8420 HVAC Design Criteria

1.1 GENERAL

A. The heating, ventilating, and air conditioning system design criteria denoted as a part of this Design Manual have been developed or are obtained directly from accepted engineering design references such as the ASHRAE manuals and standards, the state of Ohio code references, and good engineering practice. The HVAC Design Professional should review each requirement and obtain or develop the necessary information for each specific building before proceeding with the systems evaluation as denoted in Section 8410.

1.2 OUTDOOR AIR DESIGN VALUES

A. Summer and winter outside air design values shall be derived from standard ASHRAE compiled weather data located in the latest edition of the ASHRAE Fundamentals Handbook. The city nearest the proposed construction project is to be selected for evaluation. Use the 99.6 percent design values for heating design dry-bulb and the 1 percent design values for cooling design dry-bulb and mean coincidental wet-bulb.

B. In addition, it is strongly recommended that outdoor conditions be considered in the overall design where there is a high wet bulb temperature coincident with an outdoor dry bulb temperature equal to the proposed building supply air temperature for any air handling units with ventilation. For instance, address what happens to building indoor humidity levels when the outside air is 75 deg F / 90% relative humidity and a 100% outdoor air unit is supplying 75 deg. F supply air to the facility and provide dehumidification as required.

1.3 INDOOR AIR DESIGN VALUES

A. Indoor air temperature design values must reflect the need for energy conservation and shall be in accordance with the Ohio Building Code, Mechanical Code.

B. The occupied temperatures used for building load calculations shall be within the range denoted for summer and winter values. The HVAC Design Professional must consider occupant comfort, as well as energy conservation, in selecting the actual temperature for design and operation of the systems. Summer design values shall be 75 degrees Fahrenheit. Winter design values shall range from 70 degrees Fahrenheit to 72 degrees Fahrenheit. The relative humidity of the building spaces shall be targeted at 55%-60% percent during the summer. Humidification in the winter is not required but can be considered to improved indoor air quality. For mechanical and electrical spaces, the indoor winter design temperature shall be minimum 60 degrees Fahrenheit and the indoor summer design temperature (except for boiler rooms) shall be 85 degrees Fahrenheit.

C. Night setback temperatures shall be used for all systems. Winter setback temperature shall be between 55-60 degrees Fahrenheit. The summer setback temperature shall be 80-85 degrees Fahrenheit with an additional requirement that the system shall operate as required to maintain a relative humidity in the building below 60 percent at all times. Maintaining humidity levels below 60 percent will result in the periodic operation of the HVAC system during the summer months to reduce the potential for mold and mildew in the building. Warm up and cool down sequences shall be provided in the sequence of operation so that the building is back to normal occupied.

1.4 OUTDOOR AIR VENTILATION REQUIREMENTS

A. Outdoor ventilation rates shall be calculated for each occupied space and shall conform to the requirements for ASHRAE Standard 62.1 (most recent as adopted by OBC), and the

requirements of the Ohio Building Code, Mechanical Code.

B. Each system (other than systems using dedicated outdoor air units, including water source heat pumps, chilled beams or variable refrigerant flow) shall include controls for a 100 percent economizer cycle to cool the building when outside air conditions are conducive to cooling.

C. Energy recovery systems shall be designed to meet or exceed ASHRAE 90.1. The energy recovery systems will require both sensible and latent heat recovery necessitating the use of desiccant heat wheels or the equivalent. The design may omit the energy recovery on systems where demand ventilation control via a carbon dioxide measuring system is provided for large variable occupancy single-zone spaces such as gymnasium and dining/auditeria spaces.

D. Carbon dioxide levels shall be monitored through the direct digital temperature control system for proof of system operation to maintain a carbon dioxide level in the building of as recommended by ASHRAE Standard 62 and the Ohio Building Code. The use of space specific carbon dioxide sensors are recommended for this operation. Return air sensors may be considered provided accurate readings can be obtained. It is not the intention of this guideline to require the use of carbon dioxide sensors for a reduction of outside air quantities below the calculated minimum air flow requirements for all spaces, although it is required in large variable occupancy single-zone spaces such as gymnasium and dining/auditeria spaces.

E. Ventilation calculations shall use the Ventilation Rate Method or the Indoor Air Quality Method. If the IAQ Method is used, complete calculation documentation shall be submitted at the Design Development Submittal, and specifications must include a performance test after installation. Use of the IAQ Method does not supersede any other system design requirements.

F. All mechanical ventilation systems shall utilize some means of mechanical dehumidification, unless analysis is done showing dehumidification is not needed at all outside air conditions.

G. Designer shall use the 100% DOAS unit for warm up and cooldown sequences from unoccupied setpoint temperatures and as supplemental heating as needed by allowing recirculation of return air when designing systems such as heat pump, chilled beam, etc.

1.5 AIR FLOW RATES FOR BUILDING SPACES

A. Total supply airflow rates shall be a minimum of 10% higher than what is required to meet the heating and cooling and ventilation load requirements for each space. This can be achieved by including safety factor within the load calculations or by applying a minimum 10% increase on load calculations that do not include safety factor.

B. Exhaust air rates shall be the value shown below or as required by the Ohio Mechanical Code, whichever is higher, but not less than primary Supply Air. Exhaust air rates for Art Room, Science Lab and Life Skills Lab served by dedicated outside air systems (DOAS) shall be established at 110 percent of the primary supply air rate for the space and adjustments incorporated into the sequences of operation to decrease relief air whenever the local space exhaust is energized.

	SPACE	EXHAUST AIR
1.	Art Room	0.7 cfm/SF
2.	Locker Room	0.7 cfm/SF
3.	Copy/Printing Room	0.5 cfm/SF
4.	Science Lab	1.0 cfm/SF

5.	Life Skills Lab	0.7 cfm/SF
6.	Food Service	canopy hood (min. 0.7 cfm/SF)
7.	Storage Room*	1.0 cfm/SF*
8.	Toilet Room	50 / 70 cfm per fixture (continuous / intermittent)
9.	Shower Rooms	20 / 50 cfm per fixture (continuous / intermittent)
10.	Custodial	1.0 cfm/SF
11.	Recycling	1.0 cfm/SF
12.	Woodwork Classroom	0.5 cfm/SF
13.	High Bay Labs	0.5 cfm/SF

** Storage Rooms shall be not required to be exhausted if there is no possible objectional transfer (odors or hazardous gas) to adjacent spaces.*

1.6 TEMPERATURE CONTROL SYSTEM

A. All temperature control systems installed shall be electronic, direct digital controls. Pneumatic controls in all or portions of the control system will not be permitted. Each facility will be provided with the means to access the control system software with a desktop or laptop computer. It will be necessary for the HVAC Design Professional to advise the school district of the options for control and management of the building available through the direct digital control system.

B. Thermostatic zoning shall be developed using good engineering practice. Dissimilar spaces shall not be grouped on the same thermostat. Each classroom shall be an independent zone. Other zones may also be required to be separately thermostatically controlled; carefully review space requirements of the manual for these requirements. Occupied/unoccupied scheduling shall be based on the associated air handling system. Each thermostat zone associated with digital control shall have a means to override the schedule for temporary occupancy.

C. The discharge air temperature for each system shall be adjustable and shall be reset as a function of the direct digital control system.

D. The economizer control shall be set through the central direct digital controller based on global outside air temperature and humidity.

E. The direct digital control system shall be designed to place emergency calls to designated school personnel in the event of equipment failure.

F. Options shall be investigated with each direct digital control system for the operation of exterior, corridor, and restroom lighting systems through the energy management computer.

G. The commissioning agent, temperature control contractor, HVAC contractor, and design team shall have a temperature controls pre-submittal meeting to discuss the scope of work and to review the proposed graphics package.

H. Designer is to have all temperature controls indicated on the drawings, including components, sensor locations, control point diagrams, and detailed sequences of operation for each item being controlled. Deferring to the temperature control contractor to develop sequences of operation is not acceptable.

I. It is recommended that 50% of individual occupant spaces have individual thermal

comfort controls and at least one group thermal comfort control in each shared multi-occupant space to enhance occupant comfort and flexibility.

1.7 ENERGY USAGE

A. All systems shall be designed in compliance with the ASHRAE STANDARD 90.1 (most recent as adopted by the Ohio Building Code) "Energy Standard for Building Except Low-Rise Residential Buildings", and the energy usage requirements prescribed by the Ohio Building Code and the Department of Energy.

B. Systems shall be evaluated and considered to increase energy efficiency beyond requirements of ASHRAE 90.1 and reduce energy consumption costs. Electric resistance heating is discouraged from use while other fuel sources are readily available.

1.8 SYSTEM COMPONENTS REQUIRED TO BE ON BACKUP POWER

A. The intent of connecting backup power from a generator to selected components of the HVAC system is to (a) ensure the operation of life safety systems, such as the fire pump, (b) limit damage from freezing weather during a power outage of short duration, and (c) minimize disruption of building monitoring and controls during a power outage of short duration.

B. System Components (If applicable) required for Backup Power:
1. Exterior heat tracing circuits.
2. DDC system controllers and components related to remote alarming and controlling any equipment required to be on backup power.
3. Air handling unit preheat coil (heating coil) run-a-round pumps.
4. Cooling tower basin heaters unless towers are drained in the winter.
5. Chilled water circulating pump, when used for chiller freeze protection.
6. Remote fire pump house heating system.
7. Fire pump (Code Required Emergency Branch)
8. Foundation drainage sump pump.

1.9 EXTERIOR NOISE CONTROL

A. The location of exterior mechanical equipment shall be reviewed by the Design Professional for its sound impact, both inside and outside the building.

B. Exterior equipment operation shall not cause indoor sound levels to exceed generally accepted levels for the space. Refer to ASHRAE for recommended guidelines.

C. Exterior sound levels shall be in compliance with the local governmental ordinances. When these values are not governed, the following shall be used for designs. The sound level created by the equipment shall not exceed the values listed measured at the property line.

Daylight hours:	55 dBA
Nighttime hours:	50 dBA

1.10 INTERIOR BACKGROUND NOISE LEVEL (HVAC equipment only)

A. Using the methodology described in annexes B through D of ANSI Standard S12.60-2010, achieve a maximum background noise level in classrooms and other primary learning spaces of 35 dBA.

B. Per the Ohio Building Code (which references the International Building Code and ICC A117.1 standards), the maximum background noise level in an unoccupied classroom

is 35 dBA (A-weighted decibels) and 55 dBC (C-weighted decibels) for a one-hour average

1.11 CUSTOM PACKAGED PENTHOUSE SYSTEMS

A. Application – The use of Custom Package Penthouse Systems may be applied to multistory schools where more than 40% of the building is above the first floor or on schools where land use restrictions prohibit putting cooling equipment (chillers, cooling towers, etc.) on grade.

B. General Construction – It is in no way the intent of using a Custom Packaged Penthouse System to compromise the system design, maintainability, or energy efficiency of the HVAC system. The use of a Custom Packaged Penthouse should conform to the following guidelines:

1. Penthouse is a part of the building and as such the square footage counts in the prescribed formulas.

2. All components in the Penthouse shall be installed with the manufacturer's recommended clearances and code requirements.

3. Walkway heights, widths, means of egress and life safety systems shall comply with the building code for mechanical spaces.

4. Access to the Penthouse shall include a fully code compliant interior stairway. Elevator access should be considered in buildings 3 stories or more.

5. Exterior appearance of the Penthouse shall be an integral part of the building design.

6. Penthouse shall attach in such manner that it becomes an integral part of the building.

C. Fire Suppression shall comply with the applicable sections of this manual.

D. Plumbing shall comply with the applicable sections of this manual.

E. HVAC shall be designed in compliance with the approved systems in this previously listed Chapter and components in compliance with Chapter 9.

1. Exception: A Penthouse System may use direct expansion cooling with evaporative condensing in lieu of a chilled water system, provided the following criteria is met.

a. All equipment is part of the Penthouse construction.

b. Capacity control is provided on air system supply temperature from full load to 10% of full load with an accuracy of +/- 2 deg. F. without the use of hot gas bypass.

c. DX cooling coils shall be intertwined design.

d. Refrigeration compressors are either scroll, screw or centrifugal type, and the lead compressor shall be an inverter type for any equipment over 10 Tons.

e. Sound levels inside the Penthouse comply with all OSHA regulations.

1.12 HVAC SYSTEMS COMMISSIONING

A. Refer to the Commissioning Section for additional information.

1.13 ELEMENTARY MERCURY

A. No elemental mercury or mercury-containing instruments, equipment, or other items shall be permitted anywhere on school property.

1.14 LOCAL OR GENERAL EXHAUST VENTILATION

A. All indoor areas subject to the regular or frequent emission of hazardous airborne contaminants shall be equipped with local or general exhaust ventilation systems designed to effectively control emissions and minimize human exposures. Such areas include visual arts rooms, career tech labs, science rooms, and chemical storage areas. 24-hour operation of exhaust fans servicing science prep areas and custodial spaces where hazardous chemicals are used or stored shall be required. Sanitary vent stacks shall extend 2 feet above outdoor air intakes within 10 feet.

1.15 INTAKE AND RELIEF LOUVER LOCATIONS

A. ***Locations shall comply with current version of Ohio Building Code and ASHRAE 62.1 (most recent as adopted by)***

B. Intakes shall be located a minimum of 3’-0” above grade or 2’-0” above flat roof to reduce snowdrift blockage.

END OF SECTION