SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - ABBREVIATIONS

AHU	Air Handling Unit
ASHRAE	American Society of Heating, Refrigeration, Air Conditioning Engineers
BAS	Building Automation System
BTU	British Thermal Units
CFM	Cubic Feet per Minute
CHW	Chilled Water
CO2	Carbon Dioxide
CUH	Cabinet Unit Heater
DDC	Direct Digital Controls
DPT	Differential Pressure Transmitter
DOAS	Dedicated Outdoor Air System
FPS	Feet per Second
HVAC	Heating, Ventilation, Air Conditioning
O and M	Operation and Maintenance Manual
VFD	Variable Frequency Drive
VAV	Variable Air Volume
VRF	Variable Refrigerant Flow

PART 2 - GENERAL REQUIREMENTS

1. It is the intent of the College that an open and analytical approach be applied to HVAC system selections and that the College does not endorse or discourage any particular HVAC system selection.

2. Engineer shall conduct HVAC system analysis and obtain college input.

3. HVAC system selections shall be reviewed with the College at the Schematic Design level to evaluate

potential applications and determine final selections for Design Development.

4. Computer-generated mechanical load calculations shall be prepared for HVAC systems. HVAC calculations shall be as recommended in the ASHRAE handbooks and other ASHRAE publications. System sizing should be based on the latest ASHRAE 1% cooling and 99.6% or -10° degrees Fahrenheit heating design conditions whichever is colder.

5. Indoor design space temperatures shall be 75 degrees Fahrenheit / 50% RH in the summer and 72 degrees Fahrenheit in the winter.

6. HVAC system controls shall be configured to reset space temperature setpoint deadband during unoccupied hours to 60 degrees Fahrenheit (heating) and 80 degrees Fahrenheit (cooling).

7. Projects utilizing Green Building Sustainable Design Concepts shall follow the latest edition of ASHRAE Standard 189.1.

8. The materials and equipment specified for the mechanical work shall be verified with the College during the design development phase.

9. Certain projects may require the mechanical systems to accommodate expansion and future additions.

10. Ensure that mechanical equipment is installed per manufacturer's recommendations.

11. Ensure that start-up requirements are provided by factory-trained technicians for all major pieces of equipment.

12. Ensure that O&M training requirements by factory-trained technicians are as follows and must be videotaped by the manufacturer and provided to the building maintenance staff:

    A. Air Handling Units – 8 Hours.

    B. Energy Recovery Units – 8 Hours.

    C. Chillers – 16 Hours.

    D. Air Cooled Condensing Units – 8 Hours.

    E. Cooling Towers – 8 Hours.

    F. VRF Systems – 16 Hours.

    G. Boilers – 8 Hours.

    H. Hydronic Pumps – 4 Hours.

    I. Water Treatment – 4 Hours.

    J. Variable Frequency Drives – 8 Hours.

K. Building Automation System – 40 Hours.

13. The Engineer shall investigate the required utilities and possible fuel sources. All necessary information shall be obtained no later than midway through the Design Development Phase and shall be recorded and shared with the College.

PART 3 - DESIGN CONSIDERATIONS

1. The HVAC system shall be designed to comply with the latest recommendations of the ASHRAE. The system shall bring in adequate amounts of fresh air to meet the requirements of the current edition of ASHRAE Standard 62.1, and it shall provide proper exhaust from areas where objectionable or unhealthy vapors may develop.

2. Air-side (and water-side) heat recovery and other energy-saving techniques shall be used where feasible to achieve cost-effective solutions to meet the latest editions of ASHRAE Standards 62.1 and 90.1. air handling equipment shall include the use of economizers for free cooling.

3. Since much of the annual operating hours are spent at part load operation, the design of the HVAC system must provide for efficient part load operations. Performance features including energy use, maintenance, and control performance must be considered while working within limited first cost constraints.

4. Equipment Locations

    A. Discuss mechanical system and equipment location during Schematic Design.

    B. Ground-level mechanical courtyard is acceptable.

    C. If rooftop equipment is provided, preference for equipment to be located in a penthouse (first priority). If located on the roof, a screen wall assembly is required to screen the equipment.

        1. If rooftop equipment is provided, preference for equipment to be located in a penthouse (first priority). If located on the roof, a screen wall assembly is required to screen the equipment.

        2. Provide rooftop access to mechanical equipment with a full stair and 3’ minimum door.

        3. If equipment is located in a penthouse, provide a 6’ door or removable louver to allow access to equipment.

        4. Whenever possible, provide conventional stairway access to mechanical spaces not located at floor-level elevations. Use of ships ladders should be discouraged.

        5. If rooftop equipment cannot be located within a penthouse, strong consideration should be given for custom units with a service corridor for exposed rooftop equipment.

    D. Packaged roof-mounted equipment, exhaust fans, and related components are to be designed with low silhouettes and clean lines and located where least visible. Roof-mounted equipment and components shall be finished in a color to blend with background or as directed by the Architect

and/or College designated representative.

5. Maintenance access shall have a high priority. Accessibility shall be reviewed with the College during the Design Development Phase. Locate volume control boxes, valves, meters, gauges, dampers, fans, etc., above lay-in-ceiling or in exposed areas to facilitate maintenance access. Do not hide devices behind walls or above plaster ceilings. If access panels are needed, provide panels with hinges and key latch, not closure screws, unless approved by the College. Provide duct access doors where appropriate for fire dampers, etc. Consider catwalk with access ladders, and fall protection access platforms where appropriate and coordinate with structural steel.

    A. Minimum size for access panels to be 18" x 18", unless approved by College.

6. Whenever possible, locate coils in the mechanical equipment area in lieu of in a chase or ceiling plenum to avoid leaks into occupied spaces. For equipment mezzanines, locate all equipment that contains coils and condensate drain pans within a curbed waterproof area. Provide the curbed area with a floor drain or a low sump point. The curb shall be minimum 4" high. All above-ceiling HVAC equipment with a cooling coil must be equipped with a secondary drain pan and proper independent drainage system.

7. All floor-mounted equipment shall be installed on 4" minimum height concrete housekeeping pads.

8. Noise control, both indoors and outside must be considered, especially with respect to adjoining property. Locate mechanical equipment rooms away from noise-sensitive areas and/or provide appropriate sound attenuation measures based on acoustical analysis to prevent noise-related issues (see sound and vibration control).

9. HVAC systems serving frequently used entrances including lobbies and loading docks should be isolated from the main HVAC system to maintain temperature control stability and prevent objectionable fumes/odors from entering interior spaces.

10. Locate fresh air intakes away from vehicle parking, cooling towers, loading dock(s), building exhaust fans, vent stacks, and related areas where fumes/odors could be drawn into the building.

11. Provide variable frequency drives on all major pieces of HVAC equipment (fans and hydronic pumps) to conserve energy.

PART 4 - SYSTEM CONSIDERATIONS

1. General

    A. The HVAC system to be proposed shall be based on the results of a system analysis, utility investigation, energy analysis, and other considerations described in this standard. The need to plan for reduced loads and energy conservation will require close coordination with Architectural and Electrical disciplines and shall be in compliance with the latest edition of ASHRAE Standard 90.1.

    B. Building renovation/addition projects or limited structural requirements may dictate system type and shall be reviewed with and approved by the College prior to design.

C. Building outdoor air requirements should be based on the latest edition of ASHRAE Standard 62.1 with compensation for air evacuated by building exhaust systems to maintain a net positive building pressurization. The use of enthalpy wheels, plate exchangers, heat pipes, run-around loops, or other heat recovery methods should be considered for buildings with high ventilation rates, in compliance with the latest edition of ASHRAE Standard 90.1.

D. Pre-conditioning of the outdoor air by a DOAS unit is recommended to provide filtered and conditioned outdoor air to the inlet side of the main distribution air handler(s), or directly to the space for more precise temperature and humidity control. Use of a DOAS unit to deliver conditioned outside air is recommended for positive control of the outdoor air requirements. The relief/exhaust air should be returned to the DOAS unit for heat recovery purposes where applicable.

2. Humidification

A. It is not intended that buildings have humidification unless directed by College for site-specific requirements.

3. Sound and Vibration Control

A. The design must ensure appropriate environmental sound levels for occupants. Design shall conform to ASHRAE Noise and Vibration Control Guidelines. Suggest specifying the following maximum background HVAC sound levels:

1. Classrooms: NC35.

2. Private Offices: NC30.

3. Open Offices: NC35.

4. Laboratories: NC40.

5. Libraries: NC30.

6. Conference Rooms: NC30.

7. Auditoriums: NC35.

B. The selection of mechanical equipment and the design of equipment rooms shall provide for acceptable sound and vibration levels in occupied spaces.

C. Sound levels should be reduced but not so low as to produce an environment where normal sounds would be objectionable.

D. Provide vibration isolation at mechanical units with rotating components (fans, pumps, compressors, etc.) causing vibration.

1. Rooftop equipment and interior units: Isolate the fan and compressor inside the unit.

2. Equipment near critical areas: Work with acoustical consultant to limit noise.

E. Provide acoustical separation between mechanical spaces and occupied spaces. It is recommended that a wall of STC 60 be used between mechanical and occupied spaces.

F. The design of HVAC systems shall include provisions for controlling airborne equipment noise, equipment vibration, duct-borne fan noise, duct breakout noise, flow-generated noise, and duct-borne crosstalk between rooms.

4. Value Engineering Considerations

A. Any 'Value Engineering' considerations for the mechanical system shall be reviewed with the College. Evaluations (pros and cons) shall be provided as to the long-range impact on efficiency, maintenance, indoor air quality, and overall building comfort issues.

5. Equipment Manufacturers

A. See Bidding Procedures for mechanical equipment bidding requirements.

B. The specifications must be written so that bidders may solicit and include pricing on more than one manufacturer for each piece of equipment. This may be through alternates, line item equipment lists, etc. College does seek to competitively bid manufacturers and may select certain manufacturers to be listed as Base Bid or request line item pricing. The intent is to ensure quality of equipment and reduce inventory costs, simplify maintenance, operation, troubleshooting, and training.

1. Engineers shall ensure that specification language will allow for competitive bidding and provide assurance of the equipment quality expected by the College.

6. Design Standards Specifications

A. The College's design standards specifications are to be included in the Project Specifications. The Engineer is to expand the design standards specifications as required to completely define the Project in conjunction with the Design Drawings. Deviation from the College's design standard criteria shall not be made unless approved by the College.

B. Depending on the specific project(s) needs, some portions of the design standards criteria details and specifications may not apply. Extensive coordination with the College will be required. The seal of the registered professional engineer shall be affixed to each Mechanical Drawing and the Specification prepared for the proposed project.

7. Construction Phasing

A. Construction phasing shall be reviewed with the College and coordinated as required.

B. For a project where multiple 'construction' phases are required, the warranty period shall start after the final 'construction' phase of the project is complete (projects that are phased by the College due to financing do not apply). The Contractor shall obtain approval of the College to

operate building HVAC systems during construction, prior to substantial completion.

1. This MUST be included in the Project Specifications:

    a. Warranty period shall start after the final construction phase of the project is completed. Contractor shall maintain the equipment up until end of construction (Final Substantial Completion). At a minimum, equipment maintenance shall be provided by the Contractor as recommended by the manufacturer. Contractor must maintain a maintenance log of tasks performed and provide it to the college at the time of Substantial Completion. All filters should be changed as needed but at least every three months. When the contractor inserts a new filter, they must date the filter with a marker. A maintenance log must be provided by the Contractor. New filters shall be installed at the time of Substantial Completion.

8. Closeout Documents

    A. Ensure that O&M training requirements by factory technician are completed as outlined in the General Requirements information.

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - MECHANICAL IDENTIFICATION

1. Valve charts shall be laminated, framed, and mounted on the wall at an accessible location.
2. Provide ceiling tags where equipment is concealed above the ceiling.

SECTION 23 09 00 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - TEMPERATURE CONTROL SYSTEM

1. College shall approve all temperature control selections. Temperature control criteria shall be coordinated with the College.

2. Temperature controls shall be DDC unless otherwise approved. The DDC system shall provide control and monitoring functions from a single network location, as directed by the College.

3. DDC system must have web access. Systems shall be open-protocol.

4. Provide an operator's workstation where requested by the College.

5. Maintenance scheduling shall be provided within the DDC system.

6. Multiple sensor ports shall be provided throughout the system for enhanced monitoring capability.

7. All annual licensing and upgrade fees must be included. BAS software shall be updated to the latest available version at completion of construction.

8. When outdoor air is ducted directly to air handling units, airflow monitoring station(s) shall be provided to control and verify minimum outdoor air flow rate into each unit.

9. Variable frequency drives shall be provided on all pump motors and air-handling unit fan motors.

10. CO2 sensors shall be utilized for demand-controlled ventilation for assembly and large group spaces and other spaces as required by Indiana Energy Codes, the latest edition of ASHRAE Standard 90.1, and other applicable codes and regulations.

11. Locate outside air sensors on north building elevations with appropriate weather shielding.

12. Use flat-plate sensors (sensor-only thermostats) for common areas or areas with unsupervised access.

13. Provide digital output relay to operate normally closed dry contact for "critical" HVAC alarms. "Critical" HVAC alarms to be provided shall be reviewed with the College during design.

14. BAS panels shall be neatly wired and provided with one-line schematics – no "bird nest" of wiring.

15. When attic heaters are utilized, the BAS system shall sense and show attic space temperature and heater on/off status.

16. The BAS system shall show on/off status for fume hoods.

17. If applicable, provide a manual "Chiller Drained" status to BAS for air-cooled chillers.

18. Use DPTs for filters.

19. Provide discharge air temperature sensors on all air terminals with heating and/or cooling coils and all fan coil units.

20. Provide DPT on condenser water basket strainer, where applicable.

21. Use hardwired safeties in addition to software-driven safeties.

22. "J" hooks shall be used above ceilings for all temperature control wiring. Temperature control wiring connections shall terminate in junction box or enclosure.

23. Filters shall be provided upstream of all airflow measurement stations, regardless of type.

24. Review controls sequencing in detail with the College staff (and the Commissioning Agent if used), prior to bidding.

PART 2 - CRITICAL ALARMS

1. A critical alarms list shall be provided in the bid specification to include all of the following:

    A. Freezer Refrigerant Alarm: When freezer temperature rises above 10 degrees Fahrenheit.

    B. Low Heating Water Supply Temperature: When OA is less than 35 degrees Fahrenheit and HW supply temperature drops below 100° degrees Fahrenheit.

    C. High Chilled Water Temperature: Chilled water system is enabled but CHWS is greater than 50 degrees Fahrenheit.

    D. Low Building Temperature: Any space temperature less than 50 degrees Fahrenheit.

    E. High Building Temperature: Any space temperature greater than 85 degrees Fahrenheit.

    F. AHU Status: AHU fan is commanded on, but fails to operate i.e. freeze stat, no air flow, etc.

    G. Chilled water pump failure.

    H. Heating water pump failure.

    I. Chilled water system fill meter.

    J. Heating water system fill meter: Send alarm when over 3 gallons is made up in 24 hours to the system.

    K. CHW evaporator discharge temperature greater than 85 degrees Fahrenheit (even if no cooling is required).

    L. Electrical Power Loss (Building Service): Send one alarm on a loss of power.

    M. Low level in glycol makeup tank, if provided.

N. Low level in cooling tower basin or indoor sump, if provided.

O. Refrigerant alarm and emergency exhaust activation as required by ASHRAE 15.

PART 3 - CO2 SENSORS

1. CO2 sensors shall be provided for energy savings and air quality control where appropriate for systems serving large group and assembly spaces.

2. CO2 sensors shall be installed in all classrooms for monitoring and control purposes, in accordance with the latest edition of ASHRAE Standard 90.1.

SECTION 23 11 23 – GAS PIPING

1. Gas piping shall enter the building in the mechanical/boiler room and provide gas to the water heater(s), boiler(s), and the kitchen, as required.

2. Emergency gas shut-off systems with solenoid valves shall control student desks in each science lab. Gas turrets shall be equipped with integral check valves. Valves shall be contained in a concealed locked box. Emergency mushroom/slap switch with key reset shall be installed at exits from mechanical rooms with gas-fired equipment, in accordance with Code.

3. Gas-fired domestic hot water heaters and heating hot water boilers are preferred.

4. Coordinate gas service needs with labs, domestic hot water, and HVAC system needs.

5. Review requirements for gas for science labs and provide emergency gas shut-off panels.

SECTION 23 21 13 – HYDRONIC PIPING

PART 1 - GENERAL

1. Provide drain valves at all low points and manual vents at all high points on hydronic mains.

2. Automatic chemical feeders are preferred in place of manual shot feeders.

3. Provide hot water control valves on CUHs unless otherwise approved.

4. Provide isolation valves at all mechanical rooms and main branches (review with College).

5. Provide a bypass with lockable manual shut-off valve on all make-up water lines with pressure-reducing valves.

6. Branch lines to reheat coils shall be Type "L" copper, on 2½" or smaller pipe. Unions shall be provided for control valve and coil removal.

PART 2 - HEATING AND COOLING PIPING DISTRIBUTION SYSTEM

1. Differential pressure sensor/transmitter locations shall be indicated on drawings and verified on as-builts.

2. Isolation valves shall be provided for removal of each piece of equipment and at each branch take-off from the piping mains. Review with the College locations of all isolation valves for mechanical and plumbing to ensure adequacy for maintenance.

3. The distribution systems shall have valve connections to each air handling unit, fan coil unit, and terminal reheat coil. Each fan coil unit and terminal reheat coil return connection shall have an auto flow device for flow measurement and adjustment. Air handling unit hydronic cooling and heating coils shall be provided with pressure-independent control valves.

4. The systems shall be designed for use of 2-way valves for temperature control at air handlers and VAV terminals. 3-way valves may be used at the end of pipe runs to bypass minimum flow required to maintain pump operation. Heating and cooling hydronic systems shall use separate distribution piping (4-pipe system) unless approval is given to the use of or extension of an existing combined (2-pipe) system.

5. All water piping shall be sized for a maximum friction loss of 2.5' per 100' of pipe. Maximum water velocity shall be 4 FPS for 2½" and smaller pipe. Maximum velocity for larger pipe shall be 7 FPS.

6. Provide thermometers and gages at all devices that normally have a change in temperature and/or pressure. Types of thermometers and gauges shall be reviewed with and approved by the College.

7. Provide stainless steel strainers in all closed system pump suction lines.

8. Provide complete condensate drainage systems for the cooling systems. Condensate piping shall connect to plumbing waste system per Code.

9. If a sump pump is being used, it must have local audible and visual alarms. The high water alarm shall be connected to the BAS as a critical alarm.

SECTION 23 21 23 – HYDRONIC PUMPS

1. Building heating hot water pumps shall be base-mounted end suction type. Two 100% redundant building pumps are required, unless otherwise approved by the College.

2. Building chilled water pumps shall be base-mounted end suction type. Two pumps sized for 50% to 100% of the peak flow requirement, based on direction from the College, shall be provided. Primary-secondary pumping system with variable speed control for secondary pipe loop, based on pressure differential sensing, is preferred system configuration. Variable primary-only pumping may be considered when applied with the appropriate equipment selections.

SECTION 23 31 13 – METAL DUCTS

1. Airflow measuring stations must be provided in the outdoor air stream for all air handling units.

2. All main duct trunks and main branches shall be galvanized sheet metal. All outdoor air ducts shall be externally insulated for thermal purposes.

3. Fume hood and chemical storage cabinet exhaust ductwork shall be welded stainless steel, unless otherwise approved or directed by the College. If fume hood exhaust is highly acidic in concentration, fume hood exhaust ductwork shall be fiberglass or PVC-lined steel.

4. The proper medium-pressure ductwork correction factor shall be used for determination of friction loss due to roughness of the duct liner. Duct velocity shall not exceed 1500 FPM for main trunks and 750 FPM for runouts from main trunk. Engineering calculations for increased velocities must be reviewed with the college and must result in the duct system pressure drop being below the fan energy limitations stated in latest edition of ASHRAE Standard 90.1.

5. Use a rigid metal 90-degree elbow at all diffusers when a sideways connection is required (i.e. limited ceiling space).

6. Hose clamps should be used to connect flexible duct to metal duct. Tie-wraps will not be allowed.

7. Static pressure sensor locations shall be noted on drawings and verified on as-builts.

8. No internal glass fiber duct lining (insulation) unless double wall metal is used to cover the lining. EDPM-based elastomeric is acceptable in ductwork and terminal units in lieu of double-wall construction. Double-walled VAVs are preferred over externally insulated ones.

9. Conditioned supply air shall be provided to ALL restrooms.

10. Provide dust collection systems in wood shops when required by the College.

SECTION 23 36 00 – AIR TERMINAL UNITS

1. For VAV system design, pinch-style VAV terminal units or parallel fan-powered style, with reheat coils shall be utilized unless otherwise approved by the College.

SECTION 23 37 13 – DIFFUSERS, REGISTERS, AND GRILLES

1. Floor supply diffusers/registers should be avoided. The College shall approve exceptions.

2. Ceiling diffusers and grilles shall be selected to fit into the ceiling system being used. The ceiling device shall have a frame for mounting directly into the ceiling suspension system and shall be of dimensions compatible with the ceiling module or panel size.

3. Wall registers and grilles shall be selected so that style, dimensions, aspect ratios, and locations are compatible with the finish treatment of the space.

4. Air diffusers, registers, and grilles shall be designed to coordinate with the general construction and architectural treatment of the finished spaces. Exposed components shall be given a factory-baked enamel or anodized finish in a color selected by the Architect/College. Air diffusers, registers, and grilles shall be mounted in frames so the devices may be easily removed for maintenance and repair.

5. Air diffusers, registers, and grilles shall be shown on the reflected ceiling plans and wall elevations.

6. All supply diffusers and registers shall have fully adjustable air patterns. Ceiling diffusers shall have round neck connections and full air pattern adjustment.

SECTION 23 52 00 - BOILERS

1. High-efficiency condensing-type boilers shall be utilized whenever possible for energy conservation. Use of other types of boilers shall require approval by the College.

2. Building renovation/addition projects may dictate heating system type and shall be reviewed with and approved by the College prior to design.

3. Use of conventional boilers shall not be used unless approved by the College. If used, consideration shall be given to the use of primary-secondary pumping systems with variable speed control for secondary pipe loops, based on pressure differential sensing.

4. The drainage from the high-efficiency condensing boilers is acidic and must be neutralized to prevent pipe corrosion. Plumbing drains associated with the condensate draining shall be addressed to accept same.

5. Install equipment on 4” concrete housekeeping pad and locate with required clearance for servicing.

6. Boiler vents for condensing boilers shall be double-wall stainless steel and comply with Code.

7. Boiler vents for conventional boilers shall be as recommended by the manufacturer and comply with Code.

8. When using condensing boiler design, consider a maximum heating supply temperature in the range of 120-130 degrees Fahrenheit, reset down as outside air temperature increases. For conventional boiler design consider a supply temperature range of 160 – 180 degrees Fahrenheit, reset down as outside air temperature increases. Operating temperatures shall conform to manufacturer’s recommendations.

SECTION 23 64 00 - CHILLERS

PART 1 - GENERAL

1. Use of air-cooled chillers is recommended unless size dictates use of water-cooled chillers. Chiller selections must be optimized for part load conditions. Variable speed chiller compressor design should be utilized. Chiller selections must be approved by the College.

2. Glycol in chilled water system is not to be used unless approved by the College. A remote indoor evaporator bundle or remote outdoor air-cooled condenser should be utilized when possible. Glycol systems shall not be connected to makeup water. Provide a glycol makeup unit with pump, low-level audible alarm, and dry contact for monitoring by the BAS.

3. The use of water-side heat recovery systems such as heat recovery chillers shall be considered as a source for free hydronic heat, summer reheat, and to reduce the need for simultaneous heating and cooling.

PART 2 - COOLING/DEHUMIDIFICATION

1. The cooling system shall be designed for adequate temperature and humidity control.

2. A free source of reheat, such as a heat pipe, hot gas reheat, enthalpy wheel, plate exchanger, or heat recovery chiller should be provided if justified by a cost/benefit analysis.

3. The College shall approve final chiller selections. Chiller(s) shall provide efficient operation at low load and ambient conditions. Variable-speed compressor applications are preferred.

4. Building renovation/addition projects may dictate cooling system type and shall be reviewed with and approved by the College prior to design.

5. All refrigerants to be used in cooling equipment shall be reviewed with and approved by the College during design.

6. If using a water-cooled chiller:

    A. Provide stainless steel sump tank if exposed inside building (cooling tower drain down). Pump and tank packages are preferred.

    B. Cooling tower preference is for ground-mounted (not on the roof).

    C. Review the access details of the cooling tower platforms, rails, etc. (in detail) with the College to ensure appropriateness for maintenance access.

7. Provide exterior concrete pad for the entire chiller/condenser area, from wall to wall or fence to fence areas.

8. Air-cooled condensing units with digital or variable speed scroll compressors shall be considered and when used shall provide energy-efficient operation at low load and ambient conditions with a minimum

EER rating of 12.0. College shall approve all final selections.

9. Low ambient controls should be specified for all air-cooled condensing units.

10. Air-cooled units shall be selected at an entering condenser air temperature 5 degrees Fahrenheit higher than the summer design outdoor air dry bulb temperature. Design saturated suction temperature shall be between 35 degrees and 50 degrees Fahrenheit. Final selections shall be based on region location.

11. Elevator Equipment Rooms and Main Technology Rooms shall have an independent cooling system. System shall be selected with a low ambient package to allow for operation at winter design conditions. Secondary Technology Rooms may be served from the building system if approved by the College, but cannot exceed 80 degrees (see ventilation).

SECTION 23 72 00 – AIR HANDLING UNITS

PART 1 - GENERAL

1. Separate and isolated air handling systems shall be provided for technology labs where it would be objectionable to mix air streams with other occupied spaces (i.e. Automotive, Welding, Masonry, HVAC, Electrical, etc. shall be served with separate AHU systems).

    A. Additional specialty exhaust may be required for welding or other vocational labs.

PART 2 - VENTILATION

1. The use of DOAS units shall be considered to meet outdoor air requirements whenever possible with particular attention to indoor air quality and heat recovery. The outdoor air shall be filtered, cooled, heated, and dehumidified. The unit shall incorporate a method of heat recovery unless otherwise approved by the College. The pre-conditioned outdoor air shall be delivered directly to the occupied spaces or the distribution air-handling units. Building renovation projects may dictate introduction of outside air into the space and shall be reviewed with and approved by the College prior to design.

2. Building exhaust ventilation requirements shall be provided by fans located on the roof or plenum or incorporated within the DOAS unit. The air shall be exhausted through wall louvers, roof vents, exhausters, or primary air units as required.

    A. Provide additional specialized ventilation as required for welding labs and other vocational labs as required.

3. Roof curbs shall be a minimum of 16” inches high as measured from the roof surface (not the deck).

4. Toilet rooms shall be maintained at a negative air pressure relative to the adjacent areas. Minimum exhaust airflow rate shall meet the following criteria:

    A. 2 CFM per square foot or 75 CFM per plumbing fixture (water closet/urinal) or as dictated by Code, whichever is larger.

5. Use of exhaust fans as backup cooling for main and secondary technology rooms may be considered, if approved by the College.

PART 3 - AIR DISTRIBUTION SYSTEM

1. Energy-efficient and zoneable systems design such as Variable Air Volume and Variable Refrigerant Flow should be first priority considerations, as well as other HVAC systems with comparable efficiencies and zoneability qualities. College shall approve all final selections prior to start of design.

2. If space limitations or budget restraints prohibit the use of indoor central equipment, rooftop equipment may be permitted, if approved by the College. However, pre-conditioned outdoor air should be supplied either to the rooftop units or directly to the indoor spaces. The building should be maintained at a slight

positive pressure by having the total outdoor air supply exceed the total building continuous occupied mode exhaust. Building pressurization control should maintain the building at a slight positive pressure of 0.05" wc.

3. Provide two sets of pleated filters (ahead of the coils) in supply airstream – MERV 8 filters for first stage (pre-filter) and MERV 13 filters for second stage on all air handling and energy recovery units. Exhaust airstream (ahead of wheels or coils) of energy recovery units shall be provided with one set of MERV 8 filters.

4. Provide zoning for HVAC in auditoriums, community rooms, administration areas, and large gathering areas for separate scheduling use.

5. To discourage the growth of bacteria in the air-handling units and the spread of any bacteria that might develop from propagating through the ductwork, positively sloped drain pans and easily cleaned coils shall be provided.

6. Each air-handling unit casing shall be 2" thick double wall with solid inner liner.

7. Steam pre-heat coils (if used) shall have integral face and bypass dampers for freeze protection. Hydronic pre-heat coils (if used) shall have a pumped coil arrangement that provides for continuous recirculation of blended, variable-temperature water through the pre-heat coil during freezing conditions.

8. All drain pans shall be stainless steel.

9. Sound attenuators shall be provided on the supply and return of each air-handling unit unless acoustical analysis proves they aren't necessary to achieve acceptable sound levels in the building.

10. Install floor-mounted air handling units on 4" (min) housekeeping pads. Height shall be coordinated with condensate trap depth requirements.

11. Provide factory-installed base rail to support all sections of units.

12. Provide lighting in all AHU sections and at least one convenience receptable on the unit. Power for lighting and receptacle shall be provided from separate circuit from fan power circuit.

13. Maintain a minimum 24" clearance pathway around AHUs when installed next to walls or other equipment. In addition, maintain all access and service requirement distances per manufacturer's recommendations (i.e. coil pull area, tube removal area, etc.).

14. Air handling system(s) shall include economizers for free cooling and eliminate or reduce the need for mechanical cooling.

15. Air handlers must be designed and sized for approximately 15% additional capacity to accommodate future changes in space use and needs (i.e. typical classroom change to computer lab). Engineer shall review with the College the potential areas where the most likely changes could occur.

SECTION 23 82 39 – UNIT HEATERS

1. Building entrances/vestibules shall be provided with flush-mounted wall or ceiling cabinet heaters capable of maintaining the required temperature at night with the central systems shut off or set back.

2. All spaces with measurable heat loss shall be provided with heating systems. Generally, unit heaters may be used for service corridors, maintenance areas, sprinkler rooms, etc.

3. Where attic heaters are used, provide temperature and on/off status at BAS.

4. Provide a heat source for all concealed above-ceiling spaces that have sprinkler piping.