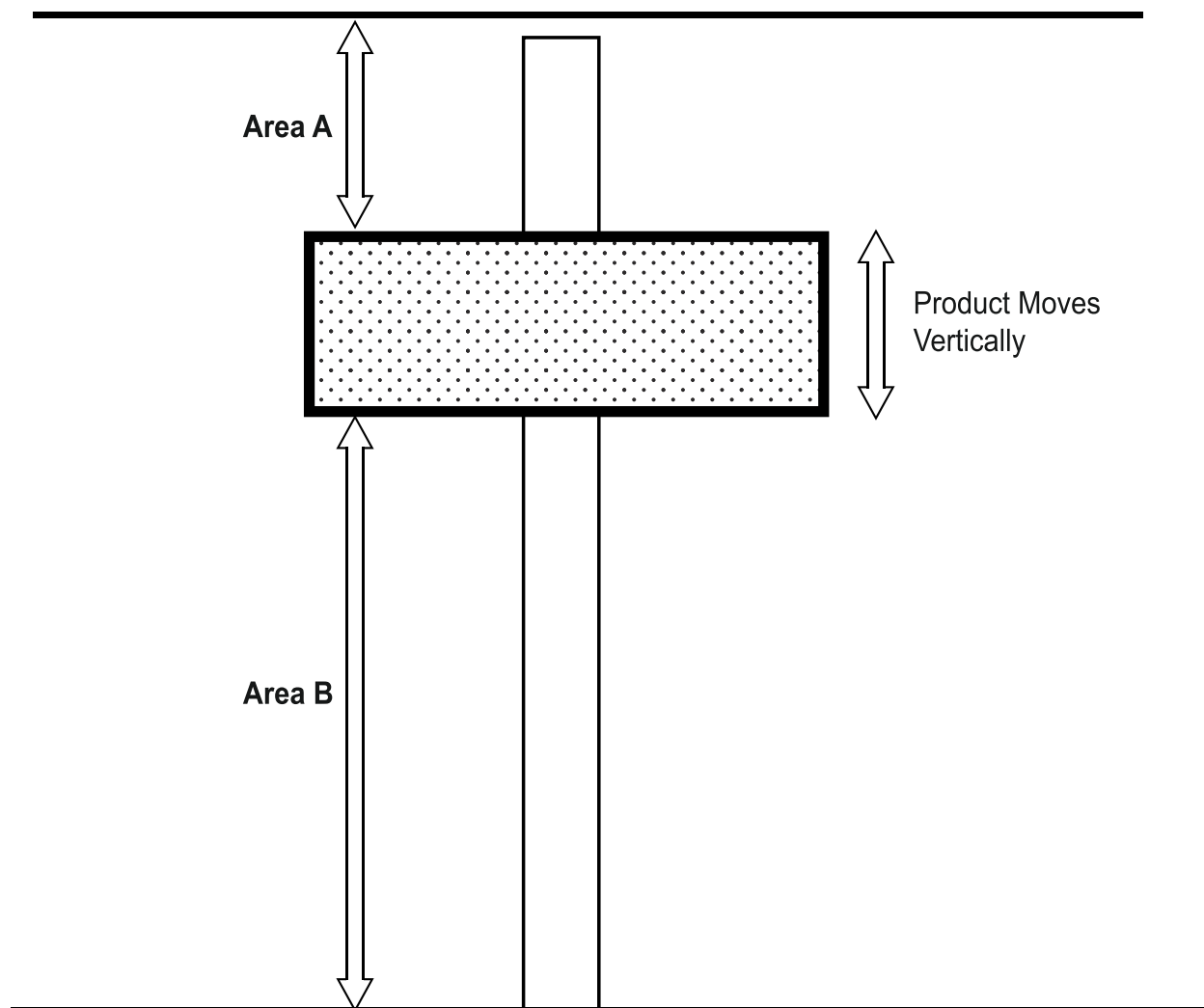


Figure 45A.3
Examples of Entrapment Areas

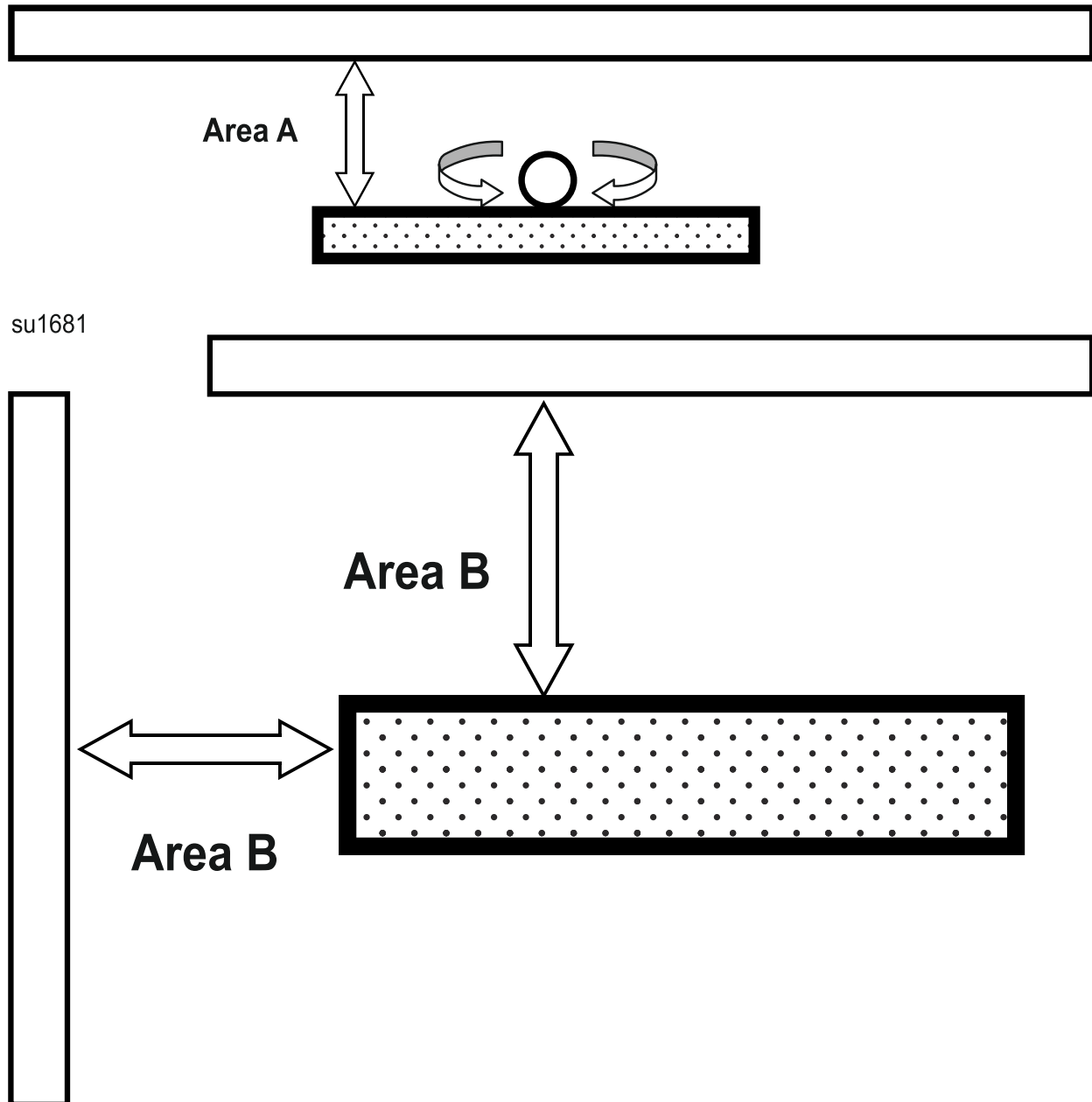


su1680

Area A – is considered to be an entrapment area when the top of the moving furnishing is located below 84 inches (2133.6 mm) from the floor. Consideration must be given to furnishings that can be moved or placed on other furnishings that have fixed objects above them such as a shelf or top of a cabinet. Use and installation instructions can be utilized to determine recommended placement.

Area B – is considered to be an entrapment area because infants, children, animals and other appendages could be within this area. Geometry and configuration can affect the entrapment concern. A furnishing that leaves 18 inches (457.2 mm) or more between the base or floor and poses no pinch concern would be considered not to be an entrapment hazard.

Figure 45A.4
Examples of Entrapment Areas



su1681

su1682

Area A – is considered to be an entrapment area when the furnishing rotates about an axis and can entrap between the furnishing and a fixed structure. Consideration must be given to furnishings that can be moved or placed on other furnishings that have fixed structures. Examples: a wall or back of a cabinet. Use and installation instructions can be utilized to determine recommended placement.

Area B – is considered to be an entrapment area when the furnishing moves horizontally side to side or back to front in relation to a fixed structure. Consideration must be given to furnishings that can be moved or placed on other furnishings that have fixed objects behind them or to the side of them such as a wall or side or back of a cabinet. Use and installation instructions can be utilized to determine recommended placement.

45A.2 Verification tests

45A.2.1 A furnishing that relies on a momentary contact switch to function in accordance with Section [28](#), Commercial Operator Attended Products — Usage Area II; Section [28A](#), Commercial Operator Attended Products — Usage Area III; and Section [28B](#), Operator Attended Products — Usage Area IA shall be subject to the following conditions with the furnishing loaded with the rated load and operating at rated voltage:

- a) When a momentary contact switch is released the corresponding moving parts shall stop within 10 mm.
- b) Upon power failure the furnishing shall remain in the existing position.
- c) Upon reinstatement of power the furnishing shall not move until the operator activates the switch controlling movement.
- d) A switch that controls the direction of travel shall be capable of being stopped and the direction of travel reversed at any point in the operation of the furnishing.

45A.2.2 When speed of a moving part is being used to avoid a potential personal injury, the speed shall not exceed 1 inch/second (2.54 cm/second) when tested as described in [45A.2.3](#).

45A.2.3 The furnishing shall be loaded, unloaded, or partially loaded, which ever method will cause the highest speed. Multiple tests may be needed to determine worst case. The furnishing shall be connected to rated voltage. The furnishing shall be operated so that all possible motions may be measured. The speed shall be measured on each part that may cause personal injury. The speed shall be measured on the portion of the part that operates at the highest speed. The speed may be measured by using an instrument that measures speed or by measuring the distance the part moves its full length of movement and dividing by the time it takes for that movement.

45A.2.4 In accordance with [28.1\(a\)](#), the lockout feature shall be engaged 10 times. After each time the lockout is engaged, the furnishing shall try to be activated. The furnishing shall not operate.

45A.2.5 In accordance with [28.1\(a\)](#), the lockout feature shall be disengaged 10 times and the furnishing operated each time. Two minutes after the furnishing has been operated, the furnishing shall try to be activated. The furnishing shall not operate.

46 Snap-fit Cover Pull-Out Test

46.1 A snap-fit cover employed as part of a furnishing electrical enclosure shall be subjected to the tests specified in [46.2](#) or [46.3](#). The cover shall not crack or dislodge from the means of support on the electrical enclosure. Any distortion of the cover resulting from the tests shall not restrict the normal removal and replacement of the cover.

46.2 The electrical enclosure is to be clamped in place and oriented so that the covered face of the electrical enclosure is parallel to the horizontal and directed down. A 25 pound (11.3 kg) weight is to be attached to any point on the edge or outside surface of the cover and gradually released until it hangs freely. The weight is then to hang for 1 minute.

46.3 For a snap-fit cover formed of polymeric material, the test specified in [46.2](#) is to be repeated on three additional samples of the cover after the samples have been conditioned as specified in Section [34](#), Conditioning of Products.

47 Tightening Torque Test

47.1 With respect to the Exception to [9.1.9](#), the tapped threads in a plate not less than 0.30 inch (7.6 mm) thick are able to be used when the threads do not strip after being subjected to the tightening torque specified in [Table 47.1](#). A screw, either supplied or specified in the instructions, is to be tightened to the terminal at a torque, and with a wire in place, as specified in [Table 47.1](#). There shall be two or more full threads in the metal. The metal is able to be extruded, when required, to provide the threads.

Table 47.1
Tightening torque for wire-binding screws

Size of terminal screw, No.	Wire sizes to be tested, AWG ^a	Tightening torque pound-inches (N·m)
8	14 (S) and 16 – 22 (ST)	16 (1.8)
10	10 – 14 (S) and 16 – 22 (ST)	20 (2.3)

^a ST – stranded wire; S – solid wire.

48 Portable Furnishing Drop Test

48.1 Three samples of a portable furnishing provided with a factory filled and sealed liquid container shall be subjected to the drop test specified in [48.2](#) without leakage of the material within the vessel as determined by visual observation following the drop.

48.2 Three samples shall be dropped 3 feet (91.4 cm) onto a nominal 1/2 inch (12.7 mm) thick trade size knot free softwood or softwood plywood sheet directly supported by a concrete floor.

ELECTRICAL TESTS

49 Leakage Current Test

49.1 A cord-connected furnishing rated for a nominal 250-volt or less single phase supply shall be tested in accordance with [49.2](#) – [49.9](#). Leakage current shall not be more than:

- a) 0.5 MIU for a two-wire cord- and plug-connected portable furnishing; and
- b) 0.5 MIU for a three-wire (including grounding conductor) cord- and plug-connected portable furnishing; and
- c) 0.75 MIU for a three-wire (including grounding conductor) cord- and plug-connected stationary or fixed furnishing.

Exception: The leakage current of a furnishing incorporating a sheath type heating element is to be monitored during heat-up and cool-down and shall not exceed 2.5 MIU during the first 5 minutes of energizing the furnishing. At the end of this time, the leakage current shall be not more than the 0.5 MIU or 0.75 MIU limit, as applicable.

49.2 All accessible conductive parts are to be tested for leakage currents. Leakage currents from these parts are to be measured to the grounded supply conductor individually as well as collectively when simultaneously accessible, and from one part to another when simultaneously accessible. A part is determined to be accessible unless it is guarded by an enclosure that is intended for protection against the risk of electric shock as defined in Section [12](#), Accessibility of Uninsulated Live Parts and Film-Coated Wire. Conductive parts are determined to be simultaneously accessible when they can be 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 do not involve a risk of electric shock. When all accessible conductive parts are bonded together and connected to the grounding conductor of the power-supply cord, the leakage current is to be measured between the grounding conductor of the product and the grounded supply conductor

49.2.1 For furnishings where the user may be in contact with water, the water is to be considered an accessible dead metal part. The water used shall be the same as described in [62.1.4](#).

49.3 When a conductive part other than metal is used for an enclosure or part of an enclosure, leakage current is to be measured using a metal foil with an area of 3.9 by 7.9 inches (10 by 20 cm) in contact with the surface. When the conductive surface has an area less than 3.9 by 7.9 inches (10 by 20 cm), the metal foil is to be the same size as the surface. The metal foil is to conform to the shape of the surface but is not to remain in place long enough to affect the temperature of the product.

49.4 A furnishing employing water or other liquid is to be tested with a hard water solution of 0.5 grams of calcium sulphate (CaSO_4) per liter of distilled water (0.07 ounces CaSO_4 per gallon of distilled water).

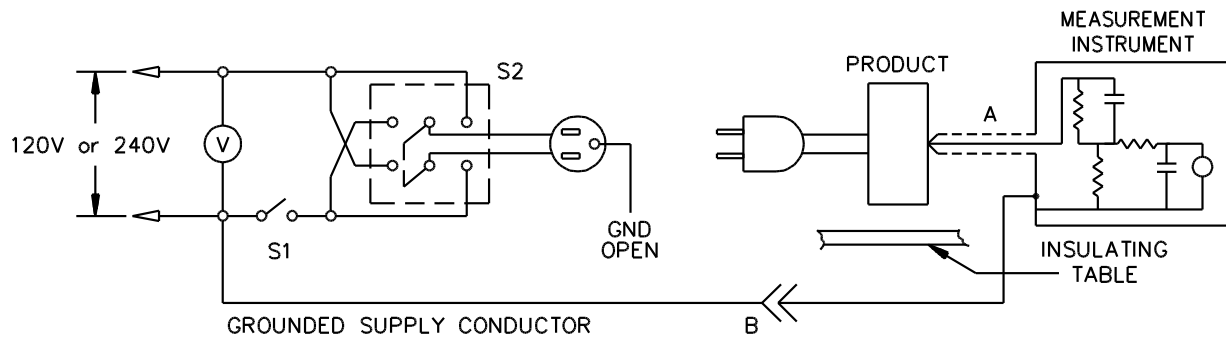
Exception: The composition of the water solution is not specified when it is determined by engineering evaluation that the leakage current will not be affected.

49.5 Typical measurement circuits for leakage current with the ground connection open are illustrated in [Figure 49.1](#). The measurement instrument is defined in [Figure 49.2](#). The meter that is used for a measurement is only required to indicate the same numerical value for a particular measurement as would the defined instrument; it is not required to have all the attributes of the defined instrument. Over the frequency range 20 Hz to 1 MHz with sinusoidal currents, the performance of the instrument is to be as follows:

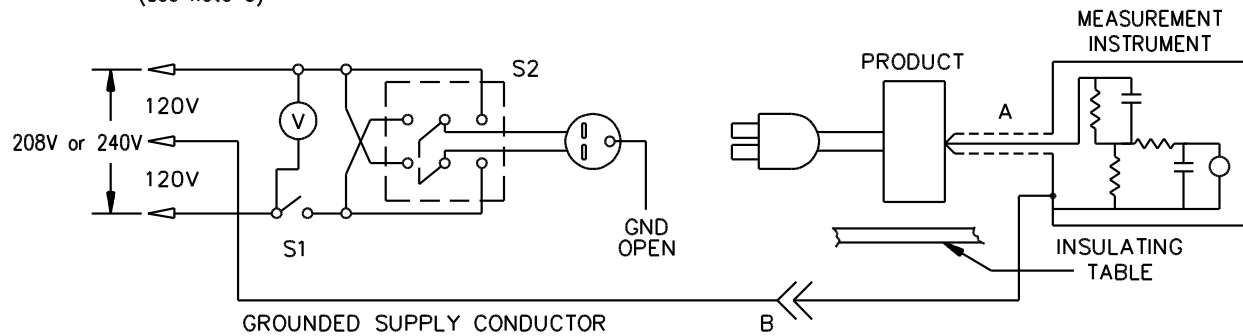
a) The measured ratio $V1/I1$ with sinusoidal voltages is to be as close as feasible to the ratio $V1/I1$ calculated with the resistance and capacitance values of the measurement instrument shown in [Figure 49.2](#).

b) The measured ratio $V3/I1$ with sinusoidal voltages is to be as close as feasible to the ratio $V3/I1$ calculated with the resistance and capacitance values of the measurement instrument shown in [Figure 49.2](#). $V3$ is to be measured by the meter M in the measuring instrument. The reading of meter M in RMS volts can be converted to MIU by dividing the reading by 500 ohms and then multiplying the quotient by 1,000. The mathematic equivalent is to simply multiply the RMS voltage reading by 2.

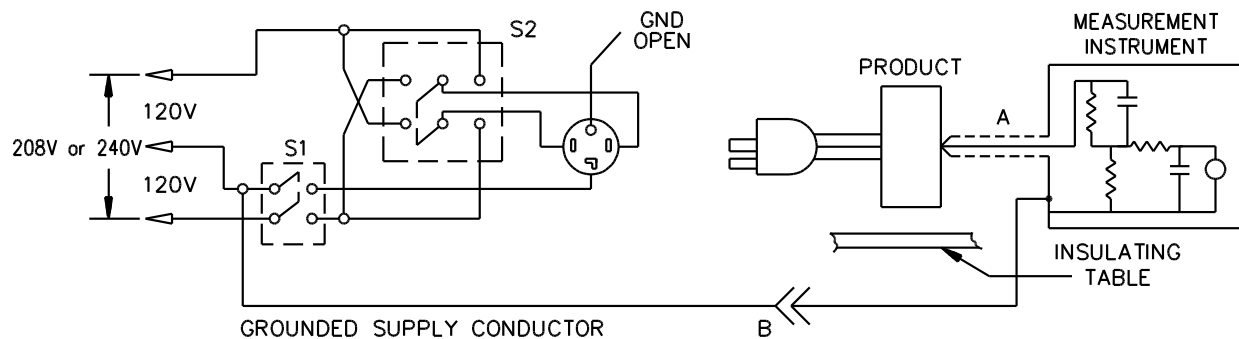
Figure 49.1
Equipment intended for connection to power supply



Equipment intended for connection to a 120-volt or an end-grounded 2-wire, 240-volt power supply
 (see note C)



Equipment intended for connection to a 2-wire grounded-neutral 208-volt or 240-volt power supply
 (see note C)



Equipment intended for connection to a 3-wire grounded-neutral 208-volt or 240-volt power supply

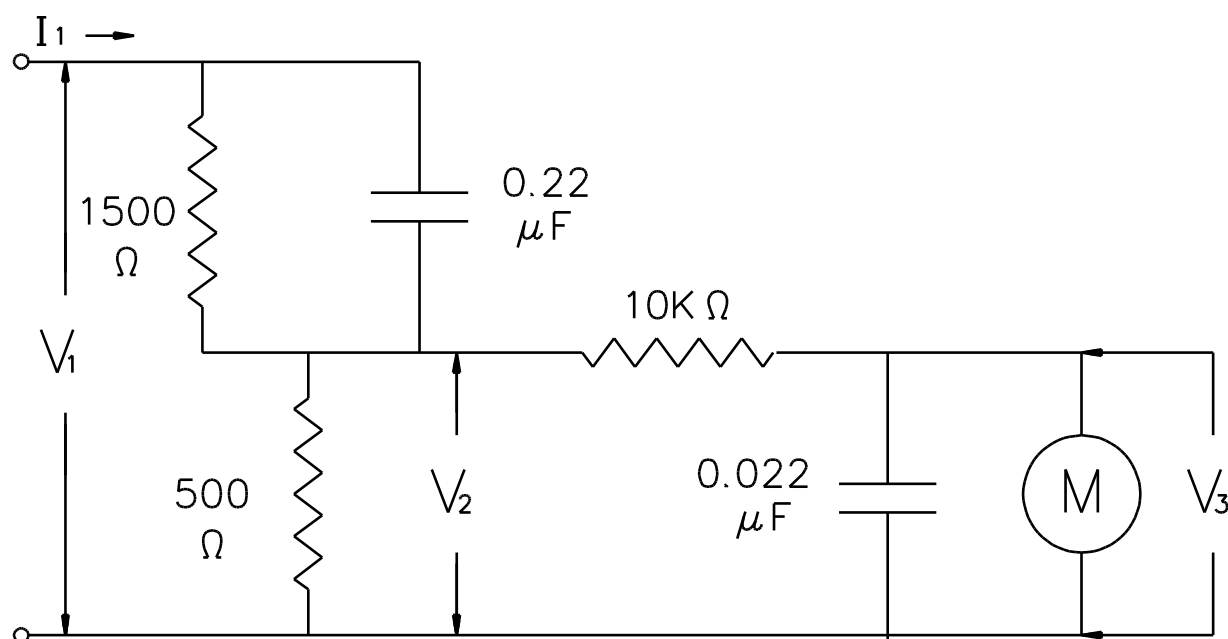
A - Probe with shielded lead.

B - Separated and used as clip when measuring currents from one part of equipment to another.

C - Equipment intended for connection to a 2-wire 240-volt power supply is to be tested assuming that the product will be connected to an end-grounded supply (top circuit, above), unless the product is marked in accordance with paragraph 86.11 of UL 197, in which case it is to be tested for connection to a grounded-neutral supply (middle circuit, above).

LC100T

Figure 49.2
Measurement instrument for reaction (leakage) current



S3263B

49.6 Unless the measurement instrument is being used to measure leakage current from one part of a furnishing to another, it is to be connected between accessible parts and the grounding and supply conductor connected to ground (the grounded or grounding conductor) that has the least extraneous voltages introduced from other equipment operated on the same supply. For products rated 120 volts or 240 volts, with one supply conductor grounded, this is likely to be the grounded supply conductor.

49.7 Prior to the test specified in 49.8, a furnishing utilizing one or more sheathed heating elements is to be conditioned for 24 hours in a chamber having a temperature of $30 \pm 5^\circ\text{C}$ ($86 \pm 9^\circ\text{F}$) and a relative humidity of 50 ± 5 percent, followed by conditioning for 48 hours in a chamber having a temperature of $30 \pm 5^\circ\text{C}$ ($86 \pm 9^\circ\text{F}$), and a relative humidity of 90 ± 5 percent. The test in 49.8 is to be conducted as soon as is practical after the conditioning, but in no case more than 24 hours after the furnishing is removed from the conditioning chamber.

Exception No. 1: The entire furnishing is not required to be conditioned if the sheathed heating elements are removed from the furnishing and conditioned as stated. The elements are to be re-installed in the furnishing before the test is conducted.

Exception No. 2: The conditioning is not required if all sheathed heating elements in the furnishing comply with the requirements of the Resistance to Moisture Test in the Standard for Sheathed Heating Elements, UL 1030.

49.8 A sample of the furnishing, conditioned as specified in 49.7, where required, is to be tested for leakage current starting with the as-received condition – the as-received condition being without prior energization, except as may occur as part of the production-line testing. The supply voltage is to be adjusted to rated voltage. The test sequence is to be as follows, with reference to the measurement circuit shown in Figure 49.1:

a) With switch S1 open, the furnishing is to be connected to the measurement circuit. Leakage current is to be measured using both positions of switch S2, and with the furnishing switching devices in all their normal operating positions.

b) Switch S1 is then to be closed, energizing the furnishing. Within 5 seconds, the leakage current is to be measured using both positions of switch S2 and with the furnishing product switching devices in all their normal operating positions.

c) Leakage current is to be monitored until thermal stabilization. Both positions of switch S2 are to be used in determining this measurement. Thermal stabilization is to be obtained by operation as in the normal temperature test.

d) The leakage current is also to be monitored with switch S1 open while the furnishing is at operating temperature and while cooling.

49.9 A sample is to be subjected to the entire leakage current test, as specified in [49.8](#), without interruption for other tests.

Exception: With the concurrence of those concerned, the leakage current test is not prohibited from being interrupted to conduct other nondestructive tests.

50 Starting Current Test

50.1 A motor-operated furnishing shall start and operate normally on a circuit protected by an ordinary – not time-delay – fuse having a current rating corresponding to that of the branch-circuit power-supply to which the furnishing is to be connected. As a result of the test the fuse shall not open or an overload protector provided as part of the furnishing shall not trip.

Exception: The requirement for an ordinary fuse does not apply when:

a) The construction of the motor-operated furnishing or the nature of its usage is such that it is used continually on the same branch circuit after installation;

b) The motor-operated furnishing starts and operates as intended on a circuit protected by a time-delay fuse;

c) The motor-operated furnishing is marked in accordance with [68.3](#); or

d) A household motor-operated furnishing is intended to be used on a 15- or 20-ampere branch circuit, and the furnishing starts and operates as intended on a circuit protected by a time-delay fuse having an ampere rating corresponding to that of the branch circuit on which the furnishing is intended to be used.

50.2 The motor-operated furnishing is to be started three times at room temperature at the beginning of the test. Each start of the motor is to be made under conditions representing the beginning of intended operation and the motor is to be allowed to come to rest between successive starts.

51 Input Test

51.1 The current or wattage input to a furnishing shall not be more than 110 percent of the rated value when the furnishing is operated under the condition of maximum normal load and when connected to a supply circuit of maximum rated voltage and rated frequency.

Exception: When the furnishing is not provided with an installed electrical load (such as motor or luminaire), the input is determined as specified under Markings.

51.2 For a furnishing having a single voltage rating, such as 115 volts, maximum rated voltage is determined to be that single value of voltage. When the rating is given in terms of a range of voltages, such as 110 – 120 volts, maximum rated voltage is determined to be the highest value of the range.

52 Temperature Test

52.1 General

52.1.1 An electrified furnishing shall be tested as described in [52.1.2](#) – [52.1.5](#). Temperatures shall not exceed the applicable values specified in [Table 52.1](#).

Exception No. 1: When the furnishing is only provided with an outlet assembly that complies with one of the following:

- a) Relocatable Power Tap, UL 1363;*
- b) Furniture Power Distribution Unit, UL 962A; or*
- c) Multioutlet Assembly, UL 111*

the temperature test is not required.

Exception No. 2: A furnishing provided with a Luminaire that complies with [3.5](#), when installed and operated per its installation and operation instructions, has no other electrical load and no receptacle outlets is not required to be subjected to the temperature test.

Exception No. 3: When the furnishing is not provided with an installed electrical load (such as motor or Luminaire), the temperature test is not required when the electrical system consists of receptacle assemblies installed and connected to a field wiring junction box or is cord and plug connected; and complies with the requirements as specified in the National Electric Code, NFPA 70.

52.1.2 The temperature limits specified in [Table 52.1](#) are based on an ambient temperature of 77°F (25°C). The temperature test is able to be conducted at any ambient temperature 50 – 104°F (10 – 40°C) and corrected to an ambient of 77°F (25°C).

Table 52.1
Maximum temperature rises

Material and component parts	°C	(°F)
1. Capacitors: ^b		
Electrolytic ^a	40	(72)
Other types	65	(117)
2. Fuses		
A. Class G, J, L, T, and CC		
Tube	100	(180)
Ferrule or blade	85	(153)
B. Other ^f	65	(117)
3. Fiber employed as electrical insulation	65	(117)

Table 52.1 Continued on Next Page

Table 52.1 Continued

Material and component parts	°C	(°F)
4. At any point within a terminal box or wiring compartment of a permanently connected furnishing in which power-supply conductors are to be connected, including such conductors themselves, unless the furnishing is marked in accordance with 70.1 .	35	(63)
5. A surface upon which a furnishing is able to be fastened in place, and surfaces that are adjacent to the furnishing when so fastened.	65	(117)
6. Surfaces that are adjacent to the cabinet light when it is mounted	65	(117)
7. Class 105(A) ^{c,h}		
Thermocouple method	65	(117)
Resistance method	75	(135)
8. Class 120(E) ^{c,h}		
Thermocouple method	75	(135)
Resistance method	85	(153)
9. Class 130(B) ^{c,h}		
Thermocouple method	85	(153)
Resistance method	95	(171)
10. Class 155(F) ^{c,h}		
Thermocouple method	110	(198)
Resistance method	120	(216)
11. Class 180(H) ^{c,h}		
Thermocouple method	125	(225)
Resistance method	135	(243)
12. Phenolic composition employed as electrical insulation or as part of the deterioration of which results in a risk of fire or electric shock ^d	125	(225)
13. Phenolic lampholder body ^g	125	(225)
14. Rubber- or thermoplastic-insulated wire and cord ^{d,e}	35	(63)
15. Sealing compound	40°C (104°F) less than melting point	
16. Varnished-cloth insulation	60	(108)
17. Wood and other combustible material	65	(117)
18. Lampholder screw shell	175	(315)
19. Current carrying parts		
A. Copper or copper alloy	175	(315)
B. Aluminum	175	(315)
C. Stainless steel, monel, nickel plated copper	225	(405)
20. Accessible parts		
A. External surfaces (other than lamps or lenses) ⁱ	65	(117)
B. Operating knobs, handles, and levers intended for momentary contact during adjustment only or areas that are able to be incidentally contacted.		
1. Wood	65	(117)
2. Plastic or rubber ^j	60	(108)
3. Glass, porcelain, or vitreous enameled material	50	(90)
4. Metal	25	(45)
C. Handles or surfaces intended to be grasped for lifting, carrying, or holding:		

Table 52.1 Continued on Next Page

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Table 52.1 Continued

Material and component parts	°C	(°F)																					
1. Metallic	20	(45)																					
2. Nonmetallic	35	(63)																					
21. The maximum acceptable temperature rise on external surfaces of a furnishing employing a heating pad in the area subject to user contact	55	(99)																					
<p>^a The temperature rise on insulating material integral with the enclosure of an electrolytic capacitor that is physically integral with or attached to a motor shall not be more than 65°C (117°F).</p> <p>^b A capacitor that operates at a temperature rise of more than 65°C (117°F) is able to be judged on the basis of its marked temperature limit.</p> <p>^c At a point on the surface of a coil where the temperature is affected by an external source of heat, the temperature rise measured by a thermocouple are not prohibited to be higher by the following amount than the maximum specified when the temperature rise of the coil, as measured by the resistance method, is not more than that specified in the table.</p> <table> <tr> <th>Item</th><th colspan="2">Additional temperature rises</th></tr> <tr> <td></td><th>°C</th><th>(°F)</th></tr> <tr> <td>7</td><td>15</td><td>(27)</td></tr> <tr> <td>8</td><td>15</td><td>(27)</td></tr> <tr> <td>9</td><td>20</td><td>(36)</td></tr> <tr> <td>10</td><td>15</td><td>(27)</td></tr> <tr> <td>11</td><td>15</td><td>(27)</td></tr> </table> <p>^d The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and found usable at higher temperatures.</p> <p>^e Rubber-insulated conductors within a Class A-insulated motor, rubber-insulated motor leads, or a rubber-insulated flexible cord entering a motor are able to be subjected to a temperature rise of more than 35°C (63°F), when a braid is employed on the conductor of other than a flexible cord. However, this does not apply to thermoplastic-insulated wires or cords.</p> <p>^f A fuse that has been investigated and found usable at a higher temperature is able to be used at that temperature.</p> <p>^g Does not apply when investigated and found to be usable at a higher temperature.</p> <p>^h A totally enclosed motor is able to have winding temperature 5°C (9°F) higher than those stated.</p> <p>ⁱ Where lens is not also serving as a portion of the shade.</p> <p>^j Includes plastic with a metal plating not more than 0.005 inch (0.13 mm) thick; and metal with a plastic or vinyl covering not less than 0.005 inch thick.</p>			Item	Additional temperature rises			°C	(°F)	7	15	(27)	8	15	(27)	9	20	(36)	10	15	(27)	11	15	(27)
Item	Additional temperature rises																						
	°C	(°F)																					
7	15	(27)																					
8	15	(27)																					
9	20	(36)																					
10	15	(27)																					
11	15	(27)																					

52.1.2.1 Material provided for direct or indirect contact with live parts and any electrical insulating barrier shall be suitable for continuous operation at the maximum temperature measured on the material.

52.1.3 When temperature readings are to be obtained by means of thermocouples, the thermocouples shall consist of wires not larger than 24 AWG (0.21 mm²). When thermocouples are used in the determination of temperatures in connection with the heating of electrical devices, it is common to employ thermocouples consisting of 30 AWG (0.05 mm²) iron and constantan wire, and an instrument specifically designed for accurate determination of the attained temperature. Such equipment is to be used whenever reference temperature measurements are required.

52.1.4 A polymeric material used as a decorative trim or part shall be rated for the temperatures to which it is subjected during intended use, in that it shall not melt or deform in such a way as to interfere with the intended operation of the furnishing.

52.1.5 A cabinet light is to be operated continuously at rated luminaire wattage until constant temperatures are attained. A motor-operated furnishing is to be on and operating at maximum load during the temperature test. A temperature is determined to be constant when the test has been running for at least 3 hours, and three successive readings, taken at 30-minute intervals, are within 1.8°F (1°C) of one another and are not still rising. A motor operated furnishing shall be operated as specified in [52.2.1](#) – [52.2.3](#).