
USACE / NAVFAC / AFCEA / NASA UFGS-23 52 46.00 20 (April 2006)

Preparing Activity: NAVFAC Replacing without change
 UFGS-15515N (June 2005)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

Latest change indicated by CHG tags

References are in agreement with UMRL dated 1 April 2006

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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 52 46.00 20

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

04/06

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SECTION 23 52 46.00 20

LOW PRESSURE WATER HEATING BOILERS (OVER 800,000 BTU/HR OUTPUT)
04/06

NOTE: This guide specification covers the requirements for low pressure hot water heating boilers over 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: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically
be deleted from this section of the project
specification when you choose to reconcile
references in the publish print process.

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 Z83.3 (1971; R 1995) Gas Utilization Equipment
in Large Boilers

ASME INTERNATIONAL (ASME)

ASME BPVC SEC IV (2004) 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 (2004) 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

NFPA 85C (1991) Prevention of Furnace Explosions in
Fuel Oil- and Natural Gas-Fired Single
Burner Boiler-Furnaces

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-B-17452 (Rev E; Am 1; Notice 1) Boilers, Steam and
Hot Water, Firetube, Scotch Packaged Type
(320,001 to 35,000,000 BTU/HR Thermal
Output Capacity)

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-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 23 03 00.00 20 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.

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 per hour with an efficiency of not less than required by the applicable military specification. Boiler shall be designed, tested, and installed in accordance with ASME BPVC SEC IV and ASME CSD-1. Boiler shall be complete with an explosion-relief door, located in accordance with manufacturer's recommendations. Paint boiler in accordance with manufacturer's standard requirements. 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 F] [_____] . Provide a thermostatically controlled three-way mixing valve on the water supply to the boiler suitable for operating conditions of the boiler.

1.3.1 Detail Drawings

Submit fuel trains schematic and wiring diagrams.

1.3.2 Water Analysis

Provide test reports of water analysis.

1.3.3 Safety Standards

Hot water boilers, burners, and any 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 or NFPA 85C.
- b. Gas-Fired Units: UL 795, NFPA 85C, or ANSI Z83.3.
- c. Combination Gas and Oil-Fired Units: UL 726, UL 795, NFPA 85C, or ANSI Z83.3.

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.

1.4 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

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, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army 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 01 33 00 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 trains

Wiring diagrams

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

SD-07 Certificates

Boilers

Burners and control equipment

Boiler trim and control equipment

Water analysis

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 system

SD-10 Operation and Maintenance Data

Boilers, Data Package 4

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Posted operating instructions for heating water **boilers**

PART 2 PRODUCTS

2.1 BOILERS

NOTE: Select boiler size required.

Shall conform to the applicable requirements of MIL-B-17452. Hot-water boilers shall be horizontal firetube, multipass, modified scotch-type of the dry or wet-back type, packaged units mounted on a skid-type structural steel base. Provide each boiler complete burner and fuel system, a forced or induced draft fan, an automatic electronic control system complete with combustion and flame safeguard controls, firing sequence programmer, safety interlocks, limit controls and central control panel, and such trim and appurtenances as are peculiar to water units as specified herein. Units shall be factory-wired and assembled except for such readily installed appurtenances as safety valves, water columns, and pressure gages. Units shall be complete and ready for operation when connected to water, fuel, and electrical supplies.

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 system.

[2.2.1 Gas-Fired Power Burner

MIL-B-18796, Class 3 - gas-fired, automatic recycling. Interrupted pilot type ignition system, and pilot shall be electrode-ignited natural gas type. The combustion control system shall be the [high-low-off] [positioning] [metering] 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 the 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 in. wc [_____] kPa (gage) psig].

] 2.2.2 Oil-Fired Power Burner

MIL-B-18796, Class 2 - Light Oil-Fired, automatic recycling. [Pressure-atomizing] [Air-atomizing; compressor or pump furnished with the burner] type burner. The combustion control system shall be the [high-low-off] [positioning] [metering] type. Ignition system shall be [direct electric-spark-ignited type] [interrupted pilot type, and pilot shall be [electrode-ignited [natural] [propane] gas type] [light oil spark-ignition type]]. Design burner and combustion control equipment for firing commercial grade no. 2 fuel oil 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 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.] Oil fired boilers shall have a steady state combustion efficiency of at least 83 percent.

] 2.2.3 Combination Gas and Light Oil-Fired Power Burner

MIL-B-18796, Class 5 - combination light oil and gas-fired. Automatic recycling burner. The combustion control system shall be the [high-low-off] [positioning] [metering] type. Partial pre-mix type gas burner, complete with primary air fan. [Pressure-atomizing] [Air-atomizing; compressor or pump furnished with burner] type oil burner.

Ignition system for firing natural gas shall be interrupted pilot type, and pilot be electrode-ignited natural gas type. Ignition system for firing light oil shall be the [direct electric-spark-ignited type] [interrupted pilot type, and pilot shall be [electrode-ignited [propane] [natural] gas type] [light oil spark-ignition type]]. 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 light, 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 in. wc] [_____] kPa (gage) psig].

] 2.3 BOILER TRIM AND CONTROL EQUIPMENT

Provide in accordance with MIL-B-17452 and MIL-B-18796. Boiler trim shall comply with ASME BPVC SEC IV and additional appurtenances specified below. Non-recycling control interlocks shall have the reset located on control interlock.

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 the 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 Gage

MIL-B-17452. Provide with a scale equivalent to 1.5 time outlet water pressure with a **150 mm 6 inch** diameter. Locate one on supply water piping and one on the return water piping.

2.3.4 Thermometers

Provide thermometers with a scale equivalent to 1.5 times the 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 **22 00 00** PLUMBING SYSTEMS. Locate upstream of by-pass.

2.3.7 Stack Thermometer

Provide flue gas-dial type thermometer with scale calibrated from **66 to 399 degrees C 150 to 750 degrees F** and mount in flue gas outlet.

2.3.8 Air Vent Valve

Provide with screwed connections, stainless steel disk, and stainless steel seats to vent entrapped air from boiler.

2.3.9 Feedwater Treatment System

Provide in accordance with **MIL-F-18113**, Type II - shot-type feeder (manual, intermittent feed), Style A - for use with pressure up to **1379 kPa (gage)** **200 psig** maximum.

2.3.10 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.

2.3.11 High Temperature Limit Switch

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, 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 shall prevent recycling of the burner equipment.

2.3.12 Low Water Pressure Control

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 of 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, 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.

2.3.13 Low Water Level Cutoff Switch

Provide float actuated type. Low water level cutoff shall cause a safety shutdown by closing fuel valves, 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 level shall require manual reset before operation can resume and prevent recycling of burner equipment.

2.3.14 Low Water Flow Interlock

Low water flow interlock required by MIL-B-17452 is not required.

2.3.15 Boiler Safety Control Circuits

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.

2.3.16 Indicating Lights

NOTE: Include indicating lights for low gas
pressure and high gas pressure on all but size 1
burners.

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 the colors required by MIL-B-18796:

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

2.3.17 Alarm Bell

Provide alarm bell not less than 100 mm 4 inches in diameter, electrically operated, with a manual disconnect. 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.

2.3.18 Post-Combustion Purge

NOTE: Select four-air-change purge for Size 1, Size 2, and Size 3 burners. Select eight-air-change purge for Size 4 burners.

Provide a post-combustion purge in addition to the operating sequence required by MIL-B-18796. Provide controls and wiring necessary to assure operation of draft fan for a period of not less than 15 seconds or of sufficient duration to provide [four] [eight] 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.

2.3.19 Draft

Comply with boiler manufacturer's recommendations.

2.3.20 Stack, Breeching, and Supports

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 recommendation and conform to NFPA 211.

2.3.21 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 [_____] degrees C F rise conforming to MIL-B-17452.

2.3.22 Smoke Density Indicator

NOTE: Specify only if input exceeds 1465 kW
5,000,000 BTU/hr.

2.3.23 Annunciator

NOTE: Specify only if input exceeds 1465 kW
5,000,000 BTU/hr.

Provide in accordance with MIL-B-18796.

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 service per Section 26 20 00 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 the 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 not 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 any abnormal conditions that could be imposed upon the equipment. Foundations shall meet requirements of the equipment manufacturer. Concrete and grout shall conform to Section 03 30 00.00 20 CAST-IN-PLACE CONCRETE.

3.3 MANUFACTURER'S FIELD SERVICES

Furnish the services of an engineer or technician approved by the boiler manufacture for installation inspection, startup, and tests of equipment as specified below. After installation of equipment the engineer or technician shall provide a signed certificate or certified written statement that the equipment is installed in accordance with the manufacturer's recommendations. Services of more than one engineer or technician may be required based on types of specific equipment. One engineer or technician as appointed by the Contractor shall supervise and be responsible for the overall installation, start-up, test, and check out of systems. This person shall remain on the job until each unit has been in successful operation for 3 days and accepted.

3.4 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.

3.5 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 minimum loss of water occurs when strainers are cleaned. Adjust safety and automatic control instruments as necessary to place them in proper operation and sequence. During startup and during tests, factory-trained engineers or technicians employed by individual suppliers of such components as the burner, flame safeguard and combustion controls, and other auxiliary equipment shall be present as required, to insure proper functioning, adjustment, and testing of individual components and systems. Test instrumentation shall be calibrated and have full scale reading from 1.5 to 2 times test values.

3.5.1 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 fuel on dual fuel units and include the following:

3.5.1.1 Preliminary Operational Test

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

3.5.1.2 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 the inspector to conduct acceptance operational test and inspection.

3.6 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. Pressure Gage Diameter	= 6 inches	= 150 mm
b. Stack Thermometer Scale Range	= 150-750 degrees F	= 66-399 degrees C
c. Alarm Bell Diameter	= 4 inches	= 100 mm

-- End of Section --