230500 COMMON WORK FOR HVAC

Part 1 – GENERAL

1.1 Description

A. This section details the guidelines and expectations for the design and installation of HVAC systems on Johns Hopkins University Homewood Campus. Project conditions and requirements vary, thus precluding the absolute adherence to the items identified herein in all cases. However, unless there is adequate written justification and approval from the JHFRE Engineering and Energy Department, it is expected that these guidelines will govern the design and specifications.

B. All scheduled utility interruptions and tie-ins shall be coordinated with JHFRE. Provide 11 working days notification.

1.2 Submittals

A. The designer shall prepare a Life Cycle Cost Analysis to determine the heating and cooling systems, fuel sources and major system components. The analysis must conform to the life cycle cost and energy criteria specified in Chapter 6 of ASHRAE 90.1.

B. Upon project completion, all as-built drawings will be delivered to the owner in latest AutoCAD version as well as hard copies.

C. Contractor shall mount 24” x 36” Xerox hard copy project drawings of new mechanical room equipment in each mechanical room. Each drawing shall be mounted under plastic, framed, and rigidly affixed to the wall in a conspicuous location.

D. Design calculations shall be furnished at the 35% design stage. Calculations shall be detailed enough to give JHFRE an understanding of how the designer arrived at their conclusions. Include projected energy use per year and projected peak flows.

E. Pipe sizes shall be indicated on drawings at each change in direction and at branch takeoffs.

F. 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. JHFRE will provide a guide for naming nomenclature.

1.3 Quality Assurance

A. In general, water-cooled equipment shall be provided for energy efficiency. Air-cooled equipment shall be utilized where project requirements show air-cooled equipment is a more effective solution. In areas without a reliable make-up water source, air-cooled chiller equipment shall be evaluated in coordination with the JHFRE.

1. Any proposed building with more than 50 tons of cooling/heating needed of available underground lot shall require a preliminary viability study for ground source heat pumps be performed.

B. Ventilation shall be provided per ASHRAE 62.1. System performance for critical health, energy and security concerns, such as proper indoor air quality, minimization of ventilation conditioning and avoidance of infiltration exposures, depend upon close attention being paid to the proper design and operation of the building ventilation systems, relief/exhaust systems and their effect on building pressurization. Create an understanding of ventilation, exhaust and pressurization requirements derived from code. Within the design, define the expected operational modes, such as air side economizer, small and large conference room control strategies (including flexibility to add in the future) and general demand control ventilation.

C. Relief air systems are part of the overall HVAC systems and are required to assist in maintaining proper building pressurization. The outdoor air introduced into the building shall be tracked through the BAS to maintain proper building pressurization. When the building pressure exceeds the predetermined set point as sensed by static pressure sensors located throughout the building, return/relief fans or separate exhaust fans shall be energized to relieve air from the building to the outdoors. Relief fans can be provided as part of the air handling unit system or as a separate exhaust system. The building pressure shall not exceed 0.05 inches water column (w.g.) and the relief air duct velocity shall not exceed 1800 fpm.

D. HVAC design analysis for new facilities or renovation of existing facilities shall include a metric-based analysis documenting that the system meets the design criteria. The analysis must provide calculations of system cooling load, energy/mass transfer through conditioning equipment and fan and a system schematic indicating state point dry bulb and wet bulb temperatures (or humidity ratios) of return air, outside air, mixed air and supply air flow streams. The system must provide the capability to condition ventilation air and maintain space relative humidity over the full range of cooling load.

1. Heating and cooling system design loads shall be determined in accordance with the calculation procedures described in ASHRAE 183 unless otherwise specified.

2. Provide a 1.15 safety factor for cooling equipment and distribution sizing, to include piping mains, to account for potential growth or change in occupancy/use. Provide a 1.10 safety factor for heating equipment and distribution sizing, to include piping mains, to account for potential growth or change in occupancy/use.

3. Contractor shall acquire the space load conditions based on the actual equipment load in the spaces. The Project Manager will assist to determine the appropriate method for sizing cooling equipment depending on specific project requirements. The A/E contractor shall be responsible for collecting existing drawings and, if necessary, for measuring the current space loads should the equipment information be unavailable. Consult equipment manufacturers for specific heat gain requirements for documentation of design criteria.

4. The Project Manager will provide the occupancy requirements for the contractor to determine the cooling load required due to occupancy. If unknown, derive from standard industry guidelines. In addition, ensure the greater of the actual space load or the anticipated/future load governs the design.

E. Outdoor Design Conditions: Unless otherwise noted, design all mechanical systems in compliance with ASHRAE Climatic Design Information for Baltimore, Downtown, MD, USA (WMO: 745944).

F. Indoor Design Conditions:

1. The A/E shall design all mechanical systems and complete all load calculations in compliance with the table below. Use the listed temperatures for use in all load calculations. If a Noise Criteria (NC) level is not indicated, the NC shall comply with industry standards. The specifications shall require the Testing and Balancing (TAB) agent to perform sound tests, or acquire the services of a sound consultant, and administer testing in accordance with applicable ASTM standards to verify the installation complies with the requirements. There shall be no testing tolerance.

Area	Temperature	Humidity	Sound NC (maximum)
Office Areas	72°F	50% +/- 15%	40
Conference Rooms	72°F	50% +/- 15%	30
Transport Closets / Comms Rooms	72°F	50% +/- 10%	55
Mechanical/Electrical Rooms / Elevator Machine Rooms	75°F	50% +/- 10%	
Electrical Closets	85°F	50% +/- 10%	
UPS Rooms	74°F	50% +/- 10%	
Battery Rooms	77°F	N/A	

2. For special areas, such as clean rooms, printing areas and industrial processes, the ambient space temperature, humidity and sound NC levels shall be determined based on the operational requirements, to include end-user specific criteria.

G. Specific HVAC Requirements by Room Type

1. Communications Rooms: Provide fan coil units (FCU) as the primary cooling equipment while the house system functions as the redundant cooling system. If the house system is not available to serve as the redundant cooling system, the A/E shall provide an alternative solution to provide adequate redundancy for the primary cooling equipment.

a. The temperature sensor within the space shall modulate the FCU control valve to maintain space conditions as required in this standard. The A/E shall be aware that there is only

a maximum humidity requirement and, to the maximum extent practical, induce a modest ventilation air change from a house air handling unit or other means to avoid staleness.

b. It is acceptable for the required ventilation to be achieved by utilizing a door undercut to the space. The FCU design is required to meet a chilled water-cooling capacity of the calculated load plus an additional 25% capacity. Evaluate the need for and feasibility of floor-mounted CRAC units to satisfy cooling requirements for the space.

2. Office Areas: Evaluate and design all office areas in accordance with ASHRAE 62.1 and the IMC to provide cooling units to maintain space conditions as required in this standard. Office areas shall have a maximum NC rating of 40. The house air system shall be sized for typical office, people and skin loads with adequate airflow to ensure for proper conditioning and ventilation distribution. Any chilled water system(s) shall be distributed under the raised access floor or located in the ceilings. The chilled water system shall be sized to accommodate any additional loads over and above the house air system.

3. Conference Rooms: Evaluate and design all conference rooms for intermittent usage per current ASHRAE 62.1 and the IMC guidelines. Conference rooms that contain audio or video conferencing equipment shall have a maximum NC rating of 30. Conference rooms that don't contain audio or video conferencing equipment shall have a maximum NC rating of 35. Where the project allows, equip the AHU with heat recovery equipment and devices. For intermittent usage applications, it is acceptable to utilize the house system, where capacity allows, with VAV and reheat coils to compensate for high minimum primary air settings.

a. For conference center applications, containing multiple conference rooms located adjacent to each other, each conference room shall be served by two separate VAV boxes (one house and one 100% outside air) each with reheat coils. The outside air VAV box shall be controlled by a wall-mounted CO2 sensor in the space. The base building HVAC portion shall be controlled by a wall-mounted thermostat.

4. Electrical Rooms: Evaluate and design all electrical rooms in accordance with NEC and ASHRAE 62.1. Provide N+1 cooling units (from independent sources) to maintain space conditions as required in this standard. Locate units to achieve even conditioning of the space. Provide fresh air ventilation from the house air handling unit(s) to create a room air change which avoids staleness.

5. Electrical Closets: Evaluate and design all electrical closets in accordance with NEC and ASHRAE 62.1. Heat shall be dissipated using transfer air by one of the following scenarios without impacting Fire Protection or Security requirements:

a. Undercut up to 1-inch

b. Provide a door louver

c. Transfer duct with appropriate protective measures and termination grille

d. Provide an exhaust fan and wall-mounted thermostat to control exhaust for maintaining space requirements.

Note: Electrical Closets containing transformers larger than 100-kVA and/or panelboards rated for 1200A or larger shall be treated as Electrical Rooms.

6. Mechanical Rooms: Evaluate and design all mechanical rooms in accordance with ASHRAE 62.1. Provide cooling units to maintain space conditions as required in this standard. Provide fresh air ventilation from the house air handling unit(s) to create a room air change which avoids staleness. Provide potable water service, associated floor drains with trap primer/guard systems and compressed-air drop wall outlet(s) for maintenance operations. Include the connections and infrastructure between communications closet and telephone such as conduit, routing, junction boxes and line connection locations.

a. A strategically placed permanent structural beam system (new construction) shall be installed overhead to allow hoist and trolley to operate in a continuous, unobstructed path to allow mechanical equipment and components (e.g. chiller, pumps, etc.) to be transported or removed into an aisle way for service from the space. Overhead hoists and beams/trolleys shall be capable of moving the heaviest installed component that would require replacement. Portable units, coordinated with the chiller manufacturer to comply with weight requirements, shall be provided for servicing chiller evaporator and condenser heads if permanent units are not feasible. Portable units shall be specified to become property of JHU upon project completion. In addition, include hand chain hoist with a geared trolley (w/ hand chain) for chiller and water pumps servicing, repair and replacement.

b. Mechanical Rooms housing chillers shall comply with all manufacturer's recommendations and the requirements listed below for installation, operation, rigging and maintenance of chiller and water pumps, and shall allow for servicing of equipment, including but not limited to chiller motor, chiller compressor, chiller suction ell, pump motor, pump casing and pump impeller.

7. Elevator Machine Rooms: Evaluate and design all elevator machine rooms in accordance with the ASME 17.1 and ASHRAE 62.1 to provide cooling and humidity control. Conditioning shall be achieved through the use of a packaged Direct Expansion (DX) and shall not obstruct or violate elevator machinery access. Obtain performance requirements and conditioning loads from the Basis of Design elevator equipment manufacturer.

H. The design of HVAC systems to maintain noise levels below those recommended for the proposed occupancy in accordance with the ASHRAE Handbook and SMACNA guidelines. Preferably, locate sound sensitive rooms away from air handlers and mechanical equipment. Acoustical duct liner is not allowed. Use double wall acoustic duct where sound attenuation cannot be accomplished by other methods and the duct is not serving occupancies that are sensitive to particulates. Increase the outside duct dimensions as required to maintain adequate internal cross sections.

Part 2 – PRODUCTS

2.1 Gauges

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

B. Provide gauges around strainers.

C. Gauges shall have a minimum of a 3-1/2" face plate with scale to be two times operating range with midpoint set for expected operation point.

D. Provide stems with a minimum length of 2-1/2" immersion, which shall be increased in insertion length as necessary to reach the centerline of pipe to which it is installed.

2.2 Meters

A. 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.

B. 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).

C. Differential Pressure Transmitters controlling secondary pump speed shall be located so as not to be affected by loop isolation or closure.

2.3 Valves

A. Header Isolation Valves are critical for piping loop isolation and rerouting in case of repairs or terminal equipment additions. Isolation valves shall be provided at each header and branch takeoff. Provide isolation valves to accommodate maintenance and isolation functions to facilitate redundant units being taken out of service. All valves shall be located to ensure accessibility for maintenance operations. When located above the ceiling or below the raised access floor, identification marker tags shall be provided to identify locations.

1. Provide isolation valves at all equipment and on branch pipes at connections to mains where branch pipes serve three or more pieces of equipment. An isolation valve shall be provided upstream from every installed gauge.

2. Valves 2" or smaller shall have screwed fittings or be copper sweat. For Isolation Applications (shutoff service), use ball valves.

3. Valves 2-1/2" or larger shall have flanged fittings. For Isolation Applications (shutoff service), use butterfly valves of the lug body type.

B. Ball valves shall be, 600psig, 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.

C. Butterfly valves shall be high performance type, 200psig 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.

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

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

D. Check valves

1. Valves 2” and smaller shall be MSS SP-80, Class 150, swing check and be bronze body, horizontal swing, regrinding type Y-pattern, renewable disc.

2. Valves 2-1/2” and larger shall conform to MSS SP-71, Class 150 and be iron body, renewable seat and disc, bolted bonnet, horizontal swing, flanged ends.

E. Gate valves shall be 200psig, outside screw and yoke, resilient wedge, epoxy coated interior and exterior, iron body, flange ends.

F. Drain valves shall be bronze ball valve with dust cover, chain and hose thread.

1. Minimum 3/4” for lines up to 2-1/2”.

2. Minimum 1-1/2” for lines 3” and over.

G. For Throttling Service (balancing), use calibrated balancing valves wherever possible. Calibrated balancing valves shall be used for all equipment and shall evaluate the need for branch lines that serve 3 or more pieces of equipment. Ensure that locations have proper distances of upstream and downstream length per the valve manufacturers’ recommendations.

H. Triple duty valves shall be cast iron body, pump-discharge fitting, with drain plug and bronze-fitted shutoff, calibrated balancing and check valve features. The valve shall be equipped with brass readout valves with integral check valve to facilitate taking differential pressure readings across the orifice for accurate system balance. Cv rating shall be provided at every 10% increment opening and the manufacturer shall supply the Cv rating for read-out of flow and pressure drop. Triple duty valves are used on discharge chilled water, condenser water, and hearing hot water pumps. Pumps can be provided alternatively with balancing valves, check valves and isolation valves, but shall be evaluated and require approval from JHFRE.

Part 3 – EXECUTION

3.1 All piping shall be installed with proper pitch and valves to facilitate drainage of the system. System and equipment drains shall be piped to a floor drain.

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

3.3 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.

3.4 All valves not specified above shall be suitable for a minimum of 150psig and 200° F.

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

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

3.7 Do not install piping in exterior walls, structural slabs, above ornamental ceilings, transformer vaults, above electrical switchboards. Avoid runs of water piping in unheated areas.

3.8 Water piping containing glycol may be buried no less than 24” from top of pipe to grade level.

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

3.10 All pipes shall be labeled showing full descriptive words and arrows indicating flow direction. Such labels shall be provided on straight runs, at valves, and where passing through walls and floors.

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