UL 732

STANDARD FOR SAFETY

Oil-Fired Storage Tank Water Heaters

UL Standard for Safety for Oil-Fired Storage Tank Water Heaters, UL 732

Seventh Edition, Dated November 10, 2023

Summary of Topics

This Seventh Edition of ANSI/UL 732, the Standard for Oil-Fired Storage Tank Water Heaters, dated November 10, 2023, incorporates editorial changes including renumbering and reformatting to align with current style.

The requirements are substantially in accordance with Proposal(s) on this subject dated July 14, 2023.

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Standard for Oil-Fired Storage Tank Water Heaters

The first through third editions were titled Oil-Fired Water Heaters.

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This ANSI/UL Standard for Safety consists of the Seventh Edition.

The most recent designation of ANSI/UL 732 as an American National Standard (ANSI) occurred on November 10, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover oil-fired storage-tank water-heating appliances having a fuel input of not more than 200,000 Btu / hour (60 kW). These requirements do not apply to heaters that include storage vessels having a water capacity of more than 120 US gallons (454.2 L), or that are intended for heating water to a temperature of more than 200 °F (93 °C).

1.2 The oil-burning equipment covered by these requirements are intended for installation in accordance with the National Fire Protection Association Standard for the Installation of Oil Burning Equipment, NFPA 31, the International Mechanical Code and the Uniform Mechanical Code.

2 Components

2.1 A component of a product covered by this Standard shall:

a) Comply with the requirements for that component as specified in this Standard;

b) Be used in accordance with its rating(s) established for the intended conditions of use; and

c) Be used within its established use limitations or conditions of acceptability.

2.2 A component of a product covered by this Standard is not required to comply with a specific component requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product;

b) Is superseded by a requirement in this Standard; or

c) Is separately evaluated when forming part of another component, provided the component is used within its established ratings and limitations.

2.3 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

2.4 A component that is also intended to perform other functions such as overcurrent protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable standard(s) that cover devices that provide those functions.

3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

4 Referenced Publications

4.1 Any undated reference to a code or standard appearing in the requirements of this Standard shall be interpreted as referring to the latest edition of that code or standard.

4.2 The following publications are referenced in this Standard:

ANSI Z21.22/CSA4.4, *Relief Valves for Hot Water Supply Systems*

ASME B36.10 (Revision of ASME B36.10M), *Welded and Seamless Wrought Steel Pipe*

ASTM D396, *Standard Specifications for Fuel Oils*

AWS B2.1, *Standard for Welding Procedure and Performance Qualification*

NFPA 31, *Standard for the Installation of Oil Burning Equipment*

NFPA 70, *National Electrical Code*

NSF No. 14, *Standard for Plastic Piping System Components and Related Materials*

UL 94, *Tests for Flammability of Plastic Materials for Parts in Devices and Appliances*

UL 2211, *Overheating Protection for Motors*

5 Glossary

5.1 For the purpose of this Standard the following definitions apply.

5.2 ANTIFLOODING DEVICE – A primary safety control that causes the fuel flow to be shut off upon a rise in fuel level or upon receiving excess fuel, and that operates before discharge of fuel can occur.

5.3 APPLIANCE FLUE – The flue passages within the appliance.

5.4 AUTOMATICALLY LIGHTED APPLIANCE – An appliance in which fuel to the main burner is turned on and ignited automatically.

5.5 BAFFLE – An object placed in an appliance to direct the flow of air or flue gases.

5.6 BURNER – A device for the final conveyance of fuel or a mixture of fuel and air to the combustion zone.

5.7 BURNER, MECHANICAL-ATOMIZING – A power operated burner that prepares and delivers the fuel and all or part of the air by mechanical process in controllable quantities for combustion. Some examples are air atomizing, high- and low-pressure atomizing, horizontal and vertical rotary atomizing, and vertical rotary wall-flame burners.

5.8 BURNER, MECHANICAL-DRAFT – A burner that includes a power driven fan, blower, or other mechanism as the principal means for supplying air for combustion.

5.9 BURNER, NATURAL-DRAFT – A burner that principally depends upon the natural draft created in the flue to induce into the burner the air required for combustion.

5.10 BURNER, VAPORIZING – A burner consisting of an oil-vaporizing bowl or other receptacle to which liquid fuel may be fed in controllable quantities; the heat of combustion is used to vaporize the fuel, with provision for admitting air and mixing it with the fuel vapor in combustible proportions.

5.11 CASING – An enclosure forming the outside of the appliance, no parts of which are likely to be subjected to intense heat.

5.12 CHIMNEY CONNECTOR – The pipe that connects a solid or liquid fuel-burning appliance to a chimney.

5.13 COMBUSTIBLE MATERIAL – Combustible material as pertaining to materials adjacent to or in contact with heat-producing appliances, chimney connectors and vent connectors, steam and hot-water pipes, and warm-air ducts means material made of or surfaced with wood, compressed paper, plant fibers, or other material that will ignite and burn. Such material shall be considered as combustible even though flameproofed, fire-retardant treated, or plastered.

5.14 COMBUSTION – The rapid oxidation of fuel accompanied by the production of heat, or heat and light.

5.15 COMBUSTION CHAMBER – The portion of an appliance within which combustion occurs.

5.16 COMBUSTION (FLAME) SAFEGUARD – A safety combustion control.

5.17 CONSTANT-LEVEL VALVE – A device that maintains a constant level of fuel oil in a reservoir for delivery to the burner.

5.18 CONTROL – A device intended to regulate the fuel, air, water, or electrical supply to the controlled equipment. It may be automatic, semiautomatic, or manual.

5.19 CONTROL, LIMIT – An automatic safety control responsive to changes in liquid level, pressure, or temperature; for limiting the operation of the controlled equipment.

5.20 CONTROL, SAFETY – An automatic control including a relay, switch, or other auxiliary equipment used in conjunction therewith to form a safety control system that is intended to reduce the likelihood of operation of the controlled equipment that would result in a risk of fire or injury to persons.

5.21 CONTROL, PRIMARY-SAFETY – An automatic safety control intended to reduce the likelihood of abnormal discharge of fuel at the burner in case of ignition failure or flame failure.

5.22 CONTROL, SAFETY-COMBUSTION – A primary-safety control responsive directly to flame properties; sensing the presence of flame and causing fuel to be shut off in event of flame failure.

5.23 DRAFT REGULATOR – A device that functions to maintain a desired draft in the appliance by automatically reducing the chimney draft to the desired value.

5.24 ELECTRICAL CIRCUITS:

a) High-Voltage Circuit – A circuit involving a potential of not more than 600 volts and having circuit characteristics in excess of those of a low-voltage circuit.

b) Low-Voltage Circuit – A circuit involving a potential of not more than 30 volts rms alternating-current (42.4 volts peak or direct current) and supplied by:

1) A primary battery;

2) A Class 2 transformer; or

3) A combination of transformer and fixed impedance that, as a unit, complies with all the performance requirements for a Class 2 transformer.

A circuit derived from a high-voltage circuit, by connecting resistance in series with the supply circuit as a means of limiting the voltage and current is not considered to be a low-voltage circuit.

c) Safety-Control Circuit – A circuit involving one or more safety controls.

5.25 FLUE COLLAR – That portion of an appliance constructed for attachment of the chimney or vent connector.

5.26 FLUE GASES – Combustion products and excess air.

5.27 FUEL OIL – Any hydrocarbon oil defined by ASTM D396.

5.28 HEATING SURFACE – A surface that transmits heat directly from flame or flue gases to the medium to be heated.

5.29 INDIRECT-FIRED APPLIANCE – An appliance constructed so that combustion products or flue gases are not mixed in the appliance with the medium to be heated; hence is provided with a flue collar.

5.30 MAINTENANCE – The periodic tasks usually performed to operate and maintain an appliance, such as air, fuel, pressure, and temperature regulation, cleaning, lubrication, resetting of controls, and the like. Repair and replacement of parts other than those expected to be renewed periodically is not considered to be maintenance. Some examples of maintenance are:

a) Cleaning or replacing nozzles, atomizers, and pilots.

b) Setting ignition electrodes.

c) Cleaning strainers or replacing strainer or filter element.

d) Resetting safety control.

e) Replacing igniter cable.

CONSTRUCTION

6 Assembly

6.1 An oil-fired water heater shall be factory built as a single complete assembly or a group of subassemblies and shall include all of the essential components necessary for its function when installed as intended. An oil-fired water heater may be shipped as two or more major subassemblies.

6.2 An oil-fired storage-type water heater may be furnished as two major subassemblies, each factory built to accommodate the other. The assembly formed when the two subassemblies are joined shall comply with the requirements in this Standard. One subassembly is to consist of the oil burner, which may include safety controls. The other subassembly is to consist of the tank assembly and its appurtenances, including the safety controls if not furnished with the burner. The two subassemblies need not originate at, nor be shipped together from, the same factory but are to be marked to identify the subassemblies to be joined.

6.3 An oil-fired water heater that is not assembled by the manufacturer as a single complete assembly shall be arranged in major subassemblies, see 6.4. Each subassembly shall be capable of being incorporated into the final assembly without requiring alteration, cutting, drilling, threading, welding, or similar tasks by the installer. Two or more subassemblies, that must bear a definite relationship to each other for the intended operation of the heater, shall be:

a) Arranged and constructed so that they can be incorporated into the complete assembly, without the need for alteration or alignment, and only in the correct relationship with each other; or

b) Assembled, tested, and shipped from the factory as one single complete assembly.

6.4 The burner assembly and the water-storage vessel, including its base, combustion chamber, and casing are considered to be major subassemblies. The controls and a wiring harness, if employed, may be packaged with either of the subassemblies.

6.5 A radiation shield or baffle employed to reduce the likelihood of excessive temperature shall be:

a) Assembled as part of the water heater;

b) Part of a subassembly that must be attached to the water heater for its normal operation; or

c) Constructed so that the water heater cannot be assembled for operation without first attaching a required shield or baffle in its intended position.

6.6 The construction of a water heater shall be such that, for any typical installation, the alteration or removal of a baffle, insulation, or a radiation shield needed to reduce the likelihood of excessive temperatures is not required.

6.7 A water heater shall be constructed so that parts requiring attention or manipulation during typical use can be easily operated.

6.8 Adjustable or movable parts shall be provided with locking devices to prevent shifting.

6.9 Any external door providing access into the combustion chamber of a water heater intended for installation with a clearance of less than 24 inches (610 mm) from the face of or 48 inches (1220 mm) above the door shall be self-closing.

6.10 A burner shall be secured so it will not twist, slide, or drop out of position.

6.11 A water heater equipped with an anti-flooding device shall be constructed so that a level heater has a minimum distance of 3/4 inch (19.1 mm) between the intended maximum oil level maintained by the oil control device and the lowest level of the point at which overflow is able to occur.

7 Accessibility for Servicing

7.1 A water heater shall be constructed so that parts, such as interior surfaces of vaporizing burners, heating surfaces in contact with combustion products, oil inlet pipes, and oil strainers, can be cleaned without major dismantling of the water heater or removal of parts required by 6.2 to be factory assembled.

7.2 The removal of an access panel, burner, blower, cap, plug, or the like, specifically constructed to permit removal and replacement for servicing and the detachment of the chimney connector is not considered major dismantling with regard to the requirement in 7.1.

7.3 Burners, controls, and safety devices shall be accessible for cleaning, inspection, repair, and replacement when the water heater is installed as recommended by the manufacturer. The arrangement of parts in the assembly that may be removed for maintenance shall be such that their replacement, following removal, will not necessitate their realignment to maintain their intended relationship with other parts of the assembly. Specific tools required for maintenance to be done by the operator shall be provided with the heater.

8 Base

8.1 A water heater shall be provided with a base or frame that will support the heater. The base or frame shall be constructed of steel or equivalent material.

9 Casing

9.1 The outer casing or jacket shall be made of steel or equivalent material, reinforced or formed if necessary, so that it is not likely to be damaged through handling in shipment, installation, and use. Sheet-metal casings shall be made of:

a) Steel not less than 0.020 inch (0.51 mm) thick if uncoated, or 0.023 inch (0.58 mm) thick if galvanized; or

b) Nonferrous sheet metal having an average thickness of not less than 0.029 inch (0.74 mm).

9.2 Access panels that need to be removed for service and accessibility shall be constructed to permit repeated removal and replacement without causing damage or reducing any required insulating value.

9.3 A removable panel through which air is drawn for combustion shall be constructed to prevent being attached in a manner that may result in a risk of fire or injury to persons and so that it is not attachable in a manner that would impede air flow.

9.4 A removable panel shall be constructed so that it cannot be interchanged with other panels on the same heater if interchange may result in a risk of fire or injury to persons.

9.5 The casing of a heater intended for installation on combustible flooring shall completely close the bottom or be constructed to provide an effective radiation barrier between the floor and the bottom of a combustion chamber, fire box, or vaporizing burner.

10 Radiation Shields

10.1 A radiation shield or liner shall be constructed, formed, and supported to provide for its intended positioning and to reduce the likelihood of distortion or sagging in service. A shield or liner shall be protected against corrosion if its deterioration may cause excessive temperature when the heater is tested for compliance with these requirements. Any finish used to provide the required resistance to corrosion shall not be damaged by heat when the heater is tested under these requirements.

11 Insulation Materials

11.1 Thermal insulation that is not acceptably self-supporting shall be securely applied to solid surfaces in a manner to reduce the likelihood of sagging. The insulating value of the material shall be unimpaired when the heater is tested under these requirements. An adhesive required for securing insulating material shall retain its adhesive qualities at any temperature attained by the adhesive when the heater is tested under these requirements and at 0 °F (minus 18 °C).

12 Combustion Chamber

12.1 A combustion chamber and flueway shall be constructed of cast iron, sheet steel, or other material having the strength, rigidity, durability, resistance to corrosion, and other physical properties equivalent to sheet steel not less than 0.042 inch (1.07 mm) thick.

12.2 A combustion chamber (fire box) lining material shall be durable, secured in place, and accessible for replacement with equivalent material.

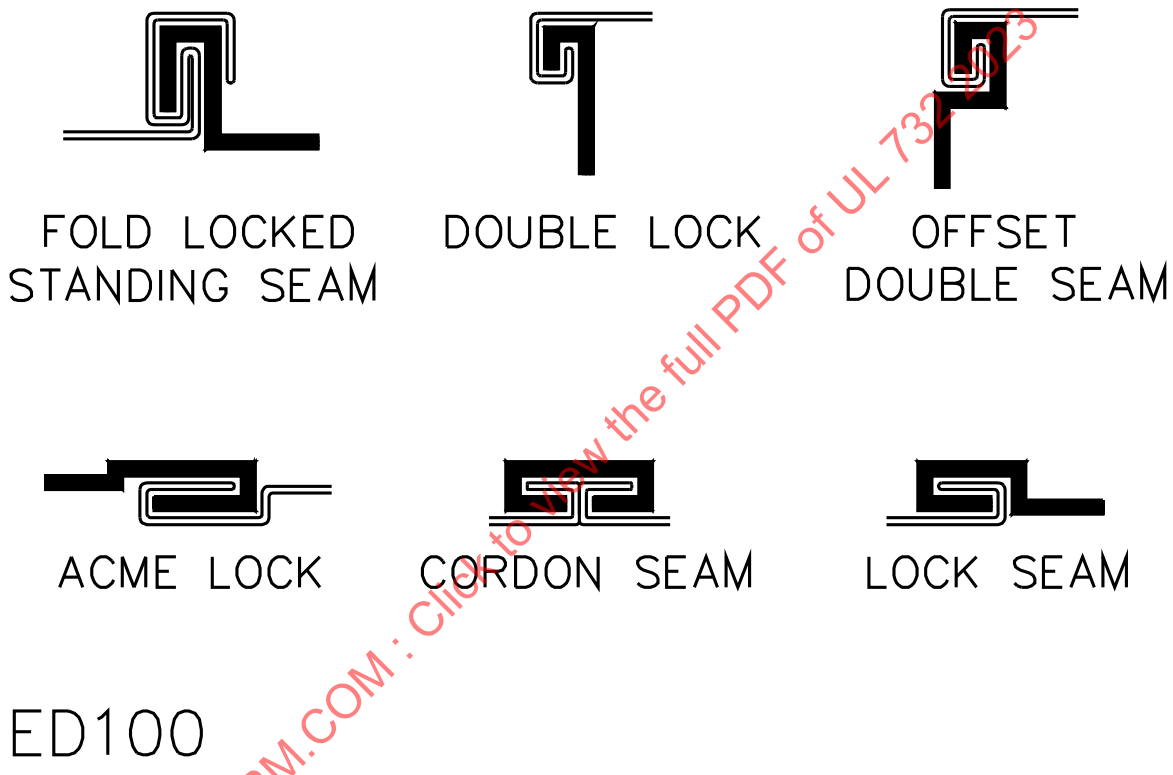
13 Heating Surface Joints

13.1 Joints in heating surfaces shall be mechanically secure and tight, for example, welded, lock-seamed, machined and bolted, riveted, or the like. A joint shall not depend on cement for tightness. A slip or lap joint shall not depend solely upon friction of the joint itself for strength.

13.2 Examples of some acceptable lock-seams are illustrated in Figure 13.1.

Figure 13.1

Types of Acceptable Lock-Seams



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14 Baffles

14.1 A baffle in a flue-gas passage or otherwise exposed to combustion products shall be constructed and arranged to remain in its intended position. A flue baffle shall be made of material having rigidity, heat, and corrosion resistance equivalent to AISI C1010 sheet steel not less than 0.042 inch (1.07 mm) thick.

14.2 A flue baffle shall be accessible for cleaning. A flue baffle that is removable for cleaning shall be constructed so that it can be removed and replaced in a manner that does not result in a risk of fire or injury to persons.

14.3 If it is necessary to remove a flue baffle to clean the flueway, the flue baffle of a water heater having an internal flue shall be constructed to allow removal within a clearance above the floor of 6.5 feet (2.00 m), or 2 feet (0.61 m) above the flue collar on a heater taller than 4.5 feet (1.37 m).

15 Flue Collars

15.1 A flue collar shall have rigidity and heat and corrosion resistance at least equivalent to that of AISI C1010 steel not less than 0.032 inch (0.81 mm) thick. The collar shall be constructed and arranged to permit secure attachment of the chimney connector.

16 Damper and Draft Regulator

16.1 An adjustable damper shall be equipped with minimum and maximum operating stops. The minimum operating stop for such damper shall be located to obtain sufficient air for complete combustion at minimum burner input.

16.2 An automatically operated damper shall maintain the intended damper opening at all times and be arranged to prevent starting of the burner unless the damper is in the intended position for starting.

16.3 A water heater to be equipped with a barometric draft regulator shall be assembled so as not to require the regulator to be installed in a false ceiling, in a different room, or in any manner that will permit a difference in pressure between the air in the vicinity external to the regulator and the combustion air supply.

17 Materials Contacting Water

17.1 A nonmetallic material in contact with water shall comply with the requirements in NSF No. 14, with regard to toxicity, taste, color, solubility, and odor.

18 Water-Storage Vessels

18.1 A water-storage vessel shall be constructed to withstand the applicable hydrostatic test specified in the Hydrostatic Test on Water-Storage Vessels, Section 46, without rupture, leakage, or visible permanent distortion, or the water-storage vessel shall carry one of the following symbols of the ASME Boiler and Pressure Vessel Code:

"H" – Designating a Steam Heating Boiler, Hot Water Heating Boiler, or Hot Water Supply Boiler, constructed in accordance with the ASME Boiler and Pressure Vessel Code, Section IV, Rules for Construction of Heating Boilers.

"HLW" – Designating a Complete Potable Water Heater, constructed in accordance with the ASME Boiler and Pressure Vessel Code, Section IV, Rules for Construction of Heating Boilers.

"U" – Designating a pressure vessel, constructed in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 Rules for Construction of Pressure Vessels.

18.2 The working pressure of a water-storage vessel that does not carry one of the symbols of the ASME Boiler and Pressure Vessel Code, specified in 18.1 shall not be higher than 50 percent of the hydrostatic-test pressure specified in Section 46.

18.3 The inside surfaces of a steel water-storage vessel shall be protected against corrosion by galvanizing, porcelain enameling, or the equivalent.

18.4 A storage vessel shall be equipped with a valve to facilitate draining of the tank.

18.5 A storage tank shall have an opening for installation of a temperature-and-pressure relief valve. The opening: