HVAC

Components – HVAC

- General
- System Selection Life Cycle Cost Analysis
- Outdoor Air Design Values
- Indoor Air Design Values
- Outdoor Air Ventilation
- Welding Ventilation
- Temperature Control Systems
- Ductwork
- HVAC Piping
- HVAC Insulation
- Interior and Exterior Noise Control
- Equipment Accessibility
- Closeout Documents
- Physical Education and Indoor Practice Facility

General Standards – HVAC

1. The heating, ventilating, and air conditioning system design standards criteria denoted as a part of this Facility Manual have been developed or are obtained directly from accepted engineering design references such as the ASHRAE handbooks and standards, the state of Arkansas code references, and good engineering practice. School HVAC system plans and specifications shall be prepared by a licensed professional engineer with a valid Arkansas registration. The HVAC Design Professional shall review each requirement and obtain or develop the necessary information for each specific building before proceeding with the systems design.
2. All systems shall be designed in compliance with ASHRAE Standard 90.1 "Energy Standard for Buildings except Low-Rise Residential Buildings", as modified by the Arkansas Energy Code.
3. All HVAC products shall be rated in accordance with the applicable ARI rating program (where rating has been established) or products manufactured in compliance with policies of the Arkansas HVACR Licensing Board and in compliance with Arkansas Law.
4. All new construction shall include air-conditioning except in some physical education and indoor practice facility spaces as hereinafter defined. Variances will be considered by the Division upon request.

Guidelines – HVAC System Selection Life Cycle Cost Analysis

- Several HVAC systems are applicable to Arkansas Schools. System selection should be based on a life cycle cost analysis of a minimum of three alternative systems. This requirement for System Selection Life Cycle Cost Analysis applies to New Construction, including new buildings and additions to existing buildings, and the replacement to upgrade HVAC units in existing buildings when the cumulative cooling tonnage exceeds 16 tons. The Life Cycle Cost Analysis should be submitted with the project final review documents. This analysis may be considered as an extra service to the design contract.

Guidelines – HVAC System Selection Life Cycle Cost Analysis (continued)

- The following are examples of acceptable programs for use in generating a detailed evaluation of proposed heating, ventilating, and air conditioning systems. Further, the building load calculations necessary for the design of each building will require the use of computer-generated data. Equivalent computer programs that are able to generate the necessary data for evaluation of the proposed heating, ventilating, and air conditioning systems and for generation of the building load data will be considered, but must be submitted for approval prior to use.
  - Trane Trace 700 (or the most recent version of Trane Trace)
    The Trane Trace 700 program is a PC based program used by the HVAC Design Professional for generation of detailed building system air conditioning loads, energy consumption analysis, and economic analysis. The current version can be obtained from the Trane Company, Customer Direct Service (CDS) Network, La Crosse, WI, (608) 787-3926.
  - Carrier HAP (or the most recent version of Carrier HAP)
    The Carrier Hourly Analysis Program is a PC based program used by the HVAC Design Professional for generation of detailed building system air conditioning loads, energy consumption analysis, and economic analysis. The current version can be obtained by contacting the local Carrier equipment representative or by calling (800) 253-1794.
  - DOE-2.E
    The DOE-2.E is a detailed energy analysis program developed through the United States Department of Energy. A number of vendors across the country have developed software that operates to meet the intent of the DOE-2.E program. Contact the Energy Science and Technology Software Center at (865) 576-2606.

Guidelines – HVAC System Selection Life Cycle Cost Analysis (continued)

- Occupancy loads and schedules will mirror the building usage schedules. Input occupancy should be calculated at 90 percent of capacity during normal school hours for classroom areas and the administration area. After hours occupancy can be considered negligible in these areas. Activity areas such as gymnasiums should be calculated at no more than 25 percent of the full load capacity during unoccupied operation.
- Lighting systems should be consistent throughout the building. The lighting load shall be input for consideration as a cooling load only, and should not be used to credit the winter heating load. Lighting loads should comply with the Arkansas Energy Code. The HVAC Design Professional should coordinate and review proposed lighting requirements for each building with the Electrical Design Professional prior to generating a final energy load analysis. Usage of the lighting systems should mirror the occupancy scheduling for each area in the building.
- Computer Locations and expected usage will impact every building designed. All classroom areas will be wired for computers. Include a minimum of 280 watts for each computer station in the building. This load includes the total expected heat gain for a desktop computer and color monitor.

Standards – HVAC Outdoor Air Ventilation

1. Outdoor ventilation rates shall be calculated for each occupied space and shall conform to the requirements of the Arkansas Mechanical Code minimum ventilation rates. The only exception will be an engineered ventilation system design with written approval of exception by the Arkansas HVACR Board.
2. Each system shall include controls for a 100 percent economizer cycle to cool the building when dictated by the Arkansas Energy Code.
3. Energy recovery shall be used as a part of the design for classroom, gymnasium, locker room, and student dining systems to reduce the energy consumption required to provide the necessary outdoor ventilation rates when required by the Arkansas Energy Code.
4. Carbon dioxide levels may be monitored through the direct digital temperature control system for proof of system operation to maintain a carbon dioxide level in the building as recommended by ASHRAE Standard 62. The use of space specific carbon dioxide sensors are

Guidelines – HVAC Outdoor Air Design Values

- Summer and winter outside air design values should 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. To determine the maximum ventilation capacity, use the 1 percent design values for Humidification design dew point and mean coincident dry bulb.

recommended for this operation. Return air sensors may be considered when a unit serves multiple spaces provided accurate readings can be obtained. It is not the intention of this paragraph to require the use of carbon dioxide sensors for a reduction of outside air quantities below the calculated minimum air flow requirements.

5. Ventilation air shall be conditioned for temperature and humidity control. Acceptable methods are dedicated OSA units, energy recovery ventilators, hot gas humidity control in packaged units and OSA conditioned in an air handling system. Untempered air shall not be introduced from exterior louvers into return air plenums or duct from the outdoors into the return air ductwork.

Guidelines – HVAC Indoor Air Design Values

- Indoor air temperature design values should reflect the need for energy conservation and should be in accordance with the Arkansas Mechanical Code and the Arkansas Energy Code.
- Design should produce indoor conditions in accordance with ASHRAE Standard 55 "Thermal Environmental Conditions for Human Occupancy."
- Night setback controls should be used for all systems. Temperature should be 55 degrees Fahrenheit. The summer setup temperature shall operate as required to maintain a relative humidity in the building area that does not exceed 60 percent. Maintaining humidity levels below 60 percent will result in periodic operation of the HVAC system during the summer months to reduce the potential for mold and mildew in the building.

Guidelines – HVAC Welding Ventilation

- Different ventilation strategies may be needed in each specific case to remove air contaminants from the welder's breathing zone. General guidelines have been published in CSA W117.2 Safety in Welding, Cutting, and Allied Processes, and ANSI Z49.1 Standard Safety in Welding and Cutting.
- Mechanical ventilation should be required when welding takes place in a space less than 10,000 cubic feet per welder, or in a room with a ceiling height of less than 16 feet. Mechanical ventilation should be at a rate of 2,000 cubic feet per minute per welder. See subsequent items below.

Guidelines – HVAC Welding Ventilation (continued)

- Dependent on the application and associated hazard, ventilation strategies fall into three general categories: Natural Dilution Ventilation, Mechanical Dilution Ventilation, and Local Exhaust Ventilation
- Night setback controls should be used for all systems
- Natural Dilution Ventilation involves introduction of fresh air into the welding area through non-mechanical mean such as opening windows and doors, and the use of exterior wall louvers. This type of ventilation is generally considered the least effective, since there is no control on movement of contaminants through the work area.
- Mechanical Dilution Ventilation involves the use of wall or roof exhaust fans to draw contaminants away from the welder's breathing zone
- Local Exhaust Ventilation involves the use of dedicated exhaust hoods or movable hoods to remove contaminants from the welder's breathing zone. Movable hoods are ducted to a central exhaust system and provide the best removal of contaminants. Local exhaust ventilation is always the preferred method for removing welding fumes and gases.
- Exhaust hoods should provide a minimum velocity of 100 feet per minute
- A downdraft exhaust bench is preferred over an overhead exhaust hood
- Exhaust air velocities higher than 100 feet per minute at the arc or flame may disturb the process or shielding gas.
- Obtain the services of an HVAC design professional for special cases and when welding materials that produce high toxicity levels

Standards - HVAC Temperature Control Systems

1. All temperature control systems installed shall be electronic, direct digital controls. Pneumatic control systems 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. Additions to buildings without DDC controls, which comprise less than 50% of the resulting building's total square footage, may utilize 7-day programmable thermostats.
2. 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 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.
3. The direct digital control system shall be capable of performing time of day scheduling, night set-back, holiday scheduling and demand limiting.
4. The ventilation system control shall be set through the central direct digital controller based on global outside air temperature and humidity to maintain indoor relative humidity below 60 percent.
5. The direct digital control system shall be designed to place emergency calls to designated school personnel in the event of equipment failure.
6. 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.

Standards – HVAC Ductwork

1. Duct systems shall be designed, constructed, and installed to provide minimum leakage and air noise, and to minimize system static pressure requirements. Design HVAC professional shall comply with SMACNA standards for construction and leakage standards.
2. Classrooms and other instructional spaces shall be ducted for supply to at least four (4) supply air devices
3. Ductwork shall be 26 gauge minimum
4. Flexible duct shall be rated ETL Class 1 Air Duct, complying to UL 181, with a maximum vapor barrier permeance of 0.05 Perm as measured by ASTM E96, Procedure A
5. Flex duct shall be limited to 6' in length

Standards – HVAC Piping

1. Hydronic piping 2" and below shall be type L copper piping.
2. Hydronic piping 2 ½" and above shall be schedule 40 steel with welded fittings.
3. HVAC condensate piping shall be schedule 40 or schedule 80 PVC or type M or L copper piping depending on system selection and design criteria.
4. Refrigerant piping shall be ACR copper tubing.

Standards – HVAC Insulation

1. Hydronic piping and condensate piping insulation shall be jacketed fiberglass insulation with vapor barrier and

preformed fittings per the latest adopted version of the Arkansas Energy code for HVAC.
2. Duct insulation shall be FRK duct wrap and a minimum of 1 ½" with a density of .75 lbs/cf.
3. ACR piping insulation shall be closed cell elastomeric insulation with non-longitudinal seams and butt connection sealant. Provide adequate UV protection for outdoor applications.
4. Maintain vapor barrier throughout the system including hangers, joints and terminations.

Standards – HVAC Interior and Exterior Noise Control

1. The location of exterior mechanical equipment shall be reviewed by the Design Professional for its sound impact, both inside and outside the building.
2. Exterior equipment operation shall not cause indoor sound levels to exceed specified levels for the space.
3. Exterior sound levels shall be in compliance with the local governmental ordinances. When these values are not governed, the sound level created by the equipment shall not exceed 70 dB measured at the property line.

Guidelines – HVAC Interior and Exterior Noise Control

- Interior HVAC acoustic design should not cause indoor sound levels to exceed NC30

Standard – HVAC Equipment Accessibility

1. Access and service space per mechanical equipment shall be in accordance with the Arkansas Mechanical Code.

Standard – HVAC Closeout Documentation

1. The contractor and/or engineer shall provide to the School District an accurate set of as-built plans, showing all construction revisions to the design set.

Guidelines – HVAC Closeout Documentation

- O & M Manuals should be provided in duplicate for the School District
- Manuals should contain approved shop drawings, operations and maintenance instructions and parts manuals for all HVAC equipment

Standards – HVAC Physical Education and Indoor Practice Facility

1. Indoor Practice Facilities shall be heated and ventilated.
2. Ventilation systems must provide ten air changes per hour in spectator facilities where facilities are not provided with HVAC systems.
3. Ventilation systems must provide five changes per hour in non-spectator spaces.
4. The ventilation must provide intake air near playing floor level and exhaust air at the opposite high wall of the space.

Guidelines – HVAC Physical Education and Indoor Practice Facility

- Gymnasiums may be heated and ventilated rather than being provided with mechanical cooling when the HVAC systems are effectively separated from other areas of the building
- Ancillary spaces such as offices and locker rooms should be served by separate HVAC systems