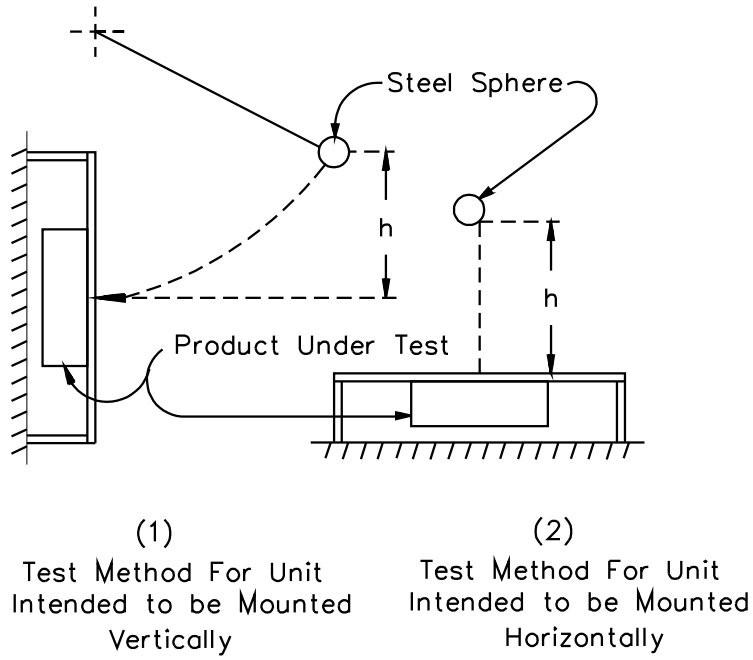
Figure 43.1
Jarring test



43.3 During this test, the unit is to be operated in the normal standby condition and connected to a rated source of supply in accordance with the requirements in 29.3.1.

44 Dielectric Voltage-Withstand Test

44.1 A unit shall withstand for 1 minute, without breakdown, the application of an essentially sinusoidal AC potential of a frequency within the range of 40 – 70 hertz, or a DC potential, between live parts and the enclosure, live parts and exposed dead metal parts, and live parts of circuits operating at different potentials or frequencies. The test potential is to be (also, see 44.2):

a) For a unit rated 30 volts AC rms (42.4 volts DC or AC peak) or less – 500 volts (707 volts, if a DC potential is used).

b) For a unit rated between 31 and 250 volts AC rms – 1000 volts (1414 volts, if a DC potential is used).

c) For a unit rated more than 250 volts AC rms – 1000 volts plus twice the rated voltage (1414 volts plus 2.828 times the rated AC rms voltage, if a DC potential is used).

44.2 For the application of a potential in accordance with 44.1(c), the voltage is to be the applicable value specified in 44.1 (a) – (c), based on the highest voltage of the circuits under test instead of the rated voltage of the unit. Electrical connections between the circuits are to be disconnected before the test potential is applied.

44.3 Exposed dead metal parts referred to in 44.1 are noncurrent-carrying metal parts that are likely to become energized and are accessible from outside of the enclosure of a unit during intended operation with the door of the enclosure closed.

44.4 If an autotransformer is in the circuit, the primary of the transformer is to be disconnected and an AC test potential in accordance with 44.1(c) is to be applied directly to all wiring involving more than 250 volts.

44.5 If the charging current through a capacitor or capacitor type filter connected across the line, or from line to earth ground, is sufficient to prevent maintenance of the specified AC test potential, the capacitor or filter is to be tested using a DC test potential in accordance with 44.1.

44.6 The test potential may be obtained from any convenient source having sufficient capacity to maintain the specified voltage. The output voltage of the test apparatus is to be monitored. Starting at zero, the potential is to be increased at a rate of approximately 200 volts per minute until the required test value is reached and is to be held at that value for 1 minute.

44.7 A printed wiring assembly or other electronic circuit component that would be damaged by the application of, or would short-circuit, the test potential, is to be removed, disconnected, or otherwise rendered inoperative before the test. A representative subassembly may be tested instead of an entire unit. Rectifier diodes in the power supply may be individually shunted before the test to avoid destroying them in the case of a malfunction elsewhere in the secondary circuits.

45 Temperature Test

45.1 The materials employed in the construction of a local burglar-alarm unit shall not attain temperature rises greater than those indicated in Table 45.1.

Table 45.1
Maximum temperature rises

Materials and components	Normal standby condition, °C	(°F)	(Signaling) alarm condition, °C	(°F)
A. COMPONENTS				
1. Capacitors:[a,b]				
a. Electrolytic types	25	(45)	40	(72)
b. Other types	25	(45)	65	(117)
2. Rectifiers – At any point				
a. Germanium	25	(45)	50	(90)
b. Selenium	25	(45)	50	(90)
1) Maximum 60 percent of rated volts	50	(90)	75	(135)
2) 61 percent or more of rated volts	25	(45)	75	(135)
3. Relay, solenoid, transformer, and other coils with:				
a. Class 105 insulation system:				
1) Thermocouple method	25	(45)	65	(117)
2) Resistance method	35	(63)	75	(153)
b. Class 103 insulation system:				
1) Thermocouple method	45	(81)	85	(153)
2) Resistance method	55	(99)	95	(171)
c. Class 155 insulation system:				

Table 45.1 Continued on Next Page

Table 45.1 Continued

Materials and components	Normal standby condition, °C	(°F)	(Signaling) alarm condition, °C	(°F)
1) Class 2 transformers;				
Thermocouple method	95	(171)	95	(171)
Resistance method	115	(207)	115	(207)
2) Power transformers;				
Thermocouple method	110	(198)	110	(198)
Resistance method	115	(207)	115	(207)
d. Class 180 insulation system:				
1) Class 2 transformers;				
Thermocouple method	115	(207)	115	(207)
Resistance method	135	(243)	135	(243)
2) Power transformers;				
Thermocouple method	125	(225)	125	(225)
Resistance method	135	(243)	135	(243)
4. Resistors[c]				
a. Carbon	25	(45)	50	(90)
b. Wire wound	50	(90)	125	(225)
c. Other	25	(45)	50	(90)
5. Solid State Devices	See footnote d			
6. Other Components and Materials:				
a. Fiber used as electrical insulation or cord bushings	25	(45)	65	(117)
b. Varnished cloth insulation	25	(45)	60	(108)
c. Thermoplastic materials	Rise based on temperature limits of the material			
d. Phenolic composition used as electrical insulation or as parts who malfunction will result in risk of fire or electric shock[e]	25	(45)	125	(225)
e. Wood or other flammables	25	(45)	65	(117)
f. Sealing compound	15°C (27°F) less than the melting point[b]			
g. Fuses	25	(45)	65	(117)
B. CONDUCTORS				
1. Appliance wiring material[f]	15°C (27°F) less than the temperature limit of the wire			
2. Flexible cord (for example, SJO, SJT)	35	(63)	35	(63)
3. Conductors of field-wired circuits to be permanently connected to the product	35	(63)	35	(63)
C. GENERAL				
1. All surfaces of the product and surfaces adjacent to or upon which the product may be mounted	65	(117)	65	(117)
2. Surfaces normally contacted by the user in operating the unit (control knobs, push buttons, levers, and the like):				
a. Metal	35	(63)	35	(63)
b. Nonmetallic	65	(108)	60	(108)
3. Surfaces subjected to casual contact by the user (enclosure, grille, and the like):				
a. Metal	45	(81)	45	(81)
b. Nonmetallic	65	(117)	65	(117)

[a] For an electrolytic capacitor which is physically integral with or attached to a motor, the temperature rise on insulating material integral with the capacitor enclosure may be not more than 65°C (117°F).

Table 45.1 Continued on Next Page

Table 45.1 Continued

Materials and components	Normal standby condition, °C	(°F)	(Signaling) alarm condition, °C	(°F)
[b] A capacitor which operates at a temperature higher than a 65°C (117°F) rise may be judged on the basis of its marked temperature rating.				
[c] The temperature rise of a resistor may exceed the values shown if the power dissipation is 50 percent or less of the manufacturer's rating.				
[d] The temperature of a solid-state device (for example, transistor, SCR integrated circuits), shall not exceed 50 percent of its rating during the Normal Standby Condition. The temperature of a solid-state device shall not exceed 75 percent of its rated temperature under the Alarm Condition or any other condition of operation which produces the maximum temperature dissipation of its components. For reference purposes, 0°C (32°F) shall be considered as 0 percent. For integrated circuits, the loading factor shall not exceed 50 percent of its rating under the Normal Standby Condition and 75 percent under any other condition of operation. Both solid-state devices and integrated circuits may be operated up to the maximum ratings under any one of the following conditions: 1. The component complies with the requirements of MIL-STD 883E. 2. A quality-control program is established by the manufacturer consisting of an inspection stress test followed by operation of 100 percent of all components, either on an individual basis, as part of a subassembly, or equivalent. 3. Each assembled production unit is subjected to a burn-in test, under the condition which results in the maximum temperatures, for 24 hours while connected to a source of rated voltage and frequency in an ambient of at least 49°C (120°F) followed by an Operation Test.				
[e] The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds which have been investigated and found to have special heat-resistant properties.				
[f] For standard insulated conductors other than those mentioned, reference should be made to the National Electrical Code, ANSI/NFPA 70; the maximum allowable temperature rise in any case is 25°C (45°F) less than the temperature limit of the wire in question.				

45.2 The values for temperature rise in Table 45.1 are based on an assumed ambient temperature of 25 ±15°C (77 ±27°F) and tests are to be conducted at an ambient temperature within that range. A temperature is considered to be constant when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but at not less than 5 minute intervals, indicate no change.

45.3 Temperatures are to be measured by thermocouples consisting of wires not larger than 24 AWG (0.21 mm^2) or by the resistance method, except that the thermocouple method is not to be employed for a temperature measurement at any point where supplementary thermal insulation is employed.

45.4 Thermocouples consisting of 30 AWG (0.06 mm^2) iron and constantan wires and a potentiometer-type indicating instrument shall be used whenever referee temperature measurements by thermocouples are necessary.

45.5 The temperature of a coil winding may be determined by the resistance method, wherein the resistance of the winding at the temperature to be determined is compared with the resistance at a known temperature by means of the formula:

$$\Delta t = \frac{R}{r}(k + t_1) - (k + t_2)$$

in which:

Δt is the temperature rise in degrees C,

t_1 is the room temperature at start of test, in degrees C,

t_2 is the room temperature at end of test, in degrees C,

R is the resistance in ohms at the end of test,

r is the resistance in ohms at the start of test, and

k is 234.5 for copper or 225.0 for electrical conductor grade aluminum.

45.6 To determine compliance with these requirements, the product is to be connected to a supply circuit of rated voltage and frequency in accordance with 29.3.1 and operated continuously under representative service conditions that are likely to produce the highest temperature.

45.7 If a current-regulating resistor or reactor is provided as a part of a unit, it is to be adjusted for the maximum resistance or reactance at intended current.

45.8 The test is to be continued until:

a) Constant temperatures are attained during the normal supervisory condition and

b) One hour has elapsed during the normal alarm signaling condition of a unit intended to produce a continuous signal until it is restored to normal.

45.9 If a control unit has provision for multiple zones, 10 percent of the total number of zones, but in no case less than three zones, shall be energized during the alarm or other intended operating condition.

46 Abnormal Operation Test

46.1 A local burglar-alarm unit operating in any condition of intended operation shall not increase the risk of fire or electric shock when abnormal fault conditions are introduced.

46.2 To determine compliance with the requirement of 46.1, the product is to be connected to a source of supply in accordance with 29.3.1 and operated under the most severe circuit fault conditions likely to be encountered in service. There shall not be emission of flame or molten metal, or any other manifestation of fire, see 46.4. The product shall also comply with the requirements of the Dielectric Voltage-Withstand Test, Section 44.

46.3 The fault condition is to be maintained continuously until constant temperatures are attained or until burnout occurs, if the fault does not result in the operation of an overload protective device. Shorting of the secondary of the power supply transformer and shorting of an electrolytic capacitor represent typical fault conditions.

46.4 The product shall be wrapped in a single layer of bleached cheesecloth having an area of 14 – 15 square yards to the pound (25.75 – 27.59 m^2/kg) and a count of 32 by 28, and then energized. There shall not be molten metal or flame emitted from the unit as a result of this test as evidenced by ignition or charring of the cheesecloth. The dielectric voltage-withstand test shall be conducted immediately at the conclusion of the test.

47 Electrical Transient Tests

47.1 General

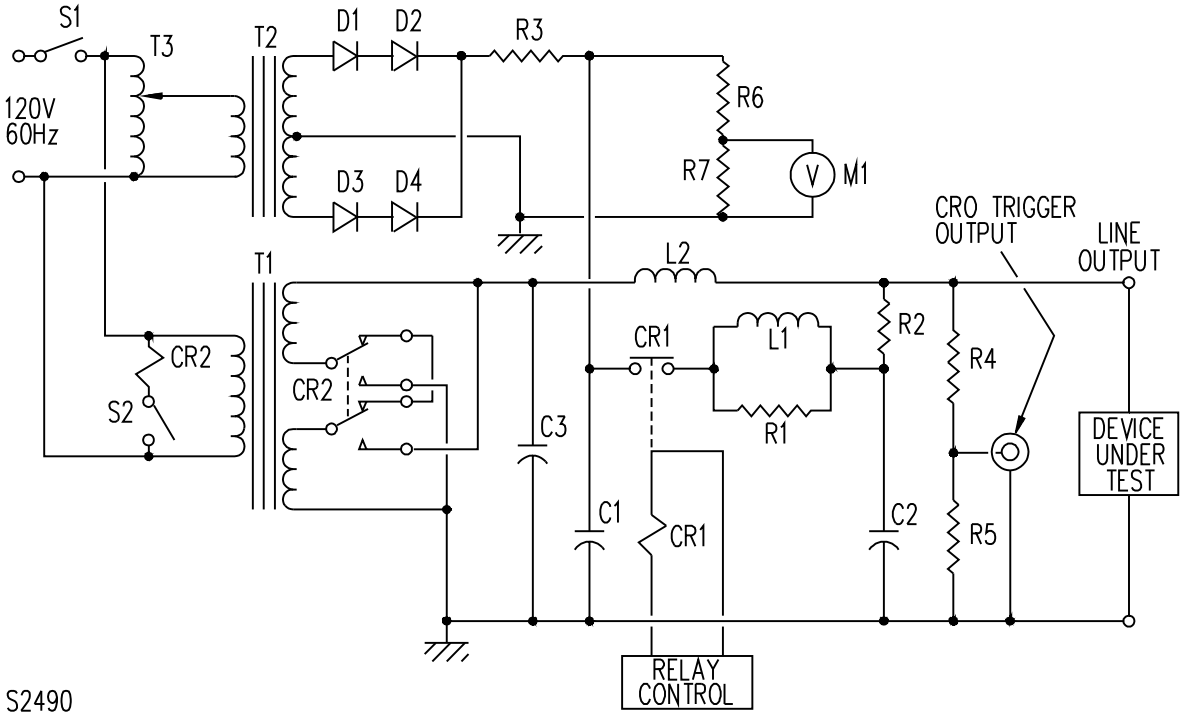
47.1.1 A local burglar-alarm unit, other than that operating from a primary battery, shall operate for its intended signaling performance after being subjected to 500 supply line transients, 500 internally induced transients, and 60 input/output circuit transients while energized from a source of supply in accordance with 29.4.

47.2 Supply line transients

47.2.1 A high-voltage ac-operated unit shall not false alarm, operate as intended, and retain required stored memory (such as date, type, and location of a signal transmission) within the unit when subjected to supply line transients induced directly between the power supply circuit conductors of the equipment under test and ground. Supplemental information stored within the unit need not be retained.

47.2.2 For this test, the unit is to be connected to a transient generator, consisting of a 2 kilovolt-ampere isolating power transformer and control equipment that produces the transients described in 47.2.3. See Figure 47.1. The output impedance of the transient generator is to be 50 ohms.

Figure 47.1
Transient generator circuit



C1– Capacitor, 0.025 µF, 10 kV
C2 – Capacitor, 0.0006 µF, 10 kV
C3 – Capacitor, 10 µF, 400 V
CR1 – Relay, coil 24 V, DC.
Contacts, 3-pole, single throw, each contact rated 25 A, 600 V, AC maximum.
All three poles wired in series
CR2 – Relay, coil 120 V, AC.
Contacts DPDT. Provides either 120 V or 240 V test circuit.
D1 – D4 – Diodes, 25 kV PIV each
L1 – Inductor, 15 µH [33 turns, 22 AWG wire, wound on 0.835 inch (21.2 mm) diameter PVC tubing]
L2 – Inductor, 70 µH [45 turns, 14 AWG wire, wound on 2.375 inch (60.33 mm) diameter PVC tubing]
M1 – Meter, 0 – 20 V, DC
R1 – Resistor, 22 ohms, 1 W, composition
R2 – Resistor, 12 ohms, 1 W, composition
R3 – Resistor, 1.3 Megohms (12 in series, 110K Ohms each, 1/2 W)
R4 – Resistor, 47K Ohms (10 in series, 4.7K Ohms each, 1/2 W)
R5 – Resistor, 470 Ohms, 1/2 W
R6 – Resistor, 200 Megohms, 2 W, 10 kV
R7 – Resistor, 0.2 Megohms (2 in series, 100K Ohms each, 2 W, carbon)
S1 – Switch, SPST
S2 – Switch, SPST, key-operated, 120 V, AC, 1 A
T1 – Transformer, 2 kVA, 120 V primary, 1:1 (120 V or 240 V output)
T2 – Transformer, 90 VA, 120/15,000 V
T3 – Variable autotransformer, 2.5 A

47.2.3 The transients produced are to be oscillatory and are to have an initial peak voltage of 6000 volts. The rise time is to be less than 1/2 microsecond. Successive peaks of the transient are to decay to a value of not more than 60 percent of the value of the preceding peak.

47.2.4 The unit is to be subjected to 500 oscillatory transient pulses induced at a rate of 6 transients per minute. Each transient pulse is to be induced 90 degrees into the positive half of the 60 hertz cycle. A total of 250 pulses are to be applied so that the polarity of the transients is positive with reference to earth ground, and the remaining 250 pulses are to be negative with respect to earth ground.

47.3 Internally induced transients

47.3.1 The product is to be energized in the standby condition while connected to a source of supply in accordance with 29.3.1. The supply source is to be interrupted a total of 500 times. Each interruption is to be for approximately 1 second at a rate of not more than 6 interruptions per minute. At the conclusion of the test, the product shall operate for its intended signaling performance. Standby power shall be connected during this test.

47.4 Input/output circuit transients

47.4.1 The unit is to be energized in the normal standby condition while connected to a source of supply in accordance with 29.3. All input/output circuits are to be tested as specified in 47.4.2.

Exception: A circuit or cable that interconnects equipment located within the same room need not be subjected to this test.

47.4.2 Input/output circuits are to be tested as specified in 47.4.3 – 47.4.5. The signaling equipment connected to these circuits shall:

a) Not false alarm,

b) Operate as intended, and

c) As appropriate, retain required stored memory (such as date, type, and location of a signal transmission) within the unit when subjected to transient voltage pulses as described in 47.4.3. Supplemental information stored within the unit need not be retained.

47.4.3 For this test, each input/output circuit is to be subjected to five different transient waveforms having peak voltage levels in the range of 100 to 2400 volts, as delivered into a 200 ohm load. A transient waveform at 2400 volts shall have a pulse rise time of 100 volts per microsecond, a pulse duration of approximately 80 microseconds, and an energy level of approximately 1.2 joules. Other applied transients shall have peak voltages representative of the entire range of 100 to 2400 volts, with pulse durations from 80 to 110 microseconds, and energy levels not less than 0.3 joule or greater than 1.2 joules. The transient pulses are to be coupled directly onto the input/output circuit conductors of the equipment under test.

47.4.4 The equipment is to be subjected to 60 transient pulses induced at a maximum rate of six pulses per minute as follows:

a) Twenty pulses (two at each transient voltage level specified in 47.4.3) between each input/output circuit lead or terminal and earth ground, consisting of ten pulses of one polarity, and ten of the opposite polarity (total of 40 pulses) and

b) Twenty pulses (two at each transient voltage level specified in 47.4.3) between any two input/output circuit leads or terminals consisting of ten pulses of one polarity and ten pulses of the opposite polarity.

47.4.5 At the conclusion of the test, the equipment shall comply with the requirements of the Normal Operation Test, Section 30.

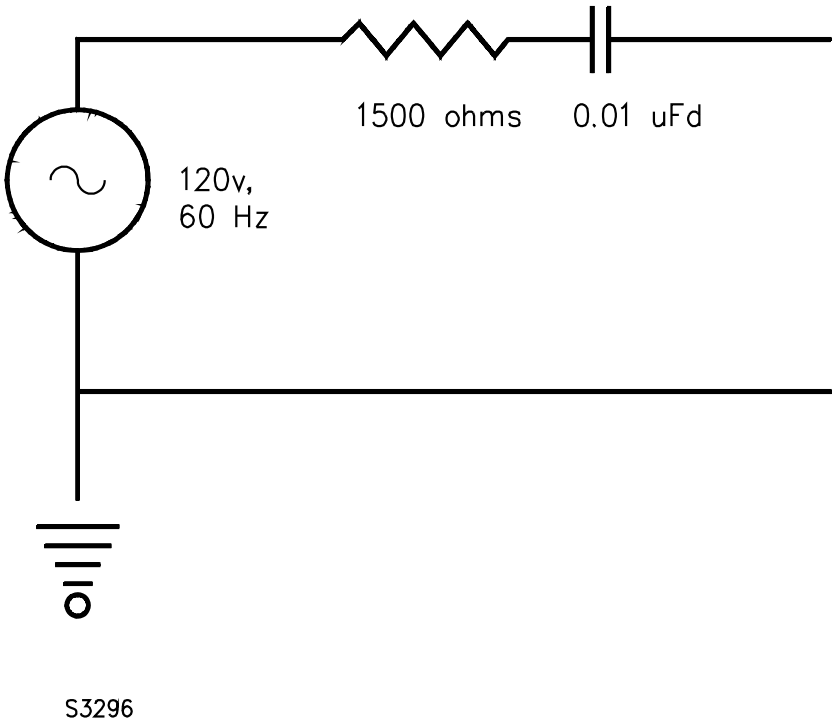
48 AC Induction Test

48.1 Local burglar-alarm units shall not false alarm and shall operate as intended when subjected to an alternating current induced in any signal leads, initiating device leads, loops, DC power leads, or in any other leads which extend throughout the premises wiring.

Exception: AC power leads and any leads consisting of conductors insulated from and surrounded by a shielding conductive surface grounded at one or more ends are exempted from this test.

48.2 To determine compliance with the requirements in 48.1, the product is to be energized from a source of rated voltage and frequency in accordance with 29.3.1 and an AC (60 Hz) current is to be injected into each circuit extending from the product. The AC signal current shall be induced as illustrated in Figure 48.1 to simulate induction from AC power sources.

Figure 48.1
AC induction test circuit



49 Polymeric Materials Test

49.1 Polymeric materials used as an enclosure or for the support of current-carrying parts shall comply with the applicable portion of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

50 Battery Replacement Test

50.1 The battery connections of a local burglar-alarm unit shall withstand removal and replacement from the battery terminals without any reduction in contact integrity. Batteries used for principal power shall be subjected to 50 cycles and standby batteries to 10 cycles of removal and replacement.

50.2 For this test, a product is to be installed as intended in service and the battery connections removed and replaced as recommended by the manufacturer. The product then shall comply with the requirements of the Normal Operation Test, Section 30.

51 Drop Test

51.1 As a result of being dropped onto a hardwood floor, as described in 51.2, the electrical spacings within a portable cord-connected high-voltage product shall not have been reduced below the limits specified in (Spacings) General, Section 27 and Components, Section 28. No high-voltage live parts shall be exposed. See 10.2.4 and 10.2.5.

51.2 A sample of a portable cord connected high-voltage product is to be dropped four times from a height of 3 feet (0.9 m) onto a hardwood floor. If it has corners, it is to be dropped on a different corner each time, selecting the corners that appear to be most susceptible to damage. If the product has no corners, it is to be dropped on the four portions which appear to be most susceptible to damage. If the product is intended to use internally mounted batteries, the batteries shall be in place for this test.

51.3 Following the test described in 51.2, the product then is to be wrapped in bleached cheesecloth having an area 14 – 15 square yards to the pound (25.8 – 27.7 m^2/kg) and having a count of 32 by 28, and energized 3 hours at rated voltage in accordance with 29.3.1. There shall not be molten metal or flame emitted from the unit, as evidenced by ignition or charring of the cheesecloth. The product shall also comply with the requirements of the Dielectric Voltage-Withstand Test, Section 44.

52 Strain Relief Test

52.1 Supply Cord

52.1.1 When tested as described in 52.1.2 strain relief means provided on the flexible cord shall withstand for 1 minute without displacement, a pull of 35 pounds-force (156 N) applied to the cord. During this test the connections within the product are to be disconnected.

52.1.2 A 35 pound (15.88 kg) weight is to be secured to the cord and supported by the product so that the strain relief means will be stressed from any angle that the construction of the product permits. There shall not be movement of the cord sufficient to indicate that stress would have been transmitted to the internal connections.

52.2 Field-wiring leads

52.2.1 Each lead employed for field connections shall withstand a pull of 10 pounds-force (44.5 N) for 1 minute without evidence of damage or of transmittal of stress to the internal connections.

53 Ignition Through Bottom-Panel Openings Tests

53.1 General

53.1.1 Both of the bottom-panel constructions described in 12.1.4 are acceptable without test. Other constructions are acceptable if they comply with the requirements specified in 53.2.1 – 53.3.3.

53.1.2 These tests do not apply to low-voltage power limited products or to products in which an internal fault does not produce flame, molten metal, flaming or glowing particles, or flaming drops. See the Abnormal Operation Test, Section 46.

53.2 Hot flaming oil

53.2.1 Openings in a bottom panel shall be so arranged and sufficiently small in size and few in number that hot, flaming No. 2 furnace oil poured three times onto the openings from a position above the panel is extinguished as it passes through the openings.

53.2.2 A sample of the complete, finished bottom panel is to be securely supported in a horizontal position several inches above a horizontal surface under a hood or other area that is well ventilated but free from drafts. One layer of bleached cheesecloth having an area of 14 – 15 square yards to the pound (25.8 – 27.7 m^2/kg) and a count of 32 by 28 is to be draped over a shallow, flat-bottomed pan that is of sufficient size and shape to completely cover the pattern of openings in the panel but is not to be large enough to catch any of the oil that runs over the edge of the panel or otherwise does not pass through the openings. The pan is to be centered under the pattern of openings in the panel. The center of the cheesecloth is to be 2 inches (50.8 mm) below the openings. Use of a metal screen or wired-glass enclosure surrounding the test area is recommended to reduce the risk of injury to persons and damage due to splattering of the oil.