33.2.3 If the residential control unit is equipped with terminals or leads for the connection of standby power, the terminals shall be marked with the voltage, current, and minimum capacity of the batteries in ampere-hours, and the number and type of batteries to be used. See 87.1(d)(2).

33.2.4 With standby power connected, neither loss nor restoration of a line voltage source shall cause a medical emergency or monitor signal.

33.2.5 To determine compliance with the requirements of 33.2.4, the signaling unit is to be energized in the normal standby condition and the supply circuit interrupted for 1 minute and restored for 1 minute for a total of 10 cycles of interruption and restoration.

33.2.6 Following restoration of power after an extended power failure of 24 hours or more, a rechargeable battery shall recharge within 48 hours to provide the standby power as required in 33.2.1. See the Charging Current Test, Section 40.

33.3 Central station receiving units

33.3.1 A central station receiving unit shall be electrically supervised so that loss of AC power will result in an audible trouble signal.

Exception: For a constantly attended receiving unit, de-energization of a normally energized display is acceptable in lieu of an audible trouble signal.

33.3.2 The capacity of the standby power shall be sufficient to operate the unit for 24 hours under the following conditions: The receiving unit shall first be operated for 24 hours in the standby mode of operation that consumes maximum power. At the end of the 24 hours of standby operation, the receiving unit shall be capable of receiving medical emergency signals from 10 percent (minimum of two) of the signaling circuits. The signals shall be initiated one at a time and acknowledged and the audible signal silenced before the next signal is initiated. The required capacity of the standby power can be accomplished by means of an engine-driven generator and storage batteries with at least a 4-hour capacity.

33.3.3 If receiving units are equipped with terminals for the connection of standby power, the terminals shall be marked with the voltage, current, and minimum capacity of batteries in ampere-hours and the number and type of batteries to be used. See 87.1(d)(2).

33.3.4 With standby power connected, neither loss nor restoration of the primary voltage source shall cause a medical emergency or monitor signal.

33.3.5 To determine compliance with the requirement of 33.3.4, the receiving unit is to be energized in the normal standby condition and the supply circuit interrupted for 1 minute and restored for 1 minute for a total of 10 cycles of interruption and restoration.

33.3.6 Following an extended power failure of 24 hours or more and subsequent restoration of power, the receiving unit shall, within 48 hours, recharge sufficiently to provide the required standby power in accordance with 33.3.2.

33.3.7 Momentary power failures and subsequent power restorations shall not render the equipment inoperative for any of its functions unless a trouble signal, as described in 33.3.1, is obtained.

34 Electrical Measurements Test

34.1 Input circuit

34.1.1 The input to a signaling unit shall not exceed 110 percent of the marked input rating while connected to an input voltage source in accordance with Table 30.1, and while delivering maximum rated output voltage and current.

34.2 Output circuit

34.2.1 With the input voltage adjusted to 110 percent of rated value, the output voltage shall not exceed 110 percent of rated value with no load (or minimum load specified by the manufacturer) connected to the output circuit. The input voltage is then to be reduced to the test value determined by Table 30.1, and rated load is to be connected to the output circuit. The input voltage is then to be reduced to 85 percent of rated test value, and the output voltage, measured at the terminals of the power supply, shall not be less than 85 percent of rated voltage.

34.2.2 With reference to the requirements of 34.2.1, rated load is that value of output current delivered by the power supply with the input voltage adjusted to the value determined by Table 30.1 and with the output connected to the maximum load specified by the installation wiring diagram.

34.3 Battery circuit

34.3.1 A home health care unit intended to be employed with a floating battery shall have sufficient capacity to maintain the battery fully charged under all conditions of intended operation and with sufficient capacity to operate the system under signaling conditions with the battery disconnected. The same regulation shall be provided with the battery disconnected.

34.3.2 With reference to the requirements of 34.3.1, a fully charged battery is defined as a battery having sufficient capacity to maintain the signaling unit in the standby operating condition for 24 hours or for the period marked in accordance with the exception to 33.2.2. Additionally the battery shall be capable of generating a complete medical emergency transmission, and at least 5 minutes of audible signal at the residence. In the normal standby condition, with the system input voltage at 85 percent of rated value, the battery charger shall maintain the battery in the fully charged condition.

34.4 Circuits connected to specific equipment

34.4.1 If a signaling unit output circuit is intended to be connected to a specific device, it need not comply with the requirements of 34.2.1 – 34.3.2 if it complies with all other requirements in this standard while connected to the device.

35 Volt-Ampere Capacity Test, Low-Voltage Power-Limited Circuits

35.1 A signaling circuit of home health care equipment intended to be installed in residences shall be of a low-voltage, power-limited type and shall be obtained, either directly or indirectly, from the output of an isolating step-down transformer or, if provided, a standby battery. For this purpose, there are two types of power limited circuits: those inherently limited by a reliable fixed impedance or reliable electronic circuitry requiring no overcurrent protection and those having power limited by a combination of a transformer or standby battery and overcurrent protection.

a) Power limitations shall be obtained by the use of any one of the following configurations:

1) Energy-limiting transformers [see (b)(1), (2), and (3)].

2) Nonenergy-limiting transformer, standby battery, or both, coupled with a noninterchangeable overcurrent protective device in the output circuit [see (b)(1), (2), and (4)].

3) Combination transformer, standby battery, or both, and reliable fixed impedance [see (b)(1), (2), and (3)].

4) Combination transformer, standby battery, or both, and reliable electronic circuit [see (b)(1), (2), and (3)].

5) Arrangement equivalent to any of the above.

b) The capacity of a low-voltage, power-limiting circuit of home health care equipment shall not be greater than the following values:

1) 100 volt-amperes, 5 amperes maximum at the maximum rated voltage and frequency.

2) 30 volts, 60 hertz (42.4 volts peak), 42.4 volts peak for nonsinusoidal AC, or 42.4 volts continuous DC.

3) For a circuit whose power is limited internally by a reliable fixed impedance or reliable electronic circuit, 8 amperes short circuit current, measured after 1 minute.

4) For a circuit whose power is limited by a combination of a nonenergy-limiting transformer, standby battery, or both, and noninterchangeable overcurrent-protective device, 250 volt-amperes under any condition of loading. If the maximum voltage from the circuit is 15 volts, 60 hertz, or less, then the maximum volt-amperes shall not be greater than 350 volt-amperes.

c) Components, circuits, or both, may be determined to be reliable by any one of the following methods:

1) The component has been previously investigated and determined to be acceptable for the application.

2) The opening or short-circuiting (singly) of any unreliable component (electrolytic capacitor, transistor junction, diode, vacuum tube, and the like) in the circuit in question does not cause the limits in 34.1.1 to be exceeded.

3) The individual component or each component of the circuit has a predicted failure rate of 2.5 or fewer failures per million hours as determined for a ″Ground Fixed″ (GF) environment by MIL-HDBK 217B, or equivalent.

35.2 To determine if the capacity of a low-voltage power-limited circuit complies with the requirements of 35.1, the output circuit is to be connected to a variable resistance load. With the unit connected to a rated source of supply voltage and frequency, the load resistor is to be varied from open circuit to short circuit conditions in such a manner that the elapsed time is between 1-1/2 and 2-1/2 minutes. Voltage and current measurements are to be recorded for each value and the maximum volt-amperes (volts times amperes) capacity is to be calculated. The short circuit current, open circuit voltage, and the current at the rated voltage value of the circuit are to be included in the measurements. The overcurrent protective device is to be shunted out during the test.

35.3 The output circuit of a power supply supplying a low-voltage, power-limited circuit, and complying with the limits of 35.1 shall not be interconnected with the output circuit of another power supply, either in series or parallel, unless the voltage and current measurements (volt-amperes) at the output terminals of the interconnected combination also comply with the requirements in 35.1. The presence of a fault condition in the interconnecting wiring is not to be considered in determining the energy capability of two or more power supplies in combination.

Exception: Two or more separate power supplies supplying low-voltage, power-limited circuits are to be treated as two separate circuits, each having its own separate output connections, and the output at each circuit shall be marked to warn that the separation shall be maintained.

35.4 For a unit provided with a standby battery, the volt-ampere capacity test is to be conducted with the unit connected to:

a) Both a rated AC supply source and a fully charged battery.

b) A rated AC supply source (battery disconnected).

c) A fully charged battery (AC power source disconnected).

CAUTION – To prevent possible shorting of the battery circuit and the resultant risk of explosion, precautions must be taken to provide acceptable overcurrent as well as physical protection during this test.

35.5 For this test, a volt-ampere load curve (from open circuit to the maximum volt-amperes that can be obtained from the battery) is required.

36 Undervoltage Operation Test

36.1 A home health care system unit shall operate for its intended signaling performance while energized at 85 percent of its rated primary and secondary supply voltages and with the appropriate value of maximum load connected to the circuit.

36.2 A product that uses batteries for standby power shall comply with the requirements of the Charging Current Test, Section 40.

37 Overvoltage Operation Test

37.1 A home health care system unit shall withstand 110 percent of its rated supply voltage continuously without damage during the standby condition and shall operate as intended at the increased voltage.

37.2 The signaling unit is to be subjected to the increased voltage in the standby condition until constant temperatures are attained, and then tested for its intended signaling operation. For this test, zero ohms line impedance is to be employed in the initiating circuit.

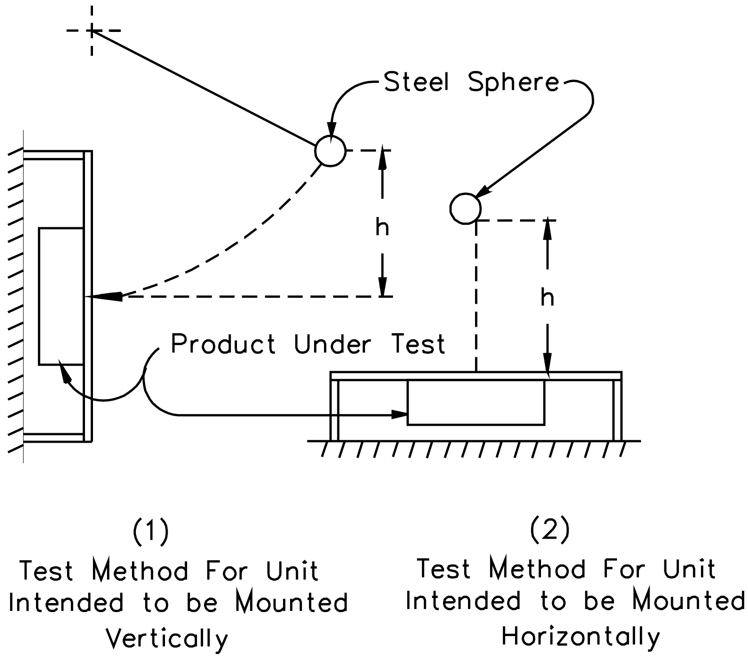
38 Jarring Test

38.1 A signaling unit shall withstand jarring resulting from impact and vibration such as might be experienced in service, without causing signaling operation of any part and without impairing its subsequent operation.

38.2 The device is to be mounted in a position of intended use to the center of a 6- by 4-foot (1.8- by 1.2-m), 3/4 inch (19.1 mm) thick plywood board secured in place at four corners. An impact of 3 foot-pounds (4.2 J) is to be applied to the center of the reverse side of this board by means of a 1.18 pound (0.54 kg), 2 inch (50.8 mm) diameter steel sphere. For this impact, the sphere is to be swung through a pendulum arc from a height (h) of 2.54 feet (0.77 m) or dropped from a height (h) of 2.54 feet, depending upon the mounting of the equipment. See Figure 38.1.

38.3 For this test the unit is to be energized in the standby condition and connected to a rated source of supply. Following the jarring, the unit is to be tested for the intended signaling operation.

Figure 38.1
Jarring test



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39 Component Temperature Test

39.1 A product, when operated under any normal condition of intended use and at maximum rated load, shall not reach a temperature at any point high enough to:

a) Result in a risk of fire or electric shock;

b) Adversely affect any materials in the product; or

c) Exceed the temperature rises at specific points as specified in Tables 39.1 and 39.2.

Exception: A component with a temperature exceeding that indicated in Table 39.1 may be used when reliability data at the higher temperature is provided by the manufacturer to justify its use. See note c to Table 39.1.

Table 39.1
Maximum temperature rises for electronic components

Component or device	Normal standby (i.e. any long term fire or security condition of operation or any non-fire or non-emergency operating condition)		Alarm condition (i.e. short term operating condition of fire, security, or emergency signaling)	
	°F	(°C)	°F	(°C)
A. COMPONENTS				
1. Capacitors [a]	45	(25)	72	(40)
2. Resistors [b]				
Carbon	45	(25)	90	(50)
Wire-wound	90	(50)	225	(125)
Other	45	(25)	90	(50)
B. SOLID-STATE DEVICES	See note (c)			

[a] In lieu of complying with these temperature limits, a component shall meet the derating parameters specified in Table 30.1 or the component reliability assessment specified in 32.4.1.

[b]In lieu of complying with these temperature limits, a resistor shall not dissipate more than one-half of its maximum power rating under the test conditions specified.

[c] The temperature of a solid-state device (such as a transistor, SCR, or integrated circuit) shall comply with one of the following:

1) Not exceed the temperature limits specified in both (a) and (b):

a) 50 percent of its rated junction temperature, or storage temperature when not rated for junction temperature, during the normal standby condition and during any non-fire or emergency signaling condition.

b) 75 percent of its rated junction temperature, or storage temperature when not rated for junction temperature, under the alarm condition or any other short term condition of operation which produces the maximum temperature dissipation of the component.

For reference purposes, 32°F (0°C) shall be determined 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 condition of operation.

2) Not exceed 100 percent of its rating under any condition of normal use and the component is subjected to one of the following:

a) For integrated circuits the component complies with the requirements of MIL-STD 883H, For all other solid state devices (such as diodes, transistors, SCR's, LEDs) the component complies with the requirements of MIL-STD-750F.

b) A quality control program established by the manufacturer consisting of inspection and testing of all pertinent parameters of 100 percent of components either on an individual basis, as part of an assembly, or the equivalent.

c) 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 120°F (49°C), followed by an operation test for normal signaling performances.

d) Component reliability data based on actual performance in a similar application, or the Military Handbook Electronic Reliability Design Handbook, MIL-HDBK-338, or equivalent, such that the failure rate is equal to or less than 0.5 failures per million hours of operation.

Table 39.2
Maximum temperature rises for materials and component parts

Materials and component parts	°F	(°C)
1. Varnished cloth insulation	108	(60)
2. Fuses:		
a) Glass G, J, L, and CC:		
Tube	180	(100)
Ferrule or blade	153	(85)
b) Others	117	(65)
3. Fiber used as electrical insulation	117	(65)
4. Wood and similar combustible material	117	(65)
5. Any point on or within a terminal box on a permanently wired unit	117	(65)
6. A surface upon which a permanently wired unit is mounted in service, and surfaces that are adjacent to the unit when it is so mounted	117	(65)
7. Enclosure surfaces:		
a) Surfaces subject to contact during intended use or maintenance:		
Metallic	63	(35)
Nonmetallic	108	(60)
b) Other surfaces:		
Metallic	81	(45)
Nonmetallic	126	(70)
8. Class 105 (formerly Class A) insulation systems on windings of relays, solenoids, magnets, transformers and similar parts:		
Thermocouple method	117	(65)
Resistance method	153	(85)
9. Class 130 (formerly Class B) insulation systems on windings of relays, solenoids, magnets, transformers and similar parts:		
Thermocouple method	153	(85)
Resistance method	189	(105)
10. Class 155 insulation systems on windings of relays, solenoids, magnets, transformers and similar parts:		
Thermocouple method	198	(110)
Resistance method	216	(120)
11. Class 180 insulation systems on windings of relays, solenoids, magnets, transformers and similar parts:		
Thermocouple method	225	(125)
Resistance method	243	(135)
12. Phenolic composition used as electrical insulation or as a part whose malfunction is capable of resulting in a risk of fire, electric shock, injury to persons or risk from electrical-energy/high-current levels.[a]	225	(125)
13. Insulated conductors, appliance wiring material	see note [b]	
14. Sealing compound	72°F (22°C) less than melting point	
15. Printed-wiring board	see note [c]	

[a] The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and determined to meet the requirements for use at higher temperatures.
[b] 77°F (25°C) less than the established temperature rating of the wire.

Table 39.2 Continued on Next Page

Table 39.2 Continued

Materials and component parts	°F (°C)
[c] Temperatures on the surface of any printed-wiring board shall not exceed the temperature limits of the board.	

39.2 All values for temperature rise apply to equipment intended for use with ambient temperatures normally prevailing in occupiable spaces which usually are not higher than 77°F (25°C). When equipment is intended specifically for use with a prevailing ambient temperature constantly more than 77°F (25°C), the test of the equipment is to be made with the higher ambient temperature, and the allowable temperature rises specified in Tables 39.1 and 39.2 are to be reduced by the amount of the difference between that higher ambient temperature and 77°F.

39.3 Temperature measurements on equipment intended for recessed mounting are to be made with the unit installed in the intended manner on or against the black painted surface of an enclosure of 3/4 inch (19.1 mm) wood such that the walls of the enclosure make a close fit with the product and extending approximately 2 inches (50.8 mm) on the top, sides and rear, and the front extended to be flush with the product cover.

39.4 A product shall be connected to a supply circuit of rated voltage. A product having a single frequency rating is to be tested at that frequency. A product rated AC/DC or DC - 60 hertz is to be tested at both direct current and 60-hertz alternating current. A product rated 25 - 60 hertz or 50 - 60 hertz is to be tested on 50-hertz alternating current.

39.5 A product that is rated for use at more than one voltage or for a range of voltages shall be evaluated at the rated voltages.

39.6 A product that is rated for use at more than one voltage, or a range of voltages, and contains a tapped transformer or other means of being adapted to different supply voltages shall be tested at the most unfavorable combination of supply voltage and voltage adjustment.

39.7 For the purpose of prescreening, thermocouples consisting of wires not larger than 24 AWG (0.21 mm^2) and not smaller than 30 AWG (0.05 mm^2), and an infrared temperature probe or the equivalent, are not prohibited from being employed to identify those components and/or materials in which compliance with 49.1 is questionable and, therefore, requiring the measurements indicated in 39.8.

39.8 Temperatures are to be measured by thermocouples except the change-of-resistance method shall be used for coil and winding temperatures where the coil is inaccessible for mounting of thermocouples (for example, a coil immersed in sealing compound) or where the coil wrap includes thermal insulation or more than two layers [1/32 inch (0.8 mm) maximum in total thickness] of cotton, paper, rayon, or the like.

39.9 Whenever temperature measurements by thermocouples are necessary, thermocouples consisting of 30 AWG (0.05 mm^2) iron and constantan wire and a potentiometer-type instrument are to be used. The thermocouple wire is to conform to the requirements in the Initial Calibration Tolerances for Thermocouples table in Standard Specification and Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples, ANSI/ASTM E230/E230M.

39.10 The temperature of a copper coil winding is determined by the change-in-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:

$$T = \frac{R}{r}(234.5 + t) - 234.5$$

in which:

T is the temperature to be determined in degrees C,

R is the resistance in ohms at the temperature to be determined,

r is the resistance in ohms at the known temperature, and

t is the known temperature in degrees C.

39.11 As it is generally necessary to de-energize the winding before measuring R, the value of R at shutdown is to be determined by taking several resistance measurements at short intervals, beginning as quickly as possible after the instant of shutdown. A curve of the resistance values and the time is to be plotted and extrapolated to give the value of R at shutdown.

39.12 The circuit of a current-regulating resistor or reactor provided as part of a product is to be adjusted for the maximum resistance or reactance at rated load.

39.13 The durations of the tests are to be not less than:

a) Sixteen hours, for the normal standby condition of any signaling unit.

b) One hour for the normal signaling condition of a signaling unit intended to be actuated by automatic or manual devices.

c) Until constant temperatures are attained for a rectifier operating at its maximum rated output.

39.14 If the signaling unit has a power supply-battery charger combination, the test sequence is to be as follows:

a) The power supply section is to be delivering maximum rated output power and the battery charger section is to be connected to a discharged battery, see 39.13, of the maximum capacity prescribed by the manufacturer. The terminal voltage of the discharged battery shall be measured prior to the beginning of this test, before input or output connections are made.

b) After operation for 1 hour, the temperature rises shall not exceed the values shown in the second column ("Signaling Condition - Short Term Operation") of Table 39.1.

c) The signaling unit is to be operated for a total of 48 hours of continuous operation (normal standby), while delivering maximum standby load.

d) At the conclusion of the 48 hour period, the product is to be subjected to the Charging Current Test, Section 40.

39.15 With reference to 39.14, a discharged battery is one that has been:

a) Fully charged, in a new condition, according to the manufacturer's instructions, then:

b) Delivering normal standby load for 24 hours or for a period marked in accordance with the Exception to 33.2.2 with primary power disconnected.

39.16 A temperature is determined to be constant when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5-minute intervals, indicate no change.

39.17 If, during the temperature test, the temperature on a lead intended to be field installed or on a surface of the wiring compartment which the lead might contact is more than 60°C (140°F), the signaling unit shall be marked as described in 87.11.

40 Charging Current Test

40.1 The Charging Current Test is to be conducted in conjunction with the Temperature Test, Section 37, on products provided with standby batteries.

40.2 At the conclusion of the 48-hour charging period [see 39.14(c)] during which the signaling unit is operating continuously with maximum standby load connected and with the AC input to the signaling unit reconnected, the battery terminal voltage shall not be less than 95 percent of the value measured after the initial battery-charging period.

40.3 With the AC source disconnected, normal standby load is to remain connected to the output for the 24 hour period (or for a period marked in accordance with the Exception to 33.2.2) specified.

40.4 After maximum standby load has been applied at the residential control unit for 5 minutes, battery terminal voltage shall be not less than 85 percent of the marked ratings of the output circuits.

Exception: Where a combination system includes carbon monoxide signaling, after the 5 minutes of home health care or carbon monoxide alarm, the maximum carbon monoxide alarm load shall continue to be applied for a period of not be less than 12 hours. The 5-second "off" time of the carbon monoxide alarm signal shall be permitted to be changed to 60 seconds plus or minus 10 percent.