Tinker Air Force Base
Installation Facilities Standards (IFS)

G09. TINKER AFB MECHANICAL REQUIREMENTS
Comply with AFCFS for Mechanical, Electrical and Plumbing:
http://afcfs.wbdg.org/facilities-exteriors/machanical-electrical-and-plumbing/index.html

NOTICE

As required by Air Force Facilities Standards (AFCFS) and Installation Facilities Standards (IFS), compliance with applicable United Facilities Criteria (UFC) requirements in effect upon Contract Solicitation and/or Award, whichever applies, is required. The contractor shall be responsible for accessing or obtaining all required publications referenced herein that are recommended, mandatory, or applicable to the project's design and engineering.

Summary of Sections in this Supplementary Document:
I. Energy Conservation Requirements
II. Fire Protection Engineering
III. Mechanical Engineering: Plumbing Systems
IV. Mechanical Engineering: HVAC/R Systems
V. Appendix

DRAFT (changes are indicated in red)

I. Energy Conservation Requirements

A. Facilities shall include those energy conservation design features which can be economically justified or are otherwise required by UFC in conjunction with this TAFB Facility Standard. Principal considerations are building envelope and mechanical systems design and operation to minimize the use of fossil fuels.

1. **Executive Order 13693 E.O. section 3(h)(i):** Improve building efficiency, performance, and management by ensuring, beginning in fiscal year 2020 and thereafter, that all new construction of Federal buildings greater than 5,000 gross square feet that enters the planning process is designed to achieve energy net-zero and, where feasible, water or waste net-zero by fiscal year 2030.

B. **Minimum Efficiency Requirements**

1. Minimum Energy Efficiency Requirements of buildings are established by the American National Standards Institute (ANSI), the American Society of Heating, Refrigerating & Air-Conditioning Engineers (ASHRAE) and the Illuminating Engineering Society (IES) and published in two separate standards. These standards are incorporated by reference into UFC 3-410-01 *Heating, Ventilating and Air Conditioning Systems.*

2. **ANSI/ASHRAE/IES Standard 90.1 - *Energy Standard for Buildings Except Low-Rise Residential Buildings*** (latest edition) establishes minimum efficiency and performance requirements for the following:

   a) Building Envelope

b) Heating, Ventilating, Air-Conditioning, Refrigeration (HVAC/R)

c) Service Water Heating (Boilers, Water Heaters)

d) Power

e) Lighting

f) Other Equipment (Electric Motors, Service Water Pressure Booster Systems, Elevators, Escalators and Moving Walks)

Note: *ASNI/ASHRAE/IES Standard 90.1 applies to new and existing building facilities at TAFB (except low-rise residential buildings).*

3. **ANSI/ASHRAE Standard 90.2** - ***Energy Efficient Design of Low-Rise Residential Buildings*** (latest edition) establishes design requirements for single-family houses, multi-family structures of three stories or fewer above grade, and manufactured houses (modular and mobile).

C. **Energy Metering**

1. Energy usage metering shall be provided for all projects in accordance with UFC 3-400-01 *Mechanical Engineering*, **ANSI/ASHRAE/IES Standard 90.1** - ***Energy Standard for Buildings Except Low-Rise Residential Buildings*,** and the most recent Energy Policy Act.

2. Reference the most current version of the "Air Force Meter Data Management Plan" maintained by AFCEC. This can be found at the following link: https://cs2.eis.af.mil/sites/10159/SitePages/Service%20Page.aspx?Service=Air%20Force%20Facility%20Metering%20Program

3. All meters shall meet the minimum requirement of the AF's Advanced Meter Reading System (AMRS).

4. AMRS and Utility Metering Requirements include but are not limited to:

   a) New meters and replacement of existing analog meters shall as a minimum be provided with pulse counter which can communicate with AMRS system at Tinker. Daily data is required for a minimum of 90 days.

   b) Electrical Meters; a) 15-minute interval data with 30 days memory, b) LED or LCD display with wireless communication capability, c) Panel mounted / "plug-&play" d) Optical Port, e) Maximum data functionality; peak, power factor, KVAR, CFM, harmonics, f) Measure energy used, and g) must communicate with the AFCEC AMRS system.

   c) Gas and Water Meters: Daily data required for 90 days.

D. **Energy Management Considerations**

1. Other items for consideration for energy conservation are economy cooling cycle, variable volume systems, and night and weekend system shutdown. Controls for night and weekend setback of space temperature shall be provided for all areas.

2. Air-Conditioning of Occupied Spaces. Occupancies where air conditioning is permitted shall be per UFC 3-410-01.

E. **Computer Analysis**

1. For all major Military Construction (MILCON) projects, computer dynamic analysis techniques shall be utilized to effectively evaluate all design parameters associated with energy conservation design.

2. In addition to the calculations and analysis requirements indicated in UFC 3-401-01, provide calculations listed in UFC 3-410-01 Chapter 5, part 5-1.2, including an Energy Compliance Analysis (ECA), "U" Factor calculations, HVAC Load Calculations, Outside Air Requirements/ Calculations, Building Air Balance Calculations, Duct Pressure Drop Calculations, Hydronic System Pressure Drop Calculations, Pipe Expansion Calculations, and Equipment Sizing Calculations.

F. **Life Cycle Cost Analysis**

1. Design features shall be evaluated via life-cycle cost analysis. The various alternatives and their costs evaluated during design shall be documented by the designer and included in submittals.

2. The National Institute of Standards and Technology (NIST) has prepared the Life Cycle Costing Manual for the Federal Energy Management Program (NIST Handbook 135), and annually issues real growth energy price indices and discount factors for life cycle cost analysis. As a companion product, NIST has also established the Building Life Cycle Cost (BLCC) computer program to perform LCC analyses. The latest versions of the BLCC program not only structure the analysis but also include current energy price indices and discount factor references. These NIST materials define all required LCC methodologies used in GSA design applications. The A/E may obtain the BLCC software and updates from NIST. The project team must integrate the LCC analysis into the concept design process, and the analysis must be completed by the design development phase. Facilities Standard for the Public Buildings Service P100 - Chapter 1.7 - Life- Cycle Costing by GSA.

G. **Design and Construction of Energy Monitoring Control Systems (EMCS)**

1. An energy monitoring control system shall be provided for all projects in accordance with UFC 3-401-01 *Mechanical Engineering*, **ANSI/ASHRAE/IES Standard 90.1** - ***Energy Standard for Buildings Except Low-Rise Residential Buildings,*** and the most recent Energy Policy Act.

2. All stages of EMCS designs shall be coordinated with the Energy Management Program monitor in the Utility Engineering section (72 ABW / CECO) and HQ AFMC. All installed control systems shall be connected to the existing base wide Civil Engineering Community Of Interest Network Enclave (CE COINE). The control systems shall be programmed into the base wide Honeywell Enterprise Building Integrator (EBI). Contractor shall contact and coordinate connections with the CE Information Assurance Manager (IAM), the CE Energy Management office and CE Operations.

3. **Control Protocol.** ASHRAE's BACnet® protocol is the preferred system for Tinker AFB monitoring and control systems. Facility HVAC control systems based on the BACnet® protocol must be designed and constructed in accordance with ANSI/ASHRAE Standard 135, UFGS 23 09 00, UFGS 23 09 23.02 and UFGS 23 09 13. For additional information refer to specific UFCs such as UFC 3-401-01 *Mechanical Engineering* and UFC 3-410-01 *Heating, Ventilating, and Air Conditioning Systems.*

4. **System Design Requirements**

Mechanical and electrical systems in facilities shall be provided with the necessary sensors, controls, and hardware points to implement the EMCS application programs per UFC 3-410-01 *Heating, Ventilating, and Air Conditioning Systems* (latest edition), following the guidance for ASHRAE BACnet monitoring and control of the systems.

a. All new and replacement building level controllers shall be Honeywell Comfort Point Open CPO-PC-6A.

b. Control system designers shall submit the proposed schedule of points to be

monitored and/or controlled in the I/O summary table format as outlined UFC 3-410-01 *Heating, Ventilating, and Air Conditioning Systems* (latest edition).

c. Site specific schematics shall be provided showing all sensors, controls, and hardware points.

d. Hand-off-automatic (HOA), off-automatic, and all similar switches shall be key-operated with all switches keyed alike.

e. Pneumatic HVAC controls are no longer allowed at Tinker AFB. All projects modifying, replacing, or installing HVAC controls shall utilize DDC.

5. **Installation Requirements**

a. All abandoned-in-place temperature controls shall be demolished as part of the construction, renovation, repair or other improvement project.

b. Where DDC controls are installed, the controls shall be fully compatible with the existing control system and the base-wide EMCS system.

c. Wiring from sensors, controls, and hardware points shall be in conduit and terminated at a Data Termination Cabinet (DTC) located in mechanical rooms. The conduit shall enter the side and bottom of the panel only.

d. Install conduits entering panels from side and bottom of panel to prevent water from entering the panels and destroying the electronics.

e. Provide adequate clear space around EMCS Data Gathering Panel (DGP) location of future FID and MUX and accessibility of maintenance personnel.

H. **Solar Heating System Requirements**

1. All new facilities and facilities undergoing major renovations must be evaluated per life cycle costing to determine if 30% or more of required domestic hot water can be supplied by a cost effective solar heating system.

End of Section

II. Fire Protection Engineering

A. **Safety Deficiencies in Existing Facilities**

1. Existing facilities requiring correction of any fire safety deficiency shall comply with Air Force Instruction 32-10141 – *PLANNING AND PROGRAMMING FIRE SAFETY DEFICIENCY CORRECTION PROJECTS*.

B. **System Design for Existing and New Facilities**

1. All fire protection system designs shall be accomplished by a qualified Fire Protection Engineer. All fire protection systems shall be designed in accordance with the following:

- UFC 3-600-01 Design: Fire Protection Engineering for Facilities,
- UFC 3-601-02 Operations and Maintenance: Inspection, Testing, and Maintenance of Fire Protection Systems,
- NFPA 13,
- *Life Safety Fire Protection System Analysis* (project specific, to be provided by the Engineer of Record).

2. Fire Protection designs shall reference the new **Air Force Corporate Facilities Standards,** which may be found at the web link listed below.

   Hyperlink to ***Air Force Corporate Facilities Standards:*** http://www.wbdg.org/ffc/af-afcec/corporate-facilities-standards-afcfs

C. **Design Submittal**

1. The designer shall provide a preliminary fire sprinkler design, including hydraulic calculations no later than 60% design.

D. **Piping System Design**

1. Piping material for dedicated fire suppression systems shall be ductile iron or steel only and meet or exceed the material standards and requirements listed in NFPA 24.
2. Minimum wall thickness for all sprinkler piping shall be schedule 40 steel.
3. All concealed and exposed fire suppression/sprinkler piping shall be painted red IAW ANSI color codes.

E. **Firewalls and Fire Area Limitations**

1. All construction, including fire walls, fire area limitations, emergency lighting systems, means of egress, and exit stairways, shall meet the more stringent requirement of both the NFPA 101 and the International Building Code.
2. All wall penetrations through existing firewalls shall be fire caulked and sealed.
3. All duct penetrations through fire walls on both new and repair projects shall have operational and code compliant dampers and seals as required by current code.
4. Identification (by painting) of Fire Rated Walls, Fire Pumps, Hydrants, Automatic Sprinkler Systems, Fire Alarm conduit, junction boxes and covers shall be provided and performed for all projects IAW UFC 3-600-01, *Fire Protection Engineering for Facilities*.

End of Section

III. Mechanical Engineering: *Plumbing Systems*

A. Plumbing Systems – General

1. Plumbing systems at Tinker AFB generally include the following facility systems:

    - Domestic water supply piping, booster pumps and related systems
    - Waste water piping and related components
    - Natural Gas piping and related components
    - Compressed air piping and related components (i.e. air-compressors)
    - Lavatory, toilet and related plumbing fixtures
    - Water heaters and boilers for domestic water heating
    - Storm drainage systems within and to 5 feet outside buildings
    - Water for landscaping
    - Water softening and treatment (small) systems for buildings
    - Corrosion control (cathodic) protection systems

2. Design and construction of plumbing systems shall be in accordance with the International Plumbing Code and the following, as applicable:

    - UFC 3-420-01 Plumbing Systems
    - UFC 3-420-02FA Compressed Air
    - UFC 3-230-01 Water Storage, Distribution and Transmission
    - UFC 3-430-09 Exterior Mechanical Utility Distribution
    - Air Force Instruction 32-1066 Backflow Prevention Program
    - NFPA

B. Facility Domestic Water Supply

1. Base domestic water supply systems shall be from potable water lines. All water used for process purposes (heating, air conditioning) shall be isolated from domestic supply systems, or 'drinking water', by means of reduced-pressure back flow prevention devices.
2. Tie-ins to existing water lines shall be analyzed to document as part of the project design analysis that existing demands shall not be adversely affected by new demands.
3. Incorporate handicapped accessible design for all toilet areas, shower areas, and drinking fountains.
4. Provide access to piping, valves, and instrumentation for maintenance personnel. Access to through wall piping shall be provided by means of wall access panels or, where space is available, from a walk-in plumbing chase. Where carriers are utilized to support fixtures, a walk-in plumbing chase is preferred.
5. Domestic hot and cold potable water piping shall be of Type L seamless copper tubing with dielectric insulators at point of contact with dissimilar metallic piping. Provide insulation for all domestic and comfort cooling supply and return lines.
6. Specify Type K copper pipe for underground domestic hot water supply applications and Type L copper pipe for above ground hot water applications.
7. Do not use dissimilar metals in contact with each other on piping in a common electrolyte such as water or soil.
8. Provide stop-valves at all plumbing fixtures.
9. Design piping with the following velocity limitations to minimize erosion:

Pipe Dimension		Maximum Velocity	
inches	*mm*	*m/s*	*ft/s*
1	25	1	3.5
2	50	1.1	3.6
3	75	1.15	3.8
4	100	1.25	4
6	150	1.5	4.7
8	200	1.75	5.5
10	250	2	6.5
12	300	2.65	8.5

10. No asbestos-containing materials of any kind shall be used in construction.
11. Water meters shall be installed on all facilities. See TAFB Facility Standard Section 6: Utilities for full metering requirements.
12. For engineering design and system sizing determinations, it shall be anticipated by project designers that the highest demand for water shall be during normal duty hours.

C. **Cross-Connection and Back flow Prevention**

1. Cross-connection and back flow prevention policies of AFI 32-1066 shall be followed to protect the potable water system and facility occupants.
2. The proper back flow prevention device shall be specified as required in AFI 32-1066 for the hazard involved.
3. Back flow prevention devices shall be located and installed to ensure they shall function, not freeze, and are readily accessible for testing, service, and repair.

D. **Wastewater Systems Design**

1. As implemented by the Air Force Instruction **AFI: 32-1066 Plumbing Systems**, the **Uniform Plumbing Code** (current edition) shall provide the general minimum design requirements for base facilities' sanitary sewer systems.

2. Where specific project requirements are determined more stringent by 72 ABW/CE, use the manual of practice Gravity Sanitary Sewer Design and Construction**,** as jointly published by the *Water Environment Federation* and the *American Society of Civil Engineers* as the MOP FD-5**.**

3. All projects on TAFB which include earthwork shall comply with Engineering Technical Letter ETL 03-1: Storm Water Construction Standards.

4. **General Requirements**

   a) Provide sanitary drain systems from lavatories, toilet areas, break areas, and non- industrial waste floor drains to sanitary lines.

   b) All Restrooms projects involving under-floor plumbing work shall locate new floor drains under the partitions in the new or final floor layout.

   c) All projects involving a janitor closet and under-floor piping shall place a floor drain in the center of the janitor room with grading to ensure removal of all water from floor.

   d) Trap primers are required on all floor drains. Trap primers are preferred to be installed in the wall with access panels and with hammer arresters.

   e) Wall cleanouts are required and are to be located 26" A.F.F. for all water closets, urinals, and lavatories. Floor cleanouts are not acceptable in restrooms.

   f) Where piping is to be installed in exterior walls, the designer must show that the exterior wall design will prevent water or waste piping from experiencing freezing conditions.

   g) Do not provide water or waste piping in attic spaces where there is danger of freezing.

   h) The installation of an electric waste disposer/food waste grinder is prohibited except as provided in UFC 3-420-01 *Plumbing Systems*.

5. **Additional Requirements**

   a) Contractor's performing renovation, repair or replacement projects that involve sanitary waste lines shall snake existing sanitary pipes 100' to prevent any blockages with the new sanitary pipe. Snake pipes that are smaller than 6". Provide video footage for sanitary pipes 6" and larger in diameter. Video footage shall be obtained pre-construction and again post-construction. Submit video evidence prior to new pipe being installed. Following construction, submit post-construction video evidence of all new and existing pipes. The Contractor shall perform the above work in the presence of the Construction Inspector.

E. **Corrosion Prevention and Control**

AFI 32-1054 Corrosion Control **https://www.wbdg.org/ffc/af-afcec/instructions-afi/afi-32-1054**

Cathodic protection for buried metallic structures shall be designed IAW UFC 3-570-02A Cathodic Protection, UFC 3-570-02N Electrical Engineering Cathodic Protection, and UFC 3-570-06 O&M Cathodic Protection System.

1. Protective coatings: Coating specifications for above and below ground high value metallic structures shall be prepared IAW the guide specifications as shown in UFC 3-190-06 *Paints &*

Protective Coatings.

2. Underground piping systems shall conform to either FS-L-C-530, Type II except tape and primer conform to AWWAC203, for epoxy or for continuously extruded polyethylene, FS-L-C-530, Type I.
3. On all metallic structures where the surface is blasted to white or near white finish, no blasted surface shall be left unprimed beyond the normal workday.
4. Coatings specified for underground or submerged use shall be those specifically designed for those types of environmental conditions.
5. Under no circumstances shall thin plastic film tapes, such as electrical tape, be used to coat underground structures or wiring.
6. Reference NACE Standard RP-01-69 for coating information.

F. **Cathodic Protection**

1. General soil conditions at Tinker AFB are very conducive to corrosion of underground metal structures.
    a) The soil varies from sandy silt to sandy clay with areas of stratification of the various types.
    b) Soil resistivity varies from a high of 26,100 ohm-cm to a low of 529 ohm-cm. There is no soil resistivity data available at the base.
2. Designer shall take readings at the locations of structures and paths of utilities having cathodic protection.
3. Design analysis shall contain a map showing the sites of such readings, type of instrument used and a table containing location designation and soil resistivity.
4. Cathodic protection design shall be a complete design and not a performance specification.
5. The cathodic protection system to be installed shall be designed by an engineer who has been accredited as a "Corrosion Specialist" by the National Association of Corrosion Engineers, which verifies that engineer has had experience in cathodic protection design, installation and testing as per UFC 3-570-02A *Cathodic Protection* and UFC 3-570-06 *O&M Cathodic Protection Systems*.
6. Guidance for the installation and/or use of corrosion mitigation equipment and procedures is provided by UFC 3-570-02A *Cathodic Protection* and UFC 3-570-06 *O&M Cathodic Protection Systems.*
7. All metals installed underground or in contact with the ground at Tinker AFB shall have cathodic protection for control of corrosion.

G. **Water Treatment**

1. Water treatment shall be provided for all transfer media in all heat transfer equipment.
2. Heat transfer equipment shall be taken to include cooling towers, chilled/hot water systems, and boilers.
3. Treatment shall contain no chromates and no heavy metals.
4. Water treatment design analysis shall contain base water analysis and step-by-step procedures used to arrive at suggested treatment.
5. This analysis shall include which of the constituents of the water is the limiting parameter.

6. All new equipment, water treatment systems and methods installed shall be in compliance with support the descriptions, recommendations, and guidelines of UFC 3-240-13FN *Industrial Water Treatment Operation and Maintenance.*

7. Air Force Non-Chemical/Nontraditional Water Treatment Devices Policy: Most non-chemical water treatment devices or equipment are not currently authorized for use on military installations, as stated in paragraph 1-1.5. The Air Force will allow their use only under an Energy Saving Performance Contract (ESPC) in which the contractor assumes all performance-based risk. The performance standards for system component protection must meet or exceed those that are achievable with chemical treatment. (See UFC 3-240-13FN Chapter 8 for details).

H. **Water Softeners/Water Treatment Equipment:**

1. Water softeners are required on all open loop makeup systems including but not limited to steam boilers, humidifiers, and commercial domestic hot water systems (kitchens).

2. Softeners shall be properly sized to allow soft water to be introduced into systems at all times, including emergency shutdown.

3. Provide adequate water/conditioned water for all boiler systems.

4. Side stream pot feeders and annual chemical treatment shall be provided on all "closed loop" systems including but not limited to heating water loops, chilled water loops, and fluid cooler applications.

I. **Existing Energy Source**

1. Natural gas is available for facility heating if steam is not available.

2. Natural gas pressure varies from 30 to 40 psig, seasonally.

3. Gas is on an uninterruptible contract.

4. Steam is supplied at various pressures for buildings served by the B3001 boiler plant only. All other areas are or will soon be decentralized. Contractors shall consult with the government regarding the decentralization plan impact on each project in order to confirm steam availability.

J. **Natural Gas Systems**

1. Exterior Distribution Piping (Mains): Refer to TAFB Facility Standard, part 6.9 **Natural Gas Delivery Systems.**

2. Building Service:

a) Install sufficient isolation valves to repair units without shutting off entire system

b) Replace natural gas regulators over 15 years old.

c) Distribution regulators: All distribution regulator sets shall be installed with:

- Regulators that do not fail in the valve "open" position (e.g., do not use pilot loaded regulators since they fail to "open").
- Valved, regulated bypasses to permit equipment repair or replacement.
- Regulators that have valve stem indicators.
- Sets that use one regulator for control of flow and a second regulator to monitor the flow.

K. **Welding**

1. All welding shall be performed by a welder certified IAW ANSI B31.1 or API 1104 codes. Welds shall be made and inspected IAW ANSI B31.8 requirements.

L. **Plumbing Piping**

1. Piping installed on new systems shall be corrosion resistant. Otherwise a cathodic protection system shall be provided. Provide necessary shutoff valves and identification.
2. Pipe Painting**:** All exposed plumbing piping shall be primed with paint suitable for metal surfaces and finish painted with color to match background. This requirement applies to repair and renovation projects as well as new construction or additions to existing building plumbing systems.
3. Pipe Labeling: All supply and return lines shall as a minimum be identified with markings denoting both flow direction and fluid transported.

M. **Piping Thermal Insulation**

1. Insulation of plumbing piping located outdoors. Where piping that serves domestic hot water, domestic cold water or similar fluid is installed outdoors or otherwise exposed to the elements, insulation shall exceed by 30% the requirements of ASHRAE 90.1, the International Mechanical Code, or the standard UFGS specification whichever is greater. This shall apply to all new construction, renovation, repair or replacement projects.
2. Insulation of plumbing piping located within a conditioned environment. Where piping is installed indoors or otherwise within a conditioned environment, thermal insulation shall meet requirements of ASHRAE 90.1, International Mechanical Code, or the standard UFGS specification, whichever is greater. This shall apply to all new construction, renovation, repair or replacement projects.

N. **Compressed Air Systems**

1. Compressed air, if required, shall be provided by base compressed air distribution system where available.
2. Where Base system is unavailable to the project site, provide stand-alone compressors and locate in facility mechanical room.
3. Provide necessary maintenance access for controls, refrigerated air dryers, and condensate handling equipment.
4. Ventilate mechanical rooms to prevent overheating of components and to maintain acceptable indoor air quality. Ventilation system designs shall comply with **ASHRAE Standard 62.1 – *Ventilation for Acceptable Indoor Air Quality,*** latest edition.
5. Install inlet air filtration with instrumentation.
6. Install vibration isolation pads (neoprene component material is preferred), including flexible connections between the compressor and its associated piping, to prevent vibration damage to compressors.
7. Noise suppression shall be provided to keep compressor noise within Occupational Safety and Health (OSHA) limitations.
8. Oil free compressors shall be required for breathing air applications.

O. **Equipment & Fixtures**

1. Electric Water Coolers/Drinking Fountains. Design electric water coolers (drinking fountains) to be dual use water coolers and bottle filling stations. Units shall be filter-less type. Provide accessible models where required.

End of Section

IV. Mechanical Engineering: *HVAC/R Systems*

A. General

1. Proper design of mechanical systems is required for the health and life safety of building occupants, operations and maintenance personnel and the general public.
2. Mechanical systems shall be designed, constructed, operated and maintained according to UFC requirements, Air Force Instructions, TAFB Instructions and other requirements. In the absence of specific criteria, follow recommendations from ASHRAE and/or the equipment manufacturer.
3. Mechanical systems, including all heating, ventilating, air-conditioning and refrigeration systems shall be designed and constructed, operated and maintained to meet applicable code requirements and Tinker AFB Standards.
4. All HVAC systems shall be tested and balanced following installation or replacement. Testing and balancing shall be performed in accordance with UFC requirements.

B. Submittal Requirements for All Mechanical Projects

1. The information herein applies to all construction and/or repair projects. Refer to contract documents for additional information on submittal requirements.
2. Design submittals shall be provided at one or more levels; schematic, preliminary, design development and final design phases (i.e. 15%, 35%, 65%, etc.) as per contract documents. In the absence of specific contract requirements, the following minimum requirements shall apply:
    a) Schematic phase: Preliminary design analysis to include manufacturer cut-sheets, sketches, preliminary load calculations.
    b) Design development phase: Preliminary design analysis, preliminary load calculations, mechanical equipment plan layout and air distribution design, preliminary hydraulic calculations, plumbing design, equipment selections, outline specifications, etc.
    c) Construction document phase: Final design analysis, final mechanical equipment plans, final air distribution design, final plumbing design, equipment selections, schedules, specifications, etc.
3. Shop drawing submittals shall consist of the following:
    a) Installing contractor or sub-contractor provided drawings to illustrate the dimensional requirements (including spatial constraints, maintenance requirements, etc.) for all systems, materials and equipment to be assembled or constructed in-place. Examples include isometric drawings for all plumbing and instrumentation (P&I), air distribution systems, buried piping, utility vaults, etc.
    b) Manufacturer's published data for all pre-manufactured items to be installed and/or otherwise provided on Tinker AFB. Data shall include, but not be limited to all of the following as applicable: certified performance data, capacities, dimensions, ratings, code approvals, the approval seal and/or published rating information for all listing agency standards, manufacturer's special requirements, general installation requirements, access requirements, electrical characteristics (voltage, frequency, phase, amperage, capacitance, resistance, inductance ratings, etc.).

4. Combine all related materials into one submittal, i.e. all plumbing fixtures, all air distribution devices, all related mechanical assemblies, etc. to be submitted using one form AF3000, with each item listed separately.
5. The following required deliverables shall be provided in electronic (PDF) format and hard copy:
    a) Installation manuals
    b) Operation & maintenance (O&M) manuals, including spare parts list
    c) Wiring diagrams, including project specific wiring diagrams, control diagrams, etc.
    d) Start-up test and check reports, Test and balance (TAB) reports, etc.
    e) Commissioning plans, reports and manuals
6. As-built drawings shall be provided in both hard copy and electronic form. Electronic documents shall be in both AutoCAD and PDF formats.
7. Specific details may be found in UFC-3-401-01, UFC 3-410-01, etc.

B. Mechanical Equipment

1. All abandoned-in-place mechanical equipment shall be demolished as part of the construction, renovation, repair or other improvement project.
2. All outdoor mechanical equipment shall be rated and installed for all weather conditions. These provisions shall include but not be limited to the following:
    a) Low voltage electrical connections to outdoor mechanical equipment.
    b) Heat tracing and insulation to prevent freezing.
    c) Aluminum protective covering for outdoor insulation.
    d) Protection for pipe insulation in high traffic areas.
    e) Rain tight NEMA rated enclosures and watertight EMT as applicable.
    f) Hail damage guards and high wind protection for refrigerant condenser coils.
    g) Low ambient capability (to at least 0 degrees F) for air-cooled refrigeration condensers, compressor-bearing condensing units and packaged outdoor HVAC units when required to operate in low ambient conditions.
3. All installed equipment utilizing refrigerants shall use a refrigerant which is approved for use on Tinker AFB as listed in the Base Refrigerant Management section of this Standard.
4. All HVAC installation, repair or replacement work shall be performed in accordance with ASHRAE and other industry-accepted standards.
5. The minimum thickness for pleated media shall be 4".
6. Whenever possible, install bypasses or some other means to ensure regular maintenance items such as strainers may be cleaned without plant shutdown.
7. Provide disconnect switches for remote controlled equipment like air handlers and exhaust fans.
8. All equipment which could be damaged by inclement weather or accidental damage shall be installed with protective equipment options or provisions including, but not limited to, hail guards for all air-cooled condensers.

9. Floor mounted equipment shall be mounted on suitable concrete housekeeping pads extending 6 inches beyond the unit footprint.
10. Mechanical equipment having rotating or reciprocating components, such as compressors, fans, motors, etc. shall be mounted on spring isolators.
11. All equipment shall be located with sufficient clearance for maintenance and be provided with access by means of identified panels, catwalks, platforms, stairs or ladders as required.
12. Requirements for Boilers: Prior to construction, contractors shall contact T.A.F.B. 72 ABW Civil Engineering Squadron, Environmental Management, Air Quality Division, regarding initial Notification Report Form and current environmental requirements for new boiler equipment. A copy of the Notification Report Form may be found in the Appendix section of this Standard. Completed forms are to be submitted to TAFB Environmental Management, Air Quality Division. **Submit forms within ten (10) days of start-up for new boiler installations.** New boiler shall meet the current metering, recording, and reporting requirements of T.A.F.B. Environmental. T.A.F.B. Environmental shall also be contacted for current environmental metering, recording, and report requirements for new boilers.
13. Infrared Heating Systems Infrared heaters and system components installed on base, specifically in buildings located near the flight line such as aircraft hangers, shall be designed to prevent movement caused by vibration during aircraft take-off operations. Consider designing with seismic protection to accomplish this measure.

C. Mechanical Piping - General

1. All abandoned in place mechanical piping shall be demolished as part of the construction, renovation, repair or other improvement project.
2. Isolation valves shall be provided at each piece of connected equipment.
3. Isolation valves shall be provided at each branch line extending from a main line (tee fitting).
4. Thermometers, pressure gauges and PT plugs shall be provided at all coils.
5. All supply and return lines shall be identified with markings denoting flow direction and fluid transport.
6. Pipe Painting: All exposed mechanical piping shall be primed with paint suitable for metal surfaces and finish painted with color to match background. This requirement applies to repair and renovation projects as well as new construction or additions to existing building systems regardless of method of project delivery.
7. Pipes containing water or other fluids subject to freezing, when routed inside of an exterior wall cavity, ceiling cavity or other location exposed to an unconditioned space or to the outdoors, shall be protected from freezing.
8. All condensation shall be drained into sanitary on all projects.
9. Piping installed on new systems shall either be manufactured as corrosion resistant, have protective coatings applied in the field or have a cathodic protection system.

D. Underground Piping

1. Steam utility piping systems shall be designed in accordance with UFC 3-430-01FA *Heating & Cooling Distribution Systems.*
2. All steam and hot water distribution systems shall have a cost analysis performed comparing aboveground, surface utility, and underground conduit systems to determine the most economical system. Comparison should include cost,

maintainability, and system performance.

3. Install cathodic protection systems to protect all piping and appurtenances located underground.

E. Piping Thermal Insulation

1. Insulation of mechanical piping located outdoors. Where mechanical piping that serves steam, chilled water, hot water, domestic water or similar fluid is installed outdoors or otherwise exposed to the elements, insulation shall exceed by 30% the requirements of ASHRAE 90.1, the International Mechanical Code, or the standard UFGS specification, whichever is greater. This shall apply to all new construction, renovation, repair or replacement projects.
2. Insulation of mechanical piping located within a conditioned environment. Where mechanical piping is installed indoors or otherwise within a conditioned environment, thermal insulation shall meet requirements of ASHRAE 90.1, International Mechanical Code, or the standard UFGS specification, whichever is greater. This shall apply to all new construction, renovation, repair or replacement projects.

F. Ductwork

1. All abandoned-in-place ductwork systems shall be demolished as part of the construction, renovation, repair or other improvement project.
2. All ductwork shall have a class A seal.
3. All HVAC ductwork shall be constructed and installed in accordance with industry-accepted standards including but not limited to ASHRAE and SMACNA standards.
4. Install sufficient insulation and vapor barrier on air conditioning ductwork and chilled water piping to prevent condensation. Duct liner shall be kept to a minimum for sound control only. The preferred thermal insulation shall be external wrap.
5. Balancing dampers in ductwork shall be installed so as to be inaccessible to the occupants of the space being served, i.e. in the take offs from the duct branches rather than in the diffusers.
6. Exposed Ductwork Painting: All exposed mechanical ducts shall be primed with paint suitable for metal surfaces and finish painted with color to match background. This requirement applies to repair and renovation projects as well as new construction or additions to existing building systems regardless of method of project delivery.

H. Natural Gas Systems

1. Refer to Plumbing Section for requirements.

I. Welding

1. All welding shall be performed by a welder certified IAW ANSI B31.1 or API 1104 codes. Welds shall be made and inspected IAW ANSI B31.8 requirements.

J. Temperature Controls / Energy Management / EMCS Systems

1. All abandoned-in-place temperature controls shall be demolished as part of the construction, renovation, repair or other improvement project.
2. Temperature controls for all renovation and new construction projects shall utilize direct digital control (DDC) systems as required by UFC 3-410-01.

3. For additional requirements, refer to **Section I – Energy Conservation Requirements** in this document.

K. Water Treatment

1. In order to protect boilers, cooling towers, chillers and other capital-intensive mechanical equipment, water treatment shall be provided as recommended by the specific equipment manufacturer. Site specific water quality testing shall be performed and written lab test results provided by an independent third party test agency. Based on the lab test results, a formal water treatment plan shall be developed and a water treatment program implemented.
2. Annual chemical treatment shall be provided on all "closed loop" systems including but not limited to heating water loops, chilled water loops, and fluid cooler applications. Side stream pot feeders shall be provided for all mechanical systems requiring chemical treatment whether or not specified on plans, drawings or otherwise.
3. Water treatment shall be provided using traditional chemical-based methods. Non-chemical treatment methods are prohibited by USAF policy.
4. Ensure the output capacity (volume and pressure) from the water treatment equipment is adequate for the volume of makeup water required, according to the boiler manufacturer.
5. Water softeners are required on all open loop makeup systems including but not limited to steam boilers, humidifiers, cooling towers and commercial domestic hot water systems (kitchens).
   a) Softeners shall be properly sized to allow soft water to be introduced into systems at all times, including emergency shutdown.
   b) Provide soft water/conditioned water for all boiler systems.

L. Mechanical Room Design

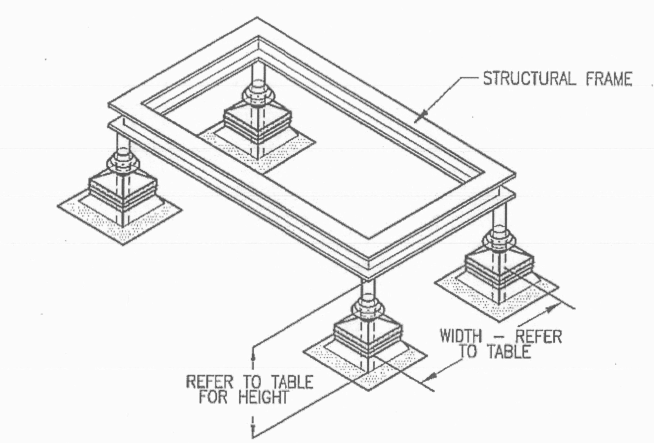
1. Dedicated mechanical room(s) shall be provided for all mechanical equipment and systems in accordance with the International Mechanical Code.
2. Mechanical rooms shall be provided with doorways suitable for passage of the mechanical equipment to be installed inside the space.
3. Mechanical rooms containing refrigeration equipment such as water chillers, refrigerant cooled equipment, coils, etc. shall comply with **ASHRAE Standard 15 *Safety Standard for Refrigeration Systems***, latest edition. *This is a mandatory, Life Safety, Health and Welfare requirement.*
4. Ventilate mechanical rooms to prevent overheating of components and to maintain acceptable indoor air quality. Ventilation system designs shall comply with **ASHRAE Standard 62.1 *Ventilation for Acceptable Indoor Air Quality***, latest edition.
5. Concrete housekeeping pads shall be provided for all floor mounted mechanical equipment. Housekeeping pads shall be constructed of approved materials and shall be secured to the building foundation by means of mechanical, structural and/or chemical-bonding material. Construct pads to extend beyond supported mechanical equipment by six inches (6") on each side. Pads shall be placed level, to a height of four inches (4") above the floor, and all exposed edges shall have a one inch (1") chamfer. Pads shall not be placed adjacent to a wall, column, or other building element unless suitable maintenance access is provided to the equipment to be mounted onto the pad.
6. For mechanical rooms housing chillers, boilers or heat exchangers, allow sufficient clearance

to access the tube bundles for tube cleaning, eddy current testing or tube replacement. Typically, to meet the "sufficient space" requirement, allow clearances equal to the overall equipment length plus 20%, measured from the accessible end(s) of the equipment (i.e. end bell covers). Where possible, this type of equipment should be located at ground floor level and near an exterior, overhead door. In cases where space is at minimum, equipment could be positioned to allow for servicing through the open doorway.

7. Chillers, boilers, heat exchangers, fans, pumps motors or other large equipment exceeding 100 HP, 100 tons in refrigerating capacity, or having serviceable components exceeding 150 lbs. should be provided with permanently installed, overhead hoist or crane rails secured to and integrated with the building structure.

M. Mechanical Equipment Location

1. Locate equipment to allow access for maintenance IAW the International Building Code (IBC) and International Mechanical Code (IMC). Avoid locating equipment on roofs due to maintenance problems. Provisions shall be made for removal of equipment for maintenance. Assure that proper distance between system components and walls is maintained to ensure ability to clean, repair, or replace system components.
2. Equipment such as Air Handling Units, large supply, return or exhaust fans, fan coil units and similar equipment shall not be located above spaces having ceilings constructed with acoustical tile (drop ceiling systems), gypsum board, or other material unless provided with dedicated code-compliant access stairways, ladders, maintenance walkways and other means of mechanical access IAW the International Building Code (IBC). This includes variable air volume (VAV) or other air terminals where the bottom of such units would be located more than 12'-0" above the finished floor space.
3. Curbed Applications. Where HVAC systems are to be installed on a roof using a roof curb assembly, the requirements of the roof assembly, including roof insulation material thickness, will need to be considered when selecting the height of the roof curb.
4. Non-Curbed Applications. Where HVAC systems must be installed above a roof in a non-curb application (no roof curb), provide an Elevated Mechanical Platform which will allow sufficient access for roof maintenance and repair without removal of the HVAC equipment. Elevated Mechanical Platform shall comply with the following requirements:
    a) Elevated Mechanical Platform shall be designed to support the HVAC equipment weight as well as the required maintenance walkway around the equipment including any stairs or ladders required for access, in addition to ductwork, piping and appurtenances.
    b) Minimum clear height from the roof surface to the elevated structure shall be as shown in Figure 1, below.
    c) Roof supports shall be secured to structure. Refer to Figure 2 (below) for typical requirements.
    d) Access to the roof below the Elevated Mechanical Platform supporting the HVAC system shall be provided on at least three sides, and the open sides shall not be obstructed with flashing, fencing, covering or other material.
    e) All penetrations, duct routing, conduit routing and equipment placement not on curbs shall be in general conformance to the representative set of details found in the Appendix section, ***Attachment of Rooftop Equipment in High-Wind Regions,* FEMA.**
    f) All pipe supports shall be structurally anchored to the deck.



WIDTH OF EQUIPMENT	HEIGHT OF LEGS
UP TO 24"	20"
25" – 36"	24"
37" – 48"	30"
49" – 60"	36"
61" AND WIDER	54"

FIGURE 1 – ELEVATED MECHANICAL PLATFORM SUPPORT STRUCTURE FOR INSTALLATIONS ABOVE ROOF

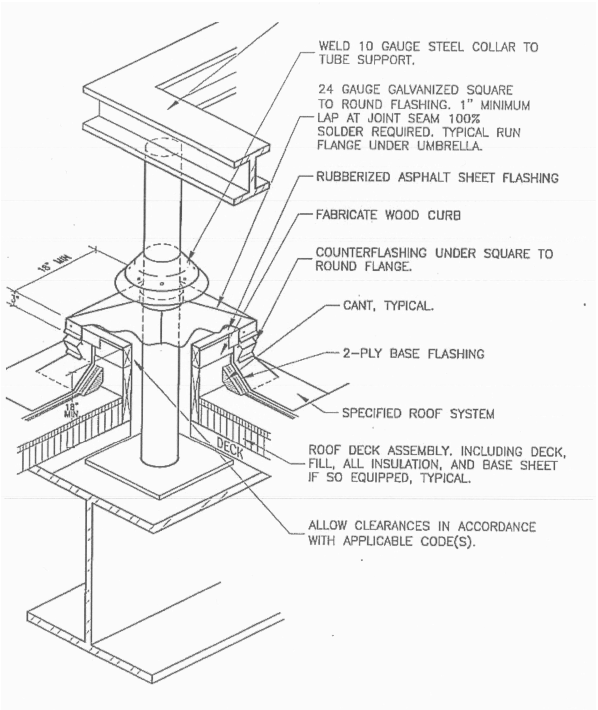


FIGURE 2 – TYPICAL ROOF SUPPORT DETAIL FOR ELEVATED PLATFORM

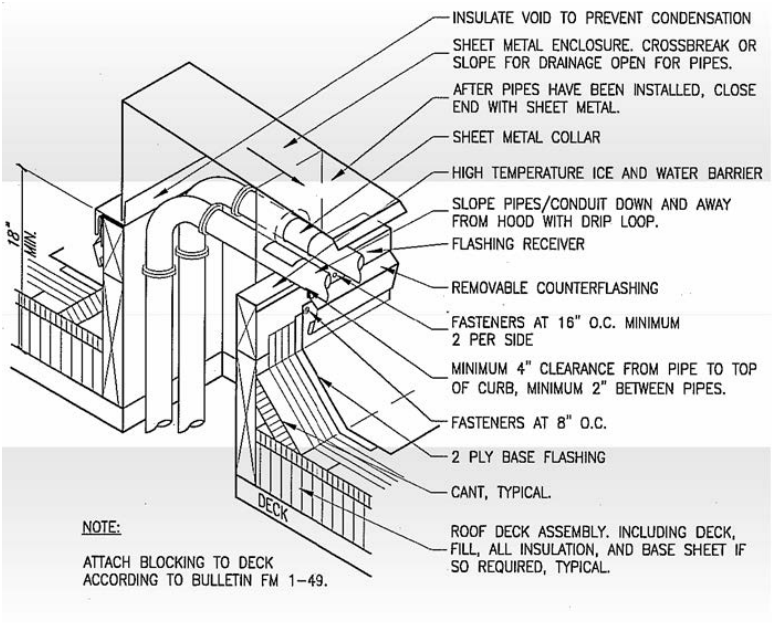


FIGURE 3 – TYPICAL PIPE AND CONDUIT ROUTING DETAIL FOR ROOF INSTALLATIONS

N. Base Refrigerant Management

1. The 72 ABW/CE is tasked to maintain a Refrigerant Management Program in accordance with the **Air Force Pamphlet 32-7089 Refrigerant Management issued 14 June 2013.**
2. **ANSI/ASHRAE Standard 34, *Designation and Safety Classification of Refrigerants***, establishes a simple means of referring to common refrigerants and assigns safety classifications and refrigerant concentration limits based on toxicity and flammability data.
3. HQ AFMC Guidance (10 Jul 95 letter from HQ AFMC/CECS) strictly prohibits contractors from purchasing, providing or removing any refrigerants that contain either *chlorofluoromethane, chlorodifluoromethane or other "CFC" gases* (such as R-11, R-12, R-500, R-502 or R-503), to or from the government's inventory to perform contracts.
4. Contractors are prohibited from purchasing, providing, or removing any prohibited refrigerants to or from the government inventory. Refer to list of Prohibited Refrigerants below.
5. It is the obligation of 72 ABW/CE to account for use of all contractor-provided refrigerants on Tinker AFB which is to be installed to contracted equipment, and this obligation consists of the following:

a) Track Environmental Protection Agency (EPA) certifications for refrigerant technicians and refrigerant recovery equipment.

b) Track refrigerant inventory levels for each type of refrigerant.

c) Report on refrigerant emissions.

6. REMOVAL OF REFRIGERANT (*Refrigerant Recovery*). Recovery of refrigerant (*as defined by 40 CFR 82*), from existing, government-owned "appliances" (*as defined by 40 CFR 82.152, i.e. HVAC, commercial refrigeration, industrial refrigeration or other refrigerant systems, except for small appliances*), <u>will be performed by the Government</u> upon written notice from the contractor. However, contractors may remove government refrigerants from contracted equipment into government-furnished containers, only when so directed in writing by the Contracting Officer.

7. NEW REFRIGERANT. All refrigerant provided or furnished for use on Tinker AFB shall be produced and sold as new, virgin refrigerant. Use of recovered, recycled, reclaimed or other category of refrigerants (i.e. used refrigerant) is strictly prohibited. Contractors shall only use refrigerant that is approved for use at Tinker AFB unless otherwise approved in writing by 72 ABW/CE.

8. <u>REFRIGERANTS APPROVED FOR USE AT TINKER A.F.B.*</u>

Refrigerant 134a
Refrigerant 410A

* There are many or multiple refrigerants which are acceptable per current EPA regulations but current TAFB Refrigerant management policy is to simplify and standardize our refrigerant inventory to R134a and R410a refrigerant inventories for new equipment wherever possible. Therefore the refrigerants automatically approved for new equipment are only R134a and R410a unless approved in writing by TAFB Base Civil Engineering.

9. <u>REFRIGERANTS PROHIBITED FROM USE AT TINKER A.F.B.</u> Prohibited refrigerants include all refrigerants other than approved refrigerants.

10. <u>EXCEPTIONS.</u>

Excluded from the list of prohibited refrigerants are "process" systems utilized in production and/or manufacturing, unless otherwise prohibited by USAF or TAFB policy.

Any other exceptions to the Base Refrigerant Management policy requirements must be approved in writing by the Base Civil Engineer for the specific equipment, system or project for which the refrigerant is required. Exceptions will be made as needed on a case by case basis only.

O. Contractor Certifications and Recordkeeping for Refrigerant Management

1. When required to install, remove or recover refrigerants pursuant to provisions of part N above, Contractors shall furnish the following in conjunction with the performance of contracted work at TAFB:

a) Prior to bringing technicians on base for installation or recovery of refrigerants to or from contracted equipment, the Contractor should submit to the Contracting Officer's Technical Representative (COTR): (1) A copy of the refrigerant technician's certification as required by 40 CFR (Code of Federal Regulations) part 82, subpart F; and (2) A copy of the certification to the EPA that the Contractor acquired refrigerant recovery equipment per 40 CFR 82.162.

b) Prior to final acceptance of contract work, the Contractor should provide a record of the

amount of refrigerant installed with the contracted equipment or recovered from equipment contracted for demolition into government furnished containers. In the case of commissioning new or retrofitted equipment, the Contractor shall provide the refrigerant amount determined to be the "Full Charge" as defined in 40 CFR 82.152.

c) The Contractor shall provide information concerning refrigerant emissions.

d) Prior to final acceptance of contract work, the Contractor shall provide to the COTR a record of any refrigerant losses to the atmosphere.

e) Included with all warranty work, the Contractor shall provide to the Contracting Officer a record of all refrigerant losses to the atmosphere. The Contractor shall assume that the amount of refrigerant added to the equipment to bring it back to "Full Charge" is the amount of refrigerant that was emitted to the atmosphere.

P. Electrical and VFD Requirements:

1. Comply with the Tinker AFB Base Electrical Standards (Appendix B) for the following:

   a) All Variable Frequency Driven (VFD) electric drives and motors.

   b) All low-voltage control wiring.

   c) All wiring and conduit for mechanical systems.

2. Variable Frequency Driven (VFD) motor applications shall comply with all NEC rules for motor disconnect. In addition:

   a) VFD selection should include provisions for radio frequency (RF) shielding on incoming feeder side by either internal protection or cables.

   b) VFD selection should include provisions for radio frequency (RF) shielding on outgoing motor side by either internal protection or cables.

   c) VFD selection shall include an integral means of disconnect by manufacturer design.

   d) When necessary to utilize a brake function, it shall be provided with a separate power supply.

Q. Anti-Terrorism Force Protection (ATFP) Requirements

1. UFC 4-010-01 *DoD Minimum Antiterrorism Standards for Buildings* applies to all facilities on Tinker AFB (*latest edition*).

2. ATFP provisions regarding Standard 18 – Emergency Air Distribution Shutoff: This provision is not applicable to small exhaust fans such as toilet exhaust fans, smoke purge (negative pressure) fans, or other fans where "*interior pressure and airflow control would more efficiently prevent the spread of airborne contaminants and/or ensure the safety of egress pathways.*"

R. Operations Engineering Requirements

1. For all projects, including repair/replacement, renovation and/or new construction, designers and contractors shall contact *Operations Engineering* to obtain the latest requirements for monitoring and baseline measurement of equipment, machinery and other building systems. Currently, these requirement include the following minimum base standards:

   a) All rotating equipment over 50 HP shall be equipped with predictive maintenance monitoring over the existing EMCS system.

   b) All large construction projects include equipment baseline measurement for rotating

equipment over 50 HP after final commissioning and that the results be recorded on the monitoring system.

c) Provide controls to allow monitoring of the HVAC DDC systems for critical equipment in aircraft support facilities such as hangars, maintenance and repair (production) building areas.

d) Provide CT sensors, vibration monitoring, ultrasonic monitoring, etc. for large motors, fans and other critical systems.

e) Additional requirements may apply; contact *Operations Engineering* for current information.

2. In order to adequately facilitate the above measures, designers and contractors shall contact *Operations Engineering* during the planning phase of a project, and then incorporate approved requirements into each phase, including the design, pre-construction, construction, and close-out.

End of Section

APPROVING OFFICIAL:

_____

William A. Ward, P.E.

Chief, Engineering Division

Civil Engineer Directorate, 72 ABW

V. Appendix

This section includes the following:

No. of Pages

- References …… 2
- Abbreviations and Acronyms …….. 1
- Attachments
    - New Boiler Installation Report Form …….. 1
    - Table 1. Attachment of Rooftop Equipment in High-Wind Regions (FEMA) …..……4

References
(Partial list - Not all inclusive)

UNITED FACILITIES CRITERIA

GENERAL

UFC 1-200-01 DoD Building Code (General Building Requirements)
UFC 1-200-02 High Performance and Sustainable Building Requirements

MECHANICAL

UFC 3-400-02 Design: Engineering Weather Data
UFC 3-401-01 Mechanical Engineering
UFC 3-410-01 Heating, Ventilating, and Air Conditioning Systems
UFC 3-410-02 Lonworks® Direct Digital Control for HVAC and Other Local Building Systems
UFC 3-410-04N Industrial Ventilation
UFC 3-420-01 Plumbing Systems
UFC 3-420-02FA Compressed Air
UFC 3-430-01FA Heating and Cooling Distribution Systems
UFC 3-430-02FA Central Steam Boiler Plants
UFC 3-430-07 Inspection and Certification of Boilers and Unfired Pressure Vessels
UFC 3-430-08N Central Heating Plants
UFC 3-430-09 Exterior Mechanical Utility Distribution
UFC 3-430-11 Boiler Control Systems
UFC 3-440-01 Facility-Scale Renewable Energy Systems
UFC 3-450-01 Noise and Vibration Control
UFC 3-460-01 Design: Petroleum Fuel Facilities
UFC 3-460-03 O&M: Maintenance of Petroleum Systems
UFC 3-470-01 Lonworks® Utility Monitoring and Control System (UMCS)

MULTI-DISCIPLINARY AND FACILITY SPECIFIC

UFC 3-190-06 Protective Coatings and Paints
UFC 3-230-01 Water Storage, Distribution and Transmission
UFC 3-240-13FN Industrial Water Treatment Operation and Maintenance
UFC 3-310-04 Seismic Design for Buildings
UFC 3-430-09 Exterior Mechanical Utility Distribution
UFC 3-520-05 Stationary Battery Areas
UFC 3-570-02A Cathodic Protection
UFC 3-570-06 O&M Cathodic Protection Systems
UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings
UFC 4-024-01 Security Engineering: Procedures for Designing Airborne Chemical, Biological, and Radiological Protection for Buildings
UFC 4-211-01N Aircraft Maintenance Hangars: Type I, Type II and Type III, with Change 3; also see the Supplement ITG FY10-01
UFC 4-211-02 Aircraft Corrosion Control and Paint Facilities
UFC 4-390-01 O&M: Unmanned Pressure Test Facilities Safety Certification Manual
UFC 4-440-01 WAREHOUSE AND STORAGE FACILITIES
UFC 4-510-01 Design: Medical Military Facilities
UFC 4-610-01 Administrative Facilities
UFC 4-826-10 Design: Refrigeration Systems for Cold Storage
UFC 4-832-01N Design: Industrial and Oily Wastewater Control

FIRE PROTECTION

UFC 3-600-01 Fire Protection Engineering for Facilities

UFC 3-601-02 Operations and Maintenance: Inspection, Testing, and Maintenance of Fire Protection Systems

AIR FORCE PUBLICATIONS

AFI 32-1054, *Corrosion Control*

AFI 32-1066, *Backflow Prevention Program*

AFI 32-1068, *HEATING SYSTEMS AND UNFIRED PRESSURE VESSELS (14 MAY 2013)*

AFI 32-10141, (3 March 2011) – *PLANNING AND PROGRAMMING FIRE SAFETY DEFICIENCY CORRECTION PROJECTS*

AFI 23-204, *Organizational Fuel Tanks*

AFI 32-7044, *Storage Tank Environmental Compliance*

AFPD 90-17, Energy Management, and AFI 90-1701, Energy Management

AIR FORCE MANUAL 32-1084, Facility Requirements

ETL 03-1: *Storm Water Construction Standards*

ETL 11-25, *Implementation of Major and Area Source Rules as Applied to Boiler Tune-ups and Energy Assessments for the Boiler MACT Rule*

INDUSTRY STANDARDS AND CODES

ANSI/ASHRAE Standard 15 *Safety Standard for Refrigeration Systems*, latest edition

ANSI/ASHRAE Standard 34 *Designation and Safety Classification of Refrigerants*

ANSI/ASHRAE Standard 62.1 *Ventilation for Acceptable Indoor Air Quality,* latest edition

ANSI/ASHRAE/IES Standard 90.1 *Energy Standard for Buildings Except Low-Rise Residential Buildings* (latest edition)

ANSI/ASHRAE Standard 90.2 *Energy Efficient Design of Low-Rise Residential Buildings* (latest edition)

ASME *Boiler and Pressure Vessel Code*

ASME *Boiler and Pressure Vessel Code*, Section IX, "Welding and Brazing Qualifications,"

Gravity Sanitary Sewer Design and Construction**,** as jointly published by the *Water Environment Federation* and the *American Society of Civil Engineers* as the MOP FD-5

National Fire Protection Association

FEDERAL

40 CFR (Code of Federal Regulations) part 82

Executive Order 13423 - Strengthening Federal Environmental, Energy, and Transportation Management

Executive Order 13693 - Planning for Federal Sustainability in the Next Decade

Executive Order - FEDERAL LEADERSHIP IN ENVIRONMENTAL, ENERGY, AND ECONOMIC PERFORMANCE

Energy Policy Act of 2005 (EPAct 2005)

EPA 40 CFR Part 63, Subpart JJJJJJ, *National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers Area Sources*

Building Life-Cycle Cost Program (BLCC) available at the Federal Energy Management Program website: http://www1.eere.energy.gov/femp/information/download_blcc.html**.**

Attachment of Rooftop Equipment in High-Wind Regions, FEMA, July 2006

Abbreviations and Acronyms

72 ABW – 72nd Air Base Wing, Tinker A.F.B.

AFCEE – Air Force Center for Engineering and the Environment
AFCESA – Air Force Civil Engineer Support Agency
AF – Air Force
AFI – Air Force Instruction
AFMAN – Air Force Manual
AFMC – Air Force Materiel Command
ANG – Air National Guard
AFPD – Air Force Policy Directive
AFRC – Air Force Reserve Command
ANSI – American National Standards Institute
ASHRAE – American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.

BCE – Base Civil Engineer
BCP – Base Comprehensive Plan

CATCODE – Category Code
CE – Base Civil Engineering
CECE – Base Civil Engineering Design & Construction
CECO – Base Civil Engineering Operations and Maintenance
CFR – Code of Federal Regulations

DoD – Department of Defense

E.T.L. – Engineering Technical Letter

FOMA – Facilities Operation and Maintenance

MAJCOM – Major Command
MILCON – Military Construction
NFPA – National Fire Protection Association

NTE – Not to Exceed

O&M – Operation & Maintenance
OH&P – Overhead and Profit
OSD – Office of the Secretary of Defense

RPIE – Real Property Installed Equipment

SIOH – Supervision, Inspection and Overhead

SRM – Sustainment, Restoration and Modernization

TAFB – Tinker Air Force Base

ATTACHMENTS FOLLOW

DOCUMENT CONTROL RECORD

ISSUE	REV	DATE	BY
ORIGINAL DRAFT FOR QC REVIEW	-0-	10-FEB-2017	KDW
ISSUED FOR BASE WIDE REVIEW	1.1	14-FEB-2017	KDW
ISSUED FOR APPROVAL	-0-	01-MAR-2017	KDW
ISSUED FOR APPROVAL	2.0	20-MAR-2018	KDW

INFORMATION REQUIRED FOR NEW BOILER

INFORMATION REQUIRED FOR INSTALLATION/START-UP OF THE BOILER IN BLDG_____
POST LOCATION_____

Boiler Information

Manufacturer:

Model and MMBtu/hr input:

Serial Number:

Type of Boiler:

Primary Fuel:

Secondary/Alternative Fuel:

Dates of construction/installation/startup

Date construction commenced:

Date of installation of boiler:

Date of boiler startup (initial startup to check if the boiler is operating properly):

Date of boiler startup for continuous operation (official startup date):

Boiler Stack Information (note units, if different than shown)

Stack Diameter (ft):

Stack Height (ft):

Rated Stack Flow (cfm):

Stack temperature (°F):

Provide brochures and specifications available for the boiler

CONTINUOUS MAINTENANCE AND RECORDKEEPING REQUIREMENTS

Tune-up requirement-

Frequency is dependent on the Rated Heat Input Capacity of the Boiler, as follows:

> =10MMBtu/hr	Annual tuneups
< 10 but >5MMBtu/hr	Tune-ups every 2 years
<= 5MMBtu/hr	Tune-ups every 5 years

CEAN must be informed every time tune-ups are performed in the boilers

Date, time, and duration of every startup and shutdown of the boiler
Type of fuel and amount of fuel used during every startup and shutdown of the boiler

For dual fuel boilers (boilers that operate using NG and have liquid fuel as backup)

Date, type and amount of alternative fuel usage. Reason for using alternative fuel. If alternative fuel is used due to a natural gas curtailment, it needs to be notified immediately to CEAN.

Attachment of Rooftop Equipment in High-Wind Regions

FEMA

HURRICANE KATRINA RECOVERY ADVISORY

Purpose: To recommend practices for designing and installing rooftop equipment that will enhance wind resistance in high-wind regions.

> **Note:** For attachment of lightning protection systems, see Hurricane Katrina Recovery Advisory on Rooftop Attachment of Lightning Protection Systems in High-Wind Regions.

Key Issues

Rooftop equipment frequently becomes detached from rooftops during hurricanes. Water can enter the building at displaced equipment (see Figure 1); displaced equipment can puncture and tear roof coverings (thus allowing water to leak into the building). Equipment blown from a roof can damage buildings and injure people. Damaged equipment may no longer provide service to the building.

Figure 1. This gooseneck was attached with only two small screws. A substantial amount of water was able to enter the building during the hurricane.

Construction Guidance

Mechanical Penthouse: By placing equipment in mechanical penthouses rather than being exposed on the roof, equipment within penthouses is shielded from high-wind loads and windborne debris (see Figure 2). Therefore, use of mechanical penthouses designed and constructed in accordance with a current building code are recommended, particularly for critical and essential facilities.

Design Loads and Safety Factors: Loads on rooftop equipment should be determined in accordance with the 2005 edition of ASCE 7.

Note: For guidance on load calculations, see "Calculating Wind Loads and Anchorage Requirements for Rooftop Equipment," ASHRAE Journal, volume 48, number 3, March 2006.

A minimum safety factor of 3 is recommended for critical and essential facilities, and a minimum safety factor of 2 is recommended for other buildings. Loads and resistance should also be calculated for heavy pieces of equipment (see Figure 2).

Figure 2. This 30' x 10' x 8' 18,000-pound HVAC unit was attached to its curb with 16 straps (one screw per strap). Although the wind speeds were estimated to be only 85 to 95 miles per hour (3-second peak gust), it blew off the building.

Simplified Attachment Table: To anchor fans, small HVAC units, and relief air hoods, the following minimum attachment schedule is recommended (see Table 1) (note: the attachment of the curb to the roof deck also needs to be designed to resist the design loads):

Table 1. Number of #12 Screws for Base Case Attachment of Rooftop Equipment

Case No.	Curb Size and Equipment Type	Equipment Attachment	Fastener Factor for Each Side of Curb or Flange
1	12"x 12" Curb with Gooseneck Relief Air Hood	Hood Screwed to Curb	1.6
2	12"x 12" Gooseneck Relief Air Hood with Flange	Flange Screwed to 22 Gauge Steel Roof Deck	2.8
3	12"x 12" Gooseneck Relief Air Hood with Flange	Flange Screwed to 15/32" OSB Roof Deck	2.9
4	24"x 24" Curb with Gooseneck Relief Air Hood	Hood Screwed to Curb	4.6
5	24"x 24" Gooseneck Relief Air Hood with Flange	Flange Screwed to 22 Gauge Steel Roof Deck	8.1
6	24"x 24" Gooseneck Relief Air Hood with Flange	Flange Screwed to 15/32" OSB Roof Deck	8.2
7	24"x 24" Curb with Exhaust Fan	Fan Screwed to Curb	2.5
8	36"x 36" Curb with Exhaust Fan	Fan Screwed to Curb	3.3
9	5'-9"x 3'- 8" Curb with 2'- 8" high HVAC Unit	HVAC Unit Screwed to Curb	4.5*
10	5'-9"x 3'- 8" Curb with 2'- 8" high Relief Air Hood	Hood Screwed to Curb	35.6*

Notes to Table:

1. The loads are based on the 2005 edition of ASCE 7. The resistance includes equipment weight.

2. The Base Case of the tabulated numbers of #12 screws (or ¼ pan-head screws for flange-attachment) is a 90-mph basic wind speed, 1.15 importance factor, 30' building height, Exposure C, using a safety factor of 3.

3. For other basic wind speeds, or for an importance factor of 1, multiply the tabulated number of #12 screws by $\left(\frac{V_D^2 \times I}{90^2 \times 1.15}\right)$ to determine the required number of #12 screws or (¼ pan-head screws) required for the desired basic wind speed, V_D (mph) and importance factor, I.

4. For other roof heights up to 200', multiply the tabulated number of #12 screws by (1.00 + 0.003 [h - 30]) to determine the required number of #12 screws or ¼ pan-head screws for buildings between 30' and 200'.

Example A: 24" x 24" exhaust fan screwed to curb (table row 7), Base Case conditions (see Note 1): 2.5 screws per side; therefore, round up and specify 3 screws per side.

Example B: 24" x 24" exhaust fan screwed to curb (table row 7), Base Case conditions, except 120 mph and importance factor of 1: 120^2 x 1 ÷ 90^2 x 1.15 = 1.55 x 2.5 screws per side = 3.86 screws per side; therefore, round up and specify 4 screws per side.

Example C: 24" x 24" exhaust fan screwed to curb (table row 7), Base Case conditions, except 150' roof height: 1.00 + 0.003 (150' - 30') = 1.00 + 0.36 = 1.36 x 2.5 screws per side = 3.4 screws per side; therefore, round down and specify 3 screws per side.

* This factor only applies to the long sides. At the short sides, use the fastener spacing used at the long sides.

Fan Cowling Attachment: Fans are frequently blown off their curbs because they are poorly attached. When fans are well attached, the cowlings frequently blow off (see Figure 3). Unless the fan manufacturer specifically engineered the cowling attachment to resist the design wind load, cable tie-downs (see Figure 4) are recommended to avoid cowling blow-off. For fan cowlings less than 4 feet in diameter, 1/8-inch diameter stainless steel cables are recommended.

Figure 3. Cowlings blew off two of the three fans shown in this photo. Cowlings can tear roof membranes and break glazing.

Figure 4. To overcome blow-off of the fan cowling, this cowling was attached to the curb with cables.

For larger cowlings, use 3/16-inch diameter cables. When the basic wind speed is 120 mph or less, specify two cables. Where the basic wind speed is greater than 120 mph, specify four cables. To minimize leakage potential at the anchor point, it is recommended that the cables be adequately anchored to the equipment curb (rather than anchored to the roof deck). The attachment of the curb itself also needs to be designed and specified.

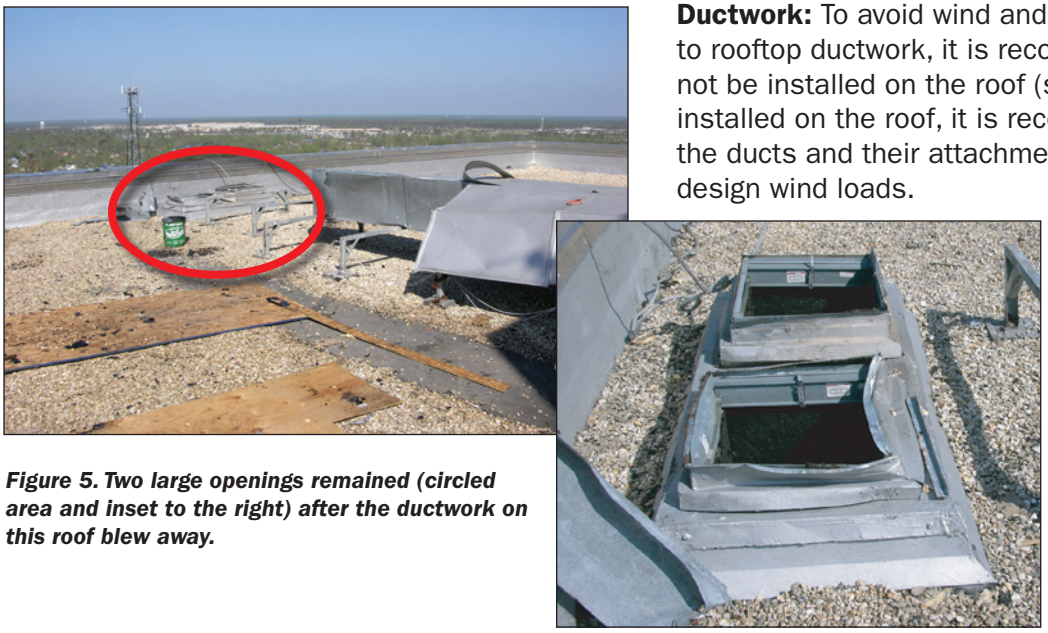


Figure 5. Two large openings remained (circled area and inset to the right) after the ductwork on this roof blew away.

Ductwork: To avoid wind and windborne debris damage to rooftop ductwork, it is recommended that ductwork not be installed on the roof (see Figure 5). If ductwork is installed on the roof, it is recommended that the gauge of the ducts and their attachment be sufficient to resist the design wind loads.

Condensers: In lieu of placing rooftop-mounted condensers on wood sleepers resting on the roof (see Figure 6), it is recommended that condensers be anchored to equipment stands. (Note: the attachment of the stand to the roof deck also needs to be designed to resist the design loads.) In addition to anchoring the base of the condenser to the stand, two metal straps with two side-by-side #14 screws or bolts at each strap end are recommended (see Figure 7).

Figure 6. Sleeper-mounted condensers displaced by high winds.

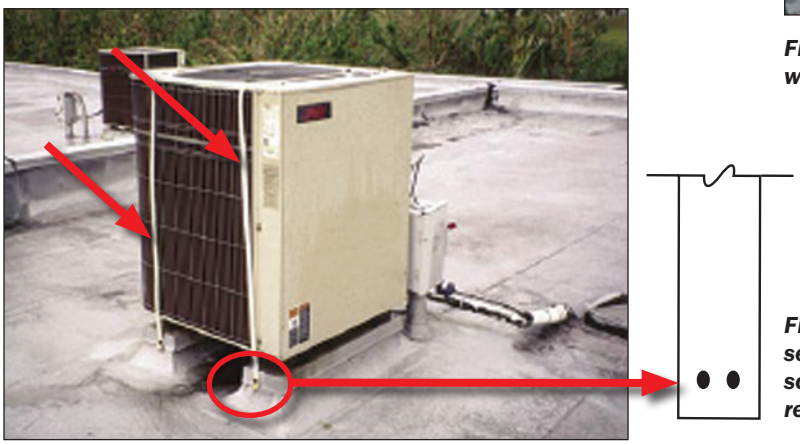


Figure 7. This condenser had supplemental securement straps (see arrows). Two side-by-side screws with the proper edge and end distances are recommended at the end of the strap.

Vibration Isolators: When equipment is mounted on vibration isolators, an isolator that has sufficient resistance to meet the design uplift loads should be specified and installed, or an alternative means to accommodate uplift resistance should be provided (see Figure 8).

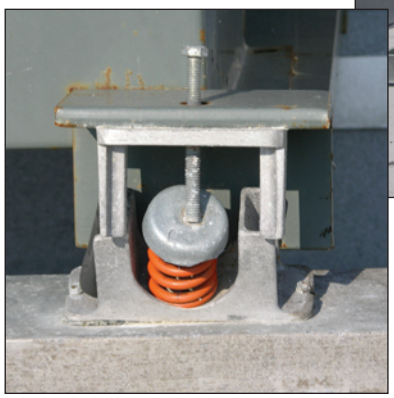


Figure 8. The equipment on this stand was resting on vibration isolators that provided lateral resistance but no uplift resistance (above). A damaged vibration isolator is shown in the inset (left).

Access Panel Attachment: Access panels frequently blow off. To minimize blow-off of access panels, job-site modification will typically be necessary (for example, the attachment of hasps and locking devices such as a carabiner). The modification details will need to be tailored for the equipment, which may necessitate detail design after the equipment has been delivered to the job site. Modification details should be approved by the equipment manufacturer.

Figure 9. Several of the equipment screen panels were blown away. Loose panels can break glazing and puncture roof membranes.

Equipment Screens: Equipment screens around rooftop equipment are frequently blown away (see Figure 9). Equipment screens should be designed to resist the wind loads derived from ASCE 7.

Note: The extent that screens may reduce or increase wind loads on equipment is unknown. Therefore, the equipment behind screens should be designed to resist the loads previously noted.

Other resources: Three publications pertaining to seismic restraint of equipment provide general information on fasteners and edge distances:

- Installing Seismic Restraints for Mechanical Equipment (FEMA 412)
- Installing Seismic Restraints for Electrical Equipment (FEMA 413)
- Installing Seismic Restraints for Duct and Pipe (FEMA 414)