UL 331

STANDARD FOR SAFETY

Strainers for Flammable Fluids and Anhydrous Ammonia

UL Standard for Safety for Strainers for Flammable Fluids and Anhydrous Ammonia, UL 331

Eighth Edition, Dated February 25, 2008

Summary of Topics

This revision of ANSI/UL 331 dated October 1, 2020 includes the following changes in requirements:

– Revisions to 10-Day Moist Ammonia-Air Stress Cracking Test; Section 18

– Clarifications to the Deformation Test; 13.2, 13.5, 13.6

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.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated July 31, 2020.

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UL 331

Standard for Strainers for Flammable Fluids and Anhydrous Ammonia

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February 25, 2008

This ANSI/UL Standard for Safety consists of the Eighth Edition including revisions through October 1, 2020.

The most recent designation of ANSI/UL 331 as an American National Standard (ANSI) occurred on October 1, 2020. 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 UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover complete, self-contained strainer or filter assemblies intended for use with designated flammable fluids and anhydrous ammonia (fertilizer grade) in residential and commercial fuel-burning, dispensing, and handling facilities. Although these devices are designated strainers, they may be either strainers or filters according to the common terminology of the industry.

1.2 The term flammable fluids as used in this standard means fuel oil, gasoline, kerosene, and similar petroleum products, liquefied petroleum gas (LP-Gas), and manufactured and natural fuel gas.

1.3 These requirements do not cover the following:

a) Strainers for handling liquids under cryogenic conditions;

b) Strainers for marine use;

c) Strainers for automotive fuel lines;

d) Strainers for handling refrigerants;

e) Strainers for use in such facilities as chemical, petrochemical, petroleum, and utility power plants; and

f) Strainers for use in fluid-power (hydraulic and pneumatic) applications.

1.4 Requirements for non-potable water strainers are covered in Supplement SA.

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.

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 If a value for measurement is followed by a value in other units in parentheses, the first stated value is the requirement.

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.

CONSTRUCTION

5 General

5.1 A strainer shall include all of the components necessary for its intended function and installation, and shall be furnished as a complete assembly.

5.2 The construction of a strainer shall be such that parts can be reassembled in the intended manner after being dismantled to the extent needed for servicing.

5.3 A strainer shall be constructed so that, when in its intended operating position, any air trapped within will not reduce the rate of liquid flow or the effective strainer element capacity.

5.4 A strainer employing a strainer element intended to be cleaned or replaced shall permit the removal of the element without disconnecting piping.

5.5 A strainer element shall be constructed so that joints or seals required to prevent fluid bypass of the element will be maintained.

5.6 A strainer shall be constructed so that, when the screen or filter element is removed for cleaning, all foreign matter (sediment and dirt) will be removed or can be removed without the probability of any foreign matter being deposited in the outlet side of the strainer.

6 Capacity

6.1 A strainer that is intended to protect the smallest orifice in oil burning equipment shall comply with the requirements in this section.

Exception: This requirement does not apply to strainers intended for use in fuel oil transfer or recirculating piping systems.

6.2 A strainer element of the wire cloth, perforated, or plate type shall have a maximum orifice (diameter) size or plate separation of:

a) 0.027 inch (0.69 mm) if the strainer is intended for use with No. 1 or 2 grade fuel oil and

b) 0.056 inch (1.42 mm) if the strainer is intended for use with No. 4, 5, or 6 grade fuel oil service.

6.3 Each strainer assembly is to be rated for capacity in terms of the maximum firing rate of the burner equipment as expressed in gallons of fuel oil per hour (3.79 l/hr). For strainers employing wire cloth or perforated screens, Figure 6.1 – Figure 6.3 specify minimum areas of screen opening based upon the grade of fuel oil used and the firing rate of the equipment to be served.

Figure 6.1

Strainer area for No. 1 grade fuel oil

NOTES – 1) Fuel oil as designated by Specification for Fuel Oils, ANSI/ASTM D396-89 : 2) 1 in^2 = 6.45 cm^2: 3) 1 Gallon = 3.79 l

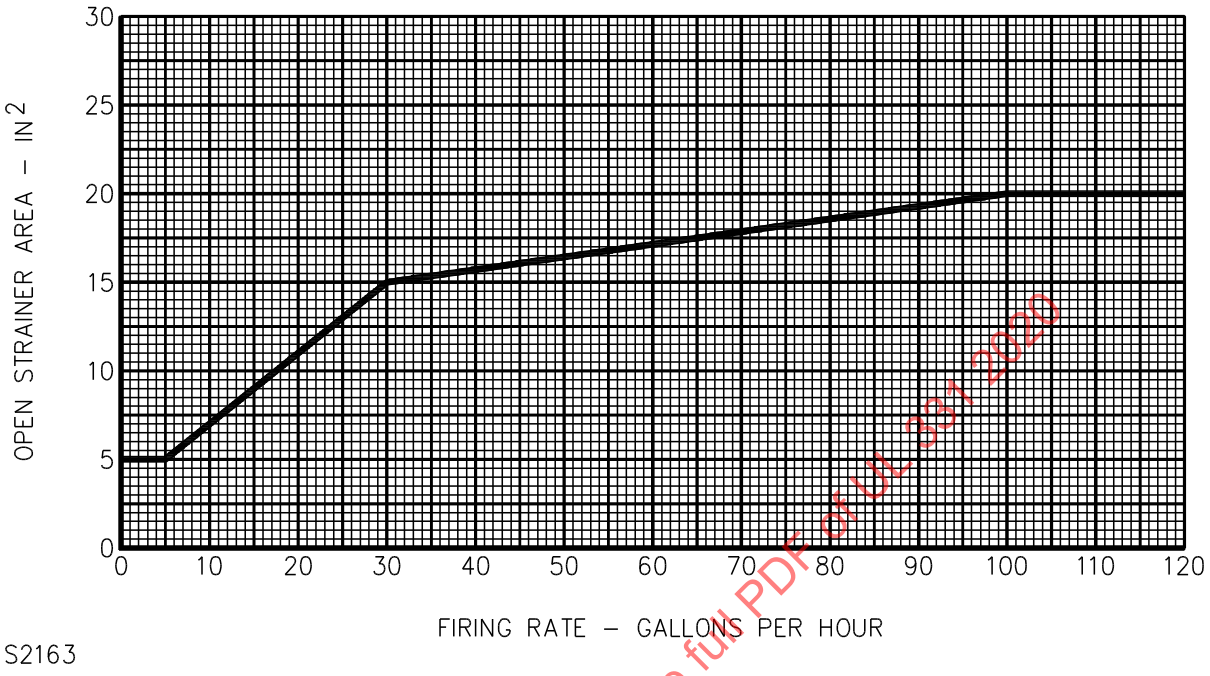
Figure 6.2

Strainer area for No. 2 grade fuel oil

NOTES – 1) Fuel oil as designated by Specification for Fuel Oils, ANSI/ASTM D396-89 : 2) 1 in^2 = 6.45 cm^2: 3) 1 Gallon = 3.79 l

Figure 6.3

Strainer area for Nos. 4, 5, 6 grade fuel oils



NOTES – 1) Fuel oils as designated by Specification for Fuel Oils, ANSI/ASTM D396-89: 2) 1 in^2 = 6.45 cm^2: 3) 1 Gallon = 3.79 l

6.4 The selection of capacity ratings based on firing rates versus open or free area for various grades of fuel oil also provides for low initial pressure losses or drops through the strainer assembly when clean.

6.5 The capacity of each size and type of element is to be determined. If possible, this is to be accomplished by calculation as outlined in 6.6 and 6.7 for wire cloth and perforated types. Elements other than these, such as filter elements of felt, cotton waste, ceramics, and the like, are to be subjected to the Clogging Test – Strainers for Oil Burners, Section 17, to:

a) Establish ratings by comparison to established properties of wire cloth or perforated screens and

b) Determine that the filter-type element will not pass particles that will be retained by the standard wire-mesh strainer element used for comparison.

6.6 A wire-cloth element has an open area equal to the total area of the cloth minus the area covered by seams, ribs, and supports multiplied by the screen factor. The screen factor is that percentage of open area of the cloth to the whole area. If the screen factor is unknown, it may be calculated as follows:

$$Screen\ factor = (1 - ND) \times (1 - nd)$$

in which:

N is the number of wires in warp per inch,

D is the diameter of wire in warp in inches,

n is the number of wires in the shoot per inch, and

d is the diameter of wire in the shoot in inches.

Note: 1 inch = 25.4 mm

6.7 A perforated element has an open area equal to the total number of openings multiplied by the area of each opening minus the area covered by seams, ribs, and supports.

6.8 The effective area of a perforated element that includes a wire-cloth insert is considered to be the smaller of the two areas determined by 6.6 and 6.7.

7 Materials

7.1 A part in contact with the fluid to be handled shall be resistant to the action of such fluid.

7.2 Zinc, copper, and copper-base alloys, such as brass, that are subject to rapid destructive action by ammonia in the presence of water shall not be used for anhydrous ammonia service.

7.3 Except as indicated in 7.4 and 7.5, fluid-containing parts other than a seal ring or a gasket shall have a melting point (solidus temperature) of not less than 950°F (510°C) and an ultimate tensile strength of not less than 10,000 psig (69 MPa) at 400°F (204°C).

Exception: For a strainer for an oil burner, an oil-containing part, other than a base (head) unit, a melting point (solidus temperature) less than 950°F (510°C) is allowed to be installed if:

a) The part is protected by a fusible-link shut-off valve with a temperature rating of not more than 350° F (177° C). The fusible-link shut-off valve shall comply with the Standard for Valves for Flammable Fluids, UL 842; and

b) The part is suitable for exposure to the intended fuel and the part complies with the requirements of the Resistance to Impact Test, Mold Stress-Relief Distortion Test, in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, with the following parameters:

1) With regard to the Resistance to Impact Test, the drop impact test shall be conducted utilizing a concrete floor or an equivalent nonresilient floor in lieu of a hardwood surface.

2) With regard to the Resistance to Impact Test, the ball impact test shall be conducted with the impact requirements of 6.8 J (5.0 ft-lbs).

3) With regard to the Mold Stress-Relief Distortion Test, the part is to be placed in an air oven maintained at 158°F (70°C) for 7 hours.

7.4 A body and a closure for anhydrous ammonia and LP-Gas service shall be of steel, ductile (nodular) iron, Grade 60-40-18 or 65-45-12, as described in the Specifications for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures, ASTM A395-88, or Specifications for Ductile Iron Castings, ASTM A536-84, or malleable iron complying with the Specifications for Malleable Iron Castings, ASTM A47-84, or the equivalent. In addition, brass or bronze may be used for such a part for LP-Gas service.

7.5 A brazing material used in joining fluid-confining parts of a strainer for LP-Gas shall have a melting point (solidus temperature) of not less than 940° C (1724° F). Brazing shall not be used on strainers for anhydrous ammonia. See 7.2.

7.6 If atmospheric corrosion of a part will interfere with the intended function of the strainer or permit external leakage, the part shall be of corrosion-resistant material or be provided with a corrosion-resistant protective coating.

Exception: A corrosion-resistant protective coating need not be provided on ferrous materials used for fluid-confining parts having the thickness specified in Table 7.1.

Table 7.1
Thickness for uncoated non-stainless ferrous materials

Fluid in contact with material	Minimum thickness			
	Sheet metal,		Sand castings,	
	inch	(mm)	inch	(mm)
Anhydrous ammonia	1/8	3.2	1/4	6.4
Manufactured and natural fuel gases	0.067	1.70	3/16	4.8
LP-gas	1/8	3.2	1/4	6.4
Fuel oils	0.042	1.07	1/8	3.2
Gasoline	a		1/4	6.4

[a] Shall be at least 0.093 inch (2.36 mm), corrosion protected or not

7.7 A protective coating shall provide resistance against corrosion to a degree not less than that provided by the protective coating specified in 7.8.

7.8 Cadmium plating shall not be less than 0.0003 inch (0.008 mm) thick, and zinc plating shall not be less than 0.0005 inch (0.013 mm) thick, except on parts where threads constitute the major portion of the area, in which case the cadmium or zinc plating shall not be less than 0.00015 inch (0.0038 mm) thick. See 7.2.

7.9 A wire-cloth element, if finer than 60 mesh, shall be resistant to corrosion. A 60-mesh or coarser element shall be resistant to the fluid it is intended to contact.

8 Bodies and Covers

8.1 An opening threaded for connection of pipe shall be threaded in accordance with the Standard for Pipe Threads, ANSI/ASME B1.20.1.

Exception: Strainers 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 20.1.

8.2 A strainer for attachment to pipe larger than 3-inch nominal size shall be provided with flanged pipe connections. Flanges shall conform to the appropriate American National Standard for pipe flanges and flanged fittings covering the material from which the flange is made, or shall be of a construction found by investigation to be equivalent for the specific application.

8.3 Cleanout and drain openings shall be closed by a standard pipe plug, a threaded, shouldered plug, or a wing-nut plug. The specified plugs shall be supplied with a seal to prevent leakage that is compatible with the intended fuel (s) as demonstrated by compliance with the performance requirements of this standard. A strainer intended for use with gasoline shall have brass plugs or, if of steel, they shall be coated to retard corrosion.

8.4 A strainer provided with a screwed cover shall employ either ground joints, gaskets, or O-rings acceptable for the purpose. If a gasket or O-ring is used, it shall be retained by the body, cover, or cap when the part is removed and shall not be damaged when the cover or cap is screwed in place.

8.5 A flat gasket employed with a bolted cover shall be cemented to the cover or body unless the construction is such that the gasket will be retained by either the body or cover when the cover is removed.

Exception: Cementing or retaining of the gasket is not necessary provided a complete set of new gaskets is furnished with each replacement cartridge for a strainer that employs a cartridge-type filtering element.

8.6 A plant fiber gasket shall not be less than 1/32 inch (0.8 mm) thick.

8.7 A cork gasket shall be graphited on one side, and when high pressures are involved, the other side shall be cemented in place so the gasket will not be blown out.

9 Stuffing Boxes

9.1 If packing is used to prevent leakage around a stem, and the construction is such that it is necessary for the user to adjust or renew the packing during usage or as wear occurs, a stuffing box complying with the requirements in 9.2 – 9.8 shall be provided.

9.2 A stuffing box shall be provided with a removable, shouldered, unthreaded follower gland, and shall have a nut or other means for adjusting the gland to maintain pressure on the packing.

9.3 A stuffing box gland shall be made of corrosion-resistant material.

9.4 A stuffing box shall be fully packed prior to shipment of the strainer.

9.5 A spring-loaded follower gland shall employ a spring made of corrosion-resistant material, or of material provided with a corrosion-resistant protective coating.

9.6 If corrosion of a stem will cause damage to a packing or seal material and result in leakage, the stem shall be of a corrosion-resistant material.

9.7 A stem shall be constructed so that it cannot be completely withdrawn from the strainer by reverse rotation. Threads of a stem shall not enter a stuffing box recess.

9.8 A stem shall be of sufficient length to permit repacking the stuffing box without requiring the strainer to be dismantled.

10 Springs

10.1 The construction and application of a spring employed in a strainer shall be such that it is not likely to fail because of corrosion, fatigue, overstress, or wear, if failure of the spring will allow the strainer elements to become displaced.

PERFORMANCE

11 General

11.1 Except as otherwise indicated, representative samples of a strainer are to be subjected to the tests described in Sections 12 – 18.

11.2 If a series of strainers is to be investigated in which the bodies differ in size only, three representative samples are to be chosen to include the largest, smallest, and one intermediate size. If a strainer having a single body size is being investigated, one sample is sufficient.

11.3 A strainer is to be investigated for a specific fluid or fluids and for the service conditions for which it is to be recommended, such as fluid temperature and fluid pressure.

12 Tests On Synthetic-Rubber Parts

12.1 A synthetic-rubber part in contact with one of the fluids specified in Table 12.1 shall not show excessive volume change or loss of weight as specified in 12.3, when considered on the basis of its intended function, following immersion in the specified test fluid in accordance with the requirements in the Standard for Gaskets and Seals, UL 157.

Table 12.1
Test liquids for synthetic-rubber materials

Fluid in contact with part	Test fluid
LP-Gas	n-Hexane
Anhydrous ammonia	Liquid anhydrous ammonia
Manufactured and natural fuel gases	IRM Oil No. 903 (ASTM-D471) and n-Hexane
Fuel oils, Nos. 1 and 2, and kerosene	IRM Oil No. 903 (ASTM D471)
Fuel oils, Nos. 4, 5, and 6	IRM Oil No. 903 (ASTM D471)
Gasoline	A and C reference fuels (ASTM D471)
Gasoline blends, alcohol	85% C Reference Fuels (ASTM D471) and 15% of specific blending fluid (Ethanol, Methanol)
Heated fuel oils	No. 6 fuel oil at 157°C (250°F)
Oxygenate	90% C Reference Fuels (ASTM D471) and 10% of oxygenate (ETBE, MTBE, TAME) and 80% C reference Fuels (ASTM D471) and 20% of oxygenate (ETBE, MTBE, TAME)
Other	C Reference Fuels (ASTM D471) and specific percentage of specified blending fluid

12.2 The Immersion-Extraction Test is not to be conducted with Reference Fuel A or IRM 903 oil.

12.3 With reference to the requirements in 12.1, the change in volume shall not be more than 25 percent swelling (40 percent in Reference Fuel C or Fuel C blends) or 1 percent shrinkage, and the weight loss (extraction) shall not be more than 10 percent.

Exception: If the limits for volume change or weight loss are exceeded, a complete strainer assembly is to be filled with the appropriate test liquid for 70 hours and then shall comply with the requirements for the Deformation and External-Leakage Test, Section 13, and the Hydrostatic-Strength Test, Section 14.

12.4 Synthetic rubber part that is in contact with fluids, shall not crack or show visible evidence of deterioration following exposure for oven aging, as specified in the requirements in the Standard for Gaskets and Seals, UL 157. The maximum service temperature used to determine the conditioning time and temperature for oven aging is to be 60° C, unless the product is designated for use at a higher temperature.

12.5 The Standard for Gaskets and Seals, UL 157, provides for the testing of either finished elastomeric parts, sheet, or slab material. Sheet or slab material is to be tested when the elastomeric parts are o-rings

having a diameter of less than 1 inch (25.4 mm). The material tested is to be the same as that used in the product, regardless of whether finished elastomeric parts, sheet, or slab material is tested.

13 Deformation and External-Leakage Test

13.1 When tested as specified in 13.2 – 13.6, a strainer shall not leak, nor shall there be evidence of damage resulting from:

a) The application of 1-1/2 times maximum rated pressure for 1 minute,

b) The tightening of threaded parts used for care and servicing, and

c) The turning effort exerted on openings threaded for piping.

13.2 Representative strainer assemblies are to be rigidly supported. Any bolts, pipe plugs, or threaded parts detached for care and servicing of the strainer are to be tightened with a torque wrench to the value specified in Table 13.1 or Table 13.2. Samples with threads other than those specified in Table 13.1 or Table 13.2 shall be torqued as specified by the manufacturer.

Table 13.1
Torque requirements for screws

American standard screw size	Torque,		I.S.O. screw size, mm	Torque,	
	lb-in	N·m		lb-in	N·m
–	–	–	4	7	0.8
No. 8	9	1.0	4.5	12	1.4
No. 10	15	1.7	5	19	2.7
1/4 inch	50	5.6	6	40	4.5
–	–	–	7	70	7.9
5/16 inch	100	11.3	8	100	11.3
–	–	–	9	130	14.7
3/8 inch	150	16.9	10	165	18.6
7/16 inch	200	22.6	12	230	26.0
1/2 inch	250	28.2	14	295	33.3
9/16 inch	300	33.9	–	–	–

Table 13.2
Torque requirements for pipe connections

Pipe size, nominal inches	Torque,	
	lb-in	N·m
1/8	150	16.9
1/4	250	28.2
3/8	450	50.8
1/2	800	90.4
3/4	1000	113
1	1200	136
1-1/4	1450	164
1-1/2	1550	175

Table 13.2 Continued on Next Page

Table 13.2 Continued

Pipe size, nominal inches	Torque, lb-in	Torque, N·m
2	1650	186
2-1/2	1750	198
3	1800	203

13.3 The sample strainer used in this test 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 body, the male threads having first been lubricated with SAE No. 10 machine oil. Each pipe is then to be tightened to the torque specified in Table 13.2.

13.4 The strainer is then to be subjected for 1 minute to a hydrostatic pressure of 1-1/2 times maximum rated pressure, but not less than 18 psig (124 kPa).

13.5 The strainer parts used for care and servicing of the strainer are then to be alternately removed and replaced 25 times, tightening each time with a torque wrench to the value specified in Table 13.1 or Table 13.2. Samples with threads other than those specified in Table 13.1 or Table 13.2 shall be torqued as specified by the manufacturer. The pressure test described in 13.4 is then to be repeated.

13.6 Any bolts or threaded parts used for care and servicing of the strainer are then to be tightened with a torque wrench to twice the value specified in Table 13.1 or Table 13.2. Samples with threads other than those specified in Table 13.1 or Table 13.2 shall be torqued to twice the value as specified by the manufacturer. The pressure test described in 13.4 is then to be repeated.

14 Hydrostatic-Strength Test

14.1 All parts of a strainer that are subjected to pressure during intended use shall withstand for 1 minute, without rupture or permanent distortion, a hydrostatic pressure of five times the maximum rated pressure, but not less than 60 psig (414 kPa).

14.2 All samples used in the Deformation and External-Leakage Test, Section 13, are to be subjected to this test.

15 Element-Collapse Test

15.1 A strainer element shall not collapse when totally clogged and subjected for 1 minute to a differential hydrostatic pressure of 18 psig (124 kPa).

15.2 The strainer-element openings are to be closed with tape, lacquer, or other means. A hydrostatic pressure is then to be applied to exert the differential pressure between the inlet and outlet sides of the element.

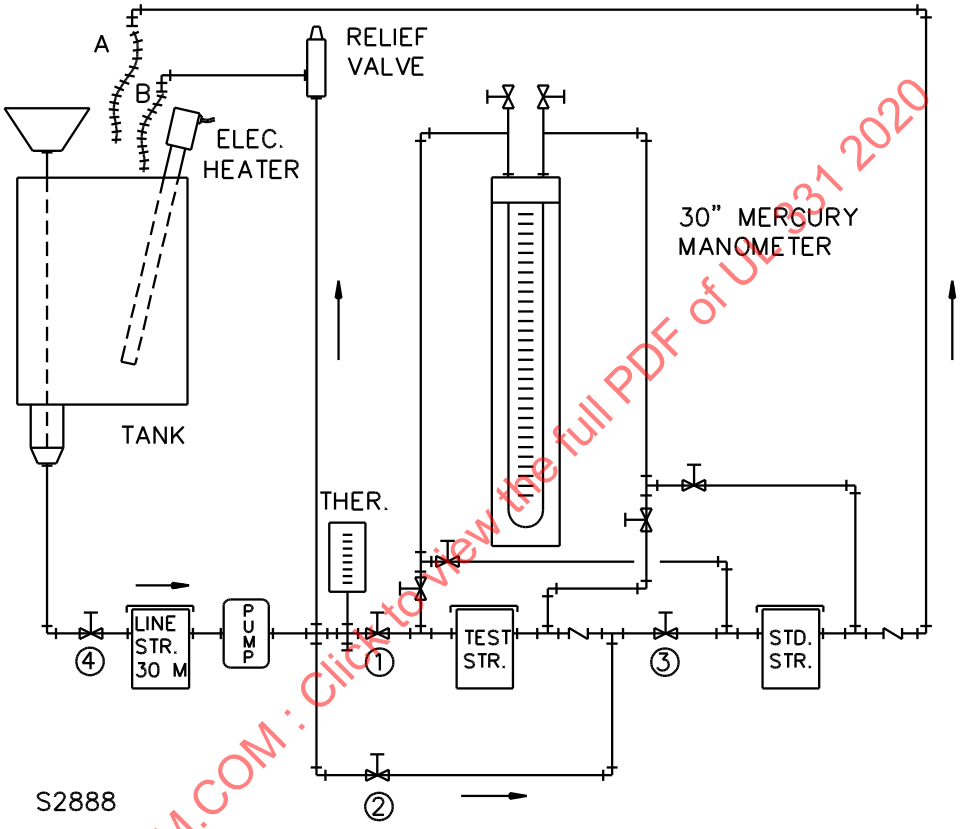
16 Pressure-Drop Test – Strainers for Oil Burners

16.1 A filter-type element when clean, other than the wire-cloth or perforated type (that is, filter elements, such as felt, cotton waste, or ceramics), shall not cause a pressure differential between inlet and outlet openings in excess of 2.04 inches mercury (6.9 kPa) when passing the intended grade of fuel oil at the rated capacity of the strainer. When a range of fuel oils is specified for use with the strainer, the test shall be performed with the fuel oil with the highest viscosity.

16.2 The sample strainer assembly is to be connected into a system of piping similar to that illustrated in Figure 16.1. The pump is to have a capacity in excess of the strainer rating. A conveniently sized reservoir is to be filled with clean fuel oil corresponding to the grade intended for use with the strainer. The strainer and valve (4) upstream from the pump are provided to protect the pump and are not a necessary part of the apparatus.

Figure 16.1

Test apparatus for pressure drop and clogging test



16.3 A strainer found to be acceptable for a specific grade of fuel oil may be considered acceptable for use with that or any lighter grades. The viscosity of the fuel oil employed in the test is to be consistent with the viscosity that may be encountered in service. The fuel used is to be circulated through the test strainer until the liquid temperature indicated at the thermometer is that which will indicate the liquid has the viscosity specified in Table 16.1.

Table 16.1
Minimum viscosity for pressure drop test

Fuel oil CS12 Grade No. 1	45 SSU
Fuel oil CS12 Grade No. 2	75 SSU
Fuel oil CS12 Grade No. 4	1000 SSU
Fuel oil CS12 Grade No. 5	4000 SSU
Fuel oil CS12 Grade No. 6	4000 SSU
NOTE – SSU refers to Saybolt Seconds Universal	

16.4 A mercury U-tube manometer or the equivalent is to be used for measuring pressure differentials between the inlet and outlet connections of the strainer. Pumped oil is to be returned to the reservoir through lines A and B (see Figure 16.1) that are to have swivel joints or flexible means of outlet so that liquid can be collected in separate containers for flow measurement purposes.

16.5 The pump is to be started with valves 1, 3, and 4 opened and valve 2 closed. Valve 1 then is to be regulated until the pressure differential indicated by the mercury manometer is 2.04 inches (1 psig or 6.9 kPa). The flow rate as measured at overflow A is to be used to determine the capacity rating of the strainer.

17 Clogging Test – Strainers for Oil Burners

17.1 A filter-type element (see 16.1) shall not cause a pressure differential between inlet and outlet openings in excess of 20 inches of mercury (68 kPa) when compared to the clogging characteristics of a standard wire-mesh strainer element of equal capacity rating. The filter-type element shall not pass particles that will be retained by the standard wire-mesh strainer element used for comparison.

17.2 The comparative open or free area of the strainer element will determine its capacity rating for any grade of fuel oil by reference to the curves illustrated in Figure 6.1 – Figure 6.3. These capacity ratings established from the curves for any grade of fuel oil are to be compared with the capacity rating established by the Pressure-Drop Test – Strainers for Oil Burners, Section 16; see 16.1. The capacity for rating purposes is to be the lower of the two values established by the two test methods.

17.3 The test apparatus is to be as described in 16.2 and 16.3. The pump is to be of any reasonable capacity. The liquid employed is to be any clean No. 1 or No. 2 grade fuel oil.

17.4 The clogging material to be employed is to be of any specification approximating the following, as this test is performed on a comparative basis. The material employed is to be in the form of oven-dried, sieve-analyzed buckwheat flour approximating that specified as option 1 or option 2 in Table 17.1.

Table 17.1
Sieve analysis of clogging material

U.S.A. Standard sieve No. (Percentage by weight to create clogging material)	
Option 1	**Option 2**
30 – 40 (1%)	30 – 80 (20%)
40 – 50 (6%)	80 – 100 (4%)
50 – 60 (5%)	100 – 120 (5%)
60 – 70 (6%)	120 – 140 (9%)
70 – 80 (2%)	140 – 200 (35%)
80 – 100 (4%)	200 – 325 (23%)
100 – 120 (5%)	Finer than 325 (4%)
120 – 140 (9%)	
140 – 200 (35%)	
200 – 325 (23%)	
Finer than 325 (4%)	

17.5 The standard strainer and element installed as illustrated in Figure 16.1 is to be any conventional bracket-type assembly of a size approximating the capacity rating sought. The element for Nos. 1, 2, and 4 fuel oils is to consist of U.S.A. Standard 150 Micron (100 mesh) wire cloth conforming to the dimensional requirements in the Specifications for Wire-Cloth Sieves for Testing Purposes, ASTM E11-87.

17.6 The open area of the standard element is to be determined before the test is conducted.

17.7 For each series of tests, the weight of clogging material introduced into the system that will cause a pressure differential in the standard strainer of 20 inches of mercury (68 kPa) is to be determined. When the strainer under test is clogged to the same extent with the same material, a comparison is to be established on the basis of the ratio of the weight of material necessary to clog the strainer under test to that necessary to clog the standard strainer.

17.8 The standard strainer and its element are to be installed in the system as illustrated in Figure 16.1. Valves 2, 3, and 4 are to be opened. Valve 1 is to be closed. The manometer is to be connected across the standard strainer. The pump is to be operated for a sufficient length of time to remove all residual foreign material from the system. This operation is to be terminated when no further increase in manometer differential pressure is indicated.

17.9 The standard strainer element is then to be removed, thoroughly cleaned, and replaced. After the conditions described in 17.8 are reestablished, clogging material is to be introduced into the system in small increments of known weight until a differential pressure of approximately 5 inches of mercury (17 kPa) has been established across the strainer. The pump is then to be stopped for 15 minutes. The process is then to be continued until a differential pressure of 20 inches of mercury (68 kPa) has been established, stopping the pump for 15 minutes at the time the differential pressure reaches approximately 10 inches of mercury (34 kPa) and again at 15 inches of mercury (51 kPa). The total weight of clogging material is to be recorded.

17.10 Increments of weighed clogging material are to be thoroughly mixed with 1 quart (0.945 l) of liquid taken from the system at overflow A and introduced into the system through the funnel shown in Figure 16.1, which is to be arranged to introduce the material directly into the piping system so that it cannot settle out in the reservoir.