

*See [UM Consultant Procedures and Design Guidelines](#). All design guidelines posted are applicable. Information below supplements and supersedes information provided in Division 23 of those documents.*

## **General**

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1. Per FGI Guidelines for Construction of Hospitals and Outpatient Facilities (FGI), if renovation efforts result in system modifications that “affect greater than 10% of the system capacity, designers shall utilize pre-renovation water/air flow rate measurements in the affected zones to verify that sufficient capacity is available and that renovations have not adversely affected flow rates in non-renovated areas.”
2. Ventilation and space-conditioning requirements shall follow ASHRAE 170 unless specific policies have been put in place by MUHC/MU FPD to allow alternate practice.
3. Consultants shall consider appropriate redundancy for each project and shall coordinate/ confirm redundancy design intent with MU Health Care.
4. Maintain a minimum access area of 24 inches around all above ceiling mounted equipment. Approval for any variance to this requirement by MUHC.
5. Equipment placement in critical areas shall be coordinated and approved early in design. Reduce or eliminate above ceiling HVAC equipment in critical areas such as: Operating Rooms, Cath Labs, and Procedure Rooms.
6. Duct or AHU humidifier installations shall include doors/access with view panel or window.
7. All cooling coils shall incorporate 5-foot standardize UV lamps to inhibit biological growth on coils. UV lamps shall be encapsulated. Also protect components from UV damage/exposure.
8. Differential pressure gages shall be installed across all filter banks.
9. Gages and devices shall be labeled to indicate normal range of operation.

10. The A/E shall include in the General Notes section of the Drawings a note stating, “No mechanical piping or HVAC duct (except where used for stairwell pressurization purposes) shall penetrate through fire resistance rated exit enclosures (stairwells and exit passageways)”.
11. Refrigerants used in any equipment must be EPA approved and not scheduled to be phased out of production within the next five years.
12. Where dampers and/or their housings are installed below 8’ in a finished space or mechanical room, protect the exposed corners in order to avoid sharp edges that may cause injury.
13. Isolation Room Exhaust:
  - Grilles are to be located within 6” of the floor and behind the bed.
  - Power for the exhaust system must be accessible to staff (Key switch, knob).
  - Monitoring devices are required to verify the pressure differential (Negative/neutral)
  - Shall meet all ACH requirements and all applicable codes.
  - The A/E shall note on the drawings “Any walls of the room that are not designated as smoke partitions or smoke barriers shall be sealed airtight.”
14. ***Smoke and fire damper locations shall appear on a dedicated drawing layer.*** Record Drawings shall include separate Fire and Smoke Damper drawing that shows locations of fire and/or smoke dampers and details.
15. One-line diagrams shall be provided for the following systems:
  - Supply/Return air flow from air handlers.
  - Exhaust fans

- Hydronic systems (Heating Hot Water, Chilled Water)
- Steam supply and return.

### **23 0513 Common Motor Requirements for HVAC Equipment**

1. All electric motors must have shaft-grounding straps when used with VFD.
2. Acceptable Manufacturers:
  - Baldor
  - Toshiba
  - WorldWide
  - Reliance
  - Weg

### **23 0593 Testing, Adjusting and Balancing**

1. TAB During Construction: First choice is to have TAB provided by MU Campus Facilities Energy Management (EM). For TAB provider other than EM, PM and MUHC shall work together to select consultant that is best suited to meet project needs.
2. Testing for current (preconstruction) performance prior to system modification is required during project evaluation and/or design. Owner will perform it for every project to confirm there is adequate air capacity to support the future or existing project program. This is required even if there is no anticipated increased load on the air handling system to confirm the system still has adequate capacity to support existing programs. Consultant shall inform PM of any specific information that needs to be captured for their use.
3. Minimum allowable airflow during balancing shall be the design CFM stated on the drawings. This must be stated in the TAB specifications.
4. TAB specification provided in the bid package shall describe the Contractor's scope of work to support Third Party TAB.
5. Separate TAB specification for the Third-Party TAB contractor's scope of work shall also be prepared. This shall be used by the CF PM to hire the Third-Party TAB firm.

6. Third Party TAB scope shall be revised to include TAB of all water systems, including plumbing.
7. Pressure critical spaces (including but not limited to OR's, Procedure Rooms and Cath Labs) shall have a series of blower door air pressure tests at the following project milestones:
  - At beginning of design to determine if the project needs to include scope to make the space air-tight
  - Prior to ceiling installation to show room has met acceptable level of tightness before substantial completion is granted. This shall occur late enough in construction that the test can be successfully completed but early enough that corrections can be made without impacting project schedule.
  - During Test and Balance (prior to substantial completion being granted). This requirement shall be met before project status can change to substantially complete.

### **23 0700 Mechanical Systems Insulation**

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1. Ductwork Insulation
2. No exposed insulation inside duct work
3. Flexible Elastomeric may be approved inside return air boots in plenum spaces with approval of MUHC Planning, Design and Construction

### **23 0800 Commissioning of HVAC Systems**

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1. Commissioning shall be performed by a 3rd party Commissioning agent contracted by Owner on every project that installs major HVAC equipment.

### **23 2100 Building Hydronic Piping and Pump Systems**

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- A. Dielectric Waterways are the preferred method to isolate dissimilar piping materials per [\*UM Consultant Procedures and Design Guidelines\*](#).

### **23 2200 Steam and Condensate Piping and Pump Systems**

1. Condensate returns shall be pumped back to make-up water system and not to waste.
2. Thermometers:
  - Provide adjustable angle, industrial thermometers with 9” scales, cast aluminum cases, and chrome plated brass separable sockets.
3. Chemical Water Treatment Products (KSMC Only):
  - Garrett Callahan
  - Nalco
4. Boilers:
  - Flow Meter – Acceptable Vendors:
5. Fluid Components International
  - American Meter

### **23 3000 HVAC Air Distribution**

1. Duct Labeling:
  - Ductwork shall be labeled with flow direction and type (general exhaust, contaminated exhaust, kitchen hood exhaust, supply, outside air, return, etc.).
  - 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.
  - Labeling shall include source equipment information (AHU#, EF-#, etc.).

- 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.
2. Access doors shall be provided where duct mounted devices will require periodic inspection, maintenance or cleaning. Including but not limited to Humidifiers, Motorized Dampers, Return/Exhaust VAVs, Fire/Smoke dampers, Air Measuring Stations and MRI waveguides. A clear path to access doors must be maintained.
  3. Duct fabrication labels shall be placed on duct exterior only. No paper identification labels shall be inside the duct.
  4. All ductwork, fittings, VAV's etc. shall be palletized and shrink wrapped for delivery to the jobsite.
  5. Where dampers and/or their housings are installed below 8' in a finished space or mechanical room, protect the exposed corners to avoid sharp edges that may cause injury.
  6. Shipping:
    - All ductwork and accessories shipped from fabrication shop(s) shall be shipped in an enclosed trailer or enclosed truck to protect the ductwork from damage, dirt, and moisture during transit to the jobsite.
    - Shop fabricated ductwork and fittings shall ship to the site completely assembled and both ends sealed with an adhered protective covering (hairnets are not acceptable).
    - Cursory cleaning shall take place when any foreign substance is noted.
  7. Handling:
    - When moving or unloading ductwork, ductwork shall not be placed on the ground.
    - Ductwork shall be placed directly in storage vans or within the building as it is unloaded, no exceptions.

- Ductwork shall be moved on carts or dollies.
- Ductwork that is wrapped shall not be dragged across the floor as it can damage the seals.

8. Installation and Final Clean:

- 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.
- Cleaning shall be performed using a 20% Isopropyl Alcohol to wipe down all interior surfaces upon installation.
- Interior surfaces must be dust-free and exterior surfaces must be free of foreign substances.
- Cover all ends of installed ductwork at the end of each workday, or when work is suspended for any length of time, i.e., breaks, lunch, etc.
- At the end of the workday, Contractor is to ensure all ends are protected with an air-tight cover on both stored and installed ductwork.
- If installed prior to roofing, protect ductwork from water infiltration.

9. Storage:

- Ductwork that is delivered to the site shall be installed as soon as possible.
- Care shall be taken to schedule only enough material on site for the immediate workload.
- 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.
- Openings and ends shall be continually protected with an air-tight cover.

- Owner reserves the right to reject any materials if contractor isn't conforming to practices for keeping materials free of dirt and contamination.
10. Support: "Clutcher" type duct supports are prohibited without prior approval from MUHC Health Facilities Managing Engineer.
  11. Fire and/or smoke dampers:
    - Dampers must have a test switch installed as an assembly by the manufacturer located at damper for testing purposes. This switch will drop the signal from the fire alarm system shutting the damper down.
    - Dampers require access panels 18" x 18" to access damper for repairs or required testing. All fire/smoke dampers will need to have easy access, above ceiling with no obstructions.
    - All walls deemed as integral to Life Safety shall be clearly marked on the Mechanical drawings in addition to the Life Safety drawing sheets for clarity and reference for the respective tradesmen.

### **23 3600 Air Terminal Units**

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1. Controllers for UH campus equipment shall be JCI.
  - Confirm early in design if controls will be purchased by CF Energy Management or by MUHC Engineering Services.
  - If controls installation is by MU Energy Management, the JCI controllers shall be ordered by Energy Management and installed by their personnel.
  - If JCI controllers are installed in VAV terminal units by the factory, units shall be completely sealed and shall not be opened until they are installed, and ductwork connected.
2. Controllers for WH equipment shall be Siemens.



## Division 23 – Heating Ventilation and Air Conditioning

3. Air Terminal Units: two-pass heat coils to shall be basis of design for operating rooms, trauma rooms and burn treatment areas. Verify with MUHC.
4. All VAV box installations shall have a service valve before the coil valve.
5. Existing terminal units shall be protected during construction.
6. It is preferable to have air terminal units control the return airflow of VAV systems rather than relying on manual dampers.
  - Vortex shedding is the preferred type for systems with large amounts of lint.
7. Acceptable manufacturers:
  - Supply
    - Titus (Basis of design)
    - Trane
    - Price
  - Return
    - Accutrol (for high lint systems; no substitutions)
    - Titus (standard return)
    - Price (standard return)
    - Trane (standard return)
8. Construction and record documents shall include a drawing or matrix detailing VAV connections to occupancy sensors.

**23 3700 Air Outlets and Inlets**

1. Air outlets should be installed with filter media or blanked off (as directed by the Owner's Representative).
2. Return air shall not be activated until all dust generating activities are complete. Temporary duct modifications, manual damper settings or overrides on control systems may be required. If return air must be activated prior to completion, upon approval by the Construction Manager, install filter media on return duct openings.

3. Discuss type of return grilles to be used for each project. Egg crate grilles have been a past standard but have proven to be difficult to clean. Current standard for patient care spaces is perforated.
4. Metal fittings shall be installed at each diffuser where flex duct is allowed. Do not attach flex duct directly to diffusers.

### **23 7000 Air Handling Units**

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1. All air handlers shall be assigned an equipment tag. Equipment numbering shall follow MUHC standard and start with the next number in the AHU equipment list. Consultant shall coordinate numbering with the MUHC Mechanical Trades Supervisor. In no instance other than new or fully renovated facilities shall air handler equipment tag numbering start with a number “1”.
2. Use of roof mounted equipment shall be approved by MU Health Care.
3. Air Handling Units (including their respective mechanical equipment rooms) and rooftop units are to be inspected for dirt/debris prior to any filter installation/start-up and shall be cleaned as necessary. Use 10% Isopropyl Alcohol solution to wipe down the inside surfaces of the air handlers.
4. Basis of Design air handlers:
  - Units serving critical spaces shall be fan-array type with N+1 fan redundancy.
  - Unit shall meet required capacity with one fan offline.
  - Each fan in the array shall be served by a dedicated VFD.
  - It is acceptable to utilize Electrically Commutated Motors (ECM) if VFDs won't fit in the mechanical room with the air handler.
  - Backdraft dampers shall be utilized at the fans. Blank-off plates are prohibited.

5. Air handling Units shall be draw-through.
6. Location of coil relative to fan shall avoid moisture carryover and biological growth in filters.
7. Elimination of moisture carryover from coils shall be included in design. Confirm parameters with MUHC PDC and ES.
8. Design shall consider means of dehumidification/dew point control. Reheat coil, separate desaturation coil, or other means approved by MUHC shall be discussed during design and approved by MUHC.
- 9.
10. UV or other MUHC approved coil disinfection strategy shall be included.
11. Steam coils are expressly prohibited.
12. AHU manufacturer's representative shall be onsite during installation/assembly of equipment. Consultant shall confirm this requirement is included in the project specifications.
13. Rooftop (outside) DX equipment shall include hail guards.
14. AHU or duct airflow measurement devices must employ vortex shedding technology. VAVs are excluded from this requirement.
15. Computer Room Air Conditioning Unit (Liebert Basis of Design, alternate Stultz):
  - All cooling equipment shall be accessible for maintenance and be dedicated to the specialty data room.
  - Service access panels installed per manufacturer specification.
16. Leakage:
  - Select an air handler with a manufacturer's designation showing air leakage is less than or equal to 2% of the design airflow rate.
  - Putty shall be installed around all conduit and wiring holes.

- UL-approved gaskets shall be used to seal cabinet doors and access panels.
- All unused conduit knockouts shall be sealed with UL listed tape or mastic.
- All fixed seams in the cabinets and all seams between the cabinet and supply or return plenums shall be sealed with mastic or mastic and fiberglass mesh fabric.
- Sealing putty shall be used to seal the inside of the high-voltage wire conduit termination point in the air handlers after wiring has been installed.
- Insulation inside the air handler where the conduit enters shall be checked by the contractor. If the insulation has been compromised, it shall be repaired with approved spray glue and additional insulation.
- Contractor shall test the airtightness of the air handler cabinet and ducts to verify that the system meets code or program airtightness requirements.

END OF SECTION