Division 23 | **Heating, Ventilation, & Air Conditioning**

Section includes various guidelines for the operation & maintenance for HVAC systems, common work results, HVAC commissioning, piping, pumps, and other HVAC equipment.

This design guideline is written to the designer of record (DOR). This guideline is written to document UA standards of work, assist the designers in ensuring UA standards are incorporated into the contract documents and provide a resource to facilitate the design process. It is the designer of record's responsibility to coordinate the criteria set forth in design guideline and in conjunction with the manufacturer requirements and use the most stringent standard.

Section 23 01 00 – Design of HVAC Systems

A. Codes and Standards

A. Codes and Standards: The University of Alabama falls under the jurisdiction of the State of Alabama Building Commission. The codes and standards currently adopted and enforced by the Alabama Building Commission as the State Building Code are available at http://www.bc.state.al.us/buildingcode.htm. Note that the body of codes adopted and enforced include standards used a reference standards within the codes listed.

B. Where specific/specialized systems and/or installations are not covered by these standards or referenced codes, designer shall reference and specify adherence to industry standard codes and apply best engineering practices applicable to these specific systems or installations. Designer shall identify codes/standards used for design of these specialized systems on the mechanical drawings.

B. Primary Mechanical Systems

A. Variable Air Volume Air Handling Systems with 4-Pipe Chilled Water Cooling and Hot Water Preheat/Reheat, Connected to Campus Central Hydronic System.

   a. This is the preferred system type for new or fully renovated Campus Buildings where Campus Central Hydronic Hot and Chilled Water System piping is nearby and cost effective to connect to.

B. Variable Air Volume Air Handling Systems with 4-Pipe Chilled Water Cooling and Hot Water Preheat/Reheat, Connected to Facility Specific Chiller and Boiler System.

   1) This is the preferred system type for new or fully renovated buildings that require cooling capacity greater than approximately 35 tons that are neither Campus Buildings nor are cost effective to connect to the Campus Central Hydronic Systems.

C. Packaged Rooftop/Split System DX Systems.

   1) This is the preferred system type for small new or fully renovated buildings that have coarse zoning requirements (small numbers of large spaces) and have an aggregate cooling capacity of less than approximately 35 tons.
   2) Indirect fired natural gas heat is preferred for packaged rooftop systems.
   3) Hydronic/domestic hot water heat is preferred for split system DX units. If hot water heat is not available, heat pumps with supplemental electric heat are acceptable.

D. Variable Refrigerant Flow (VRF) Systems.

1) This is the preferred system type for small new or fully renovated buildings that have fine zoning requirements (large numbers of small spaces) and have an aggregate cooling capacity of less than approximately 35 tons.
2) This system type may also be considered for renovation work within buildings with limited mechanical space/floor-to-floor heights.
3) When VRF system is used, provide dedicated outside air system as required to meet ASHRAE Standard 62 ventilation requirements.

C. Auxiliary Systems/System Characteristics

1. Airside Economizers shall be provided on all system types where feasible.

2. Energy Recovery Systems shall be provided on Outside Air/Exhaust Systems as required by the ASHRAE 90.1 Energy Standard, version adopted by the Alabama Building Commission.

3. Provide separate ductless split system DX units or DX computer room units as cooling capacity dictates to condition server rooms. This equipment shall be on standby power.

4. Provide dedicated cooling system in the form of a terminal unit or ductless split system DX unit for all telecom rooms. If a terminal unit is used, verify that cooling will be available to terminal unit at all times. Air handler serving terminal unit or DX unit must be on standby power. Provide cooling capacity of 18,000 sensible BTU/Hour for each telecom room unless noted otherwise.

5. Provide dedicated cooling system in the form of a terminal unit or ductless split system DX unit for all elevator equipment rooms. If a terminal unit is used, verify that cooling will be available to terminal unit at all times.

D. Outdoor Air Design Conditions:

1. HVAC Winter: 10°F

2. HVAC Summer: 96°F DB / 80°F WB

E. Indoor Design Conditions – Acoustics, Temperature and Humidity:

1. HVAC related background noise shall meet the criteria outlined in the 2011 ASHRAE Handbook – HVAC Applications, Chapter 48 "Noise and Vibration Control", Table 1.

2. Summer (air-conditioning) Design Conditions:

   1) Space Maximum Temperature: 74°F
   2) Space Maximum Humidity: 50% RH

3. Winter (heating) Design Conditions:

   1) Space Minimum Temperature: 70°F
   2) Winter humidification is generally not required, except where specifically approved by UA.

4. See UA Energy Policy http://policies.ua.edu/energy.html to setup controls system operating conditions.

5. Design conditions listed above are for Offices, Classrooms, Conference Rooms and Auxiliary spaces supporting these Occupancies. For spaces such as Laboratories, Clean Rooms or other spaces with

process or equipment specific requirements – obtain design conditions from specialty consultant and confirm criteria with UA Project Manager.

F. Positive Building Pressure:

1. The goal is for all buildings to have a slightly positive static pressure. When designing entire building systems provide for sufficient outside air intake and appropriate controls to maintain the building at a positive 0.02" static pressure at ground/entry level relative to outside air.

2. For small systems and/or where static pressure control is not cost effective, provide system capability for positive pressurization up to 10% of total supply airflow.

G. Design for Future Growth/Spare Capacity:

1. Prior to start of design obtain requirements for future growth from UA project manager. If future growth of the facility is expected, either provide supplemental system capacity at initial installation to support facility expansion or provide the ability to add future system capacity to the infrastructure provided at initial installation. Future installation of additional capacity and/or connection of additional load/systems shall not require any significant demolition of building elements or mechanical systems.

2. If no future growth requirements are provided by UA project management, provide a minimum of 10% spare capacity in air handling equipment, duct mains and main piping systems.

H. Design Review of Existing Conditions/Capacities:

1. In addition to review of existing design drawings – field verify existing conditions. Do not assume that existing record drawings are complete or accurate, if discrepancies between record drawings and existing conditions are found during design surveys and/or during construction notify the owner immediately.

2. Field verify condition of existing equipment and existence of any previously designed spare capacity prior to design. Do not assume that existing equipment is identical to equipment originally designed. Do not assume that existing equipment is operating at original design capacity.

I. Design Requirements – Maintenance Accessibility:

1. Locate equipment requiring maintenance so that it is easily accessible. Avoid installations that require the use of lifts or scaffolding, or the removal of other equipment for routine maintenance. Provide access doors to all maintainable equipment located behind walls or above permanent ceilings.

J. Cost Estimating/Project Budget:

A. Cost Estimating shall be performed as required in the Owner/Designer Agreement.

K. Manufacturers:

1. The engineer shall use the manufacturers listed in these design standards to select equipment and develop construction specifications.

2. Other manufacturers may be accepted – provide justification and obtain written approval prior to including alternate manufacturers in design drawings or specifications.

3. Sole source specification of equipment must be accompanied by a sole source justification letter and must be approved by UA.

L. Use of Foreign Materials:

1. See UA Form – General Conditions of the Contract, Paragraph 50.

2. All monolithic components (those consisting of a single solid, unbroken piece) such as but not limited to pipe, pipe fittings and structural components composed of carbon steel, cast iron, ductile iron, copper, brass, bronze, stainless steel or aluminum shall be produced in the United States or its territories.

3. All other components used within HVAC systems shall be produced in the United States or its territories unless one of the following conditions apply:

   a. The component in question is not produced at a location within the United States or its territories.
   b. Components produced within the United States or its territories are not available at prices competitive with equivalent foreign product.

   Product data for all components produced outside the United States or its territories to be used in HVAC systems must be submitted a minimum of 10 days prior to bid for approval by responsible design consultant and UA Construction Administration. Submittal information shall include fabrication location and reason for substitution of foreign component (availability, cost). Components that have sub-components of foreign manufacture must also have data submitted for approval and reason for submittal clearly noted. Components provided by approved manufacturers where produced outside the United States or its territories must also follow this submittal procedure.

M. Equipment Provided by Owner:

1. Where owner desires to purchase specific equipment due to timing and or cost considerations, designer shall be responsible for providing documentation necessary for purchasing including specifications, drawings and details (as applicable). Designer shall also provide assistance and technical support during the purchasing process as needed.

2. Design must reflect actual equipment purchased by the owner. Include submittal data of actual equipment purchased as part of contract documents.

3. Design documents shall instruct the contractor to manage all aspects of equipment receipt, including coordination with the supplier, unloading, storage/relocation as needed. Provide equipment protection as necessary.

N. Demolition Requirements:

1. To maximum extent feasible, remove abandoned branch piping and ductwork back to risers / mains. Remove abandoned conduit and equipment.

2. The A/E must caution the Contractor that all shutdowns of systems serving occupied spaces outside the area of this project shall be absolutely minimized. This will require that, for example,

branch duct runs shall be capped and sealed at the time of partial duct removal to allow use of the remaining duct system until the new ducts are installed. Temporarily rebalance if pressure relationships are critical. Ducts to be reused cannot be left open.

3. Other systems which are presently operating that are to be abandoned, as well as those previously abandoned should be removed.

O. Bid/Construction Drawing Requirements:

1. Prepare the following mechanical drawings (as applicable to the project):

   a. HVAC Schedule Drawings

      i. HVAC schedule drawings shall include design criteria. These criteria should include design outdoor temperatures/humidity. These criteria should also include design indoor temperatures, humidity, indoor background noise and cleanliness for each occupancy classification.

      ii. HVAC schedule drawings shall include outside air calculations as required by the IMC version adopted by the State of Alabama Building Commission. These outside air calculations shall indicate amount of outside air provided by each air handling system and to each space.

      iii. HVAC schedule drawings shall include detailed design information for all major mechanical equipment, including performance characteristics, utility connection requirements and accessories.

      iv. If not located on individual drawing sheets, legends identifying drawing symbols/notation shall be provided on the HVAC schedule drawings.

   b. Demolition Plans

      i. Plans to include phasing notes, where applicable.

      ii. Plans to identify equipment to be turned over to owner following demolition. Note on plans that owner has first right of refusal in addition to identified items; items that are to be turned over to the owner shall be loaded onto owner provided transport vehicle at the jobsite.

   c. HVAC Airside (Ductwork and Equipment) Plans

   d. HVAC Piping Plans

      i. Include all meter locations.

   e. HVAC Control Plans

      i. Include all temperature sensor and control switch locations and relationship to devices controlled.

      ii. Include all equipment and building level controller locations.

   f. ¼" Scale Combined HVAC/HVAC Piping Mechanical Room Plans

i. Include free space required for maintenance.

g. HVAC Sections/Elevations

i. Include sections of building showing HVAC systems at locations where HVAC components are layered more than (2) components deep.
ii. Include sections of building showing HVAC systems at building locations where ceiling space is limited and/or structure is of unusual construction.

h. HVAC & HVAC Piping Details

i. HVAC Control Diagrams

i. Include diagrams showing all control I/O devices and locations in schematic format.

ii. Include sequences of operation for equipment.

iii. Reference locations on Control Plans to locate equipment/controllers.

P. A/E and Contractor Closeout Documents:

1. See UA Front-End Specification 01700 “Project Closeout”.

23 05 13 – Common Motor Requirements for HVAC Equipment

A. Motors shall be 1750 RPM unless service dictates otherwise.

B. All motors 5 HP and larger shall be premium efficiency, inverter-ready.

C. Motors installed in outdoor or damp environments shall be TEFC.

D. Motors installed within custom built central station air handling units shall be TEFC

E. Motors serving pumps larger than 5 HP shall be TEFC.

23 05 14 – Variable Frequency Drives for HVAC Equipment

A. All variable frequency drives to be ABB model ACH550.

B. For all new and/or totally renovated buildings, specify an extra drive for each motor HP of drive in project to be delivered to UA.

C. Drives shall be provided without integral bypasses and disconnects. Disconnect to be installed separate from VFD, adjacent to VFD to facilitate service.

D. Drives shall be specified with NEMA 1 enclosures for standard indoor service, NEMA 12 enclosures for dusty/dirty indoor environments and NEMA 3R enclosures for outdoor or wet environments. Air filters shall be provided for air intake openings only on NEMA 3R and 12 enclosures.

E. Variable frequency drives shall be provided with Lonworks communication interface for direct connection to Building Automation System.

F. Variable frequency drives shall be de-rated by 10% when installed in high ambient environments.

23 05 16 – Expansion Fittings and Loops for HVAC Piping

A. Pipe movement as a result of thermal expansion shall be compensated for through the use of a system of expansion loops and/or bends in conjunction with an anchor/guide system. Packed slip, flexible ball, bellows type and other expansion compensating devices shall not be used unless specifically approved by UA.

23 05 19 – Meters and Gauges for HVAC Piping

1. Thermometers

    1) Manufacturers: Subject to compliance with requirements below – at consultant's discretion.
    2) Mercury thermometers are not to be used.
    3) Thermometer range guidelines:

Service	Range(°F)
Chilled Water	0-120
Condenser Water	0-120
Heating Water	30-240

4) Indoor locations: Digital thermometer, variable angle, electronic with LCD display and solar cell, adjustable angle, separable socket and 3.5" stem. Accuracy to +/- 1 degree F. Basis of Design – Weiss Model DVU35.
5) Outdoor or wet locations: Industrial glass thermometer, variable angle, 9" scale, aluminum case with blue liquid filled tube, separable socket and 3.5" stem. Accuracy within 1% of scale range. Basis of Design – Weiss Model A9VU35.
6) A/E shall edit thermometer ranges to project specific requirements and must show clearly on the drawings or details the locations for all thermometers.

2. Pressure Gauges

1) Manufacturers: Subject to compliance with requirements below – at consultant's discretion.
2) Water and Compressed Air Services: 4 ½" diameter face, sealed glass window, silicone filled for connections within 10 feet of pumps.
3) Steam Service: 4 ½" diameter face, sealed glass window, brass coil siphon tube.
4) Select range for twice normal operating pressure.
5) A/E shall edit gauge ranges to project specific requirements and must show clearly on the drawings or details the locations for all gauges.

23 05 23 – General Duty Valves for HVAC Piping

A. Ball Valves

1) Manufacturers: Subject to compliance with requirements below – at consultant's discretion.
2) General Service Usage in Lines 2" and smaller: Full port vented ball, full-line size bronze body with type 316 stainless steel ball, stainless steel stem, PTFE seats and FNPT end connections. Provide insulated handle for chilled water service. Pressure/temperature rating to match service requirements but at a minimum must be rated for 250 psig service at 250 degrees F.

B. Butterfly Valves

1) Manufacturers: Subject to compliance with requirements below – at consultant's discretion.
2) General Service Usage in Lines 2-1/2" and larger: Lug pattern, ductile iron body with extended neck for 2" minimum insulation. Valve to include molded-in EPDM liner bonded and fused to valve body, aluminum bronze disc and 416SS blowout-proof stem. Pressure/temperature rating to match service requirements but at a minimum must be rated for 150 psig service at 250 degrees F.
3) Do not use butterfly valves in steam service.
4) Sizes 4" and above shall have gear operated chain if located more than 8' above floor. Chain shall reach no lower than 7'-0" of floor or operating platform.
5) Direct Buried Service Valves for use in Hydronic Hot Water/Chilled Water Applications, 3" and larger: AWWA C504, Class 150 with flanged ends. Ductile iron body with type 304 stainless steel valve shaft and body seats. Valve seat to be EPDM for service up to 225 degrees F and attached to valve vane by 304 stainless steel self-locking fasteners. Valve shaft seals to be EPDM O-ring type. Basis of Design: M&H Valve – Style 4500.

C. Gate Valves

1) Manufacturers: Subject to compliance with requirements below – at consultant's discretion.
2) Steam Service Usage in Lines 2" and smaller: Bronze body with bronze trim, union bonnet, rising stem, handwheel, inside screw with backseating stem, solid wedge disc and FNPT ends. Pressure/temperature rating to match service requirements but at a minimum must be rated for 125 psig saturated steam service.

3) Steam Service Usage in Lines 2-1/2" and larger: Ductile iron body with bronze trim, bolted bonnet, outside screw and yoke, handwheel, solid wedge disc with bronze seat ring and flanged ends. Pressure/temperature rating to match service requirements but at a minimum must be rated for 150 psig saturated steam service.

23 05 29 – Hangers and Supports for HVAC Piping and Equipment

A. Pre-Engineered Support Systems

1) The use of pre-engineered support systems (such as Unistrut or B-Line) for HVAC piping and equipment is preferred as these systems have clearly defined installation instructions, load criteria and safety factors.

B. Custom/Field Fabricated Support Structures

1) Custom and/or field fabricated support structures for support of or access to HVAC piping and equipment for equipment weighing over 600 lbs and/or piping load density equal to or greater than a single 4" carbon steel pipe per support point shall be detailed and designed by the A/E.

C. Hanger/Support Design Coordination

1) HVAC equipment, HVAC piping 4" or larger and duct weighing more than 20 lbs/linear foot shall be shown on and coordinated with structural drawings.

D. Support Materials/Details

1) Support materials shall be carbon steel unless noted otherwise.
2) Indoor/Dry Environments: Support materials shall be provided with an electroplated zinc coating (0.2 mil coating) or painted with an epoxy based primer. Apply zinc coating or primer to ends of cut supports or areas where coatings have been removed during assembly/construction.
3) Outdoor/Wet Environments: Support materials shall be provided with a thermoset epoxy coating such as Unistrut Perma-Green, constructed of corrosion resistant materials such as stainless steel/aluminum or painted with an outdoor duty epoxy based primer/paint system. Apply coating or primer/paint to ends of cut supports or areas where coatings have been removed during assembly/construction.
4) Where uninsulated piping comes into contact with metal supports or support systems, provide elastomeric cushion or clamp to prevent direct metal to metal contact.

23 05 33 – Heat Tracing for HVAC Piping

A. Manufacturers: Subject to compliance with requirements below – at consultant's discretion.

B. Apply heat tracing to all above-grade HVAC hydronic piping exposed to outdoor conditions, including piping in unconditioned attics.

C. Heat trace shall be applied under pipe jacket and insulation.

D. Heat trace shall be self-regulating and rated for a minimum of 5W/LF.

E. All trace shall be thermostatically controlled. This may be accomplished via a central distribution panel or individual controllers for separate pipe sections.

23 05 48 – Vibration and Seismic Controls for HVAC

A. Seismic Controls

1) HVAC equipment, ductwork, piping and other components to be provided with Seismic restraint and control devices as required by ASCE 7-05. Mechanical design engineer to specify seismic controls based upon building Seismic Design Category and HVAC system use/service.

B. Vibration Controls

1) In general, apply vibration control and isolation as recommended in the 2011 ASHRAE Handbook – HVAC Applications, Chapter 48 "Noise and Vibration Controls". Designer to review with UA during design process all proposed vibration control methods, strategies and components prior to final selection.

23 05 53 – Identification for HVAC Duct, Piping and Equipment

A. Duct Labeling

1) Label concealed duct mains and exposed duct mains within mechanical rooms with fluorescent green spray paint stencil every 20 LF and a minimum of once within each room.
2) Letter height to be 2" and label to include directional arrow and duct type information – "Supply", "Return", "Exhaust", "OSA".

B. Pipe Labeling

1) Pipe labels are to comply with ANSI/ASME A13.1 – 1996 for labeling location/frequency, letter height, color field length and directional arrow requirements. Note that hydronic hot water supply and return shall have black on yellow color scheme in lieu of white on green.
2) Pipe labels are to be suitable for both indoor and outdoor use.
3) Pipe labels may be cylindrically coiled or flat strap-around markers with heavy duty nylon ties. Substitute stainless steel bands for nylon ties for outdoor duty applications.

C. Equipment Labeling

1) All equipment shall be labeled with multilayer, multicolor phenolic plastic labels with data mechanically engraved in the label.
2) All access doors to fire dampers, fire/smoke dampers and grease exhaust cleanout points shall be labeled with multilayer, multicolor phenolic plastic labels with data mechanically engraved in the label.
3) Phenolic plastic labels shall be a minimum of 1/16" thick, with letters a minimum of ¼" in height.
4) Labels shall be mechanically attached to equipment with stainless-steel self-tapping screws where feasible. Contact type permanent adhesive is permitted where mechanical attachment is not feasible.
5) Labels shall have white letters on black background unless equipment is served by emergency power. Equipment served by emergency power shall have white letters on red background.

D. Warning Labels

1) Warning labels shall be provided at locations and/or equipment where specific actions must be performed on a regular basis to avoid compromise of system operation.
2) Provide warning labels at equipment disconnects where equipment is served by a remote VFD.

3) Warning labels shall have white letters on yellow background. See "Equipment Labeling" above for other requirements.

E. Warning Tape for Below Grade Pipe

1) Pipe buried underground shall be provided with warning tape. Warning tape shall be installed continuously along the length of pipe 12 to 18 inches above the pipe, prior to backfilling.

23 05 63 – Anti-Microbial Coatings for HVAC Ducts and Equipment

A. Anti-microbial coatings for HVAC ducts and equipment are generally not required. Contact UA project manager if coatings are recommended for project specific application.

23 05 66 – Anti-Microbial Ultraviolet Emitters for HVAC Ducts and Equipment

A. Anti-microbial ultraviolet emitters for HVAC ducts and equipment are generally not required. Contact UA project manager if emitters are recommended for project specific application.

23 05 93 – Testing, Adjusting and Balancing for HVAC

A. Testing, Adjusting and Balancing of HVAC systems to be performed by an NEBB certified testing firm.
B. Testing firm shall have documented prior TAB experience on the UA campus. If firm does not have prior experience with work on UA campus, firm must submit qualifications to UA prior to bid for approval.

Section 23 75 00 – HVAC Duct Insulation

A. Manufacturers: At consultant's discretion.

B. Provide duct insulation thickness and thermal conductivity in conformance with the edition of ASHRAE 90.1 currently adopted and enforced by the State of Alabama Building Commission.

C. Provide insulation and associated accessories with flame-spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

D. Use of mechanical fasteners and tape to secure insulation is not acceptable unless augmented by a sealant/adhesive system such as mastic.

E. Supply Duct

a. Concealed Applications: Wrap with glass fiber external duct wrap.

b. Interior Exposed Applications: Line with glass fiber duct liner or provide double wall insulated duct.

c. Exterior Applications: Line with foamed plastic insulation.

F. Return Duct and Transfer Duct:

1) Interior Applications: Line with glass fiber duct liner for sound attenuation purposes.

2) Exterior Applications: Line with foamed plastic insulation.

G. General Exhaust Duct: Line with glass fiber duct liner only as required for sound attenuation purposes. Wrap with glass fiber external duct wrap downstream of fans to building exit point.

H. Grease Exhaust Duct: Wrap with commercial kitchen grease duct enclosure system in compliance with ASTM E2336 from hood connection to building exit point.

I. Outside Air Duct

1) Concealed Applications: Wrap with glass fiber external duct wrap.

2) Interior Exposed Applications: Provide double wall insulated duct.

3) Interior Exposed Applications (Mechanical Rooms): Wrap with glass fiber external duct wrap.

4) Exterior Applications: Line with foamed plastic insulation.

23 07 16 HVAC Equipment Insulation

A. Manufacturers: At consultant's discretion.

B. Hot Equipment: Glass Fiber Insulation – provide removable covers for equipment access points.

C. Cold Equipment: Foamed Plastic Insulation – provide removable covers for equipment access points.

23 07 19 HVAC Piping Insulation

A. Manufacturers: At consultant's discretion.

B. Provide piping insulation thickness and thermal conductivity in conformance with the edition of ASHRAE 90.1 currently adopted and enforced by the State of Alabama Building Commission.

C. Provide insulation and associated accessories with flame-spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

D. Use of mechanical fasteners and tape to secure insulation is not acceptable unless augmented by a sealant/adhesive system such as mastic.

E. Provide a continuous, unbroken, vapor seal on all cold pipe surfaces. Guides and anchors secured directly to cold surfaces shall be adequately insulated and vapor sealed to prevent condensation.

F. Provide insulation protection shields fabricated from galvanized steel at all pipe hangers in accordance with MSS SP-69.

G. Chilled Water Supply and Return

1) Concealed Applications: Cellular Glass or Polyisocyanurate (Trymer) Pipe Insulation with factory applied jacket.
2) Interior Exposed Applications: Cellular Glass or Polyisocyanurate (Trymer) Pipe Insulation with PVC jacket.
3) Interior Exposed Applications (Mechanical Rooms): Cellular Glass or Polyisocyanurate (Trymer) Insulation with aluminum jacket up to 8' above floor, factory applied jacket elsewhere.
4) Exterior Applications: Cellular Glass or Polyisocyanurate (Trymer) Pipe Insulation with Aluminum Jacket and Heat Trace.

H. Hydronic Hot Water Supply and Return

1) Concealed Applications: Glass Fiber Pipe Insulation with ASJ.
2) Interior Exposed Applications: Glass Fiber Pipe Insulation with PVC jacket.
3) Interior Exposed Applications (Mechanical Rooms): Glass Fiber Pipe Insulation with ASJ.
4) Exterior Applications: Cellular Glass Pipe Insulation with Aluminum Jacket and Heat Trace.

I. Refrigerant Piping

1) Concealed Applications: Foamed Plastic Insulation.
2) Interior Exposed Applications: Foamed Plastic Insulation with PVC jacket.
3) Interior Exposed Applications (Mechanical Rooms): Foamed Plastic Insulation.
4) Exterior Applications: Foamed Plastic Insulation with Aluminum Jacket.

J. AC Unit Drain Lines

1) Concealed Applications: Foamed Plastic Insulation.
2) Interior Exposed Applications: Foamed Plastic Insulation with PVC jacket.
3) Interior Exposed Applications (Mechanical Rooms): Foamed Plastic Insulation.

K. Steam and Steam Condensate Piping

1) Concealed Applications: Glass Fiber Pipe Insulation.
2) Interior Exposed Applications: Glass Fiber Pipe Insulation with PVC jacket.

3) Interior Exposed Applications (Mechanical Rooms): Glass Fiber Pipe Insulation.
4) Exterior Applications: Cellular Glass Pipe Insulation with Aluminum Jacket and Heat Trace.

23 08 00 - Commissioning of HVAC

1. Codes and Standards

A. Codes and Standards: The University of Alabama falls under the jurisdiction of the State of Alabama Building Commission. At the time of development of this design guideline the Energy Standard in effect for the State of Alabama is ANSI/ASHRAE/IESNA Standard 90.1-2007 "Energy Standard for Buildings Except Low-Rise Residential." This standard requires commissioning of buildings with project areas greater than 50,000 SF.

B. The University of Alabama also requires commissioning of buildings or portions of buildings with greater than 16,000 SF in project area for all core campus projects. Projects funded in their entirety by UA affiliated entities (fraternities, sororities, certain retail entities) will be provided commissioning services at the discretion of the particular entity. Contact your project manager for details.

2. Commissioning Agent

A. Engaged directly by UA. Typically after A/E team is selected and programming is complete.

B. Projects with greater than 50,000 SF in project area to include design phase and construction phase commissioning services.

1) Review schematic design/systems selection (30% Narrative)
2) Review design development drawings (60% Review)
3) Review 90% design documents.
4) Review 100% design documents.
5) Review VE proposals.
6) Review Supplemental Instructions
7) Review submittals and coordination drawings.
8) Generate test procedures and reports.
9) Review and verify TAB and test reports
10) Conduct Commissioning Meetings, generate agendas and meetings.
11) Generate Issue logs and monitor resolution.
12) Generate Training plans.
13) Generate Preliminary Construction Cx Report (prior to issue of Certificate of Occupancy), including issues report.
14) Generate Final Construction Cx report including issues resolution log. Construction Cx report to include submittals and all design documents including supplemental instructions.

C. Projects with less than 50,000 SF in project area but greater than 16,000 SF in project area are to be provided construction phase commissioning services only.

1) Review submittals and coordination drawings.
2) Generate test procedures and reports.
3) Review and verify TAB and test reports
4) Conduct Commissioning Meetings, generate agendas and meetings.
5) Generate Issue logs and monitor resolution.
6) Generate Training plans.
7) Generate Preliminary Construction Cx Report (prior to issue of Certificate of Occupancy), including issues report.
8) Generate Final Construction Cx report including issues resolution log. Construction Cx report to include submittals and all design documents including supplemental instructions.

3. Systems Requiring Commissioning

A. HVAC Systems – note that all equipment shall be functionally tested and observed by the commissioning agent, this includes all fan coil units and terminal units. Spot checking or testing only a percentage (ex. 25%) of equipment is not acceptable.

B. Emergency Generator Systems and Automatic Transfer Switches (if applicable).

4. Project Integration

A. Where design and construction phase commissioning is being provided, the following specification sections will be provided by the commissioning agent to the designer of record for incorporation into the contract documents:

1) 01 91 13 – General Commissioning Requirements
2) 23 08 00 – Commissioning of Mechanical Systems
3) 26 08 00 – Commissioning of Electrical Systems

B. Where only construction phase commissioning is being provided, the following specification sections will be provided by the designer of record for incorporation into the contract documents:

1) 01 91 13 – General Commissioning Requirements
2) 23 08 00 – Commissioning of Mechanical Systems
3) 26 08 00 – Commissioning of Electrical Systems

Section 23 09 00 - Instrumentation and Control for HVAC

A. 23 09 01 - Instrumentation and Control - General

1. The University of Alabama's standard control system for new construction and building renovations is the Schneider Electric TAC I/A Series building automation system. For purposes of system integration and maintenance – the Schneider Electric TAC I/A Series system is the only system permitted on the UA campus. Contact the UA project manager for sole-source justification information if needed.

B. 23 09 13.13 - Actuators and Operators for HVAC

1. Manufacturers: Belimo.

2. Actuators to be powered off of 24VAC control power circuits unless voltage drop caused by distance/wire sizing or actuator torque requirements makes this impractical. Use 120VAC actuators in lieu of 24VAC actuators in this application – the designer of record shall make this determination in the construction documents and not leave this as a field coordination requirement.

3. Actuators used in applications where failure of an actuator to open or close properly may cause damage to equipment, piping or ductwork due to over or under pressure conditions must be provided with limit switches integrated into the building automation system control logic.

4. When three-way flow switching or modulation applications occur in systems large enough to require butterfly type control valves – provide independent actuators for each butterfly valve in lieu of a single actuator with linkages controlling two valves.

5. Provide spring return actuators that fail to normal position unless specific application dictates otherwise. Identify normal position on control schematics.

C. 23 09 13.23 - Sensors and Transmitters for HVAC

1. Manufacturers: At consultant's discretion unless noted otherwise below.

2. Buildings served with hydronic chilled and/or hot water shall be provided Onicon System-10 type BTU meters with electromagnetic flow meters. Install BTU meters where total building loads can be measured.

3. Temperature sensors installed in chilled water, heating water, condenser water and steam lines shall be installed using thermowells. Sensors in thermowells shall be provided with a thermally conductive silicone grease similar to Omegatherm OT-201 to improve response time of the thermowell assembly.

D. 23 09 13.33 - Control Valves for HVAC

1. Manufacturers: At consultant's discretion.

2. Globe Pattern Control Valves: Use only in steam control applications.

3. Ball Valves: Normally use where the flow characteristics of ball valves 2" and smaller are applicable. Ball valves shall have stainless steel ball and stem. Provide characterized ball as required to meet specific flow requirements.

4. Butterfly Valves: Normally use where the flow characteristics of butterfly valves 2-1/2" and larger are applicable. If space or pressure constraints prevent use of butterfly valves, manifolded ball valves may be used.

5. Where used in three-way control applications, control valves shall be in the mixing (not diverting) configuration.

E. 23 09 13.43 - Control Dampers for HVAC

1. Manufacturers: Ruskin, Greenheck, NCA Manufacturing Inc.

2. Characteristics: Multi-blade, opposed blade pattern unless special application dictates otherwise.

3. Low Leakage Smoke Damper Applications: Provide low leakage smoke rated dampers at air handler inlets and outlets where isolation dampers are required.

F. 23 09 13.53 - Control Wiring for HVAC

1. Control wiring shall be run in EMT above hard ceilings and where exposed indoors.

2. Control wiring shall be run in EMT where exposed in indoor mechanical, electrical and telecommunication spaces.

3. Control wiring shall be run in rigid galvanized conduit where exposed outdoors.

4. Control wiring run in concealed, but accessible indoor locations (e.g. above lay in ceilings) shall be plenum rated and supported by a J-hook or cable tray system.

G. 23 09 23 - Direct Digital Control System for HVAC

1. The University of Alabama's standard control system configuration is Direct Digital Control unless special application dictates otherwise.

2. Construction documents for DDC systems shall include a control system architecture diagram showing the following:

   b. Building Level Controller: Enterprise or Universal Network Controller (ENC or UNC) with connection to campus network. Provide a minimum of one ENC/UNC per 100 equipment and application specific controllers.

   c. Air Handler/Central Plant Equipment Controllers: MNL-800 (also referred to as "Microzone" controllers.

   d. Application/Component Specific Controllers: MNL series and LON VAV devices.

3. Construction documents shall show at a minimum locations of Building Level Controllers and large groupings of Equipment Controllers.

4. Building Level Controllers shall communicate with the existing Enterprise server located on the UA network via Ethernet connection.

5. Equipment Controllers and Application Specific Controllers shall communicate with the Building Level Controller via Lonworks protocol (for new construction and most renovation) or ASD protocol (for existing buildings with ASD bus installed).

6. Equipment with Integral Controls:

    a. Chillers (Air and Water Cooled): DDC system to enable chiller start/stop via digital output. Chillers to be provided with LON interface for connection to building LON bus for diagnostic functions only.

    b. Boilers (High Mass Condensing): DDC system to enable boiler start/stop via digital output. DDC system to control boiler fire rate directly to maintain boiler discharge temperature. Provide 4-20 mA, 1-5V or 2-10V control signal to each boiler and provide boiler inlet and outlet temperature sensors at each boiler.

    c. Variable Frequency Drives: DDC system to enable start/stop via digital output and modulate speed via analog output. VFD's to be provided with LON interface for connection to building LON bus for diagnostic functions only.

H. 23 09 33 - Electrical Systems for HVAC Control

1. Show dedicated 120VAC power circuits for controls applications on the construction documents. Power circuit location and sizing shall be coordinated with HVAC equipment and control device power needs and locations.

2. Dedicated control power circuits shall be on standby and/or emergency power as dictated by the equipment controlled, i.e. provide standby HVAC control power when the equipment served is on standby power. Control systems for laboratory control applications shall be on standby power.

I. 23 09 43 - Pneumatic Control Systems for HVAC

1. Pneumatic controls should be avoided wherever possible. Existing pneumatic control systems are to be replaced with DDC systems. Exceptions may be granted for special applications as required.

J. 23 09 73 - Control System Devices for Plumbing Components

1. For facilities with large domestic water use (kitchens, athletic facilities, dormitories, etc.) – provide temperature sensors to monitor domestic hot water supply temperatures for each system delivering different water temperatures (i.e. 140F system, 120F system) and provide alarm if temperature drops below setpoint.

2. For facilities with domestic water booster pumps, provide pressure sensor in piping downstream of booster pump with display at DDC system user interface. Provide alarm signal if pressure drops below predetermined setpoint.

K. 23 09 83 - Telecommunication Systems for HVAC

1. Show dedicated dual port Ethernet jacks for all Building Level Controllers (UNC's) on the construction documents for connection to UA Campus Network.

L. 23 09 93 - Sequence of Operations and Control Schematics for HVAC

1. Construction documents shall contain control schematics for all controlled devices. Schematics shall identify all I/O points needed for equipment/system control. All I/O points to be viewable via building automation system user interface.

2. Provide sequences of operation for all schematics indicated above.

Section 23 20 00 - HVAC Piping and Pumps

23 21 13 - Hydronic Piping

A. Manufacturers: At consultant's discretion unless noted otherwise below. Note that all steel piping is required to be of domestic origin by General Conditions of the Contract Section "Use of Foreign Materials" and Article 39-3-4, Code of Alabama (1975).

B. Materials
   1. Chilled and Hydronic Hot Water Piping, Above Grade, 2" and smaller:

      a. ASTM B88, type L, hard drawn copper tubing. ASME B16.22 wrought copper fittings. Lead-free solder or Viega Pro-Press copper joints.

      b. Uponor Aquapex ASTM F876/F877 PEX-A tubing. Uponor ProPEX EP fittings. ProPEX ring joints. Provide Uponor PEX-A pipe support system with bend supports. Pre-insulated piping may be used in non-plenum return applications. Note: PEX-A tubing may not be usable on all projects due to chemical and temperature compatibility issues. Confer with UA mechanical engineer and project manager before specifying this product.

   2. Chilled and Hydronic Hot Water Piping, Above Grade, larger than 2":

      a. ASTM A53, Schedule 40 carbon steel. ASME B16.3, ASTM A234 forged steel fittings and ASME B16.5, ASTM A105 150# weld-neck or slip-on flanged fittings. Flanges to be compatible with connected equipment (e.g. flat faced flange for cast iron, flat face pump connection and raised face flange for control valve with raised face flange connection). AWS D1.1 butt-weld joints.

   3. Chilled and Hydronic Hot Water Piping, Below Grade:

      a. Pipe Material: ASTM A53, Schedule 40 carbon steel. ASME B16.3, ASTM A234 forged steel fittings and ASME B16.5, ASTM A105 150# weld-neck or slip-on flanged fittings. Flanges to be compatible with connected equipment (e.g. flat faced flange for cast iron, flat face pump connection and raised face flange for control valve with raised face flange connection). AWS D1.1 butt-weld joints.

      b. Insulation: Pipe and fittings shall be pre-insulated by piping manufacturer. Joints to be insulated using factory provided field insulation kits. Insulation shall be urethane with HDPE jacket. Basis of design: Thermacor Ferro-Therm SC.

   4. Condenser Water Piping, Above Grade:

      a. ASTM A53, Schedule 40 carbon steel. ASME B16.3, ASTM A234 forged steel fittings and ASME B16.5, ASTM A105 150# weld-neck or slip-on flanged fittings. Flanges to be compatible with connected equipment (e.g. flat faced flange for cast iron, flat face pump connection and raised face flange for control valve with raised face flange connection). AWS D1.1 butt-weld joints.

   5. Condenser Water Piping, Below Grade:

      a. Carbon Steel Piping:

         i. Pipe Material: ASTM A53, Schedule 40 carbon steel. ASME B16.3, ASTM A234 forged steel fittings and ASME B16.5, ASTM A105 150# weld-neck or slip-on flanged

fittings. Flanges to be compatible with connected equipment (e.g. flat faced flange for cast iron, flat face pump connection and raised face flange for control valve with raised face flange connection). AWS D1.1 butt-weld joints.

ii. Jacketing: Pipe and fittings shall be pre-jacketed by piping manufacturer. Joints to be jacketed using factory provided field jacketing kits. Jacket to be of HDPE construction. Basis of design: Thermacor Ferro-Therm SC (w/o insulation).

b. HDPE Piping:

i. Pipe Material: PE 3608 per ASTM D3350. SDR 13.5 with pressure rating of 128 psig. PE3608 fittings. Butt fusion joints & transition fittings.

ii. Provide tracer wire attached to top of both condenser water supply and return piping.

C. General

1) Use of Grooved Couplings and Fittings in Hydronic Piping Systems is prohibited. If equipment connections (e.g. chillers) require grooved fittings, provide grooved to flanged transition fitting at equipment.

2) Reducing Fittings: Select type and orientation of reducing fittings to allow gravity drainage.

3) Dielectric Protection: Where dissimilar piping materials (steel and copper) are connected, install a dielectric nipple for pipe sizes 2" and less. For pipe sizes 2 1/2" and above, install flanges with dielectric insulation kit.

4) Where piping penetrates exterior walls or floors below grade, provide pipe penetration seal kit equal to Link-Seal. Coordinate pipe insulation, sleeve and/or core drill requirements with structural and architectural requirements during development of construction documents.

5) Where hydronic piping penetrates floors provide fire-rated watertight sleeve assembly equal to 3M Fire Barrier Cast-in Device.

6) Connections to existing carbon steel lines shall be done via hot tap or saddle tee installed using a line stop system.

23 21 16 - Hydronic Piping Specialties

A. Manufacturers: At consultant's discretion, unless noted otherwise below.

B. Expansion Tanks: Bladder type with flexible EPDM bladder for temperature compatibility for both hydronic hot and cold water systems.

C. Automatic Air Vents: Float type with isolating valve. Run ¼" soft copper drain line to nearest drain. Install at system high points in piping mains. Locations of automatic air vents to be shown on plans in construction documents.

D. Manual Air Vents: Provide at all system high points where automatic air vents are not provided.

E. Air Eliminator/Dirt Separator:

1) Provide at point of system lowest pressure and highest temperature in hydronic hot water systems.

2) Provide on chilled water return line just upstream of decoupling line in stand-alone primary/secondary chilled water systems.

3) Provide on hydronic hot water and chilled water supply lines connected to the central campus distribution system at building entry points.

4) Provide line size bypass to allow service of separator without system shutdown.

5) Description: In-line coalescing type air eliminator and dirt separator with air vent, skim valve and full size blow down line to drain.

6) Manufacturers:

   a. Spirotherm

   b. Armstrong

   c. Bell & Gossett

   d. Wessels

23 21 23 - Hydronic Pumps

A. Manufacturers:
   1) Armstrong
   2) Bell & Gossett
   3) Taco
   4) WDM

B. Vertical In-Line Pumps:
   1) Use of vertical in-line pumps is preferred, but not mandatory – other types of pumps may be used if geometry or pressure/flow characteristics dictate.
   2) Pumps shall be provided with split-coupled pump shaft and coupling guard.
   3) Seals shall be outside balanced mechanical type with carbon rotating ring held against a silicon carbide seat by a stainless steel spring.

C. Sizing/Selection:
   1) Provide redundant lag or standby pumps to allow for continued system operation when a pump is down for service.
   2) For variable flow systems, the lead and lag pumps may be sized for 80% of connected load.
   3) For constant flow systems, the lead and standby pumps shall be sized for 100% of connected load.

- End -