
USACE / NAVFAC / AFCEA UFGS-15514N (June 2005)

Preparing Activity: NAVFAC Superseding
UFGS-15514N (September 1999)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

Latest change indicated by CHG tags

References are in agreement with UMRL dated 23 June 2005

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DIVISION 15 - MECHANICAL

SECTION 15514N

LOW PRESSURE WATER HEATING BOILERS (UNDER 800,000 BTU/HR OUTPUT)

06/05

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SECTION 15514N

LOW PRESSURE WATER HEATING BOILERS (UNDER 800,000 BTU/HR OUTPUT)
06/05

NOTE: This guide specification covers the requirements for low pressure hot water heating boilers under 235 kilowatt 800,000 BTU/hr output.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

PART 1 GENERAL

1.1 REFERENCES

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI Z21.13 (2001; A 2002) Gas-Fired Low-Pressure
Steam and Hot Water Boilers
- ANSI Z83.3 (1971; R 1995) Gas Utilization Equipment
in Large Boilers

ASME INTERNATIONAL (ASME)

- ASME BPVC SEC IV (2001) Boiler and Pressure Vessel Code;
Section IV, Recommended Rules for the Care
and Operation of Heating Boilers
- ASME CSD-1 (2002) Control and Safety Devices for
Automatically Fired Boilers

ASTM INTERNATIONAL (ASTM)

- ASTM A 53 (1999b) Pipe, Steel, Black and Hot-Dipped,
Zinc-Coated, Welded and Seamless
- ASTM C 59/C 59M2 (1980) Mineral Fiber Blanket Insulation
and Blanket-Type Pipe Insulation
(Metal-Mesh Covered) (Industrial Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 211 (2003) Chimneys, Fireplaces, Vents, and
Solid Fuel-Burning Appliances

U.S. DEPARTMENT OF DEFENSE (DOD)

- MIL-B-18796 (Rev F; Notice 1) Burners, Single: Oil,
Gas, and Gas-Oil Combination for Packaged
Boilers (320,001 to 125,000,000 BTU/HR
Thermal Output Capacity)
- MIL-B-18797 (Rev G; Notice 1) Burners, Single: Light
Oil, Gas, and Light Oil-Gas Combination
for Packaged Heating Boilers (up to
320,000 BTU/HR Thermal Output Capacity)
- MIL-B-18897 (Rev F) Boilers, Steam and Hot Water,
Watertube (Straight Bare and Finned Tube),
Cast Iron and Firebox, Packaged Type
(40,000 to 35,000,000 BTU/HR Thermal
Output Capacity)
- MIL-F-18113 (Rev E; Notice 1) Feeders, Boiler Water
Treatment, By-Pass and Compound Receiver
Types

UNDERWRITERS LABORATORIES (UL)

- UL 726 (1995; Rev thru Jan 2001) Oil-Fired Boiler
Assemblies
- UL 795 (1999) Commercial-Industrial Gas Heating

Equipment

1.2 RELATED REQUIREMENTS

Section 15050N BASIC MECHANICAL MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein.

1.3 DESIGN REQUIREMENTS

NOTE: Insert boiler output capacity or indicate in boiler schedule. Select boiler design working pressure, operating pressure, operating temperature, and return water temperature and indicate in boiler schedule on drawings.

Boiler shall be suitable for installation in the space shown with ample room for opening doors and cleaning and removal and replacement of tubes. Boiler shall have an output of [_____] kW BTU/hr with an efficiency not less than that required by the applicable military specification. Boiler shall be designed, tested, and installed in accordance with ASME BPVC SEC IV and ASME CSD-1. Paint boiler in accordance with manufacturer's recommendations. Boiler design working pressure shall be [207 kPa (gage)] [30 psig] [_____] . Boiler operating pressure shall be [83 kPa (gage)] [12 psig] [_____] . Boiler operating temperature shall be [82 degrees C] [180 degrees F] [_____] . Boiler return water temperature shall be [71 degrees C] [160 degrees C] [_____] . Provide a thermostatically controlled three-way mixing valve on boiler suitable for operating conditions of the boiler.

1.3.1 Detail Drawings

Submit fuel train and wiring diagram

1.3.2 Water Analysis

Provide test reports of water analysis.

1.4 SAFETY STANDARDS

Hot water boilers, burners and supplementary control devices, safety interlocks, or limit controls required under this specification, shall meet requirements of the following standards as applicable:

- a. Oil-Fired Units: UL 726.
- b. Gas-Fired Units: ANSI Z83.3, ANSI Z21.13 or UL 795.
- c. Combination Gas- and Oil-Fired Units: UL 726, ANSI Z83.3, ANSI Z21.13 or UL 795.
- d. All Units: ASME BPVC SEC IV and ASME CSD-1.

Controls not covered by the above shall have a UL label, UL listing mark, or shall be listed in the Factory Mutual Approval Guide.

1.5 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

NOTE: Include the following paragraph for SOUTHNAVFACENGCOM projects.

[Submittals for this Section shall be delivered to the Contracting Officer, who shall forward two complete sets of copies to the Commanding Officer, Southern Division, Naval Facilities Engineering Command, Code 16B, for review and approval.]

SD-02 Shop Drawings

Fuel train

Wiring diagram

SD-03 Product Data

Boilers: power output, efficiency, ASME certification, allowable working pressure, model number

Boiler trim and control equipment

Burners and control equipment

Stack, breeching, and supports

SD-06 Test Reports

Operational tests

Water analysis

SD-07 Certificates

Boilers

Burners and control equipment

Boiler trim and control equipment

Boilers

Boiler trim and control equipment

Burners and control equipment

Boiler manufacturer's certificate of boiler performance including evidence that the burners provided shall be a make, model, and type certified and approved by the manufacturer of the boiler being provided.

SD-08 Manufacturer's Instructions

Boilers

Feedwater treatment feeder

SD-10 Operation and Maintenance Data

Boilers, Data Package 4

Submit in accordance with Section 01781 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Posted operating instructions for heating water boilers

PART 2 PRODUCTS

2.1 BOILERS

NOTE: Select boiler type and style required.

MIL-B-18897. Provide hot water heating boiler complete with firing equipment, combustion chamber, insulation with steel jacket, safety and operating controls, integral electrical wiring and other appurtenances, to make the boiler a complete, self-contained, fully-automatic unit, ready for service upon completion of utility connections. [Boilers less than 88 kW 300,000 Btuh shall have an Annual Fuel Utilization Efficiency (AFUE) of at least 80 percent.] [Gas fired boilers greater than 88 kW 300,000 Btuh output shall have a steady state combustion efficiency of at least 80 percent when fired at the maximum and minimum capacities which are provided and allowed by the controls.] [Oil fired boilers greater than 88 kW 300,000 Btuh output shall have a steady state combustion efficiency of at least 83 percent when fired at the maximum and minimum rated capacities which are provided and allowed by the controls.]

2.2 BURNERS AND CONTROL EQUIPMENT

NOTE: Indicate fuel trains on the drawings.
Conform to the requirements of ASME CSD-1 and
MIL-B-18796. See MIL-B-18796 for guidelines for
selection of a combustion control systems.

[2.2.1 Atmospheric-Type Gas Burner

Atmospheric-type gas burner (under 117 kW 400,000 BTU/hr input). ANSI Z21.13. Automatic recycling burner. ON-OFF type combustion control system. [Interrupted] [Intermittent] pilot type ignition system, and pilot shall be electrode-ignited natural gas type. Design burner and combustion control equipment for firing natural gas having a specific gravity of [0.6] [_____] and a heating value of approximately [37,300 kJ per cubic meter] [1000 BTU per cubic foot] and be an integral part of the boiler. Burner controls and safety equipment shall conform to applicable requirements of ANSI Z21.13, including complete gas shut-off and pilot gas. Gas pressure available: [_____] Pa inches of water gage] [_____] kPa (gage) psig].

] 2.2.2 Gas-Fired Power Burner

Gas-fired power burner (over 117 kW 400,000 BTU/hr input). MIL-B-18796. Interrupted pilot type ignition system, and pilot shall be the electrode-ignited natural gas type. Design burner and combustion control equipment for firing natural gas having a specific gravity of [0.6] [_____] and a heating value of approximately [37,300 kJ per cubic meter] [1000 BTU per cubic foot] [_____] and be an integral part of the boiler. Burner controls and safety equipment shall conform to applicable requirements of MIL-B-18796. Mount controls; including operating switches, indicating lights, gages, alarms, motor starters, fuses, and circuit elements of control systems on a single control panel or cabinet designed for separate mounting not on the burner in accordance with MIL-B-18796. The combustion control system shall be the [on/off] [high-low-off] [positioning] [metering] type. Locate flame scanner such that testing and cleaning of scanner can be accomplished without disassembly of burner. Provide fuel train as indicated. Gas pressure available: [_____] Pa inches of water gage] [_____] kPa (gage) psig].

] 2.2.3 Oil-Fired Power Burner

Oil-fired power burner (under 117 kW 400,000 BTU/hr input). MIL-B-18797. Direct electric-spark-ignited type ignition system. Burner controls and

safety equipment shall conform to applicable requirements of MIL-B-18797. The combustion control system shall be the [on/off] [high-low-off] [positioning] [metering] type.

] [2.2.4 Oil-Fired Power Burner

Oil-fired power burner (over 117 kW 400,000 BTU/hr input). MIL-B-18796. Pressure-atomizing type burner. Direct electric-spark-ignited type ignition system. Design burner and combustion control equipment for firing commercial grade number 2 fuel oil and be an integral part of the boiler. Burner controls and safety equipment shall conform to applicable requirements of MIL-B-18796. The combustion control system shall be the [on/off] [high-low-off] [positioning] [metering] type. Mount controls; including operating switches, indicating lights, gages, alarms, motor starters, fuses, and circuit elements of control systems on a single control panel or cabinet designed for separate mounting not on the burner in accordance with MIL-B-18796. Locate flame scanner such that testing and cleaning of scanner can be accomplished without disassembly of burner. Provide fuel train as indicated.

] [2.2.5 Gas and Light Oil-Fired Power Burner

Gas and light oil-fired power burner (over 117 kW 400,000 BTU/hr Input). MIL-B-18796. The combustion control system shall be the [on/off] [high-low-off] [positioning] [metering] type. Pressure-atomizing type oil burner. Interrupted-pilot type ignition system, and pilot be electrode-ignited natural gas type, except that the oil burner be direct electric-spark-ignited. Design burner and combustion control equipment for firing commercial grade number 2 fuel oil and natural gas having a specific gravity of [0.6] [_____] and a heating value of approximately [37,300 kJ per cubic meter] [1000 BTU per cubic foot] [_____] and be an integral part of boiler. Burner controls and safety equipment shall conform to applicable requirements of MIL-B-18796. Mount controls; including operating switches, indicating lights, gages, alarms, motor starters, fuses, and circuit elements of control systems on a single control panel or cabinet designed for separate mounting not on the burner in accordance with MIL-B-18796. Locate flame scanner such that testing and cleaning of scanner can be accomplished without disassembly of burner. Provide fuel train as indicated. Gas pressure available: [_____] Pa inches of water gage] [_____] kPa (gage) psig].

] 2.3 BOILER TRIM AND CONTROL EQUIPMENT

**NOTE: Include MIL-B-18796 if power burner with
input exceeding 117 kW 400,000 BTU/hr is required.**

Provide in accordance with MIL-B-18897 [and MIL-B-18796] and additional requirements specified below.

2.3.1 Emergency Disconnect Switch

**NOTE: Indicate location of emergency disconnect
switch on drawings. Insert emergency switch
amperage required.**

Provide and locate on wall outside boiler room entrance or just inside door, when boiler room door is on building exterior to allow rapid and complete shutdown of the boiler in the event of an emergency. Emergency switch shall be a [_____] -amp. fuse-type safety switch. Switch shall be red and furnished with a label indicating function of switch.

2.3.2 Relief Valves

Provide relieving capacity for the full output of boiler installed. Relief-valve piping shall conform to ASTM A 53, schedule 40 steel pipe and be piped full-size [to a floor drain] [to 150 mm 6 inches above floor].

2.3.3 Pressure and Altitude Gage or Combination Pressure/Altitude Gage

MIL-B-18897. Provide one located on supply water piping and one on return water piping.

2.3.4 Thermometer

Provide thermometer with a scale equivalent to 1.5 times outlet water temperature. Provide one located on supply water piping and one on return water piping.

2.3.5 Drain Tapping

Provide drain valve and piping [to a floor drain] [to 150 mm 6 inches above floor].

2.3.6 Make-up Water Station

2.3.6.1 Pressure Reducing Station

NOTE: Select operating pressure required.

Provide a water pressure-reducing valve and relief valve, or a combination of the two in the makeup water line to the boiler to maintain a water pressure of [83 kPa (gage)] [12 psig] [_____] in the hot water system. Provide a 20 mm 3/4 inch globe valve by-pass around this valve.

2.3.6.2 Backflow Preventers

Section 15400 PLUMBING SYSTEMS. Locate upstream of by-pass.

2.3.7 Feedwater Treatment Feeder

Provide in accordance with MIL-F-18113, Type II - Shot-Type Feeder (manual, intermittent feed), Style A - for use with pressures up to 1379 kPa (gage) 200 psig maximum.

2.3.8 Combustion Regulator

Provide adjustable temperature, thermostatic immersion type that shall limit boiler water temperature to a maximum of 121 degrees C 250 degrees F. Control shall actuate burner through an electric relay system to maintain boiler water temperature within normal prescribed limits at loads within rated capacity of boiler.

2.3.9 Air Vent Valve

Provide with screwed connection, stainless steel disk, and stainless steel seats to vent entrapped air.

2.3.10 High Temperature Limit Switch

NOTE: Specify alarm and indicating lights if input exceeds 117 kW 400,000 BTU/hr.

Provide immersible aquastat type with a temperature setting above that of the combustion regulator and below that of the lowest relief valve setting. Aquastat shall function to cause a safety shutdown by closing fuel valves[,] [and] shutting down burner equipment [, activating a red indicating light, and sounding an alarm] in the event that boiler water temperature rises to the high temperature limit setting. A safety shutdown due to high temperature shall require manual reset before operation can resume and prevent recycling of burner equipment.

2.3.11 Low Water Pressure Control

NOTE: Specify alarm and indicating lights if input exceeds 117 kW 400,000 BTU/hr. Select operating pressure required.

Provide mercury switch type. Control shall have a main scale, adjusting screws at the top of the case, and have an internal or external bellows. Control shall be the type which will open an electric circuit on a drop in pressure below a set minimum. Control shall be set and installed to cause a safety shutdown by closing fuel valves[,] [and] shutting down burner equipment [, activating a red indicating light, and sounding an alarm] in the event that water pressure in the system drops below [83 kPa (gage)] [12 psig] [_____]. A safety shutdown due to low water pressure shall require manual reset before operation can resume and prevent recycling of burner equipment.

2.3.12 Low Water Level Cutoff Switch

NOTE: Specify alarm and indicating lights if input exceeds 117 kW 400,000 BTU/hr.

Provide float actuated type. Low water level cutoff shall cause a safety shutdown by closing fuel valves[,] [and] shutting down burner equipment [, activating a red indicating light, and sounding an alarm] in the event that water level drops below the lowest safe permissible water level established by the boiler manufacturer and ASME BPVC SEC IV. A safety shutdown due to low water shall require manual reset before operation can resume and prevent recycling of burner equipment.

2.3.13 Boiler Safety Control Circuits

NOTE: Include draft fan if power burner is

specified.

Provide boiler safety control circuits, including control circuits for burner [and draft fan], shall be single-phase, two-wire one-side grounded, and not over 120 volts. Provide safety control switching in ungrounded conductors. Provide overcurrent protection. In addition to circuit grounds, ground metal parts which do not carry current to a grounding conductor.

2.3.14 Indicating Lights

NOTE: Delete entire paragraph if boiler input does not exceed 117 kW 400,000 BTU/hr. Include draft fan if power burner is specified.

Provide indicating lights as follows. Each safety interlock requiring a manual reset shall have an individually-labeled indicating light. Non-recycling controls/interlocks shall have the reset located on control/interlock itself. Indicating lights shall have colors as follows in lieu of those required by MIL-B-18796:

- a. Amber: Ignition on
- b. Green: Main fuel safety shut-off valves open
- c. Red (One for Each): Safety lockout, flame failure, low water pressure, low water level, and high temperature
- [d. Blue: Draft]

2.3.15 Alarm Bell

NOTE: Delete entire paragraph if boiler input does not exceed 117 kW 400,000 BTU/hr.

Provide alarm bell not less than 100 mm 4 inches in diameter, electrically operated, with a manual disconnect switch. Disconnect switch shall be type and wired so that switching off alarm following a safety shutdown will not prevent alarm from sounding again upon recurrence of a subsequent safety shutdown condition.

2.3.16 Post-Combustion Purge

NOTE: Delete entire paragraph if atmospheric burner is specified.

Provide controls and wiring necessary to ensure operation of draft fan for a period of not less than 15 seconds or of sufficient duration to provide four complete air changes in the boiler combustion chamber (whichever is greater) following shutdown of burner upon satisfaction of heat demand. Upon completion of post-combustion purge period, draft fan shall automatically shutdown until next restart.

2.3.17 Draft

Comply with boiler manufacturer's recommendations.

2.3.18 Stack, Breeching, and Supports

**NOTE: NFPA 211, Type B vent can only be used with
an atmospheric burner.**

[Provide boiler stack constructed of sheet steel having a thickness of not less than 2.47 mm 0.0972 inches with welded joints. Insulate stack located inside the building with 38 mm 1 1/2 inches of mineral wool conforming to applicable requirements of ASTM C 59/C 59M2, Class II - for use up to 649 degrees C 1200 degrees F. Insulation shall receive a finish coat of finishing cement not less than 19 mm 3/4 inch thick, trowelled to a smooth finish. Provide stack supports, umbrella collar and cap, and flue transition piece. Stack diameter and height shall be in accordance with manufacturer's recommendations and conform to NFPA 211.]

[NFPA 211, [Type B - gas] [Type L - oil and gas/oil], prefabricated multi-wall type, flashed to the roof, and complete with rain cap. Stack diameter and height shall be in accordance with manufacturer's recommendations and conform to NFPA 211.]

2.3.19 Hot Water Coils

**NOTE: Delete entire paragraph unless hot water
coils are required to instantaneously heat domestic
water.**

Provide coils capable of heating [_____] L/s GPM of water with [_____] degreeCF rise conforming to MIL-B-18897.

2.3.20 Stack Thermometer

Provide flue gas thermometer with scale calibrated from 66 to 399 degrees C 150 to 750 degrees F and mounted in flue gas outlet.

2.4 ELECTRIC MOTORS

**NOTE: Select standard efficiency for motors used
less than 750 hours per year and high efficiency for
motors used over 750 hours per year. Packaged
boilers should utilize the manufacturer's standard
efficiency motor.**

Motors which are not an integral part of a packaged boiler shall be rated for [standard] [high] efficiency per Section 16402 INTERIOR DISTRIBUTION SYSTEM. Motors which are an integral part of the packaged boiler system shall be the highest efficiency available by the manufacturer of the packaged boiler.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Install equipment in accordance with manufacturer's installation instructions. Grout equipment mounted on concrete foundations before installing piping. Install piping in such a manner as not to place a strain on equipment. Do not bolt flanged joints tight unless they match. Grade, anchor, guide, and support piping without low pockets. Feedwater treatment feeders shall be mounted so that the top of the feeder is no higher than 1219 mm 48 inches above the finished floor.

3.2 EQUIPMENT FOUNDATIONS

Locate equipment foundations as indicated, designed, and made of sufficient size and weight to preclude shifting of equipment under operating conditions or under abnormal conditions that could be imposed upon the equipment. Foundations shall meet requirements of the equipment manufacturer. Concrete and grout shall conform to Section 03300N CAST-IN-PLACE CONCRETE.

3.3 BOILER CLEANING

Before being placed in service, boiler shall be boiled out for a period of 24 hours at a pressure not exceeding 83 kPa (gage) 12 psig. Solution to be used in the boiler for the boiling out process shall consist of two pounds of trisodium phosphate per 379 liters 100 gallons of water. Upon completion of boiling out, flush out boiler with potable water, drain, and charge with chemically treated water. Protect boiler and appurtenances against internal corrosion until testing is completed and boiler is accepted. Professional services are required for cleaning/treatment process.

3.4 FIELD QUALITY CONTROL

Perform and furnish everything required for inspections and tests as specified herein to demonstrate that boiler and auxiliary equipment, as installed, are in compliance with contract requirements. Start-up and operate the system. During this time, clean strainers until no further accumulation of foreign material occurs. Exercise care to minimize loss of water when strainers are cleaned. Adjust safety and automatic control instruments as necessary to place them in proper operation and sequence. Test instrumentation shall be calibrated and have full scale readings from 1.5 to 2 times test values.

3.4.1 Operational Tests

Operate each boiler and appurtenances prior to final testing and insure that necessary adjustments have been made. Provide testing equipment required to perform tests. During this testing period, provide operating instructions and training to persons tasked with operation of the boiler. Tests shall be accomplished with both fuels on dual fuel units and include the following:

3.4.1.1 Preliminary Operational Test

Operate the boilers continuously for a period of at least 8 hours to demonstrate proper operability of the combustion control, flame safeguard control, and safety interlocks.

3.4.1.2 Acceptance Operational Test and Inspection

**NOTE: Insert the appropriate Engineering Field
Division.**

Conduct a preliminary operational test prior to requesting an acceptance operational test and inspection by a [_____] Division, Naval Facilities Engineering Command Boiler inspector. The Contracting Officer, upon receipt of the notice from the Contractor, shall request the boiler be inspected by [_____] Division Naval Facilities Engineering Command. Fifteen days advance notice is required for scheduling inspector to conduct acceptance operational test and inspection.

3.5 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurements commonly agreed on by the manufacturers or other parties. The inch-pound and metric measurements shown are as follows:

<u>Products</u>	<u>Inch-Pound</u>	<u>Metric</u>
a. Alarm Bell Diameter	= 4 inches	= 100 mm
b. Stack Thermometer Scale Range	= 150-750 degrees F	= 66-399 degrees C
-- End of Section --		