Spacings, Section 27. If broken, no portion of the heating element wire shall be accessible to contact by the 1/4 inch (6.4 mm) diameter probe (Figure 7.4) through any opening in the enclosure, while the heat gun is rotated and moved as intended during normal use.

42.4.2 If a sample, after being subjected to the test specified in 42.4.1:

a) Permits the entry of a 1/4 inch (6.4 mm) diameter probe, Figure 7.4, into the enclosure to contact an uninsulated live part;

b) Is unable to comply with the dielectric voltage-withstand test specified in 38.1;

c) Experiences circuit interruption by component burnout other than operation of a one-time protective device; or

d) Has caused the 3-A fuse to ground to open;

the result is not considered to be acceptable. If still in an operating condition, the sample is to be tested in accordance with 42.4.3.

42.4.3 If a heat gun appears operable following the three drops, it is to be energized for 1 hour or until ultimate results are noted, whichever occurs first. Upon completion of this test, after dropping and operation, compliance with 42.4.2 shall be determined for each sample.

42.5 Ceramics-baking kilns and ovens

42.5.1 A kiln or oven which bears the warning marking described in 53.22 is to be operated until temperatures have become constant.

42.6 Charcoal ignitors

42.6.1 Without adding charcoal, the operation of the sample used in the normal-temperature test is to be continued for a total of 7 hours. During the test, the grounding means provided by a 3-conductor cord is to be disconnected and the ignitor sheath is to be connected to ground through a 3-A fuse. Rupture of the sheath, opening of the fuse, or dielectric breakdown when the product is tested in accordance with 38.1 and 38.2 indicates that the ignitor is not acceptable.

42.6.2 An ignitor is to be operated while supported on its integral stand on a softwood surface covered with two layers of white tissue paper.

42.6.3 There shall be no exposed live parts as a result of the following tests. The sheaths of charcoal or log lighters that have been subjected to the following tests shall not rupture or result in a dielectric breakdown when tested in accordance with 38.1 and 38.2.

a) A previously untested sample of the ignitor or log lighter is to be operated in air until thoroughly heated and is then to be dropped six times from a height of 3 ft (0.91 m) onto a concrete surface while still connected to the power supply. In three drops the sheath is to strike the concrete first, and in three drops the handle is to strike the concrete first.

b) A previously untested sample of the ignitor or log lighter is to be energized and its handle held firmly between two lightly padded surfaces with the heating element in a horizontal plane. A mass of 10 lb (4.54 kg) is to be suspended at the end of the well-heated element for 1 minute. If the element sheath bends because of this force, it shall be straightened to its original position.

42.7 Stock-tank de-icers, stock waterers, and the like

42.7.1 A device intended for heating in low-temperature air shall be operated dry in air at 25 °C (77 °F) and in air at minus 23.0 ±3.0 °C (minus 9.4 ±5.4 °F) while supported on a tissue-paper-covered softwood supporting surface with dry, shredded newspaper placed loosely over the active part of the heating surface or surfaces.

42.8 Warming trays

42.8.1 A warming tray is to be operated with the entire serving surface covered with a double layer of cheesecloth and with a 1 inch (25 mm) thick hair-felt pad. If the thermostat cycles, the test is to be repeated with only two-thirds of the serving surface covered and again with one-third of the serving surface covered. In the partial coverage test, the area of the tray farthest from the thermostat is to be covered. Operation under each of the above conditions is to be continuous for a period of 7 hours.

42.9 Immersion heaters

42.9.1 A cord-connected immersion heater is to be operated on a softwood surface covered with two layers of white tissue paper, with the sheath of the element in contact with the paper-covered surface.

42.10 Liquid heaters

42.10.1 A liquid heater is to be operated dry and with all automatic temperature controls or protective devices shunted out of the circuit, except as noted in 36.1.19.

42.11 Ovens

42.11.1 A nonautomatic oven is to be operated without any temperature regulation.

42.12 Poultry and livestock brooders

42.12.1 The brooder is to be tested while supported on a softwood surface covered with two layers of white tissue paper, and mounted in the 90 degree corner described in 36.1.17. The brooder is to be located as close to the supporting surface and to both walls of the corner as its construction will permit, and is to be so oriented that maximum heating on the walls and supporting surface will result.

42.13 Solder pots, nonautomatic

42.13.1 A nonautomatic solder pot is to be operated continuously until ultimate results are observed, while charged with the commonly used metal or alloy that results in highest temperatures. If the product incorporates a means for adjusting the heat input, this is to be set at the maximum.

42.14 Soldering irons

42.14.1 A soldering iron that does not incorporate a momentary-contact switch is to be operated on its stand until ultimate results are obtained.

42.15 Hot plates

42.15.1 A hot plate is to be operated continuously with each heating unit covered with a cast-iron circular stove plate. The plate to be used with a 6 inch (152 mm) or smaller surface unit is 7 – 8 inches (178 – 203 mm) in diameter and weighs approximately 3 lb (1.36 kg). The plate to be used with a larger surface unit is 10 – 11 inches (254 – 279 mm) in diameter and weighs approximately 7 lb (3.18 kg).

42.16 Ceramic products

42.16.1 A ceramic liquid heating appliance shall not involve risk of electric shock when operated as described in 42.16.2.

42.16.2 The product is to be filled with just enough water – the hard water solution described in 34.10 – to cover the heating element and then operated continuously, without the addition of any more water, until the heating element burns out to open the circuit, except that the time of operation is not to exceed 7 hours. After the product has cooled to room temperature, it is to be half filled with water again and connected to the supply circuit. A risk of electric shock is considered to exist if the current measured through a 500-ohm resistor between the water in the product and ground exceeds 5.0 mA. The current is to be measured again with reversed polarity of the supply circuit.

42.16.3 If the product breaks during the heating described in 42.16.2, the test is to be discontinued and the product is not to present a risk of fire or electric shock.

42.16.4 An insulating washer, gasket, or the like, used as a seal or barrier between uninsulated live parts and the liquid chamber of a liquid heating appliance shall be such that there will not be a leakage current of more than 0.5 mA between liquid in the product and ground after a product has been operated as described in 42.16.5.

42.16.5 The product is to be operated continuously for 168 hours after having been filled with the liquid usually used in the product. Liquid is to be added from time to time to keep the liquid chamber from becoming less than half full. The product is then to be subjected to a repeated leakage-current test, see 34.1, except that the test is to be discontinued when leakage current stabilizes.

42.16.6 An insulating washer or gasket as described in 42.16.4 shall show no visible signs of deterioration after being aged for 168 hours in a circulating-air oven at a temperature of 135.0 ±1.0 °C (275.0 ±1.8 °F).

42.17 Vaporizers of the resistance-wire type

42.17.1 A vaporizer of the resistance-wire type is to be operated dry, for not less than 4 hours or until ultimate conditions are obtained. The product is to be completely wrapped in a pad consisting of eight layers of bleached cheesecloth, with the pad in contact with the vaporizer parts, and then placed on a softwood surface.

42.18 Heating appliances employing fans or blowers

42.18.1 Heating appliances employing blowers or fans shall be positioned as intended on a softwood surface covered with white tissue paper. The rotor of the fan / blower motor shall be stalled. The appliance shall be operated continuously until the ultimate results have been determined.

42.19 Hybrid adhesive guns

42.19.1 General

42.19.1.1 Hybrid adhesive guns shall not pose a risk of fire or electric shock as determined by 42.1.3 – 42.1.4 and Section 38 when tested in accordance with 42.19.2 – 42.19.4.

42.19.2 Hybrid adhesive gun reverse battery polarity test

42.19.2.1 Unless the hybrid adhesive gun design precludes incorrect installation, the manufacturer's recommend battery shall be installed in the battery compartment such that the battery(ies) is inserted in the incorrect polarity. The compartment cover shall be installed and the unit placed on a soft wood supporting surface covered with tissue paper, with the battery compartment oriented in contact with or as close to the surface as the design permits. The unit shall be covered with a layer of cheesecloth and then to be energized for a period of 7 hours.

42.19.3 Battery short-circuit test

42.19.3.1 A sample of the hybrid adhesive gun with fully charged battery (ies) specified by the manufacturer shall be positioned, with the battery compartment cover closed, in the most unfavorable orientation as determined by the Normal Temperature Test of Section 36. The battery terminals shall be short-circuited. The total resistance of the shorting circuit shall not exceed 0.1 ohm. The test is to continue until the battery is to completely discharged or until the battery case temperature has peaked or reached a steady state condition.

42.19.4 Hybrid adhesive gun component fault test

42.19.4.1 Components whose failure could result in an increase risk of fire and/or electric shock during any condition of operation shall be subjected to a short of any two terminals or an open at a single connection, one test at a time. These components include electrolytic capacitors, semiconductors and resistors (open circuit only) in the battery and mains connected circuits. The sample shall be energized prior to introducing the fault shall employ new fully charged batteries.

43 Testing of Component Switches and Control Devices

43.1 Overload test for motor switches

43.1.1 A switch or other device that controls a motor employed in a heating appliance, unless previously investigated for the application or unless so interlocked that it will not have to break the locked-rotor motor current, shall be capable of performing acceptably when subjected to an overload test consisting of 50 cycles of operation, making and breaking the locked-rotor current of the motor. There shall be neither electrical nor mechanical malfunction of the device, nor undue burning, pitting, or welding of the contacts.

43.1.2 To determine whether a switch or other control device is capable of performing acceptably in the overload test, the product is to be connected to a grounded supply circuit of rated frequency and of voltage in accordance with 36.1.13 with the rotor of the motor locked in position. During the test, exposed dead metal parts of the product are to be connected to ground through a 3-A fuse, and the current-rupturing device, if single-pole, is to be located in an ungrounded conductor of the supply circuit. If the product is intended for use on direct current, or on direct current as well as alternating current, the test is to be conducted with direct current and exposed dead metal parts are to be so connected as to be positive with respect to a single-pole, current-rupturing device. The device is to be operated at the rate of 10 cycles per minute, except that a faster rate of operation may be employed if agreeable to all concerned. The performance is unacceptable if the fuse in the grounding connection opens during the test.

43.2 Overload test for automatic controls

43.2.1 An automatic control for temperature regulating or temperature limiting shall be capable of performing successfully for 50 cycles of operation, when the heater is connected to a supply circuit having a potential of 120 percent of the voltage specified in 36.1.13. There shall be neither electrical nor mechanical malfunction of the control, nor undue burning, pitting, or welding of the contacts.

43.2.2 In tests to determine whether an automatic control complies with the requirements in 43.2.1 and 43.2.3, the product is to be connected to a grounded supply circuit; the enclosure of the product, if of metal, is to be connected to ground through a 3-A fuse; and the control, if single-pole, is to be connected in an ungrounded conductor of the circuit. If the heater is intended for use on direct current, or on direct current as well as on alternating current, the test is to be conducted with direct current, and the enclosure is to be so connected as to be positive with respect to a single-pole automatic control. The device is to be operated at the rate of 10 cycles per minute, except that a faster rate of operation may be employed if agreeable to all concerned. The performance is unacceptable if the fuse in the grounding connection opens during the test.

43.2.3 An automatic control intended for use on direct current, which is so constructed that the starting handle does not stay latched with the timing knob in all of its position settings, thereby resulting in a slow break of the switch contacts upon release of the handle, shall be capable of performing successfully when tested as follows. The switch shall be subjected to 50 cycles of operation at normal load by releasing the handle slowly and, during the test, the metal frame of the product shall be connected to ground through a 3-A fuse to give indication of a flashover, should this occur. This test shall be made following the overload test and preceding the endurance test on the control. See 43.2.1 and 43.3.1.

43.3 Endurance test for thermostats

43.3.1 A thermostat shall be capable of withstanding an endurance test that, except as noted in 43.3.3, shall consist of the number of cycles indicated in Table 43.1. Unless it is specified that the test be made without load, the thermostat shall make and break the rated current of the product while connected to a circuit of rated voltage. There shall be neither electrical nor mechanical malfunction of the thermostat, nor undue burning, pitting, or welding of the contacts.

Table 43.1
Number of cycles of operation for endurance test

Type of thermostat	Automatically reset thermostat	Manually reset thermostat
Temperature-regulating	A number of cycles equivalent to 1000 hours of normal operation of the heater but not less than 6000 if a household heating appliance, or 30,000 cycles if a commercial appliance. However, the test may be omitted if, with the thermostat short-circuited, no temperatures higher than the limits given in Table 36.1 are attained during the normal-temperature test of the appliance.	To be made the subject of special consideration.[a]
Temperature-limiting	A number of cycles equivalent to 100 hours of operation of the heating appliance under any condition which causes the thermostat to function, or 100,000 cycles, whichever is greater. However, the test may be omitted if, with the thermostat short-circuited, there is no evidence of risk of fire as described in 42.1.1 – 42.1.5 during the continuous abnormal operation of the appliance.	1000 cycles under load and 5000 cycles without load. However, the test may be omitted if, with the thermostat short-circuited, there is no evidence of risk of fire as described in 42.1.1 – 42.1.5 during continuous abnormal operation of the appliance.
Combination temperature-regulating and -limiting	100,000 cycles if, with the thermostat short-circuited, there is evidence of risk of fire as described in 42.1.1 – 42.1.5. If there is no evidence of risk of fire under this condition, the thermostat is to be tested as a temperature-regulating thermostat (see above).	To be made the subject of special consideration.

[a] If the operation of the thermostat controls the physical movement of a part of the appliance, the test is to be so arranged that each cycle will involve the complete normal operation of the appliance.

43.3.2 With reference to 43.3.1 and Table 43.1, thermostats are classified as follows:

a) A temperature-regulating thermostat is one that functions only to regulate the temperature of the heating appliance under intended conditions of use, and whose malfunction would not result in a risk of fire.

b) A temperature-limiting thermostat is one that functions only under conditions that produce abnormal temperatures. The malfunction of such a thermostat might or might not result in a risk of fire.

c) A combination temperature-regulating and -limiting thermostat is one that functions to regulate the temperature of the heating appliance under intended conditions of use, and also serves to reduce the risk of fire that might result from conditions of abnormal operation of the product.

43.3.3 For a medicament vaporizer of the resistance-wire type, the endurance test of a thermostat is to consist of 100,000 cycles under load.

43.4 Limited short circuit test for motor-control devices

43.4.1 There shall not be any ignition of cotton surrounding the outer enclosure of the protective device, that, in some cases, will be the enclosure of the motor that it protects, when three samples of a device controlling a 1/2 hp or smaller motor are subjected to short circuits on a circuit limited to 200 A, and when three samples of a device controlling a motor larger than 1/2 hp are subjected to short circuits on a circuit limited to 1000 A.

43.4.2 A motor is to be considered to comply with the requirement in 43.4.1 if it is equipped with an inherent overheating protector that complies with the requirements for such protectors.

43.4.3 For the tests mentioned in 43.4.1, the power factor of the test circuit is to be 0.9 – 1.0, and the circuit capacity is to be measured without the device in the circuit.

43.4.4 In each case, a nonrenewable cartridge fuse is to be connected in series with the device under test; the fuse is to be of the maximum current rating that will be accommodated by a fuseholder of the branch circuit to which the product would be connected. The test on one sample is to be made by closing the device on the short circuit.

44 Strain Relief Test

44.1 The strain-relief means provided on an attached flexible cord, when tested in accordance with 44.2, shall be capable of withstanding for 1 minute, without displacement, a pull of 35 lbf (156 N) applied to the cord, with the connections within the product disconnected.

Exception: The cord on a soldering iron or wood-burning pencil having a mass of not more than 1/2 lb (0.227 kg) exclusive of the cord shall withstand a pull of 20 lbf (89 N).

44.2 The strain relief means provided on leads as mentioned in the Exception to 11.1.5 when tested in accordance with 44.3, shall be capable of withstanding for 1 minute without displacement a pull of 5 lbf (22 N) applied to the leads with connections at the termination disconnected.

44.3 The specified force is to be applied to the cord or leads, and the product so supported that the strain-relief means will be stressed from any angle that the construction of the product permits. The strain-relief is not acceptable if, at the point of disconnection of the conductors, there is sufficient movement of the cord or leads, to indicate that stress on the connections would have resulted.

45 Push-Back Relief Test

45.1 To determine compliance with 12.2.3, a product shall be tested in accordance with 45.2 without occurrence of any of the following conditions:

a) The supply cord is subjected to mechanical damage;

b) The supply cord is exposed to a temperature higher than that for which it is rated;

c) Spacings, such as to a metal strain-relief clamp, are reduced below the minimum required values; or

d) Internal connections or components are damaged.

45.2 The supply cord is to be held 1 inch (25.4 mm) from the point where the cord emerges from the product or cord bushing, when provided, and is then to be pushed back into the product. The cord is to be pushed back into the product in 1 inch (25.4 mm) increments until the cord buckles or the force to push the cord into the product exceeds 6 pounds-force (26.7 N). The supply cord within the product is to be manipulated to determine compliance with 45.1.

46 Permanence of Cord Tag for Outdoor-Use Heating Appliances with Power-Supply Cords Less than 6 Feet (1.8 m)

46.1 This requirement is intended for tags employed with outdoor-use heating appliances requiring the marking of 53.38 with power-supply cords less than 6 ft (1.8 m), other than as mentioned in 53.14.

46.1A A tag shall comply with Marking and Labeling Systems – Flag Labels, Flag Tags, Wrap-Around Labels and Related Products, ANSI/CAN/UL 969A, for the cord type it is applied to, and to the environmental conditions consistent with the intended use of the product (e.g. indoor or outdoor).

46.2 *Deleted*

46.3 *Deleted*

46.4 *Deleted*

46.5 *Deleted*

46.6 *Deleted*

46.7 *Deleted*

47 Crushing Resistance for Flexible Pet Heating Mats/Pads

47.1 Flexible pet heating mats/pads shall withstand a 1-minute application of the crushing force described in 47.2 without resulting in any of the following:

a) Reduction of spacings below the minimum specified in Spacings, Section 27 of this Standard and Section 8 of the Standard for Electric Heating Pads, UL 130;

b) Accessibility of insulated or uninsulated live parts as determined in accordance with accessibility requirements of this Standard;

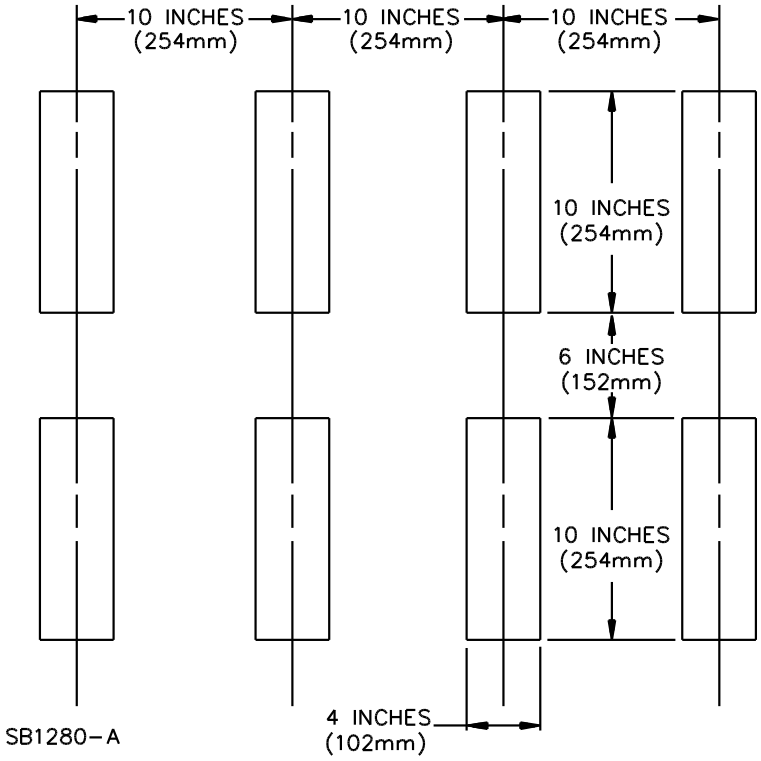
c) Breakage, cracking, rupture, or similar damage that adversely affects the insulation; or

d) A risk of electric shock, fire, or injury to persons operating the appliance per the Heating Test (Repeated) and Dielectric Withstand Test of the Standard for Electric Heating Pads, UL 130.

47.2 Three samples of the flexible pet heating mat/pad are to be backed on the mounting side by a fixed rigid supporting surface. A crushing force is to be applied to the side opposite the mounting surface. The force is to be applied through hardwood applicators each no more than 0.5 inch (12.7 mm) thick and having flat surfaces each 4 by 10 in (102 by 254 mm). Each force applicator is to exert 100 lb (45.4 kg) on the sample. As many applicators are to be applied as the sample can accommodate on the surface opposite the mounting surface, based on an arrangement of applicators as indicated in Figure 47.1.

Figure 47.1

Location of applicators for crush-resistance test



48 Appliance Coupler Retention

48.1 In order to determine compliance with the exception to 12.1.2 a hand-supported indoor use heating appliance employing a detachable supply cord shall be subjected to the requirements of 48.2 and 48.3 with acceptable results.

48.2 If a hand-supported heating appliance employs a detachable power-supply cord without a positive means of retention, the retention means shall comply with the endurance test specified in 48.3. At the end of this test the retention means shall withstand for 1 minute a 1 lb (4.4 N) withdrawal force axially applied to the cord, without the appliance coupler becoming disengaged from the retention system.

48.3 The retention means is to be subjected to 1000 cycles of appliance coupler insertion and removal, with each cycle consisting of a full insertion into and removal from the appliance. The insertion and removal of the appliance coupler is to be done at a rate not exceeding ten cycles per minute unless the manufacturer agrees to a faster rate. The appliance is not to be energized during the test.

49 Connector Current Interruption

49.1 A sample of the appliance constructed as detailed in 12.1.4 shall be subjected to the testing detailed in 49.2 without occurrence of any of the following:

a) Making uninsulated live parts accessible to contact;

b) Producing a condition that affects the mechanical performance of the appliance;

c) Producing a condition that increases the likelihood of an electric shock as determined by the dielectric voltage-withstand test in Section 38;

d) Visible pitting of the contacts in either the connector or appliance plug;

e) Carbon tracking that reduces spacings below the acceptable value; or

f) Cessation of normal function of the appliance.

49.2 A sample of the appliance shall be connected to a supply adjusted to rated voltage and operated under conditions of maximum loading. The appliance coupler shall be fully inserted and withdrawn for 50 cycles of operation at a rate of not more than 10 operations per minute with the blades or pins of the mating part connected for not more than one second. At the conclusion of the test, the appliance shall be examined for compliance with 49.1.

49A Thermal Degradation Test

49A.1 A thermoset material used as a functional part of an appliance where risk of fire, electric shock, or injury to persons is involved shall be resistant to thermal degradation at the maximum temperature to which it is exposed during normal use of the appliance. The thermal-aging characteristics of the material may be investigated by any one of the following procedures:

a) The material shall have a temperature index, based on historical data or a long-term thermal aging program, described in the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B, which indicates acceptability for use at the temperature involved; or

b) The product shall be operated with the input voltage adjusted so that the part in question operates at the maximum temperature obtained during the normal temperature test. The test is to be conducted with all temperature controls by-passed for a period of 1000 hours. There shall be no visible degradation of parts at the conclusion of the 1000 hours.

MANUFACTURING AND PRODUCTION-LINE TESTS

50 Production-Line Dielectric Voltage-Withstand Test

50.1 Each product shall withstand without electrical breakdown, as a routine production-line test, the application of a potential at a frequency within the range of 40 – 70 Hz or a dc potential, between:

a) The primary wiring, including connected components, and accessible dead metal parts that are likely to become energized;

b) Primary wiring and accessible low-voltage (42.4 V peak or less) metal parts, including terminals; and

c) The primary wiring and the battery terminals.

50.2 The production-line test shall be in accordance with either Condition A or B of Table 50.1. The full test potential is to be applied for the full time specified in Table 50.1. The test potential is to be applied gradually until the full test potential is attained; however, for the 1 second test, the full test potential is to be applied at the beginning of the test.

Table 50.1
Production-line test conditions

Product rating	Condition A			Condition B		
	Minimum test potential		Time, seconds	Minimum test potential		Time, seconds
	V DC[c]	V AC		V DC[c]	V AC	
250 volts or less without a motor rated more than 1/2 horsepower (373 W output)	1400	1000	60	1700	1200	1
250 volts or less with a motor rated more than 1/2 horsepower	1400+2.8V[a]	1000+2V[a]	60	1700+3.4V[a]	1200+2.4V[a]	1
251 – 600 volts	1400+2.8V[b]	1000+2V[b]	60	1700+3.4V[b]	1200+2.4V[b]	1
600 votes or less and product applied directly to persons	1400+2.8V[a]	1000+2V[a]	60	1700+3.4V[a]	1200+2.4V[a]	1
250 volts or less and product applied, in a wet or moist condition, directly to persons	3500	2500	60	4200	3000	1

[a] Maximum marked voltage but not less than 120 volts if the maximum marked voltage is within the range 105 – 120 volts, and not less than 240 volts if the maximum marked voltage is within the range 210 – 240 volts.

[b] Maximum marked voltage.

[c] Peak dc voltage

50.3 The product may be in a heated or unheated condition for the test.

50.4 The test shall be conducted when the product is complete (fully assembled) and with the primary switch in the on position. It is not intended that the product be unwired, modified, or disassembled for the test.

Exception No. 1: Parts, such as snap covers or friction-fit knobs that would interfere with performance of the test need not be in place.

Exception No. 2: The test may be performed before final assembly if the test represents that for the completed product.

50.5 When the product employs a solid-state component that is not relied upon to reduce the risk of electric shock and that can be damaged by the dielectric potential, the test may be conducted before the component is electrically connected provided that a random sampling of each day's production is tested at the potential specified in Table 50.1. The circuitry may be rearranged for the purpose of the test to minimize the likelihood of solid-state-component damage while retaining representative dielectric stress of the circuit.

50.6 The test equipment shall include a means of indicating the test potential, an audible or visual indicator of electrical breakdown, and either a manually reset device to restore the equipment after electrical breakdown or an automatic reject feature of any unit not capable of being used. If an ac test potential is applied, the test equipment shall also include a transformer having an essentially sinusoidal output.