



DIVISION 23 HEATING, VENTILATION AND AIR CONDITIONING

For all new construction and renovation projects, the Mechanical and HVAC design shall comply with applicable local and state codes and with the latest codes and guidelines of the following organizations:

- a. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
- b. American National Standards Institute (ANSI)/ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality
- c. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Standards for Ductwork Design
- d. ANSI/American Industrial Hygiene Association (AIHA) Z9.5 Laboratory Ventilation
- e. ANSI/ASHRAE 110 Method of Testing Performance of Laboratory Fume Hoods
- f. American Society for Testing and Materials (ASTM)
- g. National Fire Protection Association (NFPA)
- h. National Electrical Code (NEC)
- i. National Electrical Manufacturers Association (NEMA)
- j. Occupational Safety and Health Administration (OSHA)
- k. American Society of Mechanical Engineers (ASME)

DESIGN CRITERIA

The Consultant shall provide a written description of how the entire system is designed to operate. This Basis of Design (BOD) narrative also shall describe how project objectives are being met. It shall be provided in a format that can be easily understood by a layperson, the end user. The narrative shall identify items that specifically meet the Owners Project Requirements (OPR) and the most recent Facilities Management (FM) or department System Master Plan(s) and articulate a rationale for any variance.

For renovations, the systems selected shall be compatible with the existing building's mechanical systems. The integrity of the basic existing building system shall not be compromised, except when agreed to by the Owner. Work shall be designed and sequenced to minimize impact and interruptions in occupied buildings.

For site work, the Consultant shall indicate all existing underground work such as piping, valves, manholes, electric wiring and telephone, whether new connections are being



made or not. Profiles of all piping need to be shown to facilitate coordination with the crossing of other utilities. Planning and Project Management or the Project Manager will provide existing campus utility information so new work can be coordinated.

The Consultant shall incorporate any requirements from the University insurance carrier or Risk Management into the design and specifications.

The Consultant shall allow for normal expansion and contraction of the piping system. In addition to construction drawings, the project as-built drawings shall indicate expansion joints or pipe swings where designed or added.

All fluid systems shall be designed to be fully drainable.

Specialty HVAC equipment is to be purchased with an associated minimum two-year warranty on parts and labor to begin on the same day as Final Acceptance. Examples include boilers, chillers, vacuum pumps, air compressors, etc.

Mechanical equipment rooms shall be placed preferably at ground level and away from occupied spaces to minimize transmission of noise vibrations into the building.

During design development, submit for compatibility review a complete manufacture points list for controlled equipment provided under this Division, indicating if points are monitor-only or capable of remote control. Point mapping to the existing BAS system is an owner requirement and must comply with AU Division 25 integration requirements. Variances require concurrence of Facilities Management.

Include a complete description of technical control requirements such as handheld devices needed for field adjustment, software and licensing (proprietary or open source), or gateway requirements. Refer to Division 25 for building automation requirements.

MECHANICAL SYSTEMS AND ENERGY CONSERVATION

The minimum accepted standards for energy conservation as described in the District of Columbia Building Code will not only be met, but exceeded, where possible. Life cycle cost/present worth analysis that assesses the total cost of a system over its entire useful life will be used and is required on Capital Projects.

Building areas that require 24-hour-per-day occupied HVAC operation, such as libraries, security stations, and laboratories, shall be served by a system separate from those that can apply unoccupied schedules for energy savings. Typical areas with occupied and unoccupied schedules include offices, classrooms, and conference spaces.

The Consultant will incorporate energy reduction strategies in place at American University into the design. These include, but are not limited to, demand control ventilation, occupied/unoccupied mode, automated demand response, and campus



closure.

Energy recovery shall be incorporated for all single pass 100% outdoor air systems.

Areas with unique load off-season or beyond system loop piping capacity typically require supplemental cooling.

PACKAGED (FACTORY) CONTROLLERS

All equipment designed to be sequenced by a factory or packaged controller must adhere to the controller and integration requirements of Division 25.

- A. Design Phase Requirements: During the design phase, any package controller equipment or system shall be identified for review by AU. AU will provide review comments to the design team regarding controller requirements. Identify opportunities where equipment and systems can be sequenced from a packaged controller or BAS DDC controller.

When the equipment or system controller is defined in the design documents, the design team will be required to include the following:

- 1) Input/Output Matrix – Table listing the required operating points, including alarm information, hardwired points list, description of the point, and the tag ID. (This list should include ONLY the points being used to sequence or monitor the equipment or system in question.)
 - 2) Control diagrams showing connections from the packaged system or equipment controller to the AU BACNET network or gateway.
 - 3) Associated Sequence of Operations
- B. Construction Submittal Phase: The controls contractor will submit the following:
- 1) Controller IOM: The document, as provided by the manufacturer, including BACnet protocol for open communications, list of inputs/outputs, wiring diagram and complete point database with the following:
 - a. Point number
 - b. Descriptor
 - c. Factory default point units and range
 2. Equipment/System IOM:
 - a. Contact information for manufacturer's rep for service calls and maintenance.
 - b. Reference product data for package controller
 3. Finalized stand-alone points list with alarm information
 - a. Analog High Alarm
 - b. Analog Low Alarm
 - c. Digital Alarm Condition
 - d. Alarm Delay
 - e. Alarm Priority



- f. Conditions that Trip and/or Reset Alarms
 - g. Units
- C. Construction Installation: Manufacturer's representative, controls contractor and CM/GC representative will provide completed pre-functional and installation startup documentation prior to completion of installation work.

This PFC documentation will be reviewed by the Owner's BAS department and the Owner's Commissioning Agent for compliance with the pre-functional checklist and manufacturer's provided installation and startup materials.

- D. Functional Testing: During Commissioning Agent led functional testing, both the manufacturer's representative and the controls contractor shall be present on site to complete the approved functional test script under supervision of the Owner's Commissioning Agent.

All issues and deficiencies found during functional testing shall be addressed prior to turnover and wrap up of controls work for that system or equipment. Testing shall also include a dry run utilizing all available points, alarms and sequences associated with the packaged controller to ensure compliance with the design documents.

- E. Post Construction and Closeout: Once the controls work has concluded and all functional tests have passed, the manufacturer will submit to the CM/GC a complete turnover package that includes the following:
- 1) List of stand-alone points formatted in MS Excel with filters in place for sorting the list by name, point type or address.
 - 2) Final I/O Matrix with complete point list.
 - 3) Final O&M manual with a table of contents and bookmarks.
 - 4) Final updated submittal with any changes to points, sequences or alarms noted in a red-lined format.
 - 5) Final control diagrams with any changes to point or controller layout noted in a red-lined format.
 - 6) Final warranty document with complete contact list for service calls.

This final closeout package will be reviewed by the CM/GC for compliance with the project documents before being distributed to the Owner for review and approval.

CHILLED WATER RELATED DESIGN CRITERIA

The preferred cooling medium for air conditioning systems is chilled water. Spot cooling data closets and similar areas where chilled water is not continuously available may be accomplished with split systems.

For renovation projects, the Consultant shall verify that the existing chilled water system capacity will support the new load. Renovations to existing chillers and towers shall require detailed scheduling to minimize any potential loss of cooling to the building.



New systems connecting to a campus chilled water loop shall use a plate and frame heat exchanger between the building and the central chilled water loop. Chilled water systems and related terminal equipment shall be designed for a minimum 12-degree temperature differential based upon 45-degree entering water temperature.

To meet winter cooling loads, a waterside economizer may be employed where the use of 100% outdoor air is not possible. Plate and frame heat exchangers are strongly recommended for this application. Use of a side stream filter is strongly recommended for the cooling tower side of the system.

Special attention shall be paid to fresh air requirements for ventilation. Criteria for minimum fresh air shall follow the latest ASHRAE guidelines adopted by the District of Columbia. Consideration should be given to demand ventilation or on-demand I.A.Q. through use of environmental measurements including CO2 sensors. Refer to current ASHRAE guidance regarding IAQ assessment.

To satisfy system requirements for outdoor air, a dedicated minimum outside air damper is preferred for air-handling units.

The location of outside air intakes shall be chosen for proper separation from any exhaust outlets to prevent cross contamination.

Air conditioning systems should make use of re-circulated air from spaces where no air contamination exists, such as offices and classrooms.

HEATING WATER RELATED DESIGN CRITERIA

American University owns and operates a Low Temperature Hot Water System (LTHW) that provides district heating for the Main Campus. The heating demand for any new construction or renovation shall be submitted to E&E for verification of whether the existing

LTHW distribution system will be adequate to meet the new demand and the nature of required piping and flow adjustments, system balancing and equipment recalibration.

New systems connecting to the main campus LTHW system are to be designed to work with low temperature hot water of 150 degree entering water temperature without the use of secondary heating systems.

MECHANICAL EQUIPMENT ROOMS

Provide thermostatically controlled ventilation as required.

The system design should be such that it meets the needs of the application. The Consultant shall select equipment that is consistent with the design and application of the system. Mechanical systems shall be designed to accommodate reasonable future



functional space changes.

Paint equipment curb risers safety yellow.

The designer should review and incorporate supplemental information on specifics for type of room use found in the Facilities Management Space Needs document, listed in the References section of the Standards.

SOUND AND VIBRATION CONTROL

Outdoor equipment such as cooling towers, fans, and air-cooled condensers shall not produce noise levels that will exceed the interior and exterior dB levels defined in the Owner's Project Requirements. The dB level required to meet this goal shall be specified and included on the project documents and drawing schedules.

HVAC equipment located in the building shall be carefully evaluated for sound level. If sound levels are expected to be higher than recommended in ASHRAE 'Noise and Vibration' guidelines, sound control devices are required.

Room terminal units such as variable volume terminals shall be selected for low sound levels. Air supply diffusers and registers shall have sufficiently low air velocity to meet low sound criteria. Air noise from a supply outlet that exceeding the dB levels established in the Owner's Project Requirements is not acceptable.

Appropriate vibration isolation of equipment, piping and ductwork shall be specified.

VALVES

Ball valves are to be used in lieu of butterfly valves if size permits. For control valves use only ball valves that are characterized, equal percentage V-port.

Valves used for isolation and control shall provide absolute shut-off to full ANSI Class ratings with pressure in either direction, allowing flexibility in system design and utility during system maintenance.

Valve tags are to be installed down to one-inch pipe size. Valve charts are to be laminated and kept accordingly in nearest mechanical rooms or floor service closets. Note that FM and University Housekeeping do not share access to the same service spaces.

Stainless steel is preferred for valve bodies, seats, retainers and associated packing gland retainer studs. Bearings shall be stainless steel with PTFE/fiberglass mesh liner. Composite materials shall not be used.



VALVES, BALL – 23 05 23.12

Valve selection criteria is chromium plated ball or stainless steel (full port). Performance rating is minimum 400 psi CWS, 125 SWP with 600 WOG preferred and maximum temperature of 400F.

Where insulation is specified, provide factory installed extended stems to receive insulation. Service valves installed in systems below ambient temperature shall have Therma-Seal as manufactured by Apollo or approved equal.

Chain wheel operators shall be provided for all valves 2-1/2" or larger installed 72 inches or higher above finished floor. Extend chains to an elevator of 60 inches above finished floor.

Hand wheels fastened to valve stem shall be provided for valves other than quarter-turn types. Lever handles shall be provided for quarter turn valves 4" and smaller.

Gear drive operators shall be provided for quarter turn valves 6" and larger.

VALVES, BUTTERFLY – 23 05 23.13

Valve selection criteria is high performance positive shutoff on pressure or vacuum with zero leakage and bubble tight for all valves over 2 inches. All shafts shall be one-piece construction.

VALVES, CHECK – 23 05 23.14

Standard swing check valves over 4" shall be rubber faced. Special coatings such as ethylene propylene diene monomer rubber (EPDM) porcelain may also be appropriate.

Install check valve with a minimum of 5 (five) pipe diameters downstream from any flow disturbance (valve, pump, elbow or reducer) to reduce chatter and early valve failure.

VALVES, GATE – 23 05 23.15

Valve selection criteria is adjustable packing gland, blow out proof stem design, with polytetrafluoroethylene (PTFE) seats and ethylene propylene diene monomer rubber (EPDM) stem packing.

Standard steel wedge type gate valves should be outside screw and yoke, rising stem, non-rising hand wheel, and bolted bonnet.

Gate valves are to be used in specific installations only with prior approval from FM. Do not use where dirty surface medium may cause seating problems.



HEAT TRACE FOR HVAC – 23 05 33

Electric cables for freeze protection shall be on independent circuits and supplied by emergency power when available. System status shall be monitored by the building automation system and alarm based upon outside air temperature requirement when not energized.

IDENTIFICATION FOR HVAC – 23 05 53

Equipment naming and labeling shall be consistent with other University systems and used consistently throughout the project. Submit equipment schedule during design phase for confirmation of the FM AiM asset identification. Include drawings across all disciplines. See Division 26 for required color-coding of labels for equipment and components based upon energy source and the references section of this document for the naming scheme. Coordinate with Section 25 55 00.13 for integrated automation control naming consistency.

COMMISSIONING FOR HVAC – 23 08 00

In addition to required startup and performance testing, HVAC systems shall follow the connectivity and alarm requirements as described in the Building Automation Master Plan and the FM Commissioning Plan. See Division 1, section 01 91 13 and Division 25. Additional requirements by DC Green Construction Code may also apply.

DDC SYSTEM FOR HVAC – 23 09 23, 23 09 93

American University has standardized its automated building control systems. The standard specifications shall be incorporated for all projects. The standardization of building control systems does not relieve the Consultant from providing schematic control diagrams and descriptions of the sequence of operation for all systems. Refer to and incorporate Division 25 requirements along with any supplemental information in the current Building Automation Master Plan and suggested control drawings with sequences.

HYDRONIC PIPING – 23 23 13

The use of t-drill as an installation method on 2 inch and larger piping is acceptable.

Pro-press as a connection is allowed in accessible areas only and shall be so noted on the as-built drawings. FM possesses a complete Pro-press kit for maintenance purposes up to 4-inch diameter, other manufactures will not be considered.

Do not design a system that uses Victaulic or similar gasketed pipe for primary or secondary heating or cooling distribution within the building. The exceptions are readily accessible mechanical areas, equipment connections and fire suppression.



The use of die-electric isolating nipples is not allowed.

HYDRONIC SYSTEM TREATMENT – 23 25 00, 25 25 13, 23 25 16

Compatibility with the current E&E treatment program is required. Information on treatment and tie-in requirements is provided in the References section of this document. Treatment system acceptance by FM will require documentation from contractor verifying flushing, passivation and treatment by the AU chemical contractor using components and supplies from the vendor.

ENERGY METERS – 23 0923

American University is committed to energy efficiency and confirming system performance. Thermal metering is required using equipment compatible with and integrating fully with the building automation system and the existing data collection program. For meters residing on the BAS sub-network this typically requires a 4-20mA, 0-10VDC, or BACnet-MS/TP connection. For meters outside the BAS sub-network communication should be through TCP/IP Modbus or BACnet Object. Confirm specific requirements and placement with E&E Energy Manager.

AIR DUCT SPECIALTIES – 23 33 00

Contractor will have a third party inspect and verify that smoke and fire dampers are installed per manufacturer's requirements, are readily accessible for maintenance, and meet required performance. Third party inspector shall be ICB certified and acceptable to inspect and test smoke and fire dampers by the Authority Having Jurisdiction.

Inspect prior to acceptance at the 100% rate, no sampling allowed, with Commissioning Agent or University designee and at one-year interval as per NFPA 105 and NFPA 80 requirements. All dampers must pass inspection.

END OF DIVISION 23