Table 26.2Minimum spacings within motors

Table 26.2 revised October 8, 2004

Potential	Parts involved	Minimum spacings							
involved, volts		Motor diameter 178 mm (7 inches) or less <sup>a</sup>				Motor diameter more than 178 mm (7 inches) <sup>a</sup>			
		Over surface,		Through air,		Over surface,		Through air,	
		mm	(inch)	mm	(inch)	mm	(inch)	mm	(inch)
0 – 125	Between commutator bars or collector rings of a motor and the motor shaft and laminations	1.6	1/16	1.6	1/16	4.8 <sup>b</sup>	3/16	3.2 <sup>b</sup>	1/8
	Elsewhere in the motor	2.4 <sup>c</sup>	3/32	2.4 <sup>c</sup>	3/32	6.4 <sup>b,d</sup>	1/4	3.2 <sup>b,d</sup>	1/8
126 – 250	Between commutator bars or collector rings of a motor and the motor	1.0	1/10	10	1/10	4 ob	0/10	4 ob	0/10
	shaft and laminations	1.6	1/16	1.6	1/16	4.8 <sup>5</sup>	3/16	4.8 <sup>0</sup>	3/16
251 – 600	Elsewhere in the motor Between commutator bars or collector rings of a motor and the motor shaft and laminations	6.4	3/32	6.4	3/32	9.5	3/8	6.4 <sup>0,0</sup>	1/4
	Elsewhere in the motor	6.4 <sup>d</sup>	1/4	6.4 <sup>d</sup>	1/4	9.5 <sup>d</sup>	3/8	9.5 <sup>d</sup>	3/8

<sup>a</sup> See 19.1.4.

 $^{\rm b}$  Spacings of no less than 2.4 mm (3/32 mm) are allowed throughout a universal motor.

<sup>c</sup> For a motor rated 1/3 horsepower (250 W output) or less, these spacings shall be no less than 1.6 mm (1/16 inch).

<sup>d</sup> Film-coated wire is determined to be an uninsulated live part. However, a spacing of no less than 2.4 mm (3/32 inch) over

surface and through air is allowed between film-coated wire rigidly supported and held in place on a coil and a dead metal part.

26.5 The spacings through air between an uninsulated live part and an enclosure panel when tested as described in the Enclosure Strength Test, Section 52, and the Impact Test, Section 53, shall be no less than:

a) 12.7 mm (1/2 inch) for a flat panel having an unsupported area greater than 929 cm<sup>2</sup>(1 square foot) or

b) The minimum through-air spacing that is otherwise allowed between an uninsulated live part and dead metal for smaller areas.

Exception: This requirement does not apply to the inherent spacing between an uninsulated live part of a component complying with 2.1.1 and an enclosure panel on which the component is mounted.

26.5 revised October 8, 2004

26.6 When an uninsulated live part is not rigidly fixed in position by a means other than friction between surfaces, or when a moveable dead metal part is in proximity to an uninsulated live part, the construction shall be such that the spacing shall be no less than the minimum allowable spacing with the moveable part in any position.

26.7 Requirements for primary circuit spacings apply to all secondary circuits that are safety circuits and to all secondary circuits supplied by a transformer winding of 200 volt-amperes or a higher capacity – maximum available power – at a potential higher than 100 volts. Except as noted in 26.1, the spacings in all other secondary circuits are evaluated on the basis of the test described in 43.2.1.

26.8 At terminal screws and studs to which connections are capable of being made in the field by means of wire connectors, eyelets, and similar methods as described in 11.10, spacings shall be no less than as specified in Tables 26.1 and 26.2 with such connectors, eyelets, and similar parts in positions so that minimum spacings – opposite polarity and to dead metal – exist.

26.9 Film-coated wire is determined to be an uninsulated live part when spacings are being evaluated.

26.10 With regard to Tables 26.1 and 26.3, the measurement of spacings over surface shall include the walls of a groove wider than 2.0 mm (5/64 inch).

26.10 revised October 8, 2004

# Table 26.3Minimum spacings at field-wiring terminals

Parts involved	Minimum spacings <sup>a</sup>								
	0 – 250 volts				251 – 600 volts				
	Through air,		Over surface,		Through air,		Over surface,		
	mm	(inch)	mm	(inch)	mm	(inch)	mm	(inch)	
Between live parts of opposite polarity and between a live part and a dead metal part other than the enclosure	6.4	1/4	9.5	3/8	9.5	3/8	12.7	1/2	
Between a live part and an enclosure	12.7	1/2	12.7	1/2	12.7	1/2	12.7 <sup>b</sup>	1/2	

Table 26.3 revised October 8, 2004

<sup>a</sup> These spacings do not apply to connecting straps or buses extending away from wiring terminals; such spacings are evaluated under the requirements in Table 26.1.

<sup>b</sup> A spacing of no less than 9.5 mm (3/8 inch), over surface, is allowed at wiring terminals in a wiring compartment or terminal box that is integral with a motor.

26.11 An insulating lining or barrier of vulcanized fiber or similar material used where spacings are otherwise unacceptable shall be no less than 0.8 mm (1/32 inch) thick, and shall be so located or of such material that it will not be adversely affected by arcing.

Exception No. 1: Vulcanized fiber no less than 0.4 mm (1/64 inch) thick is allowed to be used in conjunction with an air spacing of no less than 50 percent of the spacing required for air alone.

Exception No. 2: An insulating liner or barrier is allowed to be less than 0.4 mm thick when the material is determined to be capable of being used for the application in accordance with Electrical Insulation, Section 17.

26.11 revised October 8, 2004

#### **PROTECTION AGAINST INJURY TO PERSONS**

#### 27 Scope

27.1 The performance and construction requirements in Sections 28 - 34 are applicable to appliances covered by this standard that are capable of involving a risk of injury to persons in intended operation.

27.2 There are risks of injury to persons inherent in some appliances that, when completely eliminated, defeat the utility of the appliance. The requirements in this section are intended to reduce such risks, while retaining the intended function of such an appliance.

#### 28 General

28.1 When operation, maintenance, or reasonably foreseeable misuse of an appliance by the user involves a risk of injury to persons, protection shall be provided for the reduction of such risk.

28.2 Among the factors to be evaluated in determining the acceptability of an exposed moving part are:

- a) Degree of exposure required to perform its intended function,
- b) Sharpness of the moving part,
- c) Risk of immediate unintentional contact,
- d) Speed of the moving part, and
- e) Risk of a part of the body being endangered or of clothing being entangled by the moving part.

These factors are to be evaluated with regard to both intended operation of the appliance and its reasonably foreseeable misuse.

28.3 The acceptability of a guard, a safety release, an interlock, and similar devices and whether or not such a device is required, are to be determined from a study of the complete appliance, its operating characteristics, and the likelihood of a risk of injury to persons resulting from a cause other than gross negligence. The investigation is to include an evaluation of the results of breakdown or malfunction of any one component; and no more than one component at a time, unless one event contributes to another. When the study shows that malfunction of a particular component is capable of resulting in a risk of injury to persons, that component is to be investigated.

28.4 Specific tests, constructions, markings, guards, and other requirements are detailed for some appliances. Such detailed requirements apply to common constructions; specific features and appliances not covered herein are to be given an appropriate evaluation.

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#### 29 Enclosures and Guards

29.1 Moving parts capable of causing injury to persons shall be enclosed.

29.2 An opening in a guard or enclosure around a moving part that involves a risk of injury to persons shall not permit the probe illustrated in Figure 6.1 to contact the part.

29.3 An enclosure, an opening, a frame, a guard, a knob, a handle, and similar parts shall not be so sharp as to result in a risk of injury to persons in normal maintenance or use.

*Exception:* A sharp edge that must be exposed to enable the appliance to perform its intended function is not required to comply with this requirement.

#### 30 Material

30.1 When the breakage or damage of a part such as an enclosure, a frame, a guard, or a similar part results in a risk of injury to persons, the material shall have such properties as to meet the demand of expected loading conditions. See the Impact Test, Section 53.

30.2 The requirements in 30.1 apply to those portions of a part adjacent to a moving part or an exposed live part determined to present a risk of injury to persons.

#### 31 Hoses and Handles

31.1 The distance between the discharge opening of the nozzle for the oil return hose and the point of the handle grip of the nozzle closest to the discharge opening shall be between 25.4 cm (10 inches) and 71.1 cm (28 inches). The distance shall be measured on a straight line from the areas described above. 31.1 revised October 8, 2004

31.1.1 A hose intended to carry or hold heated oil shall comply with the test for Parts Subject to Contact With Oil or Other Liquids, Section 57, and the Hydrostatic Pressure Test, Section 60.

31.1.1 added June 16, 1998

31.1.2 A hose intended to carry or hold oil under positive pressure shall comply with the Hydrostatic Pressure Test, Section 60. See Parts Subject to Pressure, Section 33.

Added 31.1.2 effective December 16, 1998

31.2 The nozzle noted in 31.1 shall not be constructed with a hook or similar piece that is capable of being used to secure the nozzle onto a fryer so that it is capable of being used without the operator present.

Effective date for 31.2 changed from March 1, 1998 to December 16, 1998

31.3 Insulating material used for a handle as specified in 31.1 shall comply with the Aging/Impact of Handles, Section 56.

Effective date for 31.3 changed from March 1, 1998 to December 16, 1998

31.4 The length of a hose used to pump oil into or out of a fryer shall be limited to the length required for use in accordance with the manufacturer's instructions. See 70.7.

31.5 Compliance with 31.4 shall be determined based upon the individual construction, as follows:

a) When the appliance is intended to be moved from fryer to fryer for filtering, or is intended to filter only one fryer, the hose shall be long enough to conveniently reach a fryer in the intended filtering position, and not long enough to reach an adjacent fryer.

Exception: When the intended operation of the appliance requires a hose long enough to reach an adjacent fryer, the hose shall be the minimum length required for proper operation. See the Operation Test, Section 37.

b) When the appliance is intended to filter multiple fryers from a stationary position, the length of hose shall be determined by the number and size of fryers to be filtered. When this number is unspecified, the hose is allowed to be any convenient length, and in no case more than 3.66 m (12 feet) long from the appliance outlet to the handle. See 70.7.

31.5 revised October 8, 2004

#### 32 Switches, Controls, and Interlocks

#### 32.1 Switches and controls

32.1.1 When unintentional operation of a switch is capable of resulting in a risk of injury to persons, the actuator of the switch shall be located or guarded so that such operation does not occur.

32.1.2 With regard to the requirement in 32.1.1, a switch that is located or guarded so that it is not capable of being turned on by being struck with the palm of the hand is capable of being used.

32.1.3 The actuator of a switch shall be guarded by recessing, ribs, barriers, or similar means.

32.1.4 An appliance shall be provided with a switching device having a marked "off" position that de-energizes, or cause to be de-energized, each heating element and the pump motor, as applicable.

Exception: For under-fryer filters which are removable from the appliance the filter is intended to service, it is acceptable to locate the switching device on the serviced appliance. The filter shall be provided with a twist-lock or non-standard attachment plug and marked in accordance with 70.9

Revised 32.1.4 effective December 16, 1998

32.1.5 All operating controls of an appliance, or the actuating mechanisms for such controls, shall be mounted on the appliance in a location that is readily accessible when the appliance is located in any position anticipated during intended use.

Effective date for 32.1.5 changed from March 1, 1998 to December 16, 1998

# 32.2 Interlocks

32.2.1 An automatically reset protective device shall not be used when its automatic resetting is capable of resulting in injury to persons.

32.2.2 The requirement in 32.2.1 necessitates the use of an interlock in an appliance when moving parts are capable of causing injury to persons upon the automatic restarting of a motor.

# 32A Oil Drain

32A.1 A means for draining or pumping oil from a filter shall be provided. A drain, when provided, shall be constructed so that drainage is not directed toward the operator. The oil drain shall not be caused to open without an intentional operation. For example, unintentional contact or unplugging the appliance shall not result in the opening of the drain.

33.1.1 relocated as 32A.1 effective December 16, 1998

# 33 Parts Subject to Pressure

# 33.1 General

33.1.1 Relocated as 32A.1 effective December 16, 1998

# 33.2 Pressure tests

33.2.1 A part or an assembly that is subject to liquid oil, air, or vapor pressure, including the vapor pressure in a vessel containing only a superheated fluid, during normal or abnormal operation (such as a blocked filter, blocked hose, and the conditions simulated during the Abnormal Heating Test, Section 48) shall be subjected to the Hydrostatic Pressure Test, Section 60.

Exception No. 1: A section of a pressure system constructed of tubing is determined to comply with the requirements when the maximum pressure obtained during normal or abnormal operation is no greater than the values specified in Table 33.1 for a given diameter and thickness. The tubing is to be continuous or lengths of tubing are to be connected by hard-soldered, brazed, welded joints, or threaded fittings.

Exception No. 2: A pressure vessel bearing the American Society of Mechanical Engineers (ASME) code inspection symbol, when that vessel is marked with a value of working pressure no less than that to which it is subjected during normal or abnormal operation, is not required to comply with this requirement.

Revised 33.2.1 effective December 16, 1998

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Outside diameter,		Minimum wall thickness,		Maximum pressure to which tubiong is subjected						
				Seamless copper,		Butt-welded steel,		Seamless steel,		
mm	(inch)	mm	(inch)	MPa	(Psig)	MPa	(Psig)	MPa	(Psig)	
9.5 or smaller	3/8 or smaller	.041	0.016	3.45	500	4.14	600	6.90	1000	
12.7	1/2	0.41	0.016	2.76	400	3.31	480	5.52	800	
15.9	5/8	.041	0.016	2.21	320	2.65	384	4.42	640	
15.9	5/8	0.53	0.021	2.90	420	3.48	504	5.80	840	
19.0	3/4	0.53	0.021	2.48	360	2.98	432	4.97	720	
19.0	3/4	0.64	0.025	2.90	420	3.48	504	5.80	840	
25.4	1	0.53	0.021	1.79	260	2.65	312	3.59	520	
25.4	1	0.64	0.025	2.21	320	2.65	384	4.42	640	

# Table 33.1Maximum pressure for tubing

Table 33.1 revised October 8, 2004

### 33.3 Pressure relief means

33.3.1 A part in which pressure is capable of being generated by an external fire shall be provided with a means for safely relieving pressure such as a pressure-relief device (see 33.4), a fusible plug, a soldered joint, nonmetallic tubing, or other equivalent pressure-relief means.

33.3.1 revised June 16, 1998

33.3.2 There shall be no shut-off valve between the pressure-relief means and the parts that it is intended to protect.

- 33.3.3 Relocated as 33.4.1 June 16, 1998
- 33.3.4 Revised and relocated as 33.4.2 June 16, 1998
- 33.3.5 Relocated as 33.4.3 June 16, 1998
- 33.3.6 Relocated as 33.4.4 June 16, 1998
- 33.3.7 Relocated as 33.4.5 June 16, 1998
- 33.3.8 Relocated as 33.4.6 June 16, 1998
- 33.3.9 Relocated as 33.4.7 June 16, 1998

#### 33.4 Pressure relief devices

33.4.1 A vessel having an inside diameter of more than 76 mm (3 inches) and subject to air or steam pressure generated or stored within the appliance shall be protected by a pressure-relief device. 33.4.1 revised October 8, 2004

33.4.2 A gasket shall not be used as the pressure-relief device required by 33.4.1. 33.3.4 revised and relocated as 33.4.2 June 16, 1998

33.4.3 The start-to-discharge pressure setting of the pressure-relief device shall be no higher than the working pressure marked on the vessel. The device shall have a discharge rate that relieves the pressure. 33.3.5 relocated as 33.4.3 June 16, 1998

33.4.4 A pressure-relief device shall:

 a) Be connected as close as possible to the pressure vessel or parts of the system that it is intended to protect;

b) Be installed so that it is readily accessible for inspection and repair and cannot be readily rendered inoperative; and

c) Have its discharge opening located and directed so that:

1) The risk of scalding is reduced to a level that does not result in injury to persons and

2) Operation of the device does not deposit moisture on bare live parts or on insulation or components detrimentally affected by moisture.

33.3.6 relocated as 33.4.4 June 16, 1998

33.4.5 A pressure-relief device having an adjustable setting is to be evaluated on the basis of its maximum setting unless the adjusting means is acceptably sealed at a lower setting.

33.3.7 relocated as 33.4.5 June 16, 1998

33.4.6 A pressure-relief device is determined to be a pressure-actuated valve or rupture member intended to relieve excessive pressures automatically.

33.3.8 relocated as 33.4.6 June 16, 1998

33.4.7 When a pressure-relief device is required, the control responsible for limiting the pressure in the vessel shall perform under rated load for 100,000 cycles of operation and shall prevent the pressure from exceeding 90 percent of the relief-device setting under any condition of intended operation. See the Pressure Controls Test, Section 61.

33.3.9 relocated as 33.4.7 June 16, 1998

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33A.1 The oil reservoir of a filter shall have a capacity sufficient to hold 110 percent of the rated oil capacity of the largest fryer for which the filter is intended. See 70.8.

Added 33A.1 effective December 16, 1998

# 34 Stability

34.1 An appliance not intended to be permanently anchored to a wall or similar structure shall be subjected to the Stability Test, Section 45.

Effective date for 34.1 changed from March 1, 1998 to December 16, 1998

34.2 A portable filter equipped with wheels, casters, or similar parts shall be provided with means to stabilize the appliance during intended use, cleaning, and user servicing operations. This means shall consist of at least two manually operated locks for the wheels, a floor lock, or the equivalent.

# PERFORMANCE

#### 35 General

35.1 The performance of an appliance shall be investigated by subjecting the requisite number of samples to all the applicable tests described in Sections 38 - 61. Insofar as is practicable, the tests shall be conducted in the order in which they are presented.

35.2 An appliance intended for operation on direct current as well as on alternating current is to be tested with a direct-current supply.

35.3 A pressure gauge is to be attached so as to prevent leakage. Special fittings for direct connection to the system or commercial tubing or pipe are allowed to be used for gauge connections. Volume of the pressure-measure gauge and lines shall be held to a minimum relative to pressure vessel size.

35.4 Unless otherwise specified, the test voltage is to be the higher of the voltages specified in 38.2 and 38.3, as applicable.

35.5 Unless otherwise specified, where cooking oil is required for a test, fresh, unused corn oil shall be used.

# 36 Leakage Current Test

36.1 The leakage current of a single-phase, cord-connected appliance rated for a nominal 120-, 208-, or 240-volt supply when tested in accordance with 36.3 – 36.8 shall be no more than:

a) 0.5 milliampere for a portable appliance and

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b) 0.75 milliampere for a cord-connected product intended to be fastened in place or located in a dedicated space and provided with a standard attachment plug rated 20 amperes or less.

Exception: Where a filter is provided as part of another appliance in accordance with 1.3 and is not intended to be operated independently, the leakage current test shall be conducted on the overall appliance, with the filter installed, in accordance with the requirements for that appliance.

#### Revised 36.1 effective December 16, 1998

36.2 Leakage current refers to all currents, including capacitively coupled currents, that are capable of being conveyed between exposed conductive surfaces of an appliance and ground or other exposed conductive surfaces of an appliance.

36.3 All exposed conductive surfaces are to be tested for leakage currents. The leakage currents from these surfaces are to be measured to the grounded supply conductor individually as well as collectively when simultaneously accessible and from one surface to another when simultaneously accessible. Parts are determined to be exposed surfaces unless guarded by an enclosure that provides for protection against electric shock as described in 6.1.1 - 6.1.8. Surfaces are determined to be simultaneously accessible when they are capable of being readily contacted by one or both hands of a person at the same time. These measurements do not apply to terminals operating at voltages that are not determined to present a risk of electric shock. See 6.1.2.

36.4 When a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using metal foil having an area of 10 by 20 centimeters in contact with the surface. When the surface is less than 10 by 20 centimeters, the metal foil is to be the same size as the surface. The metal foil is not to remain in place long enough to affect the temperature of the appliance.

36.5 The measurement circuit for leakage current is to be as illustrated in Figure 36.1. The measurement instrument is defined in items (a) - (c). The meter that is actually used for a measurement is only required to indicate the same numerical value for a particular measurement as the defined instrument. The meter used is not required to have all the attributes of the defined instrument.

a) The meter is to have an input impedance of 1500 ohms resistive shunted by a capacitance of 0.15 microfarad.

b) The meter is to indicate 1.11 times the average of the full-wave rectified composite waveform of voltage across the resistor or current through the resistor.

c) Over a frequency range of 0 - 100 kilohertz, the measurement circuitry is to have a frequency response – ratio of indicated to actual value of current – that is equal to the ratio of impedance of a 1500 ohm resistor shunted by a 0.15 microfarad capacitor to 1500 ohms. At an indication of 0.5 or 0.75 milliampere, the measurement is to have an error of no more than 5 percent at 60 hertz.