



These guidelines are required as a part of the design basis for all HVAC systems designed for Beth Israel Deaconess Medical Center. Where applicable codes conflict with these guidelines, the code shall supersede these requirements. Any deviation from these requirements should be brought to the attention of the Facilities Engineering Dept. during review, with an explanation why it is required, or how it improves the system.

I. Review Documents

1.1. BIDMC review

- 1.1.1. Provide documents for review at Schematic, Design Development and Construction Documents phases. This information will be reviewed and comments will be prepared by BIDMC personnel within 3 weeks of submission, or as coordinated by the BIDMC Project Manager.

1.2. Design intent document

- 1.2.1. Provide a description of the project, updated at each stage of design, including:
 - a. Applicable codes and standards
 - b. Indoor and outdoor design conditions
 - c. occupancy and usage
 - d. occupancy schedule
 - e. internal loads
 - f. Service and maintenance requirements
 - g. Acoustics and air quality requirements
 - h. Pressurization requirements
 - i. Ventilation requirements
 - j. Smoke control requirements
 - k. Energy conservation and sustainable design requirements
 - l. Commissioning requirements
 - m. Summary of control sequence
 - n. System flows, temperatures and pressures

1.3. Design drawings and specifications

- 1.3.1. Provide drawings and specifications at each stage of design, as appropriate.
- 1.3.2. Show location of connections to existing systems at each stage of design.
- 1.3.3. Provide a list of required submittals as part of the design documents.

1.4. Utility impact analysis

- 1.4.1. Provide calculation of net utility usage required from existing building systems at all phases of design, including:
 - a. Chilled Water
 - b. Steam
 - c. Hot Water
 - d. Supply Air
 - e. Exhaust Air
- 1.4.2. Provide analysis of existing systems or cite other sources, showing sufficient capacity of existing utilities.

II. HVAC

1. Matching equipment and systems

1.1. Renovations

- 1.1.1. New work shall be consistent with the design of the original system.
- 1.1.2. Field-verify existing systems
- 1.1.3. Match existing equipment manufacturers for
 - a. Terminal Boxes
 - b. Diffusers
 - c. Controls
 - d. Fan-coils
 - e. Other equipment that requires stocked maintenance parts

1.2. New Construction and Major Renovations

- 1.2.1. Equipment and systems will be designed based on a BIDMC-preferred manufacturer (see below for list). Coordinate the full list of acceptable manufacturers with BIDMC personnel.

2. Air Handling Systems

2.1. System selection and criteria

- 2.1.1. Type of air-handling system (e.g. constant volume, VAV, reheat) shall be reviewed with Facilities Engineering during the conceptual design phase.
- 2.1.2. In mixed-air systems, stratification of airstreams in cold weather shall be considered and minimized by use of blow-through fan placement, engineered mixing box configurations or air-blenders. Include stratification tests in commissioning requirements.
- 2.1.3. Return air shall be ducted where feasible.
- 2.1.4. Overhead warm air heating systems, including terminal reheat coils, must be designed for supply temperature no more than 20°F above design room temperature

2.2. Duct design

- 2.2.1. Design ducts for the following criteria, unless space constraints prevent it

Duct type	Max. Velocity (feet/min.)	Max Pressure Drop (in./100')
Diffuser runouts	700	N/A
Low Pressure	1000	.10
Medium Pressure	2000	.25

- 2.2.2. Where separate offices are served by the same ductwork, lay out duct to prevent straight-line transfer of noise.
- 2.2.3. Where duct lining is needed, consult facilities engineering.
- 2.2.4. For all duct pressure classes, transverse and longitudinal seams, as well as duct penetrations shall be sealed in accordance with SMACNA seal class A. Mains, risers and as many duct runouts as possible shall be pressure tested.

2.3. Component design

- 2.3.1. Heating and cooling coils shall be configured to allow easy draining, flushing, filling, cleaning and replacement.
- 2.3.2. Provide Ultraviolet antimicrobial lights in air handlers.

- 2.3.3. Pressure-independent terminal boxes are recommended in large constant-volume air systems. Terminal boxes are required if room pressurization is required.
- 2.3.4. Diffusers shall be sized for 50 fpm terminal velocity at midpoint to another diffuser or at 2/3 of the distance to walls. Use high-induction diffusers where possible.
- 2.3.5. Fan-coils shall have separate heating and cooling coils. Fan-coils with ducted returns shall be designed with easily accessible filters in the return grilles, sized for a maximum face velocity of 300 fpm.
- 3. **Heating systems**
 - 3.1. BIDMC campus steam shall be used as a heat source, either directly or through conversion to hot water. Steam-to-Hot Water heat exchangers and pumps shall be provided if existing hot water systems do not have sufficient capacity or are otherwise unsuitable.
 - 3.2. Steam-to-HW convertor designs shall include redundant control valves, heat exchangers and pumps. Heating systems shall be designed with a minimum 15% allowance for system warm-up. Valves, unions, and fittings shall be configured to allow service and removal of components.
 - 3.3. Electric heating systems shall be allowed only where other systems are not feasible, and as approved by Facilities Engineering.
 - 3.4. Steam systems
 - 3.4.1. Review the need for steam metering with Facilities Engineering during the Conceptual Design Phase
 - 3.4.2. A non-freeze, distributing tube or internal face-and-bypass steam coil shall be used where there is a potential for freezing air temperatures. Non-freeze coils should not be longer than 6 feet.
 - 3.4.3. Steam traps shall be located in a heated space, outside the airstream.
 - 3.4.4. Large steam coils shall include provisions for a 1/3-2/3 two-stage control.
 - 3.4.5. Steam control valves shall be sized for approximately 50% of the system operating pressure. Consult the Facilities Engineering group to determine the steam operating pressure, as it is typically much less than the design pressure.
 - 3.4.6. Steam branch piping shall connect to mains at top or side of main piping
 - 3.5. Hydronic heating systems
 - 3.5.1. Variable-volume systems, using two-way control valves shall be used. Provide variable speed drives on pumps of 3HP and above.
 - 3.5.2. Hot water coils shall be used in lieu of steam coils where air temperature controlled by a wall thermostat.
 - 3.5.3. Steam-to-HW convertor designs shall include a supply water reset schedule coordinated with BIDMC.
 - 3.5.4. Hot water heating system shall be designed for a maximum supply water temperature of 180°F. The water temperature drop shall be at least 20°F. Consult BIDMC Facilities Engineering for supply water temperature reset schedule of existing HW systems.

4. Cooling systems

- 4.1. All cooling on the main campus shall be served from the central chilled water system where feasible.
- 4.2. Review the need for chilled water metering with Facilities Engineering during the Conceptual Design Phase
- 4.3. Chilled water coils shall be selected for 44°F entering water temperature and minimum 20°F water temperature rise. Coil pressure drop should be minimized, and should in no case exceed 7 psi.
- 4.4. Variable-volume systems, using two-way control valves shall be used. Provide variable speed drives on pumps of 3HP and above.
- 4.5. Provide wye strainers at control valves or inlet to equipment over 5 tons.
- 4.6. Provide main-line chilled water wye strainers at take-offs serving floors or areas where fan-coils or chilled-water equipment below 5 tons is used.
- 4.7. Where equipment is susceptible to fouling by dirty chilled water, provide heat exchanger and circulating loop to isolate the chilled water from the equipment.
- 4.8. Direct-expansion systems are allowed only where chilled water systems are not feasible or special applications (e.g. low-temperature or low-humidity requirements)
- 4.9. Once-through water cooled systems are not allowed except as emergency back-up to critical systems per applicable code. Notify Facilities Engineering of proposed design and required permits during conceptual design phase.

5. Piping Design

- 5.1. Pressure drop
 - 5.1.1. In general, hydronic piping shall be designed for pressure drop of 1 to 4 feet per 100'.
- 5.2. Velocity
 - 5.2.1. In piping above ceilings and in occupied spaces, velocity shall be less than 4 fps. Hydronic piping in large mains and mechanical spaces may be sized for up to 10 fps.
- 5.3. Air venting and separation
 - 5.3.1. Provide automatic air vents and parallel manual vents and pressure gauge at all high points in hydronic systems. Provide air separator in closed systems that are isolated from the MATEP system.
- 5.4. Specify solid brass cap at all drain and blow-off valves.
- 5.5. Specify isolation valves to allow service and replacement of all components.
- 5.6. Specify and require submittal of a list of isolation and service valves and associated tag labels. Valve lists shall be submitted in hard copy, ready to mount in mechanical room, and electronically.
- 5.7. Glycol systems
 - 5.7.1. Provide manual make-up system in all glycol systems
- 5.8. Traps, isolation valves, drains, etc. serving AHUs shall be mounted outside casing of unit, in an enclosure or other safe location.
- 5.9. Air handler condensate drains shall not be combined or cascaded.

6. Filters

- 6.1.1. Provide pleated pre-filters (MERV-8 minimum)
- 6.1.2. Provide high-capacity final filters with HEPA-compatible rack
- 6.1.3. Coordinate filter selection with Facilities Engineering.

7. Insulation

- 7.1. Provide fiberglass insulation with all-service jacket in ceilings and walls.
- 7.2. Provide fiberglass insulation with 16-mil aluminum jacket in mechanical rooms and where subject to traffic
- 7.3. Provide removable, fitted insulation jackets on fittings that require service.
- 7.4. Labels and flow-direction arrows on insulation shall be color coded per code, and as follows, where not directed by code:
 - 7.4.1. Steam/Condensate: White
 - 7.4.2. Heating Hot water: Orange
 - 7.4.3. Chilled Water: Blue
 - 7.4.4. Potable Water: Green
 - 7.4.5. Non-potable water: Yellow
 - 7.4.6. Vent piping: Black
 - 7.4.7. Natural Gas: Yellow
 - 7.4.8. Fuel Oil: Yellow
 - 7.4.9. Fire Protection: Red

8. Motors and Variable Speed Drives

- 8.1. Provide premium efficiency motors for all applications.
- 8.2. Where variable speed drives are used, provide motors with ceramic bearings specifically designed for use with variable speed drives.
- 8.3. Variable speed drives shall be capable of direct interface with DDC control system

9. Energy Efficiency

- 9.1. Energy efficiency features, including heat recovery, airside economizer, unoccupied setback, ventilation optimization, etc should be considered in the design and included where they can be shown to have a reasonable financial payback.
- 9.2. Provide a simple payback analysis of proposed energy efficiency designs that exceed prescriptive codes.

10. Controls

- 10.1. Documentation
 - 10.1.1. Provide As-built Control diagram with complete operating sequence in both electronic and hard-copy format with close-out documents.
 - 10.1.2. The as-built control diagram shall be placed in control panel enclosure and in close-out submittal books.
- 10.2. Renovations
 - 10.2.1. Renovation designs shall use the DDC control systems that are present in the buildings for HVAC controls.
- 10.3. Zones of control

- 10.3.1. No more than 3 rooms shall be controlled by a single wall thermostat.
Only rooms of similar use and load profile shall be controlled by a common thermostat.
- 10.4. Zone temperature setback
 - 10.4.1. All zones shall have the installed capability to set-back temperature setpoints, by schedule or occupancy. Additional zones should be considered to optimize setback capability or occupant comfort.
- 10.5. Dampers and Control Valves
 - 10.5.1. Electronic actuators are preferred for new installations
 - 10.5.2. Pneumatic actuators may be used for renovations, replacements and special circumstances.
- 10.6. Computer Graphics
 - 10.6.1. Provide graphics that accurately describe the configuration of air handling units, ductwork, piping and floor layouts
 - 10.6.2. Provide a link that will display the applicable control sequence
- 10.7. Air handling system controls
 - 10.7.1. Provide airside economizer with dry-bulb temperature control.
 - 10.7.2. Provide control points and graphics for the following:
 - a. Fan status (On/Off)
 - b. Fan power usage (Amps)
 - c. Supply/Return/Exhaust flow (CFM)
 - d. Fan speed signal (0-100%)
 - e. Damper signal (0-100% open)
 - f. Unit Return Temperature (°F)
 - g. Mixed Temperature (°F)
 - h. Supply Temperature (°F)
 - i. Preheat discharge temperature (°F)
 - j. Supply and return chilled water temperature (°F)
 - k. Unit return and discharge humidity (%RH)
 - l. Control valve signal (0-100% open)
 - m. Supply and return static pressure (in. Wg)
 - n. Isolation damper (open/closed)
 - o. Outside air temperature and humidity from campus central location
 - 10.7.3. Each output point shall be capable of being alarmed
 - 10.7.4. Provide alarm points for the following:
 - a. Mixed air temperature (out of range)
 - b. Preheat discharge air temperature (out of range)
 - c. Unit Discharge air temperature (out of range)
 - d. High static pressure
 - e. Low static pressure
 - f. Freezestat
 - g. Smoke alarm
 - h. Fan status

11. Preferred Providers (others may be acceptable, as well)

11.1. Manufacturers

- 11.1.1. Air handlers
 - a. Cambridgeport, Air Enterprise, Buffalo Air Handling
- 11.1.2. Controls
 - a. Siemens
 - b. Johnson
- 11.1.3. Fans
 - a. Mechanovent, Greenheck
- 11.1.4. Filters
 - a. AeroStar, Farr
- 11.1.5. Humidifiers
 - a. Armstrong, Dri-steem, Carel
- 11.1.6. Pumps
 - a. Gould, Weinman, Taco, Bell& Gossett
 - b. Provide mechanical seals similar to Chesterton
- 11.1.7. Valves
 - a. Apollo, Watts
- 11.1.8. Variable Speed Drives
 - a. Yaskawa (with data link)
- 11.1.9. Ultraviolet emitters (in air stream)
 - a. Steril-aire
- 11.1.10. Ductless split systems
 - a. Sanyo, Mitsubishi
- 11.2. Contractors
 - 11.2.1. Commissioning Agents
 - a. Energy Management Associates, Inc.
 - b. Facility Dynamics Engineering
 - c. Synergy Consultants, Inc.
 - d. Santoro Associates
 - 11.2.2. Testing and Balancing
 - a. Leonhardt
 - b. Cox Testing and Balancing

12. Penetrations

- 12.1. Sleeves shall be provided for all floor and wall penetrations
- 12.2. Use UL-rated sealing system by Hilti (see BIDMC standard for Through-Penetration Stop Systems)
- 12.3. Specify utility mapping prior to coring floors, where there is a possibility of in-slab conduit

13. Accessibility

- 13.1. Design layout shall allow for maintenance and replacement access to new equipment and free access to existing systems.
- 13.2. Provide largest feasible access doors (minimum 12"x12") at fire dampers. Fusible link shall be less than 2'-0" from access door.
- 13.3. This access shall be a priority in the inspection of completed work.