23 00 00 Heating, Ventilating, and Air-Conditioning (HVAC)

1. The AE is responsible to follow all applicable codes and regulations regarding HVAC. These additional guidelines are intended to provide the AE with additional requirements for Central Michigan University. The AE is responsible to submit any deviations to the Owner by the completion of 95% Design Development for review and approval.
2. HVAC equipment basis of design to be Trane.
3. Owner requires that all building air conditioning utilize the campus chilled water system from approximately May 1 to November 1. During the remainder of the year, outside air is to be used in lieu of the seasonal chilled water. The need for exceptions is recognized but must be approved by the Owner.
4. For design calculations, the chilled water supply enters the building at 45 degrees Fahrenheit and must return no lower than 55 degrees Fahrenheit.
5. The steam pressure inside of buildings, after the pressure reducing valve, shall be less than 15 psi and any piece of equipment utilizing steam shall be sized accordingly.
6. All Coils must have maintenance access for full removal and replacement.
7. CMU requires that steam is the source of heat for all heating systems; and that coils in air handlers utilize water heated via a steam-water exchanger. Exceptions must be approved by the Owner. If steam is preapproved to be utilized in heating coils, then coils must utilize face and bypass to control temperature.
8. HVAC designs will include a completed matrix that lists the air balance for each individual space under occupied and unoccupied conditions. All space conditions, including heat/cooling load of the room, lab hoods, code required air changes, shall be included and accounted for in this matrix. This includes a total air balance for the building that must be net positive to the outside. The matrix, along with the building one-line diagram, shall be completed and reviewed prior to 95% Design Development.
9. Projects that modify HVAC supply air or return in existing buildings must first measure the airflow on the entire system that it serves and show the airflow of all diffusers for the existing and new locations. Please verify with the Owner for any recent balance reports. If not available, AE must provide service using the test and balance companies listed in section 23 05 93 below.
10. Dedicated HVAC training (up to 24 hours in duration) shall be provided at the project site. Contractor shall obtain a factory-authorized representative to provide 24 hours for training CMU Maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.
11. Any building, new or existing, that adds chilled water cooling must be added to the CMU campus model. The design firm shall provide the building load data to Owner prior to 95% Design Development. The design team shall allow 4 weeks from time of notification to complete the review and get a written report back. Any modifications from this review shall be incorporated into the 50% Construction Documents.
12. Provide a housekeeping pad under all equipment. Minimum 6” for equipment at or below grade, and 4” for equipment above grade. All pumps to be on 8” pads.
13. Three similar size offices with the same exposure may be combined into a single zone. AE to provide project cost analysis versus individual zones to the Owner prior to 95% Schematic Design.
14. Routing of ductwork and piping over electrical equipment to comply with electrical code and manufacturer clearances.

23 05 00 Common Work Results for HVAC

1. All insulated pipe shall have hard block insulation between the hanger and the pipe.
2. Sleeves through floors and walls shall be sized so that the required pipe insulation is continuous through the sleeve.
3. Floor sleeves shall project 2” above the finish floor.
4. All Ball Valves shall be the full port type.

5. Circuit setter valves (Bell & Gossett only) are to be installed at all pumps and coils. Do not provide balance valves for pumps with variable speed drives.
6. Butterfly valves are not permitted, resilient gate valves are preferred.
7. Triple duty valves are not permitted. Balance, check, and shut off valves are to be separate.
8. Isolation valves to be provided at each device, mains on each floor, and mechanical room mains.
9. All concealed HVAC equipment (variable air volume boxes, constant volume boxes, fan coils, hydronic valves, etc.) shall be noted on the "Record Drawings". In addition, all concealed HVAC equipment shall be labeled in the field per "CMU piping identification and valve tagging standard". Provide all required access.
10. Expansion tanks in Heating Hot Water systems shall be bladder type and ASME rated.
11. Mechanical equipment using steam as the source of heat shall be sized for the steam pressure available at the equipment location and not at the PRV station. Pressure reduction due to length of pipe, elbows, valves, etc. must be accounted for in the equipment specification.
12. The lowest, maximum allowable working pressure (m.a.w.p.) of any device utilizing steam must be greater than 100 psi.
13. Any project involving steam or condensate shall include a drawing that lists the design pressure of all steam & condensate piping, individual load calculations of steam & condensate and the m.a.w.p. of each piece of equipment.
14. AHU's, pumps, and fans shall include vibration isolators to isolate mechanical vibration and reduce noise according to ASHRAE standards.
15. Identification & Tagging for Piping: Reference Central Michigan University PIPING IDENTIFICATION AND VALVE TAGGING STANDARD.
16. All new or major remodeling of HVAC equipment and duct work shall include an Engineering Noise Study by completing a noise modeling program. This includes a baseline documentation of existing conditions. The noise study should be completed and reviewed with CMU by 95% Design Development and incorporated in the 50% Construction Documents. This study shall be contracted to:
    A. Kolano and Saha Engineers, Inc., Waterford, Michigan, (248) 674-4100
    B. Any substitutions of the above must be pre-approved in writing by the Owner.
17. Comply with ASHRAE noise guidelines for HVAC systems.
18. Include a magnehelic gauge to display the pressure drop across the each AHU filter bank. Include on the drawings, and on the gauge itself, the acceptable level of static pressure when the filters need to be changed. Gauge range should 0.5-1.0 in. w.c. higher than scheduled dirty value. Typical filter range should be 0-2.0 in. w.c.

23 05 93 Testing, Adjusting, and Balancing (TAB) for HVAC

1. The following companies shall be utilized for testing, adjusting, and balancing:
    A. Absolute Balancing, South Lyons, MI, (734)-449-0911
    B. Environ-Aire, St. Claire Shores, MI, (586) 779-6200
    C. International Test and Balance, Southfield, MI, (248) 559-5864
    D. Mechanical Testing Services, Grandville, MI, (616) 224-7044
    E. Hi-Tech Test & Balance, Freeland, MI, (989) 695-5498
    F. Pro-MEC Engineering, Grand Ledge, MI, (519) 627-8532
2. Static pressure testing of ductwork shall be the responsibility of the companies listed above.
3. No substitutes are allowed without prior written approval from the Owner.
4. After the conclusion of the balancing of the HVAC, adjustable sheaves are to be removed and replaced with fixed sheaves.
5. For commissioned projects, the TAB contractor must be onsite and provide manpower and equipment to work with the Commissioning Agent to complete the commissioning testing. This includes the TAB contractor demonstrating how they calibrate their measuring equipment and perform various measurement techniques to the Commissioning Agent.

23 06 00 Schedules for HVAC

1. New DDC system space temperature sensors shall include an occupied, standby, and un-occupied mode.
2. Occupied mode is determined by the building management system schedule or override.
    A. Temperature dead band is 70°F to 75°F (adjustable). Winter design is 70° and summer design is 75°F.
    B. Specialty laboratories or spaces that require different temperature requirements shall be identified and reviewed with the Owner prior to 95% Design Development.
    C. Default hours are 7:00am – 10:00pm M-F (adjustable) unless provided by Owner.
3. Standby mode occurs during the occupied mode when the space is vacant as registered by the occupancy sensor.
    A. Temperature dead band shall increase to 68°F to 77°F (adjustable).
    B. Notification from the occupancy sensor automatically reverts to occupied mode.
    C. Interface from occupancy sensor or controller to the HVAC controller is through hardwired dry contacts.
4. Unoccupied mode is determined by the building management system schedule.
    A. Temperature range is 64° to 78°F (adjustable).
    B. Perimeter heating is the first stage of heating, then the air handling unit.
    C. Perimeter heating shall be designed to limit unoccupied air handling unit use.
    D. Space temperature sensors shall include a push button override to allow the user 2 hours of occupied mode. Provide master/satellite buttons for all offices without a thermostat.
5. Standby mode and unoccupied push button override is required on all occupant spaces such as offices, conference rooms, labs, and classrooms. Do not provide on public spaces such as corridors and toilet rooms. Unless directed otherwise by Owner.
6. Economizer control shall be used when the outdoor air temperature is below the return air temperature. The high limit shall be an adjustable point on the Building Management System.
7. Occupancy Sensors: Reference 26 52 00 Lighting Control Equipment.

23 07 00 HVAC Insulation

1. Comply with ASHRAE 90.1 requirements.
2. Design to the following requirements.
    A. Concealed ductwork – Mineral-fiber blanket
    B. Exposed ductwork – Mineral-fiber board
    C. Piping – Mineral-fiber, preformed pipe
3. Where required, HVAC interior duct insulation shall be a closed cell type with enhanced surface.

23 09 00 Instrumentation and Control for HVAC

1. Refer to CMU Division 23 09 00 Temperature Control Guidelines.

23 20 00 HVAC Piping and Pumps

1. The AE must include a table that summarizes the testing requirements for each system and it must be included on the mechanical schedule starting with the 50% Construction Drawings. This table shall include system name, operating pressure, design pressure, maximum allowable working pressure, test pressure including duration, and acceptance level.
2. All testing of HVAC piping must be witnessed and signed by the Owner or their designated representative.

23 21 00 Hydronic Piping and Pumps:

1. Piping 2” diameter and less shall be threaded steel pipe, ASTM 106, Schedule 40; or soldered copper tubing, ASTM B88, Type L, hard drawn. No pressed joints.

2. Piping 2-1/2" diameter and greater shall be welded steel pipe, ASTM 106, Schedule 40. No grooved fittings.
3. Hot tapping of the chilled water lines is permitted per the following protocol:
    A. The chilled water flow in the tapped pipe is stopped by shutting off all associated pumps. Pressure is to remain inside the pipe.
    B. The cutting head to be used is one that is specifically made to tap HDPE/PVC mains.
    C. The tap will be made in the vertical position under main pipe pressure.
    D. After the tap is completed, the valve will be flushed to expel any remaining cuttings.
4. Chilled water tie-ins to the campus chilled water mains shall be completed between November 1 and April 1. Procedure to be approved by Owner.
5. Chilled water lines shall not be routed in the campus tunnels and must be buried a minimum depth of 5' below grade.
6. All buildings connected to the campus chilled water system must have their own chilled water pumps, isolation and drainage valves. Reference detail M-1 "CMU CHILLED WATER VALVING STANDARD" drawing.
7. Hydronic pumps:
    A. System pumps to be variable frequency drive (VFD), controlled by system pressure differential. Variable frequency drives to be Yaskawa. Provide shaft grounding rings for motor bearing protection.
    B. Systems shall include a redundant pump for standby usage and periodically operated by automatic switching on the second Wednesday of the month at 10:00 am.
    C. Snow melt and coil circulation pumps may be simplex.
    D. In-line pumps to be closed coupled and include Grundfos, Bell & Gossett, and Armstrong.
    E. Base mounted end suction pumps should be closed coupled when possible. It's recognized larger motor pumps are flexibly coupled. Manufacturers are Grundfos, Bell & Gossett, and Armstrong.
    F. Horizontal split case pumps include Grundfos, Bell & Gossett, and Armstrong.
    G. Include the pump minimum flow and system differential set point on the pump schedule.
8. Chilled water pumps:
    A. Pumps to be sized to meet the building load and match the system turndown. Preference is to minimize/eliminate system bypass through a 2-way bypass valve or 3-way valves at the coils.
    B. Size system piping and coils to allow campus loop pressure (4-5 psig) to control the building below 30% load. Provide a check valve around the pumps. Turn building pumps off during low loads and utilize campus loop pressure.
9. Hot water heating pumps:
    A. Pumps to be sized to meet the building load and match the system turndown. Provide a 2-way bypass or 3-way coil valves to meet the minimum pump flow.
    B. All heating system pumps and controls to be connected to the building generator (if applicable).
10. Pressure/Temperature plugs are to be installed on both sides of pumps, coils and strainers. Owner recognizes that maintenance needs to make measurements across HVAC components as a diagnostic tool.
11. Install a pressure gauge at the highest accessible and visible point in the system hot water heating loop. The purpose of the pressure gauge is so maintenance can check the system pressure at the top of the loop.
12. Owner does not use glycol or equivalent solutions in hydronic systems, and individual coils and piping must be designed to prevent freezing. The draining of coils and piping is not an acceptable freeze protection strategy. The use of heat trace wire is not permitted. Exception is snow melt and energy recovery loop system with 40% propylene glycol.
13. A strainer is to be installed at the main chilled water supply line in each building, prior to the pumps, and before construction commences. A manual blow down line, with ball valve, must be piped to a floor drain.

14. Air bleeds with isolation valves are required at each coil and at the very highest end of the system piping.
15. Hydronic Systems must include a method of air and dirt removal.
    A. Preferred method is an air/dirt separator manufactured by Spirotherm that includes a removable bottom section for maintenance. This shall be in the main mechanical room and include isolation valves.
    B. Provide a side stream bag filter for removing dirt in heating hot water. Reference detail M-2 "SIDE STREAM FILTER PIPING" drawing. Include a separate shot feeder and corrosion coupon rack.
16. Hydronic piping shall be designed and sized with a maximum flow or velocity per ASHRAE 90.1 or the following, whichever is less.
    A. Sizes 2" and less a maximum velocity of 4 feet per second.
    B. Sizes between 2" and 8" a maximum velocity of 6 feet per second.
    C. Sizes 8" and greater a maximum velocity of 10 feet per second.

23 22 00 Steam and Condensate Piping and Pumps

1. The steam pressure from the campus tunnels to an individual building is between 40 to 60 psi. All equipment that is directly connected to the campus steam system must operate within this range.
2. All new steam and condensate piping shall be designed and analyzed with recognized industry software to accommodate for expansion and contraction of the pipe. This includes a thorough review of the anchoring scheme and stanchion supports such that the design accommodates for the expansion/contraction at controlled sections. All equipment that utilizes steam must be isolated from the forces and moments as a result of the steam pipe.
3. Steam velocities in campus tunnels shall be under 10,000 feet per minute, and less than 4,000 feet per minute inside buildings.
4. Steam piping shall be sloped in the direction of travel at a pitch of 1 inch per 20 feet of pipe.
5. All new steam piping in the campus tunnels, up to and including the pressure reducing valves must be submitted to Owner prior to 95% Design Development for a design review and be included the campus steam model. This also includes the condensate system from the flash tank and condensate receiver back to the campus tunnels. The AE shall allot 4 weeks from time of notifying Owner, to complete the review and provide a written report. Any design corrections must be included in the 50% Construction Documents. The following design elements must be included with this review:
    A. Size of all steam and condensate piping including insulation.
    B. All piping stanchion designs including supports, hangers, rollers, guides, slides etc.
    C. All anchoring details of steam and condensate piping.
    D. All expansion loops, slip joints, or other means of addressing pipe expansion.
    E. Pressure Reducing Valve and configuration.
    F. Condensate Receiver and Pump selection.
    G. All drip legs and trap selection and configuration.
    H. All isolation valves.
6. All steam & condensate piping, inside the campus tunnels as well as individual buildings, will follow State of Michigan B31.1 code and be capable of handling CMU high pressure steam (Power House relief valve is set at 90 psi). Note: Even though the building piping and equipment shall be designed and constructed to handle CMU's high-pressure steam, the steam pressure after the reducing station shall operate < 15 psi.
7. Steam piping (15 psig and under) will be ASTM A106, schedule 40 seamless welded as a minimum.
8. Steam piping (>15 psig) will be ASTM A106, schedule 80 welded.
9. Steam & Condensate shall use resilient gate, globe, or swing with no butterfly valves.
    A. Gate & Globe acceptable Manufacturers:
        1) Lunkenheimer
        2) Jenkins
        3) Milwaukee
        4) Watts

B. Swing Check Valves Acceptable Manufacturers
    1) Lunkenheimer
    2) Crane
    3) Jenkins
    4) Milwaukee
    5) Watts
    6) Watson McDaniel

10. Steam piping in the campus tunnels shall have a three valve configuration at any main intersection of piping. One valve on the main line before and after the branch pipe, and one valve on the branch pipe.
11. Pressure Reducing Stations shall be designed with 100% redundancy by including a properly sized globe valve in the bypass loop.
    A. Acceptable Manufacturers:
        1) Spence
        2) Spirax Sarco
    B. Review project requirement for PRV safety relief. Preference is to utilize the Power House relief valve since piping and equipment is sized and installed to high pressure requirements.
    C. Pressure gauges shall be installed at the exit side of the PRV and globe valve and be rated for the full capacity of the incoming steam line.
    D. For maintenance purposes, gate valves shall be installed before and after the PRV and globe valve.
    E. Valves shall be sized for a 1/3 – 2/3 capacity.
12. Flash Tanks shall not be vented to atmosphere. They are to be sized to separate the full condensate load from the flash steam. The flash steam shall be reused and then drained to the building condensate receiver.
13. Condensate Piping to be ASTM A106, seamless, schedule 80.
    A. Pipe size 2 inches and under: 150 psig malleable iron unions for threaded ferrous piping.
        1) If maximum pressure is greater than 15 psi, than all piping including cut sections must have the mill stencil and all fittings must be traceable to their test reports. Contractor will submit the following to Owner:
            a. Map of the work performed.
            b. Copy of the P or B3 license.
            c. Mill test reports for all piping.
            d. Test Reports for all fittings.
    B. Pipe size over 2 inches: 150 psig forged steel slip-on for ferrous piping and welded.
        1) Reference welded steam and condensate piping below.
14. Condensate Pumps and Receivers:
    A. Building receivers to be designed for 100% redundant pumps and shall alternate cycles.
    B. The receiver and pumps shall be selected for approximately 1/3 run time under peak load conditions.
    C. Vent pipes shall be sloped back to the condensate receiver, minimum of 1/8” per 10 ft.
    D. Condensate Pumps and controls are to be wired to the back-up generator for emergency power.
    E. Acceptable Manufacturers:
        1) Bell & Gossett (preferred)
        2) Burke
        3) Spirax Sarco
15. Any steam device, with a two-way modulating steam valve on the inlet, must:
    A. Provide a minimum of 15 inches drop between the condensate outlet and the inlet of the trap.
    B. Be located high enough to allow gravity draining of the condensate from the trap to the condensate receiver.
16. Steam Traps:
    A. All traps to include a valve test port, on the outlet, so that maintenance personnel can visually inspect the functionality of the trap.

B. Acceptable Manufacturers of Traps:
    1) Armstrong (preferred)
    2) Barnes & Jones
    3) Spirax Sarco
C. All equipment utilizing steam shall be trapped individually. No gang traps.
D. For horizontal steam pipe in the campus tunnels, must not exceed 300 feet without a trap.
E. Be located at any drop or elevation change of the steam pipe.
F. Must utilize a drip leg when connected to the steam main. See below.
G. High pressure steam traps (above 15 psi incoming steam):
    1) If located in the campus tunnels and prior to the building pressure reducing station, shall use a sparger tube to disperse into the condensate return line. Locate the sparger tube away from the occupied spaces, preferably in the tunnel or mechanical room.
    2) If located inside a building, shall use a flash tank to separate the condensate from the steam. The rejected steam must be consumed by a steam apparatus or injected back into the main steam line with the appropriate valves.

17. Drip Legs:
    A. Shall be used on the steam mains wherever a trap is required.
    B. Diameter is the same as the steam main (up to 4”). If steam main is greater than 4”, than drip leg is 1/2 the size of the main but never less than 4”.
    C. Length of drip leg is preferred to be 28” but never less than 15”.
    D. Outlet from drip leg to trap must not be at the bottom of the drip leg, ideally 1/3 to 1/2 the distance from the bottom.
    E. Provide a 1 inch blow down at the bottom of the drip leg. Install a gate valve and cap.
18. Steam & Condensate Insulation:
    A. Provide removable jacket insulation for steam valves and pressure reducing valves at the PRV stations.
    B. Calcium Silicate is to be used at all hangers, rollers and supported locations. This also includes any section of pipe in which Maintenance Personnel must climb over or under the pipe.
    C. Thickness per ASHRAE 90.1.
19. Welded steam and condensate piping:
    A. Contractor must submit the proper paperwork to the State of Michigan and provide a copy to Owner. Owner’s copy will include:
        1) Welding Procedure Specification.
        2) Procedure Qualification Record.
        3) Welder Certification and Welder I.D.’s, including letter of acceptance from Contractor for any additional welders utilized from the local Union Hall.
        4) Welder Continuity.
        5) Weld Map.
        6) Material Test Reports.
        7) Heat Treat Numbers.
        8) Owner/User signoff sheet witnessed and signed by Owner.
    B. Each piece of welded steam and condensate piping must include the Welders I.D. stamp and mill stencil (including transferring stencil to cut sections).
20. Expansion of piping shall be calculated for each length of pipe from anchor point to the next anchor point. Expansion loops are preferred within buildings. Slip joints with flanges may be provided in tunnels.
21. Acceptable manufacturers of slip joints are:
    A. Advanced Thermal Systems
    B. Yarway Corporation
    C. Hyspan

23 23 00 Refrigerant Piping:

1. Refrigerant piping must be purged with nitrogen when brazing.
2. All refrigeration unit construction and repair shall have the following test performed and witnessed by the Owner.
    A. Pump the system down to 500 microns vacuum.
    B. Shut off the vacuum pump (assured system is sealed).
    C. System must hold 500 microns vacuum for 2 hours and 30 minutes and verified in writing by Owner.

23 30 00 HVAC Air Distribution

1. All VAV boxes, heat pumps or other air distribution equipment, shall be located in the hallway at a height for maintenance (less than 24" from drop ceiling) access from a ladder.
2. Air intake shafts shall not be located near building relief, exhaust fans, plumbing vents or generators. Meet or exceed code requirements.
3. Supply and exhaust fans in AHU's shall be direct driven with variable frequency drives (VFD).
    A. Acceptable Manufactures of VFD's:
        1) Yaskawa
    B. All VFD's to be scoped and checked for acceptable harmonics.
    C. Provide shaft grounding rings for motor bearing protection.
    D. Provide alarming capability that the fan/pump/motor is actually operating. "Doughnuts for verification of motors operating is not acceptable".
4. Drains shall be installed at every compartment in the AHU and indirectly connected to the building piping or over a floor drain.
5. External air intakes and exhausts shall be designed to prevent snow and rain from entering into the HVAC system. Intake louvers shall be sized for a maximum of 400 feet per minute with at least a 4' deep plenum.
    A. 100% outside air units require a deeper plenum with integral baffles separating the louver from the duct connection. Plenum should be elevated with drains indirectly piped to floor drains.
    B. Low points of the ductwork system (intake and exhaust) may be designed with a drain and routed to the appropriate connection point.
    C. This drain does not relieve the AE from providing methods to prevent snow and rain infiltration as mentioned.
6. Major rooftop equipment such as air handling units, makeup air units, and rooftop units shall have a defined maintenance path for maintenance carts/tools without causing roof damage.. Units capable of maintenance entry shall include internal lights. All roof mounted equipment to include a 120V receptacle.
7. New duct work shall be thoroughly cleaned after construction activity and prior to the operation of the AHU's. Ducts that are properly sealed during storage and installation, along with proper filtration during construction use, and pass a visual cleanliness test may not require additional cleaning.
8. The Mechanical Trades shall be responsible to provide all duct access doors for cleaning, accessing valves, sensors, flow stations, etc.
    A. Access doors will be provided at all intake ducts for clean out. Ladders down into ductwork will not be permitted.
9. The following criteria are required for the sizing of ductwork unless lower requirements are stated by the acoustical design:
    A. Supply Air Ductwork
        1) The inlet velocity of outside air plenum for AHU's shall be less than 400 feet per minute, 0.25" per 100 feet maximum pressure drop, and shall include top caps or elbows to reduce snow infiltration.
        2) Located in a shaft: 2,000 feet per minute maximum velocity, 0.25" per 100 feet maximum pressure drop.

3) Between fan and air terminal unit: 1,800 feet per minute maximum velocity, 0.25" per 100 feet maximum pressure drop.
4) Downstream of air terminal units: 1,000 feet per minute velocity, 0.10" per 100 feet maximum pressure drop.

B. Return Air Ductwork:
1) Located in shaft: 1,500 feet per minute maximum velocity, 0.10" per 100 feet maximum pressure drop.
2) Overhead in occupied spaces: 1,000 feet per minute maximum velocity, 0.10" per 100 feet maximum pressure drop.

C. Exhaust Ductwork:
1) Located in shaft: 1,500 feet per minute maximum velocity, 0.10" per 100 feet maximum pressure drop.
2) Overhead in occupied spaces: 1,000 feet per minute, 0.10" per 100 feet maximum pressure drop.

23 36 00 Air Terminal Units

1. Air Terminal Units (Constant or Variable) with reheat coils, shall have:
   A. A discharge air temperature sensor that is hard wired back to the unit controller.
   B. A manual override button on the space temperature sensor (in the event of an occupancy sensor malfunction). Provide master/satellite buttons for all offices without a thermostat.
2. Fan powered VAV boxes to be EC motors.

23 36 00 Ventilation Hoods

1. When designing hood systems there shall be a 1:1 correlation between exhaust and make-up air systems.
2. Must have side curtains to reduce the amount of exhaust and make up air required.
3. Exhaust hoods shall be interlocked with all make-up air units such that building balance is maintained.

23 52 00 Heating Boilers

1. CMU requires a copy of the permit application with attached documentation. Prior to project commencement.
2. CMU expects to be copied on all correspondence with the State.
3. The CSD1 shall be completed as soon as the boiler is fired. Any deficiencies shall be corrected immediately upon discovery and reported to CMU contact.
4. The completed CSD1 copy shall be left at the boiler. Provide electronic scanned copy to CMU contact.
5. CMU requires that the inspection be requested within 24 hours of the CSD1 completion.

23 57 00 Heat Exchangers for HVAC

1. Heat exchangers shall be Bell & Gossett, Armstrong, or ITT Industries.
2. Heat exchangers shall be designed with fail in position steam valves and a bypass valve.
3. The Hot Water System shall be cleaned and chemically passivated prior to charging the system. This shall be checked by the commissioning agent.
4. The heat exchanger relief vents to be piped to a drip pan next to a floor drain. The drip pan should include a water sensor connected to DDC and drain to the floor drain.
5. When designing redundant heat exchangers, the piping must include a 100% tight shut-off blocking valve.

23 60 00 Central Cooling Equipment

23 70 00 Central HVAC Equipment

23 80 00 Decentralized HVAC Equipment

23 82 00 Convection Heating

1. Perimeter heating in offices shall be finned tube radiation. Radiant ceiling panels are NOT acceptable.
2. Perimeter heating to be controlled from the air terminal unit controller.
3. Perimeter heating devices to include air vents and drains.

23 84 00 Humidity Control Equipment

1. Humidification shall NOT be provided unless required for a process or environment. Review with Owner prior to 95% Design Development.
2. Humidifiers shall be direct injection clean steam. Acceptable manufacturer is Dri-Steem.
3. No direct campus steam or electric generation. Natural gas generation should be used if steam is not available.
4. For atmospheric humidifiers, provide drain coolers prior to floor drain discharge.

DOCUMENT CONTROL PAGE:

Document Published:	November 20, 2006
Prepared By:	Robert Francisco
Reviewed By:	Mike Walton, Linda Slater, Chris Paseka, Dan Methner, Steve Esch, Jesse Reed
Approved By:	Jonathan Webb

Revision History:

Date	Revision	Approved By:
1.24.07	Clarification of the type of copper tubing to be used above grade and below grade. Included an additional booster pump manufacturer (Tigerflow). Converted to CSI 2004 format.	Steve Lawrence
12.17.07	Inserted Chilled Water System requirements and additional Miscellaneous (General) requirements	Steve Lawrence
2.22.08	Revised section E.1; Inserted into section C item 7; Inserted into section F items 21 and 22	Steve Lawrence
5.18.10	Separated General Mechanical Requirements into Division 23 HVAC and Division 22 Plumbing Guidelines. Incorporated best practices from Education Building, Brooks Hall, Ronan Renovation, Events Center, and Health Professions Addition.	Steve Lawrence
2.11.11	Added 23 09 33 Graphic Design requirements, hydronic test parameters, and dirt removal in section 23 20 00, required steam and condensate documentation, and field markings in 23 22 00, ductwork design criteria in section 23 30 00.	Steve Lawrence
5.11.12	Revised section 23 20 00 Instrumentation and Control for HVAC – Removed Corporate Johnson Control and replaced with Corporate Trane	Steve Lawrence
1.22.13	Revised hot tapping of chilled water lines in section 23 21 00 and added additional steam and condensate requirements along with a campus model review by FTC&H.	Steve Lawrence
7.22.13	Inserted TAB requirements in Section 23 0593 Testing, Adjusting, and Balancing (TAB) for HVAC	Steve Lawrence
3.30.15	Revised Section 23 0593 Testing, Adjusting, and Balancing (TAB) for HVAC	Steve Lawrence

4.16.15	Revised Section 23 09 00 Instrumentation and Control for HVAC	Steve Lawrence
10.8.18	Major revisions to the standard. Section 23 09 00 Instrumentation and Control for HVAC pulled out and is a stand-alone document.	Jonathan Webb