Energy Conservation: See the Energy Conservation section within these Standards for specific HVAC system guidelines and requirements related to energy conservation.

ASHRAE: HVAC system design not addressed within these U of I Facilities Standards shall be in accordance with recommendations of the latest version of ASHRAE Handbook – HVAC Applications.

Climatic Design Conditions: Climatic design conditions for HVAC systems shall be as published within the latest version of the ASHRAE Handbook – Fundamentals. Station Location: University of Illinois Willard Airport.

Outdoor Design Conditions: Design conditions for cooling, evaporation and dehumidification shall be based upon 0.4% annual cumulative frequency of occurrence. In order to achieve a conservative design, heating design conditions shall be based upon mean extreme DB in lieu of the 99.6% value. Humidification shall be based upon 99.6% annual cumulative frequency of occurrence. As of the time of this writing, applicable values are as follows (per ASHRAE 2009 Handbook – Fundamentals):

Heating:
Heating DB: -1.0 Degrees F
Mean Extreme DB: -9.6 Degrees F

Humidification:
Humidification DP: -6.2 Degrees F
Humidity Ratio: 4.1
Mean Coincident DB: 0.7 Degrees F

Cooling:
Cooling DB: 92.5 Degrees F
Mean Coincident WB: 76.4 Degrees F
Mean Extreme DB: 96.2 degrees F

Evaporation:
Evaporation WB: 79.8 Degrees F
Mean Coincident DB: 89.1 Degrees F
Extreme Maximum WB: 88 Degrees F

Dehumidification:
Dehumidification DP: 77.1 Degrees F
Humidity Ratio: 145.0
Mean Coincident DB: 86.3 Degrees F

Enthalpy:
Enthalpy: 43.9 BTU/LB
Mean Coincident DB: 88.3 Degrees F

Indoor Design Conditions, Occupied:
Default indoor “design-to” conditions for HVAC systems that serve standard occupied spaces:

Heating DB: 70 Degrees F
Cooling DB: 75 Degrees F / 50% RH

When a system that serves a standard building/space is provided with positive humidity control, the space humidity setpoint shall be limited as follows:

Heating: Not more than 30% RH
Cooling: Not less than 50% RH

ASHRAE Standard 55: Proposed indoor design conditions for occupied spaces other than the default values provided above will be considered by F&S Engineering Services for approval on a project by project basis. However, consideration will only be given to design conditions that fall within the range of acceptable thermal conditions presented in ASHRAE Standard 55.


Non-Standard Spaces:
Examples of non-standard spaces to which the indoor design conditions identified above do not apply are library archival storage, musical instrument storage, museums, clean rooms, animal facilities, and data centers. In order to maintain space temperature and humidity outside standard design limits specialized HVAC equipment and/or special building construction is required. (See the Doors & Windows, Glazing and Walls, Partitions sections within these General Guidelines.)

Occupied / Unoccupied: Systems shall be provided with adequate functionality and shall be zoned to support optimized occupied/unoccupied control sequences.
HVAC SYSTEMS

Central Utilities: HVAC systems shall typically utilize central distributed chilled water, central distributed steam and central distributed electricity whenever these utilities are available. Direction regarding the use of central utilities and specific design information shall be obtained from the Energy Service Division within F&S via a Utility Program Statement.

Central HVAC Systems: Each building shall be served by a minimal number of central HVAC systems rather than numerous individual/package units such as fan coil units, window air conditioning units or DX "split systems". Typically, each central system shall include an air handling unit, a return and/or exhaust fan or fans and air distribution/return/exhaust ductwork.

Institutional Quality: HVAC equipment/systems shall be institutional grade as opposed to standard commercial grade. For the purposes of this writing, institutional grade equipment/systems have minimum life expectancy of 25 years for dynamic system components such as motors, switches, pumps, valves, fans, dampers, compressors and burners, and a minimum life expectancy of 50 years for static system components such as casings, cabinets, ductwork and piping.

System Size: The number of small systems (i.e. less than 5,000 CFM) shall be minimized. The installation of a smaller number of larger systems typically results in higher equipment quality and reduced maintenance requirements while providing adequate opportunity for application of energy conserving features and control strategies.

System Configuration: HVAC systems shall be configured such that spaces with similar usage are served by a common system. As much as possible, spaces with dissimilar usage types or schedules shall not be served by the same system. Each sizeable lecture hall and public assembly area shall be served by a dedicated HVAC system. The animal facilities within a laboratory building shall be served by a dedicated HVAC system. Areas that have special temperature and/or humidity requirements shall be served by dedicated systems. This allows the design of each system to be tailored to the specific needs of the areas being served. It also allows the implementation of specific control strategies (such as occupied/unoccupied modes and temperature resetting) for each system to conserve energy while satisfying the requirements of all of the spaces served by that system.

Future Requirements: Each HVAC system shall be sized and configured so as to accommodate anticipated/potential changes in loads, layout, etc. (within practical limitations) as the use of the areas served changes in the future.

Equipment Location: Each piece of motorized HVAC equipment shall be located within a mechanical equipment room with the exception of roof mounted exhaust fans, window air conditioning units and specialized unitary equipment such as computer room air conditioning cooling units that are specifically designed to be located within the space being served. Location of motorized HVAC equipment above finished ceilings is not allowed. This includes suspended grid / drop-in tile ceilings. In no case shall motorized equipment (e.g. fan coil or blower coil units) be installed above a hard finished ceiling (e.g. sheet rock or plaster).

Sound Control: Sound control as it relates HVAC systems shall be given adequate priority. As mentioned elsewhere, the best way to control noise is to not create it in the first place. When focused attention is given to maximizing the efficiency of HVAC systems, noise is much less of an issue. The allowable HVAC-related background noise level for a given type of occupancy shall not exceed the guideline criteria provided in the chapter entitled “Sound and Vibration Control” in the “ASHRAE Handbook, HVAC Applications”.

Vibration Control: Most floor-supported rotating HVAC equipment that is located within the lowest level of a building, with the exception of air distribution equipment and reciprocating equipment (e.g. air/refrigeration compressors and internal combustion engines) may and shall be installed with virtually no special provisions for vibration isolation between the equipment.
and its support system or associated hydronic piping. This equipment shall typically be “hard mounted” directly to a reinforced concrete housekeeping pad without the use of vibration isolation devices and “hard connected” to the piping systems they serve without the use of flexible pipe connectors. The use of flexible pipe connectors shall be minimized since they have proven to be leak/failure prone. An exception to these general rules may be necessary in facilities where equipment that is especially vibration sensitive (e.g. an electron microscope) is located at the lowest level of the building in close proximity to an equipment area. Rotating HVAC equipment that is supported from any ceiling or supported by any floor other than the lowest floor of the building shall be individually evaluated to determine if vibration isolation devices, inertia bases and/or flexible pipe connectors are needed to prevent unacceptable levels of vibration from being transmitted into the building structures.

**Terminal Zoning:** HVAC systems shall be configured such that each occupied space can be controlled as a separate zone with regard to temperature and/or airflow. In other words, a minimum of one terminal control unit (e.g. VAV unit with reheat coil, finned tube heating unit) shall be provided for each occupied space. Each occupied space shall have a minimum of one dedicated thermostat (or equivalent). For the purposes of this writing, reception areas, lobbies, atriums and public assembly spaces shall be considered occupied spaces.

**Control Systems:** See the Energy Management, Building Automation Systems section within these General Guidelines for specific control system guidelines and requirements.

**Backup Equipment:** A 100% backup or duplex unit shall be provided for each critical piece of HVAC equipment that is vulnerable to failure.

**Disallowled Equipment:** The following types of HVAC equipment/systems shall not be installed in campus facilities:

1. Residential furnaces and air conditioning systems

2. Commercial grade “rooftop” units, similar packaged heating and/or cooling units

3. “Two-pipe” combination hydronic heating/cooling units/systems

4. Commercial or residential heat pumps. Exception: Ground-source heat pumps may be used with specific approval from the F&S Engineering Services.

5. Fan coil units. Exception: Cooling-only fan coil units may be used for specialty cooling applications (e.g. telecommunications rooms, computer server rooms) and certain equipment room cooling applications (electrical rooms, elevator machine rooms).

**Freeze Protection:** Neither water, steam nor condensate piping systems shall be installed in locations where they are vulnerable to freezing (e.g. outdoors without sufficient earth cover, within unheated spaces, within building exterior walls or wall cavities, within exposed overhangs, within exposed exterior walkways, etc.) Exception shall not be granted for systems to be protected via the use of glycol solution. Over time, glycol solution can become diluted to the point that it is no longer effective at providing freeze protection.

**Humidification:** HVAC equipment/systems shall not incorporate space humidification unless required for a specific application. Humidification is costly, not only in terms of first cost but also in terms of maintenance and energy consumption. With the increased use of dedicated outdoor air ventilation systems and total enthalpy heat recovery wheels the need for space humidification has been reduced. When humidification is required it shall be provided by means of a steam-to-steam humidifier located at the applicable air handling unit. Makeup water to each humidifier shall be softened to reduce scaling and, in specific applications, further conditioned with reverse osmosis and/or deionizing equipment. Steam from the campus wide central steam distribution system shall not be used for direct injection humidification.

**Animal Facilities:** See the Animal Facilities section within these General Guidelines for specific HVAC system requirements related to animal facilities.
Laboratories: See the Laboratories, Chemical and Biological and Laboratory Ventilation Systems sections within these General Guidelines for specific HVAC system requirements related to these applications.

Temporary Use of Existing HVAC Equipment: The AE and the Construction Documents shall clearly describe the conditions, if any, that allow the use of existing equipment on remodeling projects. Use of existing equipment may benefit the Construction project but at the expense of the HVAC system. In general, construction remodeling projects shall not use existing HVAC equipment. Exceptions will require an approved Variance to these Standards with the identification of specific measures designed to protect the equipment. The use of permanent HVAC systems for construction purposes is discussed in Section 01 76 00 – Protecting Installed Construction of these Standards.

Temporary Use of New Equipment during Construction: HVAC equipment shall not be used as temporary heating and cooling except by specific approval by the Owner. Only after approval by the Owner, the AE shall document the conditions by which HVAC equipment may be used during construction and clearly require the Contractor to implement measures to assure equipment will be like new when delivered to the Owner. The AE shall balance the expediency of using new HVAC equipment with the negative consequences of compromised indoor air quality, equipment warranty, cost to restore the equipment to like new condition and the impact of commissioning out-of-sequence. The use of permanent HVAC systems for construction purposes is discussed in Section 01 76 00 – Protecting Installed Construction of these Standards.