CHAPTER 13
AIR CONDITIONING, DEHUMIDIFICATION, EVAPORATIVE COOLING, HEATING, MECHANICAL VENTILATION, AND REFRIGERATION

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1. GENERAL.

a. Criteria Intent. The intents of these criteria are to assist designers in preparing professional and quality building designs that:

(1) Produce space conditions which enhance human comfort and productivity.

(2) Produce space conditions which meet the needs of processes being performed in the space.

(3) Meet the above objectives in a manner which is economically sound and energy conscious.

b. Life Cycle Cost.

(1) Systems and equipment will be selected from among functionally equivalent alternatives on the basis of lowest life cycle cost. Life cycle cost analyses will evaluate first cost, energy cost, recurring and one time maintenance and repair costs, and other costs and benefits attributed to each alternative. Designs will require that systems and equipment be installed in a manner making them easily accessible and highly maintainable.

(2) Life cycle cost analyses will be conducted as prescribed in chapter 11, except for heat pump systems or systems with night set-back; the degree day method should not be used. Throughout the design, the designer must make choices regarding materials, sizes, equipment and systems in order to establish the most cost effective design satisfying the customers' requirements and these criteria. Federal regulations specify that general economical studies be conducted routinely as part of the design process for all military facilities and, that these studies consider the life cycle cost of the facility. The life cycle cost of a design alternative is the most complete indicator of the expected cost of such choices. Thus, life cycle cost provides the most valid basis for comparing and selecting between acceptable alternatives.

(3) The scope and coverage of general economic studies for each project are discussed in TM 5-802-1 (reference 13-1) and must be determined individually, to ensure the cost effectiveness of the study effort itself. Before initiating any studies, designers should consider the following points:

(a) A life cycle cost analysis is likely to be cost effective when, the design feature or category to be examined is itself life cycle cost intensive relative to the project being designed. Post-occupancy continuing costs including fuel/energy, maintenance, custodial, and repair costs are especially important.

(b) A life cycle cost analysis is likely to be cost effective when, the design alternatives to be compared are characterized by fundamentally different cash flows.

(c) A life cycle cost analysis is not cost effective when, the cost of the analysis is likely to exceed any savings that could be achieved.

(d) A life cycle cost analysis is not cost effective when the relative economic rankings of the various alternatives have already been established for similar design conditions. This consideration encourages the use and/or revision of a previous study or analysis rather than performing a new complete analysis. The conditions and results of the previous study should be adapted and updated to the specific design alternatives being considered.

(e) A life cycle cost analysis of a particular design feature should not be initiated when its cost, added to the cost of life cycle cost analyses already conducted or planned for other design features of the same project, would cause the total cost to exceed one percent of the programmed amount.

(4) The designer of a building or facility will obtain from equipment manufacturers full and part load energy consumption data over the range which all equipment and supporting auxiliaries are expected to operate, as well as the space requirements for operation and maintenance for each component. All equipment selections will be based on life cycle costs. As a minimum, the following will be included in the life cycle cost analysis.

(a) The type of equipment to provide the space conditioning required using air-conditioning, evaporative cooling, heating, mechanical ventilation, or natural ventilation. (Purchase cost, installation cost, and maintenance cost)

(b) Architectural features and layouts of the facility. (Facility cost)

(c) Efficiency of equipment. (Energy Cost)

2. APPLICABILITY AND REQUIREMENTS. The provisions contained in this chapter apply to new construction and major renovation of or additions to, existing facilities at Army installations and activities.

a. Funding.

(1) Nonappropriated Funded (NAF) Facilities. Air conditioning requirements of this chapter do not apply where the entire life cycle cost of the facility is derived from Nonappropriated funds.

(2) Work Classification. Any size space conditioning equipment is real property and the installation of such equipment will be funded as construction work for new facilities. The same funding classification is used for space conditioning equipment in alteration work for existing facilities, except under the following circumstances:

(a) Clean Rooms. For prefabricated clean rooms installed in non air-conditioned spaces or, when the central system of the facility cannot meet the humidity and temperature requirements of the clean room operation.

(b) Equipment Operation. For types of equipment-in-place where, the manufacturer of the equipment-in-place specifically states that the equipment-in-place must be operated in an air-conditioned space.

(c) Operator Comfort. For operator comfort when the equipment-in-place to be installed will increase the humidity or temperature beyond reasonable comfort levels in the immediate area of such equipment-in-place.

b. Building Type.

(1) New Construction. Air-conditioning will be installed at the time of construction in new facilities as provided in this chapter, except as noted in paragraph 2.c. below.

(2) Facilities to be Replaced. It is recommended that air-conditioning not be installed in facilities that have been scheduled for replacement within five years, except for critical facilities that must be air-conditioned to accomplish the assigned mission.

(3) Semipermanent and Temporary Facilities. Based on weather region and occupancy, air-conditioning is recommended for semipermanent and temporary facilities that have been rehabilitated and have a planned use and life expectancy of more than five years.

(4) Personnel Living Spaces. Air-conditioning, evaporative cooling, heating, or mechanical ventilation should be provided equally for each category (married, unaccompanied officers, or unaccompanied enlisted

personnel) of personnel living spaces.

(5) Rented Units. Rented air-conditioning equipment will not be installed in any facility owned by any element of the Department of the Army. Rented air-conditioning equipment may be used when absolutely necessary in leased or rented facilities, when the terms of the occupancy agreement prohibit removal of occupant-owned central equipment.

c. Limitations On the Selection of Equipment and Systems. Air-conditioning (mechanical cooling), dehumidification, evaporative cooling, heating, and mechanical ventilation are recommended for those facilities described in **\7** TI 810-10 **/7/** (reference 13-2) and in paragraph 8., below. These recommendations for a particular system do not create mandatory or minimum requirements. It is the underlying intent to use energy conservatively and in the most cost effective manner.

(1) Energy conservation. Where a detailed engineering analysis based on historic weather data, including air temperatures and prevailing wind direction and speed, shows that satisfactory comfort conditions can be maintained without air-conditioning, then mechanical ventilation or natural ventilation should be provided.

(2) Air-conditioning in lieu of evaporative cooling is recommended for those cases where air-conditioning can be installed, maintained, and operated at equal or less life cycle cost than evaporative cooling or, where the use of evaporative cooling will impact adversely on the critical water resources of an installation.

(3) Special Systems Criteria for Hawaii. Air-conditioning is recommended. However, first consideration should be given to comfort conditions using mechanical or natural ventilation, or both, for all new and rehabilitated facilities, especially personnel living spaces. Prior to the start of design, a ventilation feasibility study should be conducted for all facilities more than 464.5 m^2 (5,000 ft^2) gross area. The study will evaluate the feasibility of using mechanical or natural ventilation, or both, in lieu of air-conditioning. Where found feasible, mechanical or natural ventilation, or both, should be installed in lieu of air-conditioning.

d. Entrance doors to Mechanical Equipment Rooms. Heater or boiler rooms and main mechanical equipment rooms shall have entrance doors directly from the outside. Additional details and rationale for this requirement as applied to new and existing buildings are located in Chapter 6 of this TI.

3. EXCEPTIONS TO CRITERIA.

a. General. Any exception to air-conditioning criteria that merits special consideration may be authorized by HQUSACE (CEMP-E), for MCA funded projects or features submitted by USACE Divisions/Districts. Authorizations are limited to the specific projects and do not establish a precedent.

b. Replacement of Existing Equipment. Replacement of existing air-conditioning equipment may be done with the approval of the installation commander.

c. Non Air-Conditioned Spaces. When a replacement is proposed for a facility space adjacent to or near a qualified, non air-conditioned facility space, then the provisions of DoD Directive 7040.2 (reference 13-3) will apply.

4. SPACE CONDITIONING DESIGN.

a. General. Unless otherwise indicated herein or, in an applicable Engineering Technical Letter (ETL), message or other formal criteria dissemination vehicle, the criteria presented in **\7** TI 810-10 **/7/** shall be used.

b. Energy Conservation. Air-conditioning, dehumidification, evaporative cooling, heating, mechanical ventilation, and refrigeration will be selected, designed, and installed according to the requirements for energy conservation. Unless stated otherwise herein, all HVAC designs will meet or exceed the basic design requirements of section 9.4 and the prescriptive requirements of Section 9.5 of ASHRAE/IES 90.1. Compliance with Corps criteria (AEI, TM, ETL, and CEGS) will result in meeting or exceeding the requirements of ASHRAE/IES 90.1. USACE criteria are based on the federally mandated requirements of 10 CFR 435. Technical differences between ASHRAE/IES 90.1 and 10 CFR 435 are essentially negligible.

c. Weather Data. **\7** Weather data will be obtained from the Air Force Combat Climatology Center, http//www.afccc.af.mil; from the American Society of Heating, Refrigeration & Air Conditioning Engineers Handbook of Fundamentals; or from other recognized and authoritative sources of weather data. **/7/**

d. Mechanical Ventilation and Ventilation Requirements for Occupants. The minimum outdoor air supply rates for occupants in heated or air-conditioned facilities, or both, will be according to ASHRAE Ventilation Standard 62 (reference 13-5).

e. Design Basis. The basis for all HVAC design shall be **\7** TI 810-10 **/7/**. In some cases the requirements of **\7** TI 810-10 **/7/**, and associated USACE criteria, may exceed requirements in Section 9.4 and Section 9.5 of ASHRAE/IES 90.1, the requirements of **\7** TI 810-10 **/7/** shall be used. Designers are encouraged to use automated design tools, provided such tools comply with established design criteria.

f. "U" Factors. The "U" factors or overall heat transfer values will be determined as prescribed in the chapter titled ENERGY CONSERVATION CRITERIA.

g. Equipment sizing. Adjustments may be made in design load calculations provided there are sound engineering requirements for same. The design analysis will include statements indicating the engineering rationale used to justify invoking any adjustments. Automated design tools should not increase equipment sizes without designer input.

(1) Special care will be taken to avoid over sizing equipment and systems. Over sizing will reduce operating efficiency, increase first cost, and may produce adverse space conditions during certain weather conditions.

(2) Ventilation Loads. Heating and cooling loads associated with ventilation requirements (forced and natural) will be included in equipment sizing.

(3) Latent Load Requirements. Cooling equipment sizing and cooling coil sizing and arrangement will be designed to satisfy latent as well as total cooling loads. Over sizing of cooling equipment will be avoided to prevent short cycling and resultant reduction of moisture removal.

(4) Unaccompanied Enlisted Personnel Housing (UEPH) and Unaccompanied Officer Personnel Housing (UOPH). Air-conditioning compressor equipment or chilled water supply from a central plant for air-conditioning in UEPH and UOPH will be sized on the basis of the expected lighting and occupancy loads.

h. Design Conditions.

(1) Indoor design conditions shall be as indicated in **\7** TI 810-10 **/7/**.

(2) Outdoor design conditions shall be as indicated in **\7** TI 810-10 **/7/**.

i. Facilities With and Without Attic Space.

(1) Facilities With Attic Space. All facilities with attic space, which are to be air-conditioned, will be

designed to achieve maximum natural ventilation. No existing facility with attic space will be air-conditioned unless insulation is added to the ceiling to bring the insulation into conformance with chapter 11.

(2) Existing Facilities Without Attic Space.

(a) Dropped Ceilings. When air-conditioning is to be added to existing facilities without attic space, and where there is a dropped ceiling, insulation will be added above the ceiling to meet the current requirements. In addition, the space between the dropped ceiling and the roof will be ventilated when possible to achieve a minimum of 7.6 L/s per m^2 (1.5 cfm per ft^2) of ceiling area. When there are engineering reasons for not ventilating an entire space, ventilation will be used to the maximum extent possible. Attic areas between fire walls will be ventilated individually.

(b) High-Bay Buildings. When hangars, shops, warehouses, or other high-bay buildings are modified in part, or as a whole, by the internal installation of normal ceiling heights to create administration, training or similar facilities, the ceilings will be insulated according to current requirements.

5. SYSTEMS AND EQUIPMENT DESIGN.

a. General. Unless otherwise indicated herein or in an applicable ETL, message or other formal criteria dissemination vehicle, the criteria presented in **\7** TI 810-10 **/7/** shall be used.

b. Corridors. Corridors in all new construction will conform to NFPA 90A (reference 13-6). In renovation of existing UEPH and UOPH, corridors may continue to be used as return air plenums for air-conditioning systems provided that the building is fully protected by an automatic sprinkler system and the corridors are provided with smoke detectors that, when activated, will shut off the air handling equipment.

c. Off-Hour Damper Shut Off. Outside air supply and/or exhaust systems are to be equipped with motorized or gravity dampers unless the total air flow is less than 1415 L/s (3,000 cfm), or the air flow is continuous.

d. Mechanical Equipment Design. **\7** A central plant or decentralized (building) type plants may be selected based on an engineering and life-cycle cost analysis. Maintenance capabilities and practices of the installation shall also be considered. Selection among the viable alternatives shall be made in coordination with the installation.**/7/** Critical facilities, such as communication or computer areas, or similar unique loads that require year around, highly reliable air-conditioning and are served by a central system, may be provided with an auxiliary system so that the critical partial load can be provided when the central system is down for repairs.

e. Nonpermanent Construction. The design of air-conditioning for semipermanent or temporary facilities will be on a minimum cost basis with exposed duct work, electrical work, and refrigerant or water piping and all other possible economies used. Every consideration will be given to the use, or expansion, of existing central plants in adjacent permanent facilities that are air-conditioned.

f. Auxiliary Systems. In facilities when, because of the small size of the off-hours or the small winter load, it is impractical to operate the primary equipment in the central plant, a secondary (auxiliary) refrigeration system may be provided.

(1) Chilled Water. When the central plant uses chilled water, this auxiliary system also should be a chilled water system so that it may be cross connected with the primary equipment in the plant. In such cases, during the summer operation, the auxiliary system should be sized to be needed only at night and over weekends, and other periods when the central plant is not being operated for reasons of economy or inadequate loading.

(2) Direct Expansion. When the central plant uses direct expansion, the auxiliary system also may be direct expansion, but the design will be based on using the same duct work.

(3) Critical Operations. For critical operations requiring a separate air-conditioning system, the need for back-up equipment can be avoided by proper design of the central system so that it can function as the alternate system by shedding noncritical loads during emergencies.

g. Non-Concurrent Zones Loading. Zones in the building that are expected to operate non-concurrently for 750 or more hours per year will be served by either a separate air distribution system or minimum position/setback devices tied into the off-hour controls. All zones having unknown occupancy patterns will be assumed to have non-concurrent operation for 750 hours or more per year. Special care will be given to the selection of heating and cooling plants supporting these loads and special load reduction capability may need to be specified.

h. Enclosures. When it is essential that air-conditioning equipment be covered or protected, a simple sheet metal enclosure similar to that now used by the industry for packaged roof-top units will be given first consideration. Air-cooled condensers, evaporative condensers, and cooling towers will be located on the exterior and will not be enclosed except where heavy snowfalls or windblown particles (sand) could prevent operation of systems for critical facilities required to operate year around. In such cases, the enclosure should be the minimum necessary to prevent snow or sand from clogging the condenser and fan. Screening may be provided in accordance with chapter 3.

i. Corrosion. Special consideration of corrosion problems will be made for any air-conditioning (including heating and ventilating) equipment that is to be installed within 16 km (10 miles) of the ocean or other salt water body.

j. Heat Pumps. Air-to-air heat pumps will be used only in locations with heating design temperatures (97.5 percent basis) greater than -11.1 °C (12 °F). This restriction will not apply to those locations in which 30 percent or more of the total annual heating hours below 18 °C (65 °F) occur during the period of May through October. Heating only air-to-air heat pumps may be used in facilities not air-conditioned based on the lowest life cycle cost analysis. Larger systems, including built-up systems, should be used where economically feasible.

k. Field-Assembled Equipment and Components. When components from one or more manufacturer are field-assembled as parts to form air-conditioning or heating equipment, including heat pumps, component efficiencies shall be specified so that the resultant field-assembled system meets the same efficiency parameters for equivalent non-field-assembled equipment. The total on-site energy input shall be determined by combining the energy inputs to all components, elements, and accessories, including controls.

l. Controls. Each HVAC system is required to have at least one automatic control device. Temperature and humidity controls will be provided when authorized or required. Controls will be designed in accordance with **\7** TI 810-11 **/7/** (reference 13-7) and as follows:

(1) Temperature Control. Individual room temperature controls are authorized when necessary for critical facilities. Temperature control will be by zone for duct air systems. Individual room temperature control is permitted in spaces served by individual terminal devices. Temperature zones and controls for perimeter spaces must be carefully designed to mitigate heating and cooling load differentiation and swings caused by solar radiation. A thermostatic control used to control both comfort heating and cooling to a space shall provide a temperature range, or "dead band" of at least 3.3 °C (6 °F), within which, the supply of heating and cooling energy to the controlled space is shut off or reduced to a minimum. This "dead band" is not required where the space is characterized by specific technical requirements for close temperature control, or where the thermostatic control is governed by manual changeover between heating and cooling modes.

(2) Humidity Control. Systems maintaining relative humidity levels by adding moisture are required to have a humidistat. Summer and winter humidity controls required for facilities will be on a zone basis, unless room

control is absolutely required by technical reasons. Summer humidity control is not authorized except for specialized technical requirements or when the design analysis indicates the sensible heat factor is less than 0.65. Winter humidity (adding moisture) control is permitted on a zone basis. Such moisture addition will be provided on the basis of an absolute minimum of new energy and a maximum of reclaimed energy. Dehumidification control is permitted in the winter in tropical locations when the winter design temperature exceeds 18.3 °C (65 °F).

(3) Automatic Changeover Thermostats. Automatic changeover between cooling and heating controls is permitted in facilities with a central air-conditioning or heating system provided, the changeover control is based on sensing outside air temperatures and, there is a neutral zone or "deadband" of a minimum of 3.3 °C (6 °F). Automatic night and weekend setback thermostats are encouraged. Facilities with specific technical requirements for close temperature control are exempt from the 3.3 °C (6 °F) neutral zone requirement.

(4) Outdoor Temperature Sensing Control. Heating systems, except for direct-fired warm air systems **6**\ or where serving heating coils in VAV terminal units /**6**/, will be provided with an outdoor temperature sensing control that cuts off the heating system for all types of administrative and living facilities when, the outdoor temperature exceeds 18.3 °C (65 °F) and, for other facilities when, the outdoor temperature reaches five degrees below the indoor design temperature or a minimum of 4.4 °C (40 °F).

(5) Hot Water System Modulation. Systems using hot water as a heat source will be controlled by a master outdoor temperature sensing unit that modulates the hot water temperature according to the outdoor temperature with a positive cut-off above 18.3 °C (65 °F).

(6) Off-Hour Setback or Shutdown. Automatic off-hour setback or shutdown during non-use is required when the full load demand is 2 kW (6828 BTUH) or greater.

m. Systems Adding Moisture to Air Streams. Systems adding water to air streams for comfort are required to limit relative humidity to a maximum of 50 percent.

n. Mechanical Spaces. The design for mechanical equipment and systems shall include adequate space for all required maintenance, testing, and inspection. Necessary space shall be provided for ductwork to be installed in accordance with the latest SMACNA Standards (reference 13-8) and as required for effective testing, adjusting, and balancing of air flows. The installation of piping shall adhere to the latest standards of the National Plumbing Code and NFPA 70 (references 13-9 and 13-10).

o. Warranties. Special emphasis shall be placed on all mechanical equipment and systems design warranties. Warranties are covered in detail in ER 415-345-38 (reference 13-16) and the Corps' Guide Specifications.

6. MECHANICAL VENTILATION DESIGN.

a. Comfort Mechanical Ventilation. Systems will be designed, installed, and protected according to the ASHRAE Handbooks (reference 13-11). A design goal of achieving an indoor temperature of 25.5 °C (78 °F), 90 percent of the time should be used. Since mechanical ventilation is used in milder climatic areas where the wet bulb temperature is lower, the ASHRAE effective temperature criteria should be considered in determining design conditions. It must be recognized that mechanical ventilation cannot achieve comfort conditions to the same extent as air-conditioning. However, the need for more prudent use of energy dictates the use of mechanical ventilation in milder areas where maximum temperatures are limited and normally of brief duration.

b. Industrial Mechanical Ventilation. Systems will be designed, installed, and protected according to the applicable volume of ASHRAE Handbooks or ACGIH Industrial Ventilation, A Manual of Recommended Practice (reference 13-12). Mechanical ventilation and exhaust systems for flammable, hazardous, and toxic gases or fumes will follow the codes of practice of NFPA (reference 13-13).

c. Radon. The severity of potential indoor radon concentrations cannot be accurately predicted. The success of radon mitigation techniques incorporated in a design is equally difficult to predict. Radon prevention and mitigation design criteria and techniques are presented in ETL 1110-3-438 (reference 13-14). The extent of radon features in a design is based upon the type of facility and measurements of indoor radon in existing buildings at the installation. The inventory of radon prevention and mitigation techniques include passive and active features depending on a facility's priority and the potential radon concentration. For new construction, the features include passive barriers, rough-in for sub-slab ventilation, passive (naturally ventilated) sub-slab ventilation, and active (fan powered) sub-slab ventilation. For alterations to existing buildings, the design will use engineering judgement and evaluate the life cycle cost/benefit of the new construction features compared to, increasing interior air pressures and outside air exchange rates and, other cost effective techniques. The HVAC aspects of radon in **\7** TI 810-10 **/7/** are to be superseded by the criteria and techniques of ETL 1110-3-438.

7. SPECIALIZED CRITERIA FOR AIR-CONDITIONED FACILITIES IN HUMID AREAS.

a. Humid Area Definitions. Humid area definitions along with further mechanical design criteria are described **\6** in TI 810-10 /**6/**. **\7** Other areas may not meet the strict definitions of a humid area but experience humid conditions on numerous occasions. In these cases, the humid area criteria addressed in TI 810-10 and in this paragraph shall be used by the designer as appropriate for the facility and the climate. **/7/** Additional requirements are as follows:

b. Architectural Criteria.

(1) Insulation. Building insulation will be of sufficient thickness to maintain the exterior surface temperature above the ambient dew point temperature.

(2) Building Materials. When selecting building materials, careful consideration will be given to paints, vapor barriers, and other finishes with respect to vapor flow through the roofs and walls to \6\ preclude: a) moisture accumulation and condensation within the building structure, b) reduction of thermal performance, and c) high latent cooling loads in the space. /**6**/ Materials used on the exterior of buildings should have higher vapor resistance than the materials used on the inside of the buildings.

(3) Infiltration. **\7** Air infiltration can be a major source of moisture in the conditioned area resulting in mold/mildew growth, an unhealthy indoor environment and excessive energy consumption. It is critical that air infiltration through the building envelope be minimized. In addition to air infiltration barriers, careful detailing will be provided **\6** in the contract /**6/** for all cracks, joints, openings and penetrations through roofs and walls to ensure proper caulking and sealing. **/7/**

(4) Floor Heights. Floor-to-floor height determination will be based on space requirements for the installation of ducted air-conditioning systems.

(5) Suspended Ceilings. Suspended ceilings should be used only where required. When suspended ceilings are used, exterior walls above the ceilings shall be sealed to preclude infiltration of moist air.

(6) Louvered Doors. Bathrooms and closets will be provided with louvered doors to permit equalization of vapor pressure through moisture diffusion. Where louvered doors are prohibited by fire regulations, other means will be employed to ventilate the bathroom or closet to minimize moisture build-up.

c. Mechanical Equipment Criteria.

(1) Calculations. In addition to calculating the cooling load at maximum design temperature, cooling load calculations or thermal simulations should also be made **\7** at maximum dew point temperatures or **/7/** for low temperature, high humidity conditions to determine the greatest dehumidification load that may be encountered.

(2) Latent Heat Gain. Latent heat gain due to water vapor flow through roofs and walls will be included in the cooling load analysis when the ambient design dew point exceeds the room design dew point by more than 11.1 °C (20 °F).

(3) Latent Cooling Load. The one percent wet bulb temperature from the approved weather data source of subparagraph 4.c., above, will be used in calculating the latent cooling load and for equipment sizing.

(4) Chilled Water Systems. The cooling capacity of chilled water systems of 350 kW (100 tons) and over will be divided between two or more chillers to ensure reliability and constant chilled water supply without temperature fluctuations, to prevent short cycling, and to minimize hot gas by-pass. The combined capacity of the chillers will not exceed the total requirement, including diversity. The selection of the number of chillers will be based on the analysis of part load operating hours for extended periods of low load conditions.

(5) Packaged Units. Packaged unitary units with multiple reciprocating compressors (not to exceed eight) will be used for systems between 123 kW and 750 kW (35 tons and 200 tons). Each compressor will have separate, independent, refrigerant circuits and cycles to provide multiple steps of capacity control. Two compressors may be combined into one independent refrigerant circuit. For systems up to 123 kW (35 tons), single compressors with a minimum of three-step capacity unloading may be used.

\7 (6) Outside Air. Where the outside air requirements are a significant part of the cooling load, the use of desiccant cooling, enthalpy wheels and similar devices for conditioning the outside air and transferring latent and sensible heat to the exhaust air shall be considered. If appropriately sized, these units can eliminate or minimize the latent load in the conditioned space saving significant energy and greatly increasing the comfort level. **/7/**

8. GUIDELINES FOR AIR-CONDITIONING, DEHUMIDIFICATION, EVAPORATIVE COOLING, HEATING, OR MECHANICAL VENTILATION OF FACILITIES.

a. General. In accordance with AR 420-49 (reference 13-15) the installation commander is responsible for approving facilities and areas of facilities for comfort cooling based on local conditions. The recommendations contained herein and space conditioning as authorized in **\7** TI 810-10 **/7/** are provided as guidelines based on past practices, normal comfort levels, occupant productivity, energy conservation and economics. Deviations to air condition a facility or specific areas of a facility may be approved by the installation commander. The installation commander should be made aware that deviations from these guidelines may have a negative impact on the installation's compliance with energy goals, may increase energy cost and may increase operating and maintenance cost. The DD Form 1391, signed by the installation commander, will indicate if the facility is to be air conditioned. All facilities will be designed and constructed to comply with stated air conditioning and comfort level requirements with minimum energy consumption.

b. Personal Comfort. Space conditioning is recommended for comfort applications in facilities as indicated in **\6** TI 810-10 /**6/** as modified below:

(1) In addition to the recommendations in **\6** TI 810-10 /**6/**, air conditioning is recommended for the following types of facilities in areas where the dry bulb temperature is 26.7 °C (80 °F) or higher for 350 or more hours per year:

(a) Dining facilities.

(b) General classrooms or schools.

(c) Indoor target ranges.

(2) In addition to those facilities listed in **\7** TI 810-10 **/7/** as not recommended for air-conditioning regardless of weather conditions, air conditioning is not recommended for the following facilities:

(a) Motor vehicle storage garages.

(b) Showers.

(c) Special areas requiring high ventilation rates.

(d) Vehicle storage areas of crash and fire stations.

(3) Air conditioning is recommended for gymnasiums and other physical activity spaces including weight rooms, running tracks, dance studios, and racquetball and handball courts in areas where the dry bulb temperature exceeds 26.7 °C (80 °F) for more than 350 hours or the wet bulb temperature exceeds 19.4 °C (67 °F) for more than 800 hours during the six warmest months of the year. Mechanical ventilation in lieu of air conditioning is recommended for other weather regions. Heating, air conditioning, and ventilation systems for gymnasiums will comply with the following:

(a) Heating systems **\7** in spaces with heavy physical activity such as running tracks, weight rooms, racquetball courts, etc…**/7/** shall be designed for a maximum temperature of 20 °C (68 °F).

(b) Air-conditioning, when provided, shall be designed to maintain not less than 25.5 °C (76 °F).

(c) No heating or cooling will be available between interior temperatures of 20 °C (68 °F) and 76 °F (25.5 °C).

(d) A separate air handling unit or units will be provided for each gymnasium.

(e) In addition to night setback/setup modes for periods of nonuse, gymnasiums with a seating capacity exceeding 300 persons **\7** will be provided with carbon dioxide sensors to automatically control the amount of outside ventilation air or **/7/** have three operating modes. Selection between the carbon dioxide sensors for automatic control of ventilation and a manual setting of the system operating mode shall be coordinated with the installation.

1/ One mode will provide minimum ventilation based on ten (10) percent occupancy and set to maintain 20 °C (68 °F) heating and 25.5 °C (76 °F) cooling, as applicable.

2/ A second mode will provide ventilation air based on 50 percent occupancy and set to maintain 20 °C (68 °F) heating and 25.5 °C (76 °F) cooling, as applicable.

3/ A third mode will provide ventilation air based on maximum occupancy and set to maintain 20 °C (68 °F) heating and 25.53 °C (76 °F) cooling, as applicable.

4/ Controls for manually indexing the gymnasium units from one mode to another mode will be located in an administrative office area of the gymnasium.

9. REFERENCES.

13-1 TM 5-802-1, Economic Studies for Military Construction Design--Applications

13-2 **\7** TI 810-10 **/7/**, Mechanical Design Heating, Ventilating, and Air-conditioning

13-3 DoD Directive 7040.2, Program for Improvement in Financial Management in the Area of Appropriations for Acquisition and Construction of Military Real Property, January 18, 1961 with changes

\7 13-4 Omitted **/7/**

13-5 ASHRAE Ventilation Standard 62 (Latest Edition), American Society of Heating, Refrigerating, and Air Conditioning Engineers

13-6 NFPA 90A, National Fire Protection Association (See reference 13-13 below)

13-7 **\7** TI 810-11 **/7/**, Heating, Ventilating, and Air Conditioning (HVAC) Control Systems

13-8 SMACNA Standards, Sheet Metal and Air Conditioning Contractors National Association, Inc.

13-9 National Standard Plumbing Code, National Association of Plumbing-Heating-Cooling Contractors, P.O. Box 6808, Falls Church, VA 22046

13-10 NFPA 70, National Electrical Code, National Fire Protection Association (See reference 13-13 below)

13-11 ASHRAE Handbooks (Fundamentals, Systems and Applications, Equipment and Refrigeration), American Society of Heating, Refrigerating, and Air Conditioning Engineers

13-12 ACGIH Industrial Ventilation, A Manual of Recommended Practice, American Conference of Government Industrial Hygienists

13-13 NFPA Codes may be obtained from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

13-14 ETL 1110-3-438, Indoor Radon Prevention and Mitigation--Design

13-15 AR 420-49, Facilities Engineering--Utility Services

13-16 ETL 415-345-38, Transfer and Warranties