Connectors.
 - a. Factory manufactured cohesive bonded strips (low pressure only).
 - b. Factory manufactured all aluminum grip flange.
 - 1) Grip flange
 - 2) F-flange
 - 3) H-flange
 - 4) U-flange
 - c. Factory manufactured galvanized 4-bolt flange.
- G. Outdoor Cladding
 - 1. Duct segments shall incorporate UV stable 39 mil high impact resistant titanium infused vinyl which is introduced during the manufacturing process.
- H. Flange coverings
 - 1. Flanges are field sealed airtight before flange covers are installed. Flange covering consists of the following:
 - a. Foam tape insulation with molded 39 mil covers.
 - b. Air gap (heating only application) with molded 39 mil covers.
- I. Weight
 - Exterior ductwork shall provide low weight stresses on the building framing and support members. Assembled exterior ductwork shall have a weight of 0.86 lbs. per square foot to maximum weight of 2.7 lbs. per square foot (depending on R-value). Hangers and tie-downs are to be detailed on the manufacturer's installing contractors detail drawings prior to installation but not exceeding 13' for duct girth <84" and 8' for duct girth >85" between hangers and designed to carry the weight and wind load of the ductwork.
- J. Interior Surface

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- 1. Galvanized steel interior liner.
- K. Access Panels
 - 1. Duct access panels or doors shall be spaced a maximum of 20 Feet and shall be provided at either side of turning vanes or dampers for duct cleaning.

PART 3 - EXECUTION

- 3.1 SHOP FABRICATION
 - A. Certification:
 - 1. Ducts shall be detailed and fully factory manufactured by an authorized manufacturer's facility system. All fabrication labor will be certified "yellow label" building trade professionals, compliant to SMWIA and SMACNA labor guidelines (work preservation observed).
 - B. Fabrication:
 - 1. Fabricated joints, seams, transitions, reinforcement, elbows, branch connections, access doors and panels, and damage repairs according to manufacturer's written and detailed instructions.
 - 2. Fabricated 90-degree mitered elbows to include turning vanes.
 - 3. Fabricated duct segments in accordance with manufacturer's written details.
 - 4. Duct Fittings shall include 6 inches of connecting material, as measured, from last bend line to the end of the duct. Connections on machine manufactured duct may be 4 inches.
 - 5. Fabricated duct segments utilizing v-groove method of fabrication. Factory welded or cohesively bonded seams will apply to fully manufactured ductwork and fittings. Internal seams will be supplied with an unbroken layer of low VOC silicone or bonding (for paint shop applications). Each duct segment will be factory supplied with either aluminum grip pro-file or pre-insulated duct connectors in accordance with manufacturer's detailed submittal guide. Applied duct reinforcement to protect against side deformation from both positive and negative pressure per manufacturer's design guide based on specified ductwork size and system pressure.
 - 6. Designed and fabricated duct segments and fittings will be in accordance with "SMACNA Duct Construction Standards" latest edition.
 - 7. Both positive and negative ductwork and fittings shall be constructed to incorporate a UL Listed as a Class 1 air duct to Standard for Safety UL 181 liner with an exterior clad for permanent protection against water intrusion.
 - 8. Duct shall be constructed to exceed requirements for snow and wind loads.

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3.2 DUCT INSTALLATION

- A. Duct segments shall be installed be competent HVAC installers.
- B. Install ducts and fittings to comply with manufacturer's installation instructions as follows:
 - 1. Install ducts with fewest possible joints.
 - 2. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
 - 3. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
 - 4. Protect duct interiors from the moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."
 - 5. Use prescribed duct support spacing as described in this specification and manufacturer's recommendations.
 - 6. Air Leakage: Duct air leakage rates to be in compliance with "SMACNA HVAC Duct Construction Standards" latest version per applicable leakage class based on pressure.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Contractor to ensure that the ductwork system is properly and adequately supported.
 - 1. Ensure that the chosen method is compatible with the specific ductwork system requirements per manufacturer's installation detail drawings. Pre-installation should be provided prior to work commencement by installing contractor for approval.
 - 2. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Supports on straight runs of ductwork shall be positioned at centers not exceeding 13 feet (3.96 m) for duct sections when fabricated in 13 foot (3.96 m) lengths with duct girth less than 84". Larger duct sizes and short segments with duct girth greater than 84" are to be supported at 8 foot centers or less, in accordance with the manufacturer's installation details provided prior to work commencement.
- C. Ductwork shall be supported at changes of direction, at branch duct connections, tee fittings, parallel under turning vanes and all duct accessories such as dampers, etc.
- D. The load of such accessories to the ductwork shall be neutralized by the accessory support.

3.4 FIELD QUALITY CONTROL

A. Inspection: Arrange for manufacturer's representative to inspect completed installation and provide written report that installation complies with manufacturer's written instructions.

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- 1. Remove and replace duct system where inspection indicates that it does not comply with specified requirements.
- B. Perform additional testing and inspecting, at the Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
- 3.5 DUCT SCHEDULE
 - A. Outdoor Ducts and Fittings:
 - 1. Exterior Rectangular Ducts and Fittings:
 - a. Minimum Panel Thickness: 1 ³/₄ in.
 - b. Cladding: minimum 0.038 inch

END OF SECTION 23 31 14

SECTION 23 33 00: - DUCT ACCESSORIES

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.2 SUMMARY
 - A. This Section includes the following:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Motor operated dampers.
 - 4. Flexible ducts.
 - 5. Turning vanes.
 - 6. Access doors in ducts
 - 7. Accessory hardware
 - 8. Flexible connectors.
 - B. Related Sections include the following:
 - 1. Division 23 Section "Air Outlets & Inlets."
- 1.3 SUBMITTALS
 - A. Provide product data for the following:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Motor operated dampers.
 - 4. Flexible ducts.
 - 5. Turning vanes.

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- 6. Access doors in ducts
- 7. Accessory hardware
- 8. Flexible connectors.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
 - 1. Special fittings and manual-volume-damper installations.
 - 2. Fire-damper installations, including sleeves and duct-mounted access doors and panels.
- C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.
- 1.4 QUALITY ASSURANCE
 - A. NFPA Compliance: Comply with the following NFPA standards:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

1.5 EXTRA MATERIALS

- 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

- 2.1 BACKDRAFT DAMPERS
 - A. Acceptable Manufacturers:
 - 1. Arrow United Industries, Inc. (Type 655)
 - 2. Air Balance Inc. (Model BS 55)
 - 3. Greenheck Fan Corp. (Series VBD-360)
 - 4. National Controlled Air (Series BD2/A2)
 - 5. Ruskin Manufacturing Co. (Series CBD6)
 - 6. Nailor

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- 7. Pottorff
- B. Backdraft dampers shall be factory made of minimum .050" extruded aluminum blades supported on aluminum or zinc plated steel rods, in nylon bearings, set in minimum .063" extruded aluminum frame.
- C. Blades shall be fitted with vinyl inserts on contact edges to prevent noise. Blades shall be 40" maximum length and 6" maximum individual width.
- D. Damper assembly shall be provided with an adjustable counter-balance device.
- E. Channel frame shall be fitted to duct, vent or wall opening and edges sealed airtight. Inside dimensions of channel frame shall not be less than the daylight opening of the grille so that frame is not visible with grille in place.
- F. Exhaust fans equipped with backdraft dampers shall be furnished with dampers conforming to the requirements of this specification, and shall be furnished with dampers full size of connecting collar.
- G. Backdraft dampers shall be provided in exhaust duct discharges and at exhaust fans to keep tramp air from entering ductwork or rooms.
- H. Where shown on the drawings, provide motor operated dampers in lieu of backdraft dampers.
- 2.2 VOLUME CONTROL DAMPERS
 - A. Acceptable Manufacturers:
 - 1. Air Balance Inc. (Rectangular Model AC-2, Round Model AC-112)
 - 2. Arrow United Industries Inc. (Model 1770)
 - 3. Louvers and Dampers, Inc. (Rectangular Model VCD-400, Round Model CD-600)
 - 4. National Controlled Air (Rectangular Model SCD-57, Round Model SCD-RD-88)
 - 5. United McGill Corp. (Round Dampers, Model SRSVL)
 - 6. Nailor
 - 7. Pottorff
 - B. The Contractor shall provide volume control dampers as indicated on the drawings.
 - C. Rectangular control dampers shall be of the factory fabricated opposed blade, multi-louver type, controlled from a single point with an adjusting device.
 - D. Install end bearings with a rubber gasket on the outside of ducts or frames to prevent air leakage around

DUCT ACCESSORIES



- E. the damper shaft and for smooth operation.
- F. Dampers shall be mounted in heavy galvanized steel channel frames and shall have smooth acting linkage.
- G. Blades shall be not less than 18 gauge galvanized, die-formed steel. Adjusting devices shall have locking mechanisms and shall be accessible.
- H. Round volume control dampers shall be factory fabricated, single blade, center pivoted, constructed of galvanized sheet steel, controlled from a single point with an accessible adjusting device with locking mechanism.
- 2.3 MOTOR OPERATED DAMPERS
 - A. Motor Operated Dampers Refer to Section 230900.

2.4 FLEXIBLE DUCTS

- A. General Requirements:
 - 1. Flexible duct in this specification is defined as an air connector or a conduit transferring air between an air duct or plenum and an air terminal unit or an air inlet or outlet.
 - 2. Flexible ducts shall be used where specifically indicated on the Drawings or where required to pass ducts around conflicting construction and for connection to air terminals.
 - 3. <u>Use of air connectors (flexible ducts) shall be kept to a minimum</u>, but shall not exceed 14 feet, as required by NFPA 90A.
 - 4. Flexible ducts, as detailed on the drawings, shall be used on straight runs only and individual lengths shall be a minimum of 5 feet and a maximum of 8 feet.
 - 5. Ducts shall be suspended with band hangers and wire spaced as recommended by the duct manufacturer and to prevent sagging and kinking.
 - 6. Flexible ducts shall be attached to ductwork and terminals with cinch-type nylon bands and duct tape.
- B. Standard Flexible Duct Construction:
 - 1. Acceptable Manufacturers:
 - a. Flexmaster USA Type 5M (Basis of Design)
 - b. Thermaflex
 - c. Wiremold Co.



- 2. Construction: Trilaminate of aluminum foil, fiberglass and aluminized polyester, mechanically locked to the duct helix without the use of adhesives.
- 3. Use a mechanical lock to form a continuous secure air tight joint without the use of adhesive.
- 4. The internal working pressure rating shall be at least as follows with a bursting pressure of at least 2-1/2 times the working pressure.
 - a. Positive: 10 inches WG
 - b. Negative: 10" inches WG thru 12" dia., 5" WG 14" & 16" dia., 1" WG 18" & 20"
- 5. The duct shall be rated for a velocity of at least 5500 feet per minute.
- 6. Suitable for operating temperatures of at least 250 °F.
- 7. Factory insulate the flexible duct with flexible fiberglass insulation. The R value shall be at least 6.0 at a mean temperature of 75 °F.
- 8. Cover the insulation with a reinforced aluminum pigmented vapor barrier jacket having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E 96, Procedure A.
- 9. The ductwork shall be UL 181 or ETL listed, Class 1 Air Duct and comply with NFPA 90A and NFPA 90B.

2.5 TURNING VANES

- A. Acceptable Manufacturers:
 - 1. Aero-Dyne Sound Control Company, High Efficiency Profile, HEP (Basis of Design). Contact: www.aero-dyne.net PH: 800-522-2423
- B. Turning vanes shall be installed at each change in direction of square or rectangular, low and medium velocity supply air ductwork, particularly at mitered elbows where radius elbows are impractical, and shall be of sizes to suit ductwork.
- C. Turning vanes shall be installed in outdoor air intake, return or exhaust ducts only where specifically shown or noted on the drawings.
- D. Turning vanes shall be an engineered, true airfoil design with smoothly rounded entry nose and extended trailing edge for low-pressure drop, anti-dirt, and positive fastening.
- E. Generated sound power level shall not exceed 54 decibels in band 4 at 2,000 FPM-duct 24 x24.
- F. Fabricate assemblies with the Aero-Dyne Side Rail support system. Install vanes on design centers of 2.4 inches across the full diagonal dimension of the elbow. Tabbed or slotted dimple fasteners are not acceptable.



G. Submittals are required; proposed substitution shall include independent performance test data for pressure loss and generated sound power levels.

2.6 ACCESS DOORS IN DUCTS

- A. Furnish and install access doors and frames to permit inspection, operation and maintenance of devices concealed behind the sheetmetal work.
- B. Provide duct access doors of insulated double panel construction, not less than 20 gauge, galvanized steel.
- C. Where ducts are uninsulated or are not lined, insulation in access doors may be omitted.
- D. Provide access doors with sponge rubber gaskets around their entire perimeter.
- E. Hang access doors in ductwork in separate frames on heavy flat hinges. Provide "Ventlok No. 100" cast zinc latches.
- F. Where space conditions preclude the use of hinges, provide a minimum of 4 heavy window type latches.
- G. Provide duct access doors not smaller than 18" x 18". Provide ducts smaller than 18" in width with access doors two inches less in width than the width of the duct. Minimum dimension of one side to be 18".

2.7 ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a wormgear action, in sizes 3 to 18 inches to suit duct size.
- D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.8 FLEXIBLE CONNECTORS

- A. Acceptable Manufacturers:
 - 1. Ventfab
 - 2. Durodyne
 - 3. Approved equal
- B. Connections between motor operated equipment and ductwork shall be made through fire resistant canvas throats.

DUCT ACCESSORIES



- C. Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel.
- D. Flexible Connector Fabric: Glass fabric double coated with polychloroprene.
 - 1. Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
 - 2. Minimum Weight: 26 oz./sq. yd.
 - 3. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inch in the filling.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible".
 - B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
 - C. Volume control dampers shall be installed on each supply, return, and general exhaust duct branch serving a diffuser, grille, or register regardless of whether they are indicated on the drawings or not.
 - D. Volume control dampers shall be placed in the ductwork sufficiently distant from diffusers, grilles, and registers to prevent the transmission of noise from the dampers through diffusers, grilles or registers.
 - E. Provide test holes at fan inlet and outlet and elsewhere as indicated.
 - F. Install fire dampers according to manufacturer's UL-approved written instructions.
 - 1. Install fusible links in fire dampers.
 - G. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
 - 1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
 - 2. Install access panels on side of duct where adequate clearance is available.
 - H. Label access doors according to Division 23 Section "Mechanical Identification."



3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 23 33 00



SECTION 23 73 30: - PACKAGED ROOFTOP UNITS (15 TO 25 TONS)

PART 1 – GENERAL

- 1.1 SECTION INCLUDES
 - A. Packaged roof top units (15 to 25 tons) and components as scheduled and shown on drawings.
 - B. Motor disconnects, motor starters, and variable frequency drives.
- 1.2 RELATED SECTIONS
 - A. The requirements of the General Conditions, Supplementary Conditions, Division 1, equipment schedules, and drawings apply.
- 1.3 GENERAL
 - A. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing a fully hermetic, suction gas cooled, direct drive compressor(s) for cooling duty and gas combustion or nickel chromium elements for heating duty.
 - B. Factory assembled, single-piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start-up.
 - C. Unit shall use R-454B refrigerant.
 - D. Unit shall have a factory installed refrigeration detection systems (RDS) which includes two refrigerant leak detection sensors to protect the unit from any damage caused by the leakage of the mildly flammable R454B refrigerant. Choice units provide an RDS as factory and field installed options. The RDS sensor can detect a refrigerant leak according to UL60335-2-40 (edition 4.0) with an accuracy of +/- 5% LFL across the working range (0-25% LFL)
 - E. Unit shall be installed in accordance with the manufacturer's instructions.
 - F. Unit must be selected and installed in compliance with local, state, and federal codes.

1.4 QUALITY ASSURANCE

- A. Unit meets ASHRAE 90.1 minimum efficiency requirements.
- B. Unit shall be rated in accordance with AHRI Standards 210/240 or 340/360.
- C. Unit shall be designed to conform to ASHRAE 15, 2001.
- D. Unit shall be UL-tested and certified in accordance with ANSI Z21.47 -2012/CSA 2.3-2012, CSA C22.2 No. 236-11 (UL 1995) 4th edition and CSA C22.2 No. 3 M 1988.

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- E. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
- F. Unit casing shall be capable of withstanding 1000-hour salt spray exposure per ASTM B117 (scribed specimen).
- G. Unit shall be designed in accordance with ISO 9001, and shall be manufactured in a facility registered by ISO 9001.
- H. Roof curb shall be designed to conform to NRCA Standards.
- I. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory and must be available upon request.
- J. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.
- K. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box.
- L. Unit shake tested to Truck 2, ASTM D4169 to ensure shipping reliability.
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - A. Unit shall be stored and handled per manufacturer's recommendations.
 - B. Overhead crane can be used to place the units on a roof using rigging holes built into the unit base rails without any additions to the unit.
 - C. Unit shall only be stored or positioned in the upright position.
- 1.6 OPERATING CHARACTERISTICS
 - A. Unit shall be capable of starting and running at 125°F (52°C) ambient outdoor temperature, meeting maximumload criteria of AHRI Standard 210/240 or 340/360 at 110% voltage.
 - B. Compressor with standard controls shall be capable of operation down to 30°F (-1°C), ambient outdoor temperatures. Low ambient kit is necessary if mechanically cooling at ambient temperatures below 30°F (1°C).
 - C. Unit shall discharge supply air vertically or horizontally as shown on contract drawings.
 - D. Unit shall be factory configured for vertical supply & return configurations.
 - E. Unit shall be field convertible from vertical to horizontal airflow on all models.
 - F. Unit shall be capable of mixed operation: vertical supply with horizontal return or horizontal supply with vertical return.



1.7 ELECTRICAL REQUIREMENTS

- A. Main power supply voltage, phase, and frequency must match those scheduled on the drawings.
- PART 2 PRODUCTS
- 2.1 ACCEPTABLE MANUFACTURERS
 - A. JCI Basis of Design
 - B. Trane
 - C. Carrier
- 2.2 EQUIPMENT SCHEDULES
 - A. Rooftop unit schedule.
 - 1. Refer to the schedule on the drawings.
- 2.3 HVAC EQUIPMENT INSULATION
 - A. Evaporator fan compartment:
 - 1. Interior cabinet surfaces shall be insulated with a minimum 1 in. thick, foil faced fiber glass insulation with thermal conductivity of 0.24 or better, adhered with acrylate polymer-based adhesive.
 - 2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
 - B. Gas heat compartment:
 - 1. Interior cabinet surfaces shall be insulated with a minimum 1 in. thick, foil faced fiber glass insulation with thermal conductivity of 0.24 or better, adhered with acrylate polymer-based adhesive.
 - 2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
 - C. Economizer and Control compartment:
 - 1. Interior cabinet surfaces shall be insulated with a minimum 1 in. thick, foil faced fiber glass insulation with thermal conductivity of 0.24 or better, adhered with acrylate polymer-based adhesive.
 - 2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
 - D. Partition, Base Pan, and Duct Panel:



- 1. Interior cabinet surfaces shall be insulated with a minimum 1 in. thick, foil faced fiber glass insulation with thermal conductivity of 0.24 or better, adhered with acrylate polymer-based adhesive.
- 2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
- 2.4 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC
 - A. Simplicity SMART Equipment Control
 - 1. Shall be ASHRAE 62- 2001 compliant.
 - 2. Shall accept 20-30 VAC input power, 50/60Hz. 24 VAC, nominal.
 - 3. Shall have an operating temperature range from -40°F to 158°F; 10-90% RH (non-condensing UI), and -4°F to 158°F; 10-90% RH (non-condensing), with a storage temperature range from -40°F to 194°F; 5-95% RH (non-condensing).
 - Shall include an option of an Economizer microprocessor controller which communicates directly with the Unit Control Board and has 8 Analog outputs, 2 Analog inputs, 2 Binary outputs, 3 Binary outputs.
 - 5. Controller shall accept the following inputs: space temperature, return air temperature sensor, set point adjustment, outdoor air temperature, indoor air quality, outdoor air quality, indoor relative humidity, compressor lock- out, fire/smoke shutdown, single and dual enthalpy, fan status, remote time clock, Sensor Actuator (SA) Bus communicated temperature/humidity/CO2 values from Network sensors, Field Controller (FC) Bus Network Overrides for space temperature, outdoor air temperature, space humidity, outdoor air quality, Indoor air quality, System purge.
 - 6. Shall accept a CO₂ sensor or multiple CO₂ sensors networked together in the conditioned space and be Demand Control Ventilation (DCV) ready.
 - 7. Shall provide compressor short-cycle protection with minimum compressor runtime set at 3 minutes standard and adjustable from 2 to 7 minutes.
 - 8. Built in lead-lag compressor sequencing to support balanced utilization of refrigerant circuits
 - 9. Shall provide the following outputs: economizer, fan, cooling stage 1, cooling stage 2, heat stage 1, heat stage 2, heat stage 3/ exhaust/ reversing valve/ dehumidify/ occupied.
 - 10. Unit shall provide surge protection for the controller through a circuit breaker.
 - 11. Shall have open communication protocols with all required points exposed. Protocols supported include: BACnet®, MS/TP, Modbus®, and N2 communication.

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- 12. Shall have an LCD display on the Unit Control Board to display fault messages as well as navigate the menu structure to review and change set points.
- 13. Shall utilize a USB connection to allow for uploading and downloading of data.
 - a. USB shall allow for downloading of "trending data" for analysis of inputs and values on another device such as a PC.
 - b. USB shall allow for uploading of new firmware to the UCB.
 - c. USB shall allow for backing up controller set points and parameters and for uploading of these same parameters to the UCB.
- 14. Shall include an RJ-12 port to be used with a Wi-Fi signal transmitting device and allow unit(s) access via any non-proprietary smart device.
 - a. Unit access shall include ability to view and change all adjustable parameters and set points using the same characteristics and values available directly through the UCB joystick and LCD display.
 - b. Unit access shall be configurable at 3 different levels to allow control over parameter and set point changes.
 - c. Wi-Fi transmitting device can be connected by 3 means.
 - 1) RJ-12 port connected directly to UCB.
 - 2) Optional connection port mounted in operating space.
 - Optional connection to building network allowing unit access from any internet browser worldwide.
- 15. Shall have the capability to control York Comfort Controls System (YCCS) zoning system
- 16. Shall not require any proprietary software or contractor tool to start-up, commission and troubleshoot unit operation.
- 17. Software upgrades will be accomplished by local download via USB port on main Unit Control Board.
- Shall be UL Recognized, File E107041, UL 916, Energy management Equipment, UL 1995, Heating and Cooling Equipment; FCC Compliant to CFR47, Part 15, Subpart B, Class B, CSA 22.2 No. 236, Signal Equipment Industry Canada, ICES-003 Recognized, and BTL certified.
- 2.5 ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC
 - A. General:



- 1. Shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24- v transformer side. Transformer shall have 75VA capability.
- 2. Shall utilize color- coded wiring.
- 3. Shall include a central control terminal board to conveniently and safely provide connection points for vital control functions such as: smoke detectors, phase monitor, gas controller, economizer, thermostat, DDC control options, and low- and high-pressure switches.
- 4. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor. See heat exchanger section of this specification.
- B. Safeties:
 - 1. Compressor over- temperature, over- current. High internal pressure differential.
 - 2. Low pressure switch and high-pressure switch
 - a. Low pressure switch shall use different color wire than the high-pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.
 - 3. Automatic reset, motor thermal overload protector.
 - 4. Heating section shall be provided with the following minimum protections:
 - a. High temperature limit switches.
 - b. Induced draft pressure sensor.
 - c. Flame rollout switch.
 - d. Flame proving controls.

2.6 PANEL AIR FILTERS

- A. Standard filter section.
 - 1. Shall consist of factory installed, low velocity, disposable 2- in. thick fiberglass filters of commercially available sizes.
 - a. Filters shall be accessible through an access panel; hinged panel with "no-tool" removal option is available as described in the Features Options and Accessories section of this specification
 - b. Filters shall be 2" MERV 8 pleated

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2.7 UNIT CABINET

- A. Unit cabinet shall be constructed of galvanized steel with exterior surfaces coated with a non-chalking, powder paint finish, certified at 1000 hour salt spray test per ASTM-B117 standards.
- B. Unit cabinet exterior paint shall be: film thickness, (dry) 3.0 MILS minimum, gloss (per ASTM D523, 60°F /16°C): 80+/-5, Hardness: H- 2H Pencil hardness.
- C. Unit cabinet shall have gas and electric utility knockouts in the side of the unit and in the unit underside. Base of unit shall have a minimum of four locations for through-the-base gas and electrical connections standard.
- D. Base Rail
 - 1. Unit shall have base rails on a minimum of 4 sides.
 - 2. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
 - 3. Holes shall be provided in the base rail for moving the rooftop by fork truck.
 - 4. Base rail shall be a minimum of 15-gauge thickness.
- E. Condensate pan and connections:
 - 1. Shall be an internally sloped condensate drain pan made of a non- corrosive material.
 - 2. Shall comply with ASHRAE Standard 62.
 - 3. Shall use a 1" NPT drain connection, possible either through the bottom or side of the drain pan. Connection shall be made per manufacturer's recommendations.
- F. Top panel:
 - 1. Shall be a multi piece top panel.
- G. Gas Connections:
 - 1. All gas piping connecting to unit gas valve shall enter the unit cabinet at a single location on side of unit.
 - 2. Through-the-base capability
 - a. Standard unit shall have a through-the-base gas-line location using a raised, embossed portion of the unit base-pan.



- b. Optional, factory approved, water- tight connection method must be used for through- thebase gas connections.
- c. No base-pan penetration, other than those authorized by the manufacturer, is permitted.
- H. Electrical Connections
 - 1. All unit power wiring shall enter unit cabinet at a single, factory prepared, and knockout location.
 - 2. Through-the-base capability.
 - a. Standard unit shall have a through-the-base electrical location(s) using a raised, embossed portion of the unit base-pan.
 - b. Factory approved, water- tight connection method must be used for through- the- base electrical connections.
 - c. No base-pan penetration, other than those authorized by the manufacturer, is permitted.
- Units meet the seismic capacity requirements of the International Code Council Evaluation Service (ICC-ES) document AC156 (Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems), the International Building Code (IBC 2009), and the California Building Code (CBC 2010) with quality testing conducted in accordance with the standards of the American Society of Civil Engineers (ASCE 7-05).
 - 1. Units are certified with an SDS (g) value of 2.0 using seismic design parameters of z/h=1.0, lp=1.5 and certified by independent structural engineers.

2.8 GAS HEAT-FULLY MODULATING WITH SUPPLY AIR TEMPERING

- A. General GAS HEAT MUST be able to fire and supply heat at all operating conditions. Gas heat for morning warm up only is NOT PERMITTED.
 - 1. Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.
 - 2. Shall incorporate a direct- spark ignition system and redundant main gas valve.
 - 3. Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.
 - 4. All units shall have two stages of heating capacity with equal capacity on each stage.
- B. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor.
 - 1. IGC board shall notify users of fault using an LED (light- emitting diode).



- 2. The LED shall be visible without removing the control box access panel.
- 3. Unit Control Board shall contain algorithms that modify evaporator fan operation to prevent future cycling on high temperature limit switch.
- 4. Unit shall be equipped with anti-cycle protection with one cycle on unit flame rollout switch or 3 short cycles on the high temperature limit switch. Fault indication shall be made using an LED.
- C. Stainless Steel Heat Exchanger construction
 - 1. Use energy saving, direct- spark ignition system.
 - 2. Use a redundant main gas valve.
 - 3. Burners shall be of the in- shot type constructed of aluminum- coated steel.
 - 4. All gas piping shall enter the unit cabinet at a single location on side of unit (horizontal plane).
 - 5. The optional stainless-steel heat exchanger shall be of the tubular-section type, constructed of a minimum of 20- gauge type 409 stainless steel.
 - 6. Type 409 stainless steel shall be used in heat exchanger tubes and vestibule plate.
- D. Induced draft combustion motor and blower
 - 1. Shall be a direct- drive, single inlet, forward- curved centrifugal type.
 - 2. Shall be made from steel with a corrosion- resistant finish.
 - 3. Shall have permanently lubricated sealed bearings.
 - 4. Shall have inherent thermal overload protection.
 - 5. Shall have an automatic reset feature.
- E. Modulating Gas Heat Unit heat shall be engineered to deliver variable heat to the supply air stream. The amount of heat available to the air stream shall be adjustable between the minimum turndown and the maximum capacity of the unit's heat. The modulating gas valve shall incorporate an outlet pressure slightly above atmospheric with the bypass closed and zero control voltage being applied. Minimum flow rate is adjusted by a manual adjustment screw on the side of the modulating valve. Controls shall be integrated into the main unit control board with a sub processor controlling modulating gas functions. An automatic safety shutoff valve is installed in series with the modulating gas valve for positive shut off in the no-heat mode of operation. In addition to all standard factory installed safeties the unit shall be equipped with the following additional safeties: Air proving flow switch, fan starter interlock, and an isolated modulating gas control power transformer.

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- F. Modulating Gas Heat Vent and Combustion Hoods Any required hoods, stacks, and hardware are shipped inside the unit. Each hood or stack must be properly attached to the furnace doors to assure proper operation and compliance with any CSA/ETL certifications. Information in the IOM that ships with the unit will provide details on the hood and stack connections particular to this unit.
- G. Modulating Gas Heat Gas Train Piping Unit gas heat sub-system shall be piped to provide a fuel gas connection at a point within 2 inches of the base unit fuel gas connection point. Size of the connection shall remain unchanged from the base unit. An external regulator and shutoff valve must be provided by the installing contractor. The gas connections must be made in accordance with all state and local codes. No gas train specialty not specifically identified in the standard factory literature for the base unit or in this addendum is provided.
- H. Modulating Gas Heat Controls Discharge Air Temperature Control The unit shall deliver discharge air at the setpoint determined by adjusting a potentiometer in the unit control panel, an LCD display, or communicated to the unit over the building automation system network, depending upon which options have been selected. Refer to the sequence of operation in this document for further details.
- I. Modulating Gas Heat Controls Supply Air Tempering The unit shall deliver tempered supply air at the supply air tempering setpoint determined by adjusting a potentiometer in the unit control panel or over a network variable, depending upon selected options. The minimum turndown capability of the modulating gas heat may cause discharge air temperatures above the supply air tempering setpoint. Refer to the sequence of operation in this document for further details.
- J. Network Compatible Controls (BACnet, Lon, N2, Modbus) The unit controls shall be equipped with a communications interface to provide network access over the selected network
- K. Modulating Gas Heat
 - 1. Mode Initiation This mode is entered upon a heat one call being present at the unitary controller.
 - 2. Gas Heat Staging Upon entering a heating mode, the unit shall index the modulating stage of gas heat to full fire and begin the ignition sequence. After 90 seconds, control of discharge air temperature to discharge air temperature setpoint shall be initiated. Setpoint is adjusted by adjusting the heat supply air temperature setpoint on a potentiometer installed in the unit control panel, an LCD display, or communicated to the unit over the building automation system network, depending upon which options have been selected. The setpoint is adjustable between 60°F and 110°F.
 - 3. After the 90 second ignition sequence the modulating stage of heat shall ramp from minimum fire to full fire. If additional heat is required the modulating stage shall be reset to minimum fire and the second stage of heat enabled if present. As the heat demand continues to increase the modulating stage shall be ramped towards full fire. Additional stages of heat behave in a similar fashion.
 - 4. Safety Interlocks –A fan proving switch and a supply fan VFD or motor starter auxiliary switch must be made prior to enabling gas heat functions. Additional high limit temperature switches are installed in the burner cabinet for safety. These additional high limit safety switches are non-adjustable limit switches. The automatic reset limit switches trip at 180°F and the manual reset limit switches trip at 200°F.



- 5. Supply Air Temperature Reset If a call for stage two heat is present at the unitary controller, the discharge air setpoint shall be indexed upwards by 20°F.
- L. Supply Air Tempering
 - Mode Initiation This mode is entered when mixed air temperature is below the supply air tempering setpoint and no compressors are enabled. Supply air tempering setpoint is changed by adjusting a potentiometer installed in the unit control panel, an LCD display, or communicated to the unit over the building automation system network, depending upon which options have been selected.
 - 2. Modulating Gas Heat Modulating gas heat is enabled and operates to maintain the discharge air temperature at the discharge air temperature setpoint. Minimum turndown capability of the modulating gas heat may cause discharge air temperatures above the supply air tempering setpoint. Supply air tempering shall turn off when supply air temperature rises above supply air tempering setpoint plus dead band.
- M. Safety Interlocks Compressor operation is disabled when in this mode of operation.
- 2.9 HOT WATER COIL
 - A. Unit shall be furnished with a factory provided and installed hot water coil. Coil must be factory installed. Coils shipped loose for field installation are not acceptable.
 - B. Hot water supply and return connections shall be located inside the unit casing in the empty gas heating section of the rooftop unit. The connections may be routed through the bottom of the unit or through the side of the unit by the installing contractor. On Series 5 units bottom penetrations are not available. On Series 10 units, very limited space is available for bottom penetrations. On Series 20 units, limited space is available for bottom penetrations, side or bottom, are field cut.
 - C. Coils shall be manufactured to ARI Standard 410 certification. The coil shall be subjected to water leak testing while under pressure of 150 psi. Casing and endplates shall be made from heavy gauge galvanized steel, meeting ASTM A527. All tubes shall be constructed with seamless copper conforming to ASTM B75 and ASTM B251 for standard pressure applications. The fins shall be constructed of die-formed aluminum. The tubes are mechanically expanded to form an interference fit with the fin collars. Unless otherwise specified elsewhere in this document, no specific vent or drain connections are provided.
 - D. 3-Way Modulating Valve (Ships Loose) The unit shall ship with a three-way modulating control valve. The valve is for field installation on the return water line of the hydronic heating coil. The valve is equipped with a modulating spring return actuator. The actuator shall accept a 2-10 VDC control signal. The actuator shall spring return open in the event of a failure. A 10 Volt signal shall indicate no heat required and a 2-volt signal shall indicate a full heat condition.

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- E. Low Limit Thermostat Wired to SE 4 Stage Board Low Limit Input The unit shall be equipped with a low limit stat installed on the leaving air side of the coil. When a low limit condition is sensed, the thermostat shall open its contacts. This thermostat it wired by Fisen to the JCI SE Controller Low Limit Input on the 4 Stage Board. The response of the unit to a low limit condition is dictated by the SE Controller sequence of operation. Refer to the SE Controller manual for details on this sequence. It is the responsibility of the installing contractor to test and implement this low limit thermostat functionality at installation and startup. Failure to do so will result in equipment damage. This low limit condition requires a manual reset.
- F. Low Limit Thermostat Physically Break Valve Power, Shutdown Supply Fan, Close Outdoor Air Damper - In addition to an indication of a tripped low limit thermostat to the JCI SE Control Board, the unit shall incorporate a series of relays to physically break power to the Hot Water Valve to force it to spring return open when the low limit thermostat trips. Additionally, the supply fan shall be shut down, the outdoor air damper forced closed, and in general unit operation inhibited.
- G. Hydronic Heating Coil Field Wired to Terminal Strip The unit shall include a factory or Fisen installed SE Controller 4 Stage Board. This board includes a Hot Water valve output available for modulating a hot water valve. Fisen shall install a terminal strip connected to the SE Control board. Fisen safeties and features are wired between the SE board and this terminal strip. Wiring of the valve to the terminal strip is the responsibility of the installing contractor. The unit controls transformer should not be used to power the valve. Refer to the JCI IOM for details and requirements related to wiring the valve to this output.

2.10 ELECTRIC HEAT

- A. Use nickel chromium elements for heating.
- B. Unit shall have SCR control factory installed. Staged Heat is not acceptable.
- C. Modulating Electric Heat Retrofit The unit installed electric heat shall be equipped with an SCR on one stage of elements for modulating control output to the heat stream. The control scheme may include a vernier controller for staging and sequencing the individual heating elements and circuits to output capacity between 0-100% depending upon heat demand.
- D. Silicon Controlled Rectified manufacturer shall install a silicon-controlled rectifier (SCR) for the purpose of modulating the electric heat capacity of the unit. The heat sink shall be fabricated of extruded aluminum. The SCR are recognized components under Underwriter's Laboratories Guide Number File E52105 Guide XAPX2. Typically, the SCR shall be installed on the first stage of electric heat and subsequent stages shall be enabled using a vernier algorithm to provide modulation across the entire capacity range.
- E. Supply Air Temperature Controls for Modulating Electric Heat SE with 4 Stage Board The unit shall deliver discharge air at setpoint determined by modifying the parameter in the JCI SE Control Board.
- F. Primary limit control with automatic reset to prevent the heating element system from operating at an excessive temperature.
- G. Heating section assembly shall slide out of the unit for easy maintenance and service.
- H. Shall be wired for single point power supply with branch circuit fusing (where required).



2.11 HOT GAS REHEAT

- A. The dehumidification system is factory installed and provides dehumidification of an occupied space while maintaining temperature control utilizing a hot gas reheat coil.
- B. Determination of unit functionality in straight cooling, straight heating, or reheat mode shall come from standard SSE control board.
- C. Reheat mode shall utilize a specific reheat coil placed after the evaporator coil to heat the conditioned air back to a neutral temperature when the occupied space requires dehumidification, but the temperature requirements are satisfied.
- D. The reheat circuit shall utilize solenoids to alter the refrigerant flow from being directed through the condenser circuit to the hot gas reheat circuit.
- E. Changeover from cooling mode to reheat mode shall be accomplished in 30 seconds or less.

2.12 COILS

- A. Standard Aluminum Fin Copper Tube Coils:
 - 1. Standard evaporator coils shall have aluminum plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
 - 2. Shall be leak tested to 150 PSIG, pressure tested to 250 PSIG, and qualified to CSA C22.2 No. 236-11(UL 1995) 4th edition burst test at 1775 PSIG.
 - 3. Assembled unit shall be pressure tested to 450 PSIG.
- B. Standard All Aluminum Microchannel Coils:
 - 1. Standard condenser coils shall have all aluminum microchannel design consisting of aluminum multiport flat tube design and aluminum fin. Coils shall be a furnace brazed design and contain epoxy lined shrink wrap on all aluminum to copper connections.
 - 2. Condenser coils on all Heat Pump and Hot Gas Reheat units shall be Standard Aluminum Fin Copper Tube coils as defined above.
 - 3. Microchannel condenser coils shall be leak tested to 150 PSIG, pressure tested to 650 PSIG, and qualified to UL 1995 bursttest at 1980 PSIG.
 - 4. Assembled unit shall be pressure tested to 450 PSIG.
- 2.13 REFRIGERANT CIRCUITS
 - A. High Efficiency AC units shall utilize <u>FOUR (4) Compressors for VAV</u> Anything less than four will not be accepted no exceptions.



- B. Refrigerant circuit shall include the following control, safety, and maintenance features:
 - 1. Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range. Shall contain removable power element to allow change out of power element and bulb without removing the valve body.
 - 2. The lead circuit shall be furnished with hot gas by-pass for unloading.
 - 3. Refrigerant filter drier Solid core design.
 - 4. Service gauge connections on suction and discharge lines.
- C. Compressors
 - 1. Unit shall use fully hermetic scroll compressors for each independent refrigeration circuit.
 - 2. Compressors shall be specifically designed for R454B refrigerant.
 - 3. Two stage models shall use a single stage compressor on each refrigeration circuit.
 - 4. Four stage models that are 15, 17.5, or 20 tons shall use a two-stage compressor on circuit one and a single stage compressor on circuit two.
 - 5. Four stage models that are 25 or 27.5 tons shall use a tandem compressor set on circuit one and a single stage compressor on circuit two.
 - 6. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
 - 7. Compressors shall be internally protected from high discharge temperature conditions.
 - 8. Compressors shall be protected from an over- temperature and over- amperage conditions by an internal, motor overload device.
 - 9. Compressor shall be factory mounted on rubber grommets.
 - 10. Crankcase heaters shall be installed in the factory as needed on tandem compressor sets.

2.14 FILTERS SECTION

- A. Filters access is specified in the unit cabinet section of this specification.
- 2.15 EVAPORATOR FAN AND MOTOR
 - A. Evaporator fan motor:
 - 1. Shall have permanently lubricated ball-bearings.



- 2. Shall have inherent automatic- reset thermal overload protection.
- 3. The job site selected brake horsepower shall be required to not exceed the motor's nameplate horsepower rating plus the service factor.
- B. Evaporator Fan:
 - 1. Fan shall be a belt drive assembly with an adjustable pitch motor pulley.
 - 2. Shall use sealed, permanently lubricated ball-bearing type.
 - 3. Blower fan shall be double-inlet type with forward-curved blades.
 - 4. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

2.16 CONDENSER FANS AND MOTORS

- A. Condenser fan motors:
 - 1. Shall be a totally enclosed motor.
 - 2. Shall use permanently lubricated ball-bearings.
 - 3. Shall have inherent thermal overload protection with an automatic reset feature.
 - 4. Shall use a shaft- down design.
- B. Condenser Fans:
 - 1. Shall be a direct- driven propeller type fan.
 - 2. Shall have aluminum blades riveted to corrosion-resistant steel spider brackets and be dynamically balanced.

2.17 VARIABLE FREQUENCY DRIVE (VFD)

- A. Shall be installed inside the unit cabinet, mounted, wired and tested.
- B. Shall contain Electromagnetic Interference (EMI) frequency protection.
- C. Insulated Gate Bi- Polar Transistors (IGBT) used to produce the output pulse width modulated (PWM) waveform.
- D. Built in LED display and controls. Does not require additional kit or options.
- E. RS485 capability standard.



- F. Electronic thermal overload protection.
- G. 5% swinging chokes for harmonic reduction and improved power factor.
- H. All printed circuit boards shall be conformal coated.
- 2.18 STANDARD INTEGRATED ECONOMIZER
 - A. Integrated, gear driven opposing modulating blade design type capable of simultaneous economizer and compressor operation.
 - B. Independent modules for vertical or horizontal return configuration shall be available. Vertical return modules shall be available as a factory installed option.
 - C. Damper blades shall be galvanized steel with metal gears. Plastic or composite blades on intake or return shall not be acceptable.
 - D. Damper blades shall be class 1A dampers.
 - E. Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below set points.
 - F. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
 - G. Economizer shall comply with, and be certified to, the AMCA 511 standard.
 - H. Standard leak rate shall be equipped with dampers not to exceed 3 cfm/ft² leakage at 1 in. WG pressure differential.
 - I. Economizer controller shall be the Johnson Controls SE Economizer Controller
 - 1. On-board Fault Detection and Diagnostics (FDD) that senses and alerts when the economizer is notoperating properly, meets the requirements for California Title 24, IECC 2015, and ASHRAE 90.1.
 - 2. Display alarms if the following occur
 - a. Economizer is economizing when conditions do not support
 - b. Economizer is not economizing when conditions do support
 - c. Damper Stuck
 - d. Excess Outdoor Air
 - e. Failed Sensor



- 3. Automatic sensor detection
- 4. Capabilities for use with multiple-speed indoor fan systems
- 5. Utilize digital sensors: Dry bulb and Enthalpy
- 6. UL, CSA, and ICES-003 recognized and FCC compliant to CFR47
- J. Shall be capable of introducing up to 100% outdoor air.
- K. Shall be equipped with power exhaust capable of relieving up to 100% return air and contain seals that meet ASHRAE 90.1 requirements.
- L. Shall be designed to close damper(s) during loss- of- power situations with spring return built into motor.
- M. Dry bulb outdoor air temperature sensor shall be provided as standard. Enthalpy sensor is also available on factory installed only. Outdoor air sensor set point shall be adjustable and shall range from 40° to 80°F / 4° to27°C. Additional sensor options shall be available as accessories.
- N. The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.
- O. The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy.
- P. Dampers shall be completely closed when the unit is in the unoccupied mode.
- Q. Economizer controller shall accept a 2-10 Vdc CO₂ sensor input for IAQ/DCV control. In this mode, dampers shall modulate the outdoor air damper to provide ventilation based on the sensor input.
- R. Actuator shall be direct coupled to economizer gear. No linkage arms or control rods shall be acceptable.
- S. Economizer controller shall provide indications when in free cooling mode, in the DCV mode, or the exhaust fan contact is closed.

2.19 PROPELLER POWER EXHAUST

- A. Power exhaust shall be used in conjunction with an integrated economizer.
- B. Horizontal power exhaust shall be mounted in return ductwork.
- C. Power exhaust shall be controlled by economizer controller operation. Exhaust fans shall be energized when dampers open past the 0- 100% adjustable set point on the economizer control.
- 2.20 PHASE MONITOR
 - A. Shall provide protection against phase reversal, phase loss, and phase unbalance.
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- B. Switch shall automatically shut off unit control circuit if any of the above conditions is detected.
- C. Shall have visual LED indication of operational status.
- 2.21 HINGED AND TOOL LESS ACCESS PANELS (FACTORY INSTALLED)
 - A. Cabinet panels shall be hinged.
 - B. Shall provide easy access with molded composite handles that are permanently attached and recessed into the panel.
 - C. Shall be on major panels of filter, control box, fan motor, and compressor.
- 2.22 UNIT-MOUNTED, NON-FUSED DISCONNECT SWITCH
 - A. Switch shall be factory installed, internally mounted.
 - B. National Electric Code (NEC) and UL approved non- fused switch shall provide unit power shutoff.
 - C. Shall be accessible from outside the unit.
 - D. Shall provide local shutdown and lockout capability.

2.23 CONVENIENCE OUTLET

- A. Powered convenience outlet.
 - 1. Outlet shall be powered from main line power to the rooftop unit.
 - 2. Outlet shall be factory installed and internally mounted with easily accessible 115- v female receptacle.
 - 3. Outlet shall include 15-amp GFI receptacles with independent fuse protection.
 - 4. Voltage required to operate convenience outlet shall be provided by a factory installed step- down transformer.
 - 5. Outlet shall be accessible from outside the unit.

2.24 ROOF CURBS (VERTICAL)

- A. Where indicated on the drawings provide sound attenuating curb in lieu of RTU Manufacturer's curb. Refer to the RTU schedule.
- B. Full perimeter roof curb with exhaust capability providing separate air streams for energy recovery from the exhaust air without supply air contamination.

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- C. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
- D. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.
- 2.25 SINGLE ENTHALPY SENSOR KIT
 - A. The single enthalpy sensor kit shall provide a relative humidity sensor to be mounted in the outdoor air stream to provide single enthalpy economizer control.
 - B. The sensor allows the unit to determine if outside air is suitable for free cooling.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install equipment per industry standards, applicable codes, and manufacturer's instructions.
- B. Do not use RTUs for temporary heating, cooling or ventilation prior to complete inspection and startup performed per this specification.
- C. Install RTUs on roof curb, as shown on drawings.
- D. Install RTUs with manufacturer's recommended clearances for access, coil pull, and fan removal.
- E. Provide one complete set of filters for testing, balancing, and commissioning. Provide second complete set of filters at time of transfer to owner.
- F. Install RTU plumb and level. Connect piping and ductwork according to manufacturer's instructions.
- G. Install supports and anchors per applicable local building codes.
- H. Insulate plumbing associated with drain pan drains and connections.
- I. Install insulation on all staggered coil piping connections, both internal and external to the unit.

3.2 FIELD QUALITY CONTROL

- A. Store per RTU manufacturer's written recommendations. Store RTUs indoors in a warm, clean, dry place where units will be protected from weather, construction traffic, dirt, dust, water and moisture. If units will be stored for more than 6 months, follow manufacturer's instruction for long-term storage.
- B. Rig and lift units according manufacturer's instructions.
- 3.3 RTU INSPECTION
 - A. Hire manufacturer's factory-trained and factory-employed service technician to perform an inspection of unit and installation prior to startup. Technician shall inspect and verify the following as a minimum:

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- 1. Damage of any kind
- 2. Level installation of unit
- 3. Proper reassembly and sealing of unit segments at shipping splits.
- 4. Tight seal around perimeter of unit at the roof curb
- 5. Installation of shipped-loose parts, including filters, air hoods, bird screens and mist eliminators.
- 6. Completion and tightness of electrical, ductwork and piping connections
- 7. Tight seals around wiring, conduit and piping penetrations through RTU casing.
- 8. Supply of electricity from the building's permanent source
- 9. Integrity of condensate trap for positive or negative pressure operation
- 10. Condensate traps charged with water
- 11. Removal of shipping bolts and shipping restraints
- 12. Sealing of pipe chase floor(s) at penetration locations.
- 13. Tightness and full motion range of damper linkages (operate manually)
- 14. Complete installation of control system including end devices and wiring
- 15. Cleanliness of RTU interior and connecting ductwork
- 16. Proper service and access clearances
- 17. Proper installation of filters
- B. Filter gauge set to zero
- C. Resolve any non-compliant items prior to proceeding with the inspection of the fan assembly.
- 3.4 INSPECTION AND ADJUSTMENT: RTU FAN ASSEMBLY
 - A. Hire the manufacturer's factory-trained and factory-employed service technician perform an inspection of the RTU fan assembly subsequent to general RTU inspection and prior to startup. Technician shall inspect and verify the following as a minimum:
 - 1. Fan isolation base and thrust restraint alignment
 - 2. Tight set screws on pulleys, bearings and fan

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- 3. Tight fan bearing bolts
- 4. Tight fan and motor sheaves
- 5. Tight motor base and mounting bolts
- 6. Blower wheel tight and aligned to fan shaft
- 7. Sheave alignment and belt tension
- 8. Fan discharge alignment with discharge opening
- 9. Fan bearing lubrication
- 10. Free rotation of moving components (rotate manually)
- B. Manufacturer shall perform service to bring fan performance within factory specifications.

3.5 STARTUP SERVICE AND OWNER TRAINING

- A. Manufacturer's factory-trained and factory-employed service technician shall startup RTUs. Technician shall perform the following steps as a minimum:
 - 1. Energize the unit disconnect switch
 - 2. Verify correct voltage, phases and cycles
 - 3. Energize fan motor briefly ("bump") and verify correct direction of rotation.
 - 4. Re-check damper operation; verify that unit cannot and will not operate with all dampers in the closed position.
 - 5. Energize fan motors and verify that motor FLA is within manufacturer's tolerance of nameplate FLA for each phase.
 - 6. Rebalance each fan and check for vibration.
- B. Provide a minimum of 2 hours of training for owner's personnel by manufacturer's factory-trained and factory-employed service technician. Training shall include RTU controls, motor starter, VFD, and RTU.
- C. Training shall include startup and shutdown procedures as well as regular operation and maintenance requirements.
- D. Submit a startup report summarizing any problems found and remedies performed.



3.6 CLEANING

- A. Clean unit interior prior to operating. Remove tools, debris, dust and dirt.
- B. Clean exterior prior to transfer to owner.
- 3.7 DOCUMENTATION
 - A. Provide Installation Instruction Manual, & Startup checklist in the supply fan section of each unit.
 - B. Provide six copies of Spare Parts Manual for owner's project system manual.

END OF SECTION 23 73 00

Attachment L

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SECTION 26 05 00: COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

- 1.1 EXECUTION OF THE WORK
 - A. The scope of work shown on the drawings and in these specifications, Division 26, 27 and 28 are all a part of this contract and shall be included in the base bid unless otherwise noted.
 - B. These Specifications call out certain duties of the Electrical Contractor and/or Subcontractors. They are not intended as a material list of items required by the Contract.
 - C. These divisions of the Specifications cover the electrical systems of the project. It includes work performed by the electrical trades as well as trades not normally considered as electrical trades.
 - D. Provide all items and work indicated on the Drawings and all items and work called for in the Specifications in accordance with the conditions of Contract (Division 1 General Requirements Documents). This includes all incidentals, equipment, appliances, services, hoisting, scaffolding, supports, tools, supervision, labor, consumable items, fees, licenses, etc., necessary to provide complete systems. Perform start-up and checkout on each item and system to verify the systems are fully operable.
 - E. Comply with all provisions of the Contract Documents including Division 1, General Conditions, and Supplementary General Conditions of the Specifications.
 - F. Certain terms such as "shall, provide, install, complete, start up" are not used in some parts of these Specifications. This does not indicate that the items shall be less than completely installed or that systems shall be less than complete.
 - G. Examine and compare the Electrical Drawings and Specifications with the Drawings and Specifications of other trades, and report any discrepancies between them to the Engineer and obtain written instructions for changes necessary in the work. At time of bid the most stringent requirements must be included in said bid. Install and coordinate the electrical work in cooperation with other trades installing interrelated work. Before installation, make proper provisions to avoid interferences in a manner approved by the Engineer. All changes required in the work of the Contractor caused by neglect shall be corrected at the expense of the Contractor.
 - H. It is the intent of the drawings and specifications to provide a complete workable system ready for the Owner's operation. These specifications are equipment and performance specifications. Items described or called out in the specification but not shown on the drawings are considered to be part of the project. Any item not specifically shown on the drawings or called for in the specifications, but normally required to conform to the intent are to be considered a part of the contract. Installation of the equipment shall be in accordance with the N.E.C., manufacturer recommendation, and industry standards.
 - I. All material furnished by the Contractor shall be new and unused (temporary lighting and power products are excluded) and free from defects. All materials used shall bear the Underwriters



Laboratory, Inc label provided a standard has been established for the material in question.

- J. All products and materials to be new, clean, free of defects and free of damage and corrosion.
- K. No exclusion from, or limitation in, the symbolism used on the Drawings for electrical work or the languages used in the Specifications for electrical work shall be interpreted as a reason for omitting accessories necessary to complete any required system or item of equipment.
- L. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.
- M. Except for conduit, conduit fittings, outlet boxes, wire and cable, all items of equipment or material shall be the product of one manufacturer throughout. Multiple manufacturers will not be permitted.

1.2 COORDINATION OF THE WORK

- A. Certain materials will be provided by other trades. Examine the Contract Documents to ascertain these requirements.
- B. Carefully check space requirements with other trades and the physical confines of the area to ensure that all material can be installed in the spaces allotted thereto including finished suspended ceilings. Make modifications thereto as required and approved.
- C. Transmit to other trades all information required for work to be provided under their respective sections in ample time for installation.
- D. Wherever work interconnects with work of other trades, coordinate with other trades to ensure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.
- E. Due to the type of the installation, a fixed sequence of operation is required to properly install the complete systems. Coordinate, project and schedule work with other trades in accordance with the construction sequence.
- F. The locations of lighting fixtures, outlets, panels and other equipment indicated on the Drawings are approximately correct, but they are understood to be subject to such revision as may be found necessary or desirable at the time the work is installed in consequence of increase or reduction of the number of outlets, or in order to meet field conditions or to coordinate with modular requirements of ceilings, or to simplify the work, or for other legitimate causes.
- G. Exercise particular caution with reference to the location of panels, outlets, switches, etc., and have precise and definite locations approved by the Engineer before proceeding with the installation.
- H. The Drawings show only the general run of raceways and approximate location of outlets. Any significant changes in location of outlets, cabinets, etc., necessary in order to meet field conditions shall



be brought to the immediate attention of the Engineer and shall receive approval before such alterations are made. All such modifications shall be made without additional cost to the Owner.

- I. Obtain from the Engineer in the field the location of such outlets or equipment not definitively located on the Drawings.
- J. Circuit "tags" in the form of arrows are used where shown to indicate the home runs of raceways to electrical distribution points. These tags show the circuits in each home run and the panel designation. Show the actual circuit numbers on the finished record tracing and on panel directory card. Where circuiting is not indicated, the Electrical Contractor must provide required circuiting in accordance with the loading indicated on the drawings and/or as directed.
- K. The Drawings generally do not indicate the exact number wires in each conduit for the branch circuit wiring of fixtures, and outlets, or the actual circuiting. Provide the correct wire size and quantity as required by the indicated circuiting and/or circuit numbers indicated and control wiring diagrams, if any, specified voltage drop or maximum distance limitations, and the applicable requirements of the NEC.
- L. Adjust locations of conduits, panels, equipment, pull boxes, fixtures, etc. to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each raceway prior to installation.
 - 1. Right of way: lines which pitch to have the right-of-way over those which do not pitch. For example: steam, condensate, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.
 - 2. Make offsets, transitions and changes in direction in raceways and as required to maintain proper head room in pitch of sloping lines whether or not indicated on the Drawings.
- M. Whenever the work is of sufficient complexity, prepare additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field.
- N. Contractor shall furnish services of experienced Superintendent, who shall be in constant charge of all work, and who shall coordinate his work with the work of other trades. No work shall be installed before coordinating with other trades.

1.3 EXAMINATION OF SITE

A. Prior to submitting of bids, the Contractor shall visit the site of the job and shall familiarize himself with all conditions affecting the proposed installation and shall make provisions as to the cost thereof. Failure to comply with the intent of this paragraph will in no way relieve the Contractor of performing all necessary work shown on the Drawings.



1.4 PROGRESS OF WORK

A. The Contractor shall order the progress of his work so as to conform to the progress of the work of other trades and shall complete the entire installation as soon as the conditions of the building will permit. Any cost resulting from the defective or ill-timed work performed under this section shall be borne by the Contractor.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Ship and store all products and materials in a manner which will protect them from damage, weather and entry of debris. If items are damaged, do not install, but take immediate steps to obtain replacement or repair. Any such repairs shall be subject to review and acceptance of the Engineer.
- B. Delivery of Materials: Deliver materials (except bulk materials) in manufacturer's unopened container fully identified with manufacturer's name, trade name, type, class, grade, size and color.
- C. Storage of Materials, Equipment and Fixtures: Store materials suitably sheltered from the elements, but readily accessible for inspection by the Engineer until installed. Store all items subject to moisture damage in dry, heated spaces.

1.6 EQUIPMENT ACCESSORIES

- A. Establish sizes and location of the various concrete bases required. Coordinate with General Contractor and provide all necessary anchor bolts together with templates for holding these bolts in position.
- B. Provide supports, hangers and auxiliary structural members required for support of the work.
- C. Furnish and set all sleeves for passage of raceways through structural, masonry and concrete walls and floors and elsewhere as will be required for the proper protection of each raceway and passing through building surfaces.
- D. Wall mounted equipment, total weight of 100 pounds or less, may be directly secured to wall by means of steel bolts. Maintain at least 1" air space between equipment and supporting wall. Groups or arrays of equipment, with total weight of more than 100 pounds, shall be mounted on adequately free standing sized steel angles, channels, or bars. Prefabricated steel channels providing a high degree of mounting flexibility, such as those manufactured by Kindorf, Globe-Strutt and Unistrut, may be used for mounting arrays of equipment.

1.7 CUTTING, PATCHING, ETC.

A. The work shall be carefully laid out in advance. Where Cutting, channeling, chasing or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support or anchorage of raceway, outlets or other equipment, the work shall be carefully done. Any damage to the building, piping, equipment or defaced finish plaster, woodwork, metalwork, etc. shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner.



- B. The Contractor shall do no cutting, channeling, chasing or drilling of unfinished masonry, tile, etc., unless he first obtains permission from the Engineer. If permission is granted, the Contractor shall perform this work in a manner approved by the Engineer.
- C. Where conduits, outlet, junction, or pullboxes are mounted on a painted surface, or a surface to be painted, they shall be painted to match the surface. Whenever support channels are cut, the bare metal shall be cold galvanized.
- D. Slots, chases, openings and recesses through floors, walls, ceilings, and roofs will be provided by the various trades in their respective materials. The trade requiring them to properly locate such openings and be responsible for any cutting and patching caused by the neglect to do so.

1.8 NOMINAL VOLTAGES (UNLESS OTHERWISE NOTED)

- A. Primary distribution: 277/480V, 3PH, 4W
- B. Secondary distribution: 120/208V, 3PH, 4W

1.9 MOUNTING HEIGHTS

- A. Unless otherwise noted or required because of special conditions, locate outlets as follows:
 - 1. Heights listed are from finished floor to center of device. Verify exact locations with the Engineer before installation.

a.	Wall switch outlets	
b.	Bracket outlets	7'- 0" to bottom
C.	Convenience outlets (general)	
d.	Convenience outlets (mechanical areas)	4' - 0"
e.	Panelboard and distribution cabinet to top	6' - 6"
f.	Fire alarm audio unit	Lower of 80" AFF or 6" below ceiling
g.	Fire alarm visual unit	
h.	Fire alarm stations	40" to top
i.	Desk telephone outlets	
j.	Wall telephone outlets	4' - 9"
k.	Desk intercommunication outlets	1' - 6"
I.	Signal bells below ceiling	1' - 0"
0.	Television outlets	
p.	Pushbuttons	4' - 8"

1.10 CLEANING UP

A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc. resulting from the installation of work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean, subject to the Architect's instructions, which shall be promptly carried out.



- B. Contractor shall clean all fixtures and equipment at the completion of the project.
- C. All switchboards, panelboards, wireway, trench ducts, cabinets, enclosures, etc. shall be thoroughly vacuumed clean prior to energizing equipment at the completion of the project. Equipment shall be opened for observation by the Architect as required.

1.11 WATERPROOFING

- A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings. Perform work so as to maintain any warranties currently in effect.
- B. If this Contractor penetrates any walls or surfaces after they have been waterproofed, this Contractor shall restore the waterproof integrity of that surface at the expense of this Contractor and as directed by the Architect.

1.12 PRODUCTS

A. If products and materials are specified or indicated on the drawings for a specific item or system, use those products or materials. Where noted in other sections of this specification, equipment has been specified for a specific performance and substitutions are not permitted. If products and materials are not listed in either of the above, use first class products and materials, subject to approval of Shop Drawings where Shop Drawings are required or as approved in writing where Shop Drawings are not required.

1.13 OMISSIONS FROM THE DRAWINGS

A. Should a Bidder find discrepancies in or omissions from the drawings or specifications or be in doubt as to their meaning, he shall notify the Architect before submitting his proposal. The Architect will in turn, send written instructions to all Bidders. Neither the Architect nor the Owner will be responsible for oral instructions. If the Contractor fails to comply with this requirement, he shall accept the Engineer's interpretations as to the intended meaning of the drawings and specifications.

1.14 EXECUTION

- A. Follow manufacturer's instructions for installing, connecting, and adjusting all equipment. Provide one copy of such instructions to the Architect before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Provide all special supports, connections, wiring, accessories, etc.
- B. Use mechanics skilled in their trade for all work.
- C. Clean all items before and after installation. Clean up all debris.



- D. Perform all tests required by local authorities in addition to tests specified herein, such as life safety systems.
- E. Applicable equipment and materials to be listed by Underwriters' Laboratories and manufactured in accordance with ASME, NEMA, ANSI or IEEE standards and as approved by local authorities having jurisdiction.
- F. Before commencing work, examine all adjoining, underlying, etc., work on which this work is in any way dependent for perfect workmanship and report any condition which prevents performance of first class work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

1.15 VERIFICATION OF ELECTRICAL REQUIREMENTS FOR EQUIPMENT FURNISHED BY OTHERS

- A. Prior to the installation of wiring systems for any equipment furnished by others, this contractor shall verify that the electrical requirements of the equipment match those shown on the electrical drawings by examining the approved shop drawings of that equipment. Any discrepancies shall be immediately reported to the engineer.
- B. If the contractor fails to comply with this requirement, he shall be responsible for any additional costs incurred at no additional cost to the Owner.

1.16 PROTECTION OF BUILDING FIRE/SMOKE BARRIERS

- A. Passages of conduit through fire barriers and/or smoke barriers shall be protected as follows:
 - 1. The space between the penetrating item and the fire barrier and/or smoke barrier shall be filled with a material capable of maintaining the fire/smoke resistance of the barrier or be protected by an approved device designed for the specific purpose.
 - 2. Where the penetrating item uses a sleeve to penetrate the fire and/or smoke barrier the sleeve shall be solidly set in the fire/smoke barrier and the space between the item and the sleeve shall be filled as described above.
 - 3. Fire barriers shall include 1-hour, 2-hour, and 3-hour rated floors and walls. Refer to architectural plans for location of fire barriers and smoke barriers and provide protection required to maintain ratings in accordance with all codes.
 - 4. Approved fill material for fire barriers shall be packed mineral wool, with ASTME-136 rating and 3M Fire Barrier caulk. Coordinate sealing of all openings with requirements of Division 7 of this specification.
 - 5. Perform work in accordance with the appropriate UL Ratings.
 - 6. Product Data: Provide manufacturer's specifications, recommendations and installation instructions for each application.

1.17 CODES AND FEES

- A. General: Comply with Codes in accordance with the Contract Documents.
- B. The electrical installation shall be in compliance with the requirements of OSHA, NEC and the rules, regulations and requirements of the power company supplying power to the building.



- D. All equipment shall be equal to or exceed the minimum requirements of NEMA, IEEE and UL.
- E. Should any change in Drawings or Specifications be required to comply with governmental regulations, the Contractor shall notify Architects prior to execution of the work. The work shall be carried out according to the requirements of such code in accordance with the instruction of the Architect and at no additional cost to the Owner.
- F. The local fees and permits and services of inspection authorities shall be obtained and paid for by the Contractor. The Contractor shall cooperate fully with local utility companies with respect to their services.
- G. Certificate of Inspection and approval shall be procured and paid for by this Contractor from an approved certified inspection agency.

1.18 GUARANTEE

- A. General: Provide a Guarantee in accordance with the Contract Documents.
- B. Submit a single guarantee stating that all portions of the work are in accordance with Contract requirements. Guarantee all work against faulty and improper material and workmanship for a period of one (1) year from date of final acceptance by the Owner, except that where guarantees or warranties for longer terms are specified herein, such longer term to apply. Within 24 hours after notification, correct any deficiencies which occur during the guarantee period at no additional cost to Owner, all to the satisfaction of the Owner and Architect. Obtain similar guarantees from subcontractors, manufacturers, suppliers and subtrade specialists.

1.19 DISPOSAL

- A. All electrical items not designated by the Owner for his use to be properly disposed of according to local, state and Federal regulations.
- B. Items containing polychlorinated biphenyl (PCB) to be removed, transported and disposed of according to Federal Toxic Substances Control Act (TSCA). Contractor to submit certification that these items have been properly disposed.

1.20 EXCAVATION AND TRENCHING

A. Provide excavation for the work. Excavate all material encountered to the depths indicated on the Drawings or required. Remove from the site excavated materials not required or suitable for backfill. Provide grading as may be necessary to prevent surface water from flowing into trenches or other excavations. Remove any water accumulating therein. Provide sheeting and shoring as may be necessary for the protection of the work and for the safety of personnel.

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- B. Provide trenches of widths necessary for the proper execution of the work. Grade bottom of the trenches accurately to provide uniform bearing and support the work on undisturbed soil at every point along its entire length. Where rock excavations are required, excavate rock to a minimum overdepth of 4 inches below the trench depths indicated on the Drawings or required. Backfill overdepths in the rock excavation and unauthorized overdepths with loose, granular, moist earth, thoroughly machine tamped to a compaction level as specified by the Engineer. Whenever unstable soil incapable of properly supporting the work is encountered in the bottom of the trench as determined by the Engineer, remove soil to a depth required and backfill the trench to the proper grade with coarse sand, fine gravel or other suitable material.
 - 1. Primary electric service: 4 feet (minimum).
 - 2. Secondary electric service: 2 feet (minimum).
 - 3. Telephone service: 2 feet (minimum).

1.21 BACKFILLING OF TRENCHES

A. Do not backfill trenches until all required tests have been performed and the installation observed by the Engineer. Comply with the requirements of other sections of these Specifications. Deposit backfill in 6 inch layers and thoroughly and carefully tamp until for work has a cover of not less than 1 foot. Backfill and tamp remainder of trench at 12 inch intervals until complete. Uniformly grade the finished surface. Install a 6 inch marking ribbon 12 inches below finished grade.

END OF SECTION 26 05 00

SECTION 26 05 53: IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Condition and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Identification for electrical raceways
 - 2. Identification of power and control cables
 - 3. Identification for branch circuit and feeder conductors
 - 4. Warning labels and signs per N.E.C.
 - 5. Instruction signs
 - 6. Identification labels for distribution equipment, junction boxes, cabinets and miscellaneous equipment.

1.3 SUBMITTALS

A. Product Data: Furnish type of material to be supplied for each electrical identification product indicated.

1.4 STANDARDS

- A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:
 - 1. Comply with ANSI A13.1
 - 2. Comply with NFPA 70
 - 3. Comply with 29 CFR 1910.144 and 29 CFR 1910.145
 - 4. Comply with ANSI Z535.4 for safety signs and labels

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors and features with requirements in the Contract Documents, shop drawings, manufacturer's wiring diagrams and operation and manual and with those required by codes and standards.

PART 2 - PRODUCTS

- 2.1 POWER RACEWAY AND METAL CLAD CABLE IDENTIFICATION MATERIALS
 - A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for

Attachment M

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each raceway size.

- B. Raceway Colors for Circuits at 600 V or Less
 - 1. Black letters on an orange field.
 - 2. Fire Alarm Circuits: Red letters on natural field.
 - 3. Legend: Indicate voltage and system or service type.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemicalresistant coating and matching wraparound adhesive tape for securing ends of legend label.
- 2.3 WARNING LABELS AND SIGNS
 - A. Comply with NFPA 70 and 29 CFR 1910.145.
 - B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
 - C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER ELECTRICAL SHOCK HAZARD EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING OSHA REGULATION AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.4 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.



PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 90A: Identify with orange self-adhesive vinyl label.
 - B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with colorcoded, self-adhesive vinyl tape applied in bands.
 - 1. Fire Alarm System: Red
 - 2. Fire-Suppression Supervisory and Control System: Red and Yellow
 - 3. Combined Fire Alarm and Security System: Red and Blue
 - 4. Security System: Blue and Yellow
 - 5. Mechanical and Electrical Supervisory System: Green and Blue
 - 6. Telecommunication System: Green and Yellow
 - 7. Control Wiring: Green and Red
 - C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
 - D. Attach signs and plastic labels with mechanical fasteners appropriate to the location and substrate.
 - E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power
 - 2. Power
 - 3. **[UPS**]

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- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
 - Colors for 208/120-V Circuits
 - 1) Phase A: Black
 - 2) Phase B: Red
 - 3) Phase C: Blue
 - 4) Neutral: White
 - 5) Ground: Green



- b. Colors for 480/277-V Circuits
 - 1) Phase A: Brown
 - 2) Phase B: Orange
 - 3) Phase C: Yellow
 - 4) Neutral: White
 - 5) Ground: Green
- c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- C. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- E. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install marking tape at flush-mounted panelboards and similar equipment in finished spaces.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- G. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- H. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.



- I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide five lines of text.
 - 1) First Line: 1/2-inch letters on the first line stating equipment name.
 - 2) Second Line (if applicable): 3/8-inch letters stating the existing equipment name in parentheses ().
 - 3) Third Line: 3/8-inch letters stating voltage/phase.
 - 4) Fourth Line: 3/8-inch letters stating the breaker number, panel name and room number/name (Owner's room number) from which the equipment is fed.
 - 5) Fifth Line: 3/8-inch letters stating function and/or equipment which it controls.
 - 2. Equipment to be Labeled
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - e. Emergency system boxes and enclosures.
 - f. Enclosed switches.
 - g. Push-button stations.
 - h. Remote-controlled switches, dimmer modules, and control devices.

END OF SECTION 26 05 53



SECTION 26 22 13: DRY-TYPE DISTRIBUTION TRANSFORMERS (1500 KVA AND BELOW)

PART 1 - GENERAL

- 1.1 SCOPE
 - A. The Contractor shall furnish and install single-phase and three-phase general purpose individually mounted dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the contract drawings.

1.2 REFERENCES

- A. The transformers and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI, NEMA and UL.
- B. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
 - 1. Outline dimensions and weights
 - 2. Transformer ratings included:
 - a. kVA
 - b. Primary and secondary voltage
 - c. Taps
 - d. Basic impulse level (BIL) for equipment over 600 volts
 - e. Design impedance
 - f. Insulation class and temperature rise
 - g. Sound level
 - 3. Product data sheets
- 1.4 SUBMITTALS FOR CONSTRUCTION
 - A. The following information shall be submitted for record purposes.
 - 1. Final as-built drawings and information for items listed in Paragraph 1.3, and shall incorporate all changes made during the manufacturing process
 - 2. Connection diagrams
 - 3. Installation information
- 1.5 QUALIFICATIONS
 - A. The manufacturer of the dry-type distribution transformers shall be the same as the manufacturer of the other major electrical distribution equipment on the project.
 - B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

- C. The manufacturer shall be a participant in the UL Data Acceptance Program (DAP) under the Client Test Data Program (CTDP) certification to ensure UL test methodologies and record traceability complies with the requirements of ISO 17025.
- D. Transformer must bear the UL Energy Efficiency Verification Mark to confirm that the unit meets the requirements of 10 CFR Part 431.
- E. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years.
- 1.6 REGULATORY REQUIREMENTS
 - A. All transformers shall be UL listed and bear the UL label.
- 1.7 DELIVERY, STORAGE AND HANDLING
 - A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- 1.8 OPERATION AND MAINTENANCE MANUALS
 - A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.
- PART 2 PRODUCTS
- 2.1 MANUFACTURERS
 - A. Eaton/Cutler-Hammer products
 - B. Square D
 - C. General Electric
 - D. Siemens
 - E. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
- 2.2 RATINGS
 - A. The kVA and voltage ratings shall be as indicated on the Drawings.
 - B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.

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- C. Transformer shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".
- D. Transformers efficiency shall be measured according to federal law 10 CFR Part 431.
- E. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

	Self-Cooled Ventilated		
	K-Factor = 1		
Equivalent Winding kVA	K-Factor = 4	K-Factor = 13	
Range	K-Factor = 9	K-Factor = 20	Self-Cooled Sealed
3.00 and Below	40	40	45
3.01 to 9.00	40	40	45
9.01 to 15.00	45	45	50
15.01 to 30.00	45	45	50
30.01 to 50.00	45	48	50
50.01 to 75.00	50	53	55
75.01 to 112.50	50	53	55
112.51 to 150.00	50	53	55
150.01 to 225.00	55	58	57
225.01 to 300.00	55	58	57
300.01 to 500.00	60	63	59
500.01 to 700.00	62	65	61
700.01 to 1000.00	64	67	63
Greater than 1000	Consult Factory	Consult Factory	Consult Factory

2.3 CONSTRUCTION – GENERAL PURPOSE TRANSFORMERS

- A. Insulation Systems
 - 1. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient, and a 24-hour average ambient of 30 degrees C.
 - 2. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.
- B. Core and Coil Assemblies
 - 1. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade copper with continuous wound construction.
 - 2. On single-phase and three-phase units rated 15 kVA and the core and coil assembly shall be completely encapsulated in a proportioned mixture of epoxy or resin and aggregate to provide a moisture proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.



- 3. On single-phase and three-phase units rated 15 kVA and above the coils assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture; the core shall be coated with HAPs (Hazardous Air Pollutants) free water reducible electrical varnish to give good corrosion resistance. The assembly shall be installed on vibration-absorbing pads.
- 4. Terminals shall be welded to the leads of the coils for better conductivity, less maintenance, and lower risk of hot spots. Terminals shall not be spot welded or bolted to the coil leads.
- C. Taps
 - Three-phase transformers rated 15 through 300 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage. Three-phase transformers rated greater than 300 kVA shall be provided with manufacturer's standard taps for that rating.
 - 2. All single-phase transformers, and three-phase transformers rated below 15 kVA and above 500 kVA, shall be provided with the manufacturer's standard tap configuration.
- D. Electrostatic Shielding
 - 1. Provide shielded isolation transformers with an electrostatic shield consisting of a single turn of aluminum placed between the primary and secondary winding and grounded to the housing of the transformer.
 - a. Electrostatic shield shall provide primary to secondary winding capacitance between 24 and 18 picofarads over the range of 100 Hz to 20 kHz.

2.4 WIRING/TERMINATIONS

A. Recommended external cable shall be rated 90 degrees C sized at 75 degrees C ampacity) for encapsulated and 75 degrees C for ventilated designs. Connectors should be selected on the basis of the type and cable size used to wire the specific transformer.

2.5 ENCLOSURE

- A. The enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees C. The core of the transformer shall be grounded to the enclosure.
- B. On three-phase units rated 15 kVA and below and single-phase units rated 15 kVA and below the enclosure construction shall be encapsulated, totally enclosed, non-ventilated, NEMA 3R, with lifting provisions.
- C. On three-phase units rated 15 kVA and above and single-phase units rated 15 kVA and above the enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting provisions. All ventilation openings shall be protected against falling dirt. On outdoor units, provide weathershields over ventilated openings.
- D. Ventilated type transformers that meet 10 CFR Part 431 efficiency requirements, with a core size of 150 kVA or less, shall be suitable for installation with 2-inch clearance from a wall or other obstruction behind the transformer enclosure.

2.6 FINISH

A. Steel enclosures shall be finished with ANSI 61 color, weather-resistant enamel.

PART 3 - EXECUTION

3.1 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
 - 1. Ratio tests at the rated voltage connection and at all tap connections.
 - 2. Polarity and phase relation tests on the rated voltage connection.
 - 3. Applied potential tests.
 - 4. Induced potential test.
 - 5. No-load and excitation current at rated voltage on the rated voltage connection.

3.2 INSTALLATION

- A. Transformers shall be floor mounted except where indicated on the Drawings to be suspended or wall mounted.
- B. Suspended transformers shall be mounted on hanger rods with a spring isolator in each rod.
- C. Floor mounted transformers shall be mounted on 4 inch high concrete housekeeping pads. Provide neoprene pads between transformer legs and housekeeping pad and anchor transformer to floor.
- D. Provide grounding electrode conductor from transformer secondary neutral to nearest effectively grounded building structural steel.
- E. Conduit connected to transformers shall be flexible metal conduit, 24 inches minimum length, 60 inches maximum length.

3.3 FIELD ADJUSTMENTS

A. Adjust taps to deliver appropriate secondary voltage.

3.4 FIELD TESTING

A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION 26 22 13

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SECTION 26 24 16: PANELBOARDS

PART 1 - GENERAL

- 1.1 DESCRIPTION
 - A. General: Provide panelboards in accordance with the Contract Documents.

1.2 STANDARDS

- A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:
 - 1. Panelboards
 - a. UL Standards #67.
 - b. UL Standard 50 Cabinet and Boxes
 - c. Federal Standard W-P-115.
 - d. NEMA Standard PB-1
 - e. Circuit Breakers Type 1, Class 1.

1.3 SUBMITTALS

- A. Submittals will be furnished. Submittals failing to meet the following criteria will be returned without a review or acceptance.
- B. With each panelboard drawing the following is required:
 - 1. Show main devices and lug sizes; branch circuit device sizes and arrangement; bus ampacities; withstandability and short circuit rating; dimensions and construction; gutter and backbox dimensions; nameplate and legend; protective coating; and all pertinent details of panel, enclosure, cover, and method of securing cover and lock.

1.4 QUALITY ASSURANCE

A. Each panelboard as a complete and finished product shall receive a single integrated equipment rating by the manufacturer. The integrated equipment short circuit wiring shall certify that all equipment is capable of withstanding the thermal and magnetic stress of a fault equal to the value specified on the Drawings. Such rating shall be established by actual tests by the manufacturer on similar equipment. This certification shall be permanently affixed to each panelboard. Test data shall be submitted to the Engineer at time of submission of Acceptance Drawings.

PART 2 - PRODUCTS

- 2.1 APPROVED MANUFACTURERS
 - A. Eaton
 - B. Square D



- C. General Electric
- D. Siemens
- E. 277/480 volts circuit breaker type panelboards are to be equal to Eaton Pow-R Line 2.
- F. 120/240 volts circuit breaker type panelboards are to be equal to Eaton Pow-R Line 1.

2.2 PANELBOARDS IN GENERAL

- Provide panelboards consisting of an assembly of branch circuit switching and protective devices (circuit breakers, switch and fuse units, or combination thereof) mounted inside a dead front enclosure. Provide the number and size of these branch circuit devices as indicated by the circuiting, on the drawings, and in the schedules.
- B. Provide the following modifications and additional equipment as shown on the Drawings:
 - 1. Main circuit breakers.
 - 2. Panelboard integral mounted relays and contactors.
 - 3. Feed through lugs and/or bus.
 - 4. Feed through cabling arrangements.
 - 5. Double lugs for multiple cables or for future provisions.
 - 6. Ground fault interrupting circuit breakers.
- C. Interiors
 - 1. Rigid removable assembly of copper bus bars and interchangeable bolted branch circuit devices.
 - Bus bars drilled to permit branch circuit devices of all sizes and number of poles to be interchangeable and installed in any spare space of sufficient size, without disturbing adjacent units; without removing main bus or branch circuit connectors and without machining, drilling, or tapping in the field.
 - 3. Arrange bus in sequence or distributed phasing so that multipole circuit breaker can replace any group of single circuit breakers of the same size.
 - 4. Provide copper neutral bus in each panelboard.
 - 5. Provide copper ground bus in each panelboard.
- D. Enclosure
 - 1. Code gauge steel box galvanized.
 - 2. Provide a bolt-on ground connector to inside of enclosure.
 - 3. Flush mounted in finished areas and where indicated. Surface mount elsewhere.
- E. Front
 - 1. Doors must be provided on all lighting and power distribution panels. On switch and fuse panelboards, doors for overcurrent devices are not to be provided.
 - 2. Heavy code gauge steel as required to maintain panel face flat.
 - 3. Hold front closed with trim clamps.
 - 4. Factory finished in medium gray enamel or two coats of air-drying lacquer over a rust inhibitor.
 - 5. Provide directory for total number of poles.
 - 6. Provide approved lock. All panels keyed alike. Furnish 4 sets of matching keys to the Owner.



- 7. Welded angle rest at the bottom of the door to facilitate cover installation.
- 8. Doors over 48" in height shall have auxiliary fasteners at top and bottom of door in addition to lock and catch.
- 9. Door-in-door construction.

F. Terminal lugs

- 1. Bolted type, labeled for either copper or aluminum conductors.
- 2. Locate main lugs properly at top or bottom, depending where main feeder enters.
- G. Electrical Ratings
 - 1. Panelboards are to be rated 120/208 or 277/480 volts 3 phase, 4 wire, full neutral with ampacities as indicated on the Drawings (unless otherwise noted).
 - 2. Short circuit withstand ratings shall be as indicated on the Drawings. Panelboards shall be fully rated. Series rated not acceptable.
 - 3. Where indicated, provide panelboards having a "service entrance" Type UL label with neutrals factory bonded to frame or enclosure.
- H. Circuit Breaker Devices
 - 1. Plastic molded case. Completely sealed enclosure. Toggle type operating handle. Trip ampere rating and ON/OFF indication clearly visible.
 - 2. Thermal-magnetic trip-free, trip-indicating, quick-make, quick-break, with inverse time delay characteristics. Single-handle and common tripping multipole breakers.
 - 3. Silver alloy contacts with auxiliary arc-quenching devices.
 - 4. Panelboard must be of the type which will accept the field installation of shunt trip devices of 60 amperes or less on the branch devices.
 - 5. Interrupting capacities shall be as indicated on the Drawings. In general, 120/208 volt devices shall be not less than (10,000 AIC). And 277/480 not less than (14,000 AIC).
 - 6. Arc Fault Circuit Breaker Devices shall be equipped with 5mA ground fault protection integrated design capability. Provide arc fault breakers (AFCI) for all bedroom lighting and power 15-ampere and 20-ampere single pole 120Volt circuits indicated on the plans.
 - 7. For lighting circuits that are controlled at panel, provide devices labeled "SWD" for switching purposes.
 - 8. Bolted type terminals UL listed for either aluminum or copper 75 degrees C cables.
 - 9. Provide main breakers in panels served from transformers.
 - 10. Locate next to each breaker or space unit an individual number.
 - 11. Circuit breakers serving kitchen equipment beneath cooking hoods shall include a shunt trip coil.
 - 12. Panelboard shall accept circuit breakers from 15 ampere to 100 ampere.
- I. Life Safety Circuit Breakers
 - 1. For all main and sub-feed circuit breakers for the life safety distribution system, the circuit breakers shall be provided with electronic trip unit with LSI settings. This is required for selective coordination. Branch circuit breakers in panelboards may be thermal magnetic trip.



J. Ground Fault Interrupters

Ground fault interrupter branch circuit breakers shall be as indicated in panel schedules. Circuit breakers shall be circuit interrupting which will operate manually for normal switching functions and automatically under overload, short circuit, and 0.005 amp line-to-ground fault conditions. The operation mechanism shall be entirely trip-free so that contact cannot be held closed against an abnormal overcurrent, short circuit, or ground fault condition. The device shall be bolt-on type with insulated case construction and shall be interchangeable with standard 1 P breakers utilized in the panelboard.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount panel 4 feet to panel center but with maximum height of 6 feet 6 inches to handle of topmost switching device.
- B. Mount surface type panels a minimum of 1 inch off wall on channels.
- C. Connect feed-through panels to main feeder by insulated parallel gutter taps. Full-size tap for two panels on a common feeder. Increase cabinet width to accommodate gutter tap.
- D. Where flush mounted, the fire integrity of the wall in which it is installed must be maintained.
- E. Neatly arrange branch circuit wires and tie together in each gutter with Thomas & Betts nylon "Ty-Raps", or approved equal at minimum 4 inch intervals.
- F. Plug all knockouts removed and not utilized.

3.2 TOUCH UP AND CLEANING

- A. Vacuum all backboxes clean of debris after installation and prior to final payment.
- B. Touch up scratch marks, etc. with matching paint.

END OF SECTION 26 24 16

SECTION 26 27 26: WIRING DEVICES

PART 1 - GENERAL

- 1.1 DESCRIPTIONS
 - A. General: Provide wiring devices in accordance with the Contract Documents.

1.2 QUALITY ASSURANCE

- A. Switches and receptacles shall be of the same manufacturer.
- B. Reference shall be made to the drawings for additional wiring devices not noted in this section of the specifications.
- C. Manufacturer shall have a minimum of ten (10) years experience in the manufacture of wiring devices similar to those specified on this project.
- D. Manufacturer shall have ISO-9002 certification.

1.3 STANDARDS

- A. Switches: Federal Specifications WS-896E, NEMA WD-1, and UL 20.
- B. Receptacles: Federal Specification W-C-596, NEMA WD-1, NEMA WD-6, and UL 498.
- C. Ground Fault Circuit Interrupter Receptacles: UL 943 Class A.
- D. USB Receptacles: UL 1310
- E. Wall Dimmers: ANSI C62.41, UL 20.

1.4 SUBMITTALS

- A. Product Data: For each type of products.
- B. Shop Drawings: List and description of materials and the method for receptacle identification.

1.5 COLORS

- A. Device and coverplate (thermostatic) colors connected to the normal power system shall be WHITE unless otherwise indicated on the architectural drawings.
- B. Switches and receptacles connected to the emergency power system shall be red.



PART 2 - PRODUCTS

- 2.1 ACCEPTABLE MANUFACTURERS
 - A. Catalog numbers shall not be used to determine colors of devices and coverplates. Catalog numbers are used to establish minimum acceptable standard.
 - B. Switches and Receptacles: Hubbell or equal, by Cooper Wiring Devices, Leviton, and Pass & Seymour.
 - C. Wall Dimmers: Lutron or equal.
 - D. Floor Boxes and Fittings
 - 1. Poke through type: Hubbell or equal.
 - 2. Recessed flush floor box type: Hubbell or equal.
- 2.2 GENERAL WIRING-DEVICE REQUIREMENTS
 - A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - B. Comply with NFPA 70.
 - C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.
 - 3. Receive Owner approval.
 - D. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
 - E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer

2.3 SWITCHES

- A. General
 - 1. Switches shall be of the type indicated on the Drawings.
 - 2. Switches shall be commercial specification grade, quiet type, 20A, 120/277V, 1 HP rated at 120V, 2HP rated at 277V, back and side wired, silent handle operation.
 - 3. Switch with pilot light shall be specified for applications where the load to be controlled is not in sight. Pilot light shall be long life, LED type and shall be on when the load is off.
- B. Lighting Switches
 - 1. Toggle Handle Type
 - a. Single pole: Hubbell: HBL1221



- C. Key Switches
 - 1. Single pole: Hubbell: HBL1221
- D. Weatherproof Switches
 - 1. Weatherproof handle/coverplate: Hubbell: HBL1795.

2.4 RECEPTACLES

- A. General
 - 1. Receptacles shall be of the type indicated on the Drawings.
 - 2. Receptacles shall be heavy duty 20A specification grade, 125V, grounding type, back and side wired.
- B. Receptacles
 - 1. Single, 20A: Hubbell: HBL5361
 - 2. Duplex, 20A: Hubbell: HBL5362
- C. Tamper Resistant Receptacles
 - 1. Duplex, 20A: Hubbell: HBL5362TR
- D. Ground Fault Circuit Interrupter Receptacles
 - 1. Duplex, 20A: Hubbell: HBLGF20LA
 - 2. Duplex 20A: Hubbell Tamper Resistant: HBLGFTR20
- E. Special purpose receptacles: Rating as indicated on the Drawings.
- F. Weatherproof Receptacles and Cover
 - Exterior weatherproof outlet shall be Hubbell. While in use, cast aluminum, 1 gang vertical, GFCI receptacle Catalog #WP26M or approved equal.

2.5 WALL DIMMERS

1.

- A. Wall dimmers shall be suitable for control of the load type (incandescent, LED, or fluorescent), load capacity, and branch circuit voltage of the lighting fixtures controlled.
- B. Thin profile, linear slide to off control, power failure memory, front accessible service switch, with singlepole or three-way switching.
- C. Lutron Nova T-Star thin profile series, or equal.

2.6 FLOOR BOXES AND FITTINGS

- A. General
 - 1. Provide floor boxes and fittings of the types, ratings, and configurations as shown on the Drawings. Complete with all fittings, wiring devices with tile or carpet assembly.
 - 2. Floor boxes and fittings shall be suitable for the fire rating and thickness of the floor.
 - 3. Combination power/telecom outlets shall have barrier to separate power and telecom wiring.



- B. Fire Rated Poke Through Assembly
 - 1. Fire rated insert, junction box, and service fitting. Combination power/telecom outlets shall have barrier to separate power and telecom wiring. Carpet flange shall be diecast aluminum, painted or plated finish as selected by Architect, Owner.
 - 2. Comply with UL 514 scrub water exclusion requirements.

2.7 SERVICE POLES

- A. Description:
 - 1. Provide service poles of the types and configurations as shown on the drawings complete with all fittings, wiring, devices, etc.
 - 2. Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
 - 3. Poles: Nominal 2.5-inch-square cross section, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.
 - 4. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.

2.8 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic
 - 3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations".

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. General
 - 1. The exact location of wiring devices shall be determined by location of equipment and as detailed on the Architectural Drawings. Prior to installation the Owner has the right to have the devices relocated 25'-0" at no cost.
 - 2. Devices mounted above counters shall be 2 inches above the top of the backsplash to the bottom of the coverplate.
 - B. Switches
 - 1. Mount switches vertically with the ON position on top.
 - 2. Mount switches on the strike side of doors, unless otherwise detailed on the drawings.
 - C. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.



- 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
- 4. Install wiring devices after all wall preparation, including painting, is complete.
- D. Conductors:
 - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.
- E. Device Installation:
 - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 - 8. Tighten unused terminal screws on the device.
 - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold devicemounting screws in yokes, allowing metal-to-metal contact.
- F. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
- G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

WIRING DEVICES

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B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with **[black] [white] [red]**-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
 - 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 - 2. Test Instruments: Use instruments that comply with UL 1436.
 - 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Wiring device will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 16: ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

- 1.1 DESCRIPTION
 - A. Provide enclosed fusible disconnect switches [and circuit breakers] in accordance with the Contract Documents.

1.2 STANDARDS

- A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:
 - 1. UL Standards #98
 - 2. NEMA KS-1

1.3 SUBMITTALS

A. Submit manufacturers' data for all disconnect switches and circuit breakers.

PART 2 - PRODUCTS

- 2.1 ENCLOSED SWITCHES
 - A. Enclosed switches shall be fused heavy-duty, single-throw knife switch with quick-make, quick-break mechanism, capable of full load operations. Meet NEMA and U.S. Government specifications for Class A switches. Install fused switches unless otherwise noted.
 - B. Provide with contact arc-quenching devices, such as magnetic blowouts or snuffing plates. Provide self-aligning switchblades with silver alloy contact areas and designed so that arcing upon making and breaking does not occur on the final contact surfaces. Provide with high-pressure, spring-loaded contact. Mount switch parts on high-grade insulating base. All safety switches shall be fused unless otherwise noted.
 - C. Enclosure: NEMA 1 with hinged door, and defeatable interlock when switch is in "On" position and can be positively padlocked in "on" and "off" positions. Utilize NEMA 3R (rain-tight) enclosure for exterior installations. NEMA 3R enclosures must be galvanized.
 - D. Size fusing and number of poles as shown or as required. Where fused, the devices must be provided with UL listed rejection feature to reject all but Class R fuses. Provide horsepower rated switch to match motor load if no size is shown. Use 3 pole plus solid neutral switches on four wire circuits and 3 pole switches on all other circuits unless otherwise noted.
 - E. Lugs must be UL listed for aluminum and/or copper conductors and be front removable.
 - F. Manufacturer to be the same as that for transformers, switchgear, etc.
 - G. Acceptable manufacturers: Square D, Cutler-Hammer, General Electric or Siemens.

Attachment Q

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2.2 TOGGLE TYPE MANUAL CONTROL SWITCHES

- A. Provide switches that operate at their full rating with fluorescent, tungsten, and resistance loads and at 80% of their rated capacity with motor loads.
- B. Switches to be heavy duty and have:
 - 1. Arc-resisting bodies.
 - 2. Slow make-and-break mechanisms.
 - 3. Silver alloy contact buttons.
 - 4. Side or back wiring with up to No. 10 AWG solid conductors.
- C. Acceptable manufacturers: Square D Class 2510, 11, or 12; General Electric Type RB and Siemens Class MMS with enclosure.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
 - 1. Cutler-Hammer
 - 2. General Electric Company
 - 3. Siemens
 - 4. Square 'D'
- B. General Requirements: Comply with UL489, NEMA AB1, and NEMA AB3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers for circuit breakers 100 amperes and below: inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
- D. Electronic Trip Circuit Breakers for circuit breakers 125 amperes and above: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long-and short-time time adjustments
 - 4. Ground-fault pickup level, time delay, and I²t response.
- E. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles
 - 2. Lugs: Suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuitbreaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - 7. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.


- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250 Type A.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Kitchen and Wash-Down Area: NEMA 250, Type 4X, stainless steel.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Non-corrosive Liquids: NEMA 250, Type 12.
 - 6. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Each piece of equipment utilizing multi-phase power shall be supplied with a safety-type disconnect switch.
- B. Each piece of equipment utilizing single-phase power and protected at over 30 amperes shall be supplied with a safety-type disconnect switch.
- C. Motor disconnects other than mentioned above may utilize a toggle type manual control switch properly sized and rated for the equipment it disconnects.
- D. Factory installed fused disconnect switches may be used to satisfy the above requirements with the Architect's prior approval.

3.2 MOUNTING

A. Switches or circuit breakers less than 100 pounds may be mounted on the wall. Equipment over 100 pounds shall be mounted on a rack that extends from floor to ceiling. Do not mount switches or circuit breakers to equipment housing.

END OF SECTION 26 28 16

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SECTION 26 52 00: SOLID STATE LIGHTING

PART 1 - GENERAL

- 1.1 DESCRIPTION
 - A. Section includes, but is not necessarily limited to, the furnishing and installation of solid state lighting (SSL) Luminaires (herein referred to as Luminaires) applied to the illumination of interior and exterior spaces. Luminaires shall be listed in accordance with national recognized testing laboratories (NETLs) approved by the United States Department of Labor, Occupational Safety and Health Administration (OSHA).

1.2 RELATED DOCUMENTS

- A. Specification Section 260923 "Lighting Control System".
- B. Specification Section 265100 "Interior Lighting".

1.3 DEFINITIONS AND STANDARDS

A. The terms and standards used or referenced herein are defined as follows:

ANSI-C78.377	American National Standard for Electric Lamps – Specifications for the Chromacity of Solid State Lighting (SSL) Products.
ANSI-C82.11	American National Standard for Lamp Ballasts – High Frequency Fluorescent Lamp Ballasts.
ANSI-C82.SSL1	SSL Drivers (in ANSI development)
CALIPER	Commercially Available LED Product Evaluation and Reporting 'A' US DOE program for the testing and monitoring of commercially available LED Luminaires and lights.
ССТ	Correlated Color Temperature: Visible light characteristic of comparing a light source to a theoretical, heated black body radiator; measured in Kelvin.
Cd	Candela: Unit of measurement of light intensity.
Chromaticity	The property of color of light.
fc	foot-candle. Unit of illuminance.
IEC-EN-61000-6-3	International Electotechnical Commission – Electromagnetic Compatibility (EMC) Generic Standards – Emission Standard for residential, commercial and light-industrial environments.
IEEE C62.41.1	IEEE Guide on the Surge Environment in Low-Voltage (1000V and less) AC Power Circuits.
IEEE C62.41.2	IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits.

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BID NO. PUR - 1751 | BID SET | MAY 2025

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ods: Electrical a	and	

Illuminating Engineering Society – Approved Methods: Electrical and Photometric Measurements of Solid-State Lighting Products.
Illuminating Engineering Society – Approved Methods: Measuring Lumen Maintenance of LED Light Sources.
Illuminating Engineering Society – Approved Methods: Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature.
Method for determining an LED luminaire or integral replacement lamp's expected operating life, based on initial performance data collected per IES-LM-80.
The extrapolated life in hours of the luminaire when the luminous output depreciates 20 percent from initial values.
Light Emitting Diode.
Material Engineering and Testing Services of the Translab.
National Electrical Manufacturers Association.
National Voluntary Laboratory Accreditation Program. A program under the US DOE to accredit independent testing laboratories to qualify.
The ratio of the real power component to the total (complex) power component.
Power consumption that the luminaire was designed and tested for at ambient temperature.
Surge Protection Device. A subsystem or component(s) that can protect the unit against short duration voltage and current surges.
Solid-State Lighting.
Total Harmonic Distortion. The amount of higher frequency power on the power line.

- B. Except as herein specified or as indicted on the Drawings, the work of this section shall comply with the following:
 - 1. ANSI-UL Standards
 - a. 924 Emergency Lighting and Power Equipment
 - b. C78.377 Chromacity of Solid State Lighting (SSL) Products
 - c. C82.11 High Frequency Fluorescent Lamp Ballasts
 - d. C82.SSL1 SSL Drivers
 - 2. IEC
 - a. EN-61000-6-3 EMC Emission Standards
 - 3. NFPA
 - a. 70-NEC
 - b. 101-Life Safety
 - 4. Standards as listed and referenced in this Specification.

C. All LED Luminaires shall have a CRI of at least 80, an estimated life of at least 50,000 hours at 70% lumen maintenance, and shall include a minimum 5-year warranty on the entire luminaire including the driver. The luminaire and LEDs shall have been tested in accordance with LM-79 and LM-80.

1.4 FIXTURE SCHEDULE

- A. No substitutions other than the equal manufacturers listed on the light fixture schedule will be accepted, unless otherwise approved in writing by the Engineer. The lighting equipment specified herein has been carefully chosen for its ability to meet luminous performance requirements of this project. Substitutions in all likelihood will be unable to meet all of the same criteria as specified equipment.
- B. This Contractor shall include in his Base Bid spare materials for all lighting fixtures installed on the project. Refer to drawings for additional information regarding spare stock. Turn this equipment over to the Owner at completion of the project. Provide a typewritten label on each fixture with lamp ordering code number for Owner's future maintenance replacement. Locate label so that it can be seen from normal viewing angle.
- C. Once Bids and Shop Drawings are approved, all lighting is to be ordered according to construction schedule and lead times. The Contractor is then to inform the Engineer immediately, in writing, the date when equipment orders are completed and delivery scheduled.

1.5 SUBMITTALS

- A. Submit shop drawings and manufacturers' data for the following items in accordance with the conditions of the contract and as specified below.
 - 1. Shop drawings shall be submitted with product datasheets that include the following information:
 - a. General device descriptions
 - b. Dimensions
 - c. Wiring details
 - d. Nomenclature
 - e. Operating temperature range
 - f. System efficacy
 - g. Rated life
 - h. Rated output
 - i. Input wattage
 - j. Inrush current
 - k. THD
 - I. Power factor
 - m. Warranty
 - n. CCT
 - o. The rated life
 - p. Lumen output

This information shall be provided for the actual lumen package and driver combination specified. Provide information regarding the effects of temperature on the rated life and lumen output. If applicable, the submittal shall also include the US Department of Energy Lighting Facts label.

2. Major luminaires and special luminaires shall show full size cross sections. Indicate finished dimensions, metal thicknesses, and materials.

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- 3. Show mounting details, including hung ceiling construction.
- 4. Shop drawings shall include a complete listing of all luminaires on a single sheet. This listing shall contain the luminaire type, manufacturer's catalog number, applied voltage, and wattage.
- 5. Submit manufacturer's fixtures and accessories Shop Drawings and data in booklet form, including rough-in dimensions, instructions for installation and maintenance.

1.6 WARRANTY

- A. The manufacturer shall provide a warranty against loss of performance and defects in materials, finishes, and workmanship for the Luminaires and all components for a minimum period of 5 years after acceptance of the Luminaires. Replacement Luminaires shall be provided promptly after receipt of Luminaires that have failed at no cost to the customer. All warranty documentation shall be provided to customer prior to random sample testing.
- B. Failure of the LED light source shall be defined as failure or negligible output of 10% or more individual LEDs within the LED array, bar, etc.

1.7 PROTECTION

A. Protect lighting fixtures and work against dirt, water or mechanical damage before, during, and after installation. Damage to fixtures prior to final acceptance shall be repaired or replaced at no cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS AND FIXTURES

A. General

- 1. Provide all lighting fixtures in accordance with Lighting Fixture Schedule and as indicated and required on Drawings.
- 2. Fixture catalog numbers only indicate type and style. Provide each fixture complete with proper fixture trim, levelers, mounting brackets, flanges, plaster rings, glassware and accessories for complete installation as required for type of ceiling and room finish schedules.
- 3. All plastic diffusers used in lighting fixtures shall be manufactured of 100 percent virgin acrylic plastic, polycarbonate, or as otherwise noted.
- 4. Provide approved fireproof enclosures UL rated (UL 0529) where recessed in fire rated ceilings.
- 5. Provide gaskets as required to prevent light spill between frames and ceilings.
- 6. Provide "wet" labels on all fixtures installed outdoors or in moist areas.
- 7. Provide continuity of ground on all fixtures used as raceways and mounted end to end.
- 8. All metal parts to be chemically treated with a rust resistant phosphatized solution, internal components and reflecting surfaces to have a factor of minimum 90%.
- 9. Provide luminaires, completely factory-assembled and wired and equipped with necessary light sources, drivers, wiring, shielding, reflectors, channels, lenses, etc., and deliver to job ready for installation.
- 10. Luminaire Reflector Care: Luminaires with Alzak reflectors shall be installed with Mylar cover over reflectors. Cover shall be UL listed for temporary lighting. Upon completion of work, remove Mylar cover with white glove and blow clean reflectors.

- 11. Finish: Porcelain or baked enamel finish matte white on interiors with minimum test reflectance of 90% matte white finish or as specified in visible exterior. Thoroughly clean base metal and bonderize after fabrication.
- 12. Where utilized as raceway, luminaires shall be suitable for use as raceways. Provide feed through splice boxes where necessary. Wiring shall be rated for 90 degrees Centigrade.

B. Luminaires

- 1. Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply). If required, components such as the LED array and driver shall be modular and replaceable without removing the luminaire.
- 2. Each luminaire shall be rated for a minimum operational life as specified on lighting fixture schedule or per basis of design luminaire, as defined by IES LM-80 and TM-21.
- 3. Each luminaire shall be designed to operate at an average operating temperature of 25°C.
- a. The typical operating temperature range shall be -10°C to +25°C, unless otherwise specified on lighting fixture schedule and Drawings.
- b. Some parameters and tests (such as IESNA standard LM-80-08) shall be conducted at different ambient temperatures.
- 4. Each luminaire shall meet all parameters of this specification throughout the minimum operational life when operated within the rated temperature range.
- 5. The individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
- 6. Each luminaire shall be listed with a nationally recognized testing laboratory (including but not limited to UL, CSA, ETL) under UL 1598 and UL 8750, or an equivalent standard from a recognized testing laboratory.
- C. LEDs
 - 1. The light source of the luminaires shall consist of LED arrays or bars. If required, the LED arrays or bars shall be removeable.
 - The LEDs shall be either white or RGB, according to the light fixture schedule and Drawings. For luminaires specified with white light, it is not acceptable to provide RGB LEDs mixed to produce white light.
 - 3. Refer to the light fixture schedule and Drawings for the specified correlated color temperature (CCT) of each luminaire.
 - 4. Individual LEDs shall be binned by manufacturer to comply with ANSI C78.377.
 - 5. The LEDs shall be manufactured by Cree, Philips, Toshiba, Osram, Samsung, or Nichia, unless otherwise noted.
- D. Drivers
 - 1. The driver or power supply for the luminaire shall be modular and replaceable.
 - 2. The rated life of the driver shall match the rated life of the LEDs and luminaire.
 - 3. In general, the drive current rating of the driver shall be minimized, while still maintaining the required lumen output, to improve luminaire efficiency and life.
 - 4. The driver shall meet the emission standards of IEC EN-61000-6-3 at a minimum. For healthcare or other applications with EMI sensitive equipment, provide drivers that meet more stringent standards as required.

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- E. Exit Lighting
 - 1. Exit lighting system shall be as indicated on Drawings.
 - 2. Equipment shall be complete with LED light sources.
 - 3. Where indicated as such, provide battery pack and charger with self-diagnostics for illumination under power failure conditions.
 - 4. Equipment shall meet BOCA, OSHA, NFPA and NEC illumination standards.
- F. Emergency Lighting
 - 1. Provide GTD or GTD20A transfer devices suitable for use with solid-state lighting (Bodine or approved equal manufacturer) as indicated on drawings, light fixture schedule, and lighting control schedule.

2.2 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel and angleiron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2 inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, ½ inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- PART 3 TECHNICAL REQUIREMENTS
- 3.1 ELECTRICAL
 - A. Power Consumption: Maximum power consumption allowed for the luminaire shall be per basis of design light fixture listed on lighting fixture schedule.
 - B. Operation Voltage
 - The luminaire shall operate from a 60 HZ ±3 HZ AC line over a voltage ranging from [110 VAC to 277 VAC as specified on the drawings. The fluctuations of line voltage shall have no visible effect on the luminous output.
 - 2. The standard operating voltages are 120 VAC as shown on drawings.
 - C. Current: The inrush current for the luminaire shall be published on the luminaire data sheet and shall be less than that of the basis of design fixture listed on the light fixture schedule.
 - D. Power Factor: The luminaire shall have a power factor of 0.90% or greater at all standard operating voltages.
 - E. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent at any standard input voltage. The luminaire shall comply with ANSI C82.11, or equivalent ANSI LED Standard C82.SSL1.



- F. Surge Suppression: The luminaire shall include surge protection to withstand high repetition noise and other interference.
 - 1. The surge protection which may reside within the driver shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 for Location Category A Low. Where failure does not mean a momentary loss of light during the transient event.
 - 2. Surge protection performance shall be tested per the procedures in ANSI/IEEE C62.45 based on ANSI/IEEE C62.41 definitions for standard and optional waveforms for Location Category A-Low
- G. Operational Performance: The LED circuitry shall prevent perceptible flicker to the unaided eye over the voltage range specified above.
- H. RF Interference: The luminaire and associated on-board circuitry must meet Class A emission limits referred in IEC EN-61000-6-3 and Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
- I. Dimming: Where dimming is specified on the drawings, the luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100% to 5% of rated lumen output. Dimming shall be controlled by a 0-10V signal, unless otherwise noted or specified.
 - 1. Dimming switches and other control system components shall be compatible with the LED driver type constant current reduction (CCR) or pulse-width modulation (PWM). The device(s) shall be rated to accommodate full load, as well as inrush current and repetitive peak currents.
 - 2. The luminaire and dimming controls shall produce a smooth change in lumen output, without any visible flicker.
 - 3. The luminaire shall be capable of dimming without any visible change in CCT and color rendition.
- J. Multi-Level Control: Where specified on drawings, the luminaire shall be provided with multiple power supplies, multi-level power supply, or other similar means to facilitate multi-level control of luminaire.
- K. Temperature Range: The luminaire shall have the capability of operating and maintaining rated lumen output and rated life within the temperature range specified on the lighting fixture schedule and Drawings, or within that of the basis of design luminaire if no temperature range is specifically listed.
- L. Lumen Output and Performance
 - 1. The luminaire shall maintain the lumen output specified on the lighting fixture schedule and Drawings, or that of the basis of design luminaire if no minimum lumen output is specifically listed.
 - 2. The lumen output shall be maintained regardless of ambient temperature fluctuations, within the rated temperature range. The luminaire data sheets shall specify any effect or variation on lumen output from temperature.
 - 3. The luminaire shall be capable of continuously monitoring system performance to allow for constant lumen management/compensation, if specified in lighting fixture schedule, Drawings, or basis of design luminaire.
 - 4. The luminaire shall provide a total system efficacy that meets or exceeds that of the basis of design luminaire listed on the light fixture schedule and Drawings.
- M. Rated Life: The luminaire shall have a rated life that meets or exceeds that listed on the lighting fixture schedule and Drawings, or that of the basis of design luminaire if no rated life is specifically listed.



3.2 PHOTOMETRIC REQUIREMENTS

- A. Light Output
 - 1. The minimum initial lumen output of the luminaire exiting the luminaire in the 0-90 degree zone as measured by IESNA Standard LM-79-08 shall be as specified in the lighting fixture schedule and Drawings, or that of the basis of design luminaire if no lumen output is specifically listed.
 - 2. The lumen output shall not decrease by more than 30% over the minimum operational life (or L70 shall be at least the minimum number of hours specified).
 - 3. The measurements shall be calibrated to standard photopic calibrations.
- B. Light Color/Quality
 - 1. Corrected Color temperature (CCT) range shall be correlated to chromaticity as defined by the absolute (X,Y) coordinates on the 2-D CIE chromaticity chart.
 - 2. The color rendition index (CRI) shall be 80 or greater for interior applications, and 70 or greater for exterior applications.

3.3 THERMAL MANAGEMENT

- A. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
 - 1. The LED manufacturer's maximum junction temperature for the expected life shall not be exceeded at the average operating ambient.
 - 2. The LED manufacturer's maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient.
 - 3. The luminaire shall have an UL IC rating, if applicable.
- B. The Driver manufacturer's maximum case temperature shall not be exceeded at the maximum operating ambient. Thermal management shall be passive by design.
 - 1. The use of fans or other mechanical devices shall not be allowed.

3.4 PHYSICAL AND MECHANICAL REQUIREMENTS

- A. The luminaire shall be a single, self-contained device, not requiring on-site assembly for installation. The power supply for the luminaire shall be integral to the unit, unless otherwise specified.
- B. The assembly and manufacturing process for the SSL luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration.
- C. The optical assembly of the luminaire shall be constructed so that individual LED images shall not be visible to the occupant.
- D. The electronics/power supply enclosure shall be internal to the SSL luminaire and be accessible per UL requirements.
- E. The circuit board and power supply shall be contained inside the luminaire.



G. For LED retrofit lamps, the weight of the unit shall be in compliance with weight ratings of the lamp sockets/bases.

3.5 MATERIALS

- A. Housings shall be fabricated from material indicated on lighting fixture schedule.
- B. If applicable, refractor or lens shall be made from UV inhibited high impact plastic (such as acrylic or polycarbonate) or heat and impact resistant glass.
- C. If applicable, polymeric materials of enclosures containing either the power supply or electronic components of the luminaire shall be made of UL94VO flame retardant materials. The lenses of the luminaire are excluded from this requirement.

3.6 LUMINAIRE IDENTIFICATION

- A. Each luminaire shall have the manufacturer's name, trademark, model number, serial number, date of manufacture (month-year), and lot number as identification permanently marked inside the each unit and the outside of each packaging box.
- B. The following operating characteristics shall be permanently marked inside each unit: rated voltage and rated power in Watts and Volt-Ampere.

3.7 QUALITY ASSURANCE

- A. The luminaires shall be manufactured in accordance with a manufacturer quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) design quality assurance and (2) production quality assurance. The production quality assurance shall include statistically controlled routine tests to ensure minimum performance levels of the modules built to meet this specification, and a documented process of how problems are to be resolved.
- B. QA process and test results documentation shall be kept on file for a minimum period of seven years.
- C. LED luminaire designs not satisfying design qualification testing and the production quality assurance testing performance requirements described below shall not be labeled, advertised, or sold as conforming to this specification.

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D. Design Qualification Testing

- 1. Design Qualification Testing shall be performed by a National Voluntary Laboratory Accreditation Program (NVLAP) testing facility. Such testing may be performed by the manufacturer or an independent testing lab hired by the manufacturer on new luminaire designs, and when a major design change has been implemented on an existing design. A major design change is defined as a design change (electrical or physical) which changes any of the performance characteristics of the luminaire, results in a different circuit configuration for the power supply, or changes the layout of the individual LED's in the module.
- 2. A quantity of two units for each design shall be submitted for Design Qualification Testing.
- Product submittals shall be accompanied by product specification sheets or other documentation that includes the designed parameters as detailed in this specification. These parameters include (but not limited to):
- 4. Maximum power in Watts
- 5. Maximum Designed Junction Temperature
- 6. L70 in hours, when extrapolated for the average operating temperature
- Product submittals shall be accompanied by performance data that is derived in accordance with appropriate IESNA testing standards and tested in a laboratory that is NVLAP accredited for Energy Efficient Lighting Products.
- 8. Product submittals shall be accompanied by a test report showing surge protection performance as tested per the definitions and procedures in ANSI/IEEE C62.41 1991
- Thermal testing data and reporting shall be provided based in the sensor input as defined below:

 Temperature sensors shall me mounted on the LED solder pads as close to the LED as possible.
- Burn-In: Before any customer design qualification testing is performed, the sample Luminaires shall be energized for a minimum of 24 hours, at 100 percent on-time duty cycle, at a temperature of +70°F (+21°C).
- 11. Any failure of the luminaire, which renders the unit non-compliant with the specification after burn-in, shall be cause for rejection.
- 12. The luminaire shall be tested as described herein.
 - a. Luminaire performance shall be judged against the specified minimum illuminance in the specified pattern for a particular application.
 - b. The luminaire lighting performance shall be adjusted (depreciated) for the minimum life expectancy.
 - The performance shall be adjusted (depreciated) by using the LED manufacturer's data or the data from the IESNA Standard LM-80-08 test report, which ever one results in a higher level of lumen depreciation.
 - c. The luminaire may be determined to be compliant photometrically, if:
 - 1) The initial minimum illuminance level is achieved in 100% of the area of the specified lighting pattern, and
 - 2) The depreciated minimum illuminance is maintained in at least 95% of the area of the specified lighting pattern, and
 - 3) The minimum length of the depreciated iso-footcandle curve is equal or greater than the length of the specified iso-footcandle curve.

3.8 QUALITY ASSURANCE TESTING (RANDOM SAMPLE TESTING)

A. Random sample testing may be performed on all shipments.



- B. Testing shall be completed within 30 days.
- C. All parameters of the specification may be tested on the shipment sample.

PART 4 - EXECUTION

4.1 INSPECTION AND PREPARATION

- A. General
 - 1. Install outlets, surface mounted, recessed or semi-recessed fixtures to maintain the alignment, spacings, layout and general arrangements indicated in the Drawings. Obtain approval of Engineer for all changes in layout required to avoid interferences with other trades.
 - 2. Install one light fixture of each type and mounting for approval of Owner and Engineer prior to mounting all light fixtures.
- B. Coordination
 - 1. Work incorporating with ceiling trades in locating and framing recessed fixtures in acoustical tile pattern or grid system to conform to layout.
 - Inform affected trades of the location and framing details necessary for the installation of flush fixtures and deliver all framing rings of these fixtures that become a part of the ceiling construction.
 - 3. Before equipment is ordered, electrical contractor to review luminaire and ceiling mechanical compatibility in each area and verify luminaire on the drawings. Contractor shall be responsible for all fixture quantities, lengths and clearances required and shall inform the Owner of the job conditions at variance with the fixture(s) specified or detailed which affect installation or location. (All stages of installation.)
 - 4. Mechanical and electrical contractors are to review and coordinate lighting locations in relationship to mechanical systems to minimize conflicts prior to installation.
 - 5. This contractor is responsible for coordinating the characteristics and the U.L. labeling of the luminaires and their components with the ambient conditions, which will exist when the luminaires are installed. No extra compensation will be permitted for failure to coordinate the luminaires with their ambient conditions.
- C. Mounting and Supports
 - 1. Install luminaires in mechanical and unfinished areas after ductwork and piping installation.
 - Where luminaires are surface mounted, they shall be labeled for such and a minimum of one-half (1/2) inch air space and shall be maintained between top of luminaire and mounting surface by an approved means.
 - 3. Pendant mounted units shall comply with the following:
 - a. Where luminaires are mounted in a continuous row, luminaires, eight feet in length shall have stems placed within 2'-0" of end of fixture. Stems shall be spaced symmetrically. A fixture, four feet or three feet in length, placed in a row, shall have a stem connected to center luminaire.
 - b. Individual luminaires, four feet in length, shall have two stems placed approximately 3 inches from each end.
 - c. Individual luminaire, three feet in length, shall have dual stems and a single canopy.
 - d. Each stem shall have a brass or steel swivel or other self-aligning device of type approved by the Engineer.



- 4. Where luminaires are mounted on surface-mounted outlet boxes in surface mounted conduit runs, this Contractor shall furnish and install a luminaire canopy sufficiently deep to permit exposed conduits to pass through. Canopy shall have proper openings cut by luminaire manufacturer through which conduits may pass. Submit sample of canopy for approval before installation.
- 5. Prior to final payment, this contractor shall clean all luminaires and replace any burned out LED modules. He shall also touch up all scratch marks, etc. in an approved manner.
- 6. Provide a minimum of two support points for all surface, pendant or recessed mounted luminaires. The supports shall be tied to the building structural system. The support points shall be totally independent of the ceiling system.
- Recessed luminaires to be installed in metal panel or acoustic modular ceilings shall be modified as required to fit into openings in ceiling construction. Shop Drawings showing details shall be submitted for approval.
- 8. All luminaires in hung ceilings are to be installed with earthquake clips.
- D. Emergency Systems Raceway and Hook-up
 - 1. Circuit wiring for the emergency systems shall be installed in separate raceway and kept entirely independent of all other wiring and equipment.

4.2 ADJUSTING AND CLEANING

- A. At project completion, before final approval:
 - 1. Aim adjustable fixtures as directed by Engineer and observe and adjust at night as required.
 - 2. Clean interior of all fixtures, all lenses and LED modules.

END OF SECTION 26 52 00

SECTION 28 31 11: ADDITIONS TO THE EXISTING ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Division 01 General Requirements
 - 2. Division 07 Thermal and Moisture Protection, Section 078413 Penetration Fire-stopping
 - 3. Division 08 Openings, Section 087100 Door Hardware
 - 4. Division 21 Fire Suppression
 - 5. Division 23 Heating Ventilating and Air Conditioning Monitoring & Control (HVAC).
 - 6. Division 26 Electrical, Section 260500 Common Work Results for Electrical

1.2 SUMMARY

- A. Section Includes:
 - 1. This specification describes providing additions to the existing addressable Fire Detection and alarm signaling system. The control panel shall be intelligent device addressable, analog detecting, low voltage and modular, with digital communication techniques, in full compliance with all applicable codes and standards. The features and capacities described in this specification are required as a minimum for this project and shall be furnished by the successful contractor.
 - 2. The system shall be in full compliance with National and Local Codes.
 - 3. The system shall include all required hardware, raceways, interconnecting wiring and software to accomplish the requirements of this specification and the contract drawings, whether or not specifically itemized herein.
 - 4. All equipment furnished shall be new and the latest state of the art products of a single manufacturer, engaged in the manufacturing and sale of analog fire detection devices for over ten years.
 - 5. The system as specified shall be supplied, installed, tested and approved by the local Authority Having Jurisdiction, and turned over to the owner in an operational condition.
 - 6. In the interest of job coordination and responsibilities the installing contractor shall contract with a single supplier for fire alarm equipment, engineering, programming, inspection and tests, and shall be capable of providing a "UL Listing Certificate" for the complete system.
 - 7. The system specified shall meet all project requirements. Other systems shall be submitted 10 days prior to bid date for approval by the Engineer. All system approved shall meet all the requirements spelled out in this specification. System approval shall be in writing by the Engineer and a copy shall be submitted with the system submittals.
 - 8. After successful Installation, Test, Inspection and Acceptance of the Fire Alarm System, this contractor shall remove the existing inclusive of all abandoned cable, wire and raceway, "Patching and Painting" as required to match the existing surfaces. The contract drawings "May Not" identify all the existing devices which will be removed. It is this contractor's responsibility to make a site survey prior to bidding this contract to identify all such devices, raceway, cable, wiring, etc., to be removed.



1.3 **DEFINITIONS**

- A. ASME: American Society of Mechanical Engineers
- B. FACP: Fire alarm control panel.
- C. FM: FM Global (Factory Mutual)
- D. Furnish: To supply the stated equipment or materials.
- E. Install: To set in position and connect or adjust for use.
- F. LED: Light-emitting diode.
- G. NCC: Network Command Center
- H. NFPA: National Fire Protection Association. Definitions in NFPA 72 apply to fire alarm terms used in this Section.
- I. NICET: National Institute for Certification in Engineering Technologies.
- J. Provide: To furnish and install the stated equipment or materials.
- K. UL: Underwriters Laboratories

1.4 SYSTEM DESCRIPTION

- A. Basic System The system shall be a complete, electrically supervised fire detection and notification system, with a microprocessor based operating system having the following capabilities, features, and capacities:
 - 1. Support of mobile test system capable of providing point test reports in NFPA standard format without manual report entries.
 - 2. The control panel shall allow control and monitoring from a wireless handheld display device during maintenance, inspection and trouble-shooting tasks.
 - a. The control panel shall allow complete control and monitoring from a wireless handheld display device during one-man testing of the system.
 - b. Testing supported should be real smoke testing of devices, automatically logged and made available in NFPA format reports. Manual test entries will not be accepted.
 - 3. System shall provide an output port for monitoring purposes by external systems. Communications to an external system shall be RS-232 or RS-485 communications.
 - 4. A single node or system shall support at least 50 remote transponders.
 - 5. The local system shall provide status indicators and control switches for all of the following functions:
 - a. Audible and visual notification alarm circuit zone control.
 - b. Status indicators for sprinkler system water-flow and valve supervisory devices.
 - c. Any additional status or control functions as indicated on the drawings, including but not limited to; emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.



- 6. The system shall be UL 1076 listed for monitoring and reporting security System Zoning.
- 7. Each intelligent addressable device or conventional zone on the system shall be displayed at the Central Alarm Receiving Terminal and the local fire alarm control panel by a unique alphanumeric label identifying its location.
- B. FACP shall have the ability to interface with earlier addressable devices. Replacement of existing field devices shall be unnecessary for proper system operation.
- C. FACP components shall have the ability to be mounted in existing enclosures. Replacement of existing back boxes shall be unnecessary.
- 1.5 PERFORMANCE REQUIREMENTS
 - A. General Performance: Comply with NFPA 72 and all contract documents and specification requirements.
 - B. All interconnections between this system and the monitoring system shall be arranged so that the entire system can be UL-Certificated.
 - C. System shall be a complete, supervised, non-coded, addressable multiplex fire alarm system conforming to NFPA 72.
 - D. The system shall have Style 4 circuits for each floor. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal.
 - E. The system shall provide the following functions and operating features:
 - 1. The FACP and auxiliary power panels shall provide power, annunciation, supervision and control for the system.
 - 2. Provide Class B initiating device circuits.
 - 3. Provide Class B notification appliance circuits (NAC), arrange circuits to allow for individual, selective, and all-call voice /visual notification by zone. Notification Appliance Circuits shall be zoned to correspond with the building fire barriers and other building features.
 - 4. Stair-towers: Each Stair-tower NAC shall be separately zoned.
 - 5. Elevators: Each Elevator Group NAC shall be separately zoned.
 - 6. Strobes shall be synchronized throughout the entire building.
 - 7. If a voice evacuation system is specified, the system amplifiers shall be configured as distributed. If necessary, convenience paging and/or background music shall be available via UL-listed speakers.
 - 8. Provide 8 channel for live and recorded voice messaging.
 - 9. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.
 - F. The system shall provide a field test function where one person can test the complete system or a specific area while maintaining full operational function of other areas not being tested. Alarms, supervisory signals, trouble signals shall be logged on the system printer and in system history during the walk-test.

- G. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.
- H. Fire alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual pull station
 - 2. Heat detector
 - 3. Addressable area smoke detector
 - 4. Duct smoke detector
 - 5. Automatic sprinkler system water flow switch.
- I. Activation of any system fire, security, supervisory, trouble, or status initiating device shall cause the following actions and indications at all network Person Machine Interfaces using basic graphics and multiple detail screens.
 - 1. Fire Alarm Condition:
 - a. Sound an audible alarm and display a custom screen/message defining the building in alarm and the specific alarm point initiating the alarm in a graphic display.
 - b. Log into the system history archives all activity pertaining to the alarm condition.
 - c. Sound the ANSI 117-1 signal with synchronized audibles and synchronized strobes throughout the facility.
 - d. Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmable to flash until system reset or alarm silencing, as required.
 - e. A signal dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
 - f. Activation of any smoke detector in a single elevator lobby or an elevator equipment room shall, in addition to the actions described, cause the recall of that bank of elevators to the 1st floor and the lockout of controls. In the event of recall initiation by a detector in the first floor lobby, the recall shall be to the alternate floor as determined by the AHJ.
 - g. Where indicated on drawings heat detectors in elevator shaft and machine rooms shall activate an elevator power shunt trip breaker. The heat detectors shall be rated at a temperature below the ratings of the sprinkler heads in respective locations to insure that the power shall be shut off before activation of sprinkler system.
 - h. Control circuits to shut down elevator power shall be "Monitored" for the presence of operating voltage in accordance with NFPA 72. Loss of power to this control circuit shall active a "Supervisory" event on the Fire Alarm System.
 - i. Activation of a detector in the elevator machine room or in the elevator shaft shall activate a "Visual Warning" in the associated elevator(s).
 - j. All Monitoring and Control Modules required to provide the required function for the elevator(s) shall be provided if either shown or not shown on the contract drawings.
 - k. System operated duct detectors as per local requirements shall accomplish HVAC shut down.
 - I. Door closure devices shall operate by floor or by local requirements.
 - m. Unlock all doors with Mag-locks.
 - n. Turn on and bring all lights in the performing hall to "Full Power" requiring two control modules, see the contract drawings.
 - o. Mute the House PA System in the Sound Booth.
 - p. Mute the "Roadie PA System" on the Stage at a new Shunt Trip Breaker.
 - q. Print the event on the system printer.

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- 2. Additional system operation for Fire Alarm Condition for Voice:
 - a. Sound a pre-announce tone followed by a field programmable digitized custom evacuation message through-out the building except in the stairs and elevators. The visual signals shall operate in a similar pattern with all signals "Synchronized".
 - b. An announcement to the stairs and elevators shall be manually operated from the panel or remote panel. Only audible notification appliances (Speakers) shall be installed in the elevators and stairs with no visual notification appliances (Strobes).
 - c. An automatic announcement or tone evacuation signal shall be capable of interruption by the operation of the system microphone to give voice evacuation instructions overriding the pre-programmed sequences.
 - d. Status lights next to speaker selection switches on the control panel shall indicate speaker circuit selection.
 - e. Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmed to flash until system reset or alarm silencing, as required by the AHJ.
- 3. Supervisory Condition:
 - a. Display the origin of the supervisory condition report at the local fire alarm control panel graphic LCD display.
 - b. Activate supervisory audible and dedicated visual signal.
 - c. Audible signals shall be silenced from the control panel by the supervisory acknowledge switch.
 - d. Record within system history the initiating device and time of occurrence of the event.
 - e. Print the event on the system printer.
- 4. Trouble Condition
 - a. Display at the local fire alarm control panel graphic LCD display, the origin of the trouble condition report.
 - b. Activate trouble audible and visual signals at the control panel and as indicated on the drawings.
 - c. Audible signals shall be silenced from the fire alarm control panel by a trouble acknowledge switch.
 - d. Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall be software selectable and shall not preclude the logging of trouble events to the historical file.
 - e. Trouble reports for primary system power failure to the master control shall be automatically delayed for a period of time equal to 25% of the system standby battery capacity to eliminate spurious reports as a result of power fluctuations.
 - f. Record within system history, the occurrence of the event, the time of occurrence and the device initiating the event.
 - g. Print the event on the system printer.
- 5. Security Condition:
 - a. Display at the local fire alarm control panel graphic LCD display, the origin of the security condition report. A dedicated security LED shall flash until the alarm has been acknowledged, then revert to a steady "ON" state.



- c. The Local Fire Control Panel shall be UL 1076 listed for security purposes.
- d. Print the event on the system printer.
- J. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Complete manufacturer's catalog data including supervisory power usage, alarm power usage, physical dimensions, and finish and mounting requirements.
- B. Power calculations. Battery capacity calculations. Battery size shall be a minimum of 125% of the calculated requirement. Provide the following supporting information:
 - 1. Supervisory power requirements for all equipment.
 - 2. Alarm power requirements for all equipment.
 - 3. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25% spare capacity.
 - 4. Amplifiers shall be sized to furnish the total connected load in a worst-case condition plus 25% spare capacity.
 - 5. Voltage drop calculations for wiring runs demonstrating worst-case condition.
 - 6. NAC circuit design shall incorporate a 25% spare capacity for future expansion.
 - 7. SLC circuit design shall incorporate a 25% spare capacity for future expansion.
 - 8. IDC circuit design shall incorporate a single initiating device so that it is uniquely identified on the system.
- C. Submit manufacturer's requirements for testing signaling line circuits and device addresses prior to connecting to control panel. At a minimum the following tests shall be required; device address, the usage (Alarm, Supervisory etc), environmental compensation, temperature ratings for thermal detectors and smoke detector sensitivities. This requirement shall need approval before any wiring is connected to the control panel.
- D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

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- 3. Complete drawings covering the following shall be submitted by the contractor for the proposed system:
 - a. Floor plans in a CAD compatible format at a scale of 1/8"=1'-0" showing all equipment and raceways, marked for size, conductor count with type and size, showing the percentage of allowable National Electric Code fill used.
 - Provide a fire alarm system function matrix as referenced by NFPA 72, Figure A-7-5.2.2 (9). Matrix shall illustrate alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions. Include any and all departures, exceptions, variances or substitutions from these specifications and/or drawings at time of bid.
- 4. Installation drawings shop drawings, and as-built drawings shall be prepared by an individual experienced with the work specified herein.
- 5. Incomplete submittals shall be returned without review, unless with prior approval of the Engineer.
- E. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Light fixtures.
 - 2. HVAC registers
 - 3. Fire protection equipment interfaces
 - 4. Special suppression system interfaces
- F. Qualification Data: For qualified Installer, Applicator, manufacturer, fabricator, professional engineer, testing agency, and factory-authorized service representative.
- G. Source quality-control reports.
- H. Field quality-control reports.
- I. Operation and Maintenance Data: For all fire alarm equipment, to include in operation and maintenance manuals.
- J. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
- K. Warranty: Sample of special warranty.



L. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make a simultaneous identical submission to the authority having jurisdiction. Include copies of annotated Contract Drawings as required to depict component locations to facilitate review. Upon receipt of comments from the authority, submit a copy of the marked-up submittal for review. Make resubmissions to the authority if required to make clarifications or revisions to obtain approval. Provide documentation verifying that this submission has been made. This shall be in accordance with Paragraph 907.1.1 of the 2009 Edition of the "International Building Code" (IBC) along with any and all Amendments adopted by the local municipality.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The publications listed below form a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation only. The latest version of each listed publication shall be used as a guide unless the authority having jurisdiction has adopted an earlier version.
 - 1. FM Global (Factory Mutual (FM)):FM Approval Guide
 - 2. National Fire Protection Association (NFPA)
 - a. NFPA 70 National Electrical Code
 - b. NFPA 72 National Fire Alarm Code
 - c. NFPA 90A Standard for The Installation of Air Conditioning and Ventilating Systems
 - d. NFPA 101 Life Safety Code
 - 3. Underwriters' Laboratories, Inc. (UL) equipment standards, Latest Edition
 - a. UL Fire Protection Equipment Directory
 - b. UL Electrical Construction Materials Directory
 - c. UL 38 Manually Actuated Signaling Boxes for Use with Fire Protection Signaling Systems
 - d. UL 228 Door Holding Devices
 - e. UL 268 Smoke Detectors for Fire Protective Signaling Systems
 - f. UL 268A Smoke Detectors for Duct Application
 - g. UL 464 Audible Signal Appliances
 - h. UL 497A Secondary Protectors for Communications Circuits
 - i. UL 521 Heat Detectors for Fire Protective Signaling Systems
 - j. UL 864 Control Units for Fire Protective Signaling Systems
 - k. UL 1076 Security
 - I. UL 1283 Electromagnetic Interference Filters
 - m. UL 1449 Transient Voltage Surge Suppressors
 - n. UL 1480 Speakers for Fire Protective Signaling Systems
 - o. UL 1971 Signaling Devices for the Hearing Impaired
 - 4. Underwriters Laboratories Canada (ULC)
 - 5. International Code Council
 - a. International Building Code
 - b. International Fire Code.
 - 6. State and Local Building Codes as adopted and/or amended by The Authority Having Jurisdiction, ADA, and/or State and local equivalency standards as adopted by The Authority Having Jurisdiction.
 - 7. California State Fire Marshal
 - 8. NY-MEA
 - 9. ISO 9002



B. Supplier Qualifications

- 1. Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided. The representative shall be licensed in the State if required by law.
- 2. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation and maintenance.
- 3. The supplies shall furnish evidence they have an experienced service organization, which carries a stock of spare and repair parts for the system being furnished.
- 4. The equipment supplier shall be authorized and trained by the manufacturer to calculate, design, install, test, and maintain the air sampling system and shall be able to produce a certificate stating such upon request.
- C. Installer Qualifications:
 - 1. Before commencing work, submit data showing that the manufacturer has successfully installed fire alarm systems of the same scope, type and design as specified.
 - 2. The contractor shall submit copies of all required Licenses and Bonds as required in the State having jurisdiction.
 - 3. The contractor shall employ on staff a minimum of one NICET level II technician or a professional engineer, registered in the State of the installation.
 - 4. The contractor shall be qualified by UL for certifying fire alarm systems. Upon completion of the installation the contractor shall certify the final system meets UL ongoing maintenance.
 - 5. Contractors unable to comply with the provisions of Qualification of Installers shall present proof of engaging the services of a subcontractor qualified to furnish the required services.
- D. Testing Agency Qualifications: Qualified for testing indicated.
- E. Source Limitations for fire alarm equipment: Obtain fire alarm equipment from single source.
- F. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
 - 3. Combustion Characteristics: ASTM E 136.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Pre-installation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.
- B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

1.9 PROJECT CONDITIONS

- A. Installed products or materials shall be free from any damage including, but not limited to, physical insult, dirt and debris, moisture, and mold damage.
- B. Environmental Limitations: Do not deliver or install products or materials until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire alarm equipment that fail(s) in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 1 year from date of Substantial Completion.

1.11 SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for 1 year.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
 - A. Manufacturers: Devices and components to match existing fire alarm system: Notifier FireWarden-100

2.2 POWER SUPPLY

- A. The system Power Supply/Charger shall be a 12-amp supply with battery charger. The power supply shall be filtered and regulated. The power supply shall have a minimum of 1 power limited output rated at 4 amps, and a minimum of 1 output rated at 12 amps. The system power supply can be expanded up to 48 amps. The auxiliary power supply module shall share common batteries with the primary power supply. The system power supply shall have 4 relays, 1 for common alarm, one for common trouble and two programmable relays. The power supply shall be rated for 120/240 VAC 50/60 Hz.
- B. The battery charger shall be able to charge the system batteries up to 100 AH batteries. Battery charging shall be microprocessor controlled and programmed with a special software package to select charging rates and battery sizes. An optional Thermistor for monitoring battery temperature to control charging rate shall be available.

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- C. The power supply shall have a plug for an AC adapter cable, which allows a technician to plug in a laptop computer for up or down loading program information or test equipment.
- D. Transfer from AC to battery power shall be instantaneous when AC voltage drops to a point where it is not sufficient for normal operation.
- 2.3 PROVIDE ADDITIONAL NAC PANELS (POWER SUPPLIES)
 - A. The NAC Panels may or may not be shown on the contract drawings but will be required to support the system load. It is the contractor's responsibility to perform and provide Loading Calculations for approval to determine the number required and provide.
 - B. The NAC Panel (supplementary power supplies) shall consist of an enclosure, a 6 amp 24VDC Power Supply, batteries, hardware, modules and circuitry as described herein. The supplementary power supply shall provide four (4) Style "W" (Class "B") Notification Appliance Circuits (NAC) and two (2) Supervised Inputs.
 - C. The NAC Panel shall be interconnected with the FACP by means of a dedicated NAC, which shall not be used for any other purpose. Only a single supplementary power supply shall be installed on an NAC.
 - D. All NAC Panels and all system Visual Notification (Strobe) NAC's shall provide "Synchronization" of all the visual notification appliances.

2.4 INTELLIGENT INITIATING DEVICES

- A. Intelligent Initiation Devices General
 - 1. All initiation devices shall be insensitive to initiating loop polarity. Specifically, the devices shall be insensitive to plus/minus voltage connections on either Style 4 or Style 6 circuits.
- B. Smoke Detectors Addressable
 - 1. The detector shall be guaranteed in writing not to false alarm when configured by the factory trained certified technician. The detector must provide up to 11 different environmental algorithms that allow the detector to provide superior false alarm immunity without the need for additional alarm verification delays.
 - 2. The detector shall have a multicolor LED to streamline system maintenance/inspection by plainly indicating detector status as follows: green for normal operation, amber for maintenance required, red for alarm.
 - 3. The multi-criteria smoke detector shall be an intelligent digital photoelectric detector with a programmable heat detector. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds. So as to minimize the effort required by the installing and maintenance technician to appropriately configure the detector to ensure optimal system design, the detectors shall be programmable as application specific. Application settings shall be selected in software for a minimum of eleven environmental fire profiles unique to the devices installed location.



- 4. The detector shall be designed to eliminate the possibility of false indications caused by dust, moisture, RFI/EMI, chemical fumes and air movement while factoring in conditions of ambient temperature rise, obscuration rate changes and hot/cold smoke phenomenon into the alarm decision to give the earliest possible real alarm condition report.
- 5. The intelligent smoke detector shall be capable of providing three distinct outputs from the control panel. The outputs shall be from an input of smoke obscuration, a thermal condition or a combination of obscuration and thermal conditions. The detector shall be designed to eliminate calibration errors associated with field cleaning of the chamber.
- 6. The detector shall support the use of a relay, or LED remote indicator without requiring an additional software address. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling.
- 7. For the detector where required, there shall be available a locking kit and detector guard to prevent unauthorized detector removal.
- 8. Where required, there shall be available a programmable remote lamp configurable to remotely duplicate the on-board LED status of another system device with the same software address.
- C. Heat Detectors Addressable
 - 1. Thermal detectors shall be rated at 135 degrees fixed temperature and 15 degrees per minute rate of rise. Detectors shall be constructed to compensate for the thermal lag inherent in conventional type detectors due to the thermal mass, and alarm at the set point of 135 degrees Fahrenheit. The choice of alarm reporting as a fixed temperature detector or a combination of fixed and rate of rise shall be made in system software and be changeable at any time without the necessity of hardware replacement.
 - 2. The detectors furnished shall have a listed spacing for coverage up to 2,500 square feet and shall be installed according to the requirements of NFPA 72 for open area coverage.
- D. Duct Smoke Detectors Addressable
 - 1. For duct detector applications, the smoke detector shall be an intelligent digital photoelectric detector with a programmable heat detector. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes.
 - 2. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds. The detector shall be mounted in a duct detector housing listed for that purpose. The duct detector shall support the use of a remote test switch. The duct detector shall be supplied with the appropriate sampling tubes to fit the installation.
 - 3. The duct housing cover shall include a test port for functional testing of the detector without cover removal. The duct housing shall include a cover removal switch capable of indicating cover removal status to the fire alarm control panel.
 - 4. All air duct smoke detectors shall be provided with a Control Module specified herein to operate the associated air handler or damper along with a Remote Indicator Lamp show or not shown on the contract drawings. It shall be the electrical contractor's responsibility to provide a custom Label for each Remote Lamp identifying it's function (IE: "AHU-1 RETURN")



E. Detector Bases – Addressable

- 1. Detector bases shall be low profile twist lock type with screw clamp terminals and self-wiping contacts. Bases shall be installed on an industry standard, 4" square or octagonal electrical outlet box.
- 2. Where selective localized control of electrical devices is required for system operation, furnish and install detector base with software programmed addressable relay integral to the base. The relay shall switch electrical loads within relay ratings, as indicated on the drawings. Operation of the addressable control circuit shall be independent of the number of detectors and relays on the circuit or the number in an alarm state. Relay bases shall be rated for resistive or inductive load (120VAC or 30VDC) 3 amps.
- F. Manual Pull Stations Addressable
 - 1. Provide addressable manual stations where shown on the drawings, to be flush or surface mounted as required. Manual stations shall contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control panel. The manual station communications shall allow the station to provide alarm input to the system and alarm output from the system within less than four (4) seconds.
 - 2. The manual station shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring. Surface mounted stations where indicated on the drawings shall be mounted using a manufacturer's prescribed matching red enamel outlet box.
 - 3. Provide single action pull station.
 - 4. Where shown on the contract drawings provide a Stopper II Protective Cover without Horn for the Manual Pull Station.
 - 5. Weather proof Manual Pull Stations shall be a conventional initiating device identical to the Addressable Manual Pull Station and "Listed" for this application. This station shall be provided with a Weather Stopper II with the required gaskets and Monitoring Module specified herein. This module shall be installed in an environmentally conditioned room.
- G. Addressable Interface Devices
 - 1. Addressable interface devices shall be provided to monitor contacts for such items as water-flow, tamper, and PIV switches connected to the fire alarm system. These interface devices shall be able to monitor a single or dual contacts. An address will be provided for each contact. Where remote supervised relay is required the interface shall be equipped with a SPDT relay rated for 4 amps resistive and 3.5 amps inductive.
 - 2. Where needed a conventional zone module shall connect to the signal line circuit, which will allow the use of conventional initiation devices. This module shall have the ability to support up to 15 convention smoke detectors and an unlimited number of contact devices. This module shall also be capable of monitoring linear beam detectors and conventional Flame detectors. Where required, there shall be an intrinsically safe detection solution for NEMA defined intrinsically safe installations compatible with the conventional zone module.
 - 3. Single device damper monitoring and control: When connected to the FACP, a single switch input shall be able to monitor all 3 states of a damper open, closed, and in transit. When connected to a FACP, a single relay shall be able to fully control a damper (through the relay connected to the motor control) while also using its switch input for monitoring all 3 states of the damper.

HAGERSTOWN REGIONAL AIRPORT – RICHARD A. HENSON FIELD | TERMINAL BUILDING EXPANSION AIP 3-24-0019-XXX-2025; MAA-GR-XX-XXX

BID NO. PUR – 1751 | BID SET | MAY 2025



2.5 NOTIFICATION APPLIANCES

- A. Strobes
 - 1. Strobes shall be White.
 - 2. The strobes shall meet and be listed for UL Standard 1971 (Emergency Devices for the Hearing-Impaired) for Indoor Fire Protection Service
 - 3. Strobe shall be listed for indoor use, and shall meet the requirements of FCC Part 15 Class B
 - 4. Strobe appliances shall produce a flash rate of one (1) flash per second over the Regulated Voltage Range, and shall incorporate a Xenon flashtube enclosed in a rugged Lexan® lens.
 - 5. All inputs shall be compatible with standard, reverse polarity supervision of circuit wiring by a Fire-Alarm Control Panel (FACP)
 - 6. The Strobe shall be of low-current design.
 - 7. The strobe intensity shall have field-selectable settings, and shall be rated per UL Standard 1971 for 15/30/75/95cd or 115/177cd for ceiling mount where Multi-Candela appliances are specified.
 - 8. The selector switch for selecting the candela shall be tamper resistant.
 - 9. The appliance shall be compatible with power supplies with built-in sync protocol when synchronization is required.
 - 10. The strobes shall not drift out of synchronization at any time during operation.
 - 11. If the sync module or Power Supply fails to operate, (i.e. contacts remain closed), the strobe shall revert to a non-synchronized flash rate.
 - 12. The strobes shall be designed for indoor surface of flush mounting.
 - 13. The Strobe Appliances shall incorporate a Patented, Integral Strobe Mounting Plate that shall allow mounting to single-gang, double-gang, 4-inch square, 100mm European type back boxes, or the Surface Back box
 - 14. The Strobe Plate shall mount to either a standard, 4-inch square back box for flush mounting, or shall mount to the back box for surface mounting.
 - 15. All notification appliances shall be backward compatible.
- B. Weatherproof Horn Strobe Appliances Located at the Fire Department Connection (FDC)
 - 1. The Red Weatherproof Horn Strobe located at the FDC shall be on a dedicated, programmable NAC programmed to operate only on sprinkler water flow unless otherwise directed by the local inspector.
 - 2. Horn Strobe and standalone Horn Appliances shall meet and be listed for:
 - a. UL Standard 1971
 - b. Standard 464 (Fire Protective Signaling)
 - c. Weatherproof, outdoor applications each provided with a weatherproof back box with gaskets.
 - Horn strobe shall be listed for indoor use and shall meet the requirement of FCC Part 15 Class B.
 - 4. All inputs shall be compatible with standard reverse polarity supervision of circuit wiring by the Fire Alarm Control Panel (FACP).
 - 5. Horn Strobe shall have a minimum of three (3) field selectable setting for dBA levels, and shall have a choice of continuous or temporal (Code 3) audible outputs.
 - 6. Horns shall be of low-current design.
 - 7. Strobe portion of the appliance shall produce a flash rate of one (1) flash per second over the Regulated Input Voltage Range, and shall incorporate a Xenon flashtube enclosed in a rugged Lexan® lens.



- Strobe intensity, where Multi-Candela appliances are specified, shall have field-selectable settings, and shall be rated per UL Standard 1971 for:
 a. 135/185cd
- 9. The selector switch for selecting the candela setting shall be tamper resistant.
- 10. The appliance shall be compatible with Power Supplies.
- 11. The strobes shall not drift out of synchronization at any time during operation.
- 12. The strobes shall revert to a non-synchronized flash-rate, if the sync module or Power Supply should fail to operate (i.e. contacts remain closed).
- 13. All notification appliances shall listed for Special Applications:
 - a. Strobes are designed to flash at 1-flash-per-second minimum over their "Regulated Input Voltage Range".
- 14. All candela ratings represent minimum-effective Strobe intensity, based on UL Standard 1971
- 15. All notification appliances shall listed for Special Applications:
 - a. Strobes are designed to flash at 1-flash-per-second minimum over their "Regulated Input Voltage Range".
- 16. All candela ratings represent minimum-effective Strobe intensity, based on UL Standard 1971
- C. Speaker and Speaker Strobes
 - 1. The Speaker and combination Speaker Strobe shall be White.
 - 2. The Speakers and combination Speaker Strobes shall not have any wording.
 - 3. Speakers shall be UL Listed under Standard 1480 for Fire Protective Service, and speakers equipped with strobes shall be listed under UL Standard 1971 for Emergency Devices for the Hearing-Impaired
 - 4. Speaker with strobes shall be certified to meet the requirements of FCC Part 15, Class B
 - 5. All speakers shall be designed for a field-selectable input of either 25 or 70 VRMS; with selectable power taps from 1/8 watt to 2 watts.
 - 6. All wall-mount models shall have listed sound output of up to 89 dBA at 10 feet and a listed frequency response of 400 to 4000 Hz
 - 7. All ceiling-mount models shall have listed sound output of up to 87 dB at 10 feet and a listed frequency response of 400 to 4000 Hz.
 - 8. Speaker shall incorporate a sealed-back construction.
 - 9. All inputs shall employ terminals that accept #12 to #18 AWG wire sizes.
 - 10. Strobe intensity, where Multi-Candela appliances are specified, shall have field-selectable settings, and shall be rated per UL Standard 1971 for:
 - a. 15/30/75/110cd (wall mounting)
 - b. 135/185cd (wall mounting)
 - 11. Strobe intensity, where Multi-Candela appliances are specified, shall have field-selectable settings, and shall be rated per UL Standard 1971 for:
 - a. 15/30/75/110cd (ceiling mounting)
 - b. 135/185cd (ceiling mounting)
 - 12. Selector switch for selecting the candela shall be tamper resistant.
 - 13. The strobe portion, when synchronization is required, shall be compatible with power supply with built-in protocol.
 - 14. The strobes shall not drift out of synchronization at any time during operation.
 - 15. The strobes shall revert to a non-synchronized flash-rate, if the sync module or Power Supply should fail to operate (i.e. contacts remain closed)



- 16. Wall-mount speaker and speaker-strobe appliances shall be designed for indoor-flush mounting to 4" x 2-1/8" electrical boxes without need for an extension ring or surface mounting.
- 17. Ceiling-mount, speaker-strobe appliances shall be designed for indoor-flush mounting.
- 18. Speaker and speaker strobe shall incorporate a speaker-mounting plate with a snap-on grille cover.
- 19. The finish of the speakers and speakers strobes shall be white or red
- 20. All speaker and speaker-strobe appliances shall listed for Special Applications: Strobes are designed to flash at 1-flash-per-second minimum over their "Regulated Input Voltage Range".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions 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. Perform work in accordance with the requirements of NFPA 70, NFPA 72 and NECA 1-2006, Standard of Good Workmanship in Electrical Contracting.
- B. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.
- C. In the event that limited energy cable installation is allowed, all cable runs shall be run at right angles to building walls, supported from structure at intervals not exceeding 3 feet and where installed in environmental air plenums, be rated for such use and tied/supported by components listed for environmental air plenums installation.
- D. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
- E. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- G. Provide primary power for each panel from normal/ emergency panels as indicated on the Electrical Power Plans. Power shall be 120 VAC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of all circuits and devices.

3.3 BOXES, ENCLOSURES AND WIRING DEVICES

A. Boxes shall be installed plumb and firmly in position.



- B. Extension rings with blank covers shall be installed on junction boxes where required.
- C. Junction boxes served by concealed conduit shall be flush mounted.
- D. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.
- E. "Fire alarm system" decal or silk-screened label shall be applied to all junction box covers.

3.4 CONDUCTORS

- A. Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.
- B. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.
- C. Wiring for strobe and audible circuits shall be a minimum 14 AWG, signal line circuits; 18 AWG twisted shielded, speaker circuits; 18 AWG twisted, telephone circuit; 18 AWG twisted shielded.
- D. All splices shall be made using solder-less connectors. All connectors shall be installed in conformance with the manufacturer recommendations.
- E. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.
- F. The installation contractor shall submit for approval prior to installation of wire, a proposed color code for system conductors to allow rapid identification of circuit types.
- G. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

3.5 DEVICES

- A. Relays and other devices to be mounted in auxiliary panels are to be securely fastened to avoid false indications and failures due to shock or vibration.
- B. Wiring within panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.
- C. All devices and appliances shall be mounted to or in an approved electrical box.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."



- B. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.
- C. A consistent color code for fire alarm system conductors throughout the installation.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Testing General:

- 1. All Alarm Initiating Devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.
- 2. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.
- 3. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector shall be corrected.
- 4. Test reports shall be delivered to the acceptance inspector as completed.
- 5. All test equipment, instruments, tools and labor required to conduct the system tests shall be made available by the installing contractor. The following equipment shall be a minimum for conducting the tests:
 - a. Ladders and scaffolds as required to access all installed equipment.
 - b. Multi-meter for reading voltage, current and resistance.
 - c. Two way radios, and flashlights.
 - d. A manufacturer recommended device for measuring air flow through air duct smoke detector sampling assemblies.
 - e. Decibel meter.
 - f. In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the acceptance inspector.

3.8 ACCEPTANCE TESTING

- A. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared by the engineer in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.
- B. A program matrix shall be prepared by the installing contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input.
- C. The installing contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.
- D. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the owner and test results recorded for use at the final acceptance test.



- E. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.
- F. Final Acceptance Test: Notify the owner in writing when the system is ready for final acceptance testing. Submit request for test at least 14 calendar days prior to the test date. A final acceptance test will not be scheduled until meggar test results, the loop resistance test results, and the submittals required in Part 1 are provided to the owner. Test the system in accordance with the procedures outlined in NFPA 72.
 - 1. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
 - Test each initiating and indicating device and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.
 - 3. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
 - 4. Visually inspect all wiring.
 - 5. Verify that all software control and data files have been entered or programmed into the FACP.
 - 6. Verify that Shop Drawings reflecting as-built conditions are accurate.
 - 7. Measure the current in circuits to assure that there is the calculated spare capacity for the circuits.
 - 8. Measure voltage readings for circuits to assure that voltage drop is not excessive.
 - 9. Measure the voltage drop at the most remote appliance on each notification appliance circuit.
- G. The acceptance inspector shall use the system record drawings in combination with the documents specified in this specification during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:
 - 1. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:
 - a. Open, shorted and grounded signal line circuits.
 - b. Open, shorted and grounded notification, releasing circuits.
 - c. Primary power or battery disconnected.
 - 2. System notification appliances shall be demonstrated as follows:
 - a. All alarm notification appliances actuate as programmed.
 - b. Audibility and visibility at required levels.
 - 3. System indications shall be demonstrated as follows:
 - a. Correct message display for each alarm input at the control display.
 - b. Correct annunciator light for each alarm input at each annunciator and graphic display as shown on the drawings.
 - c. Correct history logging for all system activity.
 - d. Correct information on the System Printer.
 - 4. System off-site reporting functions shall be demonstrated as follows:
 - a. Correct zone transmitted for each alarm input.
 - b. Trouble signals received for disconnect.



- 5. Secondary power capabilities shall be demonstrated as follows:
 - a. System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.
 - b. System primary power shall be restored for forty-eight hours and system-charging current shall be normal trickle charge for a fully charged battery bank.
 - c. System battery voltages and charging currents shall be checked at the fire alarm control panel.

3.9 DOCUMENTATION

- A. System documentation shall be furnished to the owner and shall include but not be limited to the following:
 - 1. System record drawings and wiring details including one set of reproducible drawings, and a CD ROM with copies of the record drawings in DXF format for use in a CAD drafting program.
 - 2. System operation, installation and maintenance manuals.
 - 3. System matrix showing interaction of all input signals with output commands.
 - 4. Documentation of system voltage, current and resistance readings taken during the installation, testing and ATP phases of the system installation.
 - 5. System program showing system functions, controls and labeling of equipment and devices.

3.10 PROTECTION

A. Remove and replace devices and panel components that are wet, moisture damaged, or mold damaged.

3.11 DEMONSTRATION

- A. Instructor: Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing and maintenance of the system provided. The instructor shall train the employees designated by the owner, in the care, adjustment, maintenance, and operation of the fire alarm system.
- B. Training sessions shall cover all aspects of system performance, including system architecture, signaling line circuit configurations, sensor and other initiating device types, locations, and addresses, fire alarm control panel function key operation, and other functions as designated by the owner.
- C. Required Instruction Time: Provide 4 hours of instruction after final acceptance of the system. The instruction shall be given during regular working hours on such dates and times as are selected by the owner. The instruction may be divided into two or more periods at the discretion of the owner. One training session shall be videotaped by the contractor. Videotapes shall be delivered to the owner.
- D. Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the FACP. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory and trouble. The instructions shall be approved by the owner.



- E. Comprehensive system troubleshooting training shall be provided for a single individual designated by the owner. This session shall be separate and distinct from the above described sessions.
- F. All training sessions shall be conducted following final system certification and acceptance. Three additional training sessions shall be provided for all security personnel on all shifts six months after final system certification.
- G. All training sessions shall be conducted by an authorized fire alarm system distributor representative, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided.

END OF SECTION 28 31 11







BUSHEY FEIGHT MORIN ARCHITECTS 473 NORTH POTOMAC STREET HAGERSTOWN, MD 21740 301.733.5600 BFM PROJECT # 24043



Professional Certification:	DESIGN
hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws	DRAWN
of the State of Maryland.	CHECK

License No. 6157 Expiration Date: 09/07/2026

DESIGNED:	RAK	No.	DAT
_		Rev 1	06.12.2
DRAWN:	RAK		
CHECKED	NEM		
CHECKED.			
APPROVED:	NEM		



Attachment T

	FLOORS	WALLS
	F1A- PORCELAIN TILE ACCENT - 24"x24"	W1- PAINT
	F1B- PORCELAIN TILE FIELD - 24"x24"	W2- RIGID SHEET VINYL
	F2- CONCRETE	W3- PAINT SYSTEM - TYPE 1
	F3- QUARTZ TILE - 24"x24"	W4- STONE VENEER
		W5- BRICK VENEER
		W6- PAINT SYSTEM - TYPE 2
$ \cap $		
ЦЦ		
7	BACE	
1	B1- RUBBER BASE	C1- ACOUSTICAL CEILING TILE - TYPE 1
Ш		C2- GYPSUM BOARD - PAINTED
		C3- CEILING STRUCTURE - PAINTED
		C3- EXPOSED SLOPED STOREFRONT STSTEM
l		
Ш		
Ι.		
-		
NO	TES	
1. REF 2. PR(3. PA1 4. PA1	TER TO DRAWING A9.1 FOR FLOOR PATTERN PLAN DVIDE WALL TYPE W2 UP TO 4'-0" AFF WITH TRIM T TCH AND REPAIR FLOOR AND BASE AS NEEDED. TCH AND REPAIR NEW OPENINGS AS NEEDED.	N. FOP CAP.









TRANSITION DETAIL QUARTZ TO CONCRETE 12" = 1'-0"

<u>VVALL FINISH KEY</u>			
PROJECT TITLE: TERMINAL	BUILDING EX	XPANSION	FAA AIP No.: 3-24-0019-XX-2025 Bid No.: PUR-1751 MAA Grant No.: MAA-GR-XX-XXX
HEET TITLE:			BID SET
FLOOR PATTERN PLAN -FIRST FLOOR			SHEET No.: A9.1
CALE: As indicated	DATE:	MAY 2025	66 OF 102



Attachment V
ADCI BFM

SECTION 05 50 00: METAL FABRICATIONS

- PART 1 GENERAL
- 1.1 SECTION INCLUDES
 - A. Shop fabricated ferrous metal items, galvanized and prime painted.
- 1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION
 - A. Section 03 30 00 Cast-In-Place Concrete: Placement of metal fabrications in concrete.
 - B. Section 04 20 00 Unit Masonry: Placement of metal fabrications in masonry.

1.3 RELATED SECTIONS

- A. Section 05 12 00 Structural Steel: Structural steel column anchor bolts.
- B. Section 05 30 00 Epic Metals Toris 5.5A Metal Deck.
- C. Section 05 31 00 Steel Decking: Bearing plates and angles and frame openings for metal deck bearing, including anchorage.
- D. Section 09 90 00 Painting: Paint finish.

1.4 REFERENCES

- A. ASTM A36 Structural Steel.
- B. ASTM A53 Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.
- C. ASTM A123 Zinc (Hot-Galvanized) Coatings on Products Fabricated From Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip.
- D. ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- E. ASTM A283 Carbon Steel Plates, Shapes, and Bars.
- F. ASTM A307 Carbon Steel Externally Threaded Standard Fasteners.
- G. ASTM A325 High Strength Bolts for Structural Steel Joints.
- H. ASTM A386 Zinc-Coating (Hot-Dip) on Assembled Steel Products.
- I. ASTM A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- J. ASTM A501 Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- L. AWS A2.0 Standard Welding Symbols.
- M. AWS D1.1 Structural Welding Code.
- N. SSPC Steel Structures Painting Council.

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1.5 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
- C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.6 QUALIFICATIONS

A. Welders' Certificates: Submit under provisions of Section 01 33 00, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.7 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings and shop drawings.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Steel Sections: ASTM A36.
- B. Steel Tubing: ASTM A500, Grade B.
- C. Plates: ASTM A283.
- D. Pipe: ASTM A53, Grade B Schedule 40.
- E. Fasteners: As detailed.
- F. Bolts, Nuts, and Washers: ASTM A325 galvanized to ASTM A153 for galvanized components.
- G. Welding Materials: AWS D1.1; type required for materials being welded.
- H. Shop and Touch-Up Primer: SSPC 6 SP6 Commercial Blast Cleaning and Prime.
- I. Touch-Up Primer for Galvanized Surfaces: PPG Zinc rich type 6-209 galvanized steel primer.

2.2 FABRICATION

- A. Fit and shop assemble in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

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- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- 2.3 FINISHES
 - A. Prepare surfaces to be primed in accordance with SSPC SP 6- Commercial Blast Cleaning.
 - B. Do not prime surfaces in direct contact with concrete or where field welding is required.
 - C. Prime paint items with PPG Water Base Inhibitive Metal Primer 90-712 at 4.8 mils MWF.
 - D. Galvanize in accordance with ASTM A123, exterior steel members exposed to weather. Provide minimum 1.25 oz/sq ft galvanized coating.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify that field conditions are acceptable and are ready to receive work.
 - B. Beginning of installation means erector accepts existing conditions.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated on Drawings and shop drawings.
- D. Perform field welding in accordance with AWS D1.1.
- E. Obtain Architect/Engineer approval prior to site cutting or making adjustments not scheduled.
- F. After erection, clean, brush and prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

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3.5 SCHEDULE

- A. The Schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.
- 1. Bollards: Steel pipe, concrete filled, crowned cap; galvanized with painted finishes. Omit quenching process of steel for adequate paint adhesion. See Civil Drawings for additional information including sizes, embedment, finishes, etc.
- 2. Ledge and Shelf Angles, Channels and Plates Not Attached to Structural Framing: For support of metal decking or masonry; prime paint finish.
- 3. Lintels: As detailed; Interior: prime paint finish; Exterior: galvanized finish.
- 4. TV Support Brackets: Tube steel supports as detailed on drawings.
- 5. Roof Deck Closer Channels.

END OF DOCUMENT 05 50 00





Hagerstown Regional Airport ADCI Terminal Bldg Expansion BFM # 24043/1CA8 May 12, 2025 Updated 6/10/2025

ТҮРЕ	MATERIAL	SECTION	LOCATION	MANUF.	STYLE	COLOR	NOTES
	FLOORS						
F1	Porcelain Tile	09 30 00	Lobby, Concessions, Tickets, Observation, Coffee Bar, Lactation, Vending	Atlas Concorde (Grout - Mapei)	Marvel Gems, Matt, 24" x 24"	Color A (F1A)(Accent) Terrazzo White Matt, Color B (F1B)(Field): Terrazzo Gray Matt (Grout - 47 Charcoal)	
F2	Sealed Concrete	03 30 00	Baggage				
F3	Quartz Tile	09 65 00	Offices, Breakroom	UpoFloor	Mosaic Collection, 24" x 24"	8304 Scoria Grey	
	BACE						
	BASE				Millionale Deviced		
B1	Rubber Base	09 65 00		Johnsonite	4.25" high	63 Burnt Umber	
	WALLS						
W1	Paint	09 90 00		Sherwin Williams		SW7070 Site White	
W2	Rigid Sheet Vinyl	10 26 00	Tickets, Lobby, Observation	InPro Corp.	Elements, Velvet Texture, 4' x 8'	5E032 Trestlenut	4' High w/ Trim Piece
W3	Paint System - Type 1	09 96 00	Tickets,Observation, Coffee Bar	WolfGordon	Scuffmaster, Ambient Design	AD10352 GOH34493944	
W4	Stone Veneer		Concessions, Observation				Match Existing
W5	Brick		Concessions, Lactation, Vending				Match Existing



Hagerstown Regional Airport ADCI Terminal Bldg Expansion BFM # 24043/1CA8 May 12, 2025

Updated 6/10/2025

TYPE	MATERIAL	SECTION	LOCATION	MANUF.	STYLE	COLOR	NOTES
W6	Paint System - Type 2	09 96 00	Lobby, Observation	Wolfgordon	Scuffmaster, Ambient Design	AD10360 GOH34493945	
	CEILINGS						
C1	Acoustical Ceiling Tile - Type 1	09 51 23	General	Armstrong	Ultima # 1941, 2' x 2', 15/16" Beveled Tegular	White	
C2	Gyp Bd - Painted	09 90 00		Sherwin Williams		SW7646 First Star	
C3	Clg Structure/ Framework - Painted	09 90 00		Sherwin Williams		SW7071 Gray Screen	
C4	Metal Decking - Painted	05 30 00		Epic Metals (Metal) Sherwin Williams (Paint)	Toris A, 6' wide (Metal)	SW7071 Gray Screen (Paint)	
C5	Exposed		Lactation, Vending				
	MISCELLANEOUS						
M1	Wood Doors - Stained	08 21 00		VT Industries	Red Oak Plain Sliced		Match Existing
M2	Door Frames - Painted	09 90 00		Sherwin Williams		SW7076 Cyberspace	
M3	Millwork	06 41 00					
			Coffee Bar, Observation Counter	Dupont Corian Quartz (Countertop) Formica Laminate (Cabinetry)		Ctr - Cloud White (QZ-1) Cab - 8845-58 Bleached Legno (PL-1)	



Hagerstown Regional Airport ADCI Terminal Bldg Expansion BFM # 24043/1CA8 May 12, 2025

Updated 6/10/2025

TYPE	MATERIAL	SECTION	LOCATION	MANUF.	STYLE	COLOR	NOTES
			Breakroom	Formica Laminate Countertop and Cabinetry		Ctrtop - 6317-34 Weathered Cement (PL-2) Cab - 8841-WR White Ash (PL-3)	
			Ticket Counters, Concessions	Dupont Corian Quartz (Countertop) Formica Laminate (Cabinetry)		Ctrtop - Concrete Carrarra (QZ-2) Cab - 8902-NG White Painted Wood (PL-4) and 8907-NG Fox Teakwood (PL-5)	
M4	Vinyl Transitions	09 65 00		Tarkett Johnsonite		63 Burnt Umber	
M5	Privacy Panels	10 22 19	Tickets, Mothers	Global	Universal Privacy Panels, 58.05" High Freestanding Divider, Glass Screen w/Casters, 36" w x 20" d (GCUPSG6036), 48" w x 20" d (GCYPMSG6048)	Tungsten Frame, Frosted Glass Divider	



Hagerstown Regional Airport ADCI Terminal Bldg Expansion BFM # 24043/1CA8 May 12, 2025

Updated 6/10/2025

TYPE	MATERIAL	SECTION	LOCATION	MANUF.	STYLE	COLOR	NOTES
M6	Airport Sling Seating	12 61 00	Lobby, Observation	Herman Miller	Eames Tandem Sling Seating	Polished Aluminum Base & Frame, Vinyl Fabric Color TBD	







Attachment Y

GENERAL NOTES

- 1. ALL RECEPTACLES SHALL BE TAMPER RESISTANT UNLESS OTHERWISE NOTED.
- 2. SECURITY CAMERAS BY OTHERS. COORDINATE WITH ARCHITECT PRIOR TO ROUGH IN. COORDINATE EXACT MODEL NUMBERS WITH HGR SECURITY TEAM.
- 3. ALL VISUAL, AUDIO, AND AUDIO/VISUAL DEVICES MUST BE SYNCHRONIZED.

NUMBERED NOTES

- $\langle 1 \rangle$ RECEPTACLES IN ROOM SHALL BE SPLIT CONTROLLED BY OCCUPANCY SENSOR IN SPACE. RECEPTACLE SHALL BE LABELED AS SUCH.
- 2 EMERGENCY RECEPTACLE SHALL NOT BE SPLIT CONTROLLED AND WILL BE ON PANEL ER2-2.
- $\langle 3 \rangle$ 30A, 208V, 3P, NEMA 1, FUSED DISCONNECT, FUSED AT 30A.
- $\langle 4 \rangle$ 100A, 208V, 3P, NEMA 1, FUSED DISCONNECT, FUSED AT 70A.
- $\overline{(5)}$ RUN CONDUIT ALONG CASEWORK TO NEAREST FULL HEIGHT WALL.
- 6 RECEPTACLES ON GENERAL PURPOSE CIRCUIT WITHIN ROOM SHALL BE SPLIT CONTROLLED BY OCCUPANCY SENSOR IN SPACE. RECEPTACLE SHALL BE LABELED AS SUCH.
- $\langle 7 \rangle$ RELOCATE JUNCTION BOX FOR EXISTING FIBER LINE TO ACCESS GATE. RELOCATE UNDERGROUND CONDUIT FROM NEW JUNCTION BOX TO GATE LOCATION AS REQUIRED, MATCH EXISTING CONDITIONS. COORDINATE ALL WORK WITH CONCURRENT GATE RELOCATION PROJECT.
- $\langle 8 \rangle$ EXTEND CONDUITS/CABLING AS REQUIRED FOR RELOCATED JUNCTION BOX.



	BRANCH CIRCUIT	& FEEDER SCHEDULE - COPPER CO	ONDUCTORS
UPDATED 01-01-2013	3 <u>NC</u>	TE: THIS TABLE IS FOR FEEDERS AND BRANCH CIRCUITS. IT	
COPPER CONDUCT	OR; THHN / THWN INSULATION, 600 V	OR TRANSFORMERS.	
USE FOR ALL META	L CONDUITS & PVC - 40 & PVC - 80		
SERVICE OCP			TYF (3 PHAS
20	2 #12 1 #12 GND _ 3//"C	3 #12 1 #12 GND - 3//"C	(31 HAC
20	2 #10, 1 #10 GND - 3/4"C	3 #10, 1 #10 GND - 3/4"C	4 #10 1 #10 GND - 3/4"C
30	2 #10, 1 #10 GND - 3/4"C	3 #10, 1 #10 GND - 3/4"C	4 #10 1 #10 GND - 3/4"C
35	2 #8. 1 #10 GND - 3/4"C	3 #8 1 #10 GND - 3/4"C	4 #8 1 #10 GND - 1"C
40	2 #8, 1 #10 GND - 3/4"C	3 #8, 1 #10 GND - 3/4"C	4 #8, 1 #10 GND - 1"C
45	2 #6, 1 #10 GND - 3/4"C	3 #6, 1 #10 GND - 1"C	4 #6. 1 #10 GND - 1"C
50	2 #6, 1 #10 GND - 3/4"C	3 #6, 1 #10 GND - 1"C	4 #6, 1 #10 GND - 1"C
60	2 #4. 1 #10 GND - 3/4"C	3 #4, 1 #10 GND - 1"C	4 #4, 1 #10 GND - 1 1/4"C
70	2 #4, 1 #8 GND - 1"C	3 #4. 1 #8 GND - 1"C	4 #4, 1 #8 GND - 1 1/4"C
80	2 #3, 1 #8 GND - 1"C	3 #3, 1 #8 GND - 1 1/4"C	4 #3, 1 #8 GND - 1 1/4"C
90	2 #2, 1 #8 GND - 1"C	3 #2, 1 #8 GND - 1 1/4"C	4 #2, 1 #8 GND - 1 1/2"C
100	2 #1, 1 #8 GND - 1 1/4"C	3 #1, 1 #8 GND - 1 1/4"C	4 #1, 1 #8 GND - 1 1/2"C
110	2 #1, 1 #6 GND - 1 1/4"C	3 #1, 1 #6 GND - 1 1/4"C	4 #1, 1 #6 GND - 1 1/2"C
125	2 #1, 1 #6 GND - 1 1/4"C	3 #1, 1 #6 GND - 1 1/4"C	4 #1, 1 #6 GND - 1 1/2"C
150	2 #1/0, 1 #6 GND - 1 1/4"C	3 #1/0, 1 #6 GND - 1 1/2"C	4 #1/0, 1 #6 GND - 2"C
175	2 #2/0, 1 #6 GND - 1 1/2"C	3 #2/0, 1 #6 GND - 2"C	4 #2/0, 1 #6 GND - 2"C
200	2 #3/0, 1 #6 GND - 1 1/2"C	3 #3/0, 1 #6 GND - 2"C	4 #3/0, 1 #6 GND - 2"C
225	2 #4/0, 1 #4 GND - 2"C	3 #4/0, 1 #4 GND - 2"C	4 #4/0, 1 #4 GND - 2 1/2"C
250	2-250 KCMIL, 1 #4 GND - 2"C	3-250 KCMIL, 1 #4 GND - 2 1/2"C	4-250 KCMIL, 1 #4 GND - 2 1/2"C
300	2-350 KCMIL, 1 #4 GND - 2 1/2"C	3-350 KCMIL, 1 #4 GND - 3"C	4-350 KCMIL, 1 #4 GND - 3"C
350	2-500 KCMIL, 1 #3 GND - 3"C	3-500 KCMIL, 1 #3 GND - 3"C	4-500 KCMIL, 1 #3 GND - 3 1/2"C
400	2-600 KCMIL, 1 #3 GND - 3"C	3-600 KCMIL, 1 #3 GND - 3"C	4-600 KCMIL, 1 #3 GND - 4"C
450	2 SETS EACH: 2 #4/0, 1 #2 GND - 2"C	2 SETS EACH: 3 #4/0, 1 #2 GND - 2"C	2 SETS EACH: 4 #4/0, 1 #2 GND -
500	2 SETS EACH: 2-250 KCMIL, 1 #2 GND - 2"C	2 SETS EACH: 3-250 KCMIL, 1 #2 GND - 2 1/2"C	2 SETS EACH: 4-250 KCMIL, 1 #2
600	2 SETS EACH: 2-350 KCMIL, 1 #1 GND - 3"C	2 SETS EACH: 3-350 KCMIL, 1 #1 GND - 3"C	2 SETS EACH: 4-350 KCMIL, 1 #1
700	2 SETS EACH: 2-500 KCMIL, 1 #1/0 GND - 3"C	2 SETS EACH: 3-500 KCMIL, 1 #1/0 GND - 3"C	2 SETS EACH: 4-500 KCMIL, 1 #1
800	2 SETS EACH: 2-600 KCMIL, 1 #1/0 GND - 3"C	2 SETS EACH: 3-600 KCMIL, 1 #1/0 GND - 3 1/2"C	2 SETS EACH: 4-600 KCMIL, 1 #1
1000	3 SETS EACH: 2-500 KCMIL, 1 #2/0 GND - 3"C	3 SETS EACH: 3-500 KCMIL, 1 #2/0 GND - 3"C	3 SETS EACH: 4-500 KCMIL, 1 #2
1200	3 SETS EACH: 2-600 KCMIL, 1 #3/0 GND - 3"C	3 SETS EACH: 3-600 KCMIL, 1 #3/0 GND - 3 1/2"C	3 SETS EACH: 4-600 KCMIL, 1 #3
1600	4 SETS EACH: 2-600 KCMIL, 1 #4/0 GND - 3"C	4 SETS EACH: 3-600 KCMIL, 1 #4/0 GND - 3 1/2"C	4 SETS EACH: 4-600 KCMIL, 1 #4
2000	5 SETS EACH: 2-600 KCMIL, 1-250 KCMIL GND - 3"C	5 SETS EACH: 3-600 KCMIL, 1-250 KCMIL GND - 3 1/2"C	5 SETS EACH: 4-600 KCMIL, 1-25
2500	6 SETS EACH: 2-600 KCMIL, 1-350 KCMIL GND - 3"C	6 SETS EACH: 3-600 KCMIL, 1-350 KCMIL GND - 3 1/2"C	6 SETS EACH: 4-600 KCMIL, 1-35
3000	8 SETS EACH: 2-500 KCMIL, 1-500 KCMIL GND - 3"C	8 SETS EACH: 3-500 KCMIL, 1-500 KCMIL GND - 3"C	8 SETS EACH: 4-500 KCMIL, 1-50
3500	9 SETS EACH: 2-600 KCMIL, 1-500 KCMIL GND - 3"C	9 SETS EACH: 3-600 KCMIL, 1-500 KCMIL GND - 3 1/2"C	9 SETS EACH: 4-600 KCMIL, 1-50
4000	10 SETS EACH: 2-600 KCMIL, 1-500 KCMIL GND - 3"C	10 SETS EACH: 3-600 KCMIL, 1-500 KCMIL GND - 3 1/2"C	10 SETS EACH: 4-600 KCMIL, 1-5

NOTE: FOR CABLE INSULATION OTHER THAN THHN / THWN, SIZE CONDUIT PER NEC.

3 BRANCH CIRCUIT & FEEDER SCHEDULE - COPPER CONDUCTORS 10 SCALE



6011 UNIVERSITY BLVD. SUITE 490 ELLICOTT CITY, MD 21043 PHONE: 410-465-9600 FAX: 410-465-9602 AIRPORT DESIGN CONSULTANTS, INC.

BUSHEY FEIGHT MORIN ARCHITECTS 473 NORTH POTOMAC STREET HAGERSTOWN, MD 21740 301.733.5600 BFM PROJECT # 24043



Professional Certification:	DESIGNED:	NAD	No. 1	
were prepared or approved by me, and that I am a duly licensed professional engineer under the laws	DRAWN:	NAD		
of the State of Maryland.	CHECKED:	ALD		
License No. <u>45511</u> Expiration Date: <u>06/03/2026</u>	APPROVED:	СРМ		







TERMINAL BUILDING EXPANSION

RISER DIAGRAMS

NO SCALE

DATE:

MAY 2025

MAA Grant No.: MAA-GR-XX-XXX SUBMISSION: BID SET SHEET No .: E6-1

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Attachment AA

LIGHTING FIXTURE	SCHED	ULE				
MODEL NUMBER	LUMENS	COLOR TEMP	WATTS	VOLTAGE	MOUNTING	COMMENTS
6DR-TL-L-10-8-40-DIM-UNV-O-M-OF-XF-MWT-N	1000	4000K	9W	MVOLT	RECESSED	-
RZR-AC-R-2	NA	NA	2W	MVOLT	UNIVERSAL	-
RB10L840-277-ST-ARR16SL-16CL	10000	4000K	87W	MVOLT	SUSPENDED	-
EG2R-0-A5-P-SS-40-05-WHTE-D	5000	4000K	56W	MVOLT	SURFACE	-
22-FPL1-LED-3000L-DIM10-MVOLT-40K-85	3000	4000K	30W	MVOLT	RECESSED	-
S432-5216-4-XF-M-00-0-40-ZX	30000	4000K	377W	MVOLT	SURFACE	-
4MB-4SL-RND-UNV-L840-CD1	4000	4000K	30W	MVOLT	SURFACE	-
VWPV-L30-830-T3-DBZ-SDGL-SF-PC-DIM-UNV	3000	4000K	27W	MVOLT	SURFACE	-



Project Title: Airport Data filename:

Report date: 05/06/25 Page lof 5

PROJECT TITLE:	TERMINAL	BUILDING E	XPANSION	FAA AIP No.: 3-24-0019-XX-2025 Bid No.: PUR-1751 MAA Grant No.: MAA-GR-XX-XXX
SHEET TITLE:		SCHEDULES		SUBMISSION: BID SET SHEET No.: E7-2
SCALE:	NO SCALE	DATE:	MAY 2025	102 OF 102