Codes and Standards: See *Codes, Standards and Regulations* section within these *Design Guidelines.*

Energy Conservation: See the *Energy Conservation* section within these *Design Guidelines* for specific HVAC requirements related to energy conservation.

ASHRAE: HVAC system design not addressed within these *Design Guidelines* 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: UNL - Lincoln Municipal Airport (interpolate to nearest stations for any outstate facilities). Values from 2009 ASHRAE Handbook are listed below.

Heating (10 year return period for minimum extreme dry bulb)
Heating DB: -20 Deg F

Humidification (99.6% annual cumulative frequency of occurrence)
Dew Point: -13.7 Deg F
Humidity Ratio: 2.7 Grains / Lbm DA
Mean Coincident Dry Bulb: -4.2 Deg F

Cooling (0.4% annual cumulative frequency of occurrence)
Cooling DB: 97.2 Deg F
Mean Coincident Wet Bulb: 75.1 Deg F

Dehumidification (0.4% annual cumulative frequency of occurrence)
Dew Point: 74.8 Deg F
Humidity Ratio: 136.1 Grains / Lbm DA
Mean Coincident Dry Bulb: 85.1 Deg F

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

Heating DB: 72 Degrees F
Cooling DB: 72 Degrees F / 50% RH

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

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

Proposed indoor design conditions for occupied spaces other than the default values provided above will be considered on a project by project basis.

Energy Use Policy: Occupant adjustable space temperature ranges shall be in compliance with the UNL Energy Use Policy available at the UNL – FMP website.

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 Design Guidelines.)

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

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 UNL FMP.

Central HVAC Systems: 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. Therefore, a minimal number of central HVAC systems are preferred rather than numerous individual/package units such as fan coil units, heat pumps or DX "split systems". Typically, each central system shall include an air handling unit, a return and/or exhaust fan or fans and air supply, return, exhaust ductwork.

HVAC Equipment Naming Conventions: The University has developed a standard naming convention for HVAC equipment identification and Building Automation System programming. Coordinate all HVAC equipment marks / callouts with FMP Engineering.

Institutional Quality: HVAC equipment/systems shall be institutional grade as opposed to standard commercial grade. For the purposes of this writing, intuitional 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 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. 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 and Access:

- See *Mechanical Equipment Rooms* section within these *Design Guidelines*.
- 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
- The installation of motorized HVAC equipment above finished ceilings is strongly discouraged (this includes suspended grid / drop-in tile ceilings). In no case shall any HVAC equipment such as fans, pumps, air terminal units, hand dampers, etc. shall be installed above a hard finished ceiling (e.g. sheet rock or plaster).
- The mechanical designer shall insure that adequate space provided for the service and removal of HVAC equipment (i.e., coil pull space, motor removal, etc.). All such service must be able to be accomplished without the removal / dismantling of any adjacent building systems including conduit, ductwork, walls, etc.
- All exterior equipment shall include UNL BSM approved permanent access to facilitate servicing.

- Provide access to both upstream and downstream sections of filters and coils for cleaning and inspection.
- In rooms without ceilings, all equipment requiring maintenance, calibration etc., shall be located within 12 ft. of finished floor. In rooms with ceilings, all equipment shall be located no higher than 2 ft. above the finished ceiling line.

Sound Control: Sound control as it relates HVAC systems shall be given adequate priority. 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 be installed with no special provisions for vibration isolation. This equipment shall typically be "hard mounted" directly to a reinforced concrete housekeeping pad. In order to minimize vibration / sound transmissions through building piping systems, base mounted pump hook-ups should always include flexible pipe connectors. An exception to these general rules may be necessary in facilities where equipment that is especially vibration sensitive is located 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 or inertia bases 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). Reception areas, lobbies, atriums and public assembly spaces shall be consider occupied spaces.

Control Systems: See the *HVAC Control and Building Automation Systems* section within these *Design 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. The determination of what is deemed "critical" and "vulnerable" shall be discussed with FMP engineering staff during project design.

Discouraged Equipment: The use of the following types of HVAC equipment/systems is discouraged:

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 *FMP Engineering.*

Freeze Protection: Neither water, steam nor condensate piping systems shall be installed in locations where they are vulnerable to freezing. Examples include: unheated spaces, within un-insulated building exterior walls or wall cavities, within exposed un-insulated overhangs, within exposed exterior walkways, etc.)

Humidification: Humidification is costly, not only in terms of first cost but also in terms of maintenance and energy consumption. HVAC equipment/systems shall not incorporate space humidification unless the system uses 100% outside air or there are other programmatic requirements. 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 *Design Guidelines* for specific HVAC system requirements related to animal facilities.

Laboratories: See the *Laboratories, Chemical and Biological* and *Laboratory Ventilation Systems* sections within these *Design Guidelines* for specific HVAC system requirements related to these applications.

Temporary Use of Existing HVAC Equipment: 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.

Temporary Use of New Equipment during Construction: HVAC equipment shall not be used as temporary heating and cooling except by specific approval by the UNL FMP. Only after approval by the UNL FMP, 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.

Renovations / Remodels: When designing a renovation or interior alteration project, the effect of any modification or increase in load on existing systems shall be considered. Heating or cooling shall not be diverted from an existing area to another area without analyzing the effect of such a decision. Because many existing buildings and their mechanical systems have been modified from the design shown on the original construction documents, testing and field verification of the system layout and performance are essential elements of the design process. FMP staff personnel are willing and able to assist in this endeavor.