UL 896

STANDARD FOR SAFETY

Oil-Burning Stoves

UL Standard for Safety for Oil-Burning Stoves, UL 896

Fifth Edition, Dated July 29, 1993

Summary of Topics

This revision of UL 896 dated August 19, 2022 is being issued to remove the ANSI logo and approval from the title page. No other changes have been made.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

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Standard for Oil-Burning Stoves

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INTRODUCTION

1 Scope

1.1 These requirements apply to oil-burning flue-connected room heaters and ranges as defined herein. They may be used where a competent attendant will not be constantly on duty in the room where the appliance is located, while the appliance is in operation. They are required to be equipped with automatic primary safety controls to prevent abnormal discharge of oil at the burner in case of ignition failure or flame failure. They are not intended for use in spaces in which flammable vapors or gases may be present.

1.2 Requirements for the installation and use of oil-burning equipment are included in the Standard of the National Fire Projection Association for the Installation of Oil-Burning Equipment, NFPA No. 31.

1.3 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this Standard, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements to determine that the level of safety as originally anticipated by the intent of this Standard is maintained. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this Standard shall not be judged to comply with this Standard. Where appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

2 Components

2.1 Components of an oil burner, except as specified herein, or a gas burner as well as burner and stove accessories such as constant-level oil valves, metering valves, fire pots, etc.; electrical components and materials such as attachment plugs, industrial control equipment, switches, transformers, electrically operated valves, wires, etc.; and other components or parts shall comply with the requirements for those components, except that such requirements may be modified if appropriate for the particular application.

3 Units of Measurement

3.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

4 Glossary

4.1 AIR SHUTTER – An adjustable device for varying the size of the air inlet or inlets regulating primary or secondary air.

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

4.3 APPLIANCE FLUE – The flue passages within the appliance.

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

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

4.6 BASE – The main supporting frame or structure of an assembly.

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

4.8 BURNER, MECHANICAL-ATOMIZING TYPE – A power-operated burner which prepares and delivers the oil 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 rotary, vertical rotary atomizing, and vertical rotary wall-frame burners.

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

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

4.11 BURNER, VAPORIZING TYPE – 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 being used to vaporize the fuel, with provision for admitting air and mixing it with the oil vapor in combustible proportions.

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

4.13 COMBUSTIBLE CONSTRUCTION – As pertaining to materials adjacent to or in contact with heat producing appliances and flue pipes, steam pipes, and warm air ducts connected thereto, combustible construction shall mean structures made of or surfaced with wood, compressed paper and plant fibers, or other material that will ignite and burn, whether plastered or unplastered. Plastered construction having combustible supports, regardless of the type of lath employed, and gypsum or other wallboard surfaced with combustible material, are classified as combustible construction.

4.14 COMBUSTION – As used herein, the rapid oxidation of fuel accompanied by the production of heat, or heat and light. Complete combustion of a fuel is possible only in the presence of an adequate supply of oxygen.

4.15 COMBUSTION CHAMBER – The portion of an appliance within which combustion occurs and which is usually part of the heat exchanger.

4.16 CONSTANT-LEVEL VALVE – A device for maintaining within a reservoir a constant level of fuel for delivery to the burner.

4.17 CONTROL – A device designed to regulate the fuel, air, water, or electrical supply to the controlled equipment. It may be automatic, semi-automatic, or manual.

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

4.19 CONTROL, PRIMARY SAFETY – The automatic safety control intended to prevent abnormal discharge of oil at the burner in case of ignition failure or flame failure.

4.20 CONTROL, SAFETY – See Safety Control.

4.21 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.

4.22 DAMPER – A valve or plate for regulating draft or flow of flue gases. A damper is generally considered as being located on the downstream side of the combustion chamber, usually in a flue passage of the appliance or in the flue pipe.

4.23 DAMPER, AUTOMATICALLY OPERATED – A damper operated by an automatic control.

4.24 DAMPER, MANUALLY OPERATED – An adjustable damper manually set and locked in the desired position.

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

4.26 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 and supplied by a primary battery or by a standard Class 2 transformer or other suitable transforming device, or by a suitable combination of transformer and fixed impedance having output characteristics in compliance with what is required for a Class 2 transformer.

c) A circuit derived from a source of supply classified as 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 as described in item (b).

d) SAFETY CONTROL CIRCUIT – A circuit involving one or more safety controls, in which failure due to grounding, opening, or shorting of any part of the circuit can cause unsafe operation of the controlled equipment or can introduce a direct fire or life hazard.

4.27 EXCESS AIR – Air which passes through the combustion area and the appliance flues in excess of that which is theoretically required for complete combustion.

4.28 FLUE COLLAR – That portion of an appliance designed for attachment of the flue pipe.

4.29 FLUE GASES – Combustion products and excess air.

4.30 FLUE PIPE – The conduit connecting the heating appliance with the vertical flue or chimney.

4.31 FUEL OIL – Any hydrocarbon oil as defined by Commercial Standard CS12 or ASTM D396.

4.32 FULL DRAIN – As applied to tanks, means the tank is emptied through its normal feed outlet at the bottom of the tank.

4.33 HEATER, CIRCULATING – A room heater designed to convert energy in the fuel to convected heat by the circulation of air heated by contact with the heating surfaces. Stoves with openings in the outer jacket to permit direct radiation from the heating surface are classified as radiant type from a safety point of view.

4.34 HEATER, RADIANT – A room heater designed primarily to convert energy in the fuel to radiant heat.

4.35 HEATER, ROOM – A stove for the direct heating of the space in and adjacent to that in which the device is located.

4.36 HEATING SURFACES – All surfaces which transmit heat directly from flame or flue gases to the medium to be heated.

4.37 INDIRECT-FIRED APPLIANCE – An appliance designed so that combustion products or flue gases are not mixed in the appliance with the medium (i.e., air) to be heated; hence is provided with a flue collar.

4.38 LIMIT CONTROL – See Control, Limit.

4.39 LINER – See Radiation Shield.

4.40 MANUALLY LIGHTED APPLIANCE – An appliance in which fuel to the main burner is turned on only by hand and ignited under supervision.

4.41 OIL-BURNING STOVE – A self-contained, free standing, above-the-floor flue-connected appliance equipped with one or more oil burners. It may be equipped with an integral oil tank or may be designed for connection to a separate oil supply tank.

4.42 PILOT – A flame which is utilized to ignite the fuel at the main burner or burners.

4.43 PRIMARY AIR – The air introduced into a burner and which mixes with the fuel before it reaches the ignition zone.

4.44 RADIATION SHIELD – A separate panel or panels interposed between heating surfaces and adjacent objects to reduce heat transmission by radiation.

4.45 RADIATOR – Auxiliary heat transfer surfaces within the casing, connected between the combustion chamber and the flue collar.

4.46 RANGE – A stove intended primarily for cooking.

4.47 READILY ACCESSIBLE – Capable of being reached easily and quickly for operation, adjustment, and inspection.

4.48 SAFETY CONTROL – Automatic controls, including relays, switches, and other auxiliary equipment used in conjunction therewith to form a safety control system, which are intended to prevent unsafe operation of the controlled equipment.

4.49 SECONDARY AIR – The air externally supplied to the flame at or beyond the point of ignition.

4.50 SMOKE PIPE – See Flue Pipe.

4.51 STOVE – See Oil-Burning Stove.

4.52 SUMP – The receptacle employed with a vacuum tank.

4.53 TANK, GRAVITY – A fuel tank from which the oil is delivered directly to the burner by gravity.

4.54 TANK, VACUUM – A fuel tank which maintains a definite level of oil in a sump or similar receptacle by barometric feed. Fuel is delivered from the sump to the burner by gravity.

4.55 THERMOSTAT – An automatic control actuated by temperature change to maintain temperatures between predetermined limits.

4.56 TOOLS, SPECIAL – Those tools that are not available on the open market.

4.57 VALVE, MANUAL OIL SHUT-OFF – A manually operated valve in the oil line for the purpose of completely turning on or shutting off the oil supply to the burner.

4.58 VALVE, OIL CONTROL – An automatically or manually operated device consisting essentially of an oil valve for controlling the fuel supply to a burner.

a) METERING (REGULATING) VALVE – An oil control valve for regulating burner input.

b) SAFETY VALVE – A normally closed valve of the on and off type, without any bypass to the burner, that is actuated by a safety control or by an emergency device.

5 Installation and Operating Instructions

5.1 A copy of the installation and operating instructions intended to accompany each oil-burning stove or component, or equivalent information, is to be used as a guide in the examination and test of the oil-burning stove or component. For this purpose a printed edition is not required.

5.2 The instructions should include such directions and information as deemed by the manufacturer to be adequate for attaining proper and safe installation, maintenance, and use of the appliance.

5.3 Lighting instructions shall be provided on all stoves. The following wording shall be included as a part of the lighting instructions or on a separate plate which will be readily noted when reading the lighting instructions:

"Due to High Surface Temperatures, Keep Children, Clothing, And Furniture Away."

CONSTRUCTION

6 Assembly

6.1 Each stove shall include all the essential components necessary for its normal function when installed as intended. The components shall be planned for assembly as a unit.

6.2 The various parts shall be constructed and assembled in accordance with these requirements in a manner to ensure strength, rigidity, and durability.

6.3 The various parts of a stove shall be properly assembled or jointed. Soft solder shall not be used on any fuel-handling parts if melting of the solder may allow unsafe leakage of fuel. Soft-soldered joints, where permitted, shall be made mechanically secure before soldering, except as permitted by 27.11.

6.4 The stove should be completely assembled by the manufacturer before shipment from the factory.

6.5 A stove, if not assembled by the manufacturer as a unit, shall be arranged in as few subassemblies as practicable, capable of being incorporated readily into the final assembly without requiring alteration, cutting, drilling, threading, welding, or similar tasks by the installer. Two or more subassemblies, which must bear a definite relationship to each other for the proper and safe installation or operation of the stove, shall be factory assembled in such a manner that this relationship will be maintained securely and permanently, except that the valve, sump, or tank assembly may be furnished as a separate subassembly provided each is arranged and constructed to allow it to be securely joined to the stove, without need for alteration or adjustment, and only in the correct predetermined position. Adequate and specific instructions for assembly shall be furnished with each stove not shipped as a single unit.

6.6 A constant-level valve assembly shall be rigidly and substantially mounted independently of the fuel piping. A constant-level valve or sump assembly, not enclosed within the stove casing nor otherwise adequately protected, shall withstand a load of 100 pounds when tested as prescribed in 6.7.

6.7 The valve or sump assembly is to be joined to the stove as intended and fuel lines integral with the stove attached. A 100 pound weight or load is to be applied uniformly without impact to the main body of the assembly. Successive applications of the load are to be made vertically and horizontally in any direction. Upon removal of the load after each application, the position of the assembly with respect to the stove is to be checked. The position of the assembly is not to be altered by more than 3 degrees in any horizontal or vertical plane.

6.8 When the stove is level, the minimum distance between the designed maximum normal oil level maintained by the oil control device and the level of the lowest point at which overflow may occur shall be not less than 3/4 inch.

6.9 Each stove shall afford convenient operation by the user.

7 Enclosure

7.1 A stove shall be constructed of suitable materials of sufficient strength and durability to ensure safe and reliable service of the parts and the assembly for an extended period of service. Parts shall not sag, distort, melt, oxidize, or show leakage of fuel during any of the tests specified herein.

7.2 Fuel-confining or operating parts of a stove, except as indicated in 7.3, if failure of the part will allow unsafe leakage of fuel, or unsafe operation, or prevent a safety device from functioning, shall be made of material having a melting point (solidus temperature) of not less than 950°F (510°C) and a tensile strength of not less than 10,000 pounds per square inch (psi) at 400°F (204°C).

7.3 Fuel-confining parts not conforming to 7.3 may be employed if suitable means, such as a fusible link valve, is included in the assembly of the stove so as to shut off the fuel supply in the event of excessive temperature or fire in the vicinity of such parts.

7.4 A stove shall be built to allow cleaning of parts such as interior surfaces of vaporizing burners, heating surfaces in contact with combustion products, oil inlet pipes, and oil strainers without major dismantling of the stove or removal of parts specified in 6.5 to be factory assembled.

7.5 The removal of access panels, burners, caps, plugs, etc., specifically designed to permit ready removal and replacement for servicing, and the detachment of the flue pipe are not be considered major dismantling as defined by 7.4.

7.6 Sufficient and reasonable accessibility shall be afforded for cleaning, inspection, repair, and replacement of all burners, controls, and safety devices.

7.7 The disposition of removable parts in the assembly shall be such that their restoration, following removal for cleaning, will not necessitate realignment to secure their proper relationship with other parts of the assembly.

7.8 Any exposed parts of edges which might reasonably be brought in contact with the hand during normal adjustment or usage shall be smooth and rounded.

8 Baffles

8.1 A baffle in a flue-gas passage or otherwise exposed to combustion products shall be constructed and disposed in a manner to provide for reasonable life and shall be fixed in position. It shall be made of material not lighter than that required for the combustion chamber. See 12.1 and Table 12.1.

8.2 A baffle in flue-gas passage or otherwise exposed to combustion products, the failure of which would not cause unsafe operation, which is readily observable and readily replaceable without dismantling of the appliance, need not have the durability required for extended service as required by 8.1.

8.3 A flue baffle shall be accessible for cleaning. A flue baffle which is removable for cleaning shall be of such design as will facilitate its removal and permit replacement only in a safe position.

9 Base

9.1 A base or frame on which burner and stove parts are mounted shall consist of noncombustible material and be strong and durable.

9.2 A stove intended for use with a separate fuel tank shall be provided with facilities to permit ready attachment of the stove securely to the floor. When special bolts, screws, or other parts are needed for that purpose, they shall be furnished with each stove.

9.3 Each base or frame shall incorporate suitable provision for installing the stove in a secure manner. Adjusting means for leveling and alignment shall be included for stoves employing sleeve-type burners.

9.4 It is recommended that oil-burning stoves employing pot-type burners also be supplied with a leveling provision.

10 Burners

10.1 When sheet metal is used in the construction of vaporizing burners for stoves, the thickness shall be such as to assure strength, rigidity, durability, resistance to corrosion, and other physical properties equivalent to No. 20 gage (0.032 in.) carbon steel.

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

10.3 A vaporizing burner shall be designed and installed so that the oil-inlet piping to the burner may be readily cleaned. A stuffing box for a cleaning rod, if used, shall conform to Section 25, Stuffing Boxes.

11 Casing

11.1 The outer casing or jacket shall be made of steel or other material of equivalent strength and durability so that it is not likely to be damaged by handling in shipment, installation, and use.

12 Combustion Chamber

12.1 A combustion chamber and a radiator shall be constructed of cast-iron, sheet steel, or other suitable material. Carbon sheet steel, if used, shall be not lighter than indicated in Table 12.1.

Table 12.1
Gage requirements for carbon steel combustion chambers

Maximum rated input, gallons per 24 hours	Minimum gage
8	24
11	22
over 11	20

12.2 A combustion chamber shall be constructed to provide accessibility for servicing and cleaning within the chamber and the burner.

12.3 Refractory material, when used, shall be secured in place and shall be accessible for replacement.

13 Safety Control

13.1 A stove shall be equipped to prevent abnormal discharge of oil at the burner in case of ignition failure or premature flame extinguishment.

13.2 A stove equipped with a vaporizing burner may be provided with a constant-level valve and antiflooding device or with a barometric tank and sump assembly arranged to maintain a level of oil conforming to 6.8.

13.3 A stove not equipped to provide safe automatic relighting shall be arranged to require manual restart after any control functions to extinguish the burner flame, and following restoration of an interrupted power supply when interruption of the power supply causes flame extinguishment.

14 Damper

14.1 A damper located in a passage for combustion products shall not close off more than 80 percent of the internal cross-sectional area of such passage.

15 Disposal of Combustion Products

15.1 The design of a stove shall not permit the products of combustion to discharge into the room during normal operation.

16 Draft Regulator

16.1 A stove equipped with a natural-draft burner shall be provided with a draft regulator designed to maintain the draft value for which the stove is intended to operate.

17 Fan Housing and Air Ducts

17.1 A fan housing and an air duct shall be made of noncombustible material and be strong and durable. Sheet metal shall be acceptably protected to resist corrosion.

18 Fittings and Piping

18.1 Pipe shall be standard full weight wrought iron or steel, or iron-pipe-size brass or copper pipe. Substantial malleable iron, steel, brass, or copper pipe fittings shall be used with pipe. Unions, if used, shall be the ground-joint type or the equivalent.

18.2 Tubing incorporated in the assembly of the stove at the factory shall be arranged to avoid being mechanically injured, such as by closely following the contour of the assembly. Seamless drawn aluminum or copper tubing employed in the fabrication of factory assembled equipment shall have a wall thickness in accordance with Table 18.1.

Table 18.1
Aluminum and copper tubing

Outside diameter, inches	Wall thickness, inches	Wall tolerance, plus or minus, inches
1/4	0.030	0.0035
5/16	0.030	0.0035
3/8	0.030	0.0035
1/2	0.035	0.0035
5/8	0.040	0.0035
3/4	0.042	0.0035

18.3 Steel tubing of the seamless, brazed, or welded type employed in the fabrication of factory assembled equipment shall have a wall thickness of not less than that shown in Table 18.2.

Table 18.2
Steel tubing

Outside diameter, inches	Wall thickness, inches
1/4	0.028
5/16	0.028
3/8	0.028
1/2	0.028
5/8	0.035
3/4	0.035

18.4 Steel tubing of the wall thickness specified in Table 18.2 shall be protected from corrosion.

18.5 Flexible metal hose, if used, shall be of a suitable type and be used in a manner to avoid damage to it.

18.6 All pipe ends and openings in fittings for pipe connections shall be threaded in accordance with the Standard for Pipe Threads, ANSI B2.1-1968, unless other acceptable forms of constructions are provided.

18.7 Proper care shall be observed to remove webs, shoulders, and other obstructions from the inner ends of internally threaded openings in fittings to permit making tight joints.

18.8 Fuel lines shall terminate in a manner which will permit ready connection to the stove.

18.9 Piping and tubing for oil lines shall be of size and arrangement to avoid air traps.

18.10 Openings into fuel-handling parts shall be suitably covered or encased to prevent entrance of foreign material prior to installation.

18.11 Drawn-brass tubing, floats, and other drawn-brass parts shall be capable of withstanding the 10-Day Moist Ammonia Air Stress Cracking Test in Section 50A.

19 Flue Collar

19.1 Flue collars shall be made of material not lighter than that required for the combustion chamber. See 12.1 and Table 12.1. A collar shall permit the secure attachment of the flue pipe thereto.

19.2 The flue collar shall not be in close proximity to, or directly above the fill opening of the supply tank.

20 Gaskets

20.1 A gasket for a joint in oil-handling parts shall be impervious to oil.

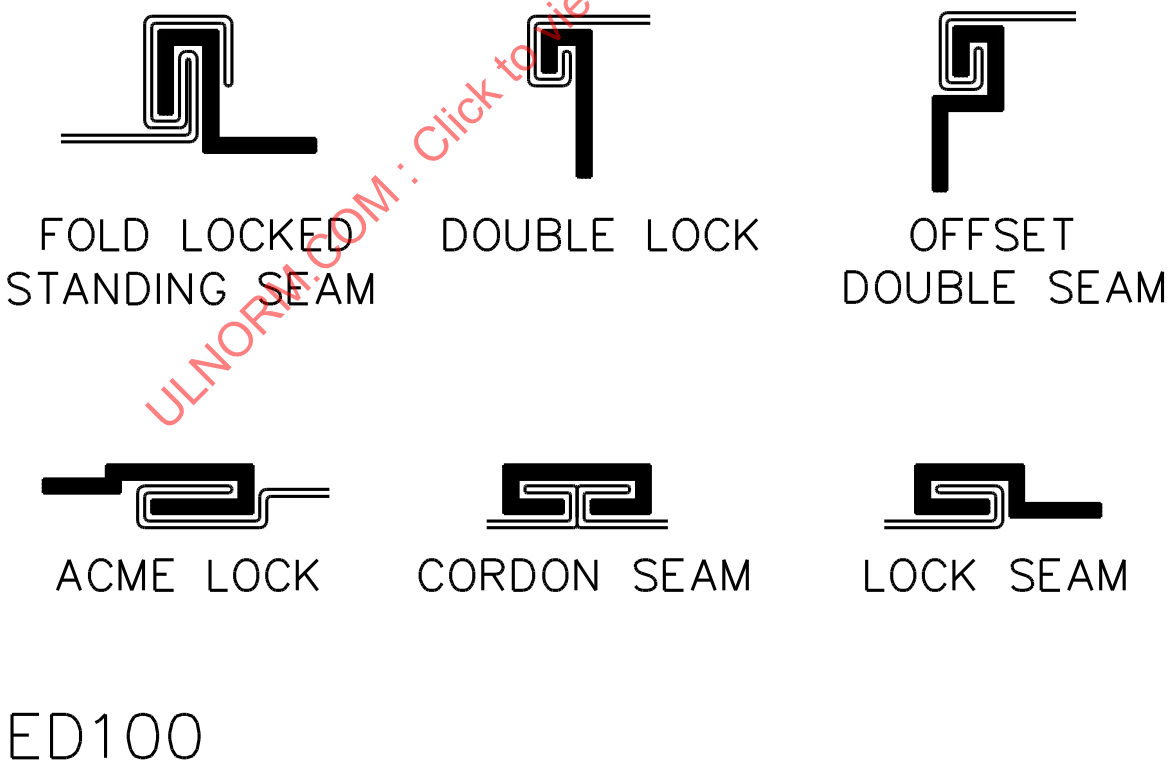
21 Heating Surface Joints

21.1 All joints of heating surfaces shall be reasonably tight and substantial, by being bolted, welded, lock-seamed, riveted, etc. A joint shall not depend primarily on cement for tightness. A slip or lap joint shall not depend solely upon friction of the joint itself for strength.

21.2 Examples of acceptable lock-seamed joints are shown in Figure 21.1.

Figure 21.1

Types of acceptable lock-seams



22 Ignition Means

22.1 A stove requiring a torch for securing ignition shall be provided with a suitable lighting torch, and with facilities for safely extinguishing and storing it, following use.

23 Radiation Shields

23.1 A radiation shield or liner shall be so constructed, formed, and supported as to insure proper positioning and to prevent distortion or sagging in service. A shield or liner shall be protected against corrosion if its deterioration may cause excessive temperature when the stove is tested in accordance with these requirements. Any finish to obtain the required resistance to corrosion shall not be damaged by heat when the stove is tested under these requirements.

23.2 A radiation shield or baffle employed to prevent excessive temperatures shall be assembled as part of the stove; or be a part of subassembly that must be attached to the stove for its normal operation; or be designed so that the stove cannot be assembled for operation without first attaching the required shield or baffle in its proper position.

23.3 Insulating material which is not adequately self-supporting, employed as a radiation shield, shall be securely applied to solid surfaces in a manner to prevent sagging and located so as to avoid it being damaged. The insulating material shall be noncombustible and its insulating value be unimpaired by heat when the stove is tested under these requirements. An adhesive for attaching insulating material shall retain its adhesive qualities at any temperature the adhesive may attain when the stove is tested under these requirements and at 0°F (minus 17.8°C).

24 Strainers

24.1 Small orifices or other openings in oil supply systems likely to become clogged shall be protected by strainers.

24.2 Individual screening openings of the straining element of a primary strainer for stoves shall be not larger than those of a 50 mesh screen.

24.3 The primary strainer element shall provide at least 1/2 square inch effective area of screen opening per gallon of fuel consumed per hour by the burner, but not less than 1 square inch total.

24.4 A metal screen more than 60 mesh shall be made of monel or equivalent, and one of 60 mesh or less shall be made of brass or equivalent.

24.5 A secondary strainer, one supplementary to the primary strainer, smaller in area than specified in 24.3 may be used in the fuel line provided its openings be considered as orifices and, when used, shall be protected by strainers of finer mesh.

24.6 A primary strainer shall be located to permit the ready removal of the screen without breaking the fuel line or disturbing any part of the stove assembly. The force necessary to open the strainer shall not permanently distort the assembly as installed on the stove.

24.7 Float valves, metering valves, and automatic regulating and shutoff valves shall be protected by a strainer of not less than 50 mesh.

24.8 A shutoff valve shall be located between an integral fuel tank and the strainer, or an equivalent provision shall be made to shut off the fuel supply when the strainer is opened for cleaning.

25 Stuffing Boxes

25.1 When packing is used to prevent leakage of fuel oil around a shaft or stem, a stuffing box conforming to 25.2 – 25.12 shall be used if the design is such that it is necessary for the user to adjust or renew the packing to prevent leakage during normal usage or as wear occurs.

25.2 A stem or part shall possess sufficient strength to avoid being twisted off or distorted by normal operation. A stem or part made of metal subject to corrosion shall engage or seat onto corrosion resistant material only.

25.3 A stuffing box shall be provided with a removable, shouldered, unthreaded follower gland and with a nut, take-up, or other means for adjusting the gland to maintain pressure on the packing as wear occurs.

25.4 A stuffing box for an automatically operated stem shall be designed to avoid binding of the stem.

25.5 When an adjustable stuffing box is used to seal an automatically actuated stem of a safety device, the design shall be such that any allowable adjustment of the packing take-up will not bind the stem sufficiently to prevent the device from functioning automatically. A gland shall be spring-loaded.

25.6 An automatic spring take-up for a gland shall employ a spring made of corrosion resistant material or one coated acceptably to retard corrosion.

25.7 The physical characteristics of a take-up spring shall be such that it will advance the gland through not less then one half its possible travel from its initial setting with the spring compressed.

25.8 At the advanced position of the gland, a take-up spring shall not require adjustment of the nut to prevent leakage from the stuffing box when tested under pressure of one and one half times maximum rated pressure.

25.9 A stuffing box gland shall be made of corrosion resistant material. The design and assembly of parts shall be such as to result in compressing the packing against the stem when the stuffing box nut or yoke is tightened.

25.10 Before shipment, a stuffing box shall be fully packed with pliable packing material, the impregnation of which is not adversely affected by contact with fuel oil.

25.11 The structure shall be such as to permit repacking the stuffing box without requiring the assembly to be dismantled.

25.12 A manually operated stem shall not backout, nor shall threads of a stem enter a stuffing box recess, when the stem is rotated or reciprocated in any allowable manner even though an adjustable packing nut or other take-up is disengaged.

26 Sumps

26.1 A sump of a stove employing barometric feed shall be made of noncombustible material. The material used shall be of sufficient thickness and be so formed as to provide strength, rigidity, and durability. Uncoated sheet steel shall be not less than No. 18 gage (0.042 in.). Coated sheet steel shall conform to 27.6 – 27.8.

26.2 A sump shall be rigidly and substantially mounted and in such a manner that the weight of the sump and fuel supply will not be supported by the fuel piping. See 6.6.

26.3 All joints below the liquid level in a sheet metal sump shall be mechanically secured and soldered, or of an equivalent construction.

27 Integral Tanks

27.1 A gravity tank intended to be included as part of the stove assembly shall have a capacity of not more than 10 gallons. A vacuum tank shall have a capacity of not more than 5 gallons, and not more than two such tanks shall be included on a single stove. A 5 percent plus tolerance is allowed for the maximum capacities in determining compliance with this requirement.

27.2 A tank shall be substantially constructed of noncombustible material suitable for the purpose. Materials other than those described in the following shall be investigated to determine their suitability for the purpose.

27.3 The thickness of sheet metal employed in tanks shall be not less than that specified in 27.4 – 27.8.

27.4 The thickness of uncoated sheet steel shall be not less than No. 18 gage (0.042 in). A preservative shall be applied to uncoated surfaces of tanks to prevent rusting prior to use.

27.5 The thickness of aluminum-coated steel, galvanized steel, terne sheet, and corrosion resistant sheet metal shall be not less than that specified in Table 27.1. Coated sheet shall be of prime finish, i.e., free from blisters, flux, and uncoated spots visible to the unaided eye.

Table 27.1
Thickness of metal

Actual capacity, gallons	Minimum thickness, gage no.
3 or less	26
3.1 – 6.0	24
6.1 – 10.5	22

27.6 Zinc coating on sheet steel shall be not less than 1.25 ounces per square foot of sheet.

27.7 The coating of terne sheet shall be not less than 8 – 12 pounds per double base box (112 sheets, 20 by 28 inches).

27.8 The coating of aluminum-coated steel shall be not less than 0.5 ounce per square foot of sheet.

27.9 Tanks made of uncoated sheet steel, aluminum-coated steel, and terne sheet shall be of full-drain construction. Full-drain construction is obtained by building a tank so that it is emptied through the fuel outlet at the bottom of the tank.

27.10 A tank not required to be of full-drain construction, and not so designed, shall allow the ready removal of any accumulation of water or sludge. For a gravity tank not over 18 inches deep, this may be accomplished by providing an accessible fill opening large enough to permit entrance of the average adult hand.

27.11 Joints of a fuel tank shall be lock-seamed, brazed, welded, or otherwise made mechanically secure, see 21.2 and Figure 21.1. All joints not continuously brazed or welded shall be thoroughly sweated with solder. Brazing or welding of coated sheets lighter than No. 18 gage shall not damage the coating of surfaces in contact with oil when the tank is full. All connections shall be made through solid threaded bosses or fittings mechanically secured to the tank.

27.12 A gravity tank shall be designed for permanent attachment to the stove. A vacuum tank shall be designed to allow removal for filling. In either case, the tank shall be supported securely in proper position on the stove. A vacuum tank shall automatically prevent the escape of fuel when the tank is lifted from the sump of the stove or replaced into the sump.

27.13 A vacuum tank, when placed on the stove sump in the intended manner, shall not become dislodged from its position when a horizontal force of 25 pounds is applied uniformly against any exposed surface of the tank when it is full or one fourth full.

27.14 An integral gravity tank shall be provided with a liquid-level indicator readily observable when the tank is being filled, unless the fill opening is of a shape and size permitting ready observation of the liquid level within the upper 2 inches below the lowest point of overflow while the tank is being filled.

27.15 A vacuum tank shall be equipped with a suitable liquid-level gauge.

27.16 A gauge glass or sight feed, the breakage of which will allow the escape of fuel into the room, shall not be used.

27.17 The top of the fill opening of a tank not equipped with a gauge conforming to 27.14 shall not be above the level at which oil will overflow the tank.

27.18 A gravity tank shall permit ready filling by the operator without requiring the operator to reach over the stove and in a manner which will avoid spillage of oil.

27.19 When a stove is equipped with a three-way valve to permit optional fuel feed from the integral tank or from a separate tank, the stove shall be arranged so that the valve cannot be positioned to permit oil to flow from one tank to the other, or permit oil to be delivered from both tanks simultaneously.

28 Valves

28.1 A fuel-metering device, when adjusted to its maximum allowable setting, shall not permit a flow in excess of that determined as safe by test in accordance with these requirements.

28.2 The means for limiting the maximum setting of a metering device shall not be readily accessible and shall be sealed with hard solder or the equivalent; or shall be of a design requiring special tools to increase the flow beyond the safe maximum.

28.3 An oil-metering valve should be of such design that not more than 1-1/2 turns are required to open it fully.

28.4 A valve controlling the supply of fuel to the burner shall be of the needle type or the equivalent. It shall be designed to maintain a constant flow of fuel when opened, and normal operation shall not enlarge the orifice appreciably.

28.5 A plug or rotating-disc type valve, employing the bearing surface of the plug or disc as the liquid seal to the exterior of the valve body, shall not be used in oil lines.

28.6 A plug or rotating-disc type valve used in an oil-supply line as a shutoff device shall be provided with a substantial handle assembly clearly designating the shutoff position of the valve.

28.7 A petcock or valve shall not be used which, when open, permits the discharge of oil into the room.

29 Internal Wiring

29.1 The wiring of high-voltage and safety control circuits shall conform to the requirements in this section.

29.2 Suitably insulated conductors having adequate current capacity for the service shall be used. A conductor shall be not smaller than 18 AWG.

29.3 Some types of suitable insulated conductors are indicated in Table 29.1 .

29.4 The wiring of all circuits included in the stove assembly shall be furnished by the manufacturer with the stove. Except as permitted by 31.2, all electrical circuits included as part of the stove assembly shall terminate at a central location at which connection to the power supply can be made. The terminus shall be one that does not require dislocation for servicing the stove.

Table 29.1
Maximum temperature rises for some items
(See note[a])
The inclusion of a temperature limit for a material in this table is not indicative of the acceptability of the material if it does not otherwise conform to these requirements.

Items	Maximum rise above inlet-air temperature			
	Column 1		Column 2	
	Degrees C	Degrees F	Degrees C	Degrees F
Oil in constant-level valve, sump, or tank	14	25	22	40
Carbon steel sheet, cast iron	517	930	683	1230
Aluminum alloys				
1100	183	330	239	430
3003	239	430	294	530
2014, 2017, 2024, 5052	294	530	350	630
Aluminum-coated steel,[b]	656	1180	767	1380
Stainless steel				
Types 302, 303, 304, 316, 321, 347	767	1380	878	1580
Type 309	961	1730	1072	1930
Types 310	1017	1830	1128	2030
Type 405	683	1230	795	1430
Type 403, 410, 416	572	1030	683	1230
Type 430	711	1280	822	1480
Type 446	961	1730	1072	1930
Galvanized steel,[c]	267	480	350	630
Carbon steel – coated with Type A19 ceramic	572	1030	683	1230
Conductors of supply circuit connected to stove and surfaces on which they may bear	35	63	60	108
Wire,[d]				
Types R, RF, FF, RW, RU	35	63	60	108
Types RH, RFH, FFH	50	90	75	135

Table 29.1 Continued on Next Page

Table 29.1 Continued

Items	Maximum rise above inlet-air temperature			
	Column 1		Column 2	
	Degrees C	Degrees F	Degrees C	Degrees F
Types T, TF, TFF, TW	35	63	60	108
Type TA	65	117	90	162
Appliance wiring material				
Thermoplastic, 80°C rating	55	99	70	126
Thermoplastic, 90°C rating	65	117	80	144
Thermoplastic, 105°C rating	80	144	95	171
200°C rating	175	315	200	360
250°C rating	225	405	250	450
Flexible cord – Types SO, ST, SJO, SJT	35	63	60	108
GTO cable	35	63	60	108
Other types of insulated wires				
Electrical insulation material[f]				
Class A (Class 105) insulation				
In open motors				
thermocouple method	65	117	100	180
resistance method	75	135	100	180
In totally enclosed motors				
thermocouple method	70	126	100	180
resistance method	80	144	100	180
In other coils				
thermocouple or resistance method	80	144	100	180
Class B (Class 130) insulation	85	153	110	180
Class C insulation	not specified as determined by test			
Class H (Class 180) insulation				
Varnished cloth insulation	60	108	85	153
Phenolic composition employed as electrical insulation or as a part whose failure would result in unsafe operation,[d]	125	225	150	270
Fiber employed as electrical insulation	65	117	90	162
Class 130 transformer enclosure	60	108	85	153
Power and ignition transformer enclosure	65	117	90	162
Sealing compounds	Maximum temperature 15°C (27°F) less than melting point			
Capacitors – electrolytic types	40	72	not specified	
other types	65	117		

[a] The specified maximum temperature rises apply to parts whose failure may cause the draft equipment to be unsafe for use.

[b] When the reflectivity of aluminum-coated steel is utilized to reduce fire hazard, the maximum allowable temperature rise is (461°C) 830°F.

[c] The specified maximum temperature rises apply when the galvanizing is required as a protective coating or the reflectivity of the surface is utilized to reduce fire hazard.

Table 29.1 Continued on Next Page

Table 29.1 Continued

Items	Maximum rise above inlet-air temperature			
	Column 1		Column 2	
	Degrees C	Degrees F	Degrees C	Degrees F
[d] The limitations on rubber and thermoplastic insulation and on phenolic composition do not apply to compounds which have been investigated and recognized as having special heat resistant properties. Thermoplastics are in no case to attain temperatures at which the material begins to flow.				
[e] For standard insulated conductors other than those mentioned, reference should be made to the National Electrical Code and the maximum allowable temperature rise is 25°C (77°F) less than the recognized temperature limit of the wire in question where Column 1 temperature rises are specified, and the maximum allowable temperature rise where Column 2 rises are specified is to be based on the heat-resistant properties of the insulation.				

30 Wiring Connections

30.1 Electrical wiring to a part which must be moved for normal servicing shall be arranged so that the part may be moved without breaking soldered connections or disconnecting conduit. Conductors to be disconnected from terminals of such part shall terminate in eyelets or connectors. When the wiring to such a part is not readily detachable, the assembly shall include provision for support of that part by means other than the wiring when the part is moved for servicing. Any allowable movement of such part shall not unduly twist, bend, or pull the wiring.

30.2 Conductors shall be enclosed within conduit, electrical metallic tubing, suitable metal raceway or electrical enclosure, or metal-clad cable, except as permitted by 30.5 – 30.6. Suitable fittings shall be used.

30.3 Splices in wiring shall be located only in accessible junction boxes. Splices shall be made mechanically secure, soldered, and suitably insulated with tape; or suitable fixture-type splicing connectors may be employed.

30.4 The design of a wireway shall be such that the interconnection of sections and fittings will provide a rigid mechanical assembly and ensure adequate electrical conductivity. The interior of the wireway shall be free from burrs, and sharp corners or edges which might cause injury to the insulation on wires. Screws and bolts, however used, shall not project into the wireway unless sharp ends and threaded sections, other than the threaded sections of machine screws or bolts which do not project into the wireway more than 1/32 inch, are covered or otherwise prevented from coming in contact with wires.

30.5 Wiring within an enclosure compartment of a stove may be made with Type SJO or SJT cord or labeled appliance wiring material having neoprene or thermoplastic insulation of equivalent thickness when supported and arranged to avoid being injured or disturbed during normal use of the stove, and provided with strain relief.

30.6 An enclosed compartment is one having no opening in the bottom nor in a top located less than 24 inches above the wiring. Sides of the compartment may contain openings located at least 2 inches above the bottom and at least 2 inches from the wiring, provided such openings located less than 18 inches above the wiring are louvered and will not permit the passage in any direction of a rod having a diameter of 1/2 inch.

30.7 Holes in metal walls, through which insulated wires not enclosed in conduit pass, shall be provided with smoothly rounded bushings, or shall have smooth, rounded surfaces, to prevent abrasion of the insulation. Bushings shall be phenolic, porcelain, or hard fiber.

30.8 A hole in porcelain, phenolic composition, or other suitable nonconducting material and having a smoothly rounded surface is considered to be the equivalent of a bushing.

30.9 Ceramic materials and some molded compositions are acceptable generally for insulating bushings; but bushings of wood or so-called hot-molded shellac and tar compositions are not acceptable.

30.10 A fiber bushing shall be not less than 1/16 inch in thickness, with a minus tolerance of 1/64 inch for manufacturing variations, shall be so formed and secured in place that it will not be affected adversely by conditions of ordinary moisture, and shall not be employed where it will be subjected to a temperature higher than 90°C (194°F) under normal operating conditions.

30.11 To provide an acceptable unbushed opening in sheet metal usually requires rolling and/or extrusion of the metal around the opening, or the insertion of an acceptable grommet.

30.12 Unless supplied with insulation suitable for the highest voltage involved, factory wired insulated conductors of circuits of one voltage shall be separated by barriers or shall be segregated from conductors of circuits of another voltage; and shall, in any case, be so separated or segregated from uninsulated current carrying parts connected to circuits of another voltage.

30.13 Segregated of insulated conductors may be accomplished by clamping, routing, or equivalent means which ensures permanent separation as stipulated in 30.12.

31 Wiring Methods

31.1 A cord provided with an oil-burning stove for the connection to the power supply shall be a Type SJ cord or the equivalent. The length of cord is not specified. Only one supply cord shall be employed to electrical components included in the assembly of a stove in accordance with 29.4, except as permitted by 31.2.

31.2 An air circulating fan, humidifier, or similar component having an input of not more than 600 watts, furnished as an optional accessory for attachment to a stove in the field, may be provided with a supply cord for direct connection to a receptacle not a part of the stove assembly. This cord, but only one, may be in addition to the one cord provided in accordance with 31.1.

31.3 The supply cord may be attached permanently to the appliance or may be in the form of a separate cord set with suitable means for connection to the appliance. Type SJO or SJT cord is acceptable.

31.4 The cord, if attached permanently, shall be readily replaceable. The other end of the cord shall terminate in an attachment plug cap.

31.5 Strain relief shall be provided so that a mechanical strain on a supply cord will not be transmitted to terminals, splices, or interior wiring.

31.6 If a knot in a flexible cord serves as strain relief, the surface against which the knot may bear or with which it may come in contact shall be free from projections, sharp edges, burrs, fins, etc., which may cause abrasion of the insulation on the conductors.

31.7 The supply cord shall be connected to the stove in a manner to avoid contact with hot surfaces and oil when the stove is in use.

31.8 Field installation conductors of high-voltage circuits shall be segregated or separated by barriers from field installation conductors or uninsulated current carrying parts connected to low-voltage circuits.

31.9 Field installation conductors of a low-voltage circuit shall be segregated or separated by barriers from uninsulated live parts to be connected to a high-voltage circuit and from any safety-control-circuit

wiring terminals and any other uninsulated live parts whose short-circuiting or grounding may result in unsafe operation of the stove.

ELECTRICAL COMPONENTS

32 General

32.1 Electrical equipment and wiring shall be located to avoid contact with oil during normal usage and care and when the fuel tank is overfilled; also to avoid contact with water from humidifiers.

32.2 Attachment plugs or separable connectors shall not be used in circuits when the breaking or making of the circuit by such devices may allow unsafe operation of the burner.

33 Enclosure

33.1 Uninsulated live parts shall be enclosed, guarded, or located to prevent accidental contact by persons during normal usage of the stove. This applies also to such parts located in a compartment into which access is required for normal care of the equipment, such as resetting controls, lubrication, cleaning, etc.

33.2 An enclosure for uninsulated live parts shall have no openings which are not closed when the stove is installed; except that an enclosure for parts other than a fuse or thermal cutout may have openings as needed for ventilation or for the device to function. Such openings shall prevent the entrance of a rod of the diameter specified herein. The diameter of the rod is to be equivalent to the distance measured from a straight edge placed across the outer face of the opening to be checked to the nearest uninsulated live part within the enclosure, but the diameter of the rod shall be not larger than 33/64 inch unless the distance is 4 inches or more, in which case the diameter of the rod may be 49/64 inch.

34 Motors

34.1 A motor shall be designed for continuous duty as indicated by the designation CONTINUOUS or CONT on the nameplate.

34.2 A motor shall be provided with suitable overcurrent protection.

34.3 Motor protection in accordance with 34.2 may be accomplished by:

a) An integral thermal protector or by overcurrent protective devices, or combination thereof. An integral thermal protective device is to comply with the requirements of UL 2111, the Standard for Overheating Protection for Motors.

b) The impedance of the motor being sufficient to prevent overheating due to failure to start or run, in which case the designation IMPEDANCE PROTECTED is to be included with the motor nameplate data.

34.4 A motor shall be enclosed in accordance with 34.5 – 34.11.

34.5 A motor shall have no openings permitting a drop of liquid, or a particle falling vertically onto the motor, to enter the motor as applied to the stove.

34.6 Conformance to 34.5 may be provided by the motor frame or by another enclosure, structure, or shield, or by a combination of two or more such items, and is to be determined with the motor applied to the assembled stove.

34.7 A motor shall have no openings from which a drop of liquid or solid particle dropping from electrical parts, windings, brushes, switches, etc., within the motor may fall to the floor, except when:

a) The motor is provided with over temperature protection equivalent to that provided by thermal protective devices, or

b) The motor is located within a metal enclosure with no combustible material located underneath the motor, or the structure directly under the motor will retain any drops of liquid or solid particles dropping from openings in the motor frame.

34.8 Conformance in accordance with 34.7 (b) may be obtained when a motor is located within an appliance compartment having a closed metal bottom; when a motor is placed directly upon a structure which serves as a pan that will collect and retain drops of liquids or particles dropping from openings in the bottom half of the motor or that will prevent them from dropping onto the building structure.

34.9 Openings in a motor frame in locations permitted by 34.5 and 34.7 shall be of such size of shape or so situated that a rod of the diameter specified herein is prevented from entering the motor. The diameter of the rod shall be equivalent to the distance measured from a straight edge placed across the outer face of the opening to be checked to the nearest uninsulated live part or enameled wire in the motor but not larger than 33/64 unless the distance is 4 inches or more, in which case the diameter of the rod may be 49/64 inch.

34.10 Conformance to 34.9 may be provided by the motor frame or by another enclosure, shield, or structure, or a combination of two or more such items, and is to be determined with the motor assembled to the stove. When a motor is within another enclosure, attempts to insert the rod are to be made from the exterior of such enclosure, the size of the rod being governed by the openings in such enclosure; but uninsulated live parts in a compartment into which access is required for normal care of the stove are to be guarded or located to prevent accidental contact by persons during normal usage of the stove.

34.11 When a motor is supported in a manner permitting placement of the motor frame in various positions, conformance to these requirements is to be obtained with the motor frame in any operating position allowed by the method of support, attached wiring, or other features of the stove structure.

35 Spacings

35.1 The spacings in a device, such as a control, receptacle, relay, snap switch, terminal block, etc., supplied as part of a stove, other than a device in a safety – control circuit, are to be not less than the minimum spacings required for the class of device in question, or not less than the spacings required for temperature-indicating and temperature regulating equipment, whichever are smaller. In a device which is part of a safety-control circuit, spacings are judged under the requirements for safety controls in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873. Compliance with the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1, and/or the applicable Part 2 standard from the UL 60730 series fulfills these requirements.

35.2 The electrical clearance resulting from the assembly of parts into the complete equipment, including clearance to grounded metal or enclosure, are judged under the spacing requirements of the Standard, UL 873. Compliance with the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1, and/or the applicable Part 2 standard from the UL 60730 series fulfills these requirements.

35.3 A combination oil-electric range is judged also under the requirements of the Standard for Household Electric Ranges, UL 858.

PERFORMANCE

36 General

36.1 The performance of a stove is to be judged upon the basis of operation tests conducted on the stove, using any grade of fuel oil recommended by the submitter of the stove. Stoves of each size and type, or a sufficient number of sizes and types to be representative of the entire range of sizes and types submitted, are to be subjected to all or part of the tests prescribed herein. If optional features affecting performance are furnished, a stove is to be tested with each such optional equipment.

36.2 A stove, when tested in accordance with these requirements, shall be uniform and reliable in operation, and free from excessive carbonization or other phenomena that may cause the stove to become unsafe. The design shall be such that the possibilities of explosions are reduced to a minimum.

36.3 If any indications are observed during the tests prescribed herein that a stove will not continue to meet the requirements in normal usage so as to assure continued safe performance, supplementary tests shall be conducted as deemed necessary to assure safe service.

37 Test Installation

37.1 Enclosures

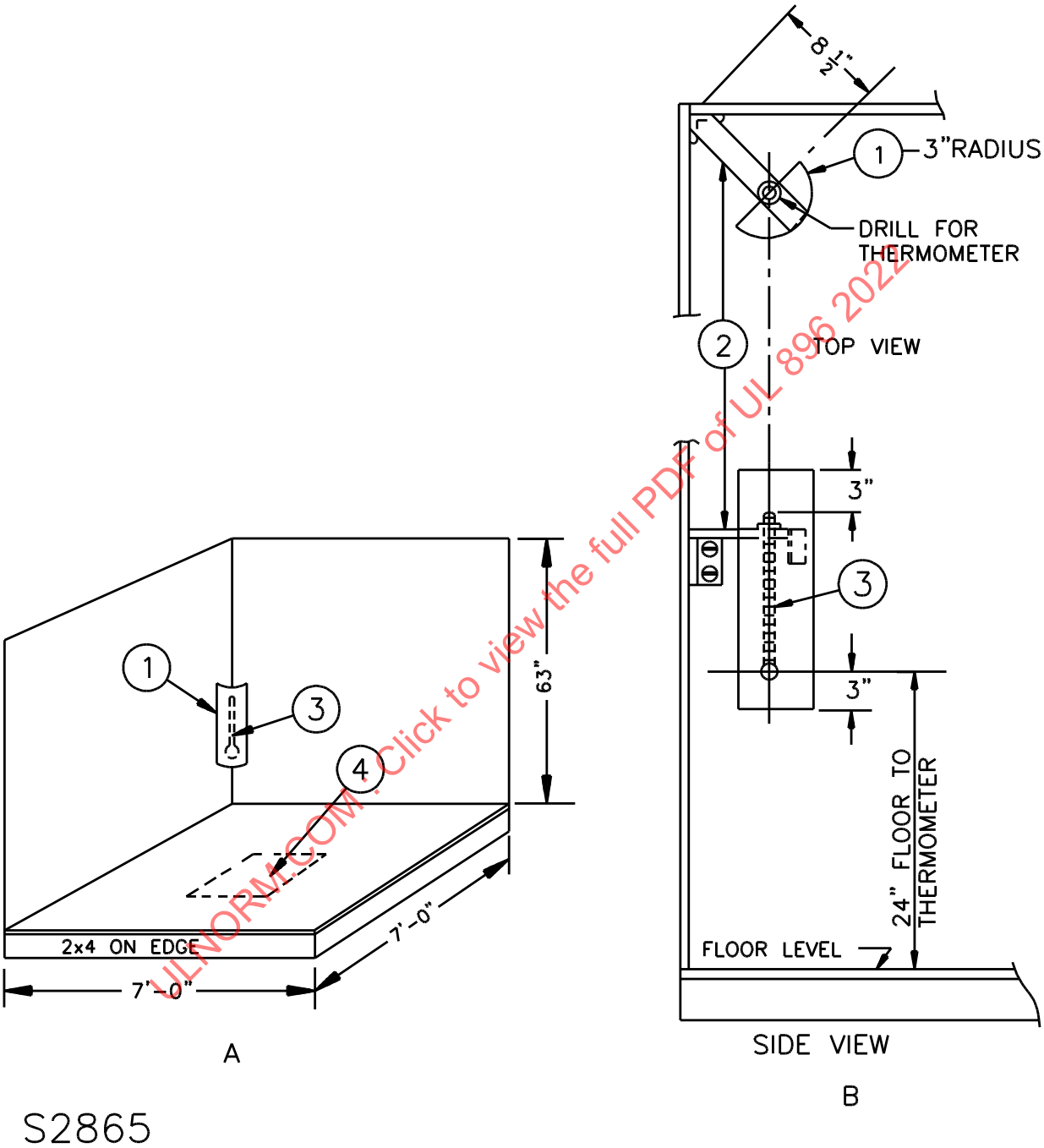
37.1.1 The walls of the test enclosure, Figure 37.1, are to be made of 1 inch, normal thickness, tongue-and-groove pine boards or 3/4 inch thick plywood finished in flat black. The walls are to be set at right angles to each other and perpendicular to the floor. The floor is to be made of 1 inch white pine flooring covered with one thickness of building paper and then by 1 inch tongue-and-groove oak flooring finished with a clear varnish. All joints in the enclosure are to be tightly sealed.

37.1.2 The flue pipe is to be No. 26 gage black stovepipe of the same nominal size as the flue collar of the stove. The flue pipe is to be installed vertically, being directly connected to, and extended vertically above, a vertical flue outlet and connected to a horizontal flue outlet by using a 90 degree sheet metal elbow at the bottom of the vertical section. See Figure 37.2. A draft regulator is to be installed in the vertical flue pipe at an elevation of not less than 7 feet above the floor, to regulate the draft during some of the test.

37.1.3 The flue pipe is to be connected to a chimney, stack, or exhaust system capable of imposing the specified draft, except as otherwise stated herein.

Figure 37.1

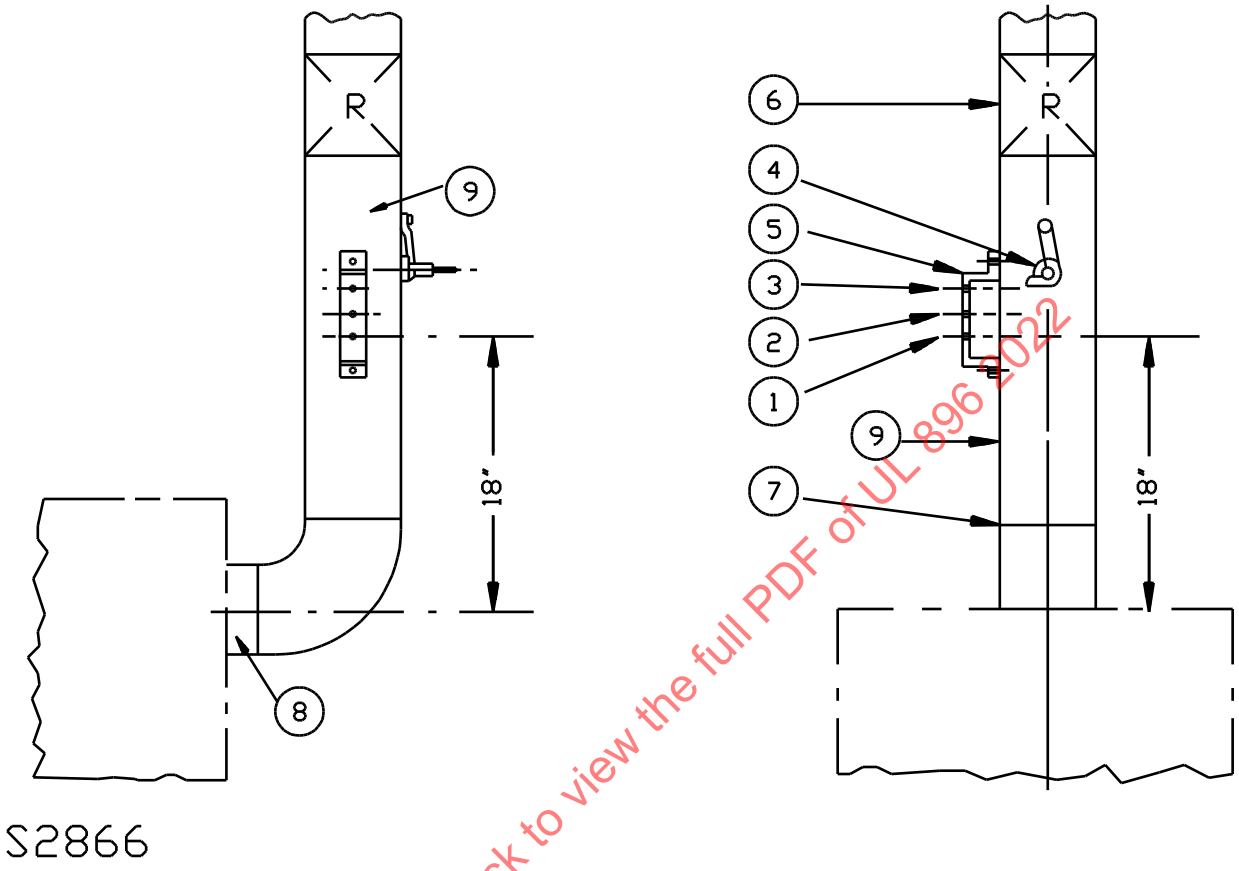
Enclosure for room heaters and ranges



1. Bright-aluminum baffle, No. 24 gage, 6 inches longer than item 3.
2. Bracket material, 1/8 by 1 inch angle and 1/8 by 1 inch strap iron.
3. Thermometer, supported by bracket.
4. Location of heater on platform.

Figure 37.2

Stove flue connections



Horizontal flue outlet

Vertical flue outlet

1. Center line of thermocouple.
2. Gas sampling tube.
3. Draft tube.
4. 8 mm clear glass rod and holder, if used.
5. Support bracker.
6. Draft regulator.
7. Seal all openings in flue pipe below gas sampling tube.
8. Flue collar.
9. Section of flue pipe, same nominal diameter as flue collar.

38 Instrumentation

38.1 Draft

38.1.1 Draft is to be measured by a draft gauge which may be read directly to 0.005 inch water column and which has an accuracy of ±0.0025 inch. A gauge is to be checked for zero reading at the beginning and the end of each test.

38.2 Fuel input

38.2.1 Flow rates of fuel-metering valves are to be determined under the following conditions:

a) No. 1 oil is to be used for testing valves of stoves equipped with pot type burners, and kerosene for valves of stoves equipped with sleeve type burners. Liquids having equivalent viscosity may be used.

b) Viscosity for flow rates based on No. 1 oil.

	Maximum	Mean	Minimum
Centistokes at 100°F (37.8°C)	2.04	1.97	1.90
Centistokes at 77°F (25.0°C)	2.44	2.34	2.24

38.2.2 It is suggested that the flow rates selected by the manufacturer for stoves equipped with pot-type burners be in accordance with the following:

8 inch burner

Pilot Flow 3-5 cc/min	High Flow 18-20 cc/min
Pilot Flow 3-5 cc/min	High Flow 20-22 cc/min
Pilot Flow 3-5 cc/min	High Flow 22-24 cc/min
Pilot Flow 3-5 cc/min	High Flow 24-27 cc/min

10 inch burner

Pilot Flow 5-7 cc/min	High Flow 28-31 cc/min
Pilot Flow 5-7 cc/min	High Flow 30-33 cc/min
Pilot Flow 5-7 cc/min	High Flow 32-35 cc/min
Pilot Flow 5-7 cc/min	High Flow 34-38 cc/min

13 inch burner

Pilot Flow 6-8 cc/min	High Flow 38-42 cc/min
Pilot Flow 6-8 cc/min	High Flow 40-44 cc/min
Pilot Flow 6-8 cc/min	High Flow 42-47 cc/min
Pilot Flow 6-8 cc/min	High Flow 45-50 cc/min

38.2.3 Oil-metering valves are tested for flow rates by use of apparatus similar to that illustrated in Figure 38.1 and Figure 38.2. The oil temperature should be 70 – 80°F (21.1 – 26.7°C). The flow rate may vary about 2 cc per minute for ±10 degree variation from 75°F (23.9°C). The flow from a temperature-compensated valve may decrease as the temperature increases.

38.2.4 With the valve open to the setting to be checked, oil is allowed to flow through the system for about 5 minutes to purge it of air. With the oil flowing properly, that discharging from the valve under test is to be retained over a measured period to determine the flow. It is well, to avoid errors, to measure the flow over a period of 3 or 4 minutes and to check the valve at each setting two or more times before concluding the test.

38.2.5 The fuel-input rate to a mechanical atomizing burner during a test is to be determined by a scale accurate to 0.01 pound or a burette capable of the same resultant accuracy.

38.3 Power measurement

38.3.1 The total electrical input to a stove is to be measured in amperes.

38.3.2 An ammeter, voltmeter, or wattmeter is to have a maximum scale range of not more than 1-1/2 times the value to be measured. The smallest scale division is to be not more than 1/50 of the maximum scale range.

38.4 Speed measurement

38.4.1 A revolution counter is to be used to measure the speed of a motor or mechanism driven by it. The load imposed by the counter is not to adversely affect motor speed. A stroboscope is recommended for measuring speed of a motor under 1/8 horsepower.

Figure 38.1

Flow rate test

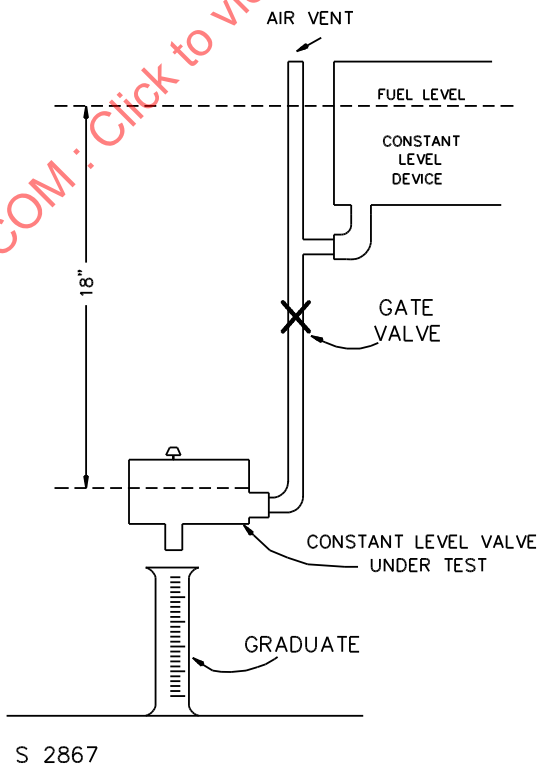
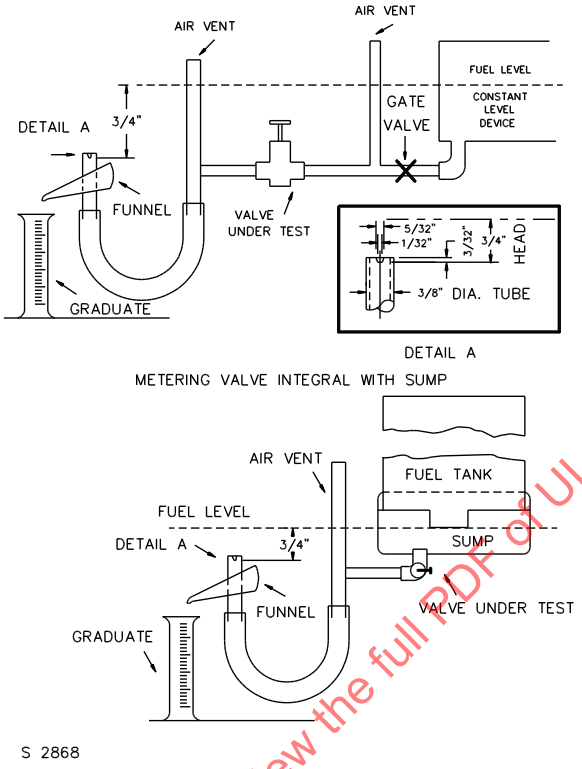


Figure 38.2

Flow rate test



38.5 Temperature measurement

38.5.1 Room temperature is to be measured by a thermometer located as indicated by Figure 37.1. Other temperatures are to be determined by means of a potentiometer and bead type thermocouples. Unless otherwise indicated, a thermocouple is to be made of wires not heavier than 24 AWG.

38.5.2 Thermocouples are to be placed on surfaces of the test enclosure at various locations as may be required to observe maximum temperatures during tests. All such wall and ceiling surfaces are to be finished a flat black.

38.5.3 Thermocouples are to be attached to other pertinent materials and parts, such as those mentioned in Table 29.1 . When electrical conductors are involved, temperatures are to be measured on surfaces of the conductor insulation.

38.5.4 Thermocouples are to be secured to wood surfaces by staples over insulated portions of the wire and with the tip held in a good thermal contact with the surface by pressure sensitive tape; except that for zero clearance the thermocouples are to be applied to surfaces of the stove at points of zero clearance.

38.5.5 Thermocouples are to be attached to metal surfaces by soldering or brazing, or may be secured under a screw head.

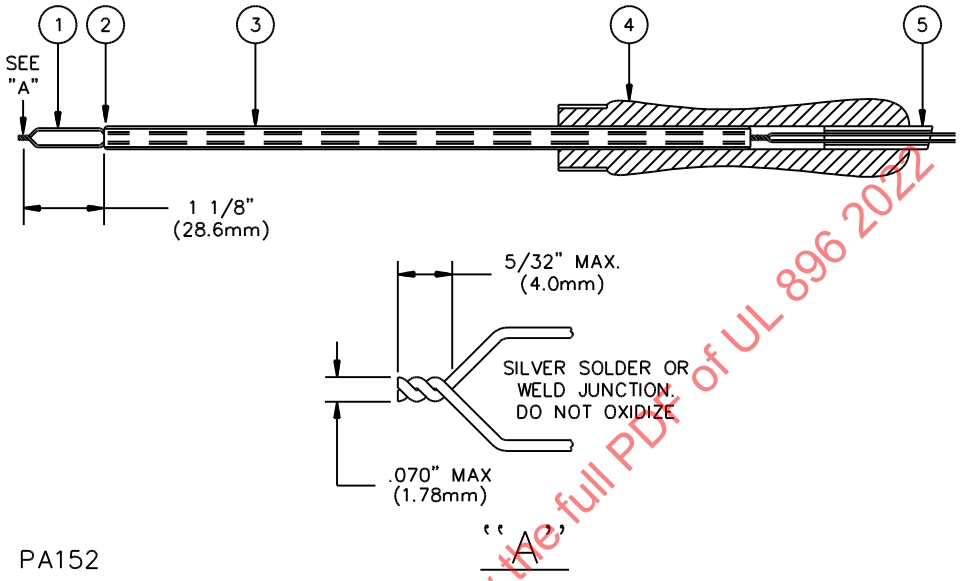
38.5.6 Thermocouples are to be attached to surfaces other than as described in 38.5.5 by being cemented or taped to the surface in a manner to assure good thermal contact with the surface.

38.5.7 The flue-gas temperature is to be measured by a thermocouple such as illustrated by Figure 38.3, inserted into the flue pipe as shown in Figure 38.4. There is to be no draft control between the stove and

the point where the flue-gas temperature is measured. If a draft control is incorporated in the stove, it is to be sealed dependably in the position allowing maximum draft during all tests, except when otherwise indicated.

Figure 38.3

Standard thermocouple for flue-gas temperature



1. 20 AWG iron constantan, asbestos, or woven glass-covered thermocouple wires extending from hot junction to potentiometer or reference junction.

2. 1 – Leeds and Northrup Standard 714B, or equal, 1/4 inch outside diameter two hole porcelain insulator cut to length and ends beveled on two sides.

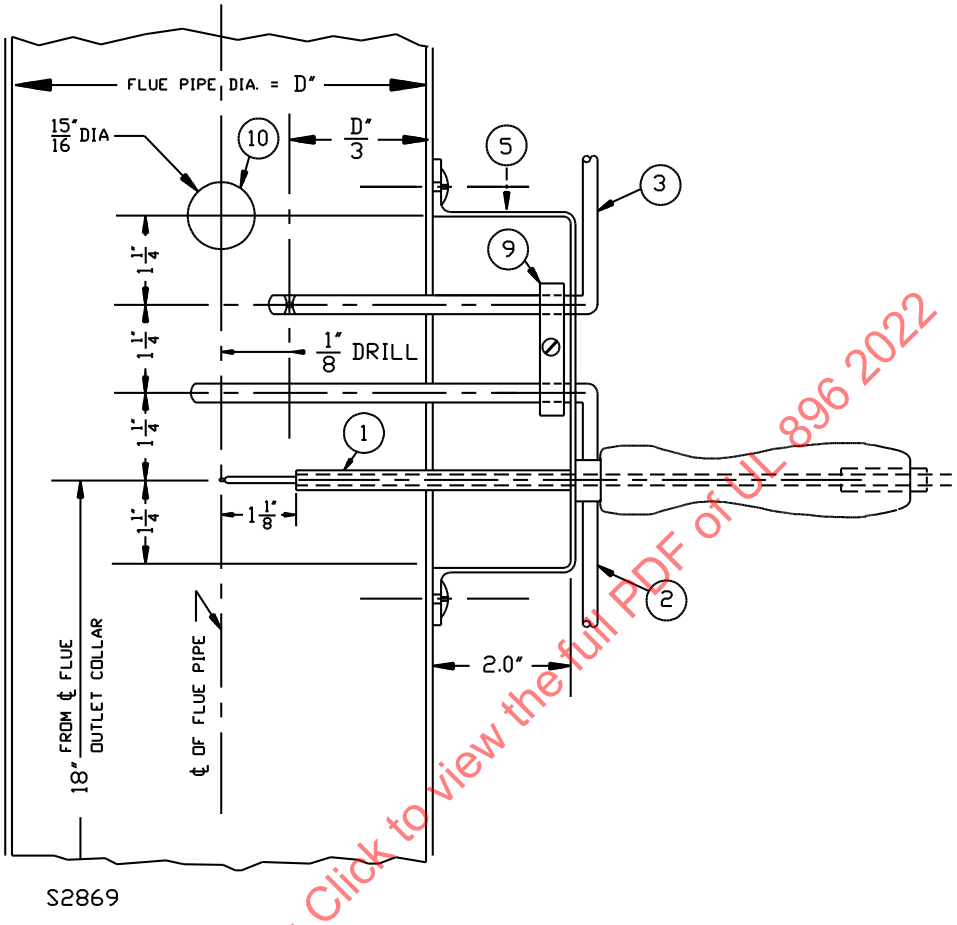
3. 1 – 5/16 inch outside diameter by 0.032 inch wall tubing. Ream, if necessary, to fit over insulator; then crimp ends over beveled ends of insulator.

4. 1 – Small wooden handle.

5. 1 – Piece of rubber tubing, approximately 5/16 by 3/32 by 2 inches long.

Figure 38.4

Gas-sampling and draft tubes, thermocouple, and support bracket assembly



1. Thermocouple.

2 and 3. Gas sampling and draft tubes (1/4 by approximately 0.032 inch wall, brass or steel).

5 and 9. Support bracket and tube clamp (1/32 by 1/2 inch flat steel).

10. Hole in flue pipe for glass rod, if used.

39 Combustion Test

39.1 Combustion shall be stable and complete in the space provided at all firing rates allowed by the fuel-metering device, from the minimum rate to the manufacturer's recommended high-fire input, without excessive smoke or the formation of excessive carbon or soot.

39.2 The recommended high-fire input is the oil-flow rate recommended by the manufacturer, which rate is to be not less than 80 percent of the maximum fuel input as determined by test in accordance with 45.3.

39.3 The maximum input is the oil-flow rate allowed by the fuel-metering device when adjusted to its maximum allowable setting. This value is determined by adding any plus tolerance allowed in the maximum valve flow. See 28.1.

39.4 A stove equipped with a manually lighted vaporizing burner is to be tested in accordance with 39.5 – 39.12.

39.5 A stove is to be arranged for operation in accordance with the instructions furnished with the stove and in a room free from drafts.

39.6 The arrangement of the flue pipe, draft regulator, and the instrumentation is to be as indicated by Figure 37.2, Figure 38.4 and Figure 39.1.

39.7 The flue pipe is to be connected into a natural draft chimney or flue of a size equivalent to one having an internal diameter of 8 inches and of a height to develop a draft equivalent to the manufacturer's recommended high-fire draft, minus 0, plus 0.02 inch with flue gases entering the chimney or flue at a temperature of 500°F (260°C). There is to be no draft regulator between the combustion chamber and the point where the flue-gas samples are taken. If one is incorporated in the stove, it is to be effectively sealed in the position allowing maximum draft.

39.8 The heating surfaces, stove flues, and the flue pipe are to be cleaned and free of soot or dust at the beginning of the test. Cleaning with a vacuum cleaner is recommended.

39.9 The stove is to be fired with the heaviest grade of fuel intended to be used and the air-fuel ratio adjusted in accordance with the manufacturer's instructions. The draft regulator is to be adjusted to maintain the manufacturer's recommended high-fire draft, which is not to exceed 0.06 inch. Draft settings are to be made normally on high fire. No change in draft or combustion air adjustment is to be made for other firing rates unless changed automatically, except for a manually regulated stove when the instructions on the stove so state, in which case correlation of the calibrations of the fuel and draft or air adjustment shall be included with those instructions.

39.10 The stove is to be fired at each operating fire rate until steady-state combustion conditions exist. Smoke observations are then made, in accordance with 39.13 – 39.15. The observed smoke is to be not more than that indicated by a one microampere reduction on the smokemeter of Underwriter's Laboratories, Inc. or the equivalent, 35 percent glass rod with the IAM smokemeter described in CS104.

39.11 Observations are to be made of the smoke produced by a pilot fire over the allowable range of pilot firing rates in 1 cc increments from the minimum rate to and including a rate of 10 cc per minute or the maximum pilot rate allowed by the fuel metering device, whichever is smaller.

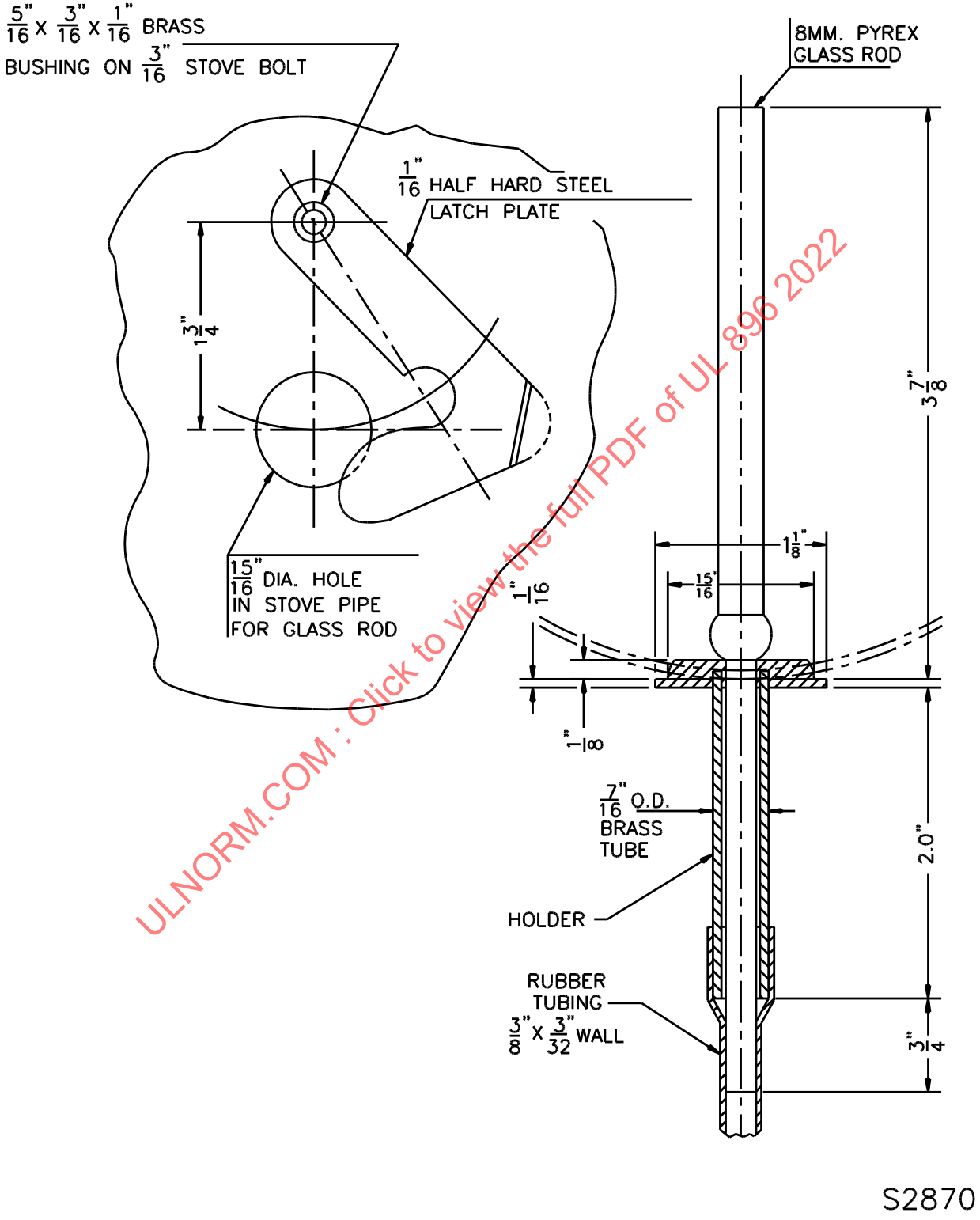
39.12 A manually regulated burner and a modulating burner are to be fired successively at rates beginning with a firing rate of 10 cc per minute or the minimum rate allowed by the fuel-metering device and then at rates progressively increasing in increments equivalent to approximately 10 percent of the maximum high-fire rate as allowed by the metering device. The smoke is to be observed at all those firing rates.

39.13 An automatically regulated burner designed to fire at one or more predetermined firing rates is to be fired at the minimum and maximum firing rates allowed by the fuel-metering device and at allowable intermediate rates in steps equivalent to approximately 10 percent of the maximum firing rate. Smoke observations are to be made at all those firing rates.

39.14 The burner is to be fired in accordance with the appropriate schedule described in 39.15 – 39.16. The firing rate selected for these tests is to be the allowable rate in each range which produced more smoke as determined in accordance with 39.11 – 39.13. The air-fuel ratio for the test is to be adjusted as recommended by the manufacturer's instructions.

Figure 39.1

Glass rod, rod holder, and latch plate



39.15 A manually regulated burner is to be fired each week of the test in accordance with the following schedule:

a) Five successive days per week –

1) Four hours at high fire

2) Four hours at intermediate rate

3) Sixteen hours at low or pilot rate, and

b) Two successive days per week at low or pilot rate.

The normal duration of the test is expected to be four weeks.

39.16 An automatically regulated burner intended to operate with an oil pilot is to be fired 30 minutes on a high fire, 30 minutes on an intermediate fire if the burner is designed to be so fired, and 30 minutes on pilot fire, as a continual cycle for five successive days per week, then on pilot continuously for two successive days per week, each week of the test. The normal duration of the test is expected to be that required to obtain 250 hours of operation on high fire.

39.17 During the test period, daily observations and recordings are to be made of draft on all operating fires, combustion characteristics, combustion chamber conditions, and any unnatural performance. The fuel-burning rate, smoke, and flue-gas temperatures are to be observed and flue gases analyzed for each burning rate of the test and are to be recorded at the beginning of the test, after each 20 hours of operation on high fire, and at the end of the test. Smoke observations, as described in 39.11 – 39.13, are to be made following the completion on the operation test.

39.18 The burner is to be turned off and the stove allowed to attain room temperature. The stove is then to be subjected to the Seepage and Burnoff Test described in 49.1 – 49.3.

39.19 The performance demonstrated during the combustion tests is deemed to be in accordance with 39.1 when:

a) Stable fires are obtained at all allowable firing rates.

b) The observed smoke at manufacturer's recommended high-fire input rated and at all lower allowable rates does not exceed that indicated by a 1 microampere reduction on the smokemeter of Underwriters' Laboratories, Inc. or the equivalent, 35 percent rod with the IAM smokemeter described in CS101 for vaporizing burners.

c) Unburned fuel gases do not occur in the flue gases during firing at all allowable rates.

d) The observed flue-gas temperature of manufacturer's recommended high-fire input does not exceed 920°F (493°C) plus room temperature.

e) No excess soot or tar has been deposited on surfaces of the heat exchanger, stove flues, or flue pipe.

f) No excess carbon, soot, or tar has been deposited on surfaces of or in vaporizers of burners. Any accumulation likely to be deleterious to the performance of the burner, that continually increases as the test progresses, that reduces area of air opening in burners, or that restricts fuel input more than 10 percent is to be deemed excessive.

40 Power Interruption Test

40.1 A power-consuming stove shall not operate unsafely during interruption of the power supply or upon subsequent restoration of the power supply.

40.2 The initial conditions for test to determine conformance to 40.1 are to be as for the test described in 39.4 – 39.8. The burner is to be supplied with the heaviest grade of fuel intended for use. While the stove is being fired at any operating fire, the power supply is to be interrupted. The power is then to be restored after being interrupted for any period of time. Fuel to the burner is to be shut off in accordance with 40.3, or combustion, if continued, is to be in accordance with 40.4.

40.3 If the burner flame is extinguished following interruption of the power supply, the abnormal discharge of oil at the burner is to be prevented. Manual restart is to be required to fire the burner upon restoration of power unless the burner is equipped to safely refire automatically.

40.4 If combustion is continued following interruption of the power supply, the burner is to be allowed to continue firing for at least 24 hours. During this period of firing, while the power supply is interrupted, complete and stable combustion is to be maintained, and the burner flame is not to produce smoke in excess of that indicated by a 1 microampere reduction on the smokemeter of Underwriters' Laboratories, Inc. or the equivalent, 7 on the Shell-Bacharach scale with the Model RDC smokemeter for mechanical atomizing burners; 35 percent rod with the IAM smokemeter described in CS101 for vaporizing burners. At the end of this period, the power supply is to be restored. The performance of the burner is to be such that:

a) Any reignition of the main burner flame is to be effected safely.

b) Flame or smoke is not to be expelled from the burner or the stove.

c) Combustion is to be complete, stable, and clean.

40.5 A stove equipped with an optional draft booster, the burner being a natural draft burner as defined by 4.10 is to be tested for conformance to 40.1 at the minimum draft required to obtain combustion in accordance with 39.1 when the draft booster is inoperative, unless the stove is designed to perform in accordance with 40.3 – 39.4 at some lower draft.

41 Air Failure Test

41.1 A stove equipped with a mechanical-draft burner shall not operate unsafely during interruption and upon restoration of the combustion air supply.

41.2 The initial conditions for test to determine conformance to 41.1 are to be as for the tests described in 39.4 – 39.8. The burner is to be supplied with the heaviest grade of fuel intended for use. While the burner is being fired at any operating fire, the fan supplying air for combustion is to be stopped, i.e., by disconnecting the fan motor only from the electrical circuit. Fuel to the main burner is to be shut off in accordance with 41.3, or combustion, if continued, is to be in accordance with 41.4.

41.3 If the burner flame is extinguished following interruption of the air supply, the abnormal discharge of oil at the burner is to be prevented. Manual restart is to be required to fire the burner upon restoration of the air supply unless the burner is equipped to safely refire automatically.

41.4 If combustion is continued following interruption of the air supply, the burner is to be allowed to continue firing for at least 48 hours. During this period of firing while the air supply is interrupted, safe and stable combustion is to be maintained. At the end of this period, the combustion air supply is to be restored. The performance of the burner is to be such that:

a) Any reignition of the main burner flame is to be effected safely.

b) Flame or smoke is not to be expelled from the burner or stove.

c) Combustion is to be stable.

d) Soot has not accumulated in the stove and flue pipe to such an extent that unsafe performance is obtained.

42 Overvoltage and Undervoltage Test

42.1 A stove equipped with electrical apparatus shall operate in accordance with these requirements when tested at any voltage between 85 and 110 percent of rated voltage for alternating current and between 80 and 110 percent of rated voltage for direct current.

42.2 The initial conditions for test are to be as for the tests described in 39.4 – 39.8. Maximum normal load conditions are to be imposed on electrical apparatus. The voltage of the power supply to the stove is to be regulated to maintain the minimum voltage specified, and the stove is to be fired in the intended manner until steady-state combustion conditions are attained. The test is to be continued with the voltage maintained at 110 percent of rated voltage. The performance of the stove is to be such that:

a) Flames are not to be expelled from the burner or stove.

b) Combustion is to be complete and stable.

c) Flames at all allowable firing rates from the minimum rate to the manufacturer's recommended high-fire input do not produce smoke in excess of that indicated by a 1 microampere reduction on the smokemeter of Underwriters' Laboratories, Inc. or the equivalent, 7 on the Shell-Bacharach scale with the Model RDC smokemeter for mechanical atomizing burners; 35 percent rod with the IAM smokemeter described in CS101 for vaporizing burners.

43 Stability Test

43.1 When a stove is tipped in any direction, the product of the minimum force, in pounds, required to tip the stove, and the angle, in degrees, through which the stove is tilted before falling of its own accord, shall be 150 or more.

43.2 The stove is to be placed on a level floor or platform. If leveling means are provided, the stove is to be raised to the highest position allowed by the leveling means.

43.3 A stove equipped with an integral tank is to be tested when the tank is full and when the tank is empty. To avoid spilling oil, the tank may be 84 percent filled with water instead of filled with oil.

43.4 The tipping angle is to be the angle included within the plane of the base of the stove and the plane of the floor when the stove is tipped to the least position from which it will fall on its side when released.

43.5 The tipping force is to be the maximum horizontal force exerted in any direction at the topmost point of any part of the unrestrained stove before any part of the base is raised from the floor.

43.6 The stove base or legs are to be blocked at the near side so that the stove will not slide in the direction of the applied force. Using a spring scale or equivalent means for indicating force in pounds, the force is to be applied at the top center of each side of the stove until it starts to tip. The force required to initiate tipping is to be recorded. The tipping force is to be continued until the least position is reached from which the stove will tip over if not restrained. The stove is to be held in that position and the tipping angle is to be measured.