

230000 Heating Ventilation and Air Conditioning

230500 Common Work for HVAC

General

Provide access panels where maintenance will be required for items behind an enclosed wall or ceiling.

All piping shall be installed with proper pitch and valves to facilitate drainage of the system.

Pipe sizes shall be indicated on drawings at each change in direction and at all branch take-offs.

Electrolysis control between dissimilar materials shall be achieved through the use of dielectric nipples and a non-dielectric union. Dielectric unions shall be avoided whenever possible.

System and equipment drains shall be piped to a floor drain.

All welding shall be performed in accordance with ASME/ANSI B31.9. The contractor shall be responsible for non-destructive testing of all welds as selected by JHU, not to exceed 10% of the total project. Testing will be performed by an owner approved testing authority and shall be either a radiographic or ultrasonic method. In the event of a failure of greater than 25%, it will be the responsibility of the mechanical contractor to replace all failed welds and to test all remaining welds.

Welder must be certified within the past three years from start time on the project. Welders shall stamp/mark all welds for later identification. Employer shall maintain records of each welder and site map of all completed welds for owner's inspection.

All testing on piping and ductwork shall be complete prior to receiving any insulation. JHU personnel should be notified 24hrs in advance to witness testing.

Mechanical equipment shall be labeled in relationship to the equipment it is served by, the floor it is located, and with a specific designated number for that equipment. For example an air terminal unit served by air handler AHU-3 located on the ground floor should be labeled ATU-AHU3-G-1. ATU represents the type of equipment, AHU3 represents the air handling unit that serves it, G represents the floor it is located on and 1 represents the number assigned to this particular air terminal unit.

230519 Meters and Gauges for HVAC

Gauges

Gauges shall be provided on the suction and discharge side of all pumps installed.

Provide gauges around strainers.

Meters

Steam meters shall be McCrometer V-Cone, with Rosemount stacked DP transmitters (#1 @ 250" WC range, #2 @ 25"WC range, model number 2051), provide with KEP ES749 Supertrol-2 flow computer, temperature and/or pressure compensation (Reotemp

Hi Accuracy 3-wire RTD, 0.01 accuracy), provide startup, programming and commissioning of systems by Flow-Tech, Inc. 410-666-3200.

Chilled water meter shall be Onicon model F-1210 insertion flow meter with analog output for flow rate and System-10-BAC-MS/TP flow processor. Provide with local display module. Flow display shall be in gallons per minute (GPM).

230523 Valves for HVAC

General

Provide valves suitable for a minimum of 150 psig and minimum of 200 degrees F.

Valves located more than 7 feet from floor in equipment room areas shall be provided with chain operated sheaves. Extend chains to about 5 feet above floor and keep clear of walking aisles.

Where piping is insulated, provide valve operator extensions to suit insulation thickness.

Balancing valves shall be provided with a locking device to secure the valve in the balanced position. Balancing valves shall not be used for isolation. Provide additional isolation valves for isolation purposes.

Clearly show location of all isolation valves on construction drawings to be able to properly isolate the system for service.

Check valves

Check Valves shall be MSS SP-80, Class 150, swing check, except sizes 2.5 inches and larger shall conform to MSS SP-71, Class 150. Valves 2 inches and smaller shall be bronze body, horizontal swing, regrinding type Y-pattern, renewable disc. Valves 2.5 inches and larger shall be iron body, renewable seat and disc, bolted bonnet, horizontal swing, flanged ends.

Ball Valves

Ball valves shall be 600 psig, bronze body, full port, stainless steel ball and stem, 2 or 3 piece construction, screwed ends, TFE seats and seals. Provide for isolation and balancing in piping 3" and smaller.

Ball valves for steam service shall be stainless steel body, full port, repairable, stainless steel ball, multifill seats, threaded or flanged ends.

Butterfly Valves

Butterfly valves shall be high performance type, 200 psig bubble tight shutoff, lug body valves suitable for dead end service. Provide butterfly valves for isolation and balancing in piping 4" and larger. All butterfly valves shall be installed with shaft in horizontal position in horizontal runs of piping. Arrange disc to open away from possible sediment buildup.

- Valves 4"- 6" shall be 150 psig, bronze or stainless steel body, aluminum bronze disc, one-piece stainless steel shaft, resilient EDPM seats with rigid backing ring, manual lever and lock.

- Valves 8" and above shall be 150 psi, stainless steel body, extended neck, aluminum bronze disc, one piece stainless steel shaft, reinforced resilient EDPM seat with rigid backing ring and gear operator.

Gate Valves

Gate valves shall be 200 psig, outside screw and yoke, resilient wedge, epoxy coated interior and exterior, iron body, flange ends. Gate valves shall only be considered in steam piping larger than 3".

Drain Valves

Drain valves shall be bronze ball valve with dust cover, chain and hose thread minimum $\frac{3}{4}$ " for lines up to 2-1/2", 1-1/2" for lines 3" and over.

230593 Testing, Adjusting and Balancing (TAB) for HVAC

General

Balancing shall be performed by a company that is AABC or NEBB certified.

The TAB contractor shall be hired under a separate contract from the mechanical contractor.

TAB reports shall include single line schematic diagrams showing locations of HVAC system components, balancing devices, and measurement locations.

Balancing devices shall be marked by the balancer to indicate final setting.

The TAB report shall provide a single line system schematic with static pressure profiles.

Specifications shall indicate providing a minimum of a ½ day service from TAB contractor to demonstrate and reproduce measurements shown in TAB report. If the recheck proves to be different from the final report by more than the tolerances allowed, the balancing report shall be rejected.

If retest elicits a measured flow deviation of 10% or more from that recorded in the certified report in 10% or more of the retested selections, the report shall be rejected. If the report is rejected, all systems shall be readjusted and tested, new data recorded, new certified reports submitted and new inspection tests made, all at no cost to the owner.

230700 HVAC Insulation

General

Insulation requirements shall conform to the latest adopted energy conservation code.

All pipe and ductwork insulation shall be continuous through walls, partitions, ceiling openings, and sleeves.

Insulation on all cold surfaces must be applied with a continuous vapor seal. Hangers, supports, etc., that are secured directly to cold surfaces must be insulated and sealed to prevent condensation.

Raw edges of insulation shall be sealed to prevent moisture from penetrating the insulation.

Provide insulation protection shields fabricated from galvanized steel at all pipe hangers and supports.

Special protection shall be considered for insulation subject to abuse, moisture, weather, etc.

Provide removable insulation on equipment that will need periodic maintenance or inspection. These items include but are not limited to valves, strainers, pressure reducing valves, pressure relief valves, steam traps, pumps, expansion tanks, air eliminators, heat exchangers, storage tanks, ect.

230900 Instrumentation and Control for HVAC

General

Auto tuning of control loops is not acceptable. Manually tune all control loops. Auto tuning will only be acceptable for air terminal unit controls.

Valve and dampers on larger systems such as chilled water, steam, and air handlers shall be pneumatically actuated.

Provide gauges at any new pneumatic apparatus.

All control systems shall be capable of communicating with the existing campus control network.

All new control work shall include graphics that can be viewed by a campus building automation system (BAS). Graphics shall be submitted for review to the engineer and owner prior to implementation.

Sequence of operations along with control diagrams shall be provided in the drawing sets for all projects. Sequence of operations should not be in the specifications. Points list can be provided in either the specifications or drawing sets.

Space thermostats shall be wall mounted with a digital temperature display with a +/- adjustment knob. In common areas thermostats only be a sensor and shall not have a readout or adjustment knob.

All new critical control points such as (Animal Holding – Temp/Humidity, Process water systems – supply and return temperature, Library Special Collections – Temp/Humidity, Data Centers – Temp/Humidity, or as specified by the University) shall be enrolled into the Remote Operating Center (ROC) for continuous offsite monitoring.

For any control renovation, if the existing building does not have an existing Network Application Engine, provide a new Network Application Engine and locate centrally within the building for future distribution.

Projects involving renovations from the older PMI system to a new DDC system should include removing points from the PMI system head end.

232000 HVAC Piping and Pumps

HVAC Piping

Heating/Chilled/Condenser water piping 2-1/2" and smaller shall be type "L" copper, brazed joints are preferred.

Heating/Chilled/Condenser water piping 3" and larger shall be schedule 40 steel with welded joints.

Air conditioning condensate shall be type "L" copper with soldered joints.

Steam Condensate piping shall be schedule 80 black steel, joints 2" and smaller shall be screwed and joints 2-1/2" and larger shall be welded.

Steam supply piping shall be schedule 40 steel, joints 2" and smaller shall be screwed and joints 2-1/2" and larger shall be welded.

Refrigerant piping shall be type "K" copper, type OXY, hard tempered cleaned with ends capped. Joints shall be non-flux silver-brazing alloy.

All piping take offs shall be from the top of the main piping. Avoid taking off on the bottom of pipes to avoid debris from being supplied via the take-off.

All new piping must be treated and cleaned prior to connection to commons systems on the university utility distribution.

Filler sections of welded piping shall not be less than 18 inches in length.

Mechanical joints of any kind will not be acceptable.

Provide electrolysis control between dissimilar materials through the use of dielectric nipples and a non-dielectric union. Dielectric unions are not acceptable.

Piping layouts shall be designed to provide organized distribution systems which permit isolation of distinct sections without disruption of the entire building. Provide isolation valves at every major branch and at all unit connections. Provide manual air vents at all high points in the system and drain valves at all low points of the piping system.

Locate expansion loops and anchors on drawings. Expansion loops shall be used unless compensation devices are reviewed and accepted by JHU.

Coils shall be piped with strainers, flow meters, balancing valves and isolation valves as individual components.

Provide consideration for future extensions to building systems.

Provide piping identification and directional flow arrows at intervals not greater than 20 feet.

All multiple stacked coils shall be piped in a reverse return configuration. Refer to detail SKM-001 for reverse return configuration of piping to multi-stacked coils.

Provide temperature and pressure gauges on the supply and return of all new equipment.

Refer to Utility guidelines: [Building Chilled Water Connection and Design Parameters](#) for Homewood chilled water connection information.

General

All effort shall be taken to drain steam condensate by gravity.

All steam traps and strainers shall be installed with isolation, check valves, and drains for cleaning, maintenance and correct use.

Float and thermostatic traps shall be used for low pressure steam (<15psi).

Thermodynamic traps shall be used for medium and high pressure steam (>15psi)

232500 Water Treatment Systems

General

All water treatment within the plant at Homewood campus shall be limited to Guardian.

Water treatment in all other buildings on the Homewood campus shall be limited to Guardian, Waterchem and Chemstar.

Systems tied into the campus system do not need means to provide chemical treatment; these systems are treated at the campus plants. Closed loop systems dedicated to the building shall have a shot feeder system to deliver chemical treatment.

Whenever a building system is drained down, provisions shall be included to provide water treatment during the refill of the system.

Provisions shall be taken to drain and refill existing glycol systems as necessary. Where possible isolate sections of renovation to eliminate having to drain and refill the entire system.

233100 HVAC Ductwork and Accessories

Ductwork

Ductwork shall be made of galvanized sheet metal for supply, return and exhaust mains. Construction shall be per SMACNA standards.

All ductwork shall be seal class A and a gauge of 24 shall be the minimum thickness of ductwork permitted.

Corrosive systems and laboratory exhaust may require the use of stainless steel ductwork. Exhaust from fume hoods shall be type 304 stainless steel up to the exhaust air main connection unless project requirements dictate otherwise.

Ductwork carrying steam or high humidity (dishwasher, sterilizer, cage wash, shower rooms, ect.) shall be stainless steel with welded seams, shall be sloped on the horizontal runs and provided with condensate drains at low points that discharges into a building drain.

The use of flexible ductwork shall be limited to a maximum of 4 feet runs to supply diffusers only. Formal approval shall be given by JHU prior to designing with flexible ductwork outside of this scope.

Ductwork and associated equipment shall be independently supported from the building structure and shall be isolated from vibration.

All seams, joints, and fittings on ductwork shall be sealed.

Provide ductwork identification and directional flow arrows at intervals not greater than 20 feet.

Accessories

Internally lined ductwork is typically not desired except for open plenum transfer ductwork. Sound attenuators shall be used for sound attenuation purposes on all pressurized ductwork. Sound attenuation should be comprised of closed cell non-porous material only.

Provide manual volume dampers on all air distribution branch ductwork and where necessary for balancing, control and air distribution. Dampers shall be opposed blade with adjustable quadrant and locking device with position indicator.

Provide flexible connections at all moving equipment.

Provide access doors at all areas in ductwork that will require access to provide servicing or inspection. Contract drawings shall show access door locations.

233400 HVAC Fans

General

Fans shall typically be provided with variable frequency drives.

Direct drive fans are generally preferred.

Fans shall be at a minimum coated with a baked on phenolic coating. More resistant finishes may be required depending on function.

Provide heavy duty, grease lubricated, precision anti-friction, self-aligning, ball, roller, or tapered double spherical roller, pillow block type bearings. Bearing shall be selected for a minimum life of 200,000 hrs. Grease fittings shall be located to provide accessibility if applicable.

For multiple fans on a common header provide each fan with an isolation damper on the inlet or outlet (depending on application and arrangement) to prevent it from turning the opposite rotation when the fan is off.

Motors on all HVAC shall be inverter duty allowing for the installation of a VFD.

233600 Air Terminal Units

General

Supply air terminal units shall be pressure independent type. Controls shall be direct digital type as manufactured by the building automaton system vendor with 24 volt actuation. Unit shall be double wall construction with factory installed insulation. Provide access doors in unit casing.

All terminal units shall be located so easy accessibility for maintenance is provided.

Exhaust air terminals shall be provided for all laboratory exhaust. General exhaust terminals shall be similar to retrofit terminal units. Exhaust terminals serving fume hoods, biosafety cabinets and animal vivaria shall be fast acting type.

Fan powered mixing boxes are not desired for use on campus. Consult with the University Mechanical Engineer in instances where the use of fan powered mixing boxes may be proposed.

233700 Air Inlets and Outlets

General

Air devices shall be selected for a maximum of 35 NC based on 12db room noise absorption and 0.1" of pressure drop. Diffuser neck velocity shall not exceed 650fpm.

In damp or wet applications aluminum shall be specified.

Air distribution devices to be coordinated with system type and capable of full to partial flow for VAV systems.

Diffusers

Ceiling air diffusers shall typically be square with a flush, louvered face. Mounting shall be lay-in type when used with an acoustical ceiling and surface mounted when used in gypsum board ceilings.

High profile areas such as conference rooms, lobbies, executive offices, or other areas as determined during the design process shall consider the use of linear diffusers.

Diffusers within 8 feet of a Bio Safety Cabinet shall be laminar flow type.

Registers

Supply, return or exhaust registers shall be fixed louvered type, surface mounted, $\frac{3}{4}$ " spacing at 30 or 45 degrees deflection and shall have opposed blade dampers.

Grilles

Grilles shall be fixed louvered type similar to registers, but without the opposed blade damper.

234100 Air Filters

Filters

Filter efficiency shall be as required by ASHRAE and JHU safety standards in conjunction with JHU.

Filters types for critical areas shall be dictated by the specific application.

Filters shall have separate holding frame with side access and slide out frames. Frames shall be located to permit easy removal of entire frame for filter replacement.

235000 Central Heating Equipment

General

Design and selection of central heating equipment shall include consultation with the University Director of Plant Operations and the University Mechanical Engineer.

Steam to hot water converters shall be shell and tube type. Tubes shall be Cu/Ni.

Where campus steam is not available, consideration shall be given to use hot water condensing boilers.

In the case that a boiler is being replaced, considerations shall be included in the design to provide an exhaust flue upgrade.

236000 Central Cooling Equipment

General

Design and selection of central cooling equipment (Chillers and Cooling towers, ect.) shall include consultation with the University Director of Plant Operations and the University Mechanical Engineer.

Controls for central cooling equipment such as chillers and cooling towers shall have BACNET capability.

237000 Central HVAC Equipment

Air Handling Units

Air handling units shall be double wall, corrosion resistant, sheet metal panel construction with thermal breaks at connections. Units shall be modular construction. Sections shall be complete with self-supporting framing.

Type, configuration and manufacturer selection shall be coordinated with the University Mechanical Engineer and Plant Operations depending on the application.

Heat reclaim methods shall be utilized wherever possible.

Units shall typically be provided with a preheat coil, cooling coil, pre and final filters and a fan section.

Units shall be provided with variable frequency drives.

In general heating coils shall be designed for use we heating hot water, steam heating coils may be considered if consulted with the University Mechanical Engineer and Plant Operations.

Mixing sections/Air Blenders shall be considered in systems mixing recalculated air with outside air.

Cooling coil selections shall be selected for a 16 degree F rise at peak conditions. Entering water shall be 45F and leaving water shall be 61F. Cooling coil framing and drain pans shall be constructed with non-corrosive material.

Freeze protection shall be provided on all applications where coils are subject to freezing.

Consult with the University Mechanical Engineer to determine if full N+1 redundancy is required.

To the greatest extent possible, mechanical equipment shall be located indoors to maximize useful service life and ease of maintenance. Maintain recommended service clearances for coils, filters and fan.

Unit shall be provided with at least 24" access space upstream and between sections that will require sensor installations, inspection and cleaning.

Provide service windows and service lighting at each accessible section.

Dampers shall be high performance, low leakage airfoil type with DDC to pneumatic actuation.

238000 Unitary HVAC Equipment

General

Air Cooled equipment shall be designed for low ambient control at 0F and any roof mounted air cooled equipment shall be rated for 105F.

Fan Coil Units

Fan coil units shall be provided with insulated cabinets, fans with variable speed ECM motors, coils, drain pans and a filter.

Fan coil units shall be selected at low or medium fan speed.

238400 Humidifier Equipment

General

Building steam shall be used whenever possible for humidifiers.

Humidifier

Electronic generated steam or ultrasonic humidifiers should only be used when building steam is not available or it is not feasible to run building steam to the humidifier location. If electronic or ultrasonic humidifiers are utilized water softening equipment shall be provided.

Follow manufacturer's guidelines for location of humidifiers.

Six feet of stainless steel ductwork shall be installed where humidifier is installed within ductwork. Slope ductwork to allow drainage and provide a piped drain to the nearest reasonable drainage location.

Provide an access panel with a glass vision panel on the downstream side of the manifold.