41 Fan Housings and Air Tubes

41.1 A fan housing and an air tube shall be made of noncombustible material having the strength and durability to not be damaged when subjected to the tests described in Sections 57 – 70.

41.2 A fan housing in which oil leaking from any oil-handling part of the assembly may accumulate shall be provided with an open drain such as an inverted fan housing on a gun-type burner.

41.3 An air tube of a gun-type oil burner shall prevent the accumulation of oil within the air tube. Any drippage from the nozzle shall drain to the fire box. A drain shall be located to avoid blockage by refractory or cement.

41.4 The exterior portion of a firing head within 6 inches (152 mm), measured parallel to its axis, of the firing end and all parts that may be in contact with masonry when the burner is installed as intended shall be made of iron or steel. Interior parts shall be made of materials that comply with 37.2 – 37.6.

41.5 An outer shell of a blast tube or firing head, if made of sheet metal, shall provide the strength, rigidity, durability, resistance to corrosion, and other physical properties equivalent to sheet steel having a thickness of no less than 0.053 inch (1.35 mm) or Type 309 stainless steel having a thickness of no less than 0.026 inch (0.66 mm).

42 Combustion Air Controls

42.1 An air shutter shall be capable of being adjusted to any intended setting and shall be provided with a means for reducing the risk of an unintentional change in the setting.

42.2 The air inlet shall be capable of supplying sufficient air for complete combustion under the specified draft condition and at the maximum rate of firing when the burner is installed as intended. All the air required for complete combustion shall be introduced to maintain thorough mixing of the fuel and air in order to complete the combustion within the combustion zone.

42.3 An air shutter shall provide a smooth surface between the shutter and the matching face.

42.4 Sheet metal air shutters shall be no less than 0.0254 inch (0.65 mm) thick. If sheet metal air shutters are less than 0.0508 inch (1.29 mm) thick, the outer edge of the shutters shall be turned at right angles or reinforced in an equivalent manner.

42.5 An air shutter, by its construction or assembly and selection of materials, shall resist sticking or corroding in position. Screws or bolts used for attaching or adjustment of an air shutter shall be of corrosion-resistant material.

42.6 An adjustable part shall be guided to prevent movement from its intended path during adjustment and the means for adjusting the part shall be accessible during servicing.

42.7 A burner constructed to change the firing rate automatically shall automatically proportion the air supply with the fuel, if necessary, to produce stable combustion at all firing rates allowed by the automatic control.

42.8 Linkage for operating air and fuel controls shall maintain the intended fuel-air ratio and shall resist unintentional damage and disengagement.

43 Fuel Strainers

43.1 A waste oil burner shall be provided with a primary strainer assembly which complies with the Standard for Strainers for Flammable Fluids and Anhydrous Ammonia, UL 331. The materials used in the strainer assembly that are exposed to waste oil fuel shall be tested for resistance to gasoline as described in 38.1.

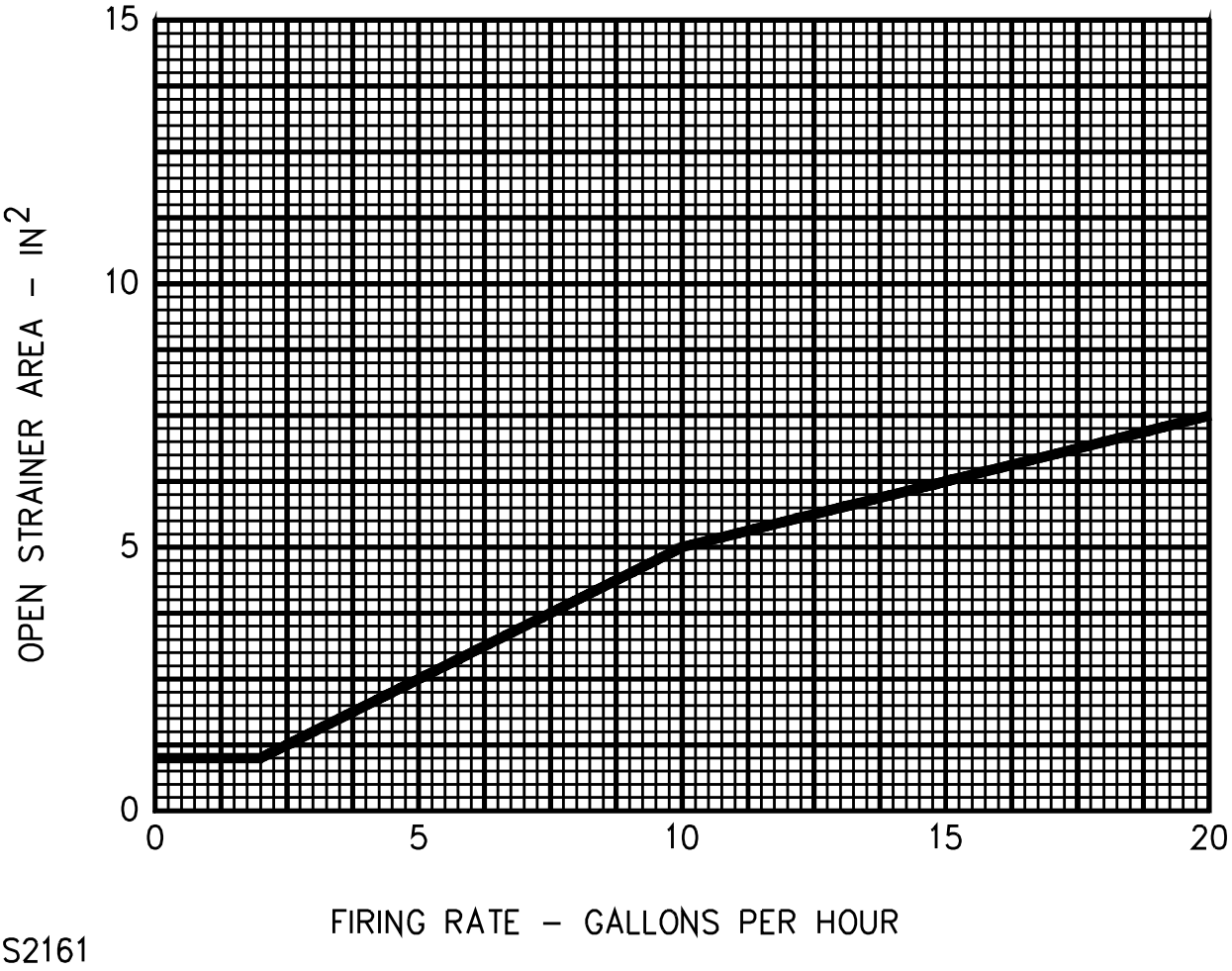
43.2 A small orifice or other opening in an oil-supply system shall be protected by a strainer as specified in 43.3 – 43.13.

43.3 The largest opening of the strainer element shall be of such size that its larger dimension will be no greater than 90 percent of the smaller dimension of the smallest fixed opening protected by the screen.

43.4 For the purpose of these requirements, a metering valve, a float valve, and an automatic safety valve shall be considered as a fixed opening having a diameter of 1/32 inch (0.8 mm) when Nos. 1 and 2 oils are used and 1/16 inch (1.6 mm) when Nos. 4, 5, and 6 oils are used.

43.5 If the strainer assembly is provided with a screen-type element, the effective area of the screen (total area of screen openings) shall be no less than as indicated in Figure 43.1, 43.2, or 43.3, as appropriate for the grade of fuel oil and the maximum firing rate.

Figure 43.1
Strainer area for No. 1 fuel oil[a]



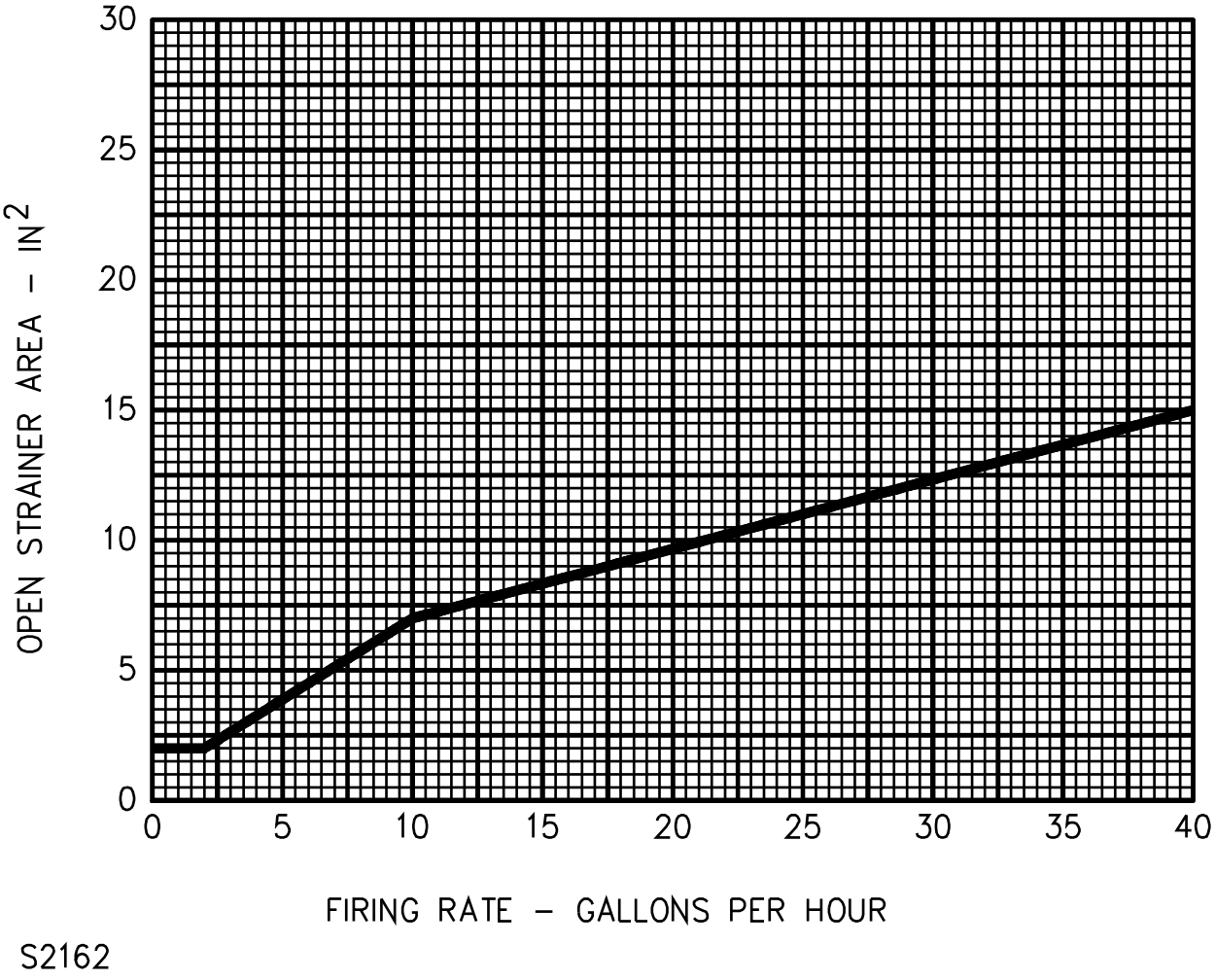
Note:

1 square inch = 6.45 cm^2

1 gallon = 3.79L

[a] As designated by the Specification for Fuel Oils, ANSI/ASTM D396

Figure 43.2
Strainer area for No. 2 Fuel oil[a]



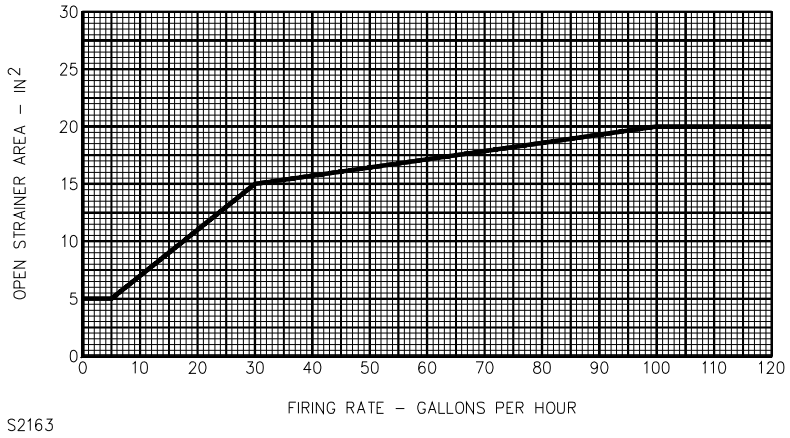
Note:

1 square inch = 6.45 cm^2

1 gallon = 3.79L

[a] As designated by the Specification for Fuel Oils, ANSI/ASTM D396

Figure 43.3
Strainer area for Nos. 4, 5, 6 fuel oils[a]



Note:

1 square inch = 6.45 cm^2

1 gallon = 3.79L

[a] As designated by the Specification for Fuel Oils, ANSI/ASTM D396

43.6 The effective area of a screen (total area of screen openings) is not required to be greater than the maximum value shown in Figures 43.1 – 43.3, regardless of the burner firing rate, but in any case the strainer shall not impair the flow of fuel supplied to fire the burner at maximum rated input.

43.7 A strainer provided with an element other than a screen shall be suitably rated for the heaviest grade of fuel oil being handled and shall have a rated capacity no less than the maximum firing rate of the burner to which it is attached.

43.8 When two strainers installed in series are provided instead of a single primary strainer, each strainer shall be of approximately equivalent size and the screen area or rated capacity of each shall be 1.4 times that required for a single strainer. The strainer downstream from the other shall be provided with a screen or element in which the size of the individual straining opening is no larger than 90 percent of the size of the straining opening in the element of the other strainer.

43.9 A secondary strainer, one supplementary to the main strainer, smaller in area than specified in 43.5 may be used in the fuel line downstream from the primary strainer.

43.10 A strainer shall be attached to permit the removal and replacement of the straining element. The force necessary to open a strainer shall not permanently distort the lines or assembly to which it is attached.

43.11 A strainer required for the protection of an automatic safety valve or a float valve shall be provided as part of the assembly incorporating the valve.

43.12 Pipe or other fuel conduit used to connect a float valve, metering valve, or safety valve to the protecting strainer shall be free of dirt and scale at the time of assembly.

43.13 A strainer shall be applied so that there will be no air trapped to affect the rate of fuel flow to the burner or to reduce the effective area of the straining element.

44 Fittings, Piping, and Tubing

44.1 An opening threaded for pipe connection shall be threaded in accordance with the Standard for Pipe Threads (except dryseal), ANSI B2.1 .

44.2 An opening for field attachment to a pipe larger than a nominal 3 inch pipe size, as specified in the Standard for Pipe Threads, ANSI B2.1, shall be provided with a flanged pipe connection complying with the Standard for Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, ANSI B16.1.

44.3 A fitting, other than one complying with the appropriate American National Standard, having openings threaded for pipe connections shall be capable of withstanding, without damage or leakage, the torque as indicated in Table 44.1, exerted as if to screw the fitting onto a pipe or into a pipe fitting.

44.4 A tool that fits snugly about the fitting or to a section of the shank shaped for a wrench, if such a section is provided, is to be used to apply the torque. The torque is to be applied to the hex of the fitting adjacent to where it is attached to piping or, if no hex is provided in this position, to the body of the fitting. The measured torque specified in Table 44.1 is to be applied to screw the fitting onto an extra-heavy pipe or into a pipe fitting of appropriate size. After the force has been applied, the fitting shall not leak when subjected to a hydrostatic pressure equivalent to 1-1/2 times the maximum working pressure.

Table 44.1
Torque requirements for pipe connections

Pipe size, ANSI B36.10	Outside diameter		Torque	
Nominal inches	Inches	(mm)	Pound-inches	(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	(137)
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)

44.5 Pipe and pipe fittings shall be wrought iron or steel or iron-pipe-size brass or copper complying with the applicable American National Standard. Unions, where used, shall be the ground-joint type or the equivalent.

44.6 Tubing shall be located to reduce the risk of being physically damaged, such as by following the contour of the burner assembly.

44.7 Seamless drawn aluminum or copper tubing and steel tubing of the seamless, brazed, or welded type used in the fabrication of factory-assembled equipment shall have a wall thickness of no less than that specified in Table 44.2.

44.8 Aluminum tubing shall not be exposed to condensation or to temperatures exceeding 700°F (371°C) and shall not be acceptable for use where it passes through insulating material of other than a neutral reaction unless the tubing is protected from the insulation.

44.9 Steel tubing having a wall thickness of 0.053 inch (1.35 mm) or less shall be constructed of corrosion-resistant material such as stainless steel or shall be plated, dipped, coated, or otherwise treated to resist external corrosion.

44.10 Cadmium plating shall have a thickness of no less than 0.0003 inch (0.008 mm) and zinc plating shall have a thickness of no less than 0.0005 inch (0.013 mm).

Exception: The thickness of the cadmium or zinc plating shall be no less than 0.00015 inch (0.0038 mm) on parts where threads constitute the major portion of the area.

Table 44.2
Wall thickness for aluminum, copper, and steel tubing

Outside diameter,		Minimum wall thickness, Inch (mm)[a]			
		Aluminum and copper		Steel	
Inches	(mm)				
1/8	(3.18)	0.029	(0.74)	0.028	(0.71)
3/16	(4.76)	0.029	(0.74)	0.028	(0.71)
1/4	(6.35)	0.029	(0.74)	0.028	(0.71)
5/16	(7.94)	0.029	(0.74)	0.028	(0.71)
3/8	(9.53)	0.032	(0.81)	0.028	(0.71)
7/16	(11.11)	0.032	(0.81)	0.028	(0.71)
1/2	(12.70)	0.035	(0.89)	0.028	(0.71)
9/16	(14.29)	0.038	(0.97)	–	–
5/8	(15.88)	0.038	(0.97)	0.035	(0.89)
3/4	(19.05)	0.045	(1.14)	0.035	(0.89)
7/8	(22.23)	0.045	(1.14)	0.049	(1.24)
1	(25.40)	0.049	(1.24)	0.049	(1.24)
1-1/8	(28.58)	0.049	(1.24)	0.049	(1.24)
1-1/4	(31.75)	0.055	(1.40)	0.049	(1.24)
1-3/8	(34.93)	0.055	(1.40)	–	–
1-1/2	(38.10)	–	–	0.065	(1.65)

[a] Nominal wall thickness of tubing shall be greater than the thickness indicated to maintain the minimum wall thickness.

44.11 Flexible-metallic hose shall not be used as a substitute for rigid piping or tubing as ordinarily used. The use of flexible-metallic hose shall be restricted to applications in which rigid piping or tubing is impractical and in which flexible connections cannot be avoided. Flexible-metallic hose shall not be subjected to torsional, tensile, or bending stresses or to abrasion and shall not be used in conjunction with safety devices or where bending is caused by automatic operation.

44.12 A fuel line shall terminate in a manner that will permit connection to the burner. A fuel-line opening shall be plugged or capped to prevent the entrance of foreign material prior to installation.

44.13 A coupling or union that is disconnected for service shall be located so that any oil dripping from the connection will not drip or run onto electrical parts.

45 Valves

45.1 The pressure rating of a valve shall be no less than the maximum operating pressure of the burner.

45.2 An automatic safety valve shall shut off in no more than 5 seconds after being de-energized and shall be constructed so that it may not be restrained or blocked in the open position.

45.3 A safety valve shall close upon being de-energized, regardless of the position of an operating lever or reset handle.

45.4 An electrically-operated safety valve shall not depend on electricity to shut off the oil flow.

45.5 A safety valve responding to pressure variations in a hydraulic or pneumatic remote control system shall close upon failure of pressure in the control system.

45.6 A manually-operated fuel-metering valve shall be provided with a means, which may be set by the installer or manufacturer, to restrict the maximum amount of fuel delivered to the burner to an amount which can be consumed as intended, or the means for adjustment shall be enclosed or shielded to discourage tampering after adjustment has been made by the installer.

45.7 A plug or rotating-disc type valve, using the bearing surface of the plug or disc as the liquid seal to the exterior of the valve body, shall not be used in a fuel oil line.

45.8 A pet-cock or valve which, when open, will permit the discharge of fuel oil into the room shall not be used.

45.9 A pressure-regulating valve shall incorporate a means of shielding or locking the adjustment to discourage tampering by unauthorized persons after being set. The valve shall be constructed so that the maximum pressure of oil at the maximum valve setting does not exceed the intended maximum pressure for the burner.

45.10 A nozzle shutoff valve of the automatic type shall close at a pressure above the minimum atomizing pressure of the burner.

45.11 A pressure-relief device shall be connected into a fuel line in which pressure may build up in excess of that necessary for normal operation; for example, due to the closing of any valve in the assembly of the burner or when the oil is heated by a preheater. A pressure relief valve shall be set to initiate its function at a pressure no greater than the design pressure of any part of the oil heating system.

46 Gauges

46.1 A glass gauge or sight feed, the breakage of which will allow the discharge of fuel oil from the fuel supply system, shall not be used.

46.2 A pressure gauge, when used, shall have a scale range of at least 1-1/2 times the maximum intended operating pressure of the burner and greater than the maximum operating pressure as well as the pressure obtained at the maximum setting of any relief or pressure-regulating valve included as part of the burner equipment.

47 Ignition Systems

47.1 The ignition system of an automatically-lighted burner shall be activated only before or simultaneously with the delivery of fuel to the ignition zone and shall remain active during the trial-for-ignition period. If ignition is cut off at the termination of the trial-for-ignition period, the ignition shall remain off for the duration of that firing cycle unless the ignition is fully restored within 0.8 seconds after unintentional extinguishment of the main burner flame.

47.2 An igniter, pilot, and pilot supervisor shall be constructed and supported so that each is fixed in its intended position.

47.3 The means for ignition shall be located so as to avoid the collection of carbon and other material or the dislocation, distortion, or burning of parts when the burner is tested in accordance with 47.1.

47.4 The construction of an oil burner shall be such that the igniter assembly may be removed from and replaced in the burner assembly during servicing of the burner without resulting in:

a) Reduction of the clearances between bare current-carrying parts, electrodes, and grounded metal parts;

b) Changes in the air-gap at electrode tips;

c) Reduction of the spacings between the high-potential cables and grounded metal parts; and

d) Changes in the position of the igniter or pilot relative to the area at which ignition is to be initiated.

48 Electric High-Tension Ignition

48.1 Assembly

48.1.1 A high-tension current-carrying part, such as a bus bar, electrode, or terminal, shall be enclosed or insulated to provide protection against the risk of unintentional contact.

48.1.2 The ignition system shall be subjected to the test specified in 68.2.1 and 68.2.2.

48.1.3 If an adjustable air deflector or similar part is used in the vicinity of high-tension parts, the construction shall be such that the deflector cannot be located in a position that may cause the deflector to not comply with the requirement specified in 68.2.1.

48.2 Electrode and bus bars

48.2.1 Bare high-tension conductors shall be self-supporting when in place.

48.2.2 An electrode or a bus bar supporting an electrode shall be constructed so that, while fixed in the intended position, the electrode or bus bar will maintain the intended gap.

48.2.3 The use of a setscrew bearing directly against an insulator shall not be used as a means for securing an ignition assembly. The construction shall be such that an insulator cannot be damaged when tightening the securing means.

48.2.4 An electrode shall be prevented from rotating within its insulator unless such rotation will not result in any change in spacing or alignment.

48.2.5 An electrode tip shall be of a material such as high-temperature alloy steel or equivalent material so that burning of the point of the tip will not be evident while the burner is being tested in accordance with these requirements.

48.2.6 An electrode slanting downward toward its insulator shall be provided with a drip loop or the equivalent to prevent oil running down the electrode from reaching the insulator.

48.3 Insulators

48.3.1 An insulator shall be made of ceramic insulating material or the equivalent that is impervious to oil and moisture and cleanable by wiping.

48.3.2 An insulator shall be subjected to the test specified in 68.3.1 and 68.3.2.

48.3.3 An insulator shall provide a distance, as measured across the surface of the insulator, between the nearest point of bare current-carrying parts and the nearest grounded metal surface as indicated in Table 48.1.

Exception: An insulator included in a proved gas pilot assembly to be energized by a transformer having a secondary voltage of no more than 6,000 volts need not comply with this requirement if ignition is to be for combustible air-gas mixtures only within or adjacent to a pilot tip or nozzle handling mixtures under pressures of no less than a 1/4 inch water column (62.3 Pa).

Table 48.1
Spacing over surface of insulators

Secondary voltage of ignition transformer, volts	Minimum surface distance over insulation	
	Inches	(mm)
No more than 10,000	1-1/2	(38.1)
No more than 15,000	2	(50.8)
NOTE – Except as indicated in the exception of 48.3.3, an insulator included in the assembly of a spark-ignited gas pilot shall have an over surface spacing of no less than 1 inch (25.4 mm) if the secondary voltage of the ignition transformer is 6000 volts or less.		

48.3.4 An insulator shall be located so that no detrimental accumulations of carbon will form on its surfaces when the burner is tested in accordance with these requirements.

48.4 Leads

48.4.1 Ignition cable shall have a voltage rating greater than or equal to the rated secondary voltage of the ignition transformer. Each end of a high-tension lead shall be provided with a fixed loop, eyelet, or connector to facilitate proper connection to the terminal. A high-tension lead or cable shall be run individually in a manner to avoid sharp bends and shall be arranged and supported to maintain a spacing of no less than 1/4 inch (6.4 mm) through air from grounded metal parts.

48.4.2 Insulators for the support of ignition cable made of porcelain or molded phenolic having a wall thickness of 1/8 and 1/16 inch (3.2 and 1.6 mm), respectively, are considered to have insulating properties equivalent to that provided by a 1/4-inch (6.4-mm) air spacing.

48.5 Transformers

48.1.5 A transformer shall be mounted as closely as possible to the spark gap to avoid long leads. The location of the transformer shall be such that it will not be placed within 1 inch (25.4 mm) of the floor when the burner is installed in accordance with the manufacturer's installation instructions.

Exception: A transformer need not be located more than 1 inch above the floor if that portion of the case within 1 inch of the floor is waterproof.

48.5.2 A spacing of no less than 1/8 inch (3.2 mm) shall be provided between a transformer high-tension insulator and any adjacent metal part other than the transformer case.

48.5.3 The requirements specified in 48.1.1 – 48.5.2 are based upon the use of ignition energy that is essentially sinusoidal. Other types of systems using ignition energy that is not essentially sinusoidal may be considered. Among the factors taken into consideration in determining the acceptability of such systems are dielectric properties, electrical spacings, the true root mean square (rms) value, the peak voltage of the system, the average pulse power, time between pulses, duration of the pulses, and duty cycles.