

007100S01 - PROGRAM DESIGN CRITERIA

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1. PROGRAM DESIGN

1. Heating Systems: Utilize the campus central system, where available.
2. Cooling Systems: Utilize the campus central chilled water system, where available.
3. Avoid the use of face and by-pass coils in air handling units.
4. Provide supports to limit axial movement of axial fans.
5. In air handling units, locate the chilled water coil down stream of the heating coil. All chilled water coils are to have modulating valves. No "wild" coils allowed in any system.
6. Variable air volume systems are preferred.
7. Air handling systems are to be designed to operate at minimum of 55 Degrees Fahrenheit cold deck.
8. Provide 100% outside air capability and 100% relief air capability.
9. Use blow through type air handling systems.
10. Air terminal units are to be designed and installed for operation with a direct acting thermostat.
11. Provide project specific filters (box, bag, cartridge, pleated, etc.) on all air handling systems.
12. Provide a differential pressure manometer across air filters. Air filtration systems are to have a minimum dust spot efficiency of 35% (80% is preferred).
13. Provide extensions to lubricate fittings that are hard or hazardous to reach.
14. Provide OSHA approved fan and belt guards with provisions to check the speed without removing the guard.
15. Advise the air handling equipment vendor if a variable speed drive system is used. This is to ensure proper balancing procedures.
16. Provide multiple air handling units to serve identifiable building functions, take advantage of different load characteristics, etc.
17. Provide heating/cooling recovery systems where economically beneficial based on life cycle costing and campus wide performance. Consideration shall be given to associated central plant expansion cost.
18. All suppliers of energy recovery equipment shall supply performance information with bids.
19. DO NOT construct utilities under a building or facility. Move the utility line to avoid building anything over existing utility lines. NO EXCEPTIONS.
20. All projects must meet all requirements of the Kentucky 401 KAR. All project designs must comply with the 401 KAR 52:020 Title V requirements. If a project design requires review and/or approval under Title V then the designing person and/or firm must submit all permitting forms, information, and submittals to obtain Title V compliance before bidding commitments are made to vendors supplying equipment and/or facilities impacted by Title V compliance.

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2. GENERAL INFORMATION

1. Indoor/outdoor design temperatures:
Cooling season occupied set point: 74 degrees F to 78 degrees F
Unoccupied set point: 85 degrees F.

Heating season occupied set point: 68 degrees F to 72 degrees F
Unoccupied set point: 55 degrees F.

Set points are in accordance with ASHRAE 55 "Thermal Conditions for Human Occupancy"

Outdoor shall adhere to ASHRAE Weather Data and Design Considerations. Winter design shall be at 99%. Summer design shall be at 2.5%.

2. Provide a schematic diagram for the HVAC system showing the control systems.
3. No rooftop units or electric resistance heat are to be used.
4. All system components are to be isolated to prevent objectionable noise or vibration.
5. Centralize systems as much as practical within the building.
6. Provide local exhaust and excess air at critical locations such as heat generators, print machines, smoking areas, etc.
7. Consider the location for all air intakes and exhausts for the project and surrounding buildings. These locations are to be approved by the owner.
8. Maintain a slight positive pressure in buildings.
9. Provide tempering of outside air and minimize the risk of freezing coils.
10. Catch pans should be of a non-corrosive material and accessible for cleaning.
11. Permanently mark the settings for all valves, dampers and other adjustable devices. Set and lock memory stops.
12. Provide a minimum of four air changes per hour.
13. Distribute the air to avoid stagnant, hot or cold pockets.
14. Consider prevailing winds, vents, exhausts, loading docks, etc. In locating air intakes to minimize contaminants and odors from entering the air intakes.
15. Mechanical equipment shall provide clear working space around all equipment. Manufacturers recommended space shall be shown on plans. Adequate working space will be provided around all equipment requiring service space.
16. Service corridors shall maintain clear walking space of 3 feet wide and 6 feet 6 inches high.

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3. CENTRAL STEAM PIPING AND EQUIPMENT

<u>OPERATING PARAMETERS</u> (At Heating Plants)	<u>LINE PRESSURE</u>	<u>CONDITION</u>
	175 PSIG 100 Deg. F	500 Deg. F Superheat
<u>DESIGN PARAMETERS</u>	<u>EQUIPMENT</u>	<u>LINE & FITTINGS</u>
Pressure	300 PSIG	300 PSIG
Temperature	500 Deg F	500 Deg. F

1. All condensate is to be returned, except when direct injection of campus steam is approved.
2. Verify through the University all connections to confirm steam availability, capacity, required line size and routing.
3. Buried steam piping is to be as in Division 15000 Mechanical Document 15060S04.
4. Buried condensate piping is to be as in Division 15000 Mechanical Document 15060S04.
5. Bedding for buried steam and condensate lines is to be undisturbed earth or properly prepared earth bedding. Piping is to be placed in a trench on a six (6) inch layer of sand then covered with sand to six (6) inches above the top of the pipe. The remainder of the trench is to be filled with earth free of large rocks and debris.
6. The minimum depth of cover is 36 inches.
7. Provide steam pits for access to valves, traps, etc.
8. Provide valving at all branches and for system isolation.
9. Provide for pipe expansion generally using expansion loops. Avoid the use of expansion joints at any point where steam may flow in both directions.
10. The main campus condensate return pressure is normally 30 PSIG. This may vary depending on location.
11. Flush all lines until clean.
12. Do not lift condensate with steam pressure. All condensate is to be gravity or pumped flow. Pump speed will not exceed 1750 RPM using duplex pumps with alternating control switch.
13. Do not use cast iron valves, fittings, pipe, etc. In high pressure steam applications.
14. Provide a condensate water meter fitted with a pulse initiator and wiring connected to the Facilities Management System.
15. Provide parallel steam traps for steam to hot water converters.
16. Provide steam pits as needed to include branch isolation valves, forced air ventilation, sump pumps, traps, gauges and lighting.
17. Steam pressure reducing valves (PRV) are to be air loaded (not self-regulating or self contained) piped in a high/low circuit. Valves will not be placed in the pilot feedback lines to the PRV unless per the manufacturer's instruction.
18. Use only cast steel pressure reducing valves with cast steel strainers for high-pressure steam. Do not use cast iron bodies.

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4. FIRE PROTECTION PIPING AND EQUIPMENT

1. Provide backflow protection for sprinkler systems.
2. Provide freeze protection where the system is subject to freezing by either a dry pipe system or dry pendant heads.
3. All piping for the fire suppression system is to be metal.
4. Provide stand pipes with 2 1/2 inch connections in a labeled cabinet with a glass breakout panel. Do not provide a 1 1/2 inch connection or fire hose.
5. Do not allow the water flow in the sprinkler pipes to exceed 32 ft/sec at any point.
6. Provide an inspectors test station at the furthest point on each zone. The test station must allow testing with out a hose and discharge to a drain or away from the building without hazard or inconvenience.
7. Do not use automatic reset or self-closing sprinkler heads.
8. All newly installed sprinkler systems must be flow tested by the contractor in the presence of the engineer, University construction representative and the University Safety Officer.
9. Do not use concealed sprinkler heads, use semi-recessed sprinkler heads (if desired).
10. Sprinkler heads are to be centered in ceiling tiles. If documented, this item may be considered as a cost reduction.
11. Provide guards where sprinkler heads are located in mechanical spaces, in work shops, in athletic spaces, below eight (8) ft. AFF or where the heads may be subject to damage.

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5. MAIN CAMPUS CENTRAL CHILLED WATER SYSTEM

1. OPERATING PARAMETERS

Differential Pressure	5 - 50 PSIG
Supply Temperature	42 Degree Fahrenheit. - All Plants
Cooling Plant #1	985 ft. elevation
	60 PSIG Minimum operating pressure
Cooling Plant #2	966 ft. elevation
	Operating pressure controlled at Cooling Plant #1
Cooling Plant #3 (Med Center)	980 ft. elevation
	Operating pressure controlled at Cooling Plant #1
Cooling Plant #4 (CUP)	970 ft. elevation
	Operating pressure controlled at Cooling Plant #1
Flow Rate	1.6 GPM/Ton All Plants

2. DESIGN PARAMETERS

Differential Pressure design shall be	5 PSIG at building.
Supply Temperature	42 Degree Fahrenheit
Temperature Differential	16 Degree Fahrenheit
Above grade	250 PSIG
Valves	250 PSIG
Below grade pipe & fittings	250 PSIG

3. TEST PRESSURE

Hydrostatic test 250 PSIG
One hour with no pressure loss

6. BUILDING CHILLED WATER PIPING AND EQUIPMENT

1. All condensate from coils is to be collected and piped to drain.
2. No short circulating of the chilled water system mains to allow water to flow directly from the supply to the return for flow control.
3. Verify through the University all connections to confirm chilled water, availability, capacity, required line size and routing.
4. Secondary building pumping with decoupled loop (See Division 15000 Mechanical Document 15541S01) is required. Consultant shall submit the control circuit and piping design for this system during Phase "A".
5. Central chilled water system will normally be shut down as the ambient temperature permits. Normally this will be December through February for Cooling #1 and #2 and the Medical Center Plant operates year round. Facilities must not be designed to use central chilled water during the shut down periods. Outages should be planned during the shut down periods.
6. Consult the University chilled water master plan and Physical Plant Manager of Utilities prior to any design work related to the central chilled water system.

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7. CAMPUS CHILLED WATER PIPING AND EQUIPMENT

1. Provide a full size in line strainer with inlet and outlet pressure gauges on the main chilled water return line from each building.
2. Provide isolation valves for each branch line.
3. Buried piping and fittings are to be thickness class 50 or 51 ductile iron, sealed cement lined, bituminous outer coating with restrained push-on joints, joints secured by set screws are not acceptable.
4. Insulate the supply line with two (2) inch foamglass or equal insulation with a protective wrap or use an approved preinsulated pipe (see the standard on pipe insulation). Return lines are to be insulated only when near a heat source. Joints are to be insulated in a manner to prevent water from penetrating the insulation and consistent with the remaining insulation. Seal the ends of the conduit on pre insulated pipe.
5. Also see Division 15000 Mechanical Document 15060S03.
6. Buried valves are to be cast iron gate valves with a by-pass valve. End of line rated, bubble tight butterfly valves may be used if installed in a utility pit.
7. Piping is to be placed in a trench on a six (6) inch layer of sand then covered with sand to six (6) inches above the top of the pipe. The remainder of the trench is to be filled with earth free of large rocks and debris. The minimum depth of cover is 36 inches.
8. Provide drains at all low points and vents at all high points.
9. All end of line points are to have a valved bypass for circulation.
10. Do not expose the system to the new piping until the new piping has been flushed and inspected by the Physical Plant Division. Provide a means to fill the lines independent of the central system. Flush and circulate clean water with a detergent through the piping until the water is clear. Provide clean water for the initial fill.
11. Provide formed concrete thrustblocks at all turns in the piping and/or concrete anchors. No joints or bolts are to be made inaccessible by the concrete.
12. Do not use grooved pipe couplings on chilled water piping.
13. Chilled water pits are to have openings to remove valves, a sump pit, lifting eyes anchored above large chilled water valves to aid in maintenance and pipe identification. Openings shall be constructed so that one man can access the pit without assistance.

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8. ROOFING DESIGN GUIDELINES

1. All roofs must meet or exceed general guidelines 07500S01.
2. Roofs are listed below in order of preference:
 1. Fluid applied roofing (foam type) with a ten (10) year guaranty.
 2. Build up roofing with a twenty five (25) year guaranty.
 3. Build up roofing with a ten (10) year guaranty.

9. BOILER INSTALLATION

1. This standard applies to the installation of boilers, pressure vessels and pressure piping under the jurisdiction of the boiler division of the departments of housing, building and construction. However; some items will apply to all boiler installations.
2. Those under the boiler division jurisdiction include water heaters of over 120-gallon capacity, 200,000 BTU/HR capacity, 210 degrees F water temperature or 57.9 KW electrical power.
3. Prior to bidding, the plans for all boiler installations are to be submitted to and approved by the boiler division.
4. Where applicable, the plans are to have the following information:
 1. Check and stop valves in the feed water line near the boiler
 2. Stop valves in the supply and return lines
 3. Drain or bottom blowdown
 4. Low water cutoff
 5. Stop valve in the expansion tank line
 6. Tee's in the return line at the boiler
 7. Combustion air vents (include size)
 8. Venting (include size)
 9. Boiler clearance (2 ft. minimum on service side)
 10. Expansion tank
 11. Safety or safety relief valve
 12. Controls
 13. Piping (including type and size)
5. Provide hot and cold water to clean the boiler.
6. Feed the blowdown and other fluid lines to an acceptable drain. Vents should be to the outside.
7. Provide fittings and equipment for water treatment.
8. Provide smoke stacks that do not need painting.

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10. DUCTWORK SPECIFICATIONS

1. Air systems are to be metal ductwork (except for the flexible termination) with external insulation.
2. Flexible ductwork must be secured with plastic or metal bands. Duct tape is only used to seal the system. The maximum length of flexible duct section is five (5) ft. and a bend radius of not less than one duct diameter.
3. Provide access doors for cleaning and service of all coils, filters, fire dampers, movable dampers, motors, etc.
4. Provide access to the base of duct risers for cleaning.
5. No troffer or linear air diffusers or returns.
6. Provide sections on the contract documents to show the location of ductwork, wireways, pipes, etc. in congested spaces. This must be coordinated with the design team.
7. Central air handling systems are to have ducted returns to maintain the integrity of the above ceiling space and enhance control of the system.
8. Provide fire stopped duct sleeves to permit the conduit and insulation to pass through partitions. In floors, sleeves are to extend one (1) inch above the floor and be water tight.

11. FLOOR DRAIN SPECIFICATIONS

1. Open receptacles are to be installed with a removable cap. The cap is to be removed when the receptacle is placed in service.
2. Provide drains, a means of cleaning and fire protection in laundry and wash chutes.
3. Do not install floor drains in chemical storage areas; spills and leaks are to be contained and not allowed to enter the sewer system.

Exception #1 Floor drains may be used where corrosive liquids only are used if the drain leads to a dilution pit capable of holding and diluting the total amount of liquid stored.

Exception #2 Floor drains may be used where flammable, toxic or reactive chemicals are used if the drain leads to a holding tank capable of containing the total volume of stored chemicals. The holding tank must be designed to allow the safe removal of the collected chemicals.

4. Floor drains in mechanical areas shall be located near appropriate equipment so that equipment drains are not run on top of floor creating safety hazard.

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12. GENERAL VALVE STANDARDS

1. Provide shut off valves on all branch lines.
2. When installing a butterfly valve, open the valve before tightening the flange to avoid pinching the seal.
3. At the Medical Center, valve numbers will be provided by the Physical Plant. Tags are by the contractor.
4. All drain, flush, condensate dump discharge, or test valves are to have access to a floor drain, outside or open receptacle (do not empty into sinks).
5. Provide chains or extensions to operate valves over 6 feet from floor level.
6. Install valves with stems at or above horizontal.
7. Provide framed valve charts.
8. Avoid use of non-rising stem gate valves.

13. HEATING, VENTILATION AND AIR CONDITIONING

1. See 00700B01, Section 3, GENERAL INFORMATION.
2. Ventilation: Meet or exceed the requirements of the ASHRAE Guide and the Kentucky Building Code.
3. Energy Conservation: Meet or exceed the requirements of "The BOCA Basic Energy Conservation Code".
4. Insulate the distribution manifolds for steam humidifiers or shut the manifold jacket steam off when cooling is required.
5. Specify a range of acceptance for the testing and balancing of the HVAC system. The materials, equipment and system tests should be witnessed by representatives of the University and the Engineer. The names of the witnesses are to be listed on the test results.
6. Hydronic system piping is to be Type L hard copper using 95-5 tin/antimony solder.
7. Provide temperature controls for each occupied space.
8. Thermostats are to have visible thermometers. Thermostats in hallways or similar public areas are to have a tamperproof cover.

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14. HYDRONIC AND LOW PRESSURE STEAM PIPING

1. Building heating systems should be hot water and not steam where possible.
2. Hydronic system piping which is four (4) inches and smaller, optional on larger sizes, is to be type L hard copper using 95-5 tin/antimony or higher quality solder. Do not use leaded solder for any reason.
3. Provide strainers and isolation valves for all pieces of equipment that require maintenance such as control valves, PRVs, traps, pumps, coils, etc.
4. Hydronic coils are to be .035 (min) inches wall thickness copper tubes with aluminum fins and copper headers.
5. Provide dielectric couplings wherever dissimilar metals are joined.
6. Provide strainers to protect specific pieces of equipment and the system in general from contaminates. On strainers 1.5 inches and larger, provide a blow-off valve.
7. Provide complete drainage for all systems and equipment. Drains are to be pipes to a floor drain, not creating a trip hazard on the floor.
8. Provide one five gallon (min) shot feeder designed to meet the capacity and pressure requirements of the system. Provide piping and valves as required to introduce the chemicals.
9. Prior to start-up provide the chemicals to flush all hydronic lines to remove dirt, oils, grease, pipe dope, particles, etc. All materials are to be non-hazardous and inhibit corrosion. The chemical is to be HVC Daly Chemical Co. H.D. cleaner No.203. Circulate the chemicals as recommended and thoroughly drain and flush the system services)
10. Install reduced pressure backflow preventers on make-up lines to closed loop water systems. Backflow preventers are to be installed at a location where they can easily be tested and repaired.

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15. MAIN CAMPUS HIGH PRESSURE STEAM (BUILDING INTERIOR)

1. Provide parallel steam pressure reducing stations with two pressure reducing valves (PRV). One PRV should be a nominal low flow valve rated at 0-25% flow and the other PRV, a nominal high flow valve, rated at 20-75% flow. The high flow PRV should be set at a higher pressure than the low flow valve. This control may require a larger than normal control offset; if a smaller control point offset is required, use a PRV with positive feedback.
2. Use only cast steel steam pressure reducing valves (PRV) with cast steel strainers for high pressure steam. Do not use cast iron bodies and do not use a control valve. The PRVs are to be air loaded (not self regulating or self contained) piped in a high/low circuit. Valves will not be placed in the pilot feedback lines to the PRV unless per the manufacturer's instruction. See a separate PRV control standard, (Division 15500 Mechanical Drawing 15520D04).
3. Provide a condensate water meter fitted with a pulse initiator for connection to the facilities management system. Provide a check valve on the pump discharge to protect against backsurge and backflow. See Condensate meters drawing 15525D01.
4. Provide duplex condensate pumps with alternating control switch.
5. Provide parallel steam traps for steam to hot water converters.
6. Avoid the use of high pressure steam outside of the main mechanical space.
7. Do not use cast iron valves, fittings, pipe, traps, etc for high pressure steam.

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16. TRANSFORMER SPECIFICATIONS

1. General Design Guidelines

1. UK's recommendations on transformer design are listed below in order of preference.
 1. Indoor transformer, VPI (Epoxy Encapsulated) coil, unit sub1st. choice
 2. Indoor transformer, cast coil, unit substation. 2nd. choice
 3. Padmount indoors, less flammable liquid, switch.3rd. choice
 4. Padmount outdoors, less flammable liquid, switch. 4th. choice
 5. Padmount outdoors, oil liquid, switch. 5th. choice
2. Cast coil and VPI coil provided shall be unit substation type mounted in line with matching switchgear including high voltage load break switch and fuses in a transformer room.
3. Padmount transformers installed outside of buildings shall be liquid filled, concrete pad mounted and completely enclosed with high voltage switching and fusing (removable oil fusing) and shall be dead front type with bushing wells and inserts, not one piece bushing. Transformers shall conform to the requirements of the State Fire Marshall's office for distance from the building.

2. Transformer Secondary Voltage Selection

1. All three phase service to be 120/208 volts wye.
 - Exception 1: Buildings with a single phase 120/240 service from the Utility Company.
 - Exception 2: Industrial only type buildings e.g. heating and cooling plants may use 277/480 volt wye, 5 wire.
 - Exception 3: Dual type Commercial/Industrial buildings e.g. Football Stadiums, Fieldhouse Training Facilities, etc. In these buildings motor loads and/or variable speed drives and lighting loads with extremely long wire runs may use 277/480 volt wye, 5 wire.

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17. CARD ACCESS CONTROL SYSTEMS

When required, card access control systems should be designed in accordance with the UK Standard 28000S04

18. EMERGENCY GENERATORS

If an emergency generator is required, it shall be provided in accordance with UK Standard 16620S01.