SECTION 7. MECHANICAL STANDARDS

7.1 HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

7.1.1 General

1. Design conditions for heating and cooling shall be in accordance with ASHRAE Fundamentals (1997) for both standard and critical facilities unless otherwise specified in project design guidance.
2. Minimum outdoor air or supply rates for occupants in heated or air conditioned facilities, or both, shall be in accordance with ASHRAE Ventilation Standard 62 (latest edition). (IAW AFR 88-15, para 15-121a).
3. In buildings authorized for air conditioning, a combination heating and cooling system shall be provided where feasible. (IAW AFR 88-15.)
4. Mechanical refrigeration will be used in general for living quarters, administrative offices, dining halls and clubs, hospitals and clinics, and shop areas with equipment requiring a controlled environment.
5. Evaporative cooling shall be used in general in shop areas without critical requirements and in occupied storage areas. Facilities utilizing both mechanical refrigeration and evaporative cooling must have effective zone separation.
6. Do not provide HVAC in vestibules, hallways, projection rooms, and storage rooms.
7. Humidification and humidity control shall not be provided without justification being provided. If provided, water softeners must be utilized in all water for humidifiers.
8. Do not install under-slab floor ducting for HVAC (AFR 88-15).
9. Grills and louvers shall have factory-applied finish.

7.1.2 Cooling Systems, General

1. Design Conditions (for non-Critical facilities):

    a. Indoor: 25.5° C (78° F) Dry Bulb
    b. Outdoor: 36.1° C (97° F) DB, xx° C (64° F) WB
    c. IAW AFR 88-15 para 15-112c and AFM 88-29.

2. Design Conditions (for Critical facilities):

    a. Indoor: 25.5° C (78° F) Dry Bulb
    b. Outdoor: 37.2° C (97° F) DB, xx° C (64° F) WB
    c. IAW AFR 88-15 para 15-112c and AFM 88-29.

3. The following policies apply to mechanical refrigeration:

   a. Condensing units shall be air-cooled. To the greatest extent possible air conditioning condensing units should be of the weatherized type and installed outside of the building, hidden from plain view. (IAW AFR 88-15, para 15-112).
   b. Avoid using centrifugal chillers.
   c. A central mechanical system shall normally be provided unless specific engineering cost analysis indicates sub-systems to be more economical (IAW AFR 88-25, para 15-69).
   d. Control systems shall be designated to comply with ETL 83-1.
   e. New refrigerant will be R22 or other types that will not adversely effect the earth's ozone layer.
   f. Controlled environments, such as computer rooms, will use direct expansion A/C equipment and will have separate systems from facility comfort cooling requirements.

4. Evaporative cooling shall be used in general in shop areas without critical requirements and in occupied storage areas. The following policies apply:

   a. Evaporative coolers shall have a cellulose material impregnated with anti-rot salt and rigidifying saturants.
   b. Media efficiency shall be 76% at 183 meters per minute (600 fpm) face velocity with no entrainment of pad water.
   c. Evaporative cooling shall be designed to provide an indoor temperature of 27° C (80° F) (IAW AFR 88-15, para 15-121a).

5. See Section 7.1.7 for additional design criteria for heating/cooling systems.

7.1.3 Heating Systems, General

1. Design Conditions (for non-Critical facilities):

   Indoors: 21° C (70° F)

   Outdoor: –13° C (8° F).

   IAW AFR 88-15 para 15-112c and AFM 88-29.

2. Design Conditions (for Critical facilities):

   Indoors: 21° C (70° F)

   Outdoor: –17.8° C (0° F).

IAW AFR 88-15 para 15-112c and AFM 88-29

3. The Base Central Heating Plant (CHP) produces High Temperature Hot Water (HTHW) which is supplied to a district heating system which is used to heat many of the Base operational buildings. HTHW is typically run through a heat exchanger (usually referred to as a converter) at each facility and is used to produce both domestic hot water and for space heating. Some industrial facilities have unit heaters which use HTHW directly. The HTHW distribution system on the Base consists of insulated buried lines. MHAFB is in the process of eliminating the HTHW distribution system and installing individual natural gas-fired boilers. HTHW will not be used for new construction or building renovations.

4. Natural gas is available for use at most locations. See Section 7.1.4 for additional information.

5. Family Housing units are heated with either natural gas or electricity. Most family housing utilizes natural gas for water heating, with some structures utilizing electric water heaters.

6. Domestic boilers shall be designed to be shut down during summer.

7.1.4 Natural Gas distribution

1. The natural gas distribution system is owned and operated by MHAFB. Construction contractors shall be required to provide connections to the existing gas system and shall supply all piping, regulators, meters, etc. Contractors may use Intermountain Gas Co. as a subcontractor.

2. Underground distribution piping shall be polyethylene (PE), Yellow “Plexco” piping or equal.

3. Mains shall be 102-mm (4-in) diameter; service runs to buildings shall be 51-mm (2-in) minimum diameter.

4. Standard burial depth of gas piping at MHAFB shall be 30” to top of pipe.

5. Pressure in the “industrial” area is 345 kPa (50 psig). The housing area is at 379 kPa (55 psig). The only connection between the two gas systems is located on North Mellen Street.

6. A continuous tracer wire shall be installed with the piping and stubbed up at the building per UPC. Tracer wires shall not be wrapped around piping. Plastic warning tape shall be placed above buried piping. Use of a metallic warning tape

alone is not acceptable, as it is not compatible with the utility detection equipment used at MHAFB.

7.1.5 Controls and Sensors

1. New facilities will be designed to be compatible with a future EMCS (IAW AFR 88-15.) Monitor (thermostat and pressure gauge) temperature and pressure on inlet/outlet of both tube and shell side of converter. Do not locate thermostats on exterior walls, near exterior door, or in private office space.

2. Automatic Control System: Temperature controls will be used to fullest extent consistent with economy of operation. They will be adequately protected against unauthorized adjustments or tampering (locking covers). (IAW AFR 88-15, para 15-128b(1)). Heating systems shall be provided with a control for positive cut-off above 18° C (65° F) outside temperature. (IAW AFR 88-15, para 15-128b(3)). Use non-electric thermostatic valve on each converter. Provide battery backup for automatic setback thermostats.

7.1.6 Energy Conservation

1. Insulate all heating/cooling pipes. Insulate all duct work carrying conditioned air through unconditioned spaces. Use heat recovery for domestic hot water (DHW) if economically feasible.

2. Locate water heaters close to point of use. Specify DHW maximum temperature at 49° C (120° F) for stored DHW. Use DHW heaters with an "R" value of 14 or greater without use of exterior insulation jackets. Avoid the need for electric heat tapes for plumbing pipes; design with passive insulation.

3. Recover heat from exhaust air if cost efficient. Minimum SEER =- 9.0, minimum COP = 2.5. Ensure unrestricted airflow around radiators. Recover heat from light fixtures if cost effective. Use evaporative coolers rather than mechanical coolers to maximum extent. Provide well-sealed dampers to close ducts during off-season.

4. Use a few large boilers/chillers rather than several small boilers/chillers. Use radiant heat in areas such as high bays. (Refer to File DE 335-85 for restrictions). Use electric ignition rather than pilot lights on oil/gas water heaters and furnaces. Use boilers with a minimum efficiency of 75% and furnaces with a minimum efficiency of 80%.

5. Try to position restrooms on outside walls so windows can be used for ventilation rather than using fans. Where fans are used, put them on separate switches from lights when bathroom is for multi-users.

6. Compare use of air curtains vs. heating and cooling losses for facilities with high traffic between interior and exterior if no vestibules are used.

7. Use automatic setback thermostats or seven-day clocks where feasible. Also, consider using heating and cooling heat band thermostats.

7.1.7 Additional design criteria for heating/cooling systems

1. Systems that may see freezing conditions shall be protected with a minimum of 30% propylene glycol in chilled water and heating water systems. Snowmelt systems shall use 50% propylene glycol.

2. Bladder or diaphragm type expansion tanks shall be used, not compression tanks. Expansion tank connections to the main shall be off the side of the pipe; ceiling suspended tanks shall be furnished with an automatic air vent. The air vent is for filling the system, not everyday use. All expansion tanks shall be installed with isolation valves that are permanently labeled "leave open at all times" or with the handles removed.

3. Industrial air vents (high volume, cast iron bodies, stainless steel trim) shall be used off of air separators.

4. Circulating pumps in hot water heating systems shall be located to draw suction from the boiler and expansion tanks. (IAW AFR 88-15.)

5. Each heating or chilled water coil shall have the following:

    a. Isolation valves on the supply and return, wafer type valves shall not be used for this application.
    b. Strainer prior to control valve or automatic flow control valve.
    c. Control valve.
    d. Automatic flow control valve (Griswald, Autoflow or similar) shall be used. Manual flow control valves (circuit setters) shall not be used for coil balancing unless the body size is greater than 64 mm (2 ½ inches). Split coils at air handlers only require one flow control device since some variation in flow between the coils will not appreciably affect coil performance.
    e. Manual air vent, 6.4 mm (¼ in) ball valve with candy cane outlet, coin operated air vents are not allowed.
    f. Pressure and temperature test plugs across the strainer and the coil.
    g. Drain plug on terminal coils or drain cock with hose connection on air handler unit coils
    h. Unions on the supply and return, unless the piping connections are grooved couplings or flanged.

6. Base mounted pumps shall be installed with suction diffusers unless 5 diameters of straight pipe can be provided to the inlet of the pump.

7. Liberally install pressure and temperature test plugs across chillers, boilers, pumps, coils, and straining devices.

8. All pumps shall have a single pressure gage (with snubber) ganged across the pump inlet, outlet and suction diffuser (if applicable). 6.4 mm (¼ in) black threaded ASTM A-53 pipe with 6.4 mm (¼ in) ball valves (not needle valves or petcocks) shall be used to make the manifold.

9. Dial type bimetallic thermometers in separable socket shall be used (not liquid filled "mercury" types).

10. Generally, pump away from boilers and heat exchangers. Generally, pump through chillers. Designs which vary from this concept shall include a justification.

11. Make-up shall be made as close the "point of no pressure change" in the system as possible.

12. Chilled water systems shall not allow variable flow through the chiller, heating water system should not allow variable flow through the boiler if possible. Chillers shall be packaged, outdoor, air-cooled type. Chillers shall be ground mounted and . Chillers shall be sized for the sum of the peak loads.

13. Chilled water loops shall contain the volume recommended by the chiller manufacturer. Generally, chilled water loops shall have 3 gallons per ton as a minimum system volume. Install storage tanks if the loop is too short to provide the minimum system volume.

14. Chilled water systems shall have relief valves at the point of no pressure change.

15. Size triple duty valves and manual calibrated balancing valves for a minimum of 1.5 meters (5 ft) pressure drop at design flow, do not line size these items unless 1.5 meters (5 ft) can be obtained.

16. Only provide one strainer in the mechanical room per system (i.e. strainers are often provided as standard equipment in suction diffusers and air separators.) If neither of these are used or feasible install one strainer in-line.

17. Provide a pot feeder assembly for each system.

18. Pumps shall be non-overloading over the entire pump curve. Primary/secondary pump systems are encouraged. Booster pump systems are strongly discouraged.

19. Boilers shall be installed with 102 mm (4 in) minimum house keeping pads.

20. Label ports on three-way control valves as to “normally closed”, “normally open” and “common”. Typically chilled water valves will fail to bypass and heating water coils will fail to heat.

21. Duct systems shall have the following features:
    a. Use of interior duct lining products shall be kept to a minimum.
    b. Factory fabricated 45 degree high efficiency take-off shall be used on duct systems, not spin-ins.
    c. Flexible duct shall be installed at ceiling diffuser connections; maximum length of flexible duct shall be 1.8 meters (6 ft).

7.2 PLUMBING

7.2.1 General

1. The Uniform Plumbing Code (latest edition) has been adopted by the USAF (IAW AFI 32-1066.)

2. In buildings normally occupied by more than 15 persons, provide separate toilet rooms for each sex; position them together and use common wall for plumbing chase. In buildings normally occupied by 1 to 15 employees, a single toilet room to serve both sexes may be provided. Furnish one water closet, one lavatory, and a room door that can be locked from the inside. IAW AFR 88-15, para 15-35a, (handicap access varies).

7.2.2 Pipe and Pipe Fittings

1. Water pipes shall be designed for a maximum velocity of 2.4 meters per second (8 fps), or manufacturer's recommendation, whichever is less.
2. Velocity shall be limited to 1.2 meter per second (4 fps) in all copper and brass piping when transporting water above 66° C (150° F). (IAW AFR 88-15, para 15-29d).
3. Where feasible, single, rather than multiple, stack venting should be provided. (IAW AFR 88-15, para 15-30c).
4. Compressed air piping shall be black steel with malleable iron fittings. (IAW AFR 88-15, para 15-31b).
5. Coordinate corrosion protection criteria with the 366 CES/CEE corrosion engineer. Wherever possible, utilize plastic pipe for buried lines.
6. Drainage systems: Position manholes at every 45-degree and 90 degree, and a minimum of 91.4 meters (300 feet) apart. Keep main building sewer at 102 mm (4 in) minimum for future add-ons.
7. Limit the use of overhead piping systems except for slab ongrade. Then ensure piping is within the heated space.

7.2.3 Valves

1. Utilize non-constricting ball valves instead of gate valves.
2. Building main water service needs "corporation stop" at main, shut off valve (with valve box, 102 mm (4 in) min) at nearest location (not in roadway), and exposed, hand-operated, labeled valve inside building.

7.2.4 Piping Specialties

1. Mechanical rooms with equipment requiring "blow down" will plumb low down through an exterior wall.
2. Use floor drain to capture leakage and condensation, if it occurs (IAW AFR 88-15, para 15-33b).
3. Use floor drains with concealed cleanouts. Have cleanout at building exterior for building sewer system.
4. Utilize dielectric unions between all dissimilar metals.

7.2.5 Plumbing Fixtures

1. Plumbing fixtures will conform to Federal Specification WW-P-541. Use self-closing valves or flushometers on sink faucets and urinals in commercial type locations. Use combination hot/cold water faucets on sinks, and water hammer arrestors, in all other facilities. (IAW AFR 88-15, para 15.345).

2. Lavatories in central restrooms shall be of cast iron with acid resistant, porcelain enamel finish, and shall be a built-in type (no wall hung) (IAW AFR 88-15, para 15-34e(3)). Sinks shall be: kitchen (non-quarters) - stainless steel; Service Porcelain-enamel, cast iron. (IAW AFR 88-15, para 15-34g).

3. Energy conservation washerless fixtures shall be all metal construction, no chrome plated plastic. All techniques shall be considered, including 3.8 liters per minute (1 gpm) flow restrictors for faucets, 11.4 liters per minute (3 gpm) low-flow shower heads, single control mixing type faucets, low-volume flush water closets, 11.4 liters (3 gallons) or less, and self-closing faucet valves. (IAW AFR 88-15, para 15-39). Showers shall have valves with pressure balance feature.

4. Specify toilets which use 11.4 liters (3 gallons) of water per flush or less and design plumbing with this in mind. Use "point of use" water heaters for low DHW consumption areas such as administrative space where cost effective.

5. Use combination hot/cold water drinking fountains. Utilize freezeless wall hydrants. Provide interior wall access (self draining) with hose attached. Wall mounted drinking fountains are preferred.

6. All applications of plumbing fixtures shall be considered for handicapped usage as directed by Air Force guidelines.

7.3 WELL/PUMPS CONTROL SYSTEM

1. All water well/lift stations on Mt. Home AFB are fully automated.

2. The Base UMCS system is a Tano/Acquatyrol radio transmitted (SCADA) system installed at the central water plant which communicates with the central computer.

3. Tano/Acquatrol W1500 Remote Telemetry units are installed at each site to control and monitor all field points.

7.4 ENERGY MONITORING AND CONTROL SYSTEM

1. Energy monitoring and control system (EMCS) features will be required in the design of a facility. (See attached EMCS diagram at the end of the section.) Coordinate with the 366 Civil Engineering EMCS Shop. EMCS design and facilities is to be in accordance with AFMAN(I) 32-1093. Guide specification CEGS-13820 is to be utilized for building preparation for EMCS. The HVAC system and associated EMCS will be designed using Direct Digital Control (DDC) technology. DDC may be described as the direct operation of Heating, Ventilation and Air Conditioning (HVAC) local loop control devices, such as valves, dampers, and actuators, by a digital computer. Control actions are determined by stored programs using inputs from real-time sensors. The digital computer and its associated software replace the local loop pneumatic (electric or electronic analog) sensors.

2. The DDC system is in compliance with Engineering Technical Letter (ETL) 86-16. Future Military Construction Program (MPC) and O&M DDC designs must comply with ETL 86-16, as well as, ETL-83-1.

3. The DDC system at Mt. Home AFB is manufactured by Johnson Controls. All DDC equipment shall be compatible with the existing Johnson Controls infrastructure. The Johnson Controls system is a microprocessor-based network designed for maintenance management and the local automatic control of HVAC equipment in an energy efficient manner. The system is comprised of a network of stand-alone units, each capable of DDC and supervisory control. The network control modules consist of a microcomputer that allows the base to perform manual operations, coordinate systems for demand reduction, view facilities status in real-time, and generate reports. In order to maintain coordinated system growth, future DDC procurements shall be compatible with the existing DDC

network. Contact EMCS shop for the specific computer requirements required for each project.

4. The means of communication between buildings is by buried single-mode tube fiber optic cable. At a minimum, an eight fiber cable will be supplied for each EMCS installation. All fiber optic cables will be installed in 102-mm (4-in) PVC conduits with four way inner duct. Each four inch PVC will be installed from the building to a (BIDDS) communications manhole. Coordinate with the EMCS shop on manhole locations. A maximum of two gradual ninety degree bends, vertically of horizontally is allowed without the installation of pull boxes in the conduit.

5. The following HVAC point schedule is an example of points that should be monitored or controlled in facilities at Mt. Home AFB:

    a. Outside Temperature (° C (° F))
    b. Air Flow Monitor (normal/low)
    c. Hot Deck (° C (° F))
    d. Return Air Temp (C ° (° F))
    e. Supply Temp to Each Zone (° C (° F))
    f. Humidity for Each Zone (%)
    g. Chilled Water Return (° C (° F))
    h. Tower Fan Status (on/off)
    i. Economizer Control
    j. BTUs Heating
    k. Tons Cooling
    l. Motor Run Time (elapsed)
    m. Filter Media
    n. Chiller Safeties
    o. Start/Stop Monitor (normal/low)
    p. Cold Deck (° C (° F))
    q. Mixed Air Temp (° C (° F))
    r. Room Air Temp for Each Zone (° C (° F))
    s. Chilled Water Supply (° C (° F))
    t. Chiller Start/Stop Control
    u. Chill Water Pump Status (on/off)
    v. Air Handler Safeties (Freezestats, Firestats)
    w. Hot Water Supply and Return Temps (° C (° F))
    x. Moisture Alarms in Raised Floor Areas
    y. Emergency Generator Status (off/on/ready)
    z. Condenser Water Supply & Return Temps (° C (° F))

This is only an example and not meant to be binding or exhaustive.

7.5 FIRE PROTECTION SYSTEMS

1. All fire protection systems shall be coordinated with MHAFB Standard 12, “Fire Safety Systems.

2. Fire hydrants shall have the following features:
   a. Hydrant valve seats shall be resilient plastic/rubber type. Metal-to-metal valves shall not be used.
   b. Hydrants shall be installed to provide a minimum clearance of 18” between grade level and the center of the 4½ inch (pumper) connection.