UL 343

STANDARD FOR SAFETY

Pumps for Oil-Burning Appliances

UL Standard for Safety for Pumps for Oil-Burning Appliances, UL 343

Ninth Edition, Dated December 17, 2008

Summary of Topics

This revision of ANSI/UL 343 dated March 13, 2024 includes the addition of Biodiesel (B100) requirements; Supplement SA title, SA1, SA7.4.1.3, SA7.4.1.4, SA7.4.2.3, SA7.4.2.4, and Supplement SB

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

The revised requirements are substantially in accordance with Proposal(s) on this subject dated March 17, 2023 and February 9, 2024.

No Text on This Page

DECEMBER 17, 2008
(Title Page Reprinted: March 13, 2024)

ANSI/UL 343-2024

UL 343

Standard for Pumps for Oil-Burning Appliances

First Edition – July, 1957
Second Edition – June, 1971
Third Edition – August, 1974
Fourth Edition – April, 1976
Fifth Edition – April, 1982
Sixth Edition – July, 1986
Seventh Edition – April, 1993
Eighth Edition – May, 1997

Ninth Edition

December 17, 2008

This ANSI/UL Standard for Safety consists of the Ninth Edition including revisions through March 13, 2024.

The most recent designation of ANSI/UL 343 as an American National Standard (ANSI) occurred on March 13, 2024. 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 ULSE's Collaborative Standards Development System (CSDS) at https://csds.ul.com.

No Text on This Page

CONTENTS

INTRODUCTION

1 Scope 5
2 Components 5
3 Units of Measurement 5
4 Undated References 5
5 Glossary 5

CONSTRUCTION

6 Assembly 6
7 Materials 7
8 Strength of Parts 7
9 Bodies, Covers, and Heads 8
10 Shaft Seals and Stuffing Boxes 9
11 Springs 11
12 Diaphragms 11
13 Bases 11
14 Integral Tanks 12
15 Strainers 13
16 Floats 13
17 Control Application 13
18 Piping and Fittings 13

ELECTRICAL EQUIPMENT

19 General 14
20 Enclosures 15
21 Motors 15
22 Wiring Methods 17

PERFORMANCE

23 General 17
24 Deformation – Test No. 1 18
25 Operation of Pressure-Regulating and Nozzle Shutoff Valves Combined With a Pump Assembly – Test No. 2 18
26 Operation of Combination Pump and Compressor Assemblies – Test No. 3 19
27 Operation of Automatic Fuel Oil Pumps – Test No. 4 19
28 Vacuum and Capacity of Power-Operated Pumps – Test No. 5 21
29 Endurance – Test No. 6 21
30 Static-Pressure Leakage – Test No. 7 22
31 High-Pressure Leakage – Test No. 8 22
32 Hydrostatic-Pressure Strength – Test No. 9 23
33 10-Day Moist Ammonia-Air Stress Cracking Test 23

MANUFACTURING AND PRODUCTION TESTS

34 General 24

MARKING

35 General 24

SUPPLEMENT SA (normative) – PUMPS FOR OIL-BURNING APPLIANCES INTENDED FOR USE WITH BIODIESEL BLENDS B6-B20/B100

SA1 General 25
SA2 Construction – Mechanical, General 25
SA7.3 Non-metallic materials 25
SA7.4.1 Static seals 25
SA7.4.2 Dynamic seals 26
SA3 Materials 27

SUPPLEMENT SB (normative) – TEST FLUIDS

SB1 Representative Aggressive Combustible Test Fuel Mixture 29

Appendix A

Standards for Components 30

INTRODUCTION

1 Scope

1.1 These requirements cover pumps that are intended to be used as part of oil-burning appliances or installed in fuel-oil piping systems serving such equipment. Oil-burning appliance pumps may be either automatic or power-operated.

1.2 Requirements for the installation and use of oil-burning appliance pumps are included in the Standard for the Installation of Oil-Burning Equipment, NFPA 31.

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components used in the products covered by this standard.

2.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

2.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.4 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.

3 Units of Measurement

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

4 Undated References

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.

5 Glossary

5.1 For the purpose of this standard, the following definitions apply.

5.2 AUTOMATIC PUMPS – Assemblies that automatically pump oil from the supply tank and deliver this oil by gravity under a constant head to an oil-burning appliance and that have automatic means to prevent the abnormal discharge of oil. These pumps are intended for installation at least 1 foot (305 mm) above the top of the supply tank and are arranged to stop pumping automatically in case of total breakage of the oil-supply line between the pump and the appliance.

5.3 DIFFERENTIAL PRESSURE – The difference in pressure, measured at the discharge port, between the value obtained with the pump operating and after shutdown.

5.4 NORMAL OPERATING PRESSURE – The pressure at which the pump is normally operated on the appliance.

5.5 POWER-OPERATED PUMPS – Pumps for use in the assembly of power-operated oil burners or for use as oil-transfer pumps.

5.6 RATED PRESSURE – The minimum and maximum operating pressures recommended by the manufacturer of the pump.

5.7 REGULATED PRESSURE – The minimum and maximum operating pressures obtainable by adjustment of the pressure-regulating valve.

CONSTRUCTION

6 Assembly

6.1 An automatic pump shall include all the components necessary for its intended function.

6.2 The construction of a pump shall be such that parts can be reassembled after being dismantled to the extent needed for servicing.

6.3 Means shall be provided for the purpose of making any necessary field adjustment.

6.4 Screws or bolts used to attach a part that is detached for servicing of the pump shall be capable of holding the part upon the application of the torques specified in Table 6.1 after removal and replacement.

Table 6.1
Torque requirements for screws or bolts

American standard screw size,		Torque,		I.S.O. screw size,	Torque,	
No. or inch	(mm)	lb-in.	(N·m)	mm	N·m	(lb-in.)
–	–	–	–	4	1.6	(14)
No. 8	(4.2)	18	(2.0)	4.5	2.6	(23)
10	(4.8)	30	(3.4)	5	4.2	(37)
1/4 inch	(6.4)	100	(11.3)	6	8.7	(77)
–	–	–	–	7	15.0	(133)
5/16	(7.9)	200	(22.6)	8	23.5	(208)
–	–	–	–	9	33.6	(297)
3/8	(9.5)	350	(39.6)	10	45.2	(400)
7/16	(11.1)	575	(65.0)	12	81.0	(715)
1/2	(12.7)	850	(96.0)	14	128.0	(1130)
9/16	(14.3)	1200	(136.0)	–	–	–
5/8	(15.9)	1600	(181.0)	16	185.0	(1640)

6.5 The pump shall incorporate a provision for support that is independent of piping, tubing, or conduit that may be connected to the pump.

6.6 A brazing material used for joining liquid-confining parts of a pump shall have a melting point (solidus temperature) not less than 538°C (1000°F).

7 Materials

7.1 Liquid-confining and operating parts of a pump, other than an automatic pump, shall be made of material having a melting point (solidus temperature) of not less than 510°C (950°F) and a tensile strength not less than 10,000 psi (68.9 MPa) at 204°C (400°F).

7.2 A part in contact with the liquid to be handled by a pump shall be resistant to the action of the liquid.

7.3 A synthetic rubber part shall not show excessive volume change when considered on the basis of its intended function, following immersion for 70 hours at a temperature of 23 ±2°C (73.4 ±3.6°F) in No. 3 Swelling Oil. The change in volume is to be determined in accordance with the Standard Test Method for Rubber Property-Effect of Liquids, ASTM D471-79(1991).

7.4 A change in volume of not more than 25 percent swelling or 1 percent shrinkage is considered to comply with the requirement in 7.3.

7.5 A part made of synthetic rubber that may be affected by aging shall not crack or show visible evidence of deterioration following exposure for 96 hours to oxygen at a pressure of 300 psig (2070 kPa), and at a temperature of 70°C (158°F).

7.6 Other parts shall be resistant to atmospheric corrosion and attack by the liquid they may contact in service if corrosion of such parts may result in external leakage. A ferrous material of the thickness specified in Table 7.1 is considered adequate for the preceding when uncoated and when intended for use with the designated liquid.

Table 7.1
Thickness of uncoated ferrous materials

Liquid in contact with material	Minimum thickness			
	Sheet metal,		Castings,	
	inch	(mm)	inch	(mm)
Fuel oils and kerosene	0.042	(1.07)	1/8	(3.2)

7.7 If atmospheric corrosion of a ferrous part will interfere with the intended function of a pump, the part shall be of a corrosion-resistant material or be provided with a corrosion-resistant protective coating.

7.8 A protective coating shall provide resistance against corrosion to a degree not less than that afforded sheet steel by the application of a uniform coating of zinc on each surface to an average thickness of not less than 0.0002 inch (0.005 mm) with a minimum thickness at any location of 0.00015 inch (0.0038 mm).

7.9 A part made of drawn brass or machined from brass rod stock shall withstand, without cracking, the 10-Day Moist Ammonia-Air Stress Cracking Test, Section 33.

7.10 A gasket used in the assembly of a pump to seal flanged joints shall be impervious to fuel oil. For flat flanges, a plant-fiber gasket shall not be more than 1/32 inch (0.8 mm) thick.

8 Strength of Parts

8.1 Parts of a pump, except mechanical shaft seals and vented tanks, that are subjected to pressure during usage shall be constructed to withstand, without bursting, a hydrostatic pressure equivalent to five times the maximum pressure to which they may be subjected. See Hydrostatic-Pressure Strength – Test No. 9, Section 32.

9 Bodies, Covers, and Heads

9.1 An opening threaded for pipe connections shall be threaded in accordance with the Standard for General Purpose Pipe Threads, ANSI/ASME B1.20.1.

Exception: Pumps intended for use in installations where pipe fittings incorporate other than NPT type threads shall be permitted to be provided with pipe threads complying with a national pipe thread standard compatible with those fittings. The pipe thread type shall be identified in accordance with 35.1.

9.2 Webs, shoulders, and other obstructions shall be removed from the inner ends of internally threaded openings in a body to permit making tight joints.

9.3 An inlet and an outlet connection threaded for attachment to pipe shall be constructed so that when a pipe that is threaded two threads beyond standard size is run into the threaded portion of the opening, it will not distort any portion of the body or adversely affect the operation of the pump.

9.4 A male thread for attachment to a pipe fitting shall have no shoulder within the distance specified in Table 9.1 from the beginning of the thread, including any chamfer, nor shall any shoulder prevent an additional turn being made within this distance as determined by assembling the pump into a fitting within a tolerance of plus or minus one thread.

Table 9.1
Shoulder distance from beginning of thread

Pipe size, nominal inches	Shoulder distance, inches	(mm)
1/8	3/8	(9.5)
1/4, 3/8	9/16	(14.3)
1/2, 3/4	3/4	(19.1)
1	15/16	(23.8)
1-1/4	31/32	(24.6)
1-1/2	1	(25.4)
2	1-1/32	(26.2)
2-1/2	1-33/64	(38.5)
3	1-37/64	(40.1)

9.5 A pump assembly for attachment to pipe larger than 3 inch nominal size shall be provided with flanged pipe connections conforming to the appropriate American National Standard for Pipe Flanges and Flanged Fittings covering the material from which they are made.

9.6 If warping of a casting can affect the tightness of fluid containing joints or the necessary fit of parts, the casting shall be stress-relieved to reduce the possibility of warping.

9.7 The removable head or heads of a pump shall be of a thickness that will prevent warping or distortion and, if necessary, shall be ribbed and constructed with bosses for the installation of bearings and the formation of stuffing box recesses.

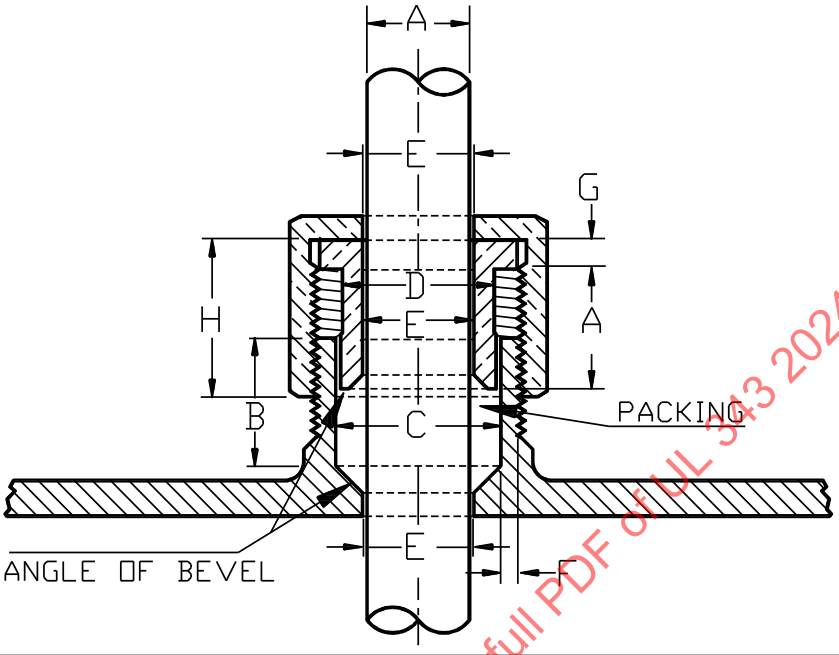
9.8 Clean-out and drain openings shall be closed by a standard pipe plug or a threaded shouldered plug. A gasket shall be retained by the pump body or the plug when the plug is removed.

10 Shaft Seals and Stuffing Boxes

10.1 If packing is used to prevent leakage around a shaft or stem of a pump part, a stuffing box that complies with the requirements in 10.2 – 10.9 shall be used if it is necessary for the user to adjust or renew the packing to prevent leakage during usage or as wear occurs. A conventional stuffing box construction is illustrated in Figure 10.1.

Figure 10.1

Conventional stuffing box construction



A	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	Inches
	4.8	6.4	7.9	9.5	11.1	12.7	24.3	15.9	17.5	19.1	mm
B	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	Inches
	7.9	9.5	11.1	12.7	14.3	15.9	17.5	19.1	20.6	22.2	mm
C	5/16	13/32	1/2	19/32	11/16	25/32	7/8	31/32	1-1/16	1-5/32	Inches
	7.9	10.3	12.7	15.1	17.5	19.8	22.2	24.6	27.0	29.4	mm
D	19/64	25/64	31/64	37/64	43/64	49/64	55/64	61/64	1-3/64	1-9/64	Inches
	7.5	9.9	12.3	14.7	17.1	19.4	21.8	24.2	26.6	29.0	mm
E	13/64	17/64	21/64	25/64	29/64	33/64	37/64	41/64	45/64	49/64	Inches
	5.2	6.7	8.3	9.9	11.5	13.1	14.7	16.3	17.9	19.4	mm
F[a]	3/32										Inches
	2.4										mm
G	1/16	1/16	5/64	3/32	3/32	1/8	1/8	9/64	9/64	5/32	Inches
	1.6	1.6	2.0	2.4	2.4	3.2	3.2	3.6	3.6	4.0	mm
H	3/8	7/16	33/64	19/32	21/32	3/4	13/16	57/64	61/64	1-1/32	Inches
	9.5	11.1	13.1	15.1	16.7	19.1	20.6	22.6	24.2	26.2	mm

[a] Thickness of retaining nut and wall of stuffing box at thinnest point shall not be less than 3/32 inch (2.4 mm).

S2829A

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

10.3 If an adjustable stuffing box is used to seal an automatically actuated stem of a safety valve or device or the shaft of a pump not normally in plain view, the construction shall be such that any allowable adjustment of the packing take-up will not bind the stem or shaft to prevent the valve or device from functioning automatically, or to cause overloading of a pump. A gland shall be spring-loaded.

10.4 An automatic spring take-up for a gland shall employ a spring made of a material that is corrosion-resistant or provided with a corrosion-resistant protective coating.

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

10.6 At the advanced position of the gland, a take-up spring shall not require further adjustment to prevent leakage from the stuffing box.

10.7 A stuffing box gland shall be made of corrosion-resistant material. The construction of parts shall be such as to result in compressing the packing against the stem or shaft when the stuffing box nut or yoke is tightened.

10.8 Before shipment, a stuffing box shall be fully packed with a material, the impregnation of which is not adversely affected by contact with the liquid for which the pump is intended for use.

10.9 A stem or shaft shall be of a length that permits repacking the stuffing box without requiring the part to be dismantled, and threads of a stem shall not enter the stuffing box recess.

11 Springs

11.1 A spring shall be guided and arranged to reduce binding, buckling, or other interference with its free movement. If necessary, both ends of a spring shall be closed and squared.

12 Diaphragms

12.1 A diaphragm-type valve or device in which a flexible diaphragm or bellows constitutes the only liquid seal shall have the atmospheric side of the diaphragm enclosed in a liquid-tight casing or shall limit leakage when ruptured to the extent specified by the requirements for Static-Pressure Leakage – Test No. 7, Section 30.

12.2 Failure of a diaphragm or bellows employed as part of a pressure relief or regulating valve shall not result in an increase of internal or regulated pressure.

12.3 A diaphragm or bellows shall be protected from damage. Positive motion of a diaphragm-type valve shall follow as a result of diaphragm movement.

12.4 Metal parts that contact a diaphragm shall have no sharp edges, burrs or projections that might chafe or abrade the diaphragm.

13 Bases

13.1 The base of a transfer pump, if furnished, shall be constructed to permit mounting and alignment of an electric motor, pulleys, gears, or other driving mechanism with the pump. The location of these parts

shall be such as to permit repacking a pump stuffing box without dismantling piping, gears, or other such operating parts.

13.2 The base or body of a power-operated pump intended for use in the assembly of an oil burner shall be constructed for mounting independently of the liquid-handling piping.

14 Integral Tanks

14.1 A tank intended to be included as part of a pump assembly shall not exceed 60 gallons (227 L) in capacity and shall be provided with a connection for venting to the outside of the building; except a tank having a capacity of not more than 10 gallons (37.9 L) may be wholly or partially vented into the building space occupied by the pump. A tank arranged for venting into the building space shall not be provided with an overflow connection to the supply tank unless the vent area is restricted to that required for pump operation or fuel supply. A 5-percent tolerance is allowed for the maximum capacities in determining compliance with this requirement.

14.2 The thickness of uncoated sheet steel shall not be less than 0.042 inch (1.07 mm) for a tank of 10 gallons (37.9 L) or less capacity and not less than 0.053 inch (1.35 mm) for larger tanks. A preservative shall be applied to uncoated surfaces of a tank to prevent rusting prior to use.

14.3 The thickness of aluminum-coated steel, galvanized steel, terne sheet, and corrosion-resistant sheet metal shall not be less than 0.034 inch (0.86 mm) for a tank of 10 gallons (37.9 L) or less capacity. Coated sheet shall be of prime finish, that is, free from blisters, flux, and uncoated spots visible to the unaided eye.

14.4 Hot-dipped mill-galvanized sheet steel shall conform with the coating Designation G90 in Table I of the Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip Process, ASTM A653/A653M, with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirement in this ASTM designation. The weight of zinc coating may be determined by any acceptable method; however, in case of question, the weight of coating shall be established in accordance with the Test Method of ASTM A90-81, Tests for Weight of Coating of Zinc-Coated (Galvanized) Iron or Steel Articles.

14.5 The coating of terne sheet shall not be less than 8 – 12 pounds (3.6 – 5.4 kg) per double-base box, 112 sheets, 20- by 28-inches (508- by 711-mm).

14.6 The coating of aluminum-coated steel shall not be less than 0.5 ounces per square foot (0.15 kg/m^2) of sheet.

14.7 A tank made of uncoated sheet steel, aluminum-coated steel, or terne sheet may be of Full-Drain construction.

14.8 Full-Drain construction shall be obtained by building a tank that is emptied through the fuel outlet at the bottom of the tank.

14.9 Joints of a tank shall be made mechanically secure by being locked-seamed, brazed, or welded. A joint not continuously brazed or welded shall be sweated with solder having a melting point (solidus temperature) higher than 538°C (1000°F). Brazing or welding of coated sheets having a thickness of less than 0.053 inch (1.35 mm) shall not damage the coating of surfaces in contact with the liquid when the tank is full. Connections shall be made through solid threaded bosses or fittings that are mechanically secured to the tank.

14.10 An overflow line connection required to prevent the discharge of oil from the tank into the building space occupied by the pump shall be located so that the top of the connection will be 3/4 inch (19.1 mm)

below any opening allowing spillage. Such overflow connection shall be one pipe size larger than the supply connection to the pump.

15 Strainers

15.1 A small orifice or other opening in an automatic fuel-oil pump shall be protected by a strainer.

15.2 A strainer shall be constructed to permit the removal and replacement of the straining element without disturbing any part of the pump assembly. The force necessary to open a strainer shall not permanently distort the assembly.

15.3 A strainer required for the protection of an automatic safety valve or device or a float valve shall be furnished as part of the assembly incorporating such valve or device.

15.4 Pipe or other fuel conduit used to connect a float valve, safety valve, or safety device to the protecting strainer shall be free of dirt and scale.

16 Floats

16.1 A float intended to actuate a mechanism shall have a buoyancy not less than 50 percent greater than that required to operate the mechanism.

16.2 A float in fuel oil shall resist damage from contact with the fuel and any impurities that may be contained therein, such as sulfur compounds and water. A metal, if used, is to have corrosion resistance equivalent to that of brass. A nonmetallic float shall be of material resistant to aging or loss of buoyancy equivalent to that afforded by natural cork.

17 Control Application

17.1 An automatic pump shall incorporate a control or equivalent provision to maintain the fuel supply at a safe level.

17.2 Supplementary provision to the level control shall be made to prevent the accumulation of excessively high oil levels. Such provision shall consist of an overflow connection or equivalent separate means of the manually reset type. An overflow connection shall not be provided for an assembly that is intended to be vented into an adjoining space unless the vent area is restricted to that required for pump operation or fuel supply. An overflow connection for draining to the supply tank shall not be less than one pipe size larger than the supply-line connection to the pump.

17.3 An automatic pump shall be arranged to prevent the continuous discharge of fuel oil because of breakage of the pump discharge line.

18 Piping and Fittings

18.1 Standard full-weight wrought-iron or steel, or iron-pipe-size brass pipe with malleable-iron, steel, or brass fittings shall be used.

18.2 Pipe threads shall be in accordance with the Standard for General Purpose Pipe Threads, ANSI/ASME B1.20.1-1983.

18.3 Unions shall be of the metal-to-metal seat type.

ELECTRICAL EQUIPMENT

19 General

19.1 Electrical equipment and wiring shall be arranged so that flammable liquids or water will not drip or run on them during intended use, or from a connection required to be uncoupled for servicing the pump.

19.2 A pump shall be constructed so that the enclosure, frame, and similar noncurrent-carrying parts of all high-voltage electrical equipment are bonded to the means provided for connecting the metal-clad cable or conduit of the supply circuit. An insulated conductor intended solely for grounding purposes shall be identified by a continuous green color with or without one or more yellow stripes.

19.3 Attachment plugs or separable connectors shall not be used in circuits if the breaking or making of the circuit by such devices may allow unintended operation of the pump.

19.4 Electrical circuits of each assembly to which connections are to be made in the field shall terminate in a box or enclosure in which connections to the circuit can be made. The box or enclosure shall permit the connection of metal-clad cable or conduit.

19.5 A box or enclosure included as part of the assembly and in which a branch circuit supplying power to the pump is to be connected shall not require that it be moved for care or servicing of the unit.

19.6 A box or enclosure in which field-installed conductors are to be connected shall be located so that the temperature of conductors within the box or surfaces of the box that will be in contact with the conductors will not exceed that specified for Type TW wire when the pump is tested in accordance with these requirements.

19.7 The size of a junction box in which field-installed conductors are to be connected by splicing shall not be less than that specified in Table 19.1. When the junction box is the terminal housing for the motor, the size of the compartment shall also comply with the requirements in the Standard for Electric Motors, UL 1004. A conductor passing through the box is counted as one conductor, and each conductor terminating in the box is also counted as one conductor. A field-furnished conductor for high-voltage circuits is determined to be not smaller than 14 AWG (2.1 mm^2).

Table 19.1
Minimum size of junction boxes

Size of conductors,		Free space within box for each conductor,	
AWG	(mm^2)	cubic inches	(cm^3)
18	(0.8)	1.5	(24.6)
16	(1.3)	1.75	(28.7)
14	(2.1)	2.0	(32.8)
12	(3.3)	2.25	(36.9)
10	(5.3)	2.5	(41.0)
8	(8.4)	3.0	(49.2)

19.8 Conductors intended for connection to a grounded neutral line shall be identified; that is, finished a white or gray color. Other conductors shall be finished in colors other than white or gray. A terminal for connection of a grounded conductor shall be identified by a metallic plated coating that is white in color and shall be distinguishable from other terminals or it shall be identified in some other manner, such as on an attached wiring diagram.

20 Enclosures

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

20.2 A cover or access panel of an enclosure for uninsulated live parts shall be provided with means for securing it in place.

20.3 An overall enclosure for uninsulated live parts shall have no openings that are not closed when the pump 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 specified diameter. The diameter of the rod is to be equivalent to the distance measured from a straightedge 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 (13.1 mm) unless the distance is 4 inches (102 mm) or more; in which case, the diameter of the rod may be 49/64 inch (19.4 mm).

21 Motors

21.1 A motor shall be constructed for continuous duty as indicated by the designation "Continuous" or "Cont." on the nameplate.

21.2 A motor shall be provided with overcurrent protection.

21.3 Motor protection in accordance with these requirements may be accomplished by:

a) An integral protective device.

b) The impedance of the motor being sufficient to prevent overheating because of failure to start or run; in which case, the designation "Impedance Protected" is to be included with the motor nameplate data.

c) The stipulated manually reset overcurrent protection included in a motor controller furnished with the pump.

d) A separate overcurrent device rated or set at not more than 125 percent of the motor full-load current rating for a motor marked to have a temperature rise not over 40°C (72°F) and at not more than 115 percent for all other types of motors, except that where these values do not correspond to the standard size or rating of a nonadjustable circuit breaker, thermal cutout, thermal relay, the heating element of a thermal trip motor switch, or possible setting of an adjustable circuit-breaker adequate to carry the load; the next higher size, rating, or setting may be used, but not higher than 140 percent of the full-load current rating of a motor marked to have a temperature rise of not over 40°C and not higher than 130 percent of the full-load current rating for all other motors. Such separate overcurrent devices, except when included as part of a magnetic motor controller shall be assembled as part of the pump equipment and be identifiable as such after assembly to the pump equipment.

21.4 A motor included in a wall-mounted pump shall be totally enclosed if not wholly enclosed within the pump casing.

21.5 A motor shall be enclosed in accordance with the following requirements if a totally enclosed motor is not required. See also 21.13.

21.6 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 pump.

21.7 Compliance with 21.8(b) may be provided by the motor frame or by other enclosure, structure, or shield; or by a combination of two or more such items and is to be determined with the motor assembled to the pump.

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

a) The motor is provided with over-temperature protection equivalent to that provided by inherent overheating protection or

b) The motor is located within a metal enclosure with no flammable 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.

21.9 Compliance with 21.8(b) may be obtained when a motor is located within a pump compartment having a closed metal bottom with no flammable material underneath the motor; when a motor is placed directly upon a structure that 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 a floor.

21.10 Openings in a motor frame in locations permitted by 21.6 and 21.8 shall be of such size or shape or so situated that a rod of the specified diameter is prevented from entering the motor. The diameter of the rod shall be equivalent to the distance measured from a straightedge placed across the outer face of the opening to be checked to the nearest uninsulated live part or film-coated wire in the motor, but not larger than 33/64 inch (13.1 mm) unless the distance is 4 inches (102 mm) or more; in which case, the diameter of the rod may be 49/64 inch (19.4 mm).

21.11 Compliance with the requirement in 21.10 may be provided by the motor frame or by other enclosure, shield, or structure; or a combination of two or more such items, and is to be determined with the motor assembled to the pump. 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). Uninsulated live parts in a compartment into which access is required for care or servicing of the pump are to be guarded or located to prevent unintentional contact by persons during usage of the pump.

21.12 If a motor is supported in a manner permitting placement of the motor frame in various positions, compliance with 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 pump structure.

21.13 A motor on a pump intended only for commercial and industrial installations shall be enclosed to the extent specified in 21.6 and 21.14.

21.14 A rod of the specified diameter shall be prevented from entering openings permitted by 21.13 in the top half of the motor. The diameter of the rod shall not be greater than 33/64 inch (13.1 mm) except that if the distance from a straightedge placed across the outer face of the opening being checked to the nearest uninsulated live part or film-coated wire within the motor is 4 inches (102 mm) or more, the diameter of the rod may be 49/64 inch (19.4 mm).

21.15 Compliance with the requirement in 21.14 may be provided by the motor frame or by other enclosure, structure, or shield; or by a combination of two or more such items, and is to be determined with the motor assembled to the pump as intended.

22 Wiring Methods

22.1 The wiring of high-voltage and safety-control circuits shall comply with the requirements in this section.

22.2 Insulated conductors having the necessary current capacity for the service shall be used. A conductor shall not be smaller than 18 AWG (0.82 mm^2).

22.3 Electrical wiring to a part that must be moved for intended 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. If the wiring to a part that also functions as an access plate or cover 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.

22.4 Conductors shall be enclosed within conduit, electrical metallic tubing, metal raceways or electrical enclosures, or metal-clad cable.

22.5 A splice in wiring shall be located only in an accessible junction box. A splice shall be made mechanically secure, soldered, and insulated with tape; or a fixture-type splicing connector may be employed.

22.6 At all points where conduit or metal-clad cable terminates, the conductor shall be protected from abrasion. If metal-clad cable is used, an insulating bushing or its equivalent shall be provided between the conductors and the cable tubing, and the connector or clamp shall be constructed so that the insulating bushing or its equivalent will be visible for inspection.

22.7 Unless supplied with insulation rated 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 be separated or segregated from uninsulated current-carrying parts connected to circuits of another voltage.

22.8 Segregation of insulated conductors may be accomplished by clamping, routing, or equivalent means that will maintain permanent separation in accordance with 22.7.

22.9 A hole in a metal wall through which insulated wires pass shall be provided with smooth, rounded bushings or shall have smooth, rounded surfaces to prevent abrasion of the insulation. A bushing shall be phenolic, porcelain, or hard fiber.

22.10 Field-installed conductors of a high-voltage circuit shall be segregated or separated by barriers from field-installation and factory-installed conductors connected to a circuit of another voltage, unless the conductors of both circuits are or will be insulated for the maximum voltage of either circuit.

22.11 Field-installed 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 the short-circuiting or grounding of which may result in the unintended operation of the pump.

PERFORMANCE

23 General

23.1 In addition to the following tests, the pump shall be tested in accordance with the requirements of 7.3 – 7.5, 21.10, and 21.14.

23.2 Except as otherwise indicated, representative samples of a pump are to be subjected to the tests described in these requirements.

23.3 The investigation of a pump is to be limited to the service conditions for which it is to be recommended, such as speed, ambient and liquid temperature, and liquid pressure.

23.4 A pump having a stuffing box employing a take-up spring is to be prepared for the following tests in accordance with 10.5 and 10.6.

23.5 A pump assembly having a float-actuated mechanism is to be prepared for the following tests in accordance with 16.1. The float or its mechanism is to be loaded or arranged so as to displace 150 percent of the liquid normally in contact with the float.

24 Deformation – Test No. 1

24.1 A pump shall not leak nor shall there be evidence of distortion or other damage resulting from the turning effort exerted on openings threaded for piping when the pump is tested in accordance with 24.2.

24.2 The sample pump is to be used in any of the following tests is to be rigidly anchored or otherwise supported. A length of Schedule 80 pipe is to be connected to a female pipe-threaded section of the pump after the male threads have been lubricated with SAE No. 10 machine oil. Each pipe is then to be tightened to the torque specified in Table 24.1.

Table 24.1
Torque requirements for pipe connections

Pipe size, nominal inches	Outside diameter, inch	(mm)	Torque, lb.-in.	(N·m)
1/8	0.405	(10.29)	150	(17)
1/4	0.540	(13.72)	250	(28)
3/8	0.675	(17.15)	450	(51)
1/2	0.840	(21.34)	800	(90)
3/4	1.050	(26.67)	1000	(113)
1	1.315	(33.40)	1200	(136)
1-1/4	1.660	(42.16)	1450	(164)
1-1/2	1.900	(48.26)	1550	(175)
2	2.375	(60.33)	1650	(186)
2-1/2	2.875	(73.03)	1750	(198)
3	3.500	(88.90)	1800	(203)
4	4.500	(114.30)	1900	(215)

25 Operation of Pressure-Regulating and Nozzle Shutoff Valves Combined With a Pump Assembly – Test No. 2

25.1 The maximum regulated pressure that can be established in the discharge line by adjustment of air or oil pressure-regulating valves shall not be more than 133 percent of the maximum rated pressure of the pump or the pump and compressor unit.

25.2 If a nozzle shutoff valve is separated from the pressure-regulating valve and a fixed shutoff pressure is to be established, the pressure in the discharge line at the time of shut off shall not be less

than 80 percent of the intended operating pressure. This differential pressure shall be effective at the minimum regulated pressure.

25.3 If the pressure-regulating valve and nozzle shutoff valve are adjusted as a unit, the pressure in the discharge line at the time of shut off shall not be less than 80 percent of the intended operating pressure. This differential pressure shall be effective at all regulated pressures.

25.4 A nozzle shutoff valve shall operate promptly to stop oil flow and prevent afterdrip from a nozzle upon stopping the pump following operation at the intended operating pressure and at the minimum rated pressure.

25.5 A pump and motor assembly is to be connected to a system of piping similar to that illustrated in Figure 27.1. The low tank part of the system is to be used for this test. The liquid fuel oil used is to be the heaviest grade and highest viscosity for that grade specified by the manufacturer. Additional tests are allowed to be conducted with the lightest grade of fuel oil and lowest viscosity for that grade as well.

25.6 The viscosity of the specified grade of fuel oil employed in the test is to be consistent with the highest viscosity that will be encountered under service conditions.

25.7 Nozzle shutoff pressure is to be determined by a pressure gauge installed in place of the nozzle. Other tests are to be conducted using a nozzle of the maximum size consistent with the rating of the pump as used in oil-burner service.

25.8 The tests for compliance with Test No. 2 are to be conducted both before and after Endurance – Test No. 6, Section 29.

26 Operation of Combination Pump and Compressor Assemblies – Test No. 3

26.1 A combination oil pump and air compressor assembly mixing oil and air within the assembly or intended to discharge the air and oil through separate conduits to an internal mixing atomizing nozzle shall not create excessive pressures of air or oil, or external leakage of fuel oil when the assembly is tested in accordance with 26.2 and 26.3.

26.2 The pump and compressor assembly is to be operated with a pressure gauge and gate valve installed in the air-oil mixture discharge line. An assembly intended to deliver air and oil to an internal mixing nozzle through separate conduit is to be equipped with a nozzle providing means for restricting the mixture outlet orifice as a substitute for the valve, and pressure gauges are to be installed in the separate air and oil lines leading to the mixing nozzle.

26.3 The valve or nozzle restricting means is to be closed sufficiently to cause an increase in the air-oil mixture pressure or the separate air and oil pressures to 1-1/2 times and then to twice the maximum rated pressure valves recommended by the manufacturer. There is to be no evidence of stalling or overloading of the compressor and its integral or specified motor at 1-1/2 times, and no external leakage of oil is to occur at twice the specified pressure.

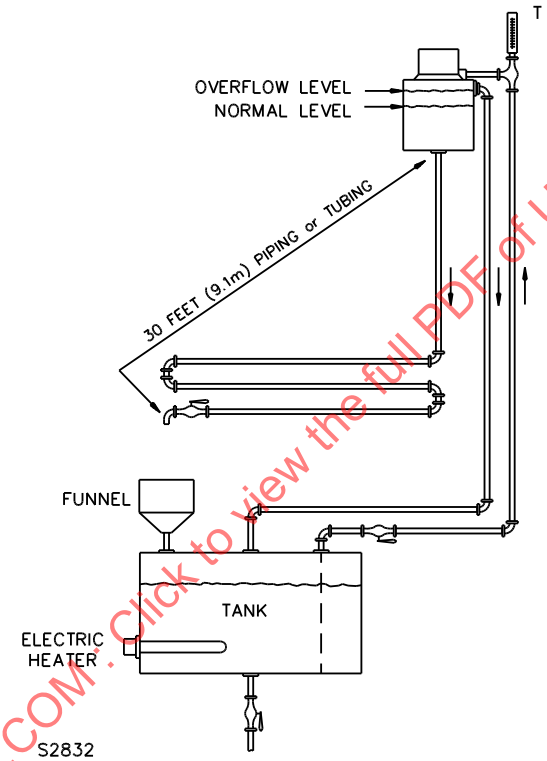
27 Operation of Automatic Fuel Oil Pumps – Test No. 4

27.1 An automatic oil pump shall not discharge more than 2 gallons (7.6 L) of oil from the discharge line in the event of a total break in such line when tested in accordance with 27.2 – 27.7. The oil level maintained in the pump reservoir for gravity discharge shall not vary more than a total of 5 percent of the lowest height recommended for the installation of the pump above the burner connection. An overflow connection or equivalent shall prevent any oil from reaching a level within 3/4 inch (19.1 mm) of any opening that allows external leakage from the assembly.

27.2 The pump is to be installed with a system of piping as illustrated in Figure 27.1. Suction, overflow, and discharge connections and conduits are to be assembled using the size and kind of materials recommended by the manufacturer. The pump is to be set so that the height of the intended oil level in the pump reservoir is at the minimum distance above the end of the discharge line or burner connection recommended by the manufacturer. The discharge-line conduit is to include at least 30 linear feet (9.1 linear m) of material from the pump connection to the end. A shutoff valve is to be installed at the end of this line, and a reservoir is to be supplied at that point for measuring the oil discharged.

Figure 27.1

Test apparatus for automatic pumps



27.3 Mechanisms depending upon electrical current to monitor the operation of the pump are to be energized at 85 percent of rated voltage.

27.4 Fuel oil in the system is to be the heaviest grade and the highest viscosity for that grade specified by the manufacturer.

27.5 The pump is to be operated and oil allowed to accumulate in the pump reservoir up to the highest normal oil level. At this time, the valve at the end of the discharge line is to be opened wide. Not more than 2 gallons (7.6 L) of oil are to be discharged as the result of this action, including the drainage of all fuel from the pump assembly and the discharge line.

27.6 The automatic pump control is to be made inactive. With the pump running, the overflow line or other means is to prevent the oil reaching a level higher than that specified.

27.7 Observations of oil level variations during pump operation are to be made under conditions of minimum oil discharge.

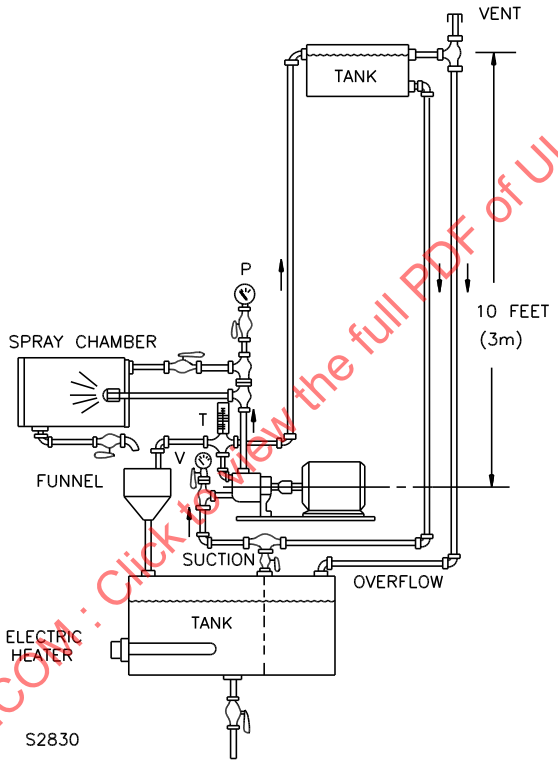
28 Vacuum and Capacity of Power-Operated Pumps – Test No. 5

28.1 A pump shall create a vacuum at its suction line connection of 10 inches (254 mm) of mercury when discharging at maximum rated pressure. The capacity of the pump is to be recorded.

28.2 Vacuum tests are to be made using the lightest grade of fuel oil and the lowest viscosity for that grade specified by the manufacturer. The oil is to be circulated through the low tank part of the pump system illustrated in Figure 28.1.

Figure 28.1

Test apparatus for power-operated pumps



28.3 The capacity of the pump to deliver oil, and the capacity for rating purposes are to be measured with the pump operating continuously and with the vacuum adjusted by increasing the resistance in the suction line by means of a flooded valve or the equivalent. The capacity is that rate capable of being delivered at the nozzle while the pump is maintaining the intended operating pressure. The test is to be conducted both before and after Test No. 6, Endurance, Section 29. The before and after capacity, for rating purposes under similar conditions, shall be within 5 percent.

28.4 The pump capacity for oil burner rating purposes for those pumps embodying built-in strainers is to be the capacity as determined by the rating of the strainer or the capacity of the pump as determined in this test, whichever is the lesser.

29 Endurance – Test No. 6

29.1 A power-operated pump and its auxiliary parts shall not seize or show evidence of external leakage during operation when tested in accordance with 29.2 – 29.5.

29.2 Endurance tests are to be conducted under the same condition and with the same system employed for Vacuum And Capacity of Power-Operated Pumps – Test No. 5, Section 28. When a pump is also intended for use with No. 5 or 6 fuel oil at elevated temperatures, an additional identical sample is to be subjected to an endurance test conducted with the heaviest fuel oil specified by the manufacturer at the maximum specified temperature. A pump is to be operated continuously for 15 days at maximum rated pressure. Following this interval, the pump is to be operated for 15 days intermittently 1 minute on and 1 minute off.

29.3 A pump sample is to be equipped with a motor that is capable of operating without overheating under the conditions of test described in 29.2. An automatic pump is to be operated intermittently at the approximate time intervals described in 29.2 by controlling the rate of discharge.

29.4 A pump equipped with pressure-regulating and nozzle shutoff valves is to be arranged to operate conventionally employing the largest capacity nozzle recommended for use with the pump.

29.5 Following the 15-day intermittent test or using separate samples concurrently, moving parts such as pressure-regulating and nozzle shutoff valves, float mechanisms, control switches, and devices are to be operated 100,000 times without breakdown or failure. Parts used in this test if previously used in the 15-day intermittent test may be credited with the cycles of operation that have accumulated during that test.

30 Static-Pressure Leakage – Test No. 7

30.1 A power-operated pump and its auxiliary parts shall show no evidence of external leakage or leakage through shutoff devices or valves when subjected to a static head pressure of 10 feet (3 m) of oil connected to its suction or supply and its return-line connection.

30.2 A diaphragm or bellows providing the liquid seal to the atmosphere shall be provided with means to limit the external discharge of oil to a rate not in excess of 1 gph (3.8 L/hr) when ruptured.

30.3 This test is to be conducted using the same samples as used for Endurance – Test No. 6, Section 29, under the same conditions and with the same system employed for Vacuum and Capacity of Power-Operated Pumps – Test No. 5, Section 28, except the upper or static pressure supply tank is to be employed. The pump is to be operated at maximum rated pressure or maximum regulated pressure, whichever is higher. The pump is to be operated continuously for 48 hours and observations made for external leakage.

30.4 The assembly is then to be subjected for 48 hours to the static head conditions while not running, and observations are to be made for external leakage plus leakage at the nozzle or other outlets protected by shutoff devices or valves. See 30.1.

30.5 Any diaphragm or bellows is then to be ruptured, and the tests as outlined in 30.3 and 30.4 are to be repeated, except that the time intervals are to be only those sufficient to establish the rate of leakage obtained under the conditions. See 30.2.

31 High-Pressure Leakage – Test No. 8

31.1 A power-operated pump and its auxiliary parts and connections, except vented tanks or parts, shall show no evidence of external leakage or leakage through shutoff devices or valves when operated at a pressure 1-1/2 times maximum rated or maximum regulated pressure, whichever is higher, but not less than 18 psig (124 kPa). Vented tanks or parts shall show no evidence of external leakage when subjected to air pressure of 1 psig (6.9 kPa).

31.2 This test is to be conducted using the same samples as used for Endurance – Test No. 6, Section 29, under the same conditions and with the same system employed for Test No. 6. The diaphragm or

bellows ruptured as described in 30.5 must be replaced before Test No. 8 continues. The motor is to be of a size capable of driving the pump when a discharge pressure of 1-1/2 times maximum rated or maximum regulated pressure or 18 psig (124 kPa), whichever is greater, is developed by the operation of the pump. Vented tanks or parts of the pump assembly are to be subjected to air pressure of 1 psig (6.9 kPa) while immersed in water.

31.3 Required pressures higher than may be attained by integral pressure-regulating devices are to be established by special springs or assemblies furnished by the manufacturer for this purpose.

31.4 The operation is to be continued for at least 10 minutes, during which time observations are to be made for external leakage and leakage through parts protected by shutoff devices.

32 Hydrostatic-Pressure Strength – Test No. 9

32.1 All liquid-handling parts of a pump, except mechanical shaft seals and vented tanks or parts, shall withstand, without rupture, a hydrostatic pressure equivalent to five times maximum rated pressure or five times maximum regulated pressure, whichever is higher, but not less than 18 psig (124 kPa). Mechanical shaft seals shall not rupture when subjected to a hydrostatic pressure equivalent to twice the maximum rated or maximum regulated pressure, whichever is higher, but not less than 18 psig.

32.2 All samples used in the tests described in Sections 24 – 31 are to be subjected to the conditions of Test No. 9.

32.3 For a positive-displacement pump equipped with an integral relief or pressure-regulating device, the test pressure is to be applied to the pressure side of the pump upstream from any nozzle shutoff valve or pressure-regulating device. This can generally be accomplished by using the pressure gauge connection. The pressure-relief devices and the discharge-line connection are to be blocked closed. Also, the suction and return-line connections are to be interconnected and arranged for the application of a hydrostatic pressure of 18 psig (124 kPa) which is to be maintained during the test described in 32.4, or impressed as a separate test to determine the effects of this pressure on these parts and on stuffing boxes or shaft seals in cavities communicating with suction- or return-line connections.

32.4 The pump is to withstand the effects of a hydrostatic pressure equivalent to five times maximum rated pressure or five times maximum regulated pressure, whichever is higher, as applied to the pressure side of the pump for 1 minute, and to the simultaneous or separate hydrostatic pressure of 18 psig (124 kPa) as applied to the suction- and return-line connections for the same period of time.

33 10-Day Moist Ammonia-Air Stress Cracking Test

33.1 After being subjected to the conditions described in 33.2 – 33.4, a brass part containing more than 15 percent zinc shall show no evidence of cracking when examined using 25× magnification.

33.2 Each test sample is to be subjected to the physical stresses normally imposed on or within a part as the result of assembly with other components. Such stresses are to be applied to the sample prior to and maintained during the test. Samples with threads, intended to be used for installing the product in the field, are to have the threads engaged and tightened to the torque specified in Table 24.1. Teflon tape or pipe compound are not to be used on the threads.

33.3 Three samples are to be degreased and then continuously exposed in a set position for ten days to a moist ammonia-air mixture maintained in a glass chamber approximately 12 by 12 by 12 inches (305 by 305 by 305 mm) having a glass cover.

33.4 Approximately 600 ml (20.3 ounces) of aqueous ammonia having a specific gravity of 0.94 is to be maintained at the bottom of the glass chamber below the samples. The samples are to be positioned 1-1/2

inches (38.1 mm) above the aqueous ammonia solution and supported by an inert tray. The moist ammonia-air mixture in the chamber is to be maintained at atmospheric pressure and at a temperature of 34 ±2°C (93.2 ±3.6°F).

MANUFACTURING AND PRODUCTION TESTS

34 General

34.1 To establish compliance with these requirements in production, the manufacturer shall provide regular production control, inspection, and tests. The program shall include at least the following:

a) External leakage test on each assembled pump or liquid-carrying part at maximum rated pressure, but not less than 18 psig (124 kPa). Oil-carrying parts vented to atmosphere shall be tested for external leakage at 1 psig (6.9 kPa), or the equivalent.

b) Running test at intended operating pressures to determine freedom of rotation or movement; correctness of assembly and operation of pressure-regulating, relief, and shutoff valves or devices.

MARKING

35 General

35.1 A pump shall be marked with the following information:

a) The manufacturer's or private labeler's name or identifying symbol;

b) A distinctive catalog designation to specifically identify the pump;

c) The electrical rating, where applicable;

d) The maximum rated pressure[a]; and

e) The grade of fuel oil for which the pump is intended[a].

f) Pumps constucted using pipe thread in accordance with the Exception to 9.1 shall be provided with a tag, label, or similar marking on the product or smallest unit package, identifying the pipe thread type for the installer.

[a] Not required when the manufacturer's catalog designation individuates each kind of pump in the line.

35.2 The marking shall be legible and permanent to the extent afforded by stamping, a metal plate, or a decalcomania transfer.

Exception: The marking required by 35.1(f) is not required to be permanent.

35.3 If a manufacturer produces pumps at more than one factory, each pump shall have a distinctive marking to identify it as the product of a particular factory.