ADDENDUM NUMBER ONE

To the Drawings and Project Manual

Dated: May 13, 2019

Entitled: MISSOURI ORTHOPAEDIC INSTITUTE
MRI 3T WIDE BORE
UM Project # CP190661

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Addendum Dated: June 4, 2019
QUESTIONS RECEIVED DURING BIDDING

Below is a list of questions received during bidding through June 2, 2019. Answers are in bold italics.

1. The specifications call for galvanized pipe for the pre-action fire protection system. Is galvanized pipe acceptable to be located above magnetic MRI equipment? - Follow the copper pipe specification from the wet pipe section for areas over the MRI rooms

2. Oxygen Monitoring System:
   a. M101B – Keyed Note 3: Indicates 2ea instances of “Oxygen Monitor System” by ETS Lindgren. – Yes. Model is ETS Lindgren OMS Air Alert. Provide with Optional Horn Strobe or equal.
   b. These items are not found in specification. – These items are not found in specs rather notes have been added on drawings.
   c. Please clarify:
      i. Under what specification responsibility are these furnished? – These shall be furnished by Temperature control contractor.
      ii. Will these require local audio/visual Alarms (Horn and Strobe)? – Yes. Please see question 2,a response.

3. MRI Chiller Flow Meter Issues:
   b. Please clarify:
      i. To what location is the Flow Analog Input cable terminated? – There won’t be any analog input, this will be removed in this addendum.
      ii. What are the Power Requirements for Flow Meter? – None because meter is analog.

4. Motor Operated Damper (MOD-#) Issues:
   a. M600 – Airflow Diagram has missing from diagram: MOD-1 & MOD-2. – These will be added in this addendum.
   b. M701, detail 5: MRI Purge Controls has missing from diagram: MOD-# Tags while Five (5) MOD appear in this detail (corresponds to three (3) signals for Damper Actuators in Point List). – Pressure vent dampers will be added in diagram and sequence in this addendum.
   c. M801 – Motor Operated Damper Schedule: Six (6) MOD-# are indicated. – Correct. Exhaust MOD is provided with the fan.
Please clarify signal origin (cable terminus) for each MOD in the Motor Operated Damper Schedule. – *MODs shall be terminated on associated rooms VAV box controller.*

5. M701 – Detail 1, VAV Box Control Diagram with Reheat Issues:
   a. Missing Zone Temperature (ZN-T) and/or Exhaust Air Temperature (EA-T) Sensors. – *Zone temperature sensors and Return temperature sensor will be added in this addendum.*
   b. KN-7 calls for JCI VG100 Series Valve (OAE) (compare to Pressure Independent (PI) Control Valve on Detail 3/M503 and Specification 230900-B.2). – *Refer to specification. Note on the detail referring model number will be removed in this addendum.*
   c. Please clarify:
      i. Each new VAV Box is to have Owner Furnished Network Sensor for ZN-T to be mounted and wired by Controls Contractor. – *Correct.*
      ii. VAV-2-1-17 and VAV-2-1-49 are to have EA-T to be furnished, mounted and wired by Controls Contractor. – *Yes, return air sensors will be added to detail.*
      iii. PI control valves are to be applied throughout and to be furnished and wired by Controls Contractor with installation by Piping Contractor. – *Correct.*

6. Humidifier Issues:
   a. M701 – Detail 6, Humidifier Controls: Indicates automatic control valves for proportional capacity control and isolation valve (OPEN/CLOSE) (Humidifier specification indicates only proportional capacity control valve furnished with EQT). – *Correct. Isolation valves shall be provided separate from EQT.*
   b. M701 – Detail 6, Humidifier Controls: Unclear how four (4) humidifiers are controlled (no Point List Provided; only Zone Humidity sensing shown on plans at 2ea ZN-T for CRAC). – *These details will be fully revised for this addendum.*
   c. M801 Schedules indicate:
      i. Four (4) Humidifiers by Armstrong, or approved equal (OAE). – *Correct.*
      ii. Two (2) CRAC Units by Liebert (OAE). – *Correct.*
   d. Please clarify that ISO valves are also furnished with Humidifier (to be spring return closed with switched 24 VAC to Actuator for OPEN/CLOSE [not 120 VAC]) and each of the four humidifiers will be provided with a dedicated local DDC Controller furnished by the Owner with Input-Output Points as suggested by M701 – Detail 6, Humidifier Controls. – *Please see response to question 6,a above for ISO valves. No separate DDC controller and Input-Output points*
needed. **VAV humidifiers will be connected to VAV controllers and CRAC humidifiers will be connected to exhaust fan controller. See revised control diagrams in this Addendum.**

**CHANGES TO THE PROJECT MANUAL**

1. SECTION 23 05 53 – HVAC IDENTIFICATION
   a. **ADD** paragraph 2.2.J – Duct Labeling.

2. SECTION 23 31 00 – DUCTWORK
   b. **ADD** paragraph 1.5 – Delivery, Storage, and Handling.

**CHANGES TO THE DRAWINGS**

**ARCHITECTURAL**

1. SHEET A101B – FIRST FLOOR DIMENSION PLAN – MRI SUITE
   a. **MODIFY** plan to show location of existing tree North of new fence around new equipment as well as clarify location of existing gravel edge and shrubs to the South.

2. SHEET A102B – FIRST FLOOR ARCHITECTURAL PLAN – MRI SUITE
   a. **MODIFY** keyed note #A06 to read “INFILL EXISTING DEPRESSED CONCRETE SLAB 2" - REINFORCE 6X6 - W1.4 - W1.4 WWF. 1/2" COMPRESSIBLE FILL AT PERIMETER - TYPICAL. REMOVE EXIST. SURFACE TREATMENTS AND DETERIORATED AND UNSOUND CONCRETE. MECHANICALLY ABR ade BASE SLABS TO PRODUCE A HEAVILY SCARIFIED SURFACE PROFILE WITH AN AMPLITUDE OF 1/4" (6MM.). PREPARE AND CLEAN EXIST. BASE SLABS, REMOVING ANY CONTAMINANTS THAT MIGHT IMPAIR BOND OF FLOOR TOPPING. FILL VOIDS, CRACKS, AND CAVITIES IN BASE SLABS. APPLY EPOXY-BONDING ADHESIVE, MIXED ACCORDING TO MANUFACTURER’S WRITTEN INSTRUCTIONS, AND SCRUB INTO DRY BASE SLABS TO A THICKNESS OF 1/16 TO 1/8 INCH (1.6 TO 3 MM), WITHOUT PUDDLING. PLACE FLOOR TOPPING WHILE ADHESIVE IS STILL TACKY.”
MECHANICAL

1. SHEET M101B – FIRST FLOOR PLAN AREA B – MECHANICAL - HVAC
   a. **ADD** humidistats in return duct above MRI equipment rooms.
   b. **MODIFY** keynotes to clarify oxygen monitoring equipment specification.

2. SHEET M503 – MECHANICAL DETAILS
   a. **MODIFY** detail 4 to add drain pan and water level sensor.
   b. **MODIFY** detail 5 to **ADD** glycol feed system scope, **REMOVE** control valves, and **REMOVE** analog input from flow meter.

3. SHEET M600 – AIRFLOW DIAGRAM
   a. **MODIFY** airflow diagram to correctly represent the system configuration.

4. SHEET M701 – MECHANICAL CONTROL DIAGRAMS
   a. **REMOVE** control detail 3 - Misc. EMCS Control Points and control detail 6 - Humidifier Controls.
   b. **ADD** CRAC unit control detail.
   c. **MODIFY** VAV Box, MRI Purge, FC BUS schematic and UH/CUH control details.

5. SHEET M702 – MECHANICAL CONTROL DIAGRAM
   a. **ADD** new sheet in its entirety to include a VAV Box with reheat and humidifier control detail.

6. SHEET M801 – MECHANICAL SCHEDULES
   a. **REVISE** terminal air box schedule for references to control type.
   b. **REVISE** fan schedule to specify EC motor.

7. SHEET P801 – PLUMBING DETAILS AND SCHEDULES
   a. **REVISE** L-1 and WC-1 on the Plumbing Material List.

ELECTRICAL

1. SHEET E001 – GENERAL NOTES, SYMBOLS & LEGENDS
   a. **MODIFY** Luminaire Schedule
      i. Fixture type C and CE: Approved equal is: “EATON (METALUX) 4SNLED-LD5-33SL-LW-UNV-L925-CD-1 AND AYC-CHAIN/SET”.

2. SHEET E201B - FIRST FLOOR PLAN AREA B -ELECTRICAL -POWER
   a. **REVISE** keynote 4.
   b. **DELETE** VFD-2.
3. SHEET E800 – ELECTRICAL SCHEDULES
   
a. DELETE VFD Schedule.

END OF ADDENDUM NUMBER ONE

Attachments:

SPECIFICATIONS:
   • 23 05 53, 23 31 00

DRAWINGS:
   • A101B, A102B, M101B, M503, M600, M701, M702, M801, P801, E001, E201B, E800
SECTION 23 05 53 - HVAC IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Identification of products installed under Division 23.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.2 MATERIALS
A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

<table>
<thead>
<tr>
<th>OD of Pipe or insulation</th>
<th>Marker Length</th>
<th>Size of Letters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to and including 1-1/4&quot;</td>
<td>8&quot;</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>1-1/2&quot; to 2&quot;</td>
<td>8&quot;</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>2-1/2&quot; to 6&quot;</td>
<td>12&quot;</td>
<td>1-1/4&quot;</td>
</tr>
</tbody>
</table>

Plastic tags may be used for outside diameters under 3/4".

B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.

C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.

D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.

E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

H. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.
I. Tracer Wire:

1. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL 83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.

2. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The minimum at any point shall not be less than 90% of the specified average thickness in compliance with UL 83.

3. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical tests shall be in accordance with UL 1581.

J. Duct Labeling: (2019.06.04 ADD_001)

1. Ductwork shall be labeled with flow direction and type (general exhaust, supply, outside air, return air etc.)

2. Labeling shall be placed every 15 feet, within 5 feet of all elbows and tees, and on both sides of a wall penetration within 3 feet of the penetration.

3. Labeling shall include source equipment information (CRAC#, EF#, etc.).

4. Labeling shall be installed on each floor of duct risers, mechanical rooms and locations where multiple duct systems share a location or identification is ambiguous.

5. Duct fabrication labels shall be placed on duct exterior only. No paper identification labels shall be inside the duct.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturer’s recommendations.

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Valves:

1. All valves (except shutoff valves at equipment) shall have numbered tags.

2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.

3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.

4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.

5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
6. Number all tags and show the service of the pipe.

7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.

2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.

3. Apply markers and arrows in the following locations where clearly visible:
   a. At each valve.
   b. On both sides of walls that pipes penetrate.
   c. At least every 20 feet along all pipes.
   d. On each riser and each leg of each "T" joint.
   e. At least once in every room and each story traversed.

4. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.

2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.

3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

F. Miscellaneous:

1. Attach self-adhesive vinyl labels at all duct access doors used to reset fusible links or actuators on fire, fire/smoke, or smoke dampers. Lettering shall be a minimum of 1/2" high. Labels shall indicate damper type.

2. Provide engraved plastic tags at all hydronic or steam system make-up water meters.
G. Tracer Wire:

1. Tracer wire shall be installed on top of all non-metallic buried utilities.
2. Tracer wire shall be taped directly to plastic water or drain pipe.
3. Tracer wire shall not be fastened directly or indirectly to gas piping.
4. Tracer wire when attached shall be secured to the pipe a minimum of every 10 feet and at all changes of direction.
5. Tape shall be Polyken "930-35", Protecto-Wrap "310", or approved equal.
6. Tracer wire shall be continuous between boxes and shall be tested for continuity.
7. Splices in tracer wire shall be made with a water proof splice kit to prevent corrosion. **Wire nuts shall not be used.**
8. The tracer wire shall daylight to grade through a 2” PVC conduit, at the point of the utility entrance to building. PVC conduit shall be capped and labeled as future contact point to locate the utility.

3.2 SCHEDULE

A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method or material is used:

<table>
<thead>
<tr>
<th>Pipe Service</th>
<th>Lettering Color</th>
<th>Background Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEATING WATER SUPPLY</td>
<td>Black</td>
<td>Yellow</td>
</tr>
<tr>
<td>HEATING WATER RETURN</td>
<td>Black</td>
<td>Yellow</td>
</tr>
<tr>
<td>LOW PRESSURE CONDENSATE</td>
<td>Black</td>
<td>Yellow</td>
</tr>
<tr>
<td>CHILLED WATER SUPPLY</td>
<td>White</td>
<td>Green</td>
</tr>
<tr>
<td>CHILLED WATER RETURN</td>
<td>White</td>
<td>Green</td>
</tr>
<tr>
<td>GLYCOL CHILLED WATER SUPPLY</td>
<td>White</td>
<td>Green</td>
</tr>
<tr>
<td>GLYCOL CHILLED WATER RETURN</td>
<td>White</td>
<td>Green</td>
</tr>
<tr>
<td>CONDENSER WATER SUPPLY</td>
<td>White</td>
<td>Green</td>
</tr>
<tr>
<td>CONDENSER WATER RETURN</td>
<td>White</td>
<td>Green</td>
</tr>
<tr>
<td>CONDENSATE DRAIN</td>
<td>Black</td>
<td>Yellow</td>
</tr>
<tr>
<td>REFRIGERANT LIQUID</td>
<td>Black</td>
<td>Yellow</td>
</tr>
<tr>
<td>REFRIGERANT SUCTION</td>
<td>Black</td>
<td>Yellow</td>
</tr>
<tr>
<td>Underground Piping</td>
<td>Varies</td>
<td>Varies</td>
</tr>
<tr>
<td>Tracer Wire - All other buried types</td>
<td>---</td>
<td>Green</td>
</tr>
</tbody>
</table>

B. Steam pipe markers shall include operating steam pressure within pipes shown in table above.

C. Match existing facility labeling scheme if different than above.

END OF SECTION 23 05 53
SECTION 23 31 00 - DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Galvanized Ductwork  
B. Aluminum Ductwork  
C. Stainless Steel Ductwork  
D. Ductwork Reinforcement  
E. Ductwork Sealants  
F. Rectangular Ductwork – Single Wall  
G. Round and Flat Oval Ductwork – Single Wall  
H. Flexible Duct  
I. Leakage Testing  
J. Ductwork Penetrations  

K. Duct Cleaning  
L. Painting (2019.06.04 ADD_001)

1.2 SUBMITTALS

A. Submit shop drawings per Division 1

B. Duct Layout Drawings: Submit detailed duct layout drawings at 1/4” minimum scale complete with the following information:

1. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.

2. Differentiate ducts that are wrapped. Include insulation thickness, type of insulation, and acoustical lagging.

3. Room names and numbers, ceiling types, and ceiling heights.

4. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each member.

5. Verify clearances and interferences with other trades prior to preparing drawings. IMEG will provide electronic copies of ventilation drawings for contractor’s use if the contractor signs and returns the “Electronic File Transfer” waiver. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for this submittal.

1.3 DEFINITIONS

A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.

B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the larger size shall continue through the fitting.
1.4 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Division 1 for required duct systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

B. Duct drawings shall be at 1/4" minimum scale complete with the following information:
   1. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.
   2. Differentiate ducts that are lined or wrapped. Include insulation thickness, type of insulation, and acoustical lagging.
   3. Location and size of all duct access doors.
   4. Room names and numbers, ceiling types, and ceiling heights.
   5. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each member.

1.5 DELIVERY, STORAGE AND HANDLING (2019.06.04 ADD_001)

A. Ductwork that is delivered to the site shall be installed as soon as possible.

B. Care shall be taken to schedule only enough material on site for the immediate workload.

C. Ductwork stored on site must be in enclosed vans or inside the building at least 4" above the floor to avoid damage from weather or spills.

D. Owner reserves the right to reject any materials if contractor isn’t conforming to practices for keeping materials free of dirt and contamination.

E. Ductwork shall be placed directly in storage vans or within the building as it is unloaded, no exceptions.

F. When moving or unloading ductwork, ductwork shall not be placed on the ground.

G. Ductwork shall be moved on carts or dollies.

H. Ductwork that is wrapped shall not be dragged across the floor as it can damage the seals.
PART 2 - PRODUCTS

2.1 GALVANIZED DUCTWORK

A. General Requirements:

1. Duct and reinforcement materials shall conform to ASTM A653 and A924.

2. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise.

3. Exterior Ductwork: G90 galvanized (0.90 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise. G60 is not acceptable for exterior use.

4. Ductwork reinforcement shall be of galvanized steel.

5. Ductwork supports shall be of galvanized or painted steel.

6. All fasteners shall be galvanized or cadmium plated.

2.2 ALUMINUM DUCTWORK (IN MRI ROOMS)

A. General Requirements:


2. All duct gauges and reinforcement shall be as called for in Tables 2-50, 2-51, 2-52, and 3-14 of the SMACNA HVAC Duct Construction Standards.

3. Ductwork reinforcement shall be of aluminum.

4. Ductwork supports shall be of aluminum, galvanized steel or painted steel. Slip cable hangers are acceptable. Acceptable manufacturers are Gripple, Ductmate, Duro Dyne, or Architect/Engineer approved.

5. All other requirements are as noted for galvanized rectangular sheet metal duct.

2.3 STAINLESS STEEL DUCTWORK

A. General Requirements:

1. Ductwork shall be Type 304L stainless steel, 16 gauge minimum.

2. Exposed ductwork shall have a #3 finish. Concealed ductwork may have milled finish.

3. Ductwork reinforcement shall be of stainless steel.

4. Ductwork supports shall be of stainless steel. Slip cable hangers are acceptable. Acceptable manufacturers are Gripple, Ductmate, Duro Dyne, or Architect/Engineer approved.
5. All fasteners shall be cadmium plated or stainless steel.

2.4 DUCTWORK REINFORCEMENT

A. General Requirements:

   1. All reinforcement shall be external to the duct except that tie rods may be used with the following limitations.
      
      a. Ducts must be over 18" wide.
      
      b. Duct dimensions must be increased 2" in one dimension (h or w) for each row of tie rods installed.
      
      c. Tie rods must not exceed 1/2" diameter.
      
      d. Manufacturer of tie rod system must certify pressure classifications of various arrangements, and this must be in the shop drawings.

2.5 DUCTWORK SEALANTS

A. One-part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20°F to +175°F, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M.

B. Where pressure sensitive tape is called for on drawings and specifications for sealing flexible ductwork, tape shall be minimum 2.5-inch wide, UL 181 B-FX listed, and marked tape having minimum 60 oz/inch peel adhesion to steel and service temperature range from -20°F to +250°F. Acceptable manufacturers include: Venture Tape 1581A, Compac #340, Scotch Foil Tape 3326, Polyken 339.

2.6 RECTANGULAR DUCT - SINGLE WALL

A. General Requirements:

   1. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space consuming reinforcement.

   2. Transitions shall not exceed the angles in Figure 4-7.

B. Exceptions and modifications to the 2005 HVAC Duct Construction Standards are:

   1. All ducts shall be cross-broken or beaded.
   
   2. Snap lock seams are not permitted.
   
   3. Turning vanes shall be used in all 90° mitered elbows, unless clearly noted otherwise on the drawings. Vanes shall be as follows:
a. Type 1:

1) **Description:** Single wall type with 22-gauge (0.029") or heavier vanes, 3-1/4" blade spacing, and 4" to 4-1/2" radius. Vanes hemmed if recommended by runner manufacturer. Runners shall have extra-long locking tabs. C-value independently tested at below 0.26. EZ Rail II by Sheet Metal Connectors or equal.

2) **Usage:** Limited to 3,000 fpm and vane lengths 36" and under.

b. Type 2:

1) **Description:** Double wall type with 3-1/4" blade spacing, 4-1/2" radius, 24-gauge minimum, and SMACNA Type 1 runners. C-value below 0.27.

2) **Usage:** No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48" long.

c. Type 3 (acoustical - where acoustical lagging is located or as noted on drawings):

1) **Description:** Same as Type 2, except filled with fiberglass and with slotted or perforated inner curve. Minimum insertion loss of 9 dB at 250 Hz and 6 dB at 1 KHz.

2) **Usage:** No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48" long.

d. Turning vanes shall operate quietly. Repair or replace vanes that rattle or flutter.

e. Runners must be installed at a 45° angle. Elbows with different size inlet and outlet must be radius type.

f. Omitting every other vane is prohibited.

4. Where smooth radius rectangular elbows are shown, they shall be constructed per SMACNA Figure 4-2. Type RE1 shall be constructed with a centerline duct radius R/W of 1.0. Where shown on drawings, Type RE3 elbows with 3 vanes shall be used with centerline duct radius R/W of 0.6 (SMACNA r/W=0.1). RE1 or RE3 elbows may be used where mitered elbows are shown if space permits. **Mitered elbows (with or without turning vanes) may not be substituted for radius elbows.** Do not make branch takeoffs within 4 duct diameters on the side of the duct downstream from the inside radius of radius elbows.

5. Rectangular branch and tee connections in ducts over 1" pressure class shall be 45° entry type per Figs. 4-5 and 4-6. Rectangular straight taps are not acceptable above 1" pressure class.

6. Bellmouth fittings shown on return duct inlets shall expand at a 60-degree total angle horizontally and vertically (space permitting) and have length of at least 25% of the smallest duct dimension.
7. Round taps off rectangular unlined ducts shall be 45° rectangular with transition to round (equal to Sheet Metal Connectors Inc. High Efficiency Takeoff). Straight taps on round duct are acceptable if pressure class is 1” or less, duct is 12” diameter or less, and the tap is not located between fans and TAB devices.

8. Cushion heads are acceptable only downstream of TAB devices in ducts up to ± 2” pressure class and must be less than 6” in length.

9. Slide-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.
   a. Apply sealant to all inside corners. Holes at corners are not acceptable.
   b. Acceptable Manufacturers: Ductmate Industries - 25/35/45, Nexus, Mez, or WDCI. Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer’s approval before any fabrication begins.

10. Formed-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.
    a. Apply sealant to all inside corners. Holes at corners are not acceptable.
    b. Flanges shall be 24-gauge minimum (not 26 gauge).
    c. Acceptable Manufacturers: Lockformer TDC, TDF, United McGill, or Sheet Metal Connectors. Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer’s approval before any fabrication begins.

2.7 ROUND AND FLAT OVAL SPIRAL SEAM DUCTWORK - SINGLE WALL

A. Conform to applicable portions of Rectangular Duct Section. Round or flat oval ductwork may be substituted for rectangular ductwork where approved by the Architect/Engineer. The spiral seam ductwork shall meet the standards set forth in this specification. The ductwork shall meet or exceed the specified cross-sectional area and insulation requirements. The substitution shall be coordinated with all other trades prior to installation.

B. Flat oval duct in negative pressure applications shall have flat sides reinforced as required for rectangular ducts of the same gauge with dimensions equal to the flat span of the oval duct.

C. 90° elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.

D. Duct and fittings shall meet the required minimum gauges listed in chapter 3 of the SMACNA requirements for the specified pressure class. Ribbed and lightweight duct are not permitted.
E. Ductwork shall be suitable for velocities up to 5,000 fpm.

F. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.

G. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.

H. Ducts with minor axis less than 22" shall be spiral seam type. Larger ducts may be rolled, longitudinal welded seam type. SMACNA seams RL-2 and RL-3 are not permitted.

I. Reinforce flat oval ducts with external angles. Internal tie rods are permitted only as indicated for rectangular ductwork.

J. Transverse Joint Connections:
   1. Crimped joints are not permitted.
   2. Ducts and fittings 36" in diameter and smaller shall have slip joint connections. Size fitting ends to slip inside mating duct sections with minimum 2-inch insertion length and a stop bead. Use inside slip couplings for duct-to-duct joints, and outside slip couplings for fitting-to-fitting joints.
   3. Ducts and fittings larger than 36" shall have flanged connections.
   4. Secure all joints with at least 3 sheet metal screws before sealing.
   5. Slide-on flanges as manufactured by Ductmate Industries - SpiralMate, Accuflange, or Sheet Metal Connectors are acceptable. Self-sealing duct systems are also acceptable (Lindab, Ward “Keating Coupling”).

2.8 FLEXIBLE DUCT

A. Flexible duct shall be listed and labeled as UL 181 Class 1 Air Duct Material, and shall comply with NFPA 90A and 90B, and meet GSA, FHA and other U.S. Government agency standards. Flexible duct shall bear the ADC Seal of Certification.

B. Flame Spread/Smoke Developed: Not over 25/50.

C. Flexible duct shall have corrosion-resistant wire helix, bonded to an inner liner that prevents air from contacting the insulation, covered with minimum 1-1/2", 3/4 lb/cf density fiberglass insulation blanket, sheathed in a vapor barrier of metalized polyester film laminated to glass mesh.

D. Inner liner shall be airtight and suitable for 6" WC static pressure through 10" diameter and shall be airtight and suitable for 4" WC static pressure 12" through 16" diameter. Outer jacket shall act as a vapor barrier only with permeance not over 0.1 perm per ASTM E96, Procedure A. "R" value shall not be less than 4.0 ft²°F/hr/Btuh. Temperature range of at least 0-180°F. Maximum velocity of 4,000 fpm.

E. Usage:
   1. Take-offs from supply ducts to inlets of terminal air boxes. Do not exceed 36" in length.
2. Connections to air inlets and outlets. Do not exceed 6'-0" in length.

F. Stretch all flexible duct to prevent sags and reduce air friction. Shorten and reinstall all sagging or loose flexible duct. Avoid sharp elbows. Elbows shall maintain 1.5 diameter centerline turning radius.

G. Install per the SMACNA Flexible Duct Manual. Secure inner layer with draw band. Wrap with pressure sensitive tape for protection prior to installing draw band. Pressure sensitive tape alone is not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide openings in ducts for thermometers and controllers.

B. Locate ducts with space around equipment for normal operation and maintenance.

C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the electrical equipment.

D. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms.

E. During construction provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork. Supply ductwork shall be free of construction debris and shall comply with level "B" of the SMACNA Duct Cleanliness for New Construction Guidelines.

F. Repair all duct insulation tears.

G. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers at air terminal device or in outlets, unless specifically shown.

H. Insulate terminal air box reheat coils. Seal insulation tight to form a tight vapor barrier.

I. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.

J. Flexible duct shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required, to include, but not limited to, all connections to air inlets, air outlets, and terminal air boxes.

K. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and Flexible and the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, where applicable. Refer to Section 23 05 50 for seismic requirements.

L. Adhesives, sealants, tapes, vapor retarders, films, and other supplementary materials added to ducts, plenums, housing panels, silencers, etc. shall have flame spread/smoke developed ratings of under 25/50 per ASTM E84, NFPA 255, or UL 723.
M. All duct support shall extend directly to building structure. Do not support ductwork from pipe hangers. Do not allow lighting or ceiling supports to be hung from ductwork or ductwork supports.

N. Ductwork systems shall be installed at the site to maintain “shop” or “mill” (free of mill oil) conditions. The ductwork shall be cleaned as necessary to maintain these conditions. (2019.06.04 ADD_001)

O. Cleaning shall be performed using a 20% Isopropyl Alcohol to wipe down all interior surfaces upon installation. (2019.06.04 ADD_001)

P. Interior surfaces must be dust free and exterior surfaces must be free of foreign substances. (2019.06.04 ADD_001)

Q. At the end of the workday, Contractor is to insure all ends are covered on both stored and installed ductwork. (2019.06.04 ADD_001)

### 3.2 DUCTWORK APPLICATION SCHEDULE

<table>
<thead>
<tr>
<th>USAGE</th>
<th>MATERIAL</th>
<th>PRESSURE CLASS</th>
<th>SEAL CLASS</th>
<th>INSULATION (Refer to Section 23 07 13 for insulation types)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Duct from Fan to Terminal Air Boxes – Single Wall</td>
<td>Galvanized Sheet Metal - Rectangular</td>
<td>+3&quot;</td>
<td>A</td>
<td>1-1/2&quot; thick Type A (R=4.5)</td>
</tr>
<tr>
<td>Supply Duct from Fan to Terminal Air Boxes – Single Wall</td>
<td>Galvanized Sheet Metal - Spiral Seam Round</td>
<td>+3&quot;</td>
<td>A</td>
<td>1-1/2&quot; thick Type A (R=4.5)</td>
</tr>
<tr>
<td>Supply Duct from Fan to Terminal Air Boxes</td>
<td>Galvanized Sheet Metal w/Slide-On Flange System or Formed-on Flanges (+6&quot;)</td>
<td>+3&quot;</td>
<td>A</td>
<td>1-1/2&quot; thick Type A (R=4.5)</td>
</tr>
<tr>
<td>Supply Duct from Terminal Air Boxes to Outlets</td>
<td>Galvanized Sheet Metal - Rectangular</td>
<td>+2&quot;</td>
<td>A</td>
<td>1-1/2&quot; thick Type A (R=4.5)</td>
</tr>
<tr>
<td>Supply Duct from Terminal Air Boxes to Outlets</td>
<td>Galvanized Sheet Metal – Spiral Seam Round or Snap-lock Seam Round</td>
<td>+2&quot;</td>
<td>A</td>
<td>1-1/2&quot; thick Type A (R=4.5)</td>
</tr>
<tr>
<td>USAGE</td>
<td>MATERIAL</td>
<td>PRESSURE CLASS</td>
<td>SEAL CLASS</td>
<td>INSULATION (Refer to Section 23 07 13 for insulation types)</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-----------------------------------</td>
<td>----------------</td>
<td>------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Return Duct</td>
<td>Galvanized Sheet Metal</td>
<td>-2&quot;</td>
<td>A</td>
<td>None</td>
</tr>
<tr>
<td>General Exhaust Duct from grille to backdraft damper</td>
<td>Galvanized Sheet Metal</td>
<td>-1&quot;</td>
<td>A</td>
<td>None</td>
</tr>
<tr>
<td>Ductwork in MRI Rooms</td>
<td>Aluminum</td>
<td>Same as applicable galvanized ductwork.</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Exposed duct in equipment rooms</td>
<td>-</td>
<td>-</td>
<td></td>
<td>2&quot; thick Type B</td>
</tr>
<tr>
<td>Ductwork Accessories (Fabric Flex Connectors, Equipment Flanges, etc.)</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1-1/2&quot; thick Type A (R=4.5)</td>
</tr>
<tr>
<td>All Terminal Air Box/Reheat Coil Headers and Duct Mounted Coil Headers</td>
<td>--</td>
<td>--</td>
<td>(Note 2)</td>
<td>1-1/2&quot; thick Type A (R=4.5)</td>
</tr>
</tbody>
</table>

† Seal Class is per SMACNA HVAC Air Duct Leakage Test Manual
‡ Type A insulation (Flexible Fiberglass Wrap) R-values noted are based on installed values (25% compression).

3.3 DUCTWORK SEALING

A. General Requirements:

1. Openings, such as rotating shafts, shall be sealed with bushings or similar.

2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.

3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.

4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil thick bands using brush, putty knife, trowel, or spray, unless manufacturer's data sheet specifies other application methods or requirements.
B. For Seal Class A ducts, all transverse joints, longitudinal seams, and duct wall penetrations shall be sealed. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jambs, duct, plenum, and casing abutments to building structures.

3.4 TESTING

A. Duct - 2" WG or Less (positive or negative):

1. Systems shall not leak more than shown in Table 4-1 of SMACNA HVAC Air Duct Leakage Test Manual for Seal Class A.

2. Leak testing of these systems is not normally required for interior ductwork. However, leak tests will be required if, in the opinion of the Architect/Engineer, the leakage appears excessive. All exterior ductwork shall be tested. If duct has outside wrap, testing shall be done before it is applied.

3. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.

4. Seal ducts to bring the air leakage into compliance.

5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

B. Test procedure shall be as listed in the latest edition of the SMACNA HVAC Duct Leakage Manual, with the following additional requirements:

1. Test pressure shall be the specified duct pressure class. Testing at reduced pressures and converting the results mathematically is not acceptable. This is required to test the structural integrity of the duct system.

2. If any leak causes discernible noise at a distance of 3 feet, that leak shall be eliminated, regardless of whether that section of duct passed the leakage test.

3. All joints shall be felt by hand, and all discernible leaks shall be sealed.

4. Totaling leakage from several tested sections and comparing them to the allowable leakage for the entire system is not acceptable. Each section must pass the test individually.

5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing. Failure to notify the Architect/Engineer of pressure testing may require the contractor to repeat the duct pressure test after proper notification.

6. Upon completion of the pressure test, the contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.

7. All access doors, taps to terminal air boxes, and other accessories and penetrations must be installed prior to testing. Including terminal air boxes in the test is not required.
8. The required leakage class for Seal Class A, both round and rectangular ducts, shall be 4.

9. Positive pressure leakage testing is acceptable for negative pressure ductwork.

3.5 DUCTWORK PENETRATIONS

A. All duct penetrations of firewalls shall have fire or fire/smoke dampers where required by code.

B. Dampers shall be compatible with fire rating of wall assembly. Verify actual rating of any wall being penetrated with Architect/Engineer.

C. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install trim strip to cover vacant space and raw construction edges of all openings in finished rooms. Install escutcheon ring at all round duct openings in finished rooms. Trim strips and rings shall be same material and finish as exposed duct.

END OF SECTION 23 31 00
GENERAL SHEET NOTES:

1. PROVIDE DUCT MOUNTED TEMPERATURE AND HUMIDITY SENSOR AND TIE INTO BUILDING CONTROL SYSTEM.
2. THERMOSTAT AND HUMIDISTAT PROVIDED BY REFER DETAIL 7 / M503 FOR CONDENSER PAD.
3. SHIELDING. PROVIDE WAVEGUIDE AT VERTICAL DUCTWORK SHALL BE ROUTED ABOVE FROM ENVIRONMENTAL CONTAMINATION.
4. MANUFACTURER.
5. RF SHIELDING WITH RF SHIELDING SHALL BE NON-FERROUS TYPE IN MRI PROJECT #.
6. PROVIDE ALL DUCTWORK, FITTINGS AND ACCESSORIES NON.
7. OR EQUAL MONITORING SYSTEM WITH COORDINATE WITH SHIELDING CONTRACTOR.

PH 816.421.0950
www.bsalifestructures.com
www.antella.com

ANTELLA CONSULTING ENGINEERS INC
St. Louis, Missouri 63105

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MRI 3T WIDE BORE
UM PROJECT # CP19061

FOR THE CURATORS OF THE UNIVERSITY OF MISSOURI

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**1. RF Shielding Penetration**

- **Notes:**
  - Does not apply to cryogenic vent (see separate detail).
  - Material to be non-ferrous.
  - Galvanized duct - ferrous.
  - Smooth.

**2. Exterior Wall Penetration**

- **Notes:**
  - Manual air vents at all supply and return.
  - Compact number of duct sections from wall to header.
  - Full size dirt leg separator.
  - Flanged view at all supply and return.

**3. Hot Water Coil Piping**

- **Notes:**
  - Supply and return with 3/4" threaded male.
  - High point in supply and return.
  - Control valve pressure independent.
  - Control valve next to coil.
  - Full size dirt leg separator.

**4. Duct Mounted Humidifier Detail**

- **Notes:**
  - Provide manual air vents at all supply and return.
  - Full size dirt leg separator.
  - Flanged view at all supply and return.
  - Compact number of duct sections from wall to header.

**5. Manual City Water Bypass Diagram**

- **Notes:**
  - Provide manual air vents at all supply and return.
  - Full size dirt leg separator.
  - Flanged view at all supply and return.
  - Compact number of duct sections from wall to header.

**6. Humidifier (Direct Injection) Piping**

- **Notes:**
  - Compact number of duct sections from wall to header.
  - Full size dirt leg separator.
  - Flanged view at all supply and return.
  - Compact number of duct sections from wall to header.

**7. Condensing Unit Pad Detail**

- **Notes:**
  - Compact number of duct sections from wall to header.
  - Full size dirt leg separator.
  - Flanged view at all supply and return.
  - Compact number of duct sections from wall to header.
**VAV BOX CONTROL DIAGRAM WITH REHEAT**

1. General Notes:
   - EIGHT VAV BOXES TO EXIST
   - CRAC UNIT NY - UNIT CONTROLS (TYP. FOR CRAC NY)
   - CRAC UNIT NY 4CRAC-A
   - CRAC UNIT NY 4WB-A
   - CRAC UNIT NY CHLR-4 ALARM
   - CRAC UNIT NY CRAC-4 HUM ISO VALVE
   - CRAC UNIT NY CRAC-4 WTR BUG ALARM
   - CRAC UNIT NY CRAC-4 ALARM
   - CRAC UNIT NY CRAC-4 HUMIDIFIER
   - CRAC UNIT NY DESCRIPTION

2. FC BUS SCHEMATIC DIAGRAM

3. MRU/PURGE SYSTEM DDC POINTS LIST

4. MRU/PURGE CONTROLS

5. CRAC - 4 UNIT CONTROLS (TYP. FOR CRAC - 5)

**General Notes:**
- Equipment and controls will be furnished by Contractor.
- All control points shall be coordinated with the Contractor.
- System shall be designed to accommodate all potential expansions and modifications.

**EXHAUST AIR**

**WIRE**

**LOW VOLTAGE**

**FC COMMUNICATION BUS**

**RETURN**
NOTES:

1. VMA TERMINAL INCLUDES CONSTANT VOLUME (CV) UNITS & VARIABLE AIR VOLUME (VAV) UNITS. UNLESS OTHERWISE NOTED, ALL CONTROL WORK SHALL BE BY CONTRACTOR.

2. CAPS FOR VAV DP TEST PORTS MUST BE 1/4" BRASS PLUGS.

KEY NOTES:

1. CONTROLLER WILL BE FURNISHED AND INSTALLED BY OWNER. CONTROLLER WILL BE JCI MODEL MS-VMA-16XX SERIES. PROGRAMMING AND COMMISSIONING WILL BE DONE BY OWNER.

2. FC COMMUNICATION BUS WIRE SHALL BE 22 AWG, PLENUM RATED, TWISTED SHIELDED, 3 CONDUCTOR, WITH BLUE OUTER CASING, DESCRIBED AS 22-03 OAS STR PLNM NEON BLU JK DISTRIBUTED BY WINDY CITY WIRE CONSTRUCTED BY CABLE-TEK, OR APPROVED EQUIVALENT.

3. CONTROLLER MUST HAVE A MINIMUM OF 18 INCHES OF ACCESSIBLE CLEARANCE.

4. VAV SUPPLY AND RETURN TEMPS SENSORS PROVIDED BY OWNER. LOCATE SUPPLY AIR SENSOR 8' FROM VAV DISCHARGE. INSTALLED & WIRED TO CONTROLLER BY CONTRACTOR.

5. FUSE LOCATED WITHIN 2FT. OF VMA CONTROLLER.

6. LOW VOLTAGE WIRE BY DIVISION 23. SEE ELECTRICAL DRAWINGS FOR SOURCE.

7. VALVE WITH PROPORTIONAL 0-10 VOLT ACTUATOR OR EQUIVALENT.

8. BO STEAM ISOLATION VALVE. 24VAC 2-POSITION.

9. SA BUS WIRE SHALL BE 22 AWG, PLENUM RATED, TWISTED SHIELDED, 4 CONDUCTOR.

10. HUMIDITY SENSOR PROVIDED AND INSTALLED BY CONTRACTOR. 0-10V, +/-2% ACCURACY.

11. 2-POSITION HIGH LIMIT AND FLOW SWITCH TO BE HARDWIRED TO SHUT DOWN HUMIDIFIER.

12. WATER BUG BI ALARM TO EMCS. PROVIDED AND INSTALLED BY CONTRACTOR.

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MECHANICAL CONTROL DIAGRAMS

KEYPLAN

AREA B

REFERENCE SCALE IN INCHES
**RATED FIRE BARRIER PENETRATION**

1. The fire resistance rating of the fire barrier shall be maintained in the area of the penetration.
2. The fire barrier shall be capable of withstanding the design fire load for the fire resistance rating of the fire barrier for the area of the penetration.
3. The fire barrier shall be capable of withstanding the design fire load for the fire resistance rating of the fire barrier for the area of the penetration.
4. The fire barrier shall be capable of withstanding the design fire load for the fire resistance rating of the fire barrier for the area of the penetration.

**PIPE SUPPORT DETAIL**

1. Refer to specification sections 22 05 29 & section 22 07 19.

**PIPE THROUGH NON-FIRE RATED WALL**

1. Refer to specification sections 22 05 29 & section 22 07 19.

**NOTES:**

1. Refer to specification sections 22 05 29 & section 22 07 19.

**PLUMBING FIXTURE SCHEDULE**

<table>
<thead>
<tr>
<th>PLUMBING DETAILS AND SCHEDULES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CODE</td>
</tr>
<tr>
<td>------</td>
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<tr>
<td>CP40004</td>
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LUMINAIRE SCHEDULE

<table>
<thead>
<tr>
<th>Type</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Coverage</th>
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</thead>
<tbody>
<tr>
<td>1.20</td>
<td>Wattstopper</td>
<td>PW-100-24</td>
<td>Full</td>
</tr>
<tr>
<td>1.21</td>
<td>Wattstopper</td>
<td>LMSW-101</td>
<td>Full</td>
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<tr>
<td>1.22</td>
<td>Wattstopper</td>
<td>LMDX-100</td>
<td>Full</td>
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<tr>
<td>1.23</td>
<td>Wattstopper</td>
<td>LMRL-100</td>
<td>Full</td>
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<tr>
<td>1.24</td>
<td>Wattstopper</td>
<td>LMRC-212</td>
<td>Full</td>
</tr>
</tbody>
</table>

**Notes:**
1. Pre-approval for equals must be submitted prior to bids per the front-end documentation. Substitutions will not be entertained post bids.
2. Contractor shall submit individual pricing. Lot pricing will not be accepted.
3. Symbol is shown in plan for clarity.
4. Cable to use to inter-connect DLM system devices to be white (or pre-approved color by owner). All cabling to be of same color.
5. Cabling used to inter-connect DLM system devices.
7. General demo notes:
   - All empty conduits shall be provided with a pull wire.
   - Use of 3M Scotchlok connectors or push-in wire connectors whips up to 6'-0" long or where specifically noted on drawings.
   - Connections to be done with wire nut connectors.
   - Connection points to use with pre-wired flexible whip furnished with light fixture.
   - Panel - breaker number (identification).
   - Phase conductors.
   - All circuits.
   - Load.
   - Motor.
   - Remote activation.
   - Isolated relay.
   - Dual relay.
   - Fuse.
   - Breaker.
   - Terminal block.
   - Isolated relay.
   - 120/277V.
   - Neutral Wht.
   - Hot Blk.
   - Sense (White 18AWG).
   - Normal Neutral.
   - Emergency Neutral.
   - Emergency Power.
   - Lighting.
   - Spot.
   - Splitter acceptable.
   - Shield together.
   - Pre-terminated.
   - Free topology &.
   - Cables or CAT5e.
   - Shielding.
   - Isolated relay.
   - Motor.
   - Remote activation.
   - Isolated relay.
   - Normal Neutral.
   - Emergency Neutral.
   - Emergency Power.
   - Lighting.
   - Pre-wired flexible whip furnished with light fixture.
   - Panel - breaker number (identification).
   - Phase conductors.
   - All circuits.
   - Load.
   - Motor.
   - Remote activation.
   - Isolated relay.
   - Dual relay.
   - Fuse.
   - Breaker.
   - Terminal block.
   - Isolated relay.
   - 120/277V.
   - Neutral Wht.
   - Hot Blk.
   - Sense (White 18AWG).
   - Normal Neutral.
   - Emergency Neutral.
   - Emergency Power.
   - Lighting.
   - Spot.
   - Splitter acceptable.
   - Shield together.
   - Pre-terminated.
   - Free topology &.
   - Cables or CAT5e.
   - Shielding.
   - Isolated relay.
   - Motor.
   - Remote activation.
   - Isolated relay.
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   - Emergency Neutral.
   - Emergency Power.
   - Lighting.
   - Pre-wired flexible whip furnished with light fixture.
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   - Phase conductors.
   - All circuits.
   - Load.
   - Motor.
   - Remote activation.
   - Isolated relay.
   - Dual relay.
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   - 120/277V.
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   - Emergency Neutral.
   - Emergency Power.
   - Lighting.
   - Spot.
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   - Shield together.
   - Pre-terminated.
   - Free topology &.
   - Cables or CAT5e.
   - Shielding.
   - Isolated relay.
   - Motor.
   - Remote activation.
   - Isolated relay.
   - Normal Neutral.
   - Emergency Neutral.
   - Emergency Power.
   - Lighting.
   - Pre-wired flexible whip furnished with light fixture.
   - Panel - breaker number (identification).
   - Phase conductors.
   - All circuits.
   - Load.
   - Motor.
   - Remote activation.
   - Isolated relay.
   - Dual relay.
   - Fuse.
   - Breaker.
   - Terminal block.
   - Isolated relay.
   - 120/277V.
   - Neutral Wht.
   - Hot Blk.
   - Sense (White 18AWG).
   - Normal Neutral.
   - Emergency Neutral.
   - Emergency Power.
   - Lighting.
   - Spot.
   - Splitter acceptable.
   - Shield together.
   - Pre-terminated.
   - Free topology &.
   - Cables or CAT5e.
   - Shielding.
   - Isolated relay.
   - Motor.
   - Remote activation.
   - Isolated relay.
   - Normal Neutral.
   - Emergency Neutral.
   - Emergency Power.
   - Lighting.
   - Pre-wired flexible whip furnished with light fixture.
   - Panel - breaker number (identification).
   - Phase conductors.
   - All circuits.
   - Load.
   - Motor.
   - Remote activation.
   - Isolated relay.
   - Dual relay.
   - Fuse.
   - Breaker.
   - Terminal block.
   - Isolated relay.
   - 120/277V.
   - Neutral Wht.
   - Hot Blk.
   - Sense (White 18AWG).
   - Normal Neutral.
   - Emergency Neutral.
   - Emergency Power.
   - Lighting.
   - Spot.
   - Splitter acceptable.
   - Shield together.
   - Pre-terminated.
   - Free topology &.
   - Cables or CAT5e.
   - Shielding.
   - Isolated relay.
   - Motor.
   - Remote activation.
   - Isolated relay.
   - Normal Neutral.
   - Emergency Neutral.
   - Emergency Power.
   - Lighting.
   - Pre-wired flexible whip furnished with light fixture.
### Electrical Schedules

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**UNIVERSITY OF MISSOURI - COLUMBIA**

**FOR THE CURATORS OF THE UNIVERSITY OF MISSOURI**

---

**E800**

---

### Electrical Schedules Table

<table>
<thead>
<tr>
<th>Panel Code</th>
<th>Panel Type</th>
<th>Description</th>
<th>KVA</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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### Electrical Schedules Diagram

- **Panel R1A** is an existing Siemens Type P1 panel. Verify circuit arrangement and spare available with field conditions.

---

**Panel Details**

- **Key:**
  - *NC* = New Circuit fed from existing circuit breaker

---

**Panel Dimensions**

- **X**
- **Y**

---

**Notes:**

- Verify circuit arrangement and spare available with field conditions.