39 Endurance Test

39.1 General

39.1.1 A central-station burglar-alarm unit shall operate at rated voltage and current for the number of cycles indicated in Table 39.1. Each cycle shall consist of setting, tripping, and restoration to standby. The rate of operation shall:

a) Not be more than 15 cycles per minute or the product's rated speed of operation, whichever is faster, for a product designed to operate repeatedly or

b) Be 2 pulses per second for a product receiving a signal from a code transmitter.

At the completion of the test, the product shall be mechanically and electrically operable and shall perform its intended function.

Table 39.1
Cycles of operation

Product	Number of cycles
Subscriber's control unit	6000
Direct-wire receiving unit	6000
Code transmitter receiving unit and register	500,000 pulses
Alarm printer	500,000 lines
Multi-function receiving processor	30,000

39.2 Separately energized circuits

39.2.1 Separately energized circuits that do not receive energy from the product shall operate as intended following the applicable Endurance Test specified in 38.1.1 while connected to a source of supply in accordance with 26.3.1 and with rated load at 60 percent power factor applied to output circuits.

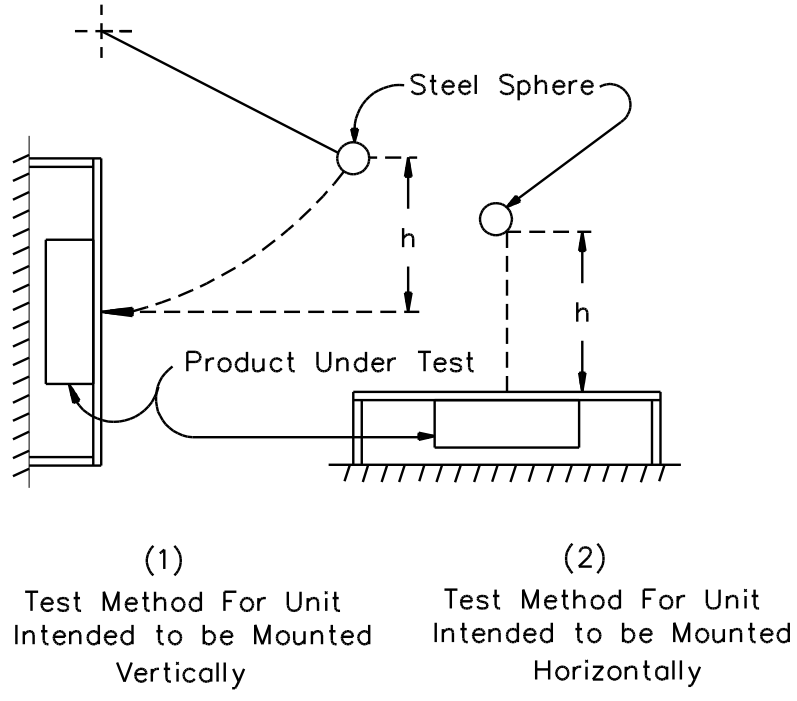
40 Jarring Test

40.1 A central-station burglar-alarm unit shall withstand jarring resulting from impact and vibration anticipated in the intended application without causing operation of any part and without causing operation of any part and without impairing its subsequent intended operation, as evidenced by compliance with the requirements in the Normal Operation Test, Section 27.

40.2 The product and associated equipment is to be mounted as intended to the center of a 6 by 4 foot (1.83 by 1.22 m), nominal 3/4 inch (19.1 mm) thick plywood board that is secured in place at four corners. An impact is to be applied to the center of the reverse side of this board by means of a 1.18 pound-mass (0.54 kg), 2 inch (50.8 mm) diameter steel sphere either swung through a pendulum arc from a height (h) of 30.5 inches (775 mm), or dropped from the height (h) of 30.5 inches, depending upon the mounting of the equipment. See Figure 40.1.

Figure 40.1

Jarring test



40.3 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 26.3.1.

41 Dielectric Voltage-Withstand Test

41.1 A product 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 41.2):

a) 500 volts (707 volts, if a DC potential is used), for a product rated 30 volts AC rms (42.4 volts DC or AC peak) or less; or

b) 1000 volts (1414 volts, if a DC potential is used), for a product rated between 31 and 250 volts AC rms; or

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

41.2 For the application of a potential between live parts of circuits operating at different potentials or frequencies, the voltage is to be the applicable value specified in 41.1 (a), (b), or (c), based on the highest voltage of the circuits under test instead of the rated voltage of the product. Electrical connections between the circuits are to be disconnected before the test potential is applied.

41.3 If an autotransformer is in the circuit, the primary of the transformer is to be disconnected and an AC test potential in accordance with 41.1(c) is to be applied directly to all wiring involving more than 250 volts.

41.4 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 maintaining the specified AC test potential, the capacitor or filter is to be tested using a DC test potential in accordance with 41.1.

41.5 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.

41.6 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 dielectric voltage-withstand tests are made. 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.

42 Temperature Test

42.1 The materials used in the construction of a central-station burglar-alarm unit shall not attain temperature rises greater than those indicated in Table 42.1.

Table 42.1
Maximum temperature rises

Materials and components	Normal standby, °C	Normal standby, (°F)	(Signaling) alarm condition, °C	(Signaling) alarm condition, (°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)
c. Silicon				
(i) Maximum 60 percent of rated volts	50	(90)	75	(135)
(ii) 61 percent or more of rated volts	25	(45)	75	(135)
3. Relay, solenoid, transformer, and other coils with:				
a. Class 105 insulation system:				
Thermocouple method	25	(45)	65	(117)
Resistance method	35	(63)	75	(135)
b. Class 130 insulation system:				
Thermocouple method	45	(81)	85	(153)
Resistance method	55	(99)	95	(171)

Table 42.1 Continued on Next Page

Table 42.1 Continued

Materials and components	Normal standby, °C	Normal standby, (°F)	(Signaling) alarm condition, °C	(Signaling) alarm condition, (°F)
c. Class 155 insulation system:				
(i) Class 2 transformers:				
Thermocouple method	95	(171)	95	(171)
Resistance method	115	(207)	115	(207)
(ii) Power transformers:				
Thermocouple method	110	(198)	110	(198)
Resistance method	115	(207)	115	(207)
d. Class 180 insulation system:				
(i) Class 2 transformers:				
Thermocouple method	115	(207)	115	(207)
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 limit of the material			
d. Phenolic composition used as electrical insulation or as parts whose malfunction or deterioration may result in a risk of electric shock, explosion, fire, or injury to persons[e]	25	(45)	125	(225)
e. Wood or other combustibles	25	(45)	65	(117)
f. Sealing compound	15°C (27°F) less than the melting point of the compound			
g. Fuses	25	(45)	65	(117)
B. CONDUCTORS				
1. Appliance wiring material[f]	25°C (45°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	60	(108)	60	(108)
3. Surfaces subjected to casual contact by the user (enclosure, grille, and the like):				

Table 42.1 Continued on Next Page

Table 42.1 Continued

Materials and components	Normal standby, °C	Normal standby, (°F)	(Signaling) alarm condition, °C	(Signaling) alarm condition, (°F)
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 shall not be more than 65°C (117°F).

[b] A capacitor which operates at a temperature higher than a 65°C (117°F) rise may be evaluated 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 Operational Test.

[e] The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds which have been investigated and determined 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.

42.2 The temperature values in Table 42.1 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.

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

42.4 Thermocouples consisting of 30 AWG (0.05 mm^2) iron and constantan wires and a potentiometer-type indicating instrument shall be used whenever referee temperature measurements by thermocouples are necessary.

42.5 The temperature of a coil winding may be determined by the change-in-resistance method, wherein resistance of the winding at the temperature to be determined is compared with the resistance at a known temperature, by means of the equation:

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

in which:

Δt is the temperature rise in degrees C;

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

r is the resistance in ohms at the start of the test;

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

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

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

42.6 To determine compliance with these requirements, the product is to be connected to a supply circuit of rated voltage and frequency in accordance with 26.3.1 and operated continuously under representative service conditions that are likely to produce the highest temperature.

42.7 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.

42.8 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.

42.9 If a product has provision for multiple zones, 10 percent of the total number of zones, but not less than three zones, are to be energized during the alarm or other intended operating condition.

43 Abnormal Operation Test

43.1 A central-station 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.

43.2 To determine compliance with the requirement in 43.1, the product is to be connected to a source of supply in accordance with 26.3.1 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 43.4. The product shall also comply with the requirements in the Dielectric Voltage-Withstand Test, Section 41.

43.3 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.

43.4 The product shall be wrapped in a single layer of bleached cheesecloth having an area of 14 – 15 square yards to the pound (26 – 28 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.

44 Electrical Transient Tests

44.1 General

44.1.1 A central-station 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 26.3.1.

44.2 Supply line transients

44.2.1 A high-voltage AC-operated product, in normal standby condition, shall:

a) Not false alarm;

b) Operate as intended; and

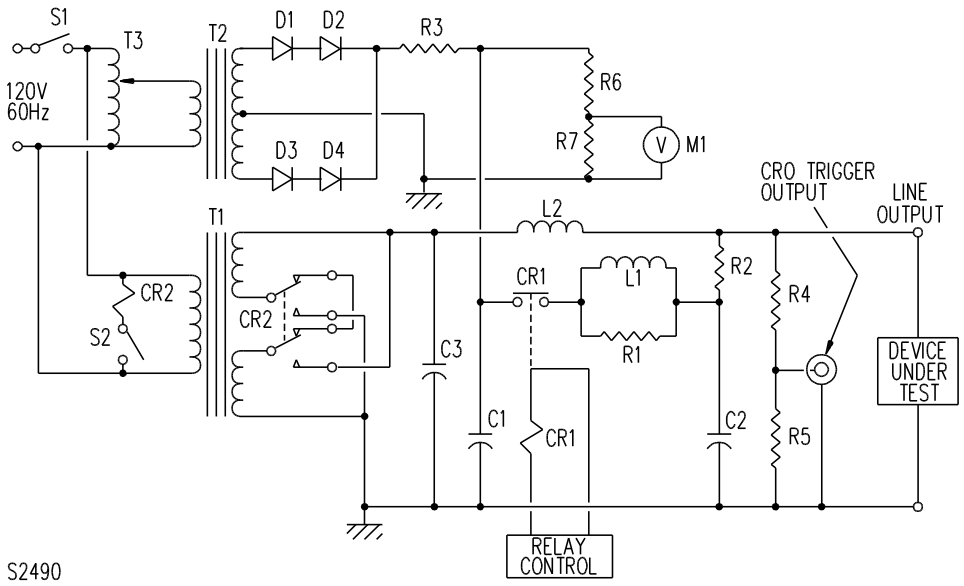
c) Retain required stored memory, such as date, type and location of a signal transmission within the unit

when subjected to supply line transients induced directly onto the power supply circuit conductors of the product under test. Supplemental information stored within the unit need not be retained.

44.2.2 For this test, the product is to be connected to a transient generator, consisting of a 2 kVA isolating power transformer and control equipment that produces the transients described in 44.2.3. See Figure 44.1. The output impedance of the transient generator is to be 50 ohms.

Figure 44.1

Surge generator circuit



C1	– Capacitor, 0.025 µF, 10 kV	R3	– Resistor, 1.3 Megohms, (twelve in series, 110 K ohms each, 1/2 W)
C2	– Capacitor, 0.006 µF, 10 kV	R4	– Resistor, 47K ohms (ten in series, 4.7 K ohms each, 1/2 W)
C3	– Capacitor, 10 µF, 400 V	R5	– Resistor, 470 ohms, 1/2 W
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	R6	– Resistor, 200 Megohms, 2 W, 10 kV
CR2	– Relay, coil 120 V, AC. Contacts, DPDT, provides either 120 V or 240 V test circuit.	R7	– Resistor, 0.2 Megohms (two in series, 100 K ohms each, 2 W, carbon)
D1 – D4	– Diodes, 25 kV PIV each	S1	– Switch, SPST
L1	– Inductor 15 µH [33 turns, 22 AWG wire, wound on 0.835 inch (21.2 mm) diameter PVC tubing]	S2	– Switch, SPST, key–operated, 120 V, AC, 1 A
L2	– Inductor, 70 µH [45 turns, 14 AWG wire, wound on 2.375 inch (60.33 mm) diameter PVC tubing]	T1	– Transformer, 2 kVA, 120 V primary, 1:1 (120 V or 240 V output)
M1	– Meter, 0 – 20 V, DC	T2	– Transformer, 90 VA, 120/15,000 V
R1	– Resistor, 22 ohms, 1 W, composition	T3	– Variable autotransformer, 2.5 A
R2	– Resistor, 12 ohms, 1 W, composition		

44.2.3 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.

44.2.4 The product 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.

44.3 Internally induced transients

44.3.1 The product is to be energized in the intended standby condition while connected to a source of supply in accordance with 26.3.1. The supply source is to be alternately de-energized for approximately 1 second, then energized for approximately 9 seconds, for a total of 500 times. Each interruption is to be at a rate of not more than 6 interruptions per minute. Standby power is to be connected during this test.

44.4 Input/output circuit transients

44.4.1 The product is to be energized in the normal standby condition while connected to a source of supply in accordance with 26.3.1. All input/output circuits are to be tested as specified in 44.4.2.

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

44.4.2 Input/output circuits are to be tested as specified in 44.4.3 – 44.4.5. 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 44.4.3. Supplemental information stored within the unit need not be retained.

Exception: Transients applied to the modem or interface module of packet switched data network systems shall not affect the operation of the system except for the modem or interface circuit. Failure of the packet switched data network signaling circuit is acceptable if the loss of communication is annunciated at the receiving station. See 66.2.

44.4.3 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.

44.4.4 The equipment is to be subjected to 60 transient pulses induced at a maximum rate of 6 pulses per minute as follows:

a) 20 pulses (2 at each transient voltage level specified in 44.4.3) between each input/output circuit lead or terminal and earth ground, consisting of 10 pulses of one polarity, and 10 of the opposite polarity (total of 40 pulses) and

b) 20 pulses (2 at each transient voltage level specified in 44.4.3) between any two input/output circuit leads or terminals consisting of 10 pulses of one polarity and 10 pulses of the opposite polarity.

44.4.5 At the conclusion of the test, the equipment shall comply with the requirements in the Normal Operation Test, Section 27.

45 AC Induction Test

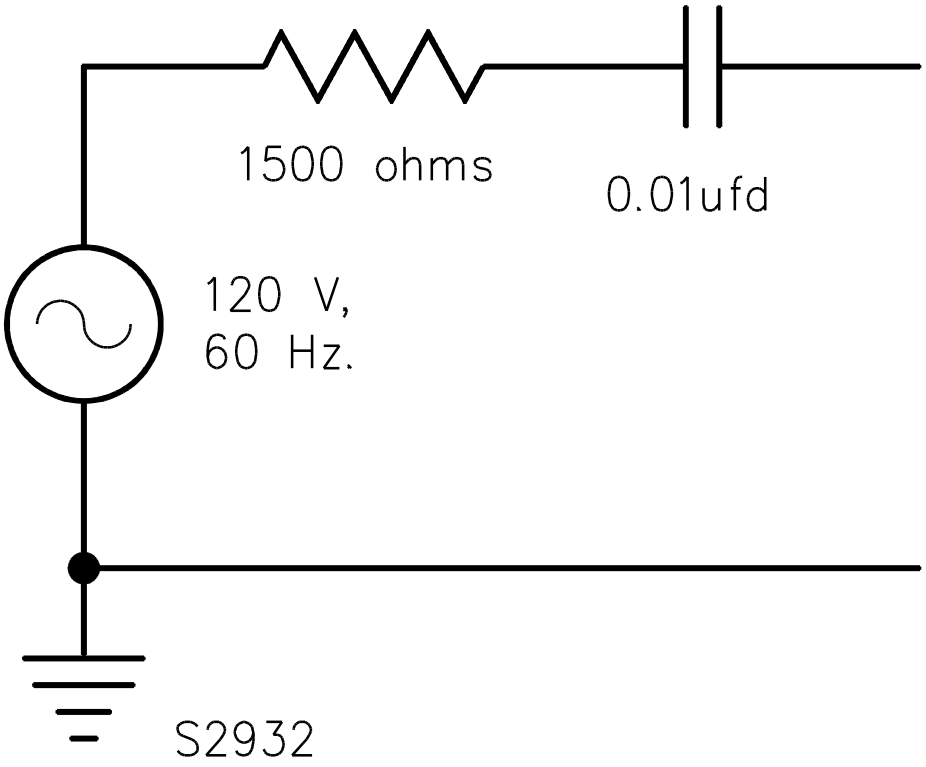
45.1 Central-station burglar-alarm units shall not false alarm and shall operate as intended when subjected to an alternating current induced in any signal leads, initiating device leads, DC power leads, or in any other leads which extend throughout the premises wiring.

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.

45.2 To determine compliance with the requirements in 45.1, the product is to be energized from a source of rated voltage and frequency in accordance with 26.3.1, and a 60-hertz current is to be injected into each circuit extending from the product. The AC signal current shall be induced by the circuit illustrated in Figure 45.1 to simulate induction from AC power sources.

Figure 45.1

AC induction test circuit



46 Polymeric Materials Test

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

47 Battery Replacement Test

47.1 The battery connections of a central-station burglar-alarm unit shall withstand removal and replacement from the battery terminals without appreciable 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.

47.2 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 in the Normal Operation Test, Section 27.

48 Drop Test

48.1 As a result of the product being dropped onto a hardwood floor, as described in 48.2:

a) The electrical spacings within a portable cord-connected high-voltage product shall not be reduced below the limits specified in Spacings, General, Section 24, and Spacings, Components, Section 25;

b) No high-voltage live parts shall be exposed; and

c) No risk of fire after product energization as described in 48.3.

See 7.2.4 and 7.2.5.

48.2 A sample of a portable cord-connected high-voltage product is to be dropped four times from a height of 3 feet (0.91 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 that appear to be most susceptible to damage. If the product is intended to use internally mounted batteries, the batteries are to be in place for this test.

48.3 Following the test described in 48.2, the product then is to be wrapped in a single layer of bleached cheesecloth having an area 14 – 15 square yards to the pound (26 – 28 m^2/kg) and having a count of 32 by 28, and energized for 3 hours at rated voltage in accordance with 26.3.1. There shall be no 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 41.

49 Strain Relief Test

49.1 Supply cord

49.1.1 When tested as described in 49.1.2, 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.

49.1.2 A 35-pounds-mass (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.