

**BY ORDER OF THE
SECRETARY OF THE AIR FORCE**

AIR FORCE INSTRUCTION 32-1068

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Civil Engineering

**HEATING SYSTEMS AND UNFIRED
PRESSURE VESSELS**



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This instruction implements Air Force policy directive (AFPD) 32-10, *Installations and Facilities*, by establishing uniform requirements for installation, operation, maintenance, and inspection of real property installed equipment (RPIE) heating systems and unfired pressure vessels (UPV). This instruction applies only to pressure vessels covered by the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code*. It does not apply to low-pressure boilers below 0.29 megawatt (MW) (1 million British thermal units per hour [MBtu/h]) output used only for domestic water heating, or pressure vessels containing noncorrosive refrigerants. This publication applies to all Air Force, Air Force Reserve Command (AFRC), and Air National Guard (ANG) units and personnel. This publication may be supplemented at any level, but all direct Supplements must be routed to the Office of Primary Responsibility (OPR) of this publication for coordination prior to certification approval. The authorities to waive wing/unit level requirement in this publication are identified with a Tier ("T-0, T-1, T-2, T-3") number following the compliance statement. See AFI 33-360, *Publications and Forms Management*, for a description of the authorities associated with the Tier numbers. Submit requests for waivers through the chain of command to the appropriate Tier waiver approval authority, or alternately, to the Publication OPR for non-tiered compliance items. Refer recommended changes and questions about this publication to the OPR using the AF Form 847, Recommendation for Change of Publication; route AF Forms 847 from the field through the appropriate functional chain of command. Ensure that all records created as a result of processes prescribed in this publication are maintained in accordance with Air Force Manual (AFMAN) 33-363, *Management of Records*, and disposed of in accordance with the Air Force Records Information Management System (AFRIMS) Records Disposition Schedule (RDS). The use of

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SUMMARY OF CHANGES

This document has been substantially revised and must be completely reviewed. Major changes include the addition of Tier wavier authority requirements, updated office symbols, and updated references.

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1. Objective. Air Force heating systems and UPVs must be safe, reliable, and efficient. Build and operate these systems to comply with the ASME *Boiler and Pressure Vessel Code* and conform to federal law.

2. Responsibilities.

2.1. Air Force Director of Civil Engineers (A4C):

2.1.1. Formulates Air Force instructions and guidance for maintaining heating systems and UPVs.

2.1.2. Directs implementation of applicable public law, safety standards, and Department of Defense (DOD) directives.

2.2. Air Force Civil Engineer Center (AFCEC):

2.2.1. Provides technical assistance to Major Commands (MAJCOMs).

2.2.2. Consolidates boiler records, tune-ups, energy assessments, recordkeeping, and reporting for enterprise-level reporting and development of air emission inventories.

2.3. MAJCOM:

2.3.1. Gives management and technical assistance to base civil engineer organizations.

2.3.2. Helps bases determine fuel requirements.

2.3.3. Overseas: Provides solid fuel requisition procedures for overseas bases.

2.3.4. Approves mixing and burning waste fuel and lubricants with heating fuel.

2.3.5. Manages the boiler inspection program for bases within the MAJCOM and coordinates inspection requirements with joint-base counterparts, as required.

2.3.6. Approves heating fuel or equipment conversion proposals.

2.3.6.1. Coordinates proposals to ensure project documentation is complete and that the economic analysis, including the life-cycle cost analysis, complies with centrally funded energy program investment procedures.

2.3.6.2. Coordinates economic analysis and approval with AFCEC.

2.3.7. Approves temporary repairs to distribution systems.

2.3.8. ANG will provide guidance to ANG installations where variations from this instruction are necessary.

2.4. Base Civil Engineer (BCE): Ensures boilers, distribution systems, and pressure vessels are constructed, installed, operated, tested, assessed, repaired, maintained, and documented in compliance with applicable codes, regulations, federal law, and host nation final governing standards (FGS) at overseas installations. **(T-0)**

2.4.1. Operates and maintains base heating and distribution systems and UPVs covered by this instruction. **(T-2)**

2.4.2. Determines liquid, solid, and gas utility fuel requirements and ensures safety and adequacy of fuel supplies. **(T-2)**

- 2.4.3. Establishes and maintains a recurring work program for heating and pressure vessel systems for maximum cost benefit. **(T-2)**
- 2.4.4. Establishes and maintains a base steam trap maintenance program. **(T-2)**
- 2.4.5. Develops and maintains local operating procedures. **(T-2)**
- 2.4.6. Maintains operating logs and records of boiler repairs. **(T-0)**
- 2.4.7. Develops schedules for inspecting and testing heating systems and UPVs; ensures that inspections are conducted as scheduled and equipment is reliable and safe. **(T-0)**
- 2.4.8. Processes and posts inspection reports and reports unsafe boilers or pressure vessels to the MAJCOM. **(T-1)**
- 2.4.9. Establishes a program to measure systems' performance and make continuous improvements. Reviews metrics from this program periodically. **(T-2)**
- 2.4.10. Assigns properly-trained, experienced personnel. **(T-2)**
- 2.4.11. Ensures a qualified inspector approves repairs to boiler pressure vessel components, fuel, and control systems. **(T-1)**
- 2.4.12. Ensures heat plant operating personnel are licensed to meet state and Environmental Protection Agency (EPA) requirements, or host nation FGS at overseas installations. **(T-0)**
- 2.4.13. Ensures system effluents conform to applicable standards. **(T-2)**
- 2.4.14. Ensures waste is burned only in approved furnaces. **(T-2)**
- 2.4.15. Recommends recurring work requirement changes for engineering short- and long-range system replacement planning. **(T-2)**
- 2.4.16. Ensures approved repairs or alterations are programmed and accomplished. **(T-2)**
- 2.4.17. Ensures all boilers, pressure vessels, and pressure piping systems are constructed, installed, tested, repaired, or replaced to meet ASME or equivalent host nation requirements. **(T0)**
- 2.4.18. Ensures all boiler fuel piping and controls meet NFPA or equivalent host nation requirements. **(T-0)**
- 2.4.19. Develops cost-effective alternatives for system and equipment monitoring, where feasible. **(T-2)**
- 2.4.20. Analyzes and plans operations, maintenance, and repair workloads. **(T-2)**
- 2.4.21. Ensures efficient management of service contracts and warranty programs for maintenance and repair of heating systems. **(T-2)**
- 2.4.22. Ensures all construction projects involving heat plants and distribution systems comply with requirements of this instruction and environmental permits and regulations. **(T-0)**
- 2.4.23. Ensures technical engineering support is provided for planning, design, management, and execution of heating system projects. **(T-2)**

2.4.24. Ensure records documenting tune-ups, energy assessments, and operational tests are maintained as required by 40 CFR Part 63, Subparts DDDDD and JJJJJ. **(T-0)**

3. Requirements.

3.1. **Fuel Conversion.** Public law requires Air Force heating systems use the most cost-effective fuel as determined by life-cycle cost analysis. Evaluate fuel suitability, availability, environmental impact, reliability, and maintainability when considering fuel conversion. Use life-cycle costing methods, procedures, and information as described in National Institute of Standards and Technology (NIST) Handbook 135, *Life-Cycle Costing Manual for the Federal Energy Management Program*, and escalation factors found in the NIST *Annual Supplement: Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis*. **(T-0)**

3.2. Solid Fuels.

3.2.1. Requisitions.

3.2.1.1. **Request for Coal Purchase.** Prepare DD Form 416, *Purchase Request for Coal, Coke, or Briquettes*, and submit to Defense Logistics Agency (DLA), DLA Energy-AC, 8725 John J. Kingman Road, Room 3830, Fort Belvoir, Virginia 22060-6222, according to dates and instructions specified by DLA Energy-AC. The MAJCOM will provide requisition and acceptance procedures for overseas bases. **(T-2)**

3.2.1.2. **Placing Orders.** DD Form 1155, *Order for Supplies or Services*, must be submitted in accordance with DLA Energy-AC instructions and at least 30 days prior to the desired delivery date. **(T-2)**

3.2.2. **Accepting Deliveries.** Before accepting a delivery, central heat plant personnel must inspect each shipment prior to unloading and at the point and time of delivery, according to the DLA Energy-AC contract for the base. **(T-2)** Samples from the coal shipment will be sent out for analysis according to the DLA Energy-AC contract for the base.

3.2.2.1. **Sampling.** Heat plant personnel must take coal samples according to the DLA Energy-AC contract for the base and attach a completed USAPL Form 710, *Request for Analysis of Coal Sample*. **(T-0)** Refer to Military Standard (MIL-STD) 3004C, *Quality Assurance/Surveillance for Fuels, Lubricants and Related Products*, Appendix C, and the applicable contract for coal sampling procedures and specific requirements. Coal sample submission procedures are found at https://usapc2.army.mil/AKO Auth/testing_sampling/coal/coal_sample.asp.

3.2.2.2. **Non-Conforming Coal.** The coal sampler will notify the Operations Flight Chief when a coal delivery does not comply with the contract, and recommends rejection to DLA Energy-AC. **(T-2)** **Note:** The DLA Energy-AC contracting officer is the final authority for rejecting a coal shipment.

3.2.3. **Inspecting Coal Stockpiles.** Heat plant personnel must inspect coal stockpiles at least twice weekly. **(T-3)** Investigate abnormally high temperatures or signs of spontaneous combustion. Use a temperature probe (or other proven method) to measure internal temperature. If internal temperature rises above 71 degrees Celsius (°C) (160 degrees Fahrenheit [°F]), coal may ignite. **(T-3)**

3.3. **Liquid Fuels.** Paragraphs 3.3.1 through 3.3.5 describe procedures for testing fuel quality, processing liquid fuel requisitions, managing organizational fuel tanks, fuel sampling, and mixing and burning waste fuel with heating fuel.

3.3.1. **Liquid Fuels Quality.** All fuels to be burned must meet requirements of Technical Order (T.O.) 42B-1-1, *Quality Control of Fuels and Lubricants*, Chapter 6. (T-1)

3.3.2. **Requisitions.** Submit liquid fuel requirements for each fiscal year to the base fuels management flight (FMF). (T-3)

3.3.3. **Managing Organizational Fuel Tanks.** Tanks owned or operated by the BCE must meet the requirements of Air Force Instruction (AFI) 23-204, *Organizational Fuel Tanks*, and AFI 327044, *Storage Tank Environmental Compliance*. (T-1)

3.3.4. **Sampling and Testing.** Fuel sampling is the responsibility of the receiving organization. The BCE will coordinate with the local Fuels Management Team (FMT) to assure fuel quality in accordance with Technical Order (TO) 42B1-1, *Quality Control of Fuels and Lubricants*. (T-1)

3.3.5. **Mixing and Burning Waste Fuel and Lubricants with Heating Fuel and Burning Biodiesel.** Coordinate requests through the BCE with the base environmental office to obtain MAJCOM approval before mixing and burning waste fuel and lubricants with heating fuel. Biodiesel fuel and biodiesel blends exceeding B5 (5% biodiesel) will not be burned in boilers. (T-2)

3.4. **Process Steam.** Where possible, supply process steam that wastes condensate (such as steam cleaning) from dedicated boilers.

3.5. **Heating and Distribution Systems and Unfired Pressure Vessels (UPV).** Design and construction of steam boilers, hot water generators, heating and distribution systems, UPVs, and pressure piping systems must comply with the ASME *Boiler and Pressure Vessel Code* or equivalent host nation requirements and this instruction. (T-0) Design of all steam and hot water heating systems must include equipment to provide industrial water treatment (see AFI 32-1054, *Corrosion Control*). (T-0) Equip all boilers and UPVs with a pressure-relieving device as required by the ASME *Boiler and Pressure Vessel Code*. Equip all steam pressure-reducing valve stations on the low-pressure side with a correctly rated and sized pressure-relief device. Compressed air receivers less than 0.04 cubic meter (1.5 cubic feet) must have the manufacturer's standard pressure-relieving device. (T-0) All pressure vessels in which moisture can accumulate must have automatic condensate drainage. (T-0)

3.5.1. **Attendance.** Minimum attendance for operating technicians must meet the requirements in Table 1 (hot water) and Table 2 (steam) at facilities or heat plants having single or multiple steam boilers and/or hot water generators with typical total capacities and pressures. (T-1) Operating technicians must be able to detect and correctly respond to equipment malfunctions or irregularities that could disrupt service, cause a hazard, or damage equipment. Plant personnel must be licensed to meet environmental regulatory agency requirements. (T-0) Recommend all steam boilers operating at or above 103 kilopascals (kPa) (15 pounds per square inch gauge [psig]) or hot water generators operating at or above 207 kPa (30 psig) which are not constantly attended, be monitored from a remote location manned full-time by a system-trained technician with the

capability to safely shut down units. Remote monitoring will not override (prevent) any boiler or hot water generator safety shutdown. **(T-0)** Variances to Table 1 must be approved by the MAJCOM. **(T-1)** Requests for variances must include a complete description of the boiler system, control technology, proposed operating procedures, and frequency of attendance. **(T-1)**

Table 1. Minimum Boiler Attendance¹ (Hot Water).

| Heating Medium | Total Boiler Capacity ² | Operating Pressure and Temperature | Fuel | Frequency of Attendance |
|----------------|--|---|---------------------------------|---|
| Hot water | under 1.465 MW (5,000,000 Btu/h) | under 207 kPa (30 psig) and 121 °C (250 °F) | all energy sources | once every month during operation ³ |
| | over 1.465 MW (5,000,000 Btu/h) | under 207 kPa (30 psig) and 121 °C (250 °F) | all energy sources | once every day during operation ³ |
| | under 1.465 MW (5,000,000 Btu/h) | 207–1103 kPa (30–160 psig) 121–177 °C (250–350 °F) | all energy sources | once per 8-hour shift during operation ³ |
| | 1.465 MW (5,000,000 Btu/h) to 8.8 MW (30,000,000 Btu/h) | 207–1103 kPa (30–160 psig) 121–177 °C (250–350 °F) | all energy sources | twice per 8-hour shift during operation ³ |
| | 8.8 MW (30,000,000 Btu/h) to 29.3 MW (100,000,000 Btu/h) | 207–1103 kPa (30–160 psig) 121–177 °C (250–350 °F) | all energy sources ⁴ | constant attendance by one person per 8-hour shift ⁵ |
| | over 29.3 MW (100,000,000 Btu/h) | 207–1103 kPa (30–160 psig) 121–177 °C (250–350 °F) | all energy sources ⁴ | constant attendance by two people per 8-hour shift |
| | under 8.8 MW (30,000,000 Btu/h) | over 1103 kPa (160 psig) over 177 °C (350 °F) | all energy sources | twice per 8-hour shift during operation ³ |
| | 8.8 MW (30,000,000 Btu/h) to 29.3 MW (100,000,000 Btu/h) | over 1103 kPa (160 psig) over 177 °C (350 °F) | all energy sources ⁴ | constant attendance by two people per 8-hour shift ⁵ |
| | over 29.3 MW (100,000,000 Btu/h) | over 1103 kPa (160 psig) over 177 °C (350 °F) | all energy sources ⁴ | constant attendance by two people per 8-hour shift |

Notes:

- Attendance at a lesser frequency than listed in the table must be approved by the MAJCOM. **(T-1)**.
- The sum of the rated capacities of all boilers and hot water generators in the facility.
- Frequency of attendance does not include time for performing maintenance tasks.
- For coal-fired plants, additional operating personnel are required for coal and ash handling consistent with installed equipment.
- Attendance can be reduced by one person per 8-hour shift only if boiler controls and safeties are automated and continuously monitored by a system-trained technician from a remote location with the capability for safe shutdown of all units.

Table 2. Minimum Boiler Attendance¹ (Steam).

| Heating Medium | Total Boiler Capacity² | Operating Pressure and Temperature | Fuel | Frequency of Attendance |
|-----------------------|--|---|---------------------------------|---|
| Steam | under 0.293 MW (1,000,000 Btu/h) | under 103 kPa (15 psig) | all energy sources | once every week during operation ³ |
| | 0.293 MW (1,000,000 Btu/h) to 1.465 MW (5,000,000 Btu/h) | under 103 kPa (15 psig) | all energy sources | twice per week during operation ³ |
| | over 1.465 MW (5,000,000 Btu/h) | under 103 kPa (15 psig) | all energy sources | once per operating day ³ |
| | under 1.465 MW (5,000,000 Btu/h) | over 103 kPa (15 psig) | all energy sources | once per 8-hour shift during operation ³ |
| | 1.465 MW (5,000,000 Btu/h) to 8.8 MW (30,000,000 Btu/h) | over 103 kPa (15 psig) | all energy sources ⁴ | twice per 8-hour shift during operation ³ |
| | 8.8 MW (30,000,000 Btu/h) to 29.3 MW (100,000,000 Btu/h) | over 103 kPa (15 psig) | all energy sources ⁴ | constant attendance by two people per 8-hour shift ⁵ |
| | over 29.3 MW (100,000,000 Btu/h) | over 103 kPa (15 psig) | all energy sources ⁴ | constant attendance by two people per 8-hour shift |

Notes:

- Attendance at a lesser frequency than listed in the table must be approved by the MAJCOM. **(T-1).**
- The sum of the rated capacities of all boilers and hot water generators in the facility.
- Frequency of attendance does not include time for performing maintenance tasks.
- For coal-fired plants, additional operating personnel are required for coal and ash handling consistent with installed equipment.
- Attendance can be reduced by one person per 8-hour shift only if boiler controls and safeties are automated and continuously monitored by a system-trained technician from a remote location with the capability for safe shutdown of all units.

3.5.2. Operating Logs. Heat plant logs give the heat plant foreman and supervisory and management personnel a summary of boiler plant operations and performance and establish a basis for conformance with environmental air quality permits. For this purpose, use AF Form 1163, *Monthly High Temperature Water Distribution System Operating Log*; AF Form 1165, *Monthly High Temperature Water Plant Operating Log*; AF Form 1458, *Daily Steam Boiler Plant Operating Log*; AF IMT 1459, *Water Treatment Operating Log for Steam and Hot Water Boilers*; and AF Form 1464, *Monthly Steam Boiler Plant Operating Log*. Computer-generated printouts are acceptable if they

contain all pertinent information. The heat plant foreman or operations flight maintenance chief must maintain boiler plant performance and operating logs for the following boilers: **(T-1)**

3.5.2.1. High pressure (over 103 kPa [15 psig] steam and 121 °C [250 °F]).

3.5.2.2. 1103 kPa (160 psig) high-temperature water (HTW) boiler plant with output capacity of 0.41 MW (1.4 MBtu/h) or more.

3.5.2.3. Low-pressure boiler plant with output of 1.41 MW (4.8 MBtu/h). The BCE sends operating logs for high-pressure plants 4.1 MW (14 MBtu/h) or larger to the MAJCOM (if required by the MAJCOM).

3.5.3. **Maintenance.** At dual-fuel plants, fire boilers at least bimonthly with standby fuel to confirm reliability. Overhaul equipment and accomplish other major maintenance during off-peak periods. Annually calibrate boiler instrumentation. Ensure that replacement materials and parts comply with boiler code safety standards. Maintain equipment ASME code stamps and labels in legible condition. The BCE will ensure that scheduled maintenance of boilers, heating equipment, and steam traps is accomplished. **(T-1)**

3.5.3.1. **Pressure Vessel Welding.** The ASME *Boiler and Pressure Vessel Code*, Section IX, "Welding and Brazing Qualifications," contains welding procedural specifications and welder qualification requirements. Do not weld or braze pressure components of steam-jacketed cooking equipment; replace failed parts. **(T-0)**

3.5.3.2. **Distribution Systems.** Accomplish maintenance according to the manufacturer's recommendations and appropriate repair codes. **(T-3)**

3.5.3.2.1. **Existing Systems.** At least annually, pressure test the outer conduit of direct burial systems (with pressure-test capability). Pressure test the outer conduit at 103 kPa (15 psig) for 24 hours. Record results in a permanent log; include a summary of events and final analysis. With systems that cannot be pressure tested, use thermograph technology or other approved testing methods as recommended by the manufacturer. **(T-2)** Recommend system be inspected annually for damage or loss of insulation. Repair as necessary to maintain insulating qualities. **(T-3)**

3.5.3.2.2. **Failed Distribution Lines.** Make temporary repairs to failed lines as soon as conditions permit. Program replacement of failed sections as soon as the extent of failure is known. Notify the MAJCOM when you are considering replacement. **(T-1)**

3.5.3.2.3. **Temporary Repairs.** Temporary repairs are permitted to direct buried systems using piping other than prefabricated conduit systems. Limit these repairs to 152.4 meters (500 feet) per repair, and replace these repairs within 18 months with an approved system and materials. Repair material must be suitable for use under the pressure and temperature conditions of the distribution system being repaired. **(T-1)**

3.5.3.2.4. **Cathodic Protection Systems.** Where cathodic protection is installed on distribution lines, inspection, testing, and maintenance must be accomplished

in accordance with AFI 321054 and Unified Facilities Criteria (UFC) 3-570-06, *Operation and Maintenance: Cathodic Protection Systems*. (T-2)

3.5.4. Replacing or Installing New Distribution Lines. Before replacing failed lines or installing new lines, select a route, then a system type.

3.5.4.1. Route Selection. The system route should be coordinated with the facility master plan. The selected route has considerable impact on system type selection. For example, aboveground systems usually are not acceptable if they create obstructions to traffic or are unsightly, while large numbers of obstructions along the system profile greatly increase the cost of underground systems. Attention should be given to any severe or complex installation conditions that adversely affect the cost of the system. The final route selected should minimize the system life-cycle cost.

3.5.4.2. System Type Selection. Evaluate potential heat distribution system types according to the following order of preference: (1) aboveground; (2) shallow concrete trench; (3) direct buried prefabricated conduit; (4) poured-in-place underground insulation system. (T-1) Select the most cost-effective system based on the results of a life-cycle cost analysis. (T-1) Calculate heat loss for each system under consideration by using standard American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) methods. (T-2) Evaluate life-cycle costs of the alternatives by using the Building Life-Cycle Cost program (BLCC) available at the Federal Energy Management Program website: <http://www1.eere.energy.gov/femp/information/download/blcc.html>. **Note:** Studies by the U.S. Army Construction Engineering Research Laboratory (USACERL) indicate that, in general, life-cycle cost is lower for shallow concrete trenches than direct burial systems. (T-2)

3.5.4.3. Installation. Install and test new systems per the Unified Facilities Guide Specifications (UFGS)(reference paragraph 3.5.4.4), manufacturer's requirements, or by other approved methods. Recommend an authorized factory representative be present during installation and testing of systems. Complete all tests and correct deficiencies prior to insulating or covering connections, joints, welds, or fittings. Promptly send a copy of the test results to the MAJCOM for evaluation. (T-1)

3.5.4.4. Unified Facilities Guide Specification (UFGS) for the Design and Construction of New or Replacement Distribution Systems. Design and construct new and replacement distribution systems to UFGS requirements. UFGS are available at the Whole Building Design Guide (www.wbdg.org). (T-1) Refer to Attachment 1 for the appropriate UFGS for design and installation of new or replacement distribution lines.

3.5.5. Inspections and Testing.

3.5.5.1. Methods and Criteria.

3.5.5.1.1. The United States, Its Territories and Possessions. Boilers and UPVs must be inspected in accordance with the *National Board Inspection Code* (NBIC). (T-0)

3.5.5.1.2. **Foreign Countries.** Boilers and UPVs must be inspected in accordance with host nation agreements or standards if comparable (minimally) to the NBIC; otherwise, follow the NBIC guidelines. **(T-0)**

3.5.5.1.3. **Air National Guard (ANG) Inspection Criteria.** ANG will inspect boilers and UPVs according to state, local, and NBIC inspection criteria for inspections at ANG bases. **(T-0)**

3.5.5.2. **Boilers and Fired Pressure Vessels.**

3.5.5.2.1. Inspect high-pressure steam boilers (above 103 kPa [15 psig]) and HTW generators (above 1103 kPa [160 psig] or 121 °C [250 °F]) and expansion tanks in active use in accordance with the requirements of Attachment 2 (inspection types, frequency of inspection, and scheduling). **(T-0)** Inspections must be performed by a certified inspector (see paragraph A2.2.9). **(T-0)**

3.5.5.2.2. Inspect steam boilers with safety valves set at 103 kPa (15 psig) or less, hot water boilers with safety valves set at 310 kPa (45 psig) or less, and pressure vessels of less than 9818 W (33,500 Btu/hr) specially constructed for laboratory purposes. **(T-0)** Inspection and evaluation can be performed by properly qualified personnel, as determined by the owner. **(T-3)**

3.5.5.3. **Steam-Jacketed Cooking Equipment.** Inspect steam kettles and other steam-jacketed cooking equipment according to the manufacturer's instructions, or perform a Type VB inspection (see Attachment 2) with hydrostatic test, excluding internal inspection, once every three years. **(T-0)** The hydrostatic test pressure will be up to the safety valve set pressure. **(T-0)**

3.5.5.4. **Unfired Pressure Vessels (UPV) Inspection Requirements.**

3.5.5.4.1. Every three years, inspect UPVs internally and externally according to the following criteria and as illustrated in Figure 1: **(T-0)**

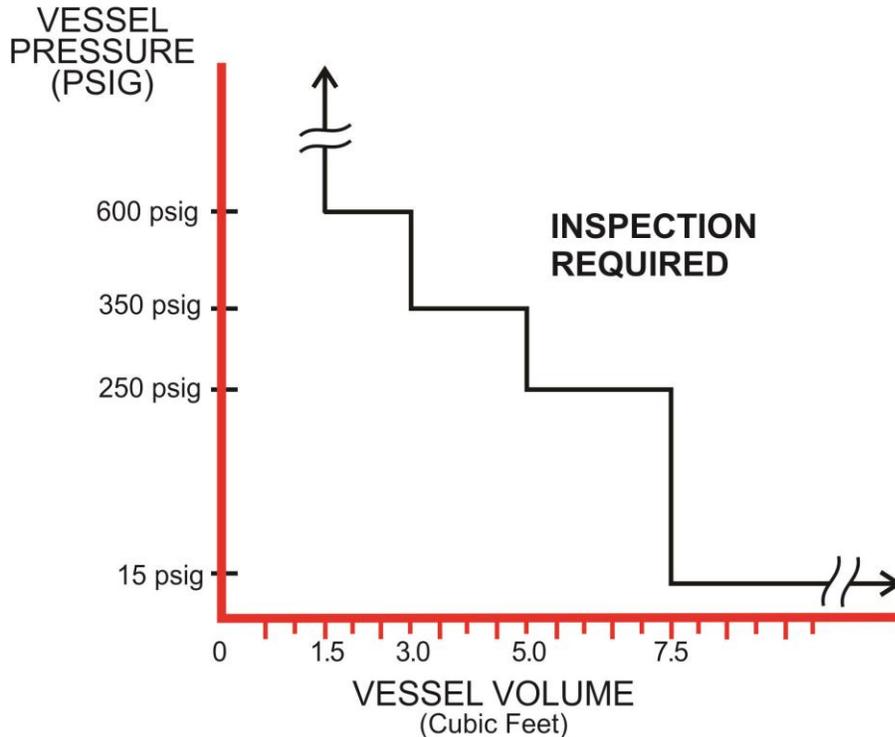
3.5.5.4.1.1. UPVs greater than 1.5 cubic feet (0.042 cubic meter) in volume and greater than 4136.85 kPa (600 psig) design pressure.

3.5.5.4.1.2. UPVs greater than 3 cubic feet (0.08 cubic meter) in volume and greater than 2413.17 kPa (350 psig) design pressure.

3.5.5.4.1.3. UPVs greater than 5 cubic feet (0.141 cubic meter) in volume and greater than 1723.1 kPa (250 psig) design pressure.

3.5.5.4.1.4. UPVs greater than 7.5 cubic feet (0.212 cubic meter) in volume and greater than 103 kPa (15 psig) design pressure.

Figure 1. Unfired Pressure Vessel (UPV) Inspection Requirements.



3.5.5.4.2. Perform a hydrostatic test to 1.5 times working pressure every three years on vessels operating above 1379 kPa (200 psig) that cannot be inspected internally and externally. **(T-0)**

3.5.5.4.3. Inspect unfired steam pressure vessels which operate at pressures above 103 kPa (15 psig) every three years, or more frequently as determined by procedures in the NBIC. **(T-0)** A Type VB inspection must be performed with a hydrostatic test to 1.5 times working pressure every three years on vessels operating above 1379 kPa (200 psig) that cannot be inspected internally and externally. **(T-0)** Where applicable, pressure vessels without access for internal inspections must be inspected by non-destructive testing (NDT) procedures. **(T-0)**

3.5.5.4.4. The following categories of UPVs are excluded from the specific inspection requirements:

3.5.5.4.4.1. UPVs with an inside diameter, width, height, or cross-section diagonal not exceeding 15 centimeters (6 inches), but with no limitation on length or pressure.

3.5.5.4.4.2. Pressure vessels for human occupancy.

3.5.5.4.4.3. Fired process tubular heaters.

3.5.5.4.4.4. UPVs with an internal or external operating pressure not exceeding 103 kPa (15 psig), but with no limitation on size.

3.5.5.4.4.5. Hot water storage tanks heated by steam or other means when the following limitations are not exceeded: a nominal water-containing capacity of 454 liters (120 gallons); a water temperature of 99 °C (210 °F); and heat input of 0.058 MW (200,000 Btu/hr).

3.5.5.4.4.6. UPVs for containing water under pressure, including vessels containing air, the compression of which serves only as a cushion, when the following limitations are not exceeded: a design pressure of 2067.7 kPa (300 psig), and a design temperature of 99 °C (210 °F).

3.5.5.4.4.7. Any structure whose primary function is transporting fluids from one location to another within a system of which it is an integral part (i.e., piping systems).

3.5.5.5. **Reporting Inspections.** Report all boiler and pressure vessel inspections on AF IMT 1222, *Boiler or Pressure Vessel Inspection Report* or Air Force equivalent. Promptly notify the MAJCOM when a boiler or pressure vessel is unsafe to operate. **(T-1)** The MAJCOM may issue separate reporting instructions. Post one copy of the inspection report (under a transparent protective cover) in a conspicuous location near the boiler or pressure vessel; send one copy to the operations flight; place one copy in the file. **(T-1)**

3.5.5.6. **Post-Inspection Repairs.** Before leaving the base, the inspector will report any serious defects to the operations flight. **(T-1)** The boiler/UPV owner must take corrective actions requested by the inspector or listed on the inspection reports. **(T-1)** If a boiler or pressure vessel is unsafe to operate, proper repairs must be made before placing it on-line. **(T-1)** All repairs to pressure components of boilers or UPVs and safety pressure-relief devices must be performed by an organization holding the appropriate NBIC code stamp and in accordance with ASME requirements. **(T-0)**

3.5.5.7. **Reporting Repairs.** After inspecting the repairs (paragraph A2.2.4), complete the following actions: post one copy of the inspection report describing the repair actions (under a transparent protective cover with the original inspection report); send one copy to the operations flight; place one copy in the file. **(T-1)**

3.5.5.8. **Boiler Tune-ups and Energy Assessments.** Boiler owners must follow the requirements of EPA 40 CFR Part 63, Subpart DDDDD, *National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters*, or Subpart JJJJJ, *National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers Area Sources*, whichever is applicable. **(T0)** The regulation sets requirements for emission levels, tune-ups, and energy assessments which identify energy conservation measures, based on boiler size, hazardous air pollutants, fuel types, and location (source) of boilers. For additional guidance, refer to Engineering Technical Letter (ETL) 11-25, *Implementation of Major and Area Source Rules as Applied to Boiler Tune-ups and Energy Assessments for the Boiler MACT Rule*.

3.6. **Real Property Similar Equipment (RPSE), Mobile Boiler, and Privately- or Contractor-Owned.** Such boilers and UPVs located on Air Force installations must be operated safely and comply with the provisions of paragraph 3.5 through paragraph 3.5.5.8.

(T-0) The unit owning organization or contract quality assurance evaluator (QAE) will monitor these boilers and UPVs to ensure the operator/owner:

3.6.1. Complies with basic safety practices similar to those required for government boilers and UPVs. **(T-0)**

3.6.2. Arranges for periodic safety inspections. **(T-0)**

3.6.3. Schedules an authorized inspection agency to perform inspections at the same intervals required for government boilers and UPVs. **(T-0)**

3.6.4. Posts inspection reports as specified for government-operated boilers and UPVs. **Note:** The equipment owner must: (1) Make repairs that the inspector recommends; (2) pay for all inspections and repairs; and (3) not operate equipment before repairing it if the inspector declares it unsafe. **(T-0)** Repair equipment according to the NBIC or host country code, as applicable. **(T0)**

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DCS/Installations, Logistics & Mission Support

Attachment 1**GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

- 40 CFR Part 51, *Requirements for Preparation, Adoption, and Submittal of Implementation Plans*
- 40 CFR Part 63, *National Emission Standards for Hazardous Air Pollutants for Source Categories*
- AFI 23-204, *Organizational Fuel Tanks*
- AFI 32-1054, *Corrosion Control*
- AFI 32-7040, *Air Quality Compliance and Resource*
- AFI 32-7044, *Storage Tank Environmental Compliance*
- AFI 33-364, *Records Disposition – Procedures and Responsibilities*
- AFMAN 33-363, *Management of Records*
- AFPD 32-10, *Installations and Facilities*, 4 March 2010
- ASME *Boiler and Pressure Vessel Code*, 2013
- ASME CSD-1, *Controls and Safety Devices for Automatically Fired Boilers*, 2009
- ETL 11-25, *Implementation of Major and Area Source Rules as Applied to Boiler Tune-ups and Energy Assessments for the Boiler MACT Rule*, 8 August 2011
- National Board Inspection Code (NBIC)*, 2011
- MIL-STD-3004C, *Quality Assurance/Surveillance for Fuels, Lubricants and Related Products*, 7 December 2012
- NFPA 85, *Boiler and Combustion Systems Hazards Code*, 2011
- NISTIR 85-3273-38, *Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis – 2013, Annual Supplement to NIST Handbook 135 and NBS Special Publication 709*, June 2013
- NIST Handbook 135, *Life-Cycle Costing Manual for the Federal Energy Management Program*, 1995
- T.O. 42B-1-1, *Quality Control of Fuels and Lubricants*, 13 August 2012
- UFC 3-570-06, *Operation and Maintenance: Cathodic Protection Systems*, 31 January 2003
- UFGS 33 60 02, *Aboveground Heat Distribution System*, April 2008
- UFGS 33 61 00, *Prefabricated Underground Heating/Cooling Distribution System*, April 2008
- UFGS 33 61 13, *Pre-engineered Underground Heat Distribution System*, August 2010
- UFGS 33 61 14, *Exterior Buried Preinsulated Water Piping*, February 2010
- UFGS 33 61 15, *Heat Distribution Systems in Concrete Trenches*, July 2006
- UFGS 33 63 13, *Exterior Underground Steam Distribution System*, April 2006

UFGS 33 63 14, *Exterior Buried Pumped Condensate Return System*, April 2006

UFGS 33 63 16, *Exterior Shallow Trench Steam Distribution System*, July 2006

UFGS 33 63 23, *Exterior Aboveground Steam Distribution*, April 2006

Prescribed Forms

AF Form 1163, *Monthly High Temperature Water Distribution System Operating Log*

AF Form 1165, *Monthly High Temperature Water Plant Operating Log*

AF 1222, *Boiler or Pressure Vessel Inspection Report*

AF 1458, *Daily Steam Boiler Plant Operating Log*

AF 1459, *Water Treatment Operating Log for Steam and Hot Water Boilers*

AF 1464, *Monthly Steam Boiler Plant Operating Log*

Adopted Forms

AF Form 847, *Recommendation for Change of Publication*

USAPL Form 710, *Request for Analysis of Coal Sample*

DD Form 416, *Purchase Request for Coal, Coke, or Briquettes*

DD Form 1155, *Order for Supplies or Services*

Abbreviations and Acronyms

°C—degrees Celsius

°F—degrees Fahrenheit

AFCEC—Air Force Civil Engineer Center

AFCEC/CO—Air Force Civil Engineer Center, Operations Directorate

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFPD—Air Force Policy Directive

AFRC—Air Force Reserve Command

AFRIMS—Air Force Records Information Management System

ANG—Air National Guard

ASHRAE—American Society of Heating, Refrigerating and Air Conditioning Engineers

ASME—American Society of Mechanical Engineers

BCE—Base Civil Engineer

BLCC—building life-cycle cost

Btu/hr—British thermal units per hour

CFR—Code of Federal Regulations

CONUS—continental United States
COR—Contracting Officer’s Representative
DD—Department of Defense (form)
DLA—Defense Logistics Agency
DOD—Department of Defense
EPA—Environmental Protection Agency
ETL—Engineering Technical Letter
FAX—facsimile (telecopying)
FGS—final governing standards
FMF—fuels management flight
HTW—high-temperature hot water
IMT—Information Management Tool
kPa—kilopascal
MACT—Maximum Achievable Control Technology
MAJCOM—major command
MBtu/h—thousand British thermal units per hour
MIL-STD—Military Standard
MW—megawatt
NBIC—National Board Inspection Code
NDT—non-destructive testing
NFPA—National Fire Protection Association
NIST—National Institute of Standards and Technology
OCONUS—outside continental United States
psig—pounds per square inch gauge
OPR—Office of Primary Responsibility
QAE—quality assurance evaluator
RDS—Records Disposition Schedule
RPIE—real property installed equipment
RPSE—real property similar equipment
T.O.—Technical Order
UFGS—Unified Facilities Guide Specification
UPV—unfired pressure vessel

USACERL—U.S. Army Construction Engineering Research Laboratory

USAPL—U.S. Army Petroleum Laboratory

W—watt

Attachment 2

INSPECTION REQUIREMENTS

A2.1. Types of Inspections.

A2.1.1. Boilers:

A2.1.1.1. **Type BA:** Internal and external inspection.

A2.1.1.2. **Type BB:** Internal and external inspection followed or preceded by external inspection while boiler is under a hydrostatic test.

A2.1.1.3. **Type BC:** Operational inspection while under steam pressure or filled with water. This inspection also includes verifying that safety devices perform as intended in accordance with ASME CSD-1 or NFPA 85, as applicable.

A2.1.1.4. **Type BD:** External inspection while under hydrostatic test.

A2.1.1.5. **Type BE:** Internal and external inspection of expansion tanks with HTW boilers.

A2.1.2. Unfired Pressure Vessels (UPV):

A2.1.2.1. **Type VA:** Internal and external inspection.

A2.1.2.2. **Type VB:** Internal and external inspection followed or preceded by external inspection while pressure vessel is under hydrostatic test.

A2.1.2.3. **Type VC:** External inspection while under operating conditions and pressure.

A2.1.2.4. **Type VD:** External inspection while under hydrostatic test.

A2.1.2.5. **Type VE:** Internal and external inspection with an ultrasonic thickness test of the pressure shell.

A2.2. Requirements.

A2.2.1. High-Pressure Steam Boilers: (T-0)

A2.2.1.1. Perform a Type BA inspection, including an internal and external inspection, annually.

A2.2.1.2. Perform a Type BB inspection, which includes a hydrostatic test, every three years. This replaces the Type BA inspection for that year.

A2.2.1.3. Accomplish a secondary inspection (Type BC) annually.

A2.2.2. High Temperature Water (HTW) Boilers: (T-0)

A2.2.2.1. Perform an external (Type BC) inspection once a year.

A2.2.2.2. Perform an internal inspection (Type BA) after the first and second year of operation.

A2.2.2.3. Perform a Type VE inspection on each expansion tank every two years. Perform a Type VC inspection during alternating years.

A2.2.3. Frequency of HTW Boiler Internal Inspections After Two Years. After operating and inspecting the boiler for two years, extend the frequency of internal inspection to three years if: **(T-0)**

A2.2.3.1. No adverse conditions such as scale or corrosion are present.

A2.2.3.2. The amount of makeup water is negligible.

A2.2.3.3. Effective chemical treatment is under strict control.

A2.2.4. Questionable Steam and HTW Boilers. Perform a Type BB inspection when: (1) a boiler has been reinstalled; or (2) a boiler had major repairs (as defined in the NBIC). Inspect before returning the boiler to normal operation. Perform a Type BA inspection six months after resuming operation. Ensure an NBIC inspector performs a preliminary Type BA or Type BB inspection before initiating a major repair. **(T-0)**

A2.2.5. Low-Pressure Heating Boilers. Perform a Type BC inspection on: (1) hot water heating boilers that operate at or below 121 °C (250 °F) and at or below 1103 kPa (160 psig) annually; or (2) low-pressure steam boilers (below 103 kPa [15 psig]) biannually. Only boilers less than 0.293 MW (1 MBtu/h) output that produce domestic hot water are exempt from this inspection requirement. **(T-1)** Inspections do not require a certified inspector but at a minimum must be accomplished by experienced, qualified base personnel as approved by the BCE. **(T-3)**

A2.2.6. Compressed Air Receivers and Other Unfired Pressure Vessels (UPV). Perform a Type VE inspection every three years, except for liquefied petroleum (propane) tanks, which require a Type VC inspection every five years. **(T-0)** When questionable conditions or inspection indicates that a safety problem exists **(T-0)**

A2.2.6.1. Conduct hydrostatic tests.

A2.2.6.2. Notify the MAJCOM by telephone, followed by letter, e-mail, or FAX, of a pressure vessel safety problem and provide a copy of the UPV inspection.

A2.2.6.3. Perform repairs as required.

A2.2.6.4. Perform a Type VE inspection annually until all problems are corrected.

A2.2.6.5. After the inspection indicates that problems are corrected, perform an inspection every three years or five years, as required. **(T-0) Note:** For pressure vessels that operate over 1379 kPa (200 psig) and cannot be inspected internally and externally, perform hydrostatic testing to 1.5 times working pressure every three years. **(T-0)**

A2.2.7. New Boilers. Perform a Type BB inspection on all new boilers (steam or HTW) before operation. **(T-0)**

A2.2.8. Scheduling and Obtaining Inspection Services.

A2.2.8.1. Continental United States (CONUS) Bases. The MAJCOM ensures an inspection contract is in place and boilers and pressure vessels are scheduled for the required inspections. The central Air Force contract may be used. The MAJCOM coordinates with AFCEC and notifies other MAJCOMs before initiating a separate contract proposal. **(T-0)**

A2.2.8.1.1. **Scheduled Inspections (CONUS Bases).** The BCE schedules inspections according to one of two methods: (1) submits annual inspection requirements according to MAJCOM instructions; or (2) confirms computer-generated schedules according to MAJCOM instructions. **(T-1)**

A2.2.8.1.2. **Unscheduled Inspections (CONUS Bases).** If a boiler or pressure vessel requires an inspection and is not on the annual schedule, the BCE or a designated representative must request approval for inspection. **(T-2)** Submit the request according to MAJCOM instructions when using the central Air Force contract. Provide the MAJCOM and the AFCEC contracting officer's representative (COR) with a request for unscheduled boiler inspections, including the following information: a point of contact and alternate; commercial phone numbers, including area code; approximate date of inspection; and location of the vessel to be inspected (e.g., building number) by telephone, e-mail, or FAX, before scheduling the inspections. The contractor must receive approval from the AFCEC COR prior to performing inspections. **(T-1)**

A2.2.8.1.3. **Special Inspections (CONUS Bases).**

A2.2.8.1.3.1. Perform a special inspection (Type BA or BB) before starting repairs to pressure components. Perform an unscheduled Type BB inspection when repairs to pressure components are complete. Arrange these special inspections through the MAJCOM. Perform a special inspection after a boiler failure with potential damage or explosion to determine the extent of damage or necessary repairs. Depending upon the boiler condition, a loss analysis or useful life study may need to be conducted. The host MAJCOM or base must fund special studies. **(T-1)**

A2.2.8.1.3.2. If the company under contract cannot make a special or emergency inspection, the BCE may hire an authorized inspection agency. An installation employee must not make these special inspections. **(T-1)**

A2.2.8.2. **Bases Outside the Continental United States (OCONUS).** MAJCOMs serving bases in foreign countries must ensure a boiler inspection program exists. **(T-0)** Some host countries have their own boiler inspection program and may require the BCE to use their services. In other cases, the MAJCOM may use the CONUS inspection guidelines to establish a separate program. Bases in Alaska, Hawaii, Guam, other non-CONUS states, possessions, or territories, and foreign countries may also use the services available to CONUS bases.

A2.2.8.3. **Special Inspections (U. S. Bases in Foreign Countries).** MAJCOMs serving these bases must have qualified and competent boiler inspectors perform special inspections. **(T-0)** (Base-level personnel must not supervise these inspectors.) **(T-1)** The inspection agency must ensure a complete report for each inspection is sent to the MAJCOM. **(T-1)**

A2.2.9. **Inspector Qualifications.** The NBIC establishes basic qualifications for boiler inspectors in the United States, its territories, and possessions. Inspectors must hold a current National Board Commission. **(T-0)** MAJCOMs must use the NBIC standards for bases in foreign countries if the host country does not have NBIC-equivalent standards. **(T-0)**

A2.2.10. Hydrostatic Testing of Boilers.

A2.2.10.1. **Establishing Test Conditions.** During hydrostatic tests to determine tightness under Type BB or BD inspections: **(T-0)**

A2.2.10.1.1. Remove safety valves before testing or hold down each disc with a test clamp or plug device designed for this purpose.

A2.2.10.1.2. Ensure water temperature is not less than ambient and between 21 °C and 49 °C (70 °F and 120 °F).

A2.2.10.1.3. Ensure test pressure is equal to boiler working pressure, but not greater than the set pressure of the safety device with the lowest setting. **Note:** For tests under a Type BB inspection, externally inspect the boiler during the safety test at the pressure described above. Set test pressure for inspections of new boilers and existing boilers before and after repairs at 1.5 times the maximum allowable working pressure.

A2.2.10.2. **When to Hydrostatically Test High-Pressure Boilers.** Subject high-pressure boilers to hydrostatic tests only under specific conditions: **(T-0)**

A2.2.10.2.1. Upon completion of installation. (Include this requirement in the construction contract as a contractor's responsibility.)

A2.2.10.2.2. After completing major repairs to any boiler component subject to steam or water pressure.

A2.2.10.2.3. Before returning boilers to service in reactivated plants.

A2.2.10.2.4. When the boiler inspector, the facility, or MAJCOM engineer recommends the test.

A2.2.10.2.5. At the frequency required in paragraphs A2.2 through A2.2.1.3.