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INTRODUCTION

1 Scope

1.1 These requirements cover electrically operated single and multiple station smoke alarms intended for open area protection in indoor locations of residential units in accordance with the National Fire Alarm Code, NFPA 72, smoke alarms intended for use in recreational vehicles in accordance with the Standard for Recreational Vehicles, NFPA 501C, and portable smoke alarms used as "travel" alarms.

1.2 A single station smoke alarm, as defined by these requirements, is a self-contained fire alarm device that consists of an assembly of electrical components including a smoke chamber, alarm sounding appliance, and provision for connection to a power supply source, either by splice leads or a cord and plug arrangement or containing integral batteries. Possible accessories include a supplemental heat detector, terminals for connection to a remote audible signaling appliance or accessory, and an integral transmitter to energize a remote audible signaling appliance.

1.3 Multiple station units are single station smoke alarms that are either interconnected for common alarm annunciation or connected to remote thermostats.

1.4 These requirements, where applicable, also cover all remote accessories that are to be connected to or are intended to be used with a single or multiple station smoke alarm. See 33.2.1.

1.5 This standard does not cover the following:

- a) Smoke detectors of the non-self-contained type that are intended for connection to a household or industrial system control unit. These are included in the Standard for Smoke Detectors for Fire Protective Signaling Systems, UL 268.
- b) Mechanically operated single and multiple station fire alarm devices that are specified in the Standard for Single and Multiple Station Heat Alarms, UL 539.
- c) Heat detectors [except for the requirements in the Fire Test (Heat Detector), Section 73] incorporated as part of a single station smoke alarm assembly whose requirements are covered in the Standard for Heat Detectors for Fire Alarm Signaling Systems, UL 521.

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components used in the products covered by this standard.

2.1.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

2.1.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.1.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

2.2 Units of measurement

2.2.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

2.3 Undated references

2.3.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

3 Glossary

3.1 For the purpose of this standard the following definitions apply.

3.2 ALARM SIGNAL – An audible signal intended to indicate an emergency fire condition.

3.3 COMBINATION SMOKE ALARM – An alarm that employs more than one smoke detecting principle in one unit. To qualify as a combination smoke alarm it is required that each principle contributes in response, either wholly or partially, to at least one of the Fire Tests, Section 44, or the Smoldering Smoke Test, Section 45.

3.4 COMPONENT, LIMITED LIFE – A component that is expected to fail and be periodically replaced and whose failure is supervised. Typical examples of such components include incandescent lamps, electronic tube heaters, functional

heating elements, and batteries. See also 36.4.2.

3.5 COMPONENT, RELIABLE – A component that is not expected to fail or be periodically replaced and is not supervised. A reliable component shall have a predicted failure rate of 2.5 or less failures per million hours.

3.6 RISK OF ELECTRIC SHOCK – A risk of electric shock is determined to exist at any part, when:

- a) The potential between the part and earth ground or any other accessible part is more than 42.4 volt peak and
- b) The continuous current flow through a 1500 ohm resistor connected across the potential exceeds 0.5 milliamperere.

3.7 RISK OF FIRE – A risk of fire is determined to exist at any point in a circuit where:

- a) The open circuit voltage is more than 42.4 volt peak, and the energy available to the circuit under any condition of load, including short circuit, results in a current of 8 amperes or more after 1 minute of operation or
- b) A power of more than 15 watts is deliverable into an external resistor connected between the two points.

3.8 SENSITIVITY – Relative degree of response of a detector. A high sensitivity denotes response to a lower concentration of smoke than a low sensitivity under identical smoke build-up conditions.

3.9 STORY – That portion of a building included between the upper surface of a floor and upper surface of the floor or roof next above.

3.10 TROUBLE POINT – Any combination of battery voltage and series resistance that results in an audible trouble signal from a battery-operated detector.

3.11 TROUBLE SIGNAL – A visible or audible signal intended to indicate a fault or trouble condition, such as an open or shorted condition of a component in the device or an open or ground in the connected wiring, or depletion of the supply battery.

3.12 VOLTAGE CLASSIFICATION – Unless otherwise indicated, all voltage and current values specified in this standard are rms:

- a) **Extra-Low-Voltage Circuit** – A circuit that has an AC voltage of not more than 30-volts alternating current (AC) (42.4 volts peak) and maximum power of 100 volt-amperes, such as supplied by a Class 2 transformer; or a circuit of not more than 30-volts direct current (DC) supplied by a primary battery; or a circuit supplied by a combination of a transformer and fixed impedance, that as a unit, complies with all the performance requirements of a Class 2 transformer. A circuit that is derived from a supply circuit of more than 30 volts by connecting resistance or impedance, or both, in series with the supply circuit to limit the voltage and current, is not identified as an extra-low-voltage circuit.
- b) **Hazardous-Voltage Circuit** – A circuit having characteristics in excess of those of an extralow-voltage circuit.

4 Alarm Reliability Prediction

4.1 The maximum failure rate for alarm units shall be 4.0 failures per million hours as calculated by a full part stress analysis prediction as described in Section 2.0 of MIL-HDBK 217B (20 September 1974) or 3.5 failures per million hours as calculated by a simplified parts count reliability prediction as described in Section 3.0 of MIL-HDBK 217B, or equivalent. A "Ground Fixed" (GF) environment is to be used for all calculations. When actual equivalent data is available from the manufacturer, it shall be used in lieu of the projected data for the purpose of determining reliability.

4.2 Any component whose failure results in energization of an audible trouble signal, energization of a separate visual indication (orange or yellow), de-energization of a power-on light, or:

- a) Does not affect the normal operation or
- b) Is evaluated by specific performance tests included in this standard does not require inclusion in the failure rate calculation. Examples include the audible signal appliance, thermostat, test switch, and battery contacts.

4.3 An integral or remote accessory, such as an integral transmitter or remote sounding appliance, is not required to be included in the reliability prediction except for those components whose failure affects the normal operation of the alarm.

4.4 A reliable light emitting diode (LED) of a single station smoke alarm employing a photocell-light assembly shall have a predicted failure rate of not greater than 2.5 failures per million hours.

4.5 A custom integrated circuit used in an alarm shall have a predicted failure rate of not greater than 2.5 failures per million hours. The failure rate is to be determined through evaluation of data in a 3000-hour burn-in test, or equivalent.

5 Installation and Operating Instructions

5.1 A copy of the installation and operating instructions, and related schematic wiring diagrams and installation drawings shall be used as a reference in the examination and test of the alarm. For this purpose, a printed edition is not required. The information is to be included in a homeowner's manual.

5.2 The instructions and drawings shall include such directions and information as deemed by the manufacturer to be

required for proper and safe installation, testing, maintenance, operation, and use of the alarm.

6 Nonfire Alarm Feature

6.1 A nonfire alarm feature, such as a burglar alarm, shall be used in common with a single or multiple station smoke alarm or both, or an accessory only when it does not degrade or interfere with operation of the smoke alarm or accessory and complies with all the requirements of this standard. See 4.3 and 34.1.9.

7 Alarm Silencing Means (When Provided)

7.1 It is not prohibited that each single and multiple station smoke alarm be provided with an automatically resettable alarm silencing means that has a fixed or variable time setting which desensitizes the alarm for a maximum of 15 minutes. Alarm silencing shall not disable the smoke alarm. Sensitivity shall not be reduced to more than 4 percent per foot of obscuration (37.5pA). Each alarm shall produce a distinctive audible or visible trouble signal while in the silence mode. Following the silenced period, the alarm shall restore automatically to its intended operation. Silencing of one alarm of a multiple station system shall not prevent an alarm operation from the other alarms in the system. See 34.2.1 and 34.2.2.

7.2 When a variable adjustment is provided on an alarm to vary the silenced period, the adjustment means shall be provided with a mechanical stop or the equivalent, so that the maximum 15-minute limitation is not exceeded.

7.3 Smoke alarms powered by a non-replaceable battery must be provided with a temporary alarm silencing means.

8 Battery Removal Indicator

8.1 Removal of a battery from a battery-operated (or AC with battery back-up) smoke alarm shall result in a readily apparent and prominent visual indication. The visual indication shall consist of:

- a) A warning flag that is exposed with the battery removed and the cover closed;
- b) A hinged cover that is resistant to being closed with the battery removed; or
- c) An equivalent arrangement. (Such as an audible trouble signal on an AC with battery backup).

8.2 Removal of a battery from a battery-operated (or AC with battery back-up) smoke alarm that is intended to be removed from its mounting location for battery replacement, shall render the unit resistant to reinstallation.

8.3 Deactivation of the battery of a smoke alarm that uses a non-replaceable battery with a 10-year minimum battery life shall result in a readily apparent and prominent visual indication. The visual indication shall consist of:

- a) A warning flag that is exposed with the battery removed and the cover closed with the battery deactivated;
- b) A hinged cover that is resistant to being closed with the battery deactivated; or
- c) An equivalent arrangement (such as an audible trouble signal on an AC with battery backup).

8.4 Deactivation of a battery of a battery-operated (or AC with battery back-up) smoke alarm that is intended to be removed from its mounting location for battery deactivation, shall render the unit resistant to reinstallation.

8.5 When a warning flag, or equivalent, is employed to comply with the requirement of 8.1 or 8.3, it shall be marked as required in 92.6.

CONSTRUCTION

ASSEMBLY

9 General

9.1 Accessories

9.1.1 Unless specifically indicated otherwise, the construction requirements specified for an alarm shall apply also for any remote accessories with which it is to be employed.

9.2 Sensitivity adjustment

9.2.1 When a field sensitivity adjustment is provided, it shall be accessible with the alarm installed as intended, marked to indicate the direction of sensitivity (high or low), and shall employ a mechanical stop at both extremes. The sensitivity at the low sensitivity end shall be within the limits indicated in 37.1.1.

Removal of a snap-on cover to gain access to the sensitivity control is permissible only when no high-voltage parts are able to be contacted by the user.

9.3 Radioactive materials

9.3.1 The manufacture, importation, distribution, marking, and disposal of smoke alarms containing radioactive material are subject to the safety requirements of local or state radiation control agencies, the U. S. Nuclear Regulatory Commission, or both.

9.3.2 Verification of the compliance of such alarms with the requirements of the regulating agency involved is required prior to (or obtained concurrently with) the establishment of compliance with the requirements of this standard.

9.4 Supplementary signaling feature

9.4.1 A supplementary signaling feature, such as a transmitter for remote signaling, included integral with a single or multiple station smoke alarm, is to be compatible with the device(s) with which it is intended to be employed, and the remote signaling device(s) shall be intended for fire alarm application.

9.5 Insect guards

9.5.1 An alarm shall be provided with a screen or equivalent protection (louvers, slots, holes) as a deterrent for entry of insects into the detecting chamber. The maximum opening size shall not exceed 0.05 inch (1.27 mm).

9.5.2 To determine that the maximum opening size has not been exceeded, openings in rigid assemblies shall not permit passage of a 0.051 inch (1.30 mm) diameter rod. For nonrigid openings, such as a screen, ten measurements are to be made at different locations by an optical micrometer; five measurements are to be made in each direction (not on diagonal).

9.6 Supplementary heat detector

9.6.1 When a heat detector is provided integral with a smoke alarm, the temperature rating of the heat detector shall not be less than 57°C (135°F). The heat detector shall be either connected in the smoke alarm circuit or intended for connection to a separate circuit.

10 Servicing and Maintenance Protection

10.1 General

10.1.1 An uninsulated live part of a high-voltage circuit within the enclosure shall be located, guarded, or enclosed so as to minimize accidental contact by persons performing service functions suitably performed with the equipment energized.

10.1.2 An electrical component which requires examination, replacement, adjustment, servicing, or maintenance with the alarm energized shall be located and mounted with respect to other components and with respect to grounded metal so that it is accessible for such service without subjecting the user to an electric shock from adjacent uninsulated high-voltage live parts.

10.1.3 The following are not identified as uninsulated live parts:

- a) Coils of relays, solenoids, and transformer windings, when the coils and windings are provided with insulating overwraps capable of being used for this purpose;
- b) Terminals and splices with insulation rated for the intended application; and
- c) Insulated wire.

10.2 Sharp edges

10.2.1 An edge, or corner of an enclosure, opening, frame, guard, knob, handle, or other similar projection of a smoke alarm shall be smooth and rounded, so as not to result in a cut-type injury when contacted during use or user maintenance.

11 Enclosure

11.1 General

11.1.1 The enclosure of an alarm shall be constructed to resist the abuses encountered in service. The degree of resistance to abuse inherent in the alarm shall preclude total or partial collapse with the attendant reduction of spacings, loosening or displacement of parts, and other defects that, alone or in combination, present a risk of fire, electric shock, or injury to persons.

11.1.2 Enclosures for individual electrical components, outer enclosures, and combinations of the two are to be evaluated in determining compliance with the requirement of 11.1.1.

11.1.3 All electrical parts of an alarm, including a separate power supply, except for plug-in blades, shall be enclosed to provide protection against contact with uninsulated live parts. A separate enclosure for

field-wiring terminals to be enclosed by a back box is not required.

11.1.4 Nonfunctional rear openings (those that are not required for operation or installation of the detector) shall not permit the passage of any air current or debris which affects detector response to test smoke following installation as intended.

11.1.5 Following installation as intended there shall not be any openings between the intended mounting surface and the rear of the detector which allow for passage of air that affects detector response from test smoke.

11.1.6 To comply with 11.1.4 and 11.1.5, one of the following methods, or a method determined to be equivalent, shall be used:

a) An elastomeric rubber or neoprene gasket, or the equivalent, interposed between the rear of the alarm and the mounting surface to seal the rear openings and preclude the escape of air from around the edge of the alarm or

b) Instructions in the installation manual provided to describe the location and method(s) of applying a sealing compound that has been found appropriate for the intended use.

11.1.7 To determine compliance with the requirements of 11.1.4 and 11.1.5, representative alarms shall be subjected to the Smoke Entry (Stack Effect) Test, Section 41.

11.1.8 The enclosure of an alarm shall be provided with means for mounting in the intended manner. Any fittings, such as brackets or hangers, required for mounting means shall be accessible without disassembling any operating part of the alarm. The removal of a completely assembled panel or cover to mount the alarm is not identified as disassembly of an operating part.

11.1.9 When the unit is intended for permanent connection, the enclosure shall either have provision for the connection of metal-clad cable, conduit, or nonmetallic sheathed cable, or have provision for mounting on an outlet box.

11.2 Cast metal enclosures

11.2.1 The thickness of cast metal for an enclosure shall be as indicated in Table 11.1. When cast metal having a thickness 1/32 inch (0.8 mm) less than that indicated in Table 11.1 is employed, the surface under consideration is to be curved, ribbed, or otherwise reinforced, or the shape of the surface, size of the surface, or both, are such that equivalent mechanical strength is provided.

Table 11.1
Cast-metal enclosures

Use or dimensions of area involved	Minimum thickness			
	Die-cast metal,		Cast metal of other than the die-cast type,	
	inch	(mm)	inch	(mm)
Area of 24 square inches (155 cm ²) or less and having no dimension greater than 6 inches (152 mm)	1/16 ^a	1.6	1/8	3.2
Area greater than 24 square inches (155 cm ²) or having any dimension greater than 6 inches (152 mm)	3/32	2.4	1/8	3.2
At a threaded conduit hole	1/4	6.4	1/4	6.4
At an unthreaded conduit hole	1/8	3.2	1/8	3.2
^a The area limitation for metal 1/16 inch (1.6 mm) thick is obtained by the provision of reinforcing ribs subdividing a larger area.				

11.2.2 When threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, there shall not be less than 3-1/2 nor more than five threads in the metal, and the construction shall be such that a standard conduit bushing is capable of being attached.

11.2.3 When threads for the connection of conduit are tapped only part of the way through a hole in an enclosure wall, there shall not be less than 3-1/2 full threads in the metal, and there shall be a smooth, rounded inlet hole for the conductors which shall afford protection to the conductors equivalent to that provided by a standard conduit bushing.

11.3 Sheet metal enclosures

11.3.1 The thickness of sheet metal used for the enclosure of an alarm shall not be less than that indicated in Table 11.2. When sheet metal of up to two gage sizes lesser thickness is used, the surface

under consideration shall be curved, ribbed, or otherwise reinforced, or the shape of the surface, size of the surface, or both shall be such that equivalent mechanical strength is provided.

Table 11.2
Sheet metal enclosures

Maximum dimensions of enclosure				Minimum thickness of sheet metal								
Length or width, inches (mm)		Area, inches ² (cm ²)		Steel, zinc-coated, inch (mm) GSG			Steel, uncoated, inch (mm) MSG			Brass or aluminum, inch (mm) AWG		
12	305	90	581	0.034	0.86	20	0.032	0.81	20	0.045	1.14	16
24	610	360	2322	0.045	1.14	18	0.042	1.07	18	0.058	1.47	14
48	1219	1200	7742	0.056	1.42	16	0.053	1.35	16	0.075	1.91	12
60	1524	1500	9678	0.070	1.78	14	0.067	1.70	14	0.095	2.41	10
Over 60	1524	Over 1500	9678	0.097	2.46	12	0.093	2.36	12	0.122	3.10	8

11.3.2 At any point where conduit or metal-clad cable is to be attached, sheet metal shall have a thickness of not less than 0.032 inch (0.81 mm) when of uncoated steel, not less than 0.034 inch (0.86 mm) when of galvanized steel, and not less than 0.045 inch (1.14 mm) when of nonferrous metal.

11.3.3 A ferrous plate or plug closure for an unused conduit opening or other hole in the enclosure shall have a thickness not less than 0.027 (0.69 mm) or 0.032 inch (0.81 mm) nonferrous metal for a hole having a 1-3/8 inch (34.9 mm) diameter maximum dimension.

11.3.4 A closure for a hole larger than 1-3/8 inch (34.9 mm) diameter shall have a thickness equal to that required for the enclosure of the device or a standard knockout seal shall be used.

11.3.5 A knockout in a sheet metal enclosure shall be secured and shall be able to be removed without undue deformation of the enclosure.

11.3.6 A knockout shall be provided with a surrounding surface for seating of a conduit bushing, and shall be located so that installation of a bushing at any knockout used during installation does not result in spacings between uninsulated live parts and the bushing of less than those indicated in Spacings, General, Section 32.

11.4 Nonmetallic enclosures

11.4.1 An enclosure or parts of an enclosure of nonmetallic material shall have the mechanical strength and durability and be formed so that operating parts are protected against damage. The mechanical strength of the enclosure shall be at least equivalent to a sheet metal enclosure of the minimum thickness specified in Table 11.2. See also the Tests of Thermoplastic Materials, Section 66.

11.4.2 The continuity of any grounding system to which an alarm is to be connected shall not rely on the dimensional integrity of the nonmetallic material.

11.4.3 Polymeric materials used for an enclosure shall comply with the following requirements:

- Enclosures containing parts including a risk of fire – minimum flammability rating of V-0 and compliance with the Flame Test (5 inch) as described in 66.4.1 – 66.4.6.
- Enclosures containing Class 2 and Class 3 circuits with a voltage not exceeding 30 volts AC, 42.4 volts-peak, or 60 volts DC – minimum flammability rating of HB and compliance with the Flame Test (3/4 inch), as described in 66.3.1 – 66.3.6.
- Enclosures containing circuits powered by batteries with energy limited to 15 watts – minimum flammability rating of HB.

11.5 Ventilating openings

11.5.1 Ventilating openings in an enclosure for high-voltage circuits including perforated holes, louvers, and openings protected by means of wire screening, expanded metal, or perforated covers, shall be of such size or shape that no opening permits passage of a rod having a diameter of 9/64 inch (3.6 mm). An enclosure for a fuse(s) or other overload protective device provided with ventilating openings shall afford protection against the emission of flame or molten metal. Openings used to clean internal parts, shall be constructed to prevent damage to functional internal components during such cleaning operations.

11.5.2 Except as noted in 11.5.3, perforated sheet metal used for expanded metal mesh shall not be less than 0.042 inch (1.07 mm) in average thickness, 0.046 inch (1.17 mm) when zinc coated.

11.5.3 When the indentation of the guard or enclosure does not alter the clearance between uninsulated

live parts and grounded metal so as to reduce spacings below the minimum values required [0.021 inch (0.53 mm) expanded metal mesh or perforated sheet metal, 0.024 inch (0.61 mm) when zinc coated], the following conditions shall be employed:

- a) The exposed mesh on any one side or surface of the product has an area of not more than 72 square inches (465 cm²) and has no dimension greater than 12 inches (305 mm) or
- b) The width of an opening so protected is not greater than 3-1/2 inches (88.9 mm).

11.5.4 The wires forming a screen protecting high-voltage current-carrying parts shall not be smaller than AWG 16 (1.3 mm²) and the screen openings shall not be greater than 1/2 square inch (3.2 cm²) in area.

11.6 Covers

11.6.1 An enclosure cover, other than the type usually employed over the sensing chamber, shall be hinged, sliding, pivoted, or similarly attached when:

- a) It provides ready access to fuses or any other overcurrent protective device, the intended protective functioning of which requires renewal or
- b) It is required that the cover be opened periodically in connection with the intended operation of the alarm.

For the purpose of this requirement, intended operation is determined to be operation of a switch for testing or operation of any other component of an alarm that requires such action in connection with its intended performance. This requirement does not apply to a photoelectric type alarm where the lamp is intended to be periodically replaced, or to the battery replacement aspect of an alarm employing a battery as the main or standby supply.

11.6.2 A cover that is intended to be removed only for periodic cleaning of the sensing chamber shall be secured by any one of the following or equivalent means: positive snap catch, plug-in or twist action, snap tab with one screw, or two or more screws.

11.6.3 When an alarm cover is not intended to be removed for cleaning, maintenance, or both, and the alarm is intended to be returned to the factory for servicing, the cover shall be secured so that it is not readily removed. Exposed screw slots or nuts, other than a tamper-proof type, shall be sealed or covered. See 92.1 (s) for supplementary marking.

Exception: These requirements do not apply when the alarm cover is intended to be removed for cleaning, maintenance, or both, even though the alarm is intended to be returned to the manufacturer for servicing.

11.6.4 A hinged cover is not required where the only fuse(s) enclosed is intended to provide protection to portions of internal circuits, such as employed on a separate printed-wiring board or circuit subassembly, to prevent circuit damage resulting from a fault. The use of such a fuse(s) shall occur only when the word "CAUTION " and the following or equivalent marking is located on the cover of a alarm employing high-voltage circuits: "Circuit Fuse(s) Inside – Disconnect Power Prior To Servicing."

11.6.5 A hinged cover shall be provided with a latch, screw, or catch to hold it closed. An unhinged cover shall be securely held in place by screws or the equivalent.

11.7 Glass panels

11.7.1 Glass covering an enclosure opening shall be held securely in place so that it is not capable of being displaced in service and shall provide mechanical protection of the enclosed parts. The thickness of a glass cover shall not be less than that indicated in Table 11.3.

11.7.2 A transparent material other than glass employed as a cover over an opening in an enclosure shall:

- a) Be mechanically equivalent to that of glass,
- b) Not distort, and
- c) Not become less transparent at the temperature to which it is subjected under normal or abnormal service conditions.

Table 11.3
Thickness of glass covers

Maximum size of opening				Minimum thickness,	
Length or width,		Area,			
inches	(mm)	inches ²	(cm ²)	inch	(mm)
4	102	16	103	1/16	1.6
12	305	144	929	1/8	3.2
Over 12	Over 305	Over 144	Over 929	See footnote a	See footnote a

^a 1/8 inch (3.2 mm) or more, based upon the size, shape, and mounting of the glass panel. A glass panel for an opening having an area greater than 144 square inches (929 cm²), or having any dimension greater than 12 inches (305 mm), shall be supported by a continuous groove not less than 3/16 inch (4.8 mm) deep along all four edges of the panel.

11.7.3 A lens, light filter, or similar part of a smoke alarm shall be constructed of a material whose transparency is not diminished by the conditions to which it is exposed in service, as represented by the Performance Tests of this standard. See Sections 34 – 76.

12 Corrosion Protection

12.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means.

12.2 The requirement of 12.1 applies to all sheet steel or cast iron enclosures, and to all springs and other parts upon which mechanical operation depends. It does not apply to minor parts, such as washers, screws, bolts, and other parts, when the failure of such unprotected parts does not result in a risk of fire or electric shock or injury to persons or impair the operation of the alarm. Parts made of stainless steel, polished or treated when required, do not require additional protection. Bearing surfaces shall be of materials that prevent binding due to corrosion.

12.3 Metal shall not be used in combinations such as to result in galvanic action which adversely affects cabinets or enclosures.

12.4 Hinges and other attachments shall be resistant to corrosion.

12.5 It is not prohibited for nonferrous cabinets and enclosures to be used without special corrosion protection.

POWER SUPPLY

13 Primary Power Supply

13.1 The primary power supply of a single station smoke alarm shall be either a commercial light and power source available in a home or an integral battery or batteries. Connection to the commercial light and power source, when used, shall be in the form of permanent wiring to terminals or leads in a separate wiring compartment (see also 11.1.9) having provision for the connection of conduit, metal-clad or nonmetallic sheathed cable, by means of a power-supply cord and attachment-plug cap, or by means of a separate power supply.

13.2 When a separate power supply is provided, it shall have limited output energy consisting of an open circuit voltage not in excess of 30 volts rms, 42.4 volts peak or direct current (DC), and its output capacity shall be limited to a maximum of 100 volt-amperes. It is not prohibited for the energy to be limited by an energy limited transformer having an output rating of 100 volt-amperes or less, or by a transformer plus additional circuitry having characteristics equivalent to those of a 100 volt-amperes transformer.

14 Secondary Power Supply

14.1 The use of a secondary power supply is not prohibited. When a secondary power supply, such as a battery, is provided it shall have the capacity to supply the maximum intended power to the detector for 7 days in the standby condition and thereafter be able to operate the detector for an alarm signal for at least 4 minutes continuously. This capacity shall be measured using a fully charged battery or other applicable rechargeable energy storage media, or a fresh non-rechargeable battery, as appropriate. Refer to 36.3.

14.1 effective August 25, 2008

14.2 When a battery is used for the secondary power supply, it shall be of either a rechargeable or non-rechargeable type. For a rechargeable type battery, the maximum charging current, as well as the maximum trickle charging current available, shall not exceed the battery manufacturer's specifications. For a non-rechargeable type battery, data on battery life, including discharge curves, shall be provided for the investigation to evaluate battery shelf aging and performance characteristics.

14.3 When a non-rechargeable or rechargeable type battery is used as a secondary power supply, the marking on the unit shall include specified periodic battery replacement instructions.

14.4 The discharge condition of a non-rechargeable or rechargeable type battery shall be monitored where a trouble indication, as described in 36.1.3 is obtained. The monitoring shall take place whether the alarm is operating on the primary supply or on the standby supply.

15 Batteries

15.1 General

15.1.1 When a battery or set of batteries is used as the main source of power of a single or multiple station smoke alarm, it shall comply to the requirements of the Battery Tests, Section 63.

15.1.2 Batteries included as part of an alarm shall be so located and mounted that terminals of cells are prevented from coming in contact with uninsulated live parts, terminals or adjacent cells, or metal parts of the enclosure as a result of shifting.

15.1.3 A battery compartment intended for use with rechargeable batteries which emit gases during charging shall be provided with vent holes.

15.1.4 Ready access shall be available to the battery compartment to facilitate battery replacement, without damage to the alarm components or disassembly of any part of the alarm, except for a cover or the equivalent. When the battery is capable of powering the alarm for a minimum of 10 years, the battery shall not be user replaceable.

15.1.5 Connections of external wiring to a battery-operated single- or multiple-station smoke alarm, or to a portable accessory, shall not be subjected to stress or motion during battery replacement, servicing, or both. Removal of the alarm or accessory from the mounting support to replace a battery or to service the unit shall occur only when the connected wiring is not subjected to flexing or stress.

15.1.6 A smoke alarm powered by a non-replaceable, ten-year life battery shall be provided with a means of activating the power prior to installation, and deactivating the battery at the end of useful battery life. The deactivation means shall require the use of a tool, or equivalent, and shall render the unit resistant to being reinstalled. The deactivation means shall also serve to completely discharge the battery(ies). Both the activation and deactivation means shall be designed to operate one time only. The installation instructions shall provide the user with information describing this one time operation. See 94.1 (o).

15.2 Battery connections

15.2.1 Lead or terminal connections to batteries shall be identified with the proper polarity, (plus or minus signs), and provided with strain relief. It is not prohibited for the polarity to be indicated on the unit adjacent to the battery terminals or leads.

15.2.2 Connections to battery terminals shall be either by a lead terminating in a positive snap action type of clip, or a fixed butt type connection which applies a minimum of 1.5 pounds (6.6 N) force to each battery contact, or equivalent. The connection shall consist of an unplated or plated metal which is resistant to the corrosive action of the electrolyte.

15.2.3 Each lead of a clip-lead assembly used as part of a battery operated alarm shall be a minimum of AWG 22 (0.32 mm²) stranded wire with a minimum 1/64-inch (0.4-mm) insulation.

16 Supplementary Signaling Circuits

16.1 For a cord-connected or battery operated single station alarm employing a supplementary signaling circuit which is energized from a separate source of supply, the source of energy shall not exceed the energy limits defined in 72.2.1 and 72.2.2.

16.2 For an alarm intended to be connected to a fixed wiring system and employing a separately energized signaling circuit, the source of energy shall not exceed the limits in 72.2.1 unless the connections are made as a Class 1 wiring system as defined in the National Electrical Code, ANSI/NFPA 70.

FIELD WIRING

17 Permanent Connection

17.1 General

17.1.1 A single station or multiple station smoke alarm intended for permanent connection shall be

provided with wiring terminals or leads for the connection of conductors of at least the size required by the National Electrical Code, ANSI/NFPA 70, corresponding to the rating of the unit.

17.2 Field-wiring compartment

17.2.1 The field-wiring compartment area is to be sized for completing all field-wiring connections as specified by the installation wiring diagram. There shall be space within the compartment to permit the use of a standard conduit bushing on conduit connected to the compartment when a bushing is required for installation.

17.2.2 Protection for internal components and wire insulation from sharp edges shall be provided by insulating barriers or metal barriers having smooth rounded edges, or by protection that has been determined to be the equivalent.

17.3 Field-wiring terminals

17.3.1 Terminal parts to which field connections are to be made shall consist of binding screws with terminal plates having upturned lugs or the equivalent to hold the wires in position. Other terminal connections when provided shall be found to be equivalent.

17.3.2 When a wiring-binding screw is employed at a field-wiring terminal, the screw shall not be smaller than a No. 6 (3.5 mm diameter).

17.3.3 Except as noted in 17.3.4, a terminal plate tapped for a wire-binding screw shall be of metal not less than 0.030 inch (0.76 mm) thick and shall not have less than two full threads in the metal.

17.3.4 It is not prohibited for a terminal plate to have the metal extruded at the tapped hole for the binding screw so as to provide two full threads. Other constructions, when employed, shall provide equivalent security.

17.4 Field-wiring leads

17.4.1 Power supply leads provided for field connection shall not be less than 6 inches (152 mm) long; shall be provided with strain relief; and shall not be smaller than AWG 18 (0.82 mm²). The insulation, when of rubber or thermoplastic, shall not be less than 1/32 inch (0.8 mm) thick.

17.4.2 Leads provided for field connection to power limited fire protective signaling circuits, such as employed for multiple station interconnection or for connection to remote signaling devices, shall not be smaller than AWG 16 (1.3 mm²), for a single conductor, AWG 19 (0.65 mm²) for two or more conductors, and AWG 22 (0.32 mm²) for four or more conductors of a multiconductor cable. The conductor shall be solid, bunch tinned stranded, or stranded copper. Stranded copper wire, consisting of not more than seven strands, shall be used only for AWG 18 (0.82 mm²) and larger conductors.

17.5 Grounded supply terminals and leads

17.5.1 A field-wiring terminal for the connection of a grounded supply conductor shall be identified by means of a metallic plated coating substantially white in color and shall be readily distinguishable from the other terminals, or proper identification of the terminal for the connection of the grounded conductor shall be clearly shown in some other manner, such as on an attached wiring diagram.

17.5.2 A field-wiring lead provided for connection of a grounded supply conductor shall be finished to show a white or gray color and shall be readily distinguishable from other leads. No other leads, other than grounded conductors, shall be so identified.

17.5.3 A terminal or lead identified for the connection of the grounded supply conductor shall not be electrically connected to a single-pole manual switching device that has an OFF position or to a single-pole overcurrent (not thermal) protective device.

18 Power Supply Cord

18.1 A cord-connected single station smoke alarm shall be provided with not less than 6 feet (1.83 m) nor more than 20 feet (6.10 m) of flexible cord and a two or three prong attachment plug of the type and rating for connection to the supply circuit.

18.2 The flexible cord shall be of Type SP-1, SPT-1, SP-2, SPT-2, SV, SVT, SJ, SJT, SPE, SVE, or equivalent, minimum AWG 18 (0.82 mm²). It shall be rated for use at the voltage and ampacity rating of the detector, in accordance with the National Electrical Code, ANSI/NFPA 70.

18.3 Means shall be provided to prevent the flexible cord from being pushed into the enclosure through

the cord-entry hole when it is possible for such displacement to:

- a) Subject the cord to mechanical damage or to exposure to a temperature higher than that for which the cord is rated,
- b) Reduce spacings below the minimum required values, or
- c) Result in damage in internal components.

18.4 A smoothly rounded restraining means shall be provided for securing the attachment plug to the receptacle. The means shall withstand for 1 minute a pull of 5 pounds force (22.25 N) while installed as intended in service without any evidence of damage to the connection.

19 Equipment Grounding

19.1 General

19.1.1 An equipment grounding terminal or lead, or equivalent, is required for a hazardous-voltage alarm provided with an overall nonmetallic enclosure and cover, that:

- a) Is intended to be serviced internally and
- b) Employs internal dead metal parts that become energized under a fault condition.

19.1.2 An equipment grounding terminal or lead is not required for:

- a) An extra-low-voltage alarm;
- b) A hazardous-voltage alarm provided with an overall nonmetallic enclosure and cover, and that is not intended to be internally serviced; or
- c) A hazardous-voltage alarm provided with an overall nonmetallic enclosure and cover, where internal dead metal parts are not capable of either being energized under a fault condition nor being contacted during servicing.

19.2 Permanently connected units

19.2.1 The surface of an insulated lead intended solely for the connection of an equipment-grounding conductor shall be green, with or without one or more yellow stripes. No other leads visible to the installer, other than grounding conductors, shall be so identified. A field-wiring terminal intended for connection of an equipment-grounding conductor shall be plainly identified, such as being marked "G," "GR," "Ground," "Grounding," or the equivalent, or by a marking on a wiring diagram provided on the alarm. The field-wiring terminal shall be located so that it shall not be removed during servicing of the alarm.

19.3 Cord connected units

19.3.1 The grounding means for a cord-connected alarm, having an overall nonmetallic enclosure and cover, that is intended to be serviced internally shall consist of a separate grounding lead integral with the supply cord and terminating in the grounding pin of a parallel blade attachment-plug cap.

20 Remote Power Supply

20.1 For an alarm that is intended to be connected to a separate remote power supply such as a transformer, the supply cord is not required to be factory wired to the alarm, or to the transformer terminals or leads, when the installation instructions provided with the unit are explicit regarding the method of connection. The minimum size conductors between the alarm and remote power supply shall not be less than AWG 18 (0.82 mm²) and shall not be longer than 20 feet (6.1 m). The interconnecting wiring is to be provided with the alarm and the transformer by the manufacturer.

20.2 Where longer runs of interconnecting wiring are used in an installation, such as in a multiple station configuration, or where several alarms are supplied by a common power supply, the wiring is not required to be provided by the manufacturer. However, the installation wiring diagram or instructions shall be marked to specify that the wiring to be used shall be in accordance with the provisions of Articles 210 and 300.3 (B) of the National Electrical Code, ANSI/NFPA 70. In addition, the resistance of the interconnecting wiring shall be a maximum of 10 ohms, unless otherwise specified by the manufacturer.

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INTERNAL WIRING

21 General

21.1 The internal wiring of an alarm shall consist of conductors having insulation rated for the potential involved and the temperatures to which it is subjected, and shall have the mechanical strength and

current-carrying capacity for the service. The wiring shall be routed away from moving parts and sharp projections and held in place with clamps, string, ties, or equivalent, unless of rigidity that retains a shaped form.

21.2 Leads, or a cable assembly, connected to parts mounted on a hinged cover shall be of a length to permit the full opening of the cover without applying stress to the leads or their connections. The leads shall be secured or equivalently arranged to prevent abrasion of insulation and jamming between parts of the enclosure.

21.3 When the use of a short length of insulated conductor is not possible, such as for a short coil lead, electrical insulating tubing shall be employed. The tubing shall not be subjected to sharp bends, tension, compression, or repeated flexing, and shall not contact sharp edges, projections, or corners. The wall thickness of the tubing shall comply to the requirements for such tubing, except that the wall thickness at any point for polyvinyl chloride tubing of 3/8 inch (9.5 mm) diameter or less, shall not be less than 0.017 inch (0.43 mm). For insulating tubing of other types the wall thickness shall not be less than that required to at least equal the mechanical strength, dielectric properties, and heat and moisture resistance characteristics of polyvinyl chloride tubing having a wall thickness of 0.017 inch (0.43 mm).

21.4 Internal wiring of circuits operating at different potentials shall be separated by barriers or shall be segregated, unless the conductors of the circuits of lower voltage are provided with insulation equivalent to that required for the highest voltage involved. Segregation of insulated conductors shall be accomplished by clamping, routing, or equivalent means that provides permanent separation.

21.5 Stranded conductors clamped under wire-binding screws, or similar parts, shall have the individual strands soldered together or be equivalently arranged, to provide reliable connections.

21.6 Wireways shall be smooth and free from sharp edges, burrs, fins, and moving parts to avoid the possibility of abrasion of the conductor insulation.

21.7 All splices and connections shall be mechanically secured to preclude shorting to adjacent uninsulated current carrying parts in the event that an improper connection, such as a cold solder joint, is made.

21.8 A splice shall be provided with insulation equivalent to that of the wires involved, when permanence of electrical spacing between the splice and uninsulated metal parts is not assured.

21.9 Splices shall be located, enclosed, and supported so that flexing, movement, or vibration shall not damage the insulation or affect the integrity of the splice.

21.10 A metal barrier shall have a thickness at least equal to that required by Table 11.2, as determined by the size of the barrier. A barrier of insulating material shall not be less than 0.028 inch (0.71 mm) thick and shall be thicker when its deformation is readily accomplished so as to defeat its purpose. Any clearance between the edge of a barrier and a compartment wall shall not exceed 1/16 inch (1.6 mm).

22 Bonding for Grounding

22.1 An exposed dead metal part of a hazardous-voltage alarm that becomes energized shall be bonded to the point of connection of the field-equipment grounding terminal or lead, when provided or required, and to the metal surrounding the knockout, hole, or bushing provided for field power-supply connections.

22.2 Uninsulated metal parts of electrical enclosures, transformer cores, mounting brackets, capacitors, and other electrical components are to be bonded for grounding when there is a possibility that they be contacted by the user or by a serviceman servicing or operating the equipment.

22.3 Metal parts as described below are not required to comply with the requirement of 22.2.

a) Adhesive attached metal foil markings, screws, handles, or similar items that are located on the outside of the alarm enclosure and isolated from electrical components or wiring by grounded metal parts so that they do not become energized.

b) Isolated metal parts, such as small assembly screws, that are positively separated from wiring and uninsulated live parts.

c) Panels and covers that do not enclose uninsulated live parts, when wiring is positively separated from the panel or cover so that it does not become energized.

d) Panels and covers that are insulated from electrical components and wiring by an insulating

barrier of vulcanized fiber, varnished cloth, phenolic composition, or similar material not less than 1/32 inch (0.8 mm) thick and secured in place.

22.4 A bonding conductor shall be of material capable of being used as an electrical conductor. When of ferrous metal, it shall be protected against corrosion by painting, plating, or the equivalent. The conductor shall not be smaller than the maximum size wire employed in the circuit wiring of the component or part. A separate bonding conductor or strap shall be installed in such a manner that it is protected from mechanical damage.

22.5 The bonding shall be by a positive means, such as by clamping, riveting, bolted or screwed connection, brazing, or welding or soldering of a mechanically secured component. The bonding connection shall penetrate nonconductive coatings such as paint. Bonding around a resilient mount shall not rely on the clamping action of rubber or similar material.

22.6 A bolted or screwed connection, that incorporates a star washer under the screwhead, is capable of being used for penetrating nonconductive coatings.

22.7 When the bonding means relies upon screw threads, two or more screws, or two full threads of a single screw, engaging metal is appropriate for use.

22.8 Metal-to-metal hinge-bearing members for doors or covers shall not be used as a means for bonding the door or cover for grounding unless a multiple bearing-pin type hinge is employed.

22.9 Splices shall not be employed in conductors used to bond electrical enclosures or components.

ELECTRICAL COMPONENTS

23 General

23.1 Mounting of components

23.1.1 A switch, lampholder, attachment-plug receptacle, plug connector, or similar electrical component, and uninsulated live parts shall be mounted securely and shall be prevented from turning.

Exception No. 1: It is not required that a switch be prevented from turning when all four of the following conditions are met:

- a) The switch is a plunger or other type that does not tend to rotate when operated. A toggle switch is determined to be subject to forces that tend to turn the switch during operation of the switch.
- b) The means for mounting the switch shall be such that the operation of the switch loosens it.
- c) The spacings are not reduced below the minimum required values when the switch rotates.
- d) The operation of the switch is by mechanical means rather than by direct contact by persons.

Exception No. 2: It is not required that a lampholder of the type in which the lamp is not capable of being replaced, such as a neon pilot or indicator light in which the lamp is sealed in a nonremovable jewel be prevented from turning when rotation does not reduce spacings below the minimum values required. See Spacings, General, Section 32.

23.1.2 Uninsulated live parts shall be secured to the base or mounting surface so that they are prevented from turning or shifting in position, where such motion results in the possibility of a reduction of spacings. Friction between surfaces shall not be relied upon as a means to prevent shifting or turning of live parts. A properly applied lock washer is accepted.

23.1.3 Uninsulated live parts, for example, field-wiring terminals, shall be secured to their supporting surfaces by methods other than friction between surfaces so that they are prevented from turning or shifting in position when such motion results in reduction of spacings below the minimum values required. This shall be accomplished by two screws or rivets; by square shoulders or mortises; by a dowel pin, lug, or offset; by a connecting strap or clip fitted into an adjacent part; or by an equivalent method.

23.2 Operating components

23.2.1 Operating components and assemblies, such as switches, relays, and similar devices, shall be protected by individual dust covers or dust tight cabinets, against the possibility of impaired operation due to dust or other material.

23.2.2 Adjusting screws and similar adjustable parts shall be prevented from loosening under the

conditions of actual use. The use of a properly applied lock washer to prevent loosening is accepted.

23.3 Current-carrying parts

23.3.1 A current-carrying part shall be of metal such as silver, copper or copper alloy, or equivalent material.

23.3.2 Bearings, hinges, and other similar parts are not to be used for carrying current between fixed and moving parts.

23.4 Electrical insulating material

23.4.1 Material for the mounting of current-carrying parts shall be porcelain, phenolic composition, cold-molded composition, or equivalent material.

23.4.2 When vulcanized fiber is used for insulating bushings, washers, separators, and barriers it shall not be as the sole support for uninsulated current-carrying parts of other than extra-low-voltage circuits.

23.4.3 Polymeric materials shall not be used for the sole support of uninsulated live parts unless found to be equivalent to the materials indicated in 23.4.1.

23.4.4 The thickness of a flat sheet of insulating material, such as phenolic composition employed for panel-mounting of parts, shall not be less than 1/16 inch (1.6 mm) thick. Material less than 1/16 inch (1.6 mm) thick shall not be employed unless the panel is supported or reinforced to provide equivalent rigidity.

23.4.5 A terminal block mounted on a metal surface capable of being grounded shall be provided with an insulating barrier between the mounting surface and all live parts on the underside of the base unless the parts are staked, upset, sealed, or equivalently prevented from loosening so as to prevent the parts and the ends of replaceable terminal screws from coming in contact with the supporting surface or reducing spacings below the minimum values required.

23.4.6 A countersunk sealed part shall be covered with a waterproof insulating compound which shall not melt at a temperature 15°C (27°F) higher than the maximum normal operating temperature of the assembly, and not less than 65°C (149°F) in any case. The depth or thickness of the sealing compound shall not be less than 1/8 inch (3.2 mm).

24 Bushings

24.1 When a lead or wire harness passes through an opening in a wall, barrier, or enclosing case, there shall be a metal or insulating type bushing, or the equivalent, which shall be substantial, secured in place, and have a smooth rounded surface against which the wire rests.

24.2 When the opening is in a phenolic composition or other nonconducting material, or in metal of thickness greater than 0.042 inch (1.07 mm), a smooth surface having rounded edges is determined to be the equivalent of a bushing.

24.3 Ceramic materials and some molded compositions are capable of being used for insulating bushings, separate bushings of wood and hot-molded shellac shall not be used.

24.4 Fiber shall be employed only where:

- a) It is not subjected to a temperature higher than 90°C (194°F) under normal operating conditions;
- b) The bushing is not less than 1/16 inch (1.6 mm) thick, with a minus tolerance of 1/64 inch (0.4 mm) for manufacturing variations; and
- c) It is not affected adversely by normal ambient humidity conditions.

24.5 When a soft-rubber bushing or similar material that deteriorates with age is employed in a hole in metal, the hole shall be free from sharp edges, burrs, or similar projections, which cut into the bushing and wire insulation.

24.6 When an insulating metal grommet is used in lieu of an insulating bushing, the insulating material used shall not be less than 1/32 inch (0.8 mm) thick and shall fill completely the space between the grommet and the metal in which it is mounted.

25 Lampholders and Lamps

25.1 A single station smoke alarm intended to be connected to a commercial alternating current (AC) power source shall be provided with a "power-on" lamp to indicate energization of the unit. When pulsed, the lamp shall pulse at least once per minute.

25.2 Where more than one lamp is provided on the alarm, the "power-on" lamp shall be white or green, an alarm indicating lamp shall be red, and a trouble lamp shall be amber or yellow. When the "power-on" lamp is of a different color it shall be marked to identify the function.

25.3 At least one spare lamp shall be provided in a single station smoke alarm that employs photocell illuminating lamps that burn out during the service life of a alarm.

25.4 A lampholder and lamp shall be rated for the circuit in which they are employed.

25.5 A lampholder in a hazardous-voltage circuit shall be wired so that the screw shell is connected to an identified (grounded circuit) conductor.

25.6 A lampholder shall be installed so that uninsulated hazardous-voltage live parts are not exposed to contact by persons removing or replacing lamps in service.

25.7 A lamp or equivalent means, such as a distinctive audible signal indication, shall be provided on an alarm intended for multiple-station interconnection to identify the unit from which the alarm was initiated.

26 Light Emitting Diode (LED) Source Lamps

26.1 A LED used as a light source of a smoke alarm employing a photocell light assembly shall comply with electrical supervision requirements specified in 36.5.1 – 36.5.5, and the reliability prediction specified in 4.1.

27 Protective Devices

27.1 Fuseholders, fuses, and circuit breakers shall be rated for the application.

28 Printed-Wiring Boards

28.1 The components of a printed-wiring board shall be secured in place and the spacings between circuits shall comply with the spacings requirements for rigidly clamped assemblies (Table 32.1). The board shall be mounted so that deflection of the board during servicing shall not result in damage to the board or risk of fire or electric shock.

29 Switches

29.1 A switch shall have a current and voltage rating not less than that of the circuit which it controls.

29.2 When a reset switch is provided, it shall be of a self-restoring type.

29.3 An alarm silencing switch or equivalent means shall be provided on a single or multiple station smoke alarm only when its "off normal" position is supervised.

30 Transformers and Coils

30.1 A transformer shall be of the two-coil or insulated type.

Exception: An autotransformer shall only be employed in an alarm intended for permanent connection only, when the terminal or lead connected to the autotransformer winding which is common to both input and output circuits is identified, and the output circuits are located within the enclosure containing the autotransformer. See 17.5.1 and 17.5.2.

30.2 The insulation of coil windings of relays, transformers and similar components shall be such as to resist the absorption of moisture.

30.3 Film-coated or equivalently insulated wire is not required to be given additional treatment to prevent moisture absorption.

31 Dropping Resistors

31.1 A carbon composition resistor shall not be used as a dropping resistor in the hazardous-voltage circuit of an alarm.

SPACINGS

32 General

32.1 Spacings shall be maintained between uninsulated live parts and dead metal parts, and between uninsulated live parts of opposite polarity. The spacings shall not be less than those indicated in Table 32.1.

32.2 The spacings between an uninsulated live part and:

- a) A wall or cover of a metal enclosure;
- b) A fitting for conduit or metal-clad cable; and
- c) Any dead metal part

shall not be less than that indicated in Table 32.1.

32.3 The "Through-Air" and "Over-Surface" spacings of Table 32.1 measured at an individual component part are to be judged on the basis of the volt-amperes used and controlled by the individual component. However, the spacings from one component to another, and from any component to the enclosure or to other uninsulated dead metal parts, excluding the component mounting surface, shall be judged on the basis of the maximum voltage and total volt-amperes rating of all components in the enclosure.

Table 32.1

Minimum spacings

Point of application	Voltage range	Minimum spacings ^{a,b}			
		Through-air, inch (mm)		Over-surface, inch (mm)	
To walls of enclosure					
Cast metal enclosures	0 – 300	1/4	6.4	1/4	6.4
Sheet metal enclosures	0 – 300	1/2	12.7	1/2	12.7
Installation wiring terminals					
With barriers	0 – 30	1/8	3.2	3/16	4.8
	31 – 150	1/8	3.2	1/4	6.4
	151 – 300	1/4	6.4	3/8	9.5
Without barriers	0 – 30	3/16	4.8	3/16	4.8
	31 – 150	1/4	6.4	1/4	6.4
	151 – 300	1/4	6.4	3/8	9.5
Rigidly clamped assemblies ^c					
100 volt-amperes maximum ^{d,e}	0 – 30	1/32	0.8	1/32	0.8
Over 100 volt-amperes ^e	0 – 30	3/64	1.2	3/64	1.2
	31 – 150	1/16	1.6	1/16	1.6
	151 – 300	3/32	2.4	3/32	2.4
Other parts	0 – 30	1/16	1.6	1/8	3.2
	31 – 150	1/8	3.2	1/4	6.4
	151 – 300	1/4	6.4	3/8	9.5

^a An insulating liner or barrier of vulcanized fiber, varnished cloth, mica, phenolic composition, or similar material employed where spacings are otherwise insufficient, shall not be less than 0.028 inch (0.71 mm) thick; except that a liner or barrier not less than 0.013 inch (0.33 mm) thick shall be used only in conjunction with an air spacing of not less than one-half of the through air spacing required. The liner shall be located so that it is not affected adversely by arcing. Insulating material having a thickness less than that specified shall be used only when it complies with the requirements for the particular application.

^b Measurements are to be made with solid wire of adequate ampacity for the applied load connected to each terminal. In no case is the wire to be smaller than AWG 16 (1.3 mm²).

^c Rigidly clamped assemblies include such parts as contact springs on relays or cam switches, printed-wiring boards, and similar assemblies.

^d Spacings less than those indicated, and not less than 1/64 inch (0.4 mm), are appropriate for the connection of integrated circuits and similar components where the spacing between adjacent connecting wires on the component is less than 1/32 inch (0.8 mm).

^e When spacings between traces on a printed-wiring board are less than the minimum specified, the boards shall be covered with a conformal coating, and the combination shall be evaluated to the requirements in Conformal Coatings of Printed-Wiring Boards, Section 77.

32.4 The spacing requirements in Table 32.1 do not apply to the inherent spacings inside motors, except at wiring terminals, nor to the inherent spacings of a component provided as part of the alarm. Such spacings are judged on the basis of the requirements for the component. The electrical clearance resulting from the assembly of a component into the complete device, including clearances to dead metal or enclosures, shall be those indicated in Table 32.1.

32.5 The ² To Wall of Enclosure² spacings of Table 32.1 are not to be applied to an individual enclosure of a component part within an outer enclosure.

32.6 Enameled or equivalently insulated wire is an uninsulated live part. Enamel is capable of being used as turn-to-turn insulation in coils.

32.7 Spacings on printed-wiring boards which are less than those indicated in Table 32.1 shall comply with the minimum spacings of Table 32.2 and shall be provided with a coating in compliance with Conformal Coatings on Printed-Wiring Boards, Section 77.

Table 32.2

Minimum over-surface spacings on printed-wiring boards

Voltage, volts ^a	Energy available, volt-amperes	Spacing,		Coating program
		inch	(mm)	
0 – 30	100 maximum	13/64	0.2	Section 77.1
0 – 30	Over 100	13/32	0.4	Section 77.1
31 – 300	Over 100	13/16	0.8	Section 77.2

NOTE – The minimum spacings are required between live parts of opposite polarity. Spacings between live parts and dead metal shall comply with Table 32.1.

^a RMS volts for sinusoidal waveform. The equivalent peak voltage is to be used for nonsinusoidal waveforms.

33 General

33.1 Test units and data

33.1.1 Alarms that are fully representative of production units are to be used for each of the following tests, unless

otherwise specified. THE SENSITIVITY SETTING OR RANGE OF SENSITIVITIES PROVIDED ON THE SAMPLES FOR TEST DEFINES THE PRODUCTION SENSITIVITY.

33 总则

33.1 测试样品及数据

33.1.1 除非有特别说明, 所有以下测试样品必须为生产中取样.产品的灵敏度规格取自送样时设定的范围.

33.1.2 The devices employed for testing are to be those specified by the wiring diagram of the alarm. Substitute devices shall produce functions and load conditions equivalent to those obtained with the devices intended to be used with the alarm in service.

33.1.2 用于测试报警器的设备为指定的设备,代用设备需要有等同的功能及加载条件.

33.2 Accessories

33.2.1 Accessories for use with single and multiple station smoke alarms are to be subjected to the following tests as applicable:

33.2 附件

33.2.1 附件用于烟雾报警器以下的测试.

a) Normal Operation Test, Section 34;

章节34-----正常操作测试

b) Circuit Measurement Test, Section 35;

章节35-----电路测量.

c) Temperature Test, Section 47;

章节47-----温度测试.

d) Overload Test, Section 48;

章节48-----过载测试.

e) Endurance Test, Section 49;

章节49-----耐久性测试.

f) Variable Ambient Temperature Test, Section 50;

章节50-----温度循环测试.

g) Humidity Test, Section 51;

章节51-----湿度测试.

h) Leakage Current Test, Section 52;

章节52-----漏电流测试.

i) Transient Tests, Section 53;

章节53-----电瞬变测试.

j) Dielectric Voltage-Withstand Test, Section 54;

章节54-----绝缘耐压测试.

k) Overvoltage and Undervoltage Tests, Section 56;

章节56-----过压及低压测试.

l) Jarring Test, Section 60;

章节60-----冲击测试.

m) Audibility Test, Section 65;

章节65-----DB测试.

n) Tests of Thermoplastic Materials, Section 66;

章节66-----热塑塑料测试.

o) Drop Test, Section 76 (portable appliance only).

章节 76-----跌落测试 (只适用于手持式)

33.3 Test voltages

33.3.1 Unless otherwise specified, the test voltage for each test shall be as indicated in Table 33.1, at rated frequency.

33.3 测试电压

33.3.1 除非有特别说明,测试电压需符合下表.

Table 33.1
Test voltages

Alarm rated voltage, nameplate	Test voltage
110 to 120	120
220 to 240	240
Other	Marked rating

33.4 Test samples and data

33.4.1 The following samples and data are to be provided for testing:

- a) At least 28 assembled alarms; 12 preset (as close as normal production calibration permits) to the nominal maximum anticipated production sensitivity (most sensitive setting), and 16 preset (as close as normal production calibration permits) to the nominal minimum anticipated production sensitivity (least sensitive setting). Four of the 12 units preset to the maximum sensitivity and four of the 16 units preset to the minimum sensitivity shall be calibrated so that the sensitivity of any individual unit does not vary more than 25 percent from any other unit in each setting and shall establish the maximum and minimum sensitivities to be employed in production. Combination smoke alarms are to be provided with means for monitoring each principle of operation during the Sensitivity Test, Section 37.
- b) One additional unassembled alarm.
- c) Three additional samples of alarms that operate on the photoelectric principle provided with means to reduce the light output as described in 62.2.
- d) Installation and Operating Instructions, see 5.1 and 5.2 and Instructions, General, Section 94.
- e) Where applicable, samples of conformal coated printed-wiring boards, as specified in Conformal Coatings on Printed-Wiring Boards, Section 77.

33.4 测试样品及数据

33.4.1 测试时需提供以下样品及数据。

A)至少28个烟雾报警器,12PCS预先调整为最大灵敏度(依正常生产线校机方式),16PCS调整为最小灵敏度,从两批中各取四个进行校机,偏差不能超过25%,制定出用于生产的最大及最小灵敏度.如果有不同功能的报警器,在进行章节37灵敏度测试需用不同的方法去监控每一种功能.

B)附加一套未装配的报警器.

C)如果是光电报警器,需要附加3个,依62.2的方法使光衰减50%输出的样品.

D)安装及操作说明,见5.1及5.2说明及总则,章节94.

E)如果需要,在线路板上有涂层覆盖的,按照77描述章节描述准备样品.

33.4.2 For alarms employing a battery as the main operating supply, 24 additional battery operated alarms for long term battery tests or equivalent test circuit set ups with appropriate measuring facilities to monitor the battery voltage, standby current, and alarm current shall be provided. See the Battery Tests, Section 63.

33.4.2 若报警器为电池供电,需多加24PCS做长时间电池测试或相等的测试电路监控电池的电压,静态电流与动态电流需要提供,见章节63—电池的测试.

33.4.3 Four battery test setups shall be provided for subjection to each of four environmental conditions. Each set up shall be representative of six alarms and shall include test terminals and switches, limiting resistors, the alarm horn, and batteries. The value of resistors shall represent the normal standby current which is obtained from a complete alarm.

33.4.3 四个电池测试装置用于四种环境条件的测试.每个装置可代表六个报警器,要设有测试端子,开关,限制电阻,蜂鸣器及电池,电阻阻值要代表报警器里静态电流的值.

33.4.4 The batteries shall be connected in the test circuit with the same terminal arrangement employed in the alarm. Provision for connection of the actual sounding appliance used in the detector for novelty and weekly testing shall also be made. See the Battery Tests, Section 63.

33.4.4 电池被连接到电路中(使用报警器中相同的电池片),同时连接与报警器相同的蜂鸣器以利进行每周测试,见电池测试章节63.

33.5 Component reliability data

33.5.1 Data on alarm components, such as capacitors, resistors, solid state devices, and similar components, shall be provided for evaluation of the reliability of the components for the intended application. When a Mil-Spec. is referenced, a

copy of the specification is to be provided for review.

33.5 元件可靠性数据

33.5.1 报警器元件的数据,如电容,电阻,固体器件以及类似的元件,用以评估元件可靠性,当参照美军标规格,需提供规格复印件用以评估.

33.5.2 The data required by 33.5.1 shall include the following or equivalent information:

33.5.2 33.5.1要求的数据需包含以下相关的信息.

a) Component and overall alarm reliability analysis per Military Standard 217B, described in 4.1.

依美军军标217B,元件及报警器总的可靠性分析,在4.1中有描述.

b) Component vendor's reliability and life expectancy data. This shall include failure rate data at rated values and derated values. The latter data is required only where the derating values form the basis of reliability.

元件供应商提供可靠性及平均寿命数据,它包括规定值及规定值以下的不良率,后者数据只在降级形势下需要

c) General description of the alarm manufacturers quality assurance (QA) program. This data shall include incoming inspection, in-process QA, burn-in data and testing. This applies to complete and partial assemblies as well as individual components.

报警器生产商品质量保证程序的总的描述,此程序应包括来料检验,制程检验,老化测试及数据,适用于成品及组件.

d) Component Fault Analysis – Effect of failure, open and short, of capacitors and limited-life components on operation of an alarm.

零部件不良分析---不良效果,开路及短路,报警器电容及有寿命限制的元器件.

e) Maximum vendor's ratings for each component as well as the actual maximum operating values (voltage and current) in the alarms.

供应商提供的最大等级,如电压及电流.

f) A description of component screening and burn-in test data for solid-state devices or integrated circuits which operate at greater than the limits described in note b of Table 47.1.

固态器件或IC超限47.1B老化测试数据.

g) General calibration procedure of test instruments employed by the manufacturer in the calibration of an alarm.

报警器制造商使用测试设备的校验程序.

h) A general description of the circuit operation under standby, alarm, and trouble conditions.

报警器待机,报警及错误信号操作条件的描述.

i) A description of the smoke test chamber, including drawings and operation procedure, to be used by a manufacturer in conducting the factory smoke tests.

制造商烟箱描述,包括图纸及操作程序.

34 Normal Operation Test

34.1 General

34.1.1 An alarm shall operate for all conditions of its intended performance, at all sensitivity settings, when energized from a source of rated voltage, under all conditions covered both in the installation instructions and in any supplementary information provided by the manufacturer.

34. 正常操作测试

34.1 总则

34.1.1 报警器应在工厂安装说明书及补充信息各种条件下通电后正常运转.

34.1.2 The test voltage is to be in accordance with 33.3.1. The alarm is to be in the standby condition and prepared for its intended signaling operation when it is connected to related devices and circuits.

34.1.2 测试电压要符合33.3.1的要求,当通电后报警器要进入随时待机报警状态.

34.1.3 The introduction of smoke into the detection chamber, such as from a smoldering cotton lamp wick, rope, or equivalent, shall result in the operation of the alarm in its intended manner. See 37.1.1. The alarm signal shall persist for at least 4 minutes under an abnormal level of smoke.

34.1.3 当报警器检测腔进入烟雾,如闷燃的棉绳或类似的物质燃烧后产生烟雾,应检测并进入状态,见章节37.1.1,报警信号在这种环境中应至少持续4分钟.

34.1.4 A smoke alarm that employs a secondary power supply shall operate for alarm signals with the main power de-energized.

34.1.4 若报警器有主电及电池供电,在主电断电后报警器仍能正常工作.

34.1.5 When single station smoke alarms are intended for multiple station connection, the operation for alarm of one station shall result in the alarm signal of all connected stations being energized and the station that initiated the alarm signal shall be identified. See 25.7. When the interconnection wiring is not supervised for opens, shorts, and grounds, no more than 12 smoke alarms, or 18 alarms [12 smoke and 6 other (heat, CO, or similar alarms)] shall be specified for interconnection. When the interconnection is supervised, no more than 64 alarms shall be specified for interconnection.

34.1.5 当单个报警器连机,一个报警器要能激发所有报警器报警,并能识别最初报警的单机,见25.7.若报警器互连不能监控开路,短路以及接地,不能超过12个烟雾报警器或18个(12个烟雾报警器与6个其它的报警器(热报警器,CO报警器或其它的报警器)),若互连有监控则不能超过64个报警器。

34.1.6 When a heat detector is provided integral with a single station smoke alarm, or is intended to be connected to a remote initiating device circuit of a multiple station smoke alarm, actuation of the heat detector shall result in the same type of alarm signal as when actuated by smoke.

34.1.6 当热检测器与烟雾报警器互联,或连接到带遥控电路的互联烟雾报警器,激活热检测器将导致烟雾报警器如同在烟雾里发出相同的报警信号。

34.1.7 Neither principle of operation of a combination smoke alarm shall be rendered inoperative by any of the Performance Tests, Sections 34 – 76, of this standard. A circuit analysis shall be made, supplemented by electrical measurements when required, to determine that both principles of operation contribute to alarm actuation.

34.1.7 不是这两种工作原理的综合烟雾报警器对本标准34-76的测试不适用,要分析电路,必要时测量电气以确定这两种工作原理能否激活报警器。

34.1.8 Operation for alarm of a smoke alarm with integral transmitter that is energized by an initial pulse(s) shall result in an alarm signal being locked in for at least 4 minutes at a compatible receiving unit located at the maximum distance specified by the manufacturer, when tested under free-field conditions with no obstructions between the detector transmitter and receiver units. Refer to 94.1 (m) for instructions to be provided. Lock-in of the receiver is not required when the receiving unit audible alarm signal is energized in time sequence and duration with the detector.

34.1.8 关于带无线功能的烟雾报警器,在制造商规定的在无障碍空旷场地最大距离发送触发信号,能持续报警4分钟,见94.1(m)的说明,当报警器接到报警信号时无需再固定接收端。

34.1.9 An alarm or accessory that employs one or more nonfire-alarm features shall operate as follows:

a) The smoke alarm fire alarm signal shall take precedence or be clearly recognizable over any other signal even when the nonfire alarm signal is initiated first.

34.1.9 报警器或配件使用一个或多个非火警特征需要有下面的操作功能.;

a) 烟雾报警器在激发时火警信号要优先发出,即使先检测到非火警信号也要这样。

b) Distinctive signals shall be obtained between the smoke detector fire alarm and other nonfire alarm functions. The use of a common sounding appliance for the fire alarm and nonfire alarm function(s) shall be used only when distinctive signals are obtained. A steady continuous sound for a fire alarm function and a pulsing sound for the nonfire-alarm (burglary) signaling function is appropriate. When an audible trouble signal is additionally provided it shall be distinctive from all alarm signals. It is not prohibited that the trouble signal is common to all functions employed.

b) 在烟雾检测器,火警以及其它非火警报警功能中要有不同的声音.稳定连续的声音是火警,脉冲声音为非火警(盗警).烟雾报警器报警时要不同于这些声音,但不限制故障声音报警。

c) Any fault condition of limited life nonfire alarm components shall not interfere with the operation and supervision of the smoke alarm. See 36.1.5.

c) 非火警部件在寿命故障不能干预到烟雾报警器的正常运转及监控,见36.1.5。

34.2 Alarm silenced period

34.2.1 To determine the duration of the alarm silenced period each of four smoke alarms, in the normal standby condition, is to be placed in the sensitivity test chamber. See the Sensitivity Test, Section 37. The smoke is to be increased until the alarm goes into an alarm condition. The smoke is to be maintained at an abnormal amount for the duration of the test. After the alarm has been in an alarm condition for 1 minute, the silencing means is to be actuated and the time recorded between operation of the silencing means and reactivation of the alarm signal. The maximum time of silencing shall not exceed 15 minutes. See 7.1.

34.2 HUSH时间

34.2.1 取四个烟雾报警器确定HUSH时间,在待机状态下放入烟箱,见章节37灵敏度测试.增加烟量致使报警器报警,在报警器持续报警1分钟,按下HUSH键并记录时间,在报警器再次报警HUSH时间不能超过15分钟,见7.1。

34.2.2 With the maximum number of alarms interconnected in a multiple station configuration as specified by the installation instructions, one alarm is to be placed into an alarm condition by permitting an abnormal amount of smoke to fill the sensitivity test chamber in accordance with the procedure described in 34.2.1. The alarm silencing means on that one unit is then to be actuated. The time is then to be recorded between operation of the silencing means and reactivation of the alarm. During the silenced period, the other alarms in the system are also to be subjected to an abnormal amount of smoke to determine that they are still operational for initiating an alarm. The maximum silenced period shall not exceed 15 minutes. See 7.1.

34.2.2 依照安装说明书,最大数量互联烟雾报警器,将其中一个报警器置于烟箱依34.2.1测HUSH并记录时间,同时其它报警器也置于烟箱要在报警状态.HUSH时间不能超过15分钟,见7.1.

34.3 Standardized alarm signal

34.3.1 An alarm shall produce an audible signal in the form of the three pulse temporal pattern shown in Figure 34.1. Each ON phase shall last 0.5 second 10 percent, followed by an OFF phase of 0.5 second 10 percent. After the third of these ON phases, there shall be an OFF phase that lasts 1.5 seconds 10 percent.

34.3 标准报警信号

34.3.1 报警器应产生三声脉冲声音信号,如图34.1. ON方波(波峰)脉冲应持续0.5S+/-10%,OFF停顿时间0.5S+/-10%,经过三次响声后将停顿1.5S+/-10%.

34.3.2 A voice message shall be permitted to be included with the standardized alarm signal in one or both of the formats noted below.

34.3.2 允许在报警信号中增加语音信息或以下描述的两种形式.

a) A voice message of 1.5 seconds or less in length shall be permitted to be inserted into any or all of the 1.5 second OFF phases of the temporal pattern.

A) 1.5S或少于1.5S的语音信息允许插入1.5S的停顿时间.

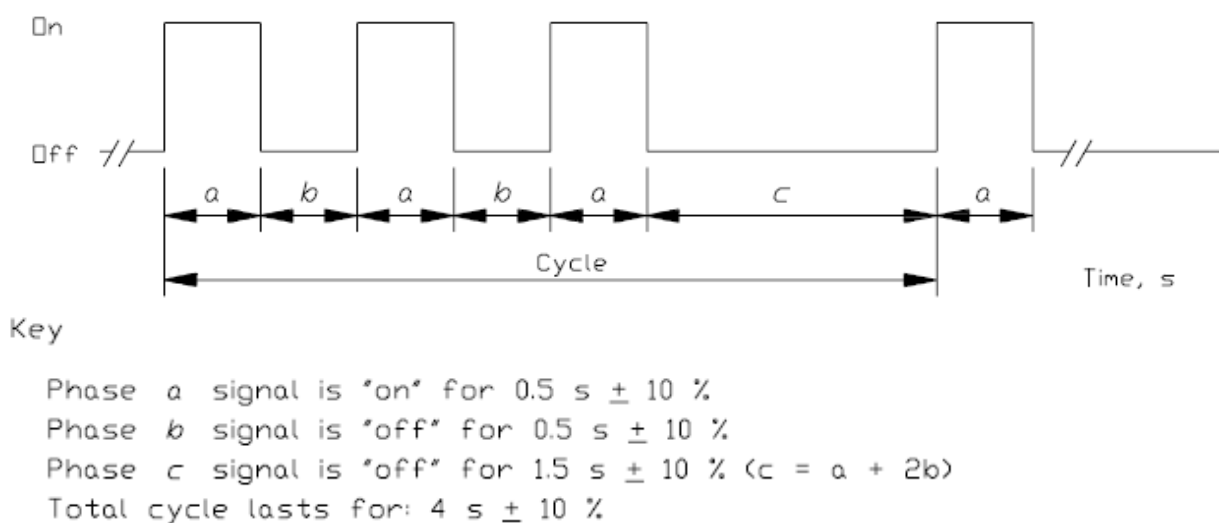
b) A voice message that exceeds 1.5 seconds but does not exceed 10 seconds in length shall be permitted to be inserted following a minimum of 8 cycles of the initial "three pulse" temporal pattern. This voice message shall be followed by not less than 2 cycles of the "three pulse" temporal pattern. The voice message shall then be permitted to be repeatedly inserted provided that each additional use of the voice message follows at least 2 cycles of the "three pulse" temporal pattern.

B) 大于1.5S但小于10S的语音信息允许在最少8次正常循环报警后插入,语音信息要跟在致少两次正常报警模式后并允许此模式重复.

c) In Board and Care Occupancies, provisions should be made to allow premise staff to have multiple languages available which reflect the general region.

C) 语音信息依不同区域要有不同语言.

Figure 34.1
Standardized alarm signal temporal pattern



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34.4 Sensitivity shift criteria

34.4.1 During or immediately after performance tests, the sensitivity of the detectors shall not vary more than ± 1 percent per foot obscuration (0.014 optical density per meter) from the value recorded prior to the test. In no circumstance shall the sensitivity of a detector shift outside the sensitivity limits as specified in 37.1.1.

34.4 灵敏度变化标准

34.4.1 在测试中或刚刚测试后,报警器的灵敏度偏差不能超过先前测试值的 $\pm 1\%OBS(0.014I_{光强})$,灵敏度不能超过37.1.1的界限.

35 Circuit Measurement Test

35.1 Current input

35.1.1 Except for a battery operated alarm, the input current of a smoke alarm shall not exceed the marked rating by more than 10 percent when the alarm is connected to a source of supply in accordance with 33.3.1 and operated under the conditions of intended use (standby and alarm).

35 电路测量测试

35.1 电流输入

35.1.1 除只有电池供电的报警器,当接入33.3.1要求的电源,在待机及报警状态下输入电流不能超出额定电流的10%

35.2 Battery trouble voltage determination

35.2.1 An increase in the internal resistance, or a decrease in terminal voltage, of a battery employed as the primary source of power to an alarm shall not impair operation for an alarm signal before a trouble signal is obtained. In addition, any combination of voltage and resistance at which a trouble signal is obtained shall be greater than the battery voltage and resistance combination measured over the manufacturer's specified battery life (a minimum of 1 year) period in the room ambient condition of the Battery Tests, Section 63.

35.2 电池低压检测

35.2.1 报警器内所用电池,在未有低压信号发出前,不能因为内阻及内压降低而削弱报警信号强度,在获得低压报警信号的电压及阻抗要高于工厂的规定,电池室温环境至少一年使用寿命,见章节63,电池的测试.

35.2.2 The trouble level of a battery operated smoke alarm shall be determined (using the test circuit in Figure 35.1 and the voltage-resistance curves of Figure 35.2) for each of the following voltages:

- a) Rated battery voltage.
- b) Trouble level voltage (assuming minimal or no series resistance).
- c) Voltages between rated and trouble level voltage.

35.2.2 报警器低压应被确定(使用35.1测试电路及35.2电压&阻抗曲线).

A) 电池额定电压.

B) 电池低压(如果是最小的或没有串联电阻的)

C) 低压与额定电压之间的电压段.

35.2.3 To determine compliance with 35.2.1 each of three alarms is to be connected in series with a variable regulated direct current power supply and a variable resistor as illustrated in Figure 35.1. The trouble level is to be determined by the following steps:

35.2.3 确定符合35.2.1,取3个报警器做此测试,将其串连接入35.1示图的可调直流电源及可变电阻,低压规格将由以下步骤决定:

a) Rated Battery Voltage – The voltage of the power supply is to be set at the rated battery voltage and the series resistor at 0 ohm. The resistor is to be increased in increments of 0.1 – 10 ohms, at a rate of not more than one increment per minute, until a trouble signal is obtained. The alarm is to be tested for alarm operation at each resistance level and at the trouble signal level.

A) 电池额定电压----将直流电源电压调整为电池额定电压,并把串联电阻调整为0OHM.电阻以0.1-10OHM增量增加,每分钟增量不能超过1个,直到获得低压信号为止,报警器在此过程中,不同阻值及低压信号时要测试报警信号.

b) Trouble Level Voltage – With the variable resistor set at 0 ohm, the voltage of the power supply connected to the alarm is to be reduced in increments of 1/10 volt per minute to the level where the trouble signal is obtained. The alarm is to be tested for alarm operation at each voltage level and at the trouble signal level.

B) 电池低压-----将可变电阻调为0OHM,连接报警器的直流电源以每分钟0.1V的速度减少,直到获取低压信号,测试过程中在各电压段及低压段要测试报警信号.

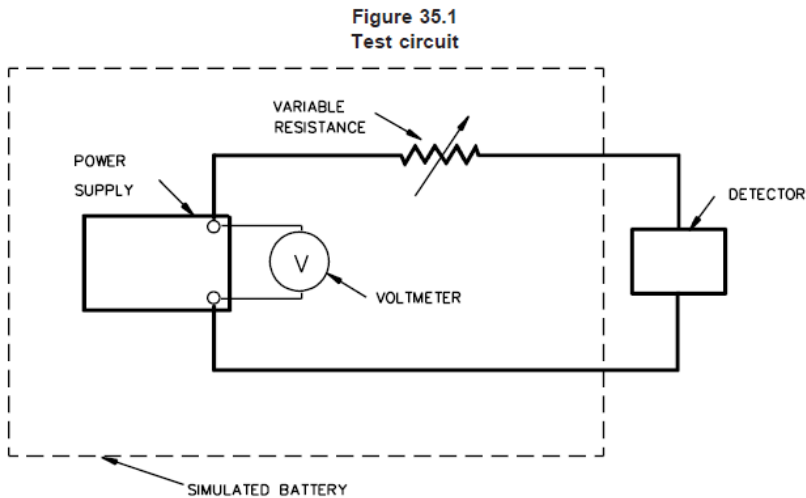
c) Voltage Values Between Rated and Trouble Level Voltages – The voltage of the power supply is to be set at

prespecified voltages between the rated battery voltage and the trouble level voltage. The series resistor is then to be increased in increments of 0.1 – 10 ohms, at a rate of not more than one increment per minute, until a trouble signal is obtained. The alarm is to be tested for alarm operation at each resistance and voltage level and at the trouble voltage level. A number of voltage values shall be used to determine the shape of the trouble level curve.

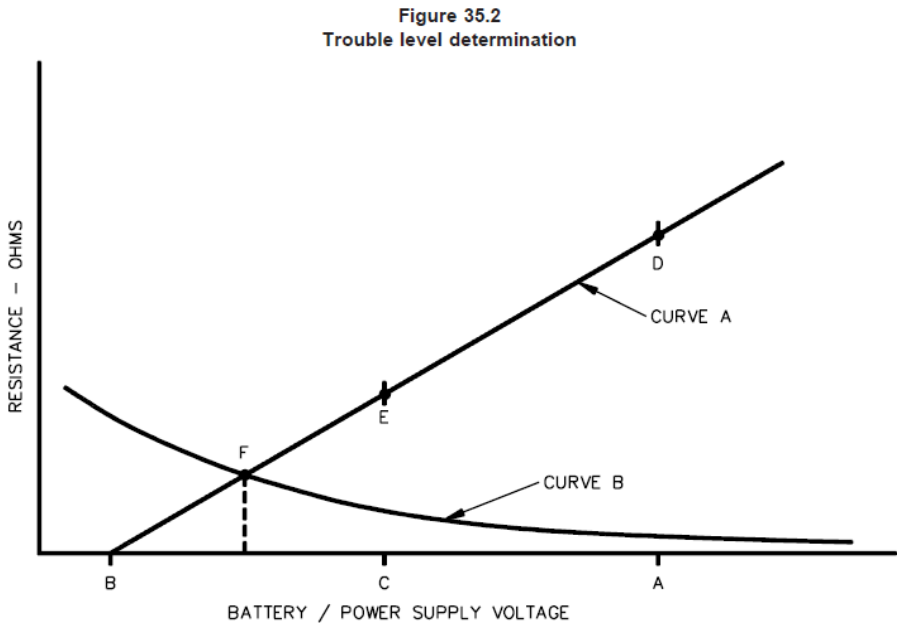
C) 电池额定电压及低压之间电压值---直流电源在额定电压与低压之间被提前设定.串联电阻以0.1-10OHM增量增加,每分钟不能超过一个增量值,直到低压值获得,在不同阻值及电压值及低压值要测试报警信号,一定数量的电压值用来决定低压曲线.

35.2.4 To determine that a battery is capable of supplying alarm and trouble signal power to the alarm for at least the manufacturer's specified battery life (1 year minimum) under the room ambient condition described in the Battery Tests, Section 63, Curve A of Figure 35.2 is to be plotted from the data obtained in the measurements described in 35.2.3 and compared to Curve B of Figure 35.2, which is plotted from data generated in the 1 year battery test. The intersection of Curves A and B shall not occur before the manufacture's specified battery life (1 year minimum) and all points of Curve B to the right of point F (extended to the base line), shall be below Curve A.

35.2.4 用于确定电池依章节63电池的测试,生产商规定室温环境下至少使用一年,在此时间段内电池要用能力供应报警与低压报警,图35.2曲线A数据来源于35.2.3的测量值,曲线B数据来源于电池一年测试,曲线A与曲线B在制造商规定电池寿命(最小一年)未到前不会交叉,所有曲线B延长过F点到X轴将低于曲线A.



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- A – Rated battery voltage.
- B – Trouble level voltage (assuming minimal resistance).

C – Voltage value between rated and trouble level.

D – Trouble level resistance at rated battery voltage.

E – Trouble level resistance at voltage value C.

F – Maximum permissible battery resistance and minimum voltage after 1 year in long-term battery test.

Curve A – Sample plot of voltage versus resistance (Alarm Trouble Level Curve) at which a trouble signal in an alarm is obtained.

Audibility measurement is to be made at points between D and F.

Curve B – Sample plot of battery internal resistance versus battery open circuit voltage derived from long term (minimum 1 year)

battery test. Shape and slope of curve, as well as point of intersection with Curve A, varies based on battery used.

A) 额定电池电压.

B) 故障电压(最小阻抗).

C) 故障电压与额定电压中间值.

D) 额定电压下的故障阻抗.

E) 电压C点的故障阻抗.

F) 经过一年长时间测试,电池允许的最大阻抗及最小电压.

曲线A---样品电压&阻抗点,低压报警曲线,在D与F之间要测DB.

曲线B---取自电池最小一年长时间测试内阻与开路电压对应点,形状与曲线斜率对A线的交点依电池的使用而不同.

36 Electrical Supervision Test

36.1 General

36.1.1 A single station smoke alarm shall be electrically supervised so that failure of a limited life component, open in an externally connected detector circuit, or ground fault on any externally connected wiring which prevents operation for an alarm signal from the alarm shall result in an audible trouble signal.

36 电气监控测试

36.1 总则

36.1.1 单点烟雾报警器要有电气监控以致于有寿命的元件开路,地线接错导致报警信号错误.

36.1.2 The wiring extending between alarms wired in a multiple station configuration shall be electrically supervised so that a short or multiple ground fault, which prevents operation for an alarm signal, shall result in an audible trouble signal or result in an alarm signal. An ☐open☐in any of the wiring between alarms is not required to be indicated by a trouble signal when the operation as a single station alarm is not prevented. This requirement does not apply to the interconnected wiring of alarms intended to be connected by a Class 1 wiring method.

36.1.2 互联的报警器连接点要监控以防止短路,地线接错导致错误报警,单点报警器接线处断路不用特别监控,此要求不适用于互联报警器采用CLASS 1的接线方法.

36.1.3 When an audible trouble signal is required to indicate a fault condition, it shall be produced at least once every minute for a minimum of seven consecutive days. The trouble signal shall be distinctive from the alarm signal.

36.1.3 当要求有错误声音信号指示错误条件,要至少每分钟发出一声并至少连续7天,故障信号要不同于报警信号.

36.1.4 To determine that an alarm unit complies with the requirements for electrical supervision, the alarm is to be energized in the standby condition, and the type of fault to be detected is then to be introduced. Each fault is to be applied separately, the results noted and the fault removed. The alarm is then to be restored to the standby condition prior to establishing the next fault.

36.1.4 确定报警器符合符合电气监控的要求,先将报警器在正常条件下激活,分别将各种错误接入验证是否有效,移除故障,报警器恢复正常状态.

36.1.5 A fault condition (open, ground, or short), of other than the smoke detection circuit of a smoke alarm with a nonfire-alarm feature shall not prevent alarm signal operation as a smoke alarm. For this test the alarm is to be energized from a rated source of supply in the normal standby condition and the fault is to be applied. With the fault applied the alarm is then to be subjected to an abnormal smoke condition which shall result in an audible smoke alarm.

36.1.5 错误信号(开路,接地,短路),除了烟雾检测线路有非火警特征,这种测试,报警器要用额定电源供电,加入烟导致报警器报警.

36.2 AC powered units

36.2.1 Failure of the main power supply to an alarm other than those powered from a primary battery shall be indicated by de-energization of a ☐power-on☐lamp.

36.2 AC供电的报警器

36.2.1 AC供电的报警器需要有电源指示灯.

36.2.2 Neither loss nor restoration of power shall result in an alarm signal under either momentary or extended (at least 1/2 hour) power outage conditions. Momentary energization of the alarm circuit (maximum of 1 second), and energization of the trouble circuit (maximum of 2 minutes), is appropriate. A gradual increase to 110 percent of rated voltage or reduction to 0 volts from rated voltage at a rate of not greater than 5 volts per minute shall not result in energization of the alarm signal for more than 1 second, nor energization of the trouble circuit for more than 2 minutes.

36.2.2 断电通电瞬间需要有报警信号发出或电耗尽条件下能延长半小时.报警电路瞬间通电(最大1S),故障电路通电(最大2分钟)是合适的.逐渐增加额定电压的110%或以小于5V/MIN降低电压到0V,将不会导致报警大于1S,也不会导致故障报警大于2分钟.

36.2.3 Loss of power to a single unit of a multiple station alarm configuration, while energized in the standby condition, shall not result in a false alarm and shall not prevent the operation of the remaining units for alarm.

36.2.3 联机报警器其中一个单机断开电源在通电状态下不会导致误报警也不会阻止其它报警器报警.

36.3 Battery powered (primary or secondary) units

36.3.1 An alarm which uses a battery as the main source of supply shall be capable of producing an alarm signal for at least 4 minutes at the battery voltage at which an audible trouble signal is obtained followed by 7 days of audible trouble signal indication.

36.3 电池供电的报警器

36.3.1 当报警器为电池供电,在故障状态下,要有能力产生至少4分钟的报警并能连续7天.

36.3.2 An alarm which uses a battery (or other applicable rechargeable energy storage media) as the secondary source of supply shall be capable of supplying the alarm with a minimum of 7 days of power in the normal standby condition, and producing an alarm signal for at least 4 minutes at the battery voltage at which an audible trouble signal is obtained followed by 7 days of audible trouble signal indication.

36.3.2 当报警器采用电池或充电电池为备用电源要有能力供应报警器正常工作至少7天,故障信号至少4分钟持续7天.

36.3.3 To determine compliance with 36.3.1, three samples, powered from primary battery supplies, shall be equipped with batteries which have been depleted to the trouble signal level. The samples are then to be placed in alarm for 4 minutes. Following the 4 minutes of alarm the trouble signal shall persist for at least seven consecutive days. It is possible to deplete a fresh battery by applying a 1 percent or smaller loading factor based on the ampere hour rating of the battery. For example, a 1000 milliampere-hour rated battery is depleted by applying a 10 milliamperes (1 percent load) or less drain continuously until the battery voltage reaches the predetermined test level.

36.3.3 确定是否符合36.3.1的要求,取3个报警器用快耗到低压报警的电池供电,让报警器报警4分钟后,故障信号持续至少7天,电池可能要用新电池加1%的负载(AH),如额定1000MAH的电池加10MAH负载或少一点直到电池耗到低压报警点.

36.3.4 To determine compliance with 36.3.2 for alarms whose secondary supply is a battery or other applicable rechargeable energy storage media, three samples shall be powered from secondary sources of supply (with the primary source of supply disabled) which are fully charged, or in fresh condition (see 14.1) and allowed to remain in the normal standby condition for a minimum of 7 days. The samples shall not emit audible low battery trouble signals before the end of the 7 day period. Three samples shall also be equipped with secondary supplies (with the primary source of supply disabled) which have been depleted to the trouble signal level. The samples are then to be placed in alarm for 4 minutes. Following the 4 minutes of alarm the trouble signal shall persist for at least 7 consecutive days. It is possible to deplete a fresh battery by applying a 1 percent or smaller loading factor based on the ampere hour rating of the battery. For example, a 1000 milliampere-hour rated battery is depleted by applying a 10 milliamperes (1 percent load) or less drain continuously until the battery voltage reaches the predetermined test level.

36.3.4 当报警器采用电池或充电电池为备用电源确认是否符合36.3.2,取3个报警器样品将市电断开,用满额电池供电(见14.1),在在常待机下至少保持7天,7天内不能发出低压报警声,三个报警器再用达到低压水平的电池持续报警4分钟后又至少连续7天低压报警,电池可能要用新电池加1%的负载(AH),如额定1000MAH的电池加10MAH负载或少一点直到电池耗到低压报警点.

36.3.5 When a battery operated alarm locks-in on alarm, it shall automatically transfer from alarm to audible trouble when the battery voltage reaches the trouble signal level. When an alarm does not lock-in on alarm, automatic transfer from alarm to trouble is not required.

36.3.5 当电池供电的报警器锁定在报警状态下,会自动转到低压报警状态,当没有锁定在报警状态,从报警转到低压报警是不需要的.

36.3.6 To determine compliance with 36.3.5, two samples of an alarm that locks-in on alarm shall be equipped with batteries which have been depleted and stabilized at just above the trouble signal level. The samples are then to be placed in alarm and the battery voltage monitored. The samples shall automatically transfer to audible trouble when the battery trouble voltage is reached. The trouble signal shall persist for seven consecutive days. In cases where the battery voltage recovers to a point where the trouble signal is no longer emitted, the unit shall be placed into alarm again until the trouble signal is reinstituted.

36.3.6 符合36.3.5的确认,电池供电的两个报警器锁定在报警状态到故障报警信号发出,监控电池电压,当电池故障电压达到将自动转为故障声音信号,故障信号将持续7天,万一电池电压恢复不发出故障信号,再按住报警直到故障信号获取。

36.3.7 A decrease in the battery capacity of an alarm, which uses a battery as the main power supply, to a level where at least a 4-minute alarm signal is not obtainable shall result in an audible trouble signal. The trouble signal is to be produced at least once each minute for seven consecutive days.

36.3.7 用电池供电的报警器,电池耗到4分钟持续报警,若没达到,将直接进入故障信号,至少每分钟一次连续7天。

36.4 Component failure

36.4.1 Failure of a limited life electronic component, such as opening or shorting of electrolytic capacitors, shall be indicated by an audible trouble or alarm signal, or a reliable component shall be used. The reliable component shall fail within the reliability prediction described in 3.5.

36.4 零部件失效

36.4.1 有效年限的电子零件失效,如电解电容的开路或短路,需有报警信号发出,或者使用一个可靠的零件,可靠性零件失效要符合3.5。

36.4.2 Internal shorts between any two elements of an electronic tube which prevent operation of the unit shall be indicated by either an audible trouble signal or an alarm signal. Such failures shall not result in a risk of fire.

36.4.2 晶体管内部短路阻止报警器正常操作,需要有报警信号或故障信号发出,这种失效将不影响火灾风险。

36.4.3 The heaters of all electronic tubes or other functional heating elements employed in an alarm shall be electrically supervised to indicate an open circuit fault by an audible trouble signal when the fault prevents operation of the unit or results in loss of sensitivity or response to the Fire Tests, Section 44, and the Smoldering Smoke Test, Section 45.

36.4.3 所有电子管加热器或其它功能的加热部件需要有电气监控,当开路阻止报警器正常工作或导致灵敏度损耗,影响火灾测试(章节44)及闷燃测试(章节45)需要有故障信号指示。

36.5 Photocell illuminating lamps

36.5.1 The filament(s) of a photocell illuminating lamp(s), which burns out periodically, shall be electrically supervised to indicate an open circuit fault by an audible trouble signal.

36.5 光电池照明灯

36.5.1 光电池灯丝周期的烧坏,需要有电气监控,指示开路的故障报警。

36.5.2 A limited life LED employed as the light source of an alarm shall be electrically supervised to indicate an audible trouble signal in the event of an open, short, or, except as exempted in 36.5.3, 50 percent or greater light degradation. Energization of the alarm signal for a maximum of 5 seconds prior to the trouble signal is appropriate.

36.5.2 有寿命周期的LED用于报警器做光源需要有电气监控,一旦开路,短路或不在36.5.3中描述的光衰减50%或更多需要有故障声音报警.最多5秒提前于故障信号之前是合适的。

36.5.3 An audible trouble signal for greater than 50 percent light degradation of a limited life LED is not required when light degradation data is supplied by the LED manufacturer to show that, for the conditions under which it is to be operated, the LED does not reach 50 percent light output at the end of the reliability prediction period. See 3.5.

36.5.3 当LED制造商提供数据输出未达到50%,也不影响报警器正常操作,这时对故障信号发出没有要求.见3.5。

36.5.4 When the light output of an LED source lamp is reduced to the 50 percent level, or the light level anticipated at the end of the reliability prediction is less than 50 percent, the sensitivity of the alarm shall not be reduced by more than 50 percent of the value at full output, and in no case shall it exceed 4 percent per foot (12.5 percent/m) for gray smoke and 10 percent per foot (29.2 percent/m) for black smoke. See the Reduction in Light Output Test, Section 62.

36.5.4 当LED光源输出衰减到50%或亮度提前低于预定寿命的50%,报警器的灵敏度不能低于50%,任何情况下,灰烟里灵敏度不能超过4OBS,黑烟里不能超过10OBS,见光线输出衰减测试(章节62)。

36.5.5 An LED employed as the light source of a photoelectric smoke alarm is required to be electrically supervised by means of an audible trouble signal unless it is reliable based on its use in the detector and supporting reliability data provided by the component manufacturer. It is possible for failure of the reliable LED at the end of the failure rate

prediction described in 3.5, to result in an alarm signal.

36.5.5 如果LED用于光电报警器的光源,除非它有很好的可靠性及制靠商提供的可靠性数据,否则需要有故障声音的监控,尽可能的在预估失效期内失效导致报警,见描述3.5.

36.6 External wiring

36.6.1 An open or ground fault in the loop wiring connected from a single station smoke alarm to additional remote heat detectors that prevent operation for alarm signals from any of the interconnected alarms, shall not result in an alarm signal and shall result in an audible trouble signal. It is possible for a short or double ground fault in the leads to result in an alarm.

36.6 外部引线

36.6.1 单点烟雾报警器互联热报警器连接线开路或接地错误不应导致报警,应产生故障信号,(引线短路或都接地有可能导致报警).

36.6.2 An open, ground fault, or short in any power limited fire protective circuit wiring among multiple station interconnected alarms or any wiring extending to a remote signaling device is not required to be indicated by a trouble signal when the fault does not prevent operation of any of the interconnected units as a single station alarm. It is not prohibited for a ground fault to prevent operation for alarm when the interconnected wiring is to be made in accordance with Class 1 requirements of the National Electrical Code, ANSI/NFPA 70. The installation wiring diagram shall indicate the type of connections to be employed.

36.6.2 互联报警器AC供电消防电路或多点报警器延长线开路,接地错误只影响单个报警器工作,组内不影响其它报警器,这时不要求有故障信号监控,接地错误影响报警操作,但互联接线为NFPA70 CLASS1接线要求的不限制.安装接线图要指出是哪种接线方式.

36.6.3 An open, ground fault, or short in the power limited fire protection circuit conductors extending between the output of a separate power supply and an alarm, which prevents operation of the alarm, shall result in de-energization of the smoke alarm □power-on□□light.

36.6.3 当有额外供电的AC消防电路之间开路,接地故障或短路阻碍报警器工作,需要有断电提醒(亮灯指示).

37 Sensitivity Test

37.1 General

37.1.1 A smoke alarm when calibrated to each end of its production window shall operate within the limits specified below when subjected to an aerosol buildup using the test equipment described in 37.3.1 –37.3.3, and when subjected to a range of air velocities. For an alarm which employs a variable sensitivity setting, test measurements are to be made at maximum and minimum settings. The sensitivity measurement is to be made with the alarm located in the air stream in the least and most favorable horizontal positions for smoke entry as determined in the Directionality Test, Section 39.

Percent per foot	Percent per meter	OD ^a per foot	OD per meter
4.0	12.5	0.0177	0.0581 maximum
0.5	1.6	0.0022	0.0072 minimum
^a See 37.3			

- a) Visible Smoke Obscuration Limits:
- b) Measuring Ionization Chamber (MIC) Measurement:
93 pA (minimum) – 37.5 pA (maximum)

37 灵敏度测试

37.1 总则

37.1.1 当使用37.3.1-37.3.3要求的设备及风速范围内产生烟雾下校验灵敏度窗口,要在上表的范围内.当报警器应用可变灵敏度设定,测试测量要被设定在最大及最小值.灵敏度测试时要将报警器固定在气流最不利与最有利进入的水平位置,见章节39---方向性测试.

- A)烟雾浓度界限.
- B)离子检测腔.

93 pA (minimum) – 37.5 pA (maximum)

37.1.2 A smoke alarm employing a secondary power supply shall operate within the limits specified in 37.1.1 when operating from the secondary power supply.

37.1.2 若烟雾报警器应用电池供电,当使用电池供电时,灵敏度要在37.1.1的范围内.

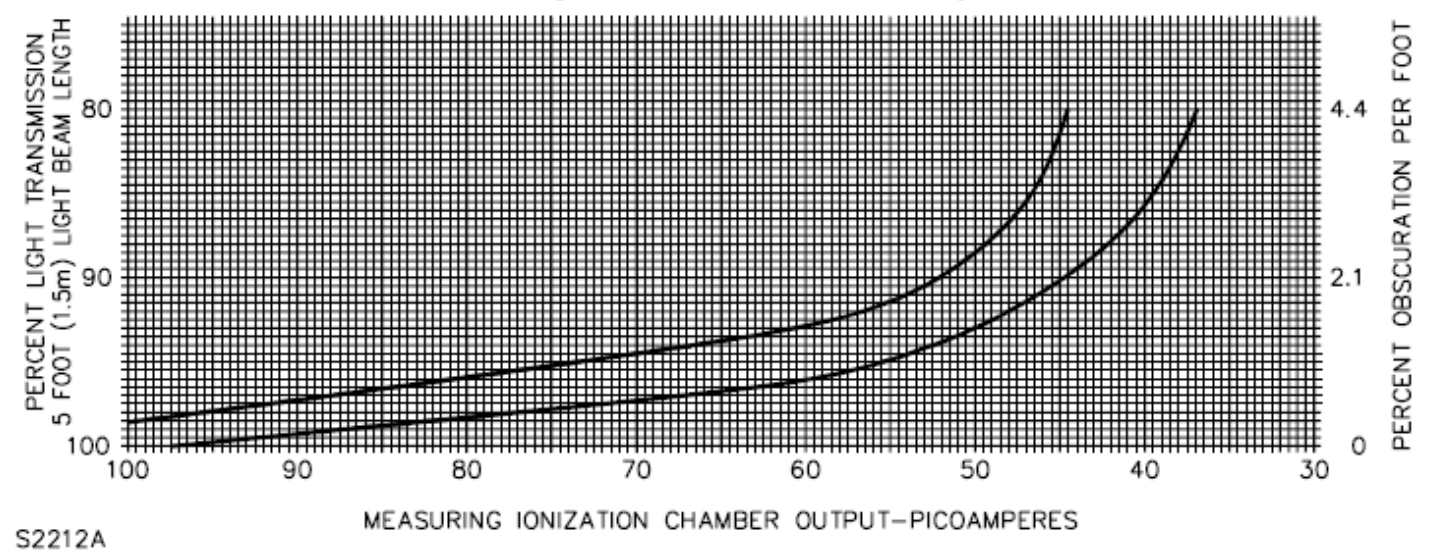
37.2 Aerosol generation equipment

37.2.1 The equipment used shall generate the buildup rates specified in Figures 37.1 and 37.2. The aerosol shall be produced mechanically, or by the slow smoldering of a cotton wick, or similar item, only when the appropriate buildup rates are obtained.

37.2 烟雾发生设备

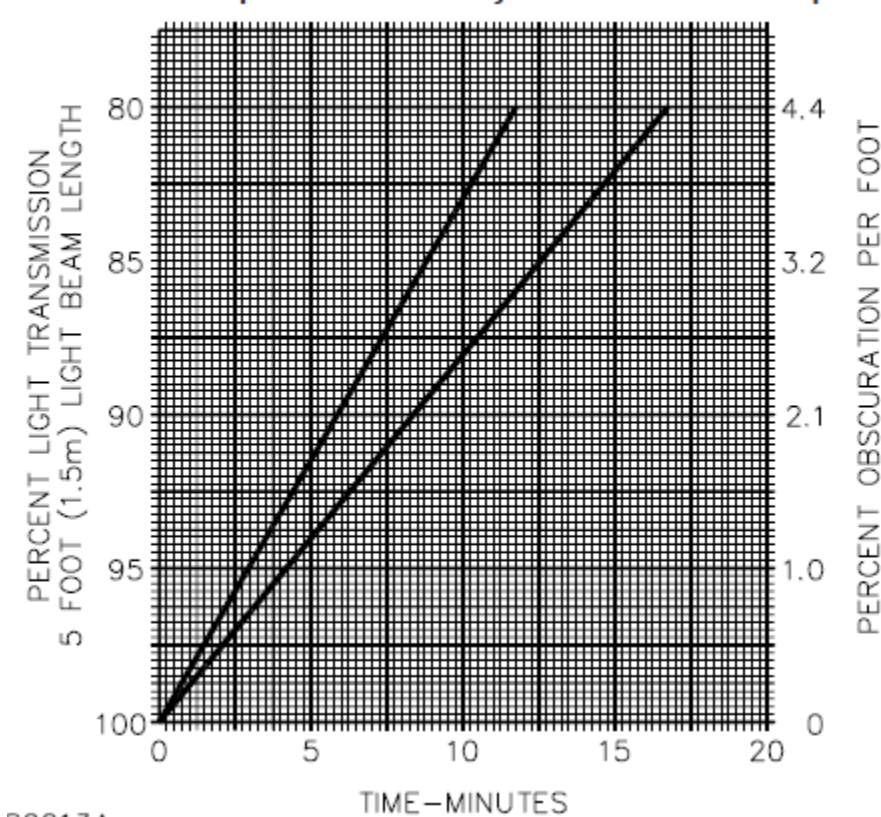
37.2.1 设备产生烟雾累积率曲线如图37.1及37.2,烟雾将被机械性的产生或棉芯闷燃产生或类似的方法,只要符合以下曲线就可以.

Figure 37.1
Sensitivity test limits – aerosol – 32 fpm



S2212A

Figure 37.2
Smoke build-up rate – sensitivity test – aerosol – 32 fpm



S2213A

37.3 Test equipment

37.3.1 The visible aerosol obscuration (optical density) in the test compartment is to be measured by means of a DC type micrometer having a maximum internal resistance of 100 ohms and full scale reading of 100 μ A used with a barrier type selenium photovoltaic cell, enclosed in a hermetically sealed case. An equivalent meter consists of a digital voltmeter having a minimum input impedance of 10 megohms in parallel with a 100 ohms resistance, and a 500 ohms

potentiometer. The meter and cell are to be used in conjunction with the light produced by a tungsten filament automotive type lamp (such as a prefocused spotlight bulb) energized from a constant current source at half rated voltage to provide a light beam of uniform flux density. The photoelectric cell and lamp are to be spaced 5 feet (1.5 m) apart. The following equations are to be used (Appendix B is provided for reference):

37.3 测试设备.

37.3.1 烟箱里的光学密度测量,使用DC微安表(最大内阻100OHM,100UA全刻度)连接硒光电池(密封在箱子里).类似的表包括数字伏特表(最小输入阻抗10MOHM)并联100OHM电阻及500OHM的电位计.表跟电池由汽车型的车灯(由1/2电压直流供电聚光灯)发出的均衡的光激活,光电池与灯的距离为1.5M,用下面的方程式(附件B供参考).

a) At any distance, the percent obscuration per foot (or per meter) is:

A) 在任何距离,烟雾浓度可见度为:

$$O_u = \left[1 - \left(\frac{T_s}{T_c} \right)^{\frac{1}{d}} \right] 100$$

in which:

O_u is the percent obscuration per foot (or per meter).

Qu:为烟雾浓度可见度.

T_s is the aerosol density meter reading with smoke.

Ts:为烟雾密度表烟雾下读数.

T_c is the aerosol density meter reading with clear air.

Tc:烟雾密度表纯净空气中读数.

d is the distance in feet (or meters).

d: 距离

b) The percent obscuration of light for the full length beam at any distance is:

b) 任何距离全波长光波可见度.

$$O_d = \left[1 - \frac{T_s}{T_c} \right] 100$$

in which:

O_d is the percent obscuration at distance d.

Qd: d距离的可见度.

T_s is the aerosol density meter reading with smoke.

Ts:为烟雾密度表烟雾下读数.

T_c is the aerosol density meter reading with clear air.

Tc:烟雾密度表纯净空气中读数.

c) The percent transmission of light for the full length beam at any distance is:

C) 任何距离全波长光线透射率

$$T_d = \left[\frac{T_s}{T_c} \right] 100$$

in which:

T_d is the percent transmission at distance d.

Td: d距离光线透射率.

T_s is the aerosol density meter reading with smoke.

Ts:为烟雾密度表烟雾下读数.

T_c is the aerosol density meter reading with clear air.

Tc:烟雾密度表纯净空气中读数.

d) When the percent obscuration per foot (or per meter) is known, it is possible to determine the percent obscuration for the full length of any longer beam by the following:

d)当烟雾浓度是知道的,就可以确定任何波长光线可见度.

$$O_d = \left[1 - \left(1 - \frac{O_u}{100} \right)^d \right] 100$$

in which:

O_d is the percent obscuration at distance d.

Qd: d距离的可见度.

O_u is the percent obscuration per foot (or per meter).

Qu:为烟雾浓度可见度.

d is the distance in feet (or meters).

d: 距离

e)At any distance the total optical density is:

e)在任何距离总的光学密度.

$$OD_t = \log_{10} \left(\frac{T_c}{T_s} \right)$$

in which:

OD_t is the Optical Density.

ODt: 光学密度.

T_c is the aerosol density meter reading with clear air.

Tc:烟雾密度表纯净空气中读数.

T_s is the aerosol density meter reading with aerosol.

Ts:为烟雾密度表烟雾下读数.

f) At any distance, the optical density per foot (or per meter) is:

f)任何距离下每英尺光学密度.

$$OD = \frac{\log_{10} \left(\frac{T_c}{T_s} \right)}{d}$$

in which:

OD is the Optical Density per foot (or per meter).

OD: 每英尺光学密度

T_c is the aerosol density meter reading with clear air.

Tc:烟雾密度表纯净空气中读数.

T_s is the aerosol density meter reading with smoke.

Ts:为烟雾密度表烟雾下读数.

d is the distance in feet (or meters).

d: 距离(英尺).

aA meter used for this purpose is Weston Instrument, Model 622, in conjunction with a Weston Instrument, Model 594 RR Photronic Cell.

所使用的表为**Weston**仪器,型号:622与同品牌的光电管配套(型号:594)

37.3.2 A Measuring Ionization Chamber (MIC)^b is to be used to measure the relative buildup of particles of combustion during each trial. The MIC utilizes the ionization principle with air drawn through the chamber at a rate of 25+/-5 liters per minute by a regulated vacuum pump.

^bElektronikcentralen, Horsholm Denmark, Measuring Ionization Chamber (MIC), Type EC 23095.

37.3.2 MIC用来监测每个测试循环所产生烟雾的浓度, (MIC利用离子原理,烟箱用真空泵所产生的风量在25+/-5升/分钟.)

MIC型号, EC23095,生产公司为Elektronikcentralen, Horsholm Denmark

37.3.3 A typical test chamber consists of the following items. It is not prohibited for different chamber configurations to be used as long as they provide a homogeneous aerosol mix and a laminar air flow across the alarm, adjustable from 30 to 150 feet per minute (0.16 to 0.76 m/s).

37.3.3 一个标准的烟箱包括以下几项,但并不禁止相同功能的油箱将汽雾水平吹过报警器,风速调整为30-150英尺/分钟 (0.16-0.76米/秒).

a) Outer Cabinet – Constructed of 3/4-inch (19.1-mm) exterior grade plywood, has overall inside dimensions of 65-3/4 inches (1.67 m) long by 19-1/4 inches (490 mm) deep by 18-1/8 inches (460 mm) wide. Has a centrally located gasketed hinged top door 33-7/8 inches (860mm) wide in the top with a 12 by 24 inch (305 by 610 mm) clear plastic window. A 1/4-inch (6.4-mm) diameter hole is located in the window center for air flow measurement. Box is provided with a 7-inch (178-mm) diameter exhaust port in the right end centered 4-1/2 inches (114 mm) above the bottom and employed with a sliding or hinged wooden cover.

a) 烟箱外围: 3/4英寸(19.1MM)耐风化的胶合板,内部尺寸65-3/4英寸(1.67M)长, 19-1/4英寸(490MM)深, 18-1/8英寸(460MM)宽.上盖33-7/8英寸宽, 有一个12X24英寸的透明塑料窗. 透明窗中心有一个直径1/4英尺圆孔用于测量风速,烟箱有一个直径7英寸排气孔位于烟箱右端靠底部4-1/2英寸处并带有一个滑动木盖.

b) Inner Compartment – Constructed of 3/4-inch (19.1-mm) exterior grade plywood, inside dimension 41-3/4 inches (1.06 m) long by 11-1/2 inches (292 mm) high covering the entire width of the inside of the outer cabinet. The left end has a 4-inch (102-mm) diameter hole for the 30 – 35 fpm circulating fan centered 4-1/2 inches (114 mm) from the side and 3-7/8 inches (98 mm) from the bottom near corner, a 5-3/4-inch (146-mm) diameter hole for the 150 fpm circulating fan centered 3-7/8 inches (96.1 mm) above the bottom and a 4-inch (102-mm) diameter hole for the light beam centered 3 inches (76.2 mm) in either direction from the top back corner. The right end is the same as the left end except it has one additional 4-inch (102-mm) diameter hole centered 3 inches (76.2 mm) in either direction from the top front corner. Molding strips nominal 5/8-inch (15.9-mm) are used to secure the end pieces and the top. All interior surfaces are painted with a flat black paint.

b) 箱体内部结构: 3/4英寸(19.1MM)耐风化的胶合板,内部尺寸41-3/4英寸长,高11-1/2英寸高,罩住整个箱体宽度.靠左末端有一个4英寸直径的孔用来安装30-35转速的循环风扇,固定位置,距侧面4-1/2英寸,距底角3-7/8英寸. 150转速的风扇孔直径5-3/4英寸距离底部中心3-7/8英寸.4英寸直径的圆孔用于安装光源灯距离后顶角3英寸.箱体右端与左端相同,只是有一个4英寸直径的孔距离前顶角3英寸,螺钉一般5/8英寸用于固定板面,所有内表面涂亚光黑.

c) Circulating Fan c – sized sufficient to obtain 30 – 35 fpm. The fan is connected to a regulated power supply.

c) 循环风扇C:规格 30-35转速,连接到指定的直流电源.

d) Circulating Fan d or e – sized sufficient to obtain 150 fpm. The fan shall be located on either side of the opening. The fan is connected to a motor controller or equivalent for speed adjustment.

d) 循环风扇D或E: 转速150,两面通风,此风扇连接到速控器.

e) Exhaust Fan – Same as (d), except speed not adjustable.

e) 排气扇规格与D相同,区别在于不可调速.

f) Photocell f – Selenium barrier layer type, 1.5-inch (38-mm) diameter for active area. Photovoltaic cell active material is sealed against environment and mounted on a 3/4-inch(19.1-mm) plywood bracket 5 inches (127 mm) behind a panel that has a 2-1/2-inch (63.1-mm) diameter hole to limit the detection of forward-scattered light. Photocell has a 25 percent maximum deviation from true linearity at 200 foot-candles (2152 lm/m²) with a 200 ohm load resistance, and has a sensitivity of 4.4 ± 0.3 microamperes per foot-candle (0.416 ± 0.046 microamperes per lm/m²) flowing through a 200 ohm load (meter resistance or other). The photocell (in use) is loaded with a nominal 100 ohm, 1 percent load, trimmed with a 10,000 ohm, ten turn potentiometer placed across the loaded photocell in a configuration which has negligible affect on the total photocell load regardless of the potentiometer setting, as shown in Figure 37.3 and is nominally illuminated at 22 foot-candles (236.7 lm/m²). Spectral response peak is between 530 and 580 nanometer with 30 percent sensitivity response at 350 and 660 nanometer.

f) 光电池F—硒层类型,有效面积直径1.5英寸,活性材料密封与外界隔绝,安装在箱体背面胶合板拖盘5X3/4英寸,当中有一个2-1/2英寸的孔用于检测射过来的光线,光电池加载200OHM电阻,在200尺烛光下有25%的偏差,有4.4+/-0.3微安/尺烛光的灵敏度.通常使用光电池要加载一个100OHM的电阻, 1%加载,并联一个10KOHM可变电阻,然后滑动分压器,伏特表内阻可忽略不计,如图37.3. 一般在22尺烛光,光谱灵敏度峰值在530-580纳米, 在350-660纳米误差是30%.

g) Airstream Deflector – Sheet aluminum, 18 inches (457 mm) wide by 15-1/2 inches (394 mm) long secured at each end by screws to two 3/4-inch (19.1-mm) thick plywood sections; each section is to be 8-5/8 inches (219 mm) high, 9-1/4 inches (235 mm) long (adjacent to top of test box), and a 10-inch (254-mm) radius curved section to which the deflecting plate is to be attached. The plate is to extend 1 inch (25.4 mm) beyond the upper edge and 5/8 inch (15.9mm) beyond the lower edge. Each plywood cutout is to be secured to the side wall of the test compartment.

g) 偏流器—铝片18长X15-1/3宽 英寸,末端用螺丝固定在两3/4英寸厚的胶合板上,胶合板高8-5/8英寸9-1/4英寸长(接近箱顶部),疏流网半径10英寸,与上边沿延长1英寸,下边沿5/8英寸,胶合板剪切部分需与侧面固定好.

h) Airstream Straightener_g – Aluminum honeycomb nominal 1/4 inch (6.4 mm) cell size; overall dimensions are to be 7 by 18 by 3 inches (178 by 457 by 76 mm). When an equivalent honeycomb is employed, the cell size length to diameter ratio shall be greater than 10.

h)疏流器--- 铝蜂窝,孔径1/4英寸,整体尺寸7X18X3英寸,若使用相似蜂窝,孔长/直径需大于10.

i) Screen – Screening material of aluminum wire 0.01-inch (0.3-mm) diameter, having nominal 1/16 inch (1.6 mm) square openings 18-1/8 inches (464 mm) long by 7 inches (178 mm) wide. To be wedged adjacent to airstream straightener.

i)屏网—铝线,直径0.01英寸,一般1/16平方英寸的孔,长18-1/8,宽7,嵌在疏流器上.

j) Monitoring Head_h – Measuring Ionization Chamber mounted on backwall adjacent to test sample area 1 inch (25 mm) above test platform. Employed with (p).

j)监控: 安装于背面的MIC,位置接近样品安装盘上方1英寸处.

k) Detector Under Test – Located in center on inner compartment top. Positioned to rest on back (as illustrated) or inverted and suspended from the box cover. Samples spaced at least 2 inches (51 mm) from the nearest edge of the monitoring head. Located so that least favorable position for aerosol entry faces oncoming air flow.

k) 样品测试:安装在箱盖正中央,离MIC至少2英寸,安装在气流最不易进入的地方.

l) Outlets – 120-volt receptacles for test samples, controlled by a variable autotransformer on the control cabinet.

i)输出: 供样品120V, 可变供电控制箱.

m) Lamp – Low-voltage automotive spot-light type 4515 or equivalent, rated at 6 volts DC, and mounted on 3/4-inch (19.1-mm) plywood bracket 4 inches (102 mm) from the side wall in-line with the photocell. The distance from the lamp (lens face) to photocell is to be exactly 5 feet (1.52 m). The lamp is to be operated from a regulated voltage supply typically 2.40 volts which yields a lamp color temperature of 2373+/-50 Kelvin. At that level, the photocell current is to be 100 ± 25 microamperes into 100 ohms. The lamp is not to result in random meter fluctuations.

m)灯: 低压聚光汽车灯,型号4515或类似的, 6VDC,安装在3/4英寸的胶合板上,板距侧侧墙4英寸,与光电池在同一条直线上,灯面距光电池5英尺,使用直流稳压源供电,2.4V,所产生色温2373+/-50开尔文,这时光电池在100OHM电阻时所产生的电流是100+/-25%微安,灯光一直稳定.

n) Meter Assembly – Digital micrometer assembly consisting of a voltmeter having a minimum impedance of 10 megohms (clear air condition is indicated as 10 millivolts), and a trim potentiometer for adjustment of the meter. Connected directly to photocell (e). An analog direct current micrometer, having a maximum impedance of 100 ohms and a linearity of 1 percent or better over a range of 50 – 100 microamperes, is also appropriate for use.

n)组合表,数字表,可测电压,阻抗至少10MOHM,电压可调,直接连到光电池上,类似的直流表,最大阻抗100OHM,线性1%或更好的超出50-100微安范围的,也可以使用.

o) Control Cabinet – Cabinet for mounting timers, switches, variable autotransformer for varying supply voltage to outlets (l), and potentiometer for speed control of circulating fan (c).

o)控制箱: 控制箱用于安装定时器, 开关,可调自耦变压器以对外提供不同的电压.电压表用于调整循环风扇转速.

p) Monitor Head Meter_i – High impedance meter 100 picoamperes full scale. Employed with (j) and (r).

p)监控表: 高阻抗表,量程100微安,与I和R一同使用.

q) Air Diffuser – Same type of screening material as described in (i). To be wedged between the underside of the air stream straightener and the deflector at a 45-degree angle with the horizontal.

q)空气扩散器: 与I材质与致.嵌入空气疏流器下侧,与档流板水平线成45度角.

r) Control Equipment (Monitoring Head) – Consists of a suction control unit employed with a vacuum pump and an amplifier with power supply. Employed with (j) and (p).

r)监控探头:由真空泵,放大器与电源组成,与I和P一起使用.

s) Recorder_j – X-Y plotter. Records buildup of visible smoke versus MIC output.

s)记录器:XY坐标,记录MIC输出的烟雾曲线.

t) Velometer_k – Velocity measuring instrument with probe sensor. Probe inserted through hole in plastic window to measure air flow 1 inch (25.4 mm) above platform.

t)风速仪: 用探针传感器测量速度的仪器.将探针插入塑料窗口测量气流速度,距离底盘1英寸.

u) Power Supply (Not Shown) – Variable, regulated DC supply, 0 – 40 volt output. Employed with (c), 30 – 35 fpm circulating fan.

u)电源:可调,DC电压0-40V输出,与30-35转速风扇一起用.

c) Rotron, Model MD24B2, or equivalent.

cROTRON: 型号MD24B2或相似的型号.

dA fan used for this purpose is Model 7600, rated 115 volts, 60 hertz, by Pamoter, Inc. or equivalent.

d风扇型号7600, 115V 60HZ, 制造商PAMOTER INC或类似的.

eE G & G Rotron, Model CL2L2, or equivalent.

e. EG&G ROTRON: 型号CL2L2, 或类似的产品.

fA photocell used for this purpose is Weston Instruments, Model 594 RR.

f. 光电池, 品牌WESTON INSTRUMENTS 型号594RR.

gExpanded Commercial Grade Honeycomb 1/4 CGH – 5.2 N American Cyanamid Company, is appropriate for this purpose.

g. 蜂窝, 制造商AMERICAN CYANAMID COMPANY.

hAn instrument used for this application is a Measuring Ionization Chamber (MIC), Type EC 23095, and control equipment manufactured by Elektronikcentralen, Horsholm Denmark.

h. MIC, 型号EC23095C 以及控制箱, 制造商为Elektronikcentralen, Horsholm Denmark.

iFluke, Model 8022A multimeter, or equivalent.

i. 万用表: FLUKE 8022A或类似的.

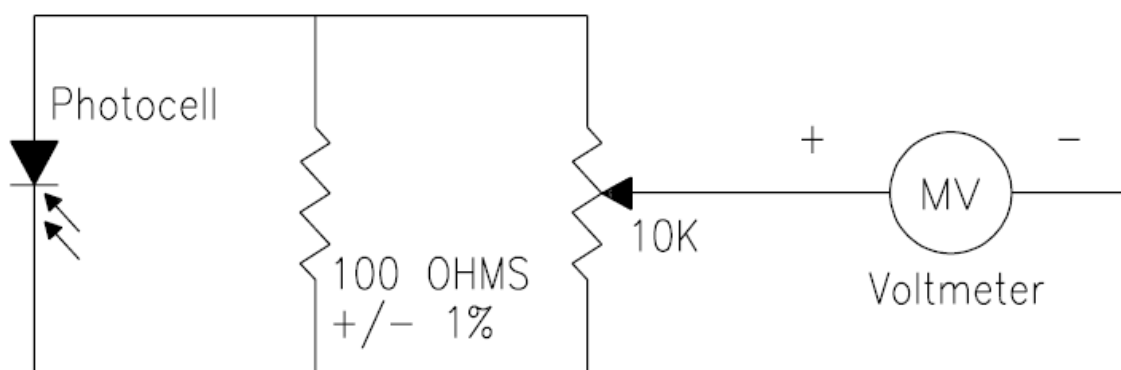
jHeath, Model SR-207, rated 120 volts, 50/60 cycles, 35 watts, or equivalent.

j. HEATH: 型号 SR-207, 120VAC, 50/60W, 或类似的.

kAlnor Instrument Co., Type 8500, or equivalent.

k. ALNOR仪器公司, 型号8500或类似的.

Figure 37.3
Potentiometer placement



S4646

37.4 Test method

37.4 测试方法

37.4.1 The test is to be conducted in an ambient temperature of $23\pm3^{\circ}\text{C}$ ($73.4\pm5^{\circ}\text{F}$) at a relative humidity between 50 ± 20 percent and a barometric pressure of 760 ± 30 mm (93.3 kPa) of mercury.

37.4.1 测试的环境为温度 $23\pm3^{\circ}\text{C}$ ($73.4\pm5^{\circ}\text{F}$), 相对湿度 $50\pm20\%$, 大气压为 760 (93.3 kPa) ± 30 毫米汞柱;

37.4.2 A minimum of 12 samples of the alarm, previously energized from a source of supply in accordance with 33.3.1 for at least 16 hours or for a time interval as specified by the manufacturer, are to be subjected to this test. The alarm under test is to be tested in the least and most favorable horizontal positions of aerosol entry. See 39.1.

37.4.2 最少需要十二个样品, 按照33.3.1要求提供的电源通电之前, 最少放置16小时或者按照制造商的标准, 进行测试, 测试的样品按照39.1的要求测试最不灵敏和最灵敏的方向;

37.4.3 The air velocity in the test compartment is to be maintained at 32 ± 2 fpm (0.16 ± 0.001 m/s), as measured 1 inch (25.4 mm) in front (upstream) of the middle section of the alarm with a hot wire anemometer, or equivalent air velocity measuring instrument. The velocity measurement is to be made with the alarm removed.

37.4.3 测试箱里的风速必须维持在 32 ± 2 英尺每分钟(0.16 ± 0.001 米/秒), 用热线风速计, 或相当的仪器, 在报警器中间前(上面)1英寸(25.4毫米)处测量, 测量风速时, 把报警器移走;

37.4.4 The aerosol is to be admitted into the test chamber and operation is to be continued until the alarm is actuated in a continuous (steady or pulsing) alarm condition. For units whose alarm is nonpulsing and which emit alarm pulses with the

initial entry of smoke, a continuous alarm condition is one that is continuous (nonpulsing) for not less than 5 seconds. The MIC/light relationship and the visible smoke build-up rate is to remain within the limits represented by the curves illustrated in Figures 37.1 and 37.2. When the trial-to-trial variation in percent light transmission at alarm is ± 0.2 or less, only three trials are required to be conducted on each sample. When the variation is greater than ± 0.2 , five trials are to be performed. The test chamber is to be exhausted between each trial until the MIC and light beam indicate a clear condition. The airflow is to be let to stabilize for at least 30 seconds before each test trial.

37.4.4 用可以进行喷雾的测试箱，一直进行喷雾，直到报警器进入持续（稳定或脉冲）的报警，对于当烟雾进入时，报警有脉冲和没有脉冲发出的产品，在持续报警时，报警的时间不能小于5秒，MIC/LTC和相关的烟雾曲线必须在图37.1和37.2表示的曲线内，当每次测试的LTC变化率小于 ± 0.2 ，每一个样品只需要测试三次，当变化超过 ± 0.2 ，需要测试五次，每次测试前，测试箱MIC读数为零；在每次测试之前至少三十秒，风速必须稳定。

37.4.5 The final value used for the sensitivity shall be the average of the total number of readings. The following readings are to be recorded for each trial at the moment of actuation:

37.4.5 最终的灵敏度结果应该是多次测量的平均值，在每一个测试过程中，以下的结果必须被记录

a) Visible Aerosol Obscuration (percent light transmission),

b) LTC读数

b) Measuring Ionization Chamber (MIC) Meter Reading, and

b) MIC的读数,和

c) Time of test trial.

c) 测试的时间

For combination smoke alarms, the sensitivity of each principle of operation is to be recorded. For an alarm which has a variable sensitivity setting, test trials are to be made at the maximum and minimum sensitivity settings.

对于有组合功能的烟雾报警器，按照工作原理，每一种功能的灵敏度都要被测试和记录。对于可调灵敏度的报警器，需要测试能设置的最小灵敏度和最大灵敏度。

38 Velocity-Sensitivity Test

38.1 The sensitivity of an alarm shall not vary more than specified in 34.4.1, using aerosol, when tested in accordance with the sensitivity test at air velocities of 32 and 150 fpm (0.16 and 0.76 m/s) ± 10 percent. In no case shall the sensitivity exceed the limits specified in 37.1.1 for aerosol.

38 速度灵敏度测试

38.1 报警器的灵敏度在用喷雾设备测量时，当空气流速在32到150英尺每分钟 (0.16到0.76米/秒) $\pm 10\%$ 变化时，灵敏度变化不能超过34.4.1的规定，对于测试，不能有任何情况超出37.1.1要求的灵敏度。

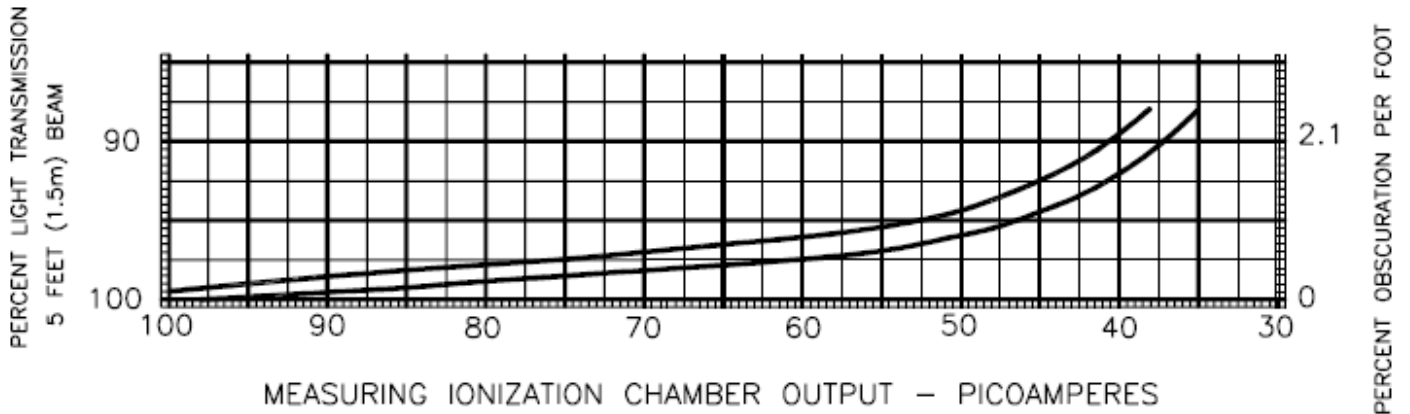
38.2 Two alarms, one at maximum and one at minimum sensitivity are to be subjected, in turn, to the sensitivity test; first at a velocity of 32 fpm (0.16 m/s), and then at a velocity of 150 fpm (0.76 m/s). At 150 fpm, the aerosol buildup is to be such that the relationship between the MIC output and the percent light transmission remains within the limits represented by the curve illustrated in Figure 38.1. The aerosol buildup rate is to be maintained within the limits of Figure 38.2.

38.2 两个样品，一个在最大灵敏度，一个在最小灵敏度轮流地进行灵敏度测试，开始的风速是32英尺每分钟 (0.16米/秒)，然后风速为150英尺每分钟(0.76米/秒)，在150英尺每分钟，喷雾设备上的MIC输出和光传导的百分比的相关性仍然在图38.1描述的曲线内，喷雾装置的速率必须维持在图38.2描述的规格内。

38.3 For this test the alarms are to be oriented, in turn, in the least favorable and then the most favorable position for aerosol entry.

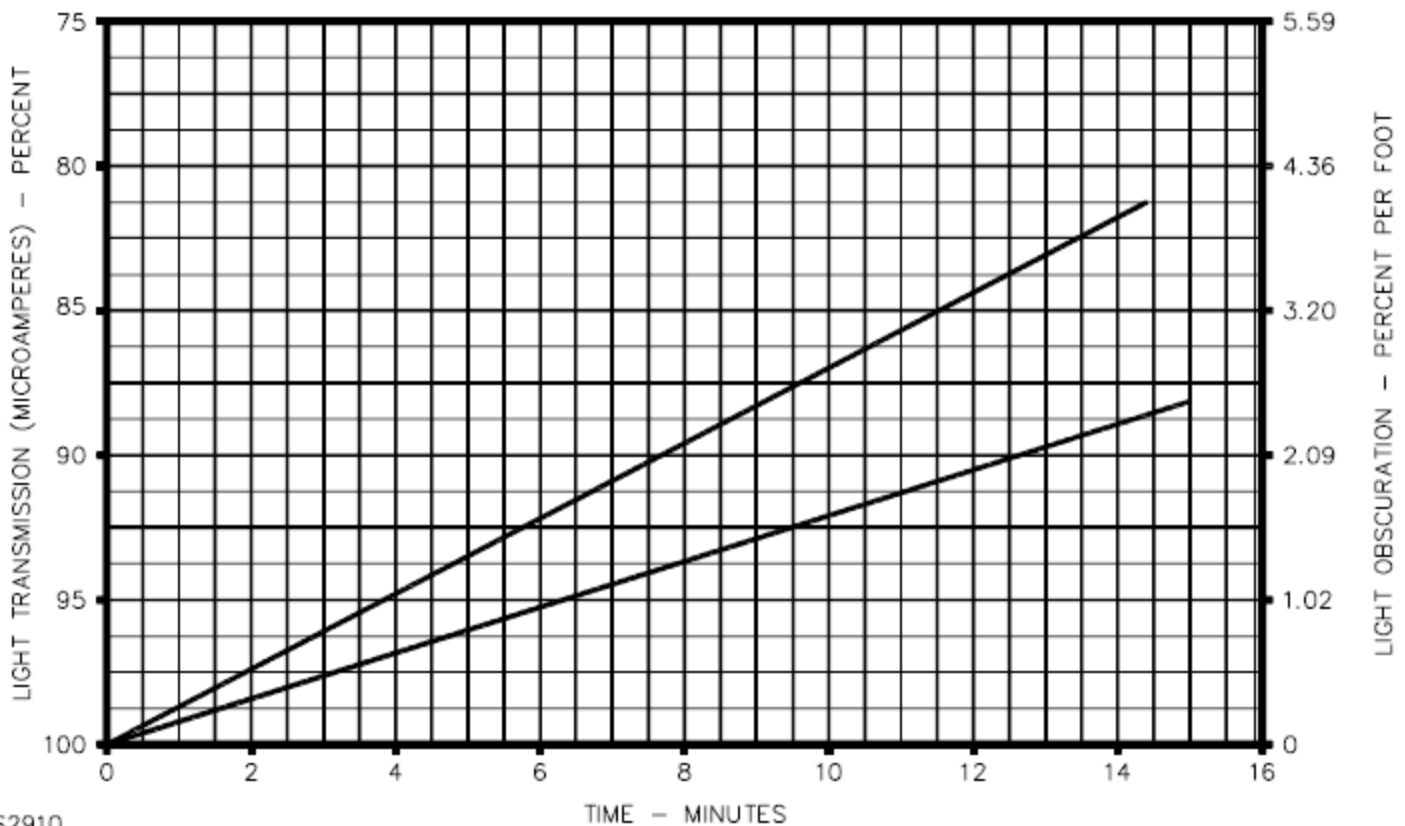
38.3 做方向性测试的样品，按照烟雾入口方向，先测试最不灵敏的方向，然后测试最灵敏的方向。

Figure 38.1
Smoke entry test limits – aerosol – 150 fpm



S2216

Figure 38.2
Smoke build-up rate – velocity-sensitivity test – aerosol – 150 fpm



S2910

39 Directionality Test

39.1 The sensitivity of the alarm shall comply with the requirements of 37.1.1 for aerosol, in any orientation with the air flow in the chamber. The alarm shall be tested at a 30 – 35 fpm (0.15 – 0.18 m/s) air velocity in its least favorable position and at each 90 degree angle from the position. The positions include all four compass points with the detector in a horizontal position with the oncoming air directed to each of four sides and with the detector positioned on edge with the alarm front facing the oncoming air. The locations of the least and most favorable smoke entry positions are to be marked on all alarms to be used in subsequent Sensitivity Tests, Section 37; the Fire Tests, Section 44; and the Smoldering Smoke Test, Section 45.

39 方向性测试

39.1 报警器的灵敏度在测试箱里面空气流动的任何方向，必须符合37.1.1烟雾测试的要求；报警器在最不灵敏的方向，风速速度为30 – 35英尺每分钟 (0.15 – 0.18 米/秒)，从这个位置开始，每过九十度测试一次，位置包括四边所有四个迎着空气来的在水平位置的罗盘点和报警器面对着迎面而来的空气的边缘位置，所有测试的报警器在后面的按照第37章灵敏度 / 第44章点火测试 / 第45章闷燃测试时，需要标注最不灵敏和最不灵敏的方向。

39.2 Two samples, one employing a maximum sensitivity, and one employing a minimum sensitivity, are to be employed

for this test. An alarm positioned on edge is to be mounted on a wooden board so that the edge of the alarm rests on the mounting platform. The mounting board is to extend a maximum of 2 inches (50.8 mm) beyond the vertical sides of an alarm and no extension beyond the top edge.

39.2 两个样品，一个在最大灵敏度，一个在最小灵敏度进行方向性测试。报警器的边缘位置安装在木板上，所以报警器的边缘能够放在平台上，安装的板在报警器的垂直面最大延伸2英寸 (50.8毫米)，不能超过上面的边缘；

39.3 When the height of an alarm is too great to be accommodated in the platform test area, it is to be located adjacent to the left edge of the mounting platform with the top edge touching the roof of the test compartment and corresponding adjustments made in the location of the velocity measurement. See 37.4.3.

39.3 当报警器的高度太大了，导致不能被测试平台容纳，它是可以位于相邻的安装平台的左边缘，并且顶边接触测试室的顶部和在速度测量的位置作出相应调整，具体见37.4.3

40 Sensitivity Test Feature

40.1 A sensitivity test feature shall be provided on a smoke alarm, to simulate either mechanically or electrically a specified level of smoke in the sensing chamber. The test feature shall be accessible from outside the alarm, with the alarm installed as intended. The maximum permissible measured level shall not exceed 6 percent per foot [0.027 OD/foot (0.088 OD/m)] obscuration using aerosol.

40.2 Four samples, two at maximum and two at minimum sensitivity, shall be subjected to this test. Each sample is to be connected to a rated supply voltage, except that an alarm employing a battery as the main supply shall be tested at the test voltage level (rated or trouble level voltage) that results in the lowest sensitivity measurement. The sensitivity is to be determined by conducting a curve plot of obscuration versus an instrument (meter) reading, or equivalent.

40 灵敏度测试功能

40.1 烟雾报警器需要测试灵敏度测试的功能，模拟机械或电气规定的烟雾进入感应室；报警器安装后，测试功能从报警器外部也可以测试；最大允许的数值不能超过0.06OBD[0.027 OD/英尺 (0.088 OD/米)]；

40.2 四个报警器，两个在最大的灵敏度，两个在最小的灵敏度，进行这项实验，每一个产品由额定电压连接，除了产品用电池作为主要的电源提供(相关的或故障信号电压)，在最低灵敏度的测量结果。灵敏度将对LTC的读数或相等于的，进行曲线绘制来决定结果；

41 Smoke Entry (Stack Effect) Test

41.1 The sensitivity of a smoke alarm shall not vary by more than specified in 34.4.1 when subjected to the test conditions described in 41.2 – 41.4, which simulate air passing through an electrical conduit system that is connected to a smoke alarm.

41 烟入口（烟囱效应）测试

41.1 烟雾报警器在按照41.2 – 41.4描述的测试条件下，模拟空气通过一个电缆系统连接到一个烟雾报警器，灵敏度不能有超过34.4.1要求的变化，

41.2 The test box shown in Figure 41.1 is to be employed. Fan operation is to be adjusted so that the free flow air velocity at the center of the hole in the base is 300 feet per minute (91.4 mpm) and with the hole covered, the fan shall produce a back pressure measuring between 0.012 – 0.015 inches (0.304 – 0.381 mm) of water. The fan is then to be turned off. A smoke alarm is to be installed in accordance with the manufacturer's installation instructions, facing downward and covering the hole in the base of the test box, to simulate installation in a ceiling.

41.2 图41.1描述的测试箱将被用来做测试，风扇的运转可以进行调整，孔覆盖时，使在底座上的孔的中心的自由流动的空气流速是每分钟300英尺(91.4米每分钟)，风扇产生背压测量介于0.012 - 0.015英寸(0.304-0.381毫米)的水，然后关闭风扇，烟雾报警器按照制造商安装的要求进行安装，面向下，覆盖测试箱底座的孔，模拟在天花板上安装。

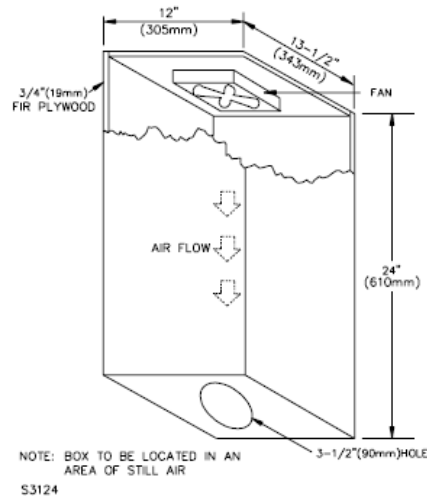
41.3 The entire test box smoke alarm assembly is to be placed (alarm side down) in an opening provided in a modified top door of the test chamber described in the Sensitivity Test, Section 37. The alarm shall then be tested for sensitivity while in this position. Two samples are to be tested, one at maximum, and one at minimum sensitivity.

41.3 整个测试箱的组件,(报警器面向下)覆盖在按照第37章灵敏度测试描述的烟箱(修改了上面的门)的开口处，报警器必须在这个位置测试灵敏度；两个样品，一个在最大的灵敏度，一个在最小的灵敏度进行测试；

41.4 The procedure described in 41.2 and 41.3 is to be repeated on both alarms, except the fan is to be turned on.

41.4 按照41.2和41.3描述在两个报警器上重复做，除了风扇打开；

Figure 41.1
Test apparatus – smoke entry (stack effect) test



Note: The box shall be located in an area having still air.

42 Lamp Interchangeability Test (Photoelectric)

42.1 The sensitivity of an alarm employing a replaceable light source shall vary not more than specified in 34.4.1 using aerosol and shall comply with the requirements of the Sensitivity Test, Section 37, when tested with the intended replacement lamps.

42 灯互换性测试(光电)

42.1采用更换光源的报警，在更换光源后，灵敏度在按照第37章节，灵敏度测试要求下进行烟雾测试，变化不超过34.4.1中的规定，

42.2 Three samples, set at the minimum sensitivity setting, are to be subjected to the Sensitivity Test, Section 37. The alarms then are to be de-energized, the photocell illuminating lamp replaced, reenergized, and again subjected to the Sensitivity Test.

42.2 三个调到最小灵敏度样品，按照第37章节，灵敏度测试要求下进行测试，然后报警器断电，更换光源的灯，重新通电，再做灵敏度测试；

43 Stability Tests

43.1 There shall be no false alarms of a smoke alarm set at the maximum sensitivity setting when two representative samples are subjected to the following test conditions. Different alarms are to be employed for each test. A test is not required when the principle of operation is such that conducting the test has no possible effect. Alarms whose sensitivity is affected by air velocity are to be tested in the horizontal position in which a false alarm is most probable. Momentary energization of the alarm (maximum of 1 second) is not prohibited during this test.

43 稳定性测试

43.1 两个调到最大灵敏度的典型样品，在进行下面的测试条件后，不能有误报警的不良；每次测试用不同的样品；当工作原理对测试的结果没有任何影响时，这个测试是不需要的；灵敏度是受风速影响的报警器，在水平位置（误报警最有可能的位置）测试，在测试过程中，瞬间通电的误报警（最多1秒）是可以接受的。

a) Operation for 90 days in a clean atmosphere in an air stream having a velocity of 300 ± 25 fpm (1.5 ± 0.13 m/s) in an ambient of $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3^\circ\text{F}$) and 30 – 50 percent relative humidity.

a) 在一个干净的环境中，风速为 300 ± 25 英尺每分钟（ 1.5 ± 0.13 米/秒），温度 $23 \pm 2^\circ\text{C}$ （ $73.4 \pm 3^\circ\text{F}$ ）和30 - 50%的相对湿度环境中运行90天；

b) Three plunges from an ambient humidity of 20 ± 5 percent relative humidity to an ambient of 90 ± 5 percent relative humidity at $40 \pm 2^\circ\text{C}$ ($73.4 \pm 4^\circ\text{F}$).

b) 在 $40 \pm 2^\circ\text{C}$ （ $73.4 \pm 4^\circ\text{F}$ ），相对湿度从 $20 \pm 5\%$ 提升到 $90 \pm 5\%$ 的湿度，做三次；

c) Ten cycles of temperature variation between 0°C (32°F) and 49°C (120°F).

c) 温度变化从 0°C （ 32°F ）到 49°C （ 120°F ），做十个循环；

d) Ten cycles of change of air velocity from 0 – 300 fpm ($0 - 1.5$ m/s) ± 25 fpm (± 0.13 m/s).

d) 风速从0到300英尺每分钟（ 1.5 米/秒） ± 25 英尺每分钟（ ± 0.13 米/秒），做十个循环；

e) Ten cycles of a 2 inch (50.8 mm) change of air pressure starting from 31 – 29 inches (787 – 737 mm) ± 0.5 inches (± 12.7 mm) of mercury.

e) 十个周期为2英寸（50.8毫米）的空气压力变化，从31 - 29英寸（787-737毫米） ± 0.5 英寸（ ± 12.7 毫米）的汞柱；

f) Fifty cycles of momentary (1/2 second) interruption of the detector power supply at a rate of not more than 6 cycles per minute followed by 10 cycles of very rapid OFF-ON switching (each consisting of 3 OFF-3 ON sequences in 1-1/2 seconds) to simulate a loose wire connection in the home or an automatic reclosing circuit in the distribution line, at not more than 1 cycle per minute. Battery operated alarms are capable of being tested in conjunction with the Battery Replacement Test, Section 68.

f) 五十个周期的瞬时（0.5秒）中断报警器电源，速率不超过每分钟6个周期，然后10个循环的非常迅速的OFF-ON开关(每个循环在0.5秒内按照3 OFF-3ON的顺序)，不超过一分钟一次，以模拟一个松散的线连接在家里或在配电线路的自动重合闸电路；电池供电的报警器能够按照第68章节，更换电池测试进行测试。

g) Twenty cycles subjected to high light intensity from a distance of 1 foot (0.3 m), 10 cycles using a 150-watt incandescent lamp, 10 cycles using a 4 light fluorescent fixture with 40-watt daylight lamps at a rate of 4 cycles per minute. Each cycle is to consist of 10 seconds ON and 5 seconds OFF.

g) 20个周期在1英尺(0.3米)的距离使用高光强度照射，10个周期使用一个150瓦的白炽灯，按照每分钟4个周期的速度，10个周期使用4个40瓦的日光灯光荧光灯夹具，每个周期包括10秒的ON和5秒OFF；

43.2 Two alarms, employing a maximum sensitivity setting, are to be mounted in a position of normal use, energized from a source of supply in accordance with 33.3.1 and subjected to each of the above test conditions.

43.2 两个设置在最大灵敏度的报警器，根据正常使用情况进行安装，按照33.3.1的要求提供电源，进行上面的每一个测试。

43.3 For 43.1 (b), the alarm is to be plunged from one humidity level to the other in not more than 3 seconds per plunge and maintained at each humidity level for not less than 1/2 hour between plunges.

43.3 对于43.1 (b)，湿度从一个湿度跳跃到另外一个湿度，中间在每一个湿度停留不超过3秒，在两个极端的湿度保持不少于0.5小时，

43.4 For 43.1 (c), the time of cycling from one extreme to the other shall be a maximum of 1 hour and a minimum of 5 minutes and not less than 15 minutes at each temperature level. For (d) the air velocity is to be turned on and off abruptly with a maximum of 1 hour between applications. For (e), the time of change from one pressure to the other is to be 30 seconds. For (g), the alarm is to be positioned in a plane to permit the maximum entry of light into the chamber. Each cycle is to start at one test condition, changing to the other extreme, and returning to the original test condition.

43.4 对于43.1 (c)，从一个极端温度到另一个极端温度时间在五分钟到一个小时之间，在每个温度不能少于十五分钟；对于(d),从一个风速到另一个的时间小于一个小时，对于(e),从一个压力到另一个压力时间是三十秒，对于(g)，报警被定位在一个平面上，允许的最大光线进入到腔室。每一个循环从一个测试条件开始，然后改变到另一个极端条件，再回到最初的测试条件。

43.5 For 43.1 (g) the peak luminous intensity of the incandescent lamp test shall be 175 candela. The peak luminous intensity of the fluorescent fixture test shall be 424 candela.

43.5对于43.1 (g)，用于测试的白炽灯，最大发光强度是175坎德拉，荧光灯最大发光强度是424坎德拉。

43.6 The test samples subjected to (a) – (g) of 43.1 are to be tested for sensitivity, using aerosol (see the Sensitivity Test, Section 37), following the completion of each test. The response of any alarm, when tested in accordance with the Sensitivity Test, shall vary not more than specified in 34.4.1.

43.6 用于43.1(a) – (g)测试的样品，按照第三十七章灵敏度测试的要求，在每个实验完成后需要测试灵敏度，根据灵敏度测试的要求，必须报警，并且灵敏度的变化不能超过34.4.1的要求。

44 Fire Tests

44着火点测试

44.1 General

44.1 总则

44.1.1 Each alarm subjected to the tests specified in 44.2.1 – 44.4.1 shall operate for alarm when installed as intended in service and exposed to the following four types of controlled test fires. The maximum response time shall be 4 minutes for Tests A and B, 3 minutes for Test C, and 2 minutes for Test D. All combustibles shall be ignited with the device as described. The bottom of the container for all combustibles is to be 3 feet (0.9 m) above the floor. Both the paper and wood brand are to be preconditioned in a relative humidity of 50 ± 5 percent at a temperature of 232°C ($73.4 \pm 3^{\circ}\text{F}$) for at least 48 hours prior to the test.

44.1.1 每一个做44.2.1-44.4.1 规定实验的报警器,当安装或暴露在下面4种控制的实验火的情况下,都必须报警;对于实验A和B测试, 必须在4分钟内报警,实验C必须在3分钟内报警, 实验D必须在2分钟内报警,所有的易燃物必须被下面按要求的设备点燃,所有易燃物托盘的底部必须比地面高3英尺(0.9米), 所有实验用的纸和木头在实验之前,必须在50±5%湿度和23±2度(73.4±3F) 的情况下至少放置48小时.

44.1.2 With reference to the requirements of 44.1.1, smoke alarms with precalibrated alarm settings are not required when alarms are employed which are equipped with a means to provide an analog output (electrical measurement) of the alarm sensitivity during the course of the test trials. The alarms then are to be subjected to the Sensitivity Test, Section 37, in the smoke box with the analog output recorded to translate the electrical reading into an obscuration measurement. With this type of arrangement the minimum production sensitivity setting is obtained without conducting repeat tests after recalibration. This method is also appropriate for the Soldering Smoke Test, Section 45.

44.1.2 对于44.1.1 的要求,在实验期间,符合配置装置能提供模拟输出(电器测量)的报警灵敏度,报警器是不需要重新校准的,按照第37章节的灵敏度测试方法测试产品的灵敏度,根据烟箱里面的模拟输出记录,转换成光传输测量的电子读数,根据这种安排,在重新校准之后,如果不进行重复的测试,就直接获得产品的最小灵敏度,这种方法也适用于第45章节的焊接烟雾测试;

44.2 Paper fire – Test A

44.2.1 The following materials and procedures shall be used for the paper fire test:

- a) Combustible – Shredded newsprint (black printing only) is to be cut in strips 1/4 to 3/8 inch (6 to 10 mm) wide, 1 to 4 inches (25.4 to 102 mm) long, total weight 1-1/2 oz (42.6 g). The paper is to be poured into the receptacle, see (b), with the bottom covered temporarily by a flat plate. The receptacle is to be tamped periodically during the pouring operation until the paper contents are even with the top of the receptacle. The paper is then to be further tamped by hand or by a rod 1 inch in diameter until the paper level is 4 inches below the top edge of the receptacle. A hole 1 inch diameter is to be formed through the center from top to bottom of the paper. The temporary bottom plate is then to be removed and the assembly mounted 3 feet (0.9 m) above the floor on a 5-inch (127-mm) diameter ring support.
- b) Receptacle – To be formed of 1/32 inch (0.79 mm) thick sheet metal, 4 inches (102 mm) in diameter and 12 inches (0.3 m) high and seamed together, with no air gap at the seam, with support rods at the bottom.
- c) Point of Ignition – The probe tips of the igniter are to be placed at the bottom center of the receptacle touching the paper and arcing sustained for up to 5 seconds.

44.2 实验A—纸火

44.2.1 下面叙述的物料和程序将被用于纸火测试:

- a) 可燃 - 手撕新闻纸(黑白打印)切条1/4至3/8英寸(6毫米至10毫米)宽,1至4英寸(25.4至102毫米)长,总重量1.5盎司(42.6克).纸片被不断的放进容器,见(b),底部临时覆盖平板,在实验期间, 容器内的纸张被一直填塞,一直到报纸和容器的上面平行,然后纸被手或者直径1英寸的木棒填塞,直到纸的高度比容器顶边低4英寸,纸的中间从上到下打一个直径为1英寸的孔,这个临时的平盘被移动并被装到离地板3英尺(0.9米)高,5英寸(127毫米) 环内
- b) 容器—用1/32英寸(0.79毫米)厚的金属片,围成直径为4英寸(102毫米),高度为12英寸(0.3米), 接口处没有缝隙, 底部有木棒支撑.
- c) 燃烧点---点火器的探针针尖被放置在容器底部中心与纸张相接触并产生持续可达5秒的电弧
- d) Smoke Profile – For this test the following conditions apply:
 - 1) Flame breakthrough shall occur between 1 and 3 minutes.
 - 2) The first principal peak of light obscuration shall occur between 1 and 3 minutes.
 - 3) Smoke shall peak between 27 and 37 percent per foot obscuration [0.137 and 0.2 OD/foot (0.45 and 0.66 OD/m)] at the ceiling alarm location; and between 21.5 and 37 percent per foot [0.105 and 0.2 OD/foot (0.345 and 0.66 OD/m)] at each sidewall alarm location.
 - 4) There shall be between 20 and 40 seconds of 4 percent per foot [0.018 OD/foot (0.058 OD/m)] or higher obscuration at the ceiling alarm location; and between 10 and 30 seconds of 10 percent per foot [0.045 OD/foot (0.15 OD/m)] or higher obscuration at the sidewall alarm locations.
 - 5) The secondary peak shall not exceed 13 percent per foot obscuration [0.061 OD/foot (0.2 OD/m)] at any alarm location.
 - 6) Length of test shall be 4 minutes.
- d) 烟雾简介----对于这个测试,要符合下面的条件:
 - 1) 火焰突破应出现1至3分钟;
 - 2) 灯光第一个峰值应该出现在1至3分钟;

- 3) 在顶部报警器位置的烟雾的峰值在0.27-0.37OBS[0.137和0.2 OD/英尺 (0.45和0.66 OD/米)],在每一个报警器最边的位置必须在0.215-0.37OBS [0.105和0.2 OD/英尺(0.345和0.66 OD/米)],
- 4) 在顶部报警器位置的烟雾在20到40秒内的值在0.04OBS [0.018 OD/英尺(0.058 OD/米)]或更高,在每一个报警器最边的位置在10到30秒内必须在0.13OBS [0.045 OD/英尺(0.15 OD/米)]或更高;
- 5) 第二个峰值在任何位置都不能超过0.13OBS [0.061 OD/英尺(0.2 OD/米)]
- 6) 测试时间长度为4分钟;

44.3 Wood fire – Test B

44.3.1 The following materials and procedures shall be used for the wood fire test:

a) Combustible – A wood brand formed of three layers of kiln dried fir strips, each strip 3/4 inch (19.1 mm) square in cross section, 6 inches (152 mm) long with six strips in each layer, is to be used. Wood strips are to be nailed or stapled together with adjacent layers at right angles to each other. Overall dimensions of the wood brand are to be 6 by 6 by 2-1/2 inches (152 by 152 by 64 mm). The brand is to be supported on a 5-inch (127-mm) diameter ring support 3 feet (0.9 m) above the test room floor.

44.3 实验B-木火

44.3.1 下面叙述的物料和程序将被用于木火测试:

- a) 可燃物—品牌的杉木被烘干后由3层构成,每一条的横截面为0.75英寸(19.1毫米)的正方形,每一层有6条长6英寸的木条组成,木条被钉在一起,与相邻层成直角,杉木整个长度是6X6X2.5英寸(152X152X64毫米),所有的木头放在离测试房地面3英尺高的5英寸(127毫米)的圆环中;
- b) Promoter – The wood brand is to be ignited by burning 4 milliliters of denatured alcohol consisting of 190 proof (95 percent) ethanol to which 5 percent methanol is added as a denaturant. The alcohol is to be placed in a 1-1/2 inch (38 mm) diameter, 1-inch (25.4-mm) deep metal container, the bottom of which is to be 3-1/2 inches (89 mm) below the bottom of the wood brand and centered so that the flame does not break through the top of the wood brand. The container is to be supported by a 1/4-inch (6.4-mm) hardware cloth. The alcohol is to be placed in the container no earlier than 30 seconds prior to ignition.
- b) 具体操作—品牌杉木将被190标准(95%)的酒精加上5%的甲醇的变性剂组成的4毫升酒精点燃,酒精被装在直径1.5英寸(38毫米),1英寸高的金属容器内,其底部是3-1/2英寸(89毫米),低于杉木的底部和中心,使火焰不突破杉木的顶部,容器要由一个4英寸(6.4毫米)的金属布支撑,酒精放在容器内的时间不能早于点火前30秒;
- c) Point of Ignition – Ignition is to be by probes in alcohol. Probe tips of the igniter are to be placed as near the container lip as possible without arcing to the sides.
- c) 燃烧点—用酒精针进行点燃,点火器的探头要放在尽量靠近容器的边缘,没有弧度的两边;
- d) Smoke Profile – For this test the following conditions apply:
 - 1) Smoke buildup shall begin between 80 and 120 seconds at the ceiling alarm location; and between 60 and 120 seconds at each sidewall alarm location.
 - 2) There shall be at least 60 seconds of 4 percent per foot obscuration [0.018 OD/foot (0.058 OD/m)] at all alarm locations.
 - 3) Maximum obscuration shall not exceed 17 percent per foot [0.081 OD/foot (0.265 OD/m)] at the ceiling alarm location; and 27.5 percent per foot [0.14 OD/foot (0.46 OD/m)] at either sidewall alarm location.
 - 4) Flame breakthrough shall occur between 150 and 190 seconds.
 - 5) Length of test shall be 4 minutes.

Douglas Fir, S4 (smooth on all sides), clear of knots and holes, weight – 1.05 – 1.32 pounds per 10 foot length.

d) 烟雾简介--对于这个测试,要符合下面的条件:

- 1) 烟雾聚集在天花板报警器位置必须在实验开始后80-120秒之间,至少在60-120秒到达两边报警器的位置;
- 2) 在所有报警器的位置,在60秒之内必须要达到0.04OBS[0.018OD/英尺 (0.058 OD/米)]
- 3) 在天花板上报警器的位置,最大的烟雾浓度不能超过0.17OBS[0.081 OD/英尺 (0.265 OD/米)],在两边报警器的位置不能超过0.275OBS[0.14 OD/英尺(0.265 OD/米)];
- 4) 火焰突破点发生在150-190秒之间;
- 5) 测试的时间为4分钟;

道格拉斯冷杉, S4 (所有方向都需要光滑), 没有结或孔, 每10英尺长度的重量为1.05-1.32磅;

44.4 Flammable liquid fire – Test C

44.4.1 The following materials and procedures shall be used for the gasoline fire test:

- a) Combustible – Consists of a mixture of 25 percent toluene and 75 percent heptane which is to be burned in a metal receptacle in a large enough quantity to generate curves within the limits specified by Figure 44.1.
- b) Receptacle – To be formed of 0.025-inch (0.635-mm) stainless steel, 6-1/4 inches (158 mm) in diameter and 1-1/4 inches (32 mm) deep, the bottom having 1/2 inch (12.7 mm) rounded base, located 3 feet (0.9 m) above the test room floor and centered with a ring support. The liquid is to be poured into the receptacle 30 seconds prior to ignition.
- c) Point of Ignition – The probe tips of the igniter are to be placed so that they are above the lip of the pan and not extending into the pan. This results in ignition of the vapors above the liquid.
- d) Smoke Profiles – For this test the following conditions apply:
- 1) Maximum obscuration shall not exceed 13 percent per foot [0.061 OD/foot (0.199 OD/m)] or 17 percent per foot [0.081 OD/foot (0.265 OD/m)] at either side wall alarm location.
 - 2) Length of test shall be 4 minutes.

44.4 实验C--可燃液体燃火

44.4.1 下面叙述的物料和程序将被用于汽油点火测试:

- a) 可燃物--由25%的甲苯和75%的庚烷组成的, 在金属容器内燃烧, 有足够大的数量, 形成的曲线需在图44.1所制定的范围内,
- b) 容器--由0.025英寸(0.635毫米)厚的不锈钢组成,直径为6.25英寸(158毫米),1.25英寸(32毫米)深, 底部有直径为0.5英寸(12.7毫米)的圆盘,容器位于测试房地面以上3英尺(0.9米),中心是圆环.在点火之前30秒,将液体倒入容器内;
- c) 燃烧点--点火器的探针针尖放置,使它们在盘边缘上,而不是延伸到盘内,这将导致在液体上方的蒸气的点燃;
- d) 烟雾简介--对于这个测试,要符合下面的条件:
- 1) 在墙两边报警器的任何位置,最大的烟雾浓度不能超过0.13OBS[0.061 OD/英尺(0.199 OD/米)]或者0.17OBS[0.081 OD/英尺 (0.265 OD/米)];
 - 2) 测试的时间为4分钟;

44.5 Igniter assembly

44.5.1 The igniter assembly is to consist of the following or equivalent components:

- a) Igniter Probes – The metal probes, 1/4 inch (6.4 mm) diameter and tapered at the ends to form a point and maintained 1/2 inch (12.7 mm) apart, are to be connected to the high-voltage insulated output leads of an oil burner ignition transformer, see (c). Adjustment and support for the probes is to be provided by metal clamps affixed to a vertical steel bar integral with the igniter assembly.
- b) Support – A ring clamp, 5 inches (127 mm) in diameter is clamped to a ring stand to support the container holding the combustible.
- c) Ignition Source – Consists of a 120 volt, 60 hertz primary, 10,000 volt, 23 milliamperes secondary oil burner ignition transformer, the output of which is to be connected to the igniter probes. The arc used for ignition is to be obtained by the closure of a remote, low-voltage, momentary contact switch which energizes a relay whose contacts control the transformer primary.

44.5 点火器

44.5.1 点火器由以下或相当的零件组成:

- a) 点火针--金属针,直径为0.25英寸(6.4毫米)顶部,成锥形,逐步过渡到0.5英寸(12.7毫米),是要连接到高电压绝缘的油燃烧器点火变压器输出线,见(c). 调整针的支撑,使点火器被金属夹具贴在一个垂直的钢条上;
- b) 支撑--直径为5英寸的环钳,被钳位到一个环形的台阶,以支持该可燃容器的固定;
- c) 点火源--由初级为120伏/60赫兹,次级为10000伏/23毫安燃油炉点火变压器,输出和点火针连接,用于点火的电弧是通过以下方式获得一个远程,低电压,继电器触点被变压器初级控制瞬时接触开关关闭;

44.6 Test conditions

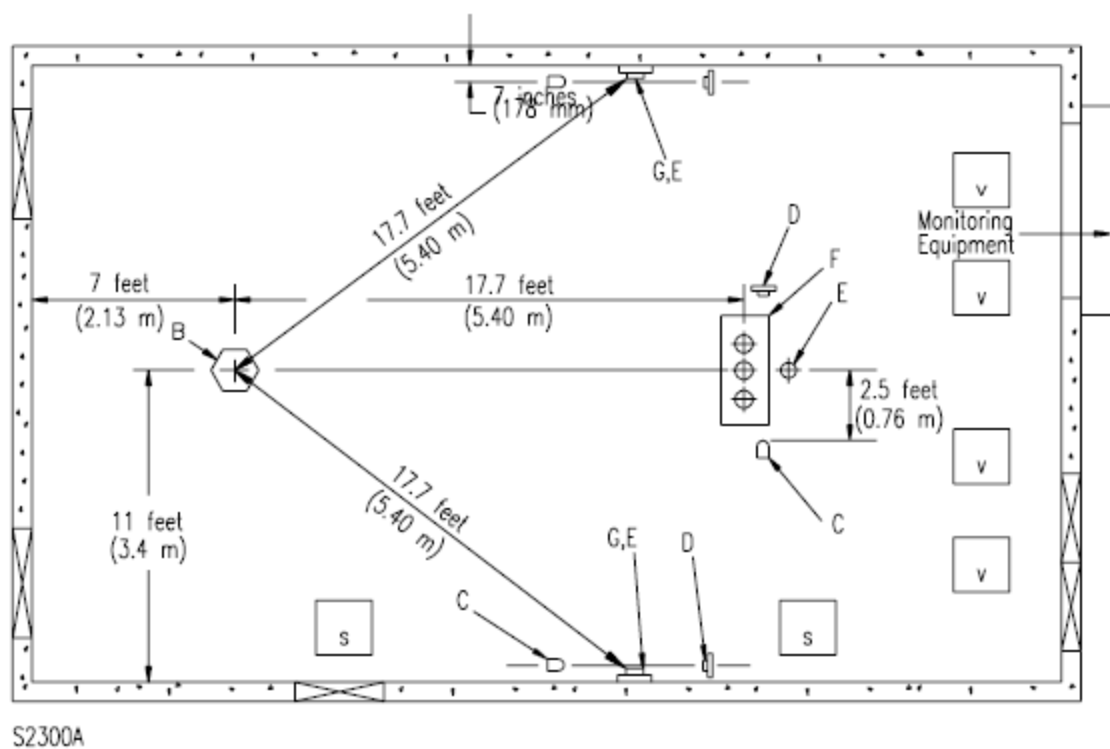
44.6.1 The fire tests are to be conducted in a 36 foot long by 22 foot wide by 10 foot high (10.9 by 6.7 by 3.1 m) room having a smooth ceiling with no physical obstructions. Air movement in the test room shall be zero. The distance from the base of the combustible to the ceiling is to be 7 feet (2.1 m). The room is to be provided with a means for the removal of smoke. Where required, heating, humidity, and air conditioning are to be provided for maintaining the room ambient, and are to be shut down during the test trial. See Figure 44.2.

44.6 测试条件

44.6.1 点火测试在一个36英尺长,22英尺宽,10英尺高,有一个光滑的,没有任何阻挡天花板的房间内进行,测试房间内没有空气流动,可燃物的底部到天花板的距离是7英尺(2.1米),房间要有去除烟雾的能力,在需要时,加热,湿度,和空调是要提供

点火测试房间尺寸

Figure 44.2
Fire test room



1. Length – 36 feet (11 m)
长度--36英尺(11米)
2. Width – 22 feet (6.7 m)

宽度--22英尺(6.7米)

3. Ceiling – height 10 feet (3.0 m) suspended type. Consists of 2 by 4 feet (0.6 by 1.2 m) by 5/8 inch (15.9 mm) thick incombustible fissured mineral fiber layer in panels.

屋顶--悬吊式10英尺(3.0米)高, 由厚0.625英寸(15.9毫米),2X4英尺(0.6X1.2米)不可燃烧的矿物纤维的面板层组成。

B. Test Fire

测试的火

1. 3 feet (0.91 m) above floor for the Fire Tests, Section 44

按照第44章,点火测试要求的, 离地面高3英尺(0.91米);

2. 8 inches (203 mm) above floor for the Smoldering Smoke Test, Section 45

按照第45章,闷燃测试要求的, 离地面高8英寸(203毫米);

- C. Lamp Assembly – 4 inches (102 mm) below ceiling, 7 inches (178 mm) from each side wall.

灯组合--天花板下四英寸(102毫米), 距离两边墙7英寸(178毫米);

- D. Photocell Assembly – Spaced 5 feet (1.5 m) from lamp, photocell center 4 inches (102 mm) below ceiling, 7 inches (178 mm) from each side wall.

光元件组合--距离灯有5英尺 (1.5 米), 光元件的中心在天花板下4英寸(102毫米), 距离墙边有7英寸(178毫米);

- E. Measuring Ionization Chamber (MIC) – See 45.8.

测量电离室(MIC) --见45.8;

- F. Test Panel, Ceiling Mounted Alarms – see Figures 44.3 and 44.5.

安装在天花板上的测试样板—见图44.3 and 44.5.

- G. Test Panel, Sidewall Mounted Alarms – see Figures 44.4 and 44.5.

安装在天花板上的测试样板--见图44. 4 and 44.5.

- S. Air Supply

气源

- V. Exhaust Vents

排气孔

44.6.2 The tests are to be conducted in an ambient temperature between 20.0 and 25.5°C (68 and 78°F) and a relative humidity of 50±10 percent. The alarm samples are to be energized from a source of supply in accordance with 33.3.1 except that alarms powered from a battery shall be energized by batteries depleted to their trouble signal voltage levels unless the minimum sensitivity is measured at rated voltage.

44.6.2 实验进行的环境是温度20.0到25.5°C (68到78°F), 湿度为50±10%, 除了产品由电池供电, 可以由电池供电, 其他的按照33.3.1要求提供的电源通电, 除非在额定电压下测量最小灵敏度有报警故障信号;

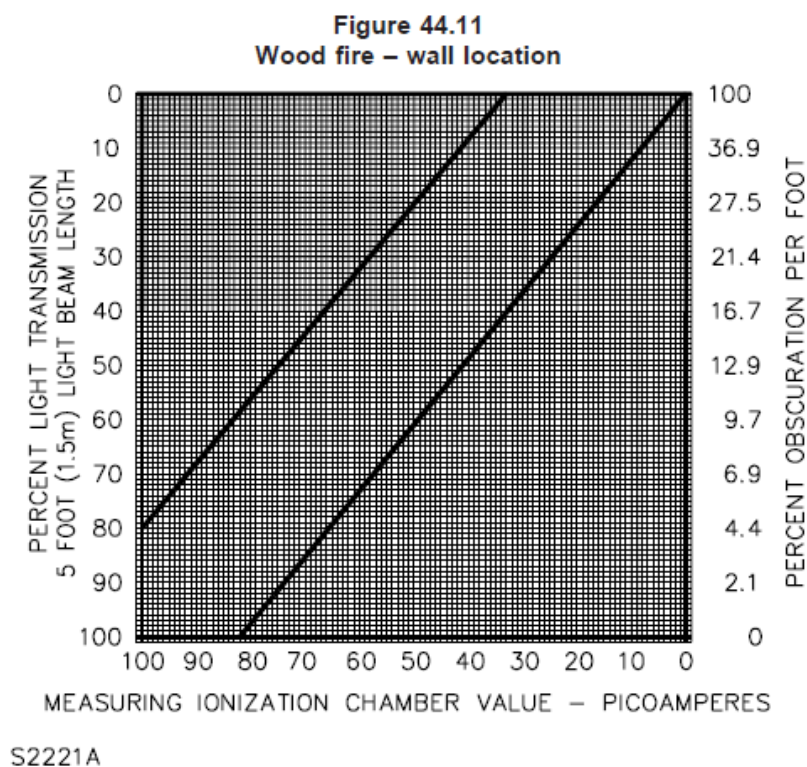
44.6.3 When intended for ceiling mounting only, three alarms are to be tested on a ceiling panel. See Figure 44.2.

When intended for wall mounting only, two alarms are to be tested, one on each sidewall. See Figure 44.3. For detectors intended for both wall and ceiling mounting, five alarms are to be tested: three on the ceiling and one on each side wall. See Figure 44.5. For alarms intended as portable (travel) alarms, two units are to be mounted, one on each side wall, 16 inches (406 mm) from the ceiling to the top of the alarm. The ceiling mounted alarms are to be mounted such that the least favorable position of one sample faces the oncoming smoke flow, with the remaining two samples rotated 120 and 240 degrees, respectively.

44.6.3 当只在屋顶安装, 三个报警器安装在天花板面板上测试, 见图44.2; 当只在墙上安装时, 只需要测试两个报警器, 一边墙安装一个报警器, 见图44. 3; 当报警器可能安装在墙上或天花板上时, 需要测试5个产品, 三个安装在天花板上, 一边墙安装一个产品, 见图44. 5; 如果产品是便携式(可移动)报警器, 2个产品, 一边墙安装一个; 产品顶部到天花板的尺寸是16英寸(406毫米).在天花板上安装产品时, 一个产品最不灵敏的方向对着烟雾来的方向, 另外两个产品分别各自转120和240度,

44.6.4 All alarm samples, each adjusted to its minimum sensitivity setting, shall respond to each combustible. The test time is to start at ignition. Each alarm shall operate for continuous (steady or pulsing) alarm. For units whose alarm is nonpulsing and that emit alarm pulses with the initial entry of smoke, a continuous alarm is one that is continuous (nonpulsing) for not less than 5 seconds. The smoke obscuration level at each of three alarm locations (ceiling and each side wall) is to be monitored by a photocell-light-beam assembly, mounted directly on the ceiling and spaced 5 feet (1.52 m) apart. See 37.3.3 (e) and (l) for a description of this assembly. Combination smoke alarms are to be provided with means for monitoring each principle of operation during testing. Each principle shall contribute in response, either wholly or partially, to at least one of the test fires, or the Smoldering Smoke Test, Section 45, or to both.

44.6.4 所有的产品，都调整到最小灵敏度，在每一个燃烧测试中都必须有反馈，测试时间从点火开始计算，每个产品的报警都必须是连续的（稳定的或脉冲的）。对于最初入口的烟雾，无脉冲的和有脉冲的产品，连续报警是一个是连续的（非脉冲），时间不小于5秒；三个产品（天花板上和两边墙上）的烟雾灵敏度被直接安装在天花板上，间隔5英尺（1.52米）光电组合监控，这个光电组合具体见37.3.3(e)和(i)；如果是组合的烟雾报警器，在测试过程中，按照每一个的工作原理进行监控，每一个工作原理的都要有反馈，不管是全部的还是部分的，至少在四种点火测试之一，或者第45章节的闷燃测试，或者二者都有反应；



45 Smoldering Smoke Test

45.1 Each smoke alarm shall operate for continuous (steady or pulsing) alarm when installed as intended in service, and exposed to the following controlled smoldering smoke condition. For a smoke alarm whose alarm is nonpulsing, yet emits alarm pulses with the initial entry of smoke, a continuous alarm condition is one that is continuous (nonpulsing) for not less than 5 seconds.

45、闷燃烟雾测试

45.1 按照正常安装后,在下面被控制的闷燃烟雾条件，每一个报警器都能连续（稳定的或者脉冲）报警,如果报警是非脉冲的，初始入口的烟雾的发出报警脉冲的烟雾报警器，报警条件是一个连续非脉冲报警时间不少于 5 秒。

45.2 Unless specifically indicated otherwise in the alarm installation instructions, the alarms are to be installed in the least favorable position for smoke entry (except where noted in 44.6.3) with respect to the smoldering smoke source as determined by the Directionality Test, Section 39. Detectors adjusted to the minimum production sensitivity are to be employed for this test.

45.2 除非特别注明，否则在报警器安装说明时，报警器被安装在烟雾进入最不利的位置(按照第 39 章节方向性测试，报警器调到最小产品灵敏度，被应用于此测试,除了 44.6.3 的注释)来做闷燃烟雾源。

45.3 The combustible for this test is to be ten ponderosa pine sticks (nonresinous, free from knots or pitches) placed in a spoke pattern on the hotplate such that the sticks are 36 degrees (0.63 rad) apart. The end of each stick is to be flush with the edge of the hotplate. Each stick is to be 3 by 1 by 3/4 inches (76.2 by 25.4 by 19.1 mm) with the 3/4 by 3 inch (19.1 by 76.2 mm) face in contact with the hotplate. All surfaces of each stick are to be smooth and free from burrs or holes. The grain of the wood is to be parallel to the stick length. Each stick is to be conditioned for not less than 48 hours at 52°C (125°F) in an air-circulating oven. The stick weight is to be 16±2 grams (0.56 ±0.07 oz) following the oven conditioning.

45.3 用于此测试的可燃物为放在电炉上的美国黄松木棒（无油脂，树结及毛刺），所有木棒的表面必须光滑没有毛边及孔，木质的纹理要平行于木棒的长度，每根木棒在使用前要放在 52°C（125°F）循环气流炉内不少于 48 小时，在下面炉子条件下,木棒重量 16±2 克(0.56±0.07 盎司)，下面是木棒的要求：

8 根木棒分成 4 行,每行 2 个在电炉上相贴着，一个是 1X3/4 英寸(25.4X19.1 毫米)，另一个是 3/4X3 英寸(19.1X76.2 毫米)，木棒最远的角必须和电炉平齐,每一行的距离大约是 0.5 英寸(12.7 毫米)

45.4 The heat source is to be a 240 volt, 1550 watt hotplate, having a steel plate 8-1/2 inch (216 mm) diameter by 1/4 inch (6.4 mm) thick, the topmost portion of which is 8 inches (200 mm) above the floor. The temperature of the hotplate is to be monitored by an iron-constantan AWG 30 (0.05 mm²) (Type J) thermocouple attached to the edge of the steel plate by placing its junction in a hole 0.015 inch (0.38 mm) in diameter and 1/4 inch (6.4 mm) deep and peening over the opening to secure it. The thermocouple is to be connected to a proportioning temperature controller which is able to be precisely set for the specified hotplate temperature. The controller sensitivity is adjusted so that all conditions for this test are met. Once set for a specific temperature, the hotplate shall be maintained at that temperature (as monitored by a temperature measuring meter). Prior to the start of the test, the hotplate temperature is to be 23 ±2°C (73±4°F). The initial proportioning controller temperature setting is to be 205°C (401°F). The hotplate and controller then are to be energized and the test time started (T=0). The proportioning controller setting is to be increased to obtain the temperature sequence included in Table 45.1 and Figure 45.1. (The hotplate temperature normally lags the controller setting by 2 minutes during incremental increases.)

mA hotplate for this purpose is Emerson Electric Co., Series PH-400 Chromalox.

45.4 加热源为 8.5 英寸（216mm）直径,1/4 英寸（6.4mm）厚度, 电压为 240V, 1550W 电炉^M, 电炉最顶部的地方距离地面 8 英寸（200mm）, 加热盘的温度被铁-铜-镍合金的热电藕所监控（30AWG（0.05 mm²）（型号 J）, 把它放在钢盘的边缘, 连接孔 0.015 英寸（0.38mm）直径, 1/4 英寸（6.4mm）深, 把头部用锤子锤进去加以保护, 热电藕连接到均衡温度控制器, 可以准确设定发热盘规定的温度, 控制器的灵敏度是可调的, 以便适合所有的测试条件, 一旦设定到指定的温度, 发热盘将保持在指定的温度（被温度测量计监控）;在开始的测试之前, 加热盘的温度为 23±2°C（73±4°F）, 最初的均衡控制器温度设定为 205°C（401°F）, 加热盘及控制器这时被激活, 测试时间开始（T=0）, 均衡控制器设定将被增加去获得温度在表 45.1 及图 45.1 中顺序出（在升温过程中时, 加热盘温度慢于控制器设定温度 2 分钟）。

备注：加热板是 Emerson Electric 公司 PA-400 Chromalox 系列

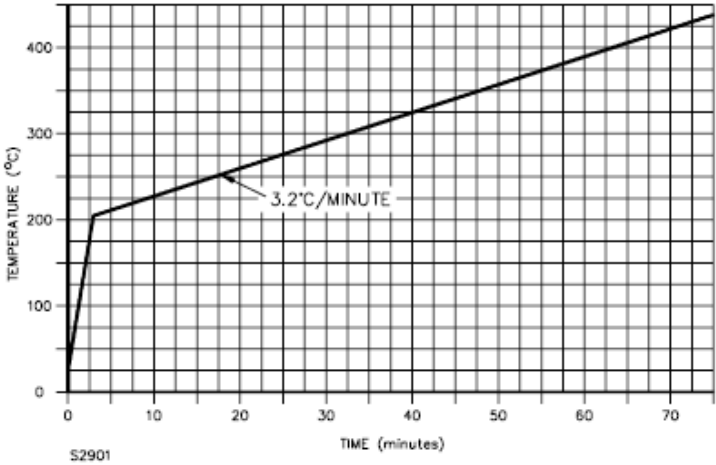
45.5 The Smoldering Smoke Test is to be conducted in the same room and ambient conditions and under the same mounting conditions as employed for the Fire Tests. See 44.6.1 – 44.6.3 and 44.6.5. The alarm samples are to be energized from a source of supply in accordance with 33.3.1 except that alarms, powered from a battery shall be energized by batteries that are depleted to their trouble signal voltage levels unless the minimum sensitivity is measured at rated battery voltage.

45.5 闷燃烟雾测试将被放在和燃烧测试相同的测试室内, 相同的外界条件, 具体见 44.6.1--44.6.3 及 44.6.5, 报警样品将被符合 33.3.1 要求的供应电源所激活, 如果报警器的电源为电池, 将电池放电, 直到达到它们的故障信号电压水平, 在此额定电池电压所测量出最小的灵敏度。

Table 45.1
Hotplate temperature

Time (minutes)	Hot plate temperature
0	23 ±2°C (73 ±4°F)
0 – 3	Increased 60.7°C (109°F) per minute to 205°C (401°F)
3 +	Increased 3.2°C (5.8°F) per minute for remainder of test

Figure 45.1
Hotplate temperature profile



45.6 All alarms shall respond to the test trial before the obscuration level exceeds 10.0 percent per foot (29.26 percent per meter) [0.0458 OD/foot (0.15 OD/m)] at the alarm location as measured by the photocell-lamp assembly described in 37.3.3 (f) and (m). Flaming of the wood shall not occur before the obscuration level is reached.

45.6 在被组装的光电组合 (37.3.3(f)和(m)中描述)测量, 在报警器安置的位置,浓度超过 0.1OBS (29.26%/米) [0.0458OD/英尺 (0.15OD/米)]之前, 所有报警器将对试验做出响应;在浓度达到之前,木材不会燃烧。

45.7 For this test, the visible smoke buildup rate is to be maintained within the limits illustrated in Figure 45.2. At no time during the test trial shall the buildup rate exceed 5 percent obscuration per minute as measured over the length of the 5 foot (1.5 m) light beam.

45.7 关于此测试, 可见烟雾增强率应保持在图 45.2 所显示的界限内, 在测试试验中, 在 5 英尺(1.5 米)发光源测量,增强率浓度不能超过 0.05OBS。

45.8 A Measuring Ionization Chamber (MIC)ⁿ is to be used to measure the relative buildup of particles of combustion during the test. The MIC utilizes the ionization principle with air drawn through the chamber at a rate of 25 ±5 liters per minute by a regulated vacuum pump. The monitoring head is to be located as shown in Figure 44.2.

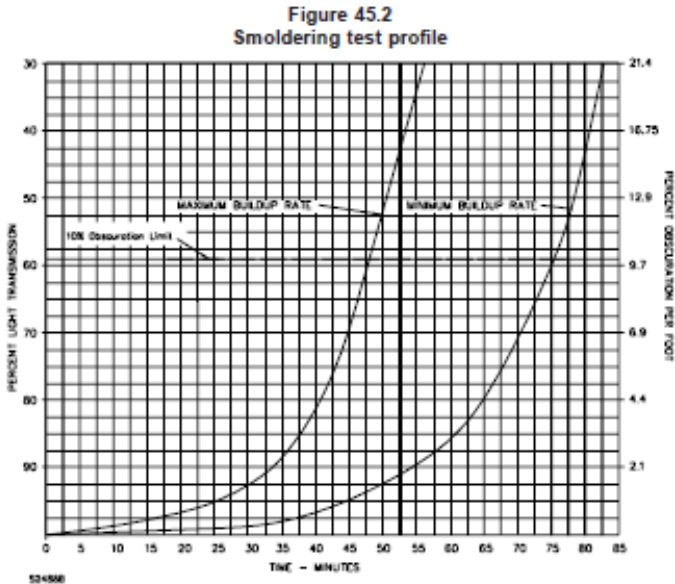
ⁿCerberus Ltd., Mannedorf, Switzerland, or Elektronikcentralen, Horsholm, Denmark, Measuring Ionization Chamber (MIC), Type EC 23095.

45.8 用 MICⁿ 来测量测试过程中可燃物相关的增强粒子, MIC 利用离子原理, 利用标准的真空泵鼓风,以 25±5 升/分钟速率穿过雾化室的气流, 监控头被安置在图 44.2 中指示位置。

ⁿCerberus 有限公司, 门内多夫, 瑞士, 或 Elektronikcentralen, 赫斯霍尔姆, 丹麦, 测量电离室 (MIC), EC 型 23095。

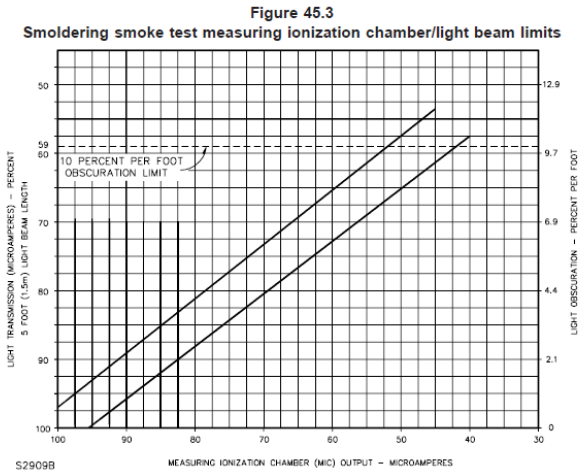
45.9 Prior to the test, the MIC shall be calibrated in clean air for a value of 100 picoamperes. As the smoke level increases during the test, the meter reading decreases.

45.9 在测试之前,MIC将被清洁空气校验到100uA的数值, 在测试过程中,随着烟雾的增加,MIC读数减少。



45.10 To determine the acceptability of the test trial, the relationship between the MIC output (ordinate) and the percent light transmission (abscissa) shall be plotted at 1 minute intervals during the test. The points generated shall remain within the curves illustrated in Figure 45.3.

45.10 为确定试验的接收水平, 在测试过程中,每 1 分钟测量一次在 MIC 输出 (纵轴) 及光线传输百分比 (横轴) 之间的关系, 生成的点将仍然在图 45.3 表示的曲线内。



46 Smoldering Smoke Test (Maximum Obscuration Without Alarm)

46.1 Each of four alarms, calibrated to the maximum sensitivity anticipated in production, shall not alarm prior to an obscuration level of 0.5 percent per foot (1.65 percent/m), or less, measured in the alarm area when subjected to the Smoldering Smoke Test, Section 45.

46 闷燃烟雾测试(不报警的最大烟雾)

46.1 四个报警器, 预期生产校验的最高灵敏度, 测量位置同闷燃烟雾测试 45 章节描述的,在浓度标准达到 0.5OBS/英尺 (1.65%/米) 或更少时,不会报警。

46.2 All conditions for this test are to be as described for the Smoldering Smoke Test, Section 45, except that the four samples subjected to this test are to be adjusted to the maximum production sensitivity and the samples are to be oriented in the most favorable position facing the fire as determined in the Directionality Test, Section 39.

46.2 此测试的所有条件都在闷燃烟雾测试, 第 45 章节中有描述, 除非这四个样品在第 39 章节方向性测试,被调到最大的产品灵敏度以及样品被面向火源,处在最有利的位罝。

47 Temperature Test

47.1 The materials or components employed in an alarm shall not be subjected to a temperature rise greater than that indicated in Table 47.1, under any condition of operation. Exception: When failure of a component results in an audible trouble signal resulting in the temperature rise of the component in the standby condition to exceed the limits in Table 47.1, in no case shall it be greater than the temperature permitted under an alarm condition.

47、温度测试

47.1 在任何操作条件下, 应用于报警器中的材料及元件都不能有高于表 47.1 中指示的温度。

例外: 在待机状态下, 当元件失效可导致可听度问题, 在产品能报警的条件下,元件的温升可以超过表 47.1 中的限制;其它任何情况,都不能超过规定的温度。

47.2 Except as noted in 47.3, all values for temperature rises apply to equipment intended for use in prevailing ambient temperatures, usually not higher than 25°C (77°F).

47.2 除了 47.3 中的备注外, 所有应用于外界设备的温度, 一般不高于 25°C (77°F)。

47.3 When equipment is intended specifically for use with a prevailing ambient temperature constantly more than 25°C (77°F), the test of the equipment is to be made at the higher ambient temperature, and temperature rises specified in Table 47.1 are to be reduced by the amount of the difference between that higher ambient temperature and 25°C (77°F).

47.3 当设备指定用在环境温度始终超过 25°C (77°F) 时,设备的测试在更高的环境温度, 表 47.1 指定的温度将降低到较高的外界温度及 25°C (77°F) 之间;

47.4 Temperature measurements on equipment intended for recessed mounting are to be made with the unit installed in an enclosure of nominal 3/4-inch (19.1-mm) wood having clearance of 2 inches (50.8 mm) on the top, sides and rear, and the front extended to be flush with the smoke alarm cover.

47.4 用于温度测量设备,嵌入式安装在 3/4-英寸 (19.1 毫米) 厚度的木头上,顶部, 侧面和后部有 2 英寸 (50.8 毫米) 的间隙, 前面扩展到于烟雾报警器盖平齐。

47.5 A temperature is constant when three successive readings, taken at not less than 5 minute intervals, indicate no change.

47.5 在不到 5 分钟的时间间隔,取三个连续的读数, 如果没有变化,表示温度是不变的。

47.6 Temperatures are to be measured by means of thermocouples consisting of wires not larger than AWG 24 (0.21 mm²). The method of measuring the temperature of a coil shall be either the thermocouple or change-in-resistance method. The thermocouple method is not to be used for a temperature measurement at any point where supplementary thermal insulation is employed.

47.6 通过直径不大于AWG24 (0.21平方毫米) 的电线组成的热电偶来测量温度, 测量线圈温度的方法, 应该是热电藕及改变电阻的方法, 热电藕的方法不适用于应用补充隔热材料地方的温度测量。

47.7 Thermocouples consisting of AWG 30 (0.06 mm²) iron and constantan wires and a potentiometer-type indicating instrument are to be used whenever referee temperature measurements by thermocouples are required.

47.7 由 30AWG (0.06mm²) 铁-铜-镍-合金线和电位器指示仪器组成的热电藕,可应用于任何需要热电偶测量温度的情况。

47.8 The thermocouple wire is to comply with the requirements specified in the Initial Calibration Tolerances for Thermocouples table in Temperature Measurement Thermocouples, ANSI/ISA MC96.1.

47.8 热电藕线必须符合 ANSI/ISA MC96.1,关于热电偶温度测量中初始公差校验的规定要求。

47.9 The temperature of a copper coil winding is determined by the change-in-resistance method by comparing the

resistance of the winding at the temperature to be determined with the resistance at a known temperature by means of the equation:

47.9 绕铜线圈的温度可以用改变电阻的方法，依据此温度下的电阻,利用已知的温度和此温度下的电阻,通过公式计算得到。

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

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,
- t is the known temperature in degrees C.

- T 表示想要知道的温度;
- R 表示在此温度下电阻的阻值;
- R 表示已知温度下的电阻阻值;
- T 表示已知的温度

Table 47.1
Maximum temperature rises

Device or material	Normal standby,		Alarm condition,	
	°C	(°F)	°C	(°F)
A. COMPONENTS				
1. Capacitors	25	45	40	72
2. Fuses	25	45	65	117
3. Rectifiers – At any point				
a. Germanium	25	45	50	90
b. Selenium	25	45	50	90
c. Silicon	(1) Maximum 60 percent of rated volts		50	75
	(2) 60 percent > rated volts		75	135
4. Relays and other coils with:				
a. Class 105 insulated windings				
Thermocouple method	25	45	65	117
Resistance method	35	63	75	135
b. Class 103 insulated windings				
Thermocouple method	45	81	85	153
Resistance method	55	99	95	171
5. Resistors ^a				
a. Carbon	25	45	50	90
b. Wire wound	50	90	125	225
c. Other	25	45	50	90
6. Sealing compounds	15°C (27°F) less than its melting point			
7. Solid state devices	See Note ^b			
B. INSULATED CONDUCTORS ^c				
1. Appliance wiring material	25°C (45°F) less than the temperature limit of the wire			
2. Flexible cord	35	63	35	63
C. ELECTRICAL INSULATION – GENERAL				
1. Fiber used as electrical insulation or cord bushings	25	45	65	117
2. Phenolic composition used as electric insulation or as parts where deterioration results in a risk of fire or electric shock	25	45	125	225

Table 47.1 Continued

Device or material	Normal standby,		Alarm condition,	
	°C	(°F)	°C	(°F)
3. Varnished cloth	25	45	60	108
D. GENERAL				
1. Mounting surfaces	25	45	65	117
2. Wood or other combustible material	25	45	65	117

^a When the temperature rise of a resistor other than a line voltage dropping resistor exceeds the value shown, the power dissipation shall be 50 percent or less of the resistor manufacturer's rating.

^b 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) is 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 are operated up to the maximum ratings under any one of the following conditions:

1. The component complies with the requirements of MIL-STD. 883C.
2. A quality control program is established by the manufacturer consisting of inspection and test 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 a recalibration of the sensitivity and retested.

^c For standard insulated conductors other than those identified, reference shall be made to the National Electrical Code, ANSI/NFPA 70 : the maximum temperature rise in any case is 25°C (45°F) less than the temperature limit of the wire in question.

47.10 As it is required to de-energize the winding before measuring R, it is appropriate for the value of R at shutdown 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 shall be plotted and extrapolated to give the value of R at shutdown.

47.10 根据要求,在测量电阻之前切断绕组,通常在关闭的时候需要测量几个电阻阻值,以得到合适的电阻阻值;尽快开始后,瞬间关机;应绘制电阻阻值及时间的曲线,并推断在关闭时的 R 值。

47.11 To determine compliance with this test, an alarm is to be connected to a source of supply in accordance with 33.3.1 and operated under the following conditions:

- a) Standby – 16 hours minimum. Constant temperatures.
- b) Alarm – 1 hour.
- c) Alarm – 7 hours or to battery depletion. Abnormal test.

47.11 确定这个测试的符合性,一个报警器将被连接到符合 33.3.1 的电源供应,在以下条件下操作:

- a) 待机---恒定温度下至少 16 小时。
- b) 报警---1 小时。
- c) 报警---7 小时或电池用尽,非正常测试。

47.12 When the temperature limits for 47.11 (c) are exceeded there shall be no manifestation of a fire or approaching failure, and the alarm shall operate as intended following the test.

47.12 当47.11 (C) 的温度界限超出将不表明起火或类似的失效,报警器将继续进行测试。

47.13 The alarm is to be subjected to the Dielectric Voltage-Withstand Test, Section 54, following 47.11 (b) or (c).

47.13 报警器经过47.11 (b、c) 后,按照54章节进行绝缘耐压测试。

48 Overload Test

48.1 Detector

48.1.1 An alarm other than that operating from a primary battery shall be capable of operating as intended after being subjected to 50 cycles of alarm signal operation at a rate of not more than 6 cycles per minute with the supply circuit to the detector at 115 percent of the rated test voltage. Each cycle shall consist of starting with the alarm energized in the standby condition, initiation of an alarm by smoke or equivalent means, and restoration of the alarm to standby.

48、过载测试

48.1 检测器

48.1.1 报警器除了用电池供电,要有能力在 115%的额定电压下,频率不能超过每分钟六次,进行 50 次的报警循环操作,每一个循环包括在待机状态下的报警通电开始,启动烟雾报警装置或等效,并恢复到待机报警。

48.1.2 Rated test loads are to be connected to those output circuits of the alarm which are energized from the alarm

power supply, such as remote indicators, relays, and other devices. The test loads shall be those devices, or the equivalent, normally intended for connection. When an equivalent load is employed for a device consisting of an inductive load, a power factor of 60 percent is to be employed. The rated loads are established initially with the alarm connected to a source of supply in accordance with 33.3.1 following which the voltage is increased to 115 percent of rating.

48.1.2 评价测试负载被连接到那些从报警电源通电的报警输出电路, 例如远端指示器, 继电器及其它装置, 通常, 用于连接测试负载应是那些设备, 或相等物, 当等效负载的设备组成的一个感性负载, 功率因数为 60%时, 可以采用, 额定负载开始是符合 33.3.1 供应电源, 然后增加到额定电压的 115%。

48.1.3 For direct current rated signaling circuits, an equivalent inductive test load is to have the required DC resistance for the test current and the inductance (calibrated) to obtain a power factor of 60 percent when connected to a 60 hertz AC potential equal to the rated DC test voltage. When the inductive load has both the required DC resistance and the required inductance, the current equals 0.6 times the current measured with the load connected to a DC circuit when the voltage of each circuit is the same.

48.1.3 对于额定直流信号电路, 等效的电感测试负载, 是具有所需的测试电流的直流电阻和校准的电感连接时, 获得的功率因数为 60%到 60 赫兹的交流电或相等的额定的直流测试电压; 当电感负载有直流电阻和电感的要求, 当每个电路的电压相同, 与直流电路的负载连接测量, 电流等于 0.6 倍测量的电流。

48.2 Separately energized circuits

48.2.1 Separately energized circuits of an alarm, such as dry contacts, shall be capable of operating as intended after being subjected for 50 cycles of signal operation at a rate of not more than 6 cycles per minute while connected to a source of supply in accordance with 33.3.1, with 150 percent rated loads at 60 percent power factor applied to output circuits which do not receive energy from the alarm. There shall be no electrical or mechanical failure of the switching circuit.

48.2.2 The test loads shall be set at 150 percent of rated current while connected to a separate power source of supply in accordance with 33.3.1.

48.2 单独供电电路

48.2.1 报警器中单独供电电路, 例如干接点, 要有能力在连接到符合 33.3.1 的电源电压下, 150%的负载, 60%功率因素, 不能从报警器输出电路接受能量, 频率不能超过每分钟六次, 进行 50 次的报警循环操作. 在切换电路时, 不应有任何电气或机械故障的。

48.2.2 按照 33.3.1 要求, 测试负载在连接到一个单独的电源供应源, 应被设置在额定电流的 150%。

49 Endurance Test

49.1 Smoke alarm

49.1.1 An alarm shall operate as intended after being subjected to 6000 cycles of 5 second alarm signal operation, at a rate of not more than 10 cycles per minute, with the alarm connected to a source of supply in accordance with 33.3.1 and with related devices or equivalent loads connected to the output circuits. There shall not be electrical or mechanical failure or evidence of failure of the alarm components. It is appropriate for battery operated units to be connected to an equivalent filtered DC power supply source for this test.

49.1.2 Sensitivity measurements, using aerosol, are to be recorded before and after the Endurance Test, in accordance with the Sensitivity Test, Section 37. The sensitivity values shall vary not more than specified in 34.4.1.

49 耐久测试

49.1 烟雾报警

49.1.1 报警器要在供电电源供应符合 33.3.1 中要求, 相关的装置或类似的负载连接到输出电路上时, 在通过 6000 次, 速率不能超过 10 次/分钟, 5 秒钟的报警后能正常操作, 报警器元件不得有电气或机械的失效或类似失效的现象, 这个测试也适合电池供电或者等同于类似直流供电的产品。

49.1.2 使用雾化装置测量灵敏度, 灵敏度测试要求按照第 37 章节, 记录耐久测试之前和之后的灵敏度, 灵敏度的值不能偏离 34.4.1 指定的要求。

49.2 Separately energized circuits

49.2.1 Separately energized circuits of an alarm shall operate as intended, when operated for 6000 cycles at a rate of not more than 10 cycles per minute at a 50 percent duty cycle. When an electrical load is involved, the contacts of the device shall be made to make and break the normal current at the voltage specified by 33.3.1. The load is to represent that which the device is intended to control. The Endurance Tests of the separately energized circuits shall be conducted

either separately or in conjunction with the Endurance Test of the alarm. There shall not be electrical or mechanical malfunction of the alarm nor malfunction or welding of any relay contacts.

Exception: When the contact rating is at least twice that of the load controlled, this test is not required.

49.2 单独供电电路

49.2.1 用单独供电电路的报警器,在通过 6000 循环,在 50%的工作循环,速率不能超过 10 次/分钟,能正常操作,当一个电气负载包括在内,在 33.3.1 规定的电压电流条件下,产品做通断电测试,这个负载表示这个装置的目的是受控的,单独供电电路的耐久测试,对于耐久测试的报警器,必须做单独或联机测试,报警器不得有电子或机械的故障,也没有任何继电器触点焊接的故障。

除非:当接触额定值至少是负载控制的 2 倍以上,此测试不做要求;

49.3 Audible signaling appliance

49.3.1 The audible signaling appliance of each of two alarms shall operate as intended when the alarms are operated for 8 hours of alternate 5-minute periods of energization and de-energization in the standby and alarm conditions, followed by 72 hours of continuous energization in an alarm condition. For this test, the alarms are to be connected to a source of rated voltage and frequency. For a battery operated alarm, a filtered DC supply is to be employed that has an output voltage equivalent to the fresh battery voltage.

49.3 两个报警器中可听度信号,在待机及报警条件下每 5 分钟的交替通电和断电,连续工作 8 小时,或者在报警条件下,连续 72 小时通电后功能正常,此测试报警器将连接到额定电压及频率的电源,如果是电池供电的报警器,滤波后的直流电源是具有相当于新电池电压的输出电压,也可以采用。

49.4 Test means

49.4.1 A sensitivity adjustment switch, test means, alarm silencing means, or reset switch provided on an alarm shall operate as intended after being operated for 1500 cycles at the rate of not more than 10 cycles per minute. The time of actuation of a test means is to be long enough to obtain at least 1 second of alarm. For this test one alarm is to be connected to a rated source of supply voltage and frequency. This test is to be conducted either separately or in conjunction with the Endurance Test of the alarm.

49.4 测试方法

49.4.1 能调节灵敏度的开关,测试按键,HUSH 按键,以及报警器复位开关,在进行速率不高于 10 次/分钟的 1500 次循环后功能正常,测试条件的按键的时间要足够长,应至少有 1 秒报警以上,此测试报警器将被连接到额定电源供应电压及频率,这种测试方法将被应用到报警器单独或联机的耐久性测试。

50 Variable Ambient Temperature Test

50.1 Operation in high and low ambient

50.1.1 An alarm shall operate for its intended signaling performance when tested in an ambient temperature of 0 and 49°C (32 and 120°F) at a relative humidity of 30 to 50 percent. Two alarms, one at maximum and one at minimum sensitivity, are to be maintained at each ambient temperature for at least 3 hours so that thermal equilibrium is reached. The units then are to be tested for sensitivity while connected to a source of supply in accordance with 33.3.1.

50、可变的环境温度测试

50.1 高低温环境的操作

50.1.1 当测试环境温度为 0°C和 49°C (32°F和 120°F),湿度 30%-50%RH,报警器应功能正常,两个报警器,一个最高灵敏度,一个在最低灵敏度在每一个温度至少放置 3 个小时,目的为达到热量平衡,当连接到符合 33.3.1 要求的电源,然后进行灵敏度测试。

50.1.2 Sensitivity measurements shall be recorded before and during exposure to each ambient temperature in accordance with the Sensitivity Test, Section 37, except that the relationship between the MIC output and the percent light transmission remains within the limits represented by the curves illustrated in Figures 50.1 and 50.2 for the 0°C (32°F) and 49°C (120°F) ambients, respectively. The visible smoke buildup rates are to be maintained within the limits illustrated in Figures 50.3 and 50.4 for the 0 and 49°C ambients, respectively.

50.1.2 根据第 37 章节的灵敏度测试要求,必须测试之前和在每个温度的灵敏度。除非在 0°C (32°F) 和 49°C (120°F) 情况下,MIC 输出及光线传输之间的关系仍然在图 50.1 和 50.2 中的曲线内;在 0°C及 49°C的条件下,可见烟雾增强率将保持在图 50.3 及 50.4 界限内。

50.1.3 Each unit shall operate as intended in each ambient. The sensitivity readings using gray smoke measured in each ambient temperature shall vary not more than specified in 34.4.1 from the value recorded prior to the Variable Ambient Temperature Test, Section 50, and shall not, in any case, exceed the limits specified in 37.1.1.

50.1.3 每个产品将在每个环境条件下工作，在每一个的外界温度测试的烟雾灵敏度(来自之前第50章节的可变的环境温度测试的数据)的读数的变化,不能偏离超过34.4.1中的指示，任何情况下都不能超出37.1.1中的规定。

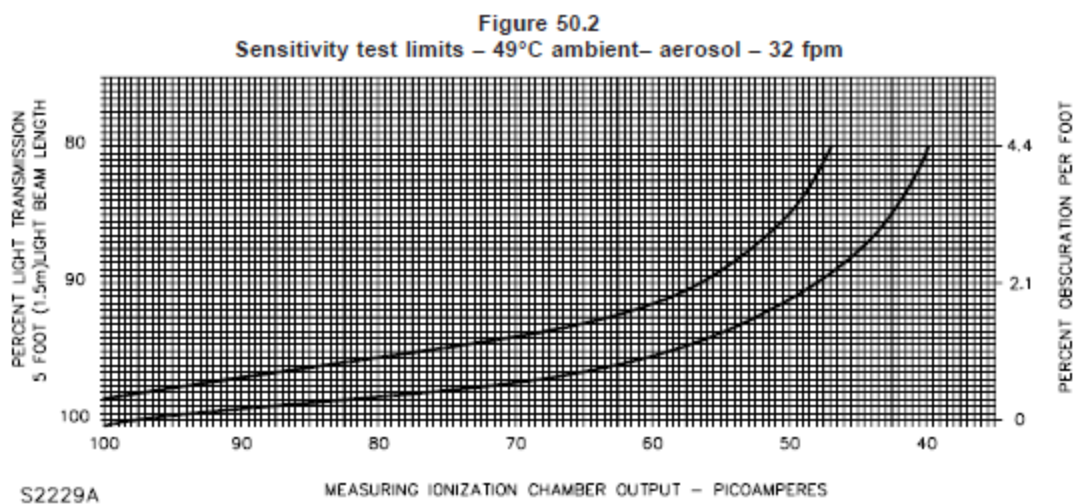
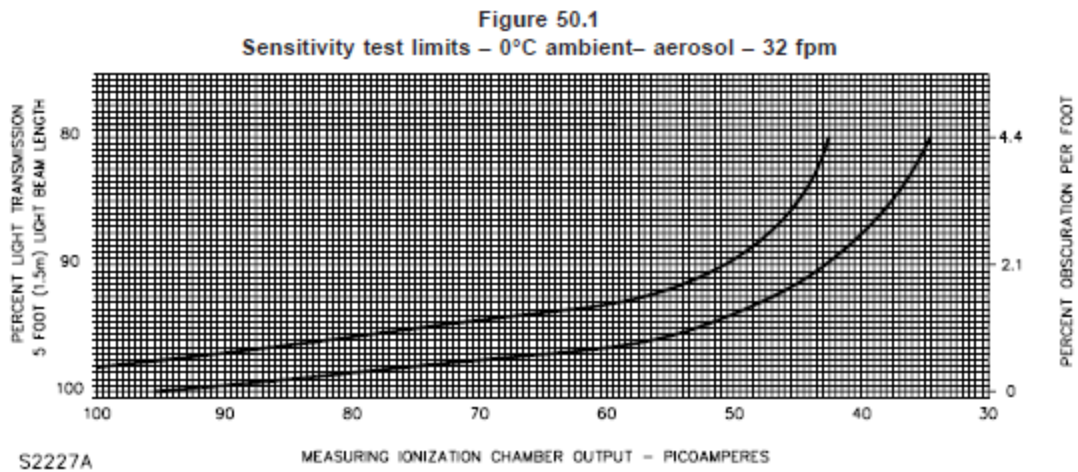


Figure 50.3
Smoke build-up rate – sensitivity test – 0°C ambient – aerosol – 32 fpm

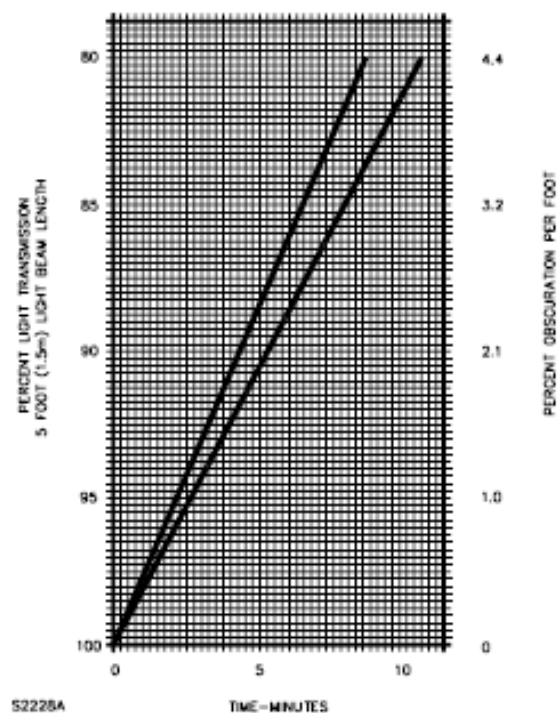
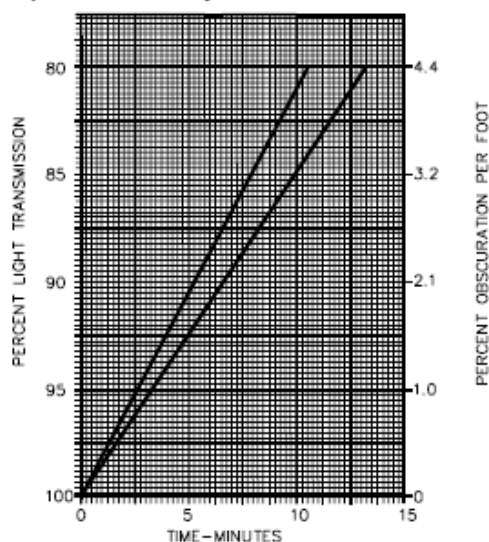


Figure 50.4
Smoke build-up rate – sensitivity test – 40°C ambient – aerosol – 32 fpm



50.2 Effect of shipping and storage

50.2.1 The sensitivity of an alarm shall not be impaired by exposure to high and low temperatures representative of shipping and storage.

50.2.2 Two alarms, one at maximum and one at minimum sensitivity, are to be subjected, in turn, to a temperature of 70°C (158°F) for a period of 24 hours, let to cool to room temperature for at least 1 hour, exposed to a temperature of minus 30°C (minus 22°F) for at least 3 hours, and then permitted to warm up to room temperature for at least 3 hours. The alarms then are to be tested for sensitivity using aerosol while connected to a source of supply in accordance with 33.3.1.

50.2.3 Sensitivity measurements are to be recorded, before and after exposure to both ambient conditions, in accordance with the Sensitivity Test, Section 37.

50.2.4 The sensitivity readings using aerosol measured after exposure shall vary not more than specified in 34.4.1.

50.2 运输及储存影响

50.2.1 报警器的灵敏度在运输及储存的高低温中不能被损坏。

50.2.2 两个报警器，一个在最大灵敏度，一个在最小灵敏度，将被轮流放入温度 70°C (158°F) /24 小时，冷却到室温至少 1 个小时，暴露于-30°C 的温度 (-22°F) 至少 3 个小时，然后允许升温到室温至少 3 个小时，报警器将被符合 33.3.1 要求的电源连接，进行灵敏度测试（使用雾质）。

50.2.3 根据第 37 章节灵敏度测试的要求，记录之前和在 2 种温度环境下的灵敏度结果；

50.2.4 使用雾质测量之后的灵敏度偏离不能超出 34.4.1 中指定。

51 Humidity Test

51.1 Two alarms, one at maximum and one at minimum sensitivity, shall operate for their intended signaling performance when exposed for 168 hours to air having a relative humidity of 93 ±2 percent at a temperature of 40 ±2°C (104 ±4°F) while energized from a source of supply in accordance with 33.3.1. There shall not be false alarms during the exposure.

51.2 Sensitivity measurements shall be recorded before and during exposure to the humidity condition in accordance with the Sensitivity Test, Section 37, except that the relationship between the MIC output and the percent light transmission remains within the limits represented by the curves illustrated in Figure 37.2. The buildup rate is to be maintained within the limits represented by the curves illustrated in Figure 37.1.

51.3 The sensitivity values shall not vary more than specified in 34.4.1 from the value recorded prior to the Humidity Test.

51.4 Following the Humidity Test, a detector other than that operating from a primary battery, shall be subjected to the Leakage Current Test, Section 52.

51、湿度测试

51.1 两个报警器，一个在最大灵敏度，一个在最小灵敏度，当放置于空气湿度 93±2%RH，温度 40±2°C (104±4°F) 168 小时后，当被符合 33.3.1 的电源连接，能正常工作，在测试中不能有误报警。

51.2 根据第 37 章节，灵敏度测试要求测试之前和之后的灵敏度，除非在 MIC 输出及光线传输百分比之间的关系仍然在图 37.2 的曲线内，增强率仍然在图 37.1 中的曲线界限内。

51.3 在湿度测试之前的灵敏度数值不能偏离 34.4.1 中的规定。

51.4 按照湿度测试，报警器为电池供电的，要按照第 52 章节进行漏电流测试。

52 Leakage Current Test

52.1 The leakage current of an alarm not operating from a primary battery shall not exceed 0.5 milliampere, AC or DC, after being subjected to the Humidity Test, Section 51, when measured as follows:

- a) Between any exposed surface of an alarm that is contacted by a person and earth ground, and
- b) Between any interior parts of an alarm that are contacted by a person during servicing and earth ground.

All grounding connections to the unit being tested are to be disconnected prior to making the measurement. The leakage current measurement is to be made at the supply connection polarity indicated on the installation wiring diagram supplied with the alarm and also with the polarity reversed. See Figure 52.1.

52、漏电流测试

52.1 不是用电池供电的报警器的漏电流不能超过 0.5MA，不管是 AC 或 DC，在第 51 章湿度测试以后，应按照以下测量：

- a) 在报警器暴露的任何的表面可能被人及大地接触。
- b) 报警器内部元件在维修过程中可能被人以及被地接触。

在进行测量之前断开所有的接地连接到被测试的产品，漏电流测量要保证供应连接的极性与报警器线路安装图一致，也可以颠倒一下极性,具体见图 52.1.

52.2 For this test the alarm is to be de-energized, removed from the humidity environment, placed on a dry insulating surface, and immediately reenergized from a rated source of supply. The leakage measurement then is to be made within 5 minutes of energization while in the standby and alarm conditions. The leakage current value is to be rms values for DC (nonfiltered rectified AC) and sinusoidal waveforms up to 1 kilohertz. For frequencies above 1 kilohertz the leakage current limit is to be the value given multiplied by the frequency in kilohertz up to a maximum multiplier of 100.

52.2 此测试，报警器断电，从湿度环境中移出来，放到一个干燥的绝缘平面上，迅速使用额定电源通电，在待机和报警的状态下，漏电流须在通电 5 分钟内被测量，漏电流的数值为 DC（非整流滤波的 AC）的 rms(有效)值，和高达 1 千 HZ 的正弦波形，在频率超过 1000HZ 的漏电流的界限为给出的数值乘以频率,最大乘以 100。

52.3 The test meter employed to measure the leakage current is to be an average responding AC milliammeter that indicates the rms value of a pure sine wave, having an error of not greater than 5 percent, and a maximum input impedance of 1000 ohms. For AC measurements, a DC milliammeter, with a maximum impedance of 1000 ohms in the test circuit, is to be employed.

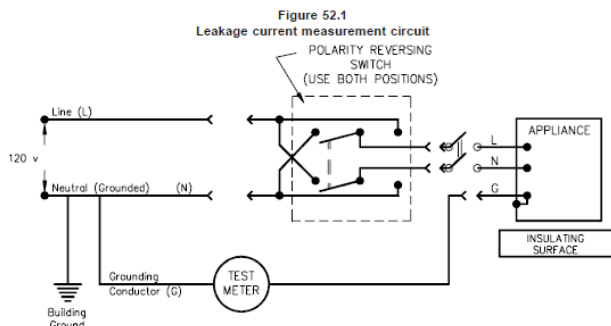
52.3 测量泄漏电流测试仪是一个平均响应表现为纯正弦波 rms(有效)值 AC 毫安表，具有不大于 5%，最大输入阻抗为 1000 欧姆的误差，对于 AC 测量的直流毫安表，在测试电路的最大阻抗为 1000 欧姆，是可以使用的。

52.4 When a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using a metal foil with an area of 10 by 20 centimeters (4 by 8 inches) placed in contact with the surface. Where the surface is less than 10 by 20 centimeters (4 by 8 inches), the metal foil is to be the same size as the surface. The metal foil is not to be pressed into openings and is not to remain in place long enough to affect the temperature of the sample.

52.4 当用于外壳或外壳的一部分，除金属以外的导电性表面，漏电流的测量使用的金属箔面积为 10×20 厘米（4×8 英寸）放置在与表面接触，如果此表面少于 10×20cm（4×8 英寸），金属箔的大小应与表面一致，金属箔不能被压断，不能保留过长时间以影响样品的温度。

52.5 When an alarm is intended for multiple station connection, leakage currents are to be measured with the maximum number of alarms intended to be interconnected, unless it is established by circuit analysis that the leakage current is independent of interconnection.

52.5 当报警器联机时，漏电流的测量须使用最大连接数量的报警器，除非它被分析,漏电流在互连中是独立的。



53 Transient Tests

53.1 General

53.1.1 An alarm shall operate for its intended signaling performance with its sensitivity not affected adversely when two representative samples (one preset to the maximum and one preset to the minimum production sensitivity) are subjected to 500 supply line (high-voltage) transients, 500 internally induced transients, extraneous transients, and 60 supply line (low-voltage) circuit transients, while energized from a source of supply in accordance with 33.3.1 and connected to the device(s) intended to be used with the alarm.

53.电瞬变测试

53.1 总则

53.1.1 2 个报警器,一个为最大的灵敏度,一个为最小的灵敏度,当被符合 33.3.1 的电源连接时,在经受 500V 高压的瞬变测试, 500 内部引起的瞬变, 多余的瞬变, 和 60V 低电压的瞬变测试, 灵敏度不会受到不利影响

53.1.2 Different alarms are to be used for each test. The alarms shall not false alarm for more than 1 second. Alarms using a primary battery as a power supply are to be subjected to the extraneous transients test only. When an alarm is intended for multiple-station connection, the transient tests are to be conducted with the maximum number of alarms intended to be connected.

53.1.3 Sensitivity measurements using aerosol, recorded before and after each transient condition, shall not vary more than specified in 34.4.1.

53.1.2 不同的报警器用来做每一个测试, 报警器误报警时间不超过 1 秒, 用电池供电的报警器只做外部瞬变测试, 若报警器为联机连接, 瞬变测试为最大数量连接的报警器。

53.1.3 使用雾质进行的灵敏度测量, 记录每次瞬变测试之前与之后灵敏度, 偏离不能超过 34.4.1 中的规定。

53.2 Supply line (high-voltage) transients

53.2.1 For this test, the alarm is to be connected to a transient generator, consisting of a 2 kilovolt-amperes isolating power transformer and control equipment capable of producing the transients described in 53.2.2. See Figure 53.1. The output impedance of the transient generator is to be 50 ohms.

53.2.2 The transients produced are to be oscillatory and have an initial peak voltage of 6000 volts. The rise time is to be less than 1/2 microsecond. Successive peaks of the transients are to decay to a value of no more than 50 percent of the value of the preceding peak. Each transient is to have a total duration of 20 microseconds.

53.2.3 Each unit is to be subjected to 500 oscillatory transient pulses induced at a rate of once every 10 seconds. 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.

53.2 电源线（高压）瞬变

53.2.1 此测试报警器将连接到一个瞬变发生器, 由 2 千伏安隔离电源变压器和按照 53.2.2 中的描述的要求, 具体见图 53.1, 能控制设备产生的瞬变,瞬变发生器的输出阻抗为 50Ω。

53.2.2 所产生的瞬间振动, 有初始的峰值电压为 6000 伏, 上升时间要小于 0.5 微秒, 连续的瞬变峰值衰减不能超过先前峰值的 50%, 每一次瞬变至少持续 20 微秒的时间。

53.2.3 每一个产品将进行 500 次, 每 10 秒钟一次, 振荡变换脉冲, 每个瞬态脉冲是被感应到正 90 度的 60 赫兹的周期的一半。250 个瞬变脉冲式正的接地,另外 250 个瞬变脉冲是负的接地;

53.3 Internally induced transients

53.3.1 The alarm is to be energized in the standby condition while connected to a source of supply in accordance with 33.3.1. The supply is to be interrupted for 1 second at a rate of not more than 6 cycles per minute for a total of 500 cycles. Following the test the alarm is operated for its intended signaling performance.

53.3 内部引起的瞬变

53.3.1 报警器将在待机状态下通电, 连接的电源符合 33.3.1 需求, 电源被 1 秒钟干扰一次, 每分钟不多于 6 次循环的条件下, 做 500 个循环, 在此测试中, 报警器功能正常。

53.4 Extraneous transients

53.4.1 Single or multiple station smoke alarms shall not false alarm and their intended operation shall not be impaired when subjected to extraneous transients generated by the devices and appliances described in 53.4.2. In addition, the alarm shall respond to smoke during application of the transient condition.

53.4 外部瞬变

53.4.1 单机或联机烟雾报警器在外部经过 53.4.2 中描述瞬变时,不会出现误报警,功能也不会受到损坏,另外,报警器在瞬变过程中,将对烟雾做出反应。

53.4.2 Two single and two sets of multiple station smoke alarms are to be energized from a source of rated voltage and frequency and subjected to transients generated from the following devices located 1 foot (305 mm) from the alarm, interconnecting wires, or both. The time of application for the condition specified in (a) is to be at least 2 minutes. The conditions specified in (c), (d), and (e) are to be applied for 10 cycles, each application of 2 seconds duration, except the last application shall be of a 10-minute duration. Near the end of the last cycle, an abnormal amount of smoke is to be introduced into the alarm chamber to determine whether the unit is operational for smoke with the transient applied.

53.4.2 两个单机报警器及两组联机烟雾报警器将被额定电压及频率的电源通电,受到位于装置 1 英尺(305mm)处的德报警器,或者互连线,或者二者产生的瞬变。(a)中规定的条件的应用是时间至少为 2 分钟,在(c)、(d)、(e)规定的条件中运用 10 次循环,每次应用持续 2 秒;除了最后的应用,将持续 10 分钟,在最后一个循环的结束,异常数量的烟量将被放入报警室内,确定产品在瞬间烟雾操作下是否能正常工作。

a) Sequential arc (Jacob's ladder) generated between two 15 inch (381 mm) long, AWG 14 (2.1 mm²) solid copper conductors attached rigidly in a vertical position to the output terminals of an oil burner ignition transformer or gas tube transformer rated 120 volts, 60 hertz primary; 10,000 volts, 60 hertz, 23 milliamperes secondary. The two wires are to be formed in a taper starting with an 1/8 inch (3.2 mm) separation at the bottom (adjacent to terminals) and extending to 1-1/4 inches (31.8 mm) at the top.

a) 两个15英寸(381毫米)长, 14 AWG (2.1 mm²) 的实心铜导体牢固地竖立在垂直位置,开始,额定120伏/60赫兹,然后是10000V /60HZ/23Ma,油燃烧器点火变压器或天然气管变压器输出端子按次序产生电弧(雅各布阶梯)。此两根线是锥状结构,底部0.125英寸(3.2mm),延伸到顶部为1.25英寸(31.8mm)。

b) Energization and transmission of random voice message of five separate transmitter-receiver units (cellular phones) in turn, and operating in the following nominal frequencies:

- 1) 27 megahertz,
- 2) 150 megahertz,
- 3) 450 megahertz,
- 4) 866 megahertz, and
- 5) 910 megahertz.

A total of six energizations in each of two orientations are to be applied from each transmitter-receiver; five to consist of 5 seconds on and 5 seconds off, followed by one consisting of a single 15-second energization. For this test, the cellular phones are to be in the same room and on the same plane as the detector under test. The cellular phones are to be positioned to generate a field strength of 20 volts/meter at the surface of the detector's printed-wiring board. The test is to be conducted with the antenna tip pointed directly at the detector, and at right angle to the first position centered on the detector.

b) 通电时和五个独立的收发两用机(蜂窝电话)随机话音消息传输,在下面的频率下进行操作。

- 1) 27MHZ
- 2) 150MHZ
- 3) 450MHZ
- 4) 866MHZ
- 5) 910MHZ

一共有在每个两个取向中的六次的通电是被应用于从每个发射器的接收器,5次包括5秒开,5秒关,接着包括一个15秒的通电,此测试,蜂窝电话同测试的报警器一样,在同样的房间及在相同平面,蜂窝电话的位置是能在产品的PCB板表面产生20伏/米的场强,此测试的天线顶端正对着报警器,开始的位置是天线角度正对着报警器的中心。

c) Energization of an electric drill rated 120 volts, 60 hertz, 2.5 amperes.

d) Energization of a soldering gun rated 120 volts, 60 hertz, 2.5 amperes.

e) Energization of a 6-inch (152-mm) diameter solenoid-type vibrating bell with no arc suppression and rated 24 volts.

oEdwards, Model 439D-6AW, vibrating bell rated 0.075 amperes, 20/24 volts DC or equivalent.

C)120V/60HZ/2.5A 电钻通电;

D)120V/60HZ/2.5A 焊枪通电;

E)额定24V,无电弧抑制的6英寸(152毫米)直径电磁式振动贝洛通电。

Edward的439D-6AW产品,振动贝洛是0.075A/20或24V直流电源或相当于的电源。

53.5 Supply line (low-voltage) circuit transients

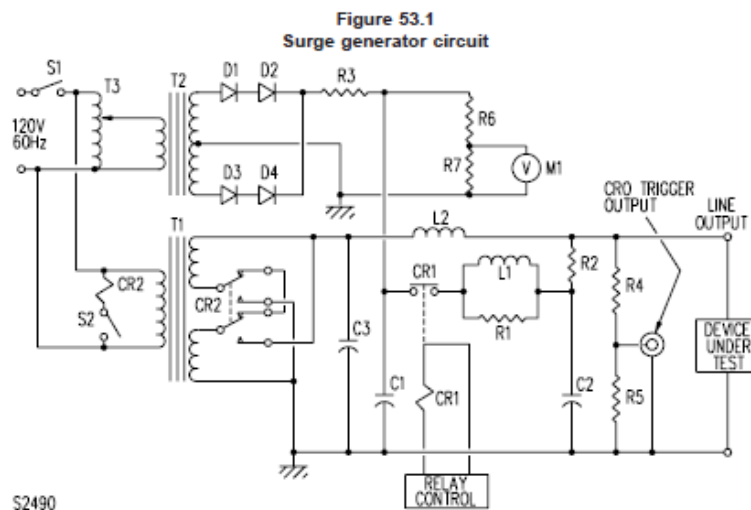
53.5.1 Each of two low-voltage smoke alarms is to be subjected to 60 transient voltage pulses. The pulses are to be induced into:

- The smoke alarm circuit intended to be connected to the low-voltage initiating device circuit of a system control unit and
- The low-voltage power supply circuit of the alarm.

53.5 电源线(低压)瞬变

53.5.1 两个低电压烟雾报警器中的每一个是要经受 60 瞬变电压脉冲，此脉冲产生将感应为：

- 烟雾报警器电路被连接到低电压启动设备电路系统控制单元；
- 报警器低压电源供应电路。



C1 – Capacitor, 0.025 μ F, 10 kV

C2 – Capacitor, 0.006 μ F, 10 kV

C3 – Capacitor, 10 μ F, 400 V

CR1 – Relay, coil 24 VDC. Contacts, 3-pole, single throw, each contact rated 25 A, 600 VAC maximum, all three poles wired in series.

CR2 – Relay, coil 120 VAC. Contacts DPDT. Provides either 120 V or 240 V test circuit.

D1 – D4 – Diodes, 25 kV PIV each

L1 – Inductor 15 μ H [33 turns, AWG 22 wire, wound on 0.835 inch (21.2 mm) diameter PVC tubing]

L2 – Inductor, 70 μ H [45 turns, AWG 14 wire, wound on 2.375 inch (60.33 mm) diameter PVC tubing]

M1 – Meter, 0 – 20 VDC

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 composition)

S1 – Switch, SPST

S2 – Switch, SPST, key-operated, 120 VAC, 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

53.5.2 For this test, each 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 80 microseconds, and an energy level of 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.

53.5.2 此测试中,每个电路是要经受五种不同的瞬态波形具有峰值在 100 至 2400 伏的范围内的电压电平,交付到 1 个 200Ω 的负载,在 2400 伏的瞬态波形应具有 100 伏每微秒脉冲上升时间,1 个脉冲持续 80 微秒,为 1.2 焦耳的能量级,其它供应的瞬变具有 100-2400V 整个区间,持续脉冲 80-110 微秒。能量级别不小于 0.3J 或大于 1.2J,代表性的峰值电压。

53.5.3 The alarm is to be subjected to 60 transient pulses induced at the rate of six pulses per minute as follows:

- a) Twenty pulses (two at each transient voltage level specified in 53.5.2) between each 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 53.5.2) between any two circuit leads or terminals consisting of ten pulses of one polarity and ten of the opposite polarity.

53.5.3 报警器将进行 60 次瞬变,频率 6 次脉冲/分钟,如下脉冲:

- a) 在每一个电路引脚或端子及接地间进行 20 次脉冲(两个在 53.5.2 规定的瞬变电压等级内),包括 10 次脉冲同一极性,10 次脉冲相反极性(共 40 次脉冲)。
- b) 在任何两个电路引脚或端子之间 20 次脉冲(两个在 53.5.2 规定的每一个变换电压标准内)包括 10 次脉冲同一极性,10 次脉冲相反极性

53.5.4 At the conclusion of the test, the alarm shall comply with the requirements of the Normal Operation Test, Section 34, and the Sensitivity Test, Section 37.

53.5.4 此测试的结论,报警器应符合第 34 章正常操作测试和第 37 章的灵敏度测试要求。

53.6 Surge immunity test (combination wave)

53.6.1 The smoke alarm shall be subjected to the Surge Immunity Test without demonstrating, either during or after testing, any of the following:

- a) Emission of flame, molten metal, glowing or flaming particles through any openings (preexisting or created as a result of the test) in the product;
- b) Ignition of the enclosure; nor
- c) Creation of any opening in the enclosure that results in accessibility of energized parts.

Added 53.6.1 effective August 4, 2015

53.6 浪涌抗扰度试验 (组合波)

53.6.1 烟雾报警器在没有指明的情况下,通过浪涌抗扰度试验,不管在实验中或实验后,符合任何下面的条件:

- A 产品火焰燃烧,熔融金属,通过任何开口的发光或燃烧颗粒(预先存在的或作为结果创建的测试)
- B 点火器的外壳,或
- C 建立的任何机箱开口,导致达到带电的附件

增加的 53.6.1 从 2015 年 8 月 4 日起执行

53.6.2 The test method is to be conducted in accordance with the testing methods described in IEC 61000-4-5 Electromagnetic Compatibility (EMC) Part 4-5: Testing and Measurements Techniques – Surge Immunity Test. The surges (five positive and five negative) are to be applied at phase angles of 90 and 270 electrical degrees.

Added 53.6.2 effective August 4, 2015

53.6.2 测试的方法按照 IEC61000-4-5 电磁兼容性(EMC) 第 4-5 部分:实验和测量技术---浪涌抗扰度试验要求进行测试,浪涌(五次正的,五次负的) 执行在 90 和 270°电角度的相位角;

增加的 53.6.2 从 2015 年 8 月 4 日起执行

53.6.3 The surge impulse test levels in Table 53.1 are to be used (combination 1.2/50 μs , 8/20 μs Voltage/Current surge waveform). A separate smoke alarm shall be used for each surge level.

Added 53.6.3 effective August 4, 2015

Added 53.6.3 effective August 4, 2015

53.6.3 浪涌抗扰度试验水平按照表 53.1 执行(1.2/50us,8/20us 组合的浪涌电压/电流波形),单独的报警器将被每一个浪涌水平进行测试;

增加的 53.6.3 从 2015 年 8 月 4 日起执行

Table 53.1
Surge impulse levels
Added Table 53.1 effective August 4, 2015

Peak Voltage (kV)	Peak Current (kA)
2	1
4	2
6	3

53.6.4 At the conclusion of the test, the alarm is to comply with the requirements of the Normal Operation Test, Section 34, and the Sensitivity Test, Section 37.

Added 53.6.4 effective August 4, 2015

53.6.4 实验的结论,测试的报警器必须符合第 34 章节的正常操作测试和第 37 章节的灵敏度测试;
增加的 53.6.4 从 2015 年 8 月 4 日起执行

53.7 Surge current test

53.7.1 Each of three previously untested representative devices of the smoke alarm are to be subjected to the Surge Current Test without demonstrating, either during or after testing, any of the following:

- a) Emission of flame, molten metal, glowing or flaming particles through any openings (preexisting or created as a result of the test) in the product;
- b) Charring, glowing, or flaming of the supporting surface, tissue paper, or cheesecloth;
- c) Ignition of the enclosure; nor
- d) Creation of any openings in the enclosure that results in accessibility of live parts.

Added 53.7.1 effective August 4, 2015

53.7 浪涌电流测试

53.7.1 每 3 个先前没有经过测试的典型产品,在没有指明的情况下,须通过浪涌抗扰度试验,不管在实验中或实验后,符合任何下面的条件:

- A 产品火焰燃烧, 熔融金属, 通过任何开口的发光或燃烧颗粒 (预先存在的或作为结果创建的测试);
- B 炭化, 发光, 或燃烧的支撑面, 纸巾或纱布
- C 点火器的外壳,或
- D 建立的任何机箱开口,导致达到带电的附件

增加的 53.7.1 从 2015 年 8 月 4 日起执行

53.7.2 The smoke alarm is to be mounted on a ceiling surface covered with a double layer of white tissue paper. Each smoke alarm is to be loosely draped with a double layer of cheesecloth. The cheesecloth shall cover openings (for example, ventilation openings) where flame, molten metal, or other particles are not prohibited from being expelled as a result of the test. However, the cheesecloth is to not be deliberately pushed into openings.

Added 53.7.2 effective August 4, 2015

53.7.2 烟雾报警器安装在天花板表面,覆盖 2 层白纸巾, 每一个报警器松散的覆盖 2 层纱布,纱布须覆盖在开口处(例如, 通风开口处), 其中,火焰,熔融金属或其他颗粒不会被禁止作为测试结果被拿出 然而,纱布不能故意地塞到开口里面;
增加的 53.7.2 从 2015 年 8 月 4 日起执行

53.7.3 A permanently-connected smoke alarm is to be subjected to a minimum surge of 6 kV at 10 kA. The surge shall be a combination 1.2/50 μ s, 8/20 μ s voltage/current surge waveform. The polarity of the impulses shall be one positive applied at a phase angle of 90 degrees (+0, -15) and one negative applied at a phase angle of 90 degrees (+0, -15).

Added 53.7.3 effective August 4, 2015

53.7.3 一个永久连接的烟雾报警器在 10KA 须经受最少 6KV 的浪涌测试,浪涌须有 1.2/50us,8/20us 组合的浪涌电压/电流波形. 脉冲的极性是一个正施加在相位角为 90 度(+0,-15)和一个负施加在相位角为 90 度(+0,-15);
增加的 53.7.3 从 2015 年 8 月 4 日起执行

53.8 Full phase voltage - high current abnormal overvoltage test

Added 53.8 effective August 4, 2015

53.8.1 A previously untested representative sample of the smoke alarm is to be subjected to the full phase voltage - high current abnormal overvoltage test without demonstrating, either during or after testing, any of the following:

- a) Emission of flame, molten metal, glowing or flaming particles through any openings (preexisting or created as a result of the test) in the product;

- b) Charring, glowing, or flaming of the supporting surface, tissue paper, or cheesecloth;
- c) Ignition of the enclosure; nor
- d) Creation of any openings in the enclosure that results in accessibility of live parts.

Added 53.8.1 effective August 4, 2015

53.8 三相电压 - 高电流异常过压测试

增加的 53.8 从 2015 年 8 月 4 日起执行

53.8.1 一个先前没有经过测试的典型烟雾报警器样品,在没有指明的情况下,需要通过三相电压-高电流异常过压测试,不管在实验中或实验后,符合任何下面的条件:

- A 产品火焰燃烧, 熔融金属, 通过任何开口的发光或燃烧颗粒 (预先存在的或作为结果创建的测试);
- B 炭化, 发光, 或燃烧的支撑面, 纸巾或纱布
- C 点火器的外壳,或
- D 建立的任何机箱开口,导致达到带电的附件

增加的 53.8.1 从 2015 年 8 月 4 日起执行

53.8.2 The smoke alarm is to be mounted on a ceiling surface covered with a double layer of white tissue paper. Each smoke alarm is to be loosely draped with a double layer of cheesecloth. The cheesecloth shall cover openings (for example, ventilation openings) where flame, molten metal, or other particles are not prohibited from being expelled as a result of the test. However, the cheesecloth is to not be deliberately pushed into openings.

Added 53.8.2 effective August 4, 2015

53.8.2 烟雾报警器安装在天花板表面,覆盖 2 层白纸巾, 每一个报警器松散的覆盖 2 层纱布,纱布须覆盖在开口处(例如, 通风开口处), 其中,火焰,熔融金属或其他颗粒不会被禁止作为测试结果被拿出 然而,纱布不能故意地塞到开口里面;

增加的 53.8.2 从 2015 年 8 月 4 日起执行

53.8.3 The smoke alarm is to be subjected to the application of a test voltage as specified in Table 53.2. The ac power source is to have an available short-circuit (fault) current (Isc) rating of 5,000 Arms at a power factor of 0.4 – 0.5. For each representative device, the overvoltage is to be applied for 7 hours, or until current to, or temperatures within the smoke alarm attain equilibrium, or until the smoke alarm becomes disconnected from the ac supply (due, for example, to open circuiting).

Added 53.8.3 effective August 4, 2015

53.8.3 烟雾报警器根据 53.2 表要求的测试电压, 交流电源是有可用短路（故障）电流（Isc）额定值为 5000 Arms,功率因数为 0.4-0.5.每一个有代表性的报警器,施加过压时间是 7 小时, 或电流/温度达到报警器的平衡, 或直到报警器 AC 电源被断开(例如,断路);

增加的 53.8.3 从 2015 年 8 月 4 日起执行

Table 53.2

Test voltage selection table

Added Table 53.2 effective August 4, 2015

Device rating	Test voltage
110 – 120 V	240
220 – 240 V	415
254 – 277 V	480

53.9 Limited current abnormal overvoltage test

Added 53.9 effective August 4, 2015

53.9.1 Each of four previously untested representative samples of the smoke alarms are to be subjected to the Limited Current Abnormal Overvoltage Test without demonstrating, either during or after testing, any of the following:

- a) Emission of flame, molten metal, glowing or flaming particles through any openings (preexisting or created as a result of the test) in the product;
- b) Charring, glowing, or flaming of the supporting surface, tissue paper, or cheesecloth;
- c) Ignition of the enclosure; nor
- d) Creation of any openings in the enclosure that results in accessibility of live parts.

Added 53.9.1 effective August 4, 2015

53.9 限流异常过压测试

增加的 53.9 从 2015 年 8 月 4 日起执行

53.9.1 每 4 个先前没有经过测试的典型烟雾报警器产品,在没有指明的情况下,通过限流异常过压测试,不管在实验中或实验后,符合任何下面的条件:

- A 产品火焰燃烧, 熔融金属, 通过任何开口的发光或燃烧颗粒 (预先存在的或作为结果创建的测试);
- B 炭化, 发光, 或燃烧的支撑面, 纸巾或纱布
- C 点火器的外壳,或
- D 建立的任何机箱开口,导致达到带电的附件

增加的 53.9.1 从 2015 年 8 月 4 日起执行

53.9.2 Each smoke alarm is to be mounted on a ceiling surface covered with a double layer of white tissue paper. Each smoke alarm is to be loosely draped with a double layer of cheesecloth. The cheesecloth is to cover openings (for example, ventilation openings) where flame, molten metal, or other particles are not prohibited from being expelled as a result of the test. However, the cheesecloth is to not be deliberately pushed into openings.

Added 53.9.2 effective August 4, 2015

53.9.2 烟雾报警器安装在天花板表面,覆盖 2 层白纸巾, 每一个报警器松散的覆盖 2 层纱布,纱布须覆盖在开口处(例如, 通风开口处), 其中,火焰,熔融金属或其他颗粒不会被禁止作为测试结果被拿出 然而,纱布不能故意地塞到开口里面;

增加的 53.9.2 从 2015 年 8 月 4 日起执行

53.9.3 Each of four previously untested smoke alarms is to be connected to an ac power supply having an open circuit voltage equal to the test voltage specified in Table 53.2. The power supply is to incorporate a series variable resistor that can be adjusted to obtain the short-circuit current (I_{sc}) specified below. The variable resistor is to be adjusted such that I_{sc} equals 5 A for the first representative device, 2.5 A for the second, 0.5 A for the third, and 0.125 A for the fourth. The four representative devices are to be energized for 7 hours, or until temperatures within the smoke alarm attain equilibrium, or until the smoke alarm becomes disconnected from the ac supply (due, for example, to open circuiting of a thermal or overcurrent protective device).

Added 53.9.3 effective August 4, 2015

53.9.3 每 4 个先前没有经过测试的典型产品被交流电压的开路电压等于 53.2 的表中指定测试电压连接, 电源包括一个串联可以调整的可变电阻, 以取得下面指定短路电流 (I_{sc}), 可以调整的可变电阻在典型设备中第一次 I_{sc} 等于 5A,第二次为 2.5A,第三次为 0.5A, 第四次为 0.125A;四个典型的设备通电 7 小时,直到温度达到报警器的平衡, 或直到烟雾报警器 AC 电源被断开(例如,热或过电流保护装置的断路);

54 Dielectric Voltage-Withstand Test

54.1 An alarm shall withstand for 1 minute, without breakdown, the application of a sinusoidal AC potential of a frequency within the range of 40 – 70 hertz, or a DC potential, between high-voltage live parts and exposed dead metal parts, and live parts of high- and low-voltage circuits. The test potential is to be:

- a) For an alarm rated 30 volts AC rms (42.4 volts DC or AC peak) or less – 500 volts (707 volts, when a DC potential is used).
- b) For an alarm rated between 31 and 250 volts AC rms – 1000 volts (1414 volts, when a DC potential is used).
- c) For an alarm 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, when a DC potential is used).

54、绝缘耐压测试

54.1 报警器必须能经受住报警持续 1 分钟不中断,服从正弦 AC 频率在 40-70HZ 之间的电位, 或 DC 电位, 高压带电部分和裸露的带电金属部件之间, 高低压电路的带电部件, 测试电压如下:

- a) 报警电压 30V AC rms (42.4V DC 或 AC 峰值) 或少于-500V (当 DC 电势使用时,707V)。
- b) 报警电压在 31 及 250V AC rms-1000V (当 DC 电势使用时,1414V) 之间。
- c) 对于报警额定加上两倍的额定电压超过 250 伏交流电有效值 - 1000 伏 (当 DC 电势使用时,1414 伏加 2.828 倍的额定交流电压有效值)。

54.2 Any reference grounds are to be disconnected prior to the test applications.

54.2 在测试之前,任何接地参考都将为此测试而拆除。

54.3 When the charging current through a capacitor or capacitor-type filter connected across the line, or from line to earth ground, is capable of preventing maintenance of the specified AC test potential, The capacitors and capacitor-type filters are to be tested using a DC potential in accordance with 54.1.

54.3 当充电电流通过线跨接一个电容或电容型滤波器,或者从线到地连接时, 能够防止指定的 AC 测试电势维持, 电容及电容型滤波器将被第 54.1 一致的 DC 电势进行测量。

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

54.4 测试电压是从周围任何方便的来源,须有能力保持在指定的电压,测试仪器输出的电压将被监控,开始为 0V,供应的电势将被以 200V/分增加,直到达到测试要求的值并在此值持续停留 1 分钟时间。

54.5 A printed-wiring assembly or other electronic-circuit component that short circuits or is damaged by application of the test potential, is to be removed, disconnected, or otherwise rendered inoperative before the test. It is not prohibited for a representative subassembly be tested instead of an entire unit.

54.5 线路板组装或其它的电子电路元件,若被应用的测试电势造成短路或损坏,将被移除,拆开连接,或其它方式在测试前失效,并没有禁止以典型的半成品组装测试代替整个产品。

55 Abnormal Operation Test

55.1 An alarm shall operate continuously under abnormal (fault) conditions without resulting in a risk of fire or electric shock.

55.2 To determine that an alarm complies with the requirement of 55.1, it is to be operated under the most severe circuit fault conditions to be encountered in service while connected to a source of supply in accordance with 33.3.1. There shall not be emission of flame or molten metal, or any other manifestation of a fire, or dielectric breakdown when tested in accordance with the Dielectric Voltage-Withstand Test, Section 54, after the abnormal test.

55、非正常操作测试

55.1 报警器应在非正常条件下连续工作,不会导致火灾或从电击的危险。

55.2 要确认报警器是否符合 55.1 的要求,把它连接符合 33.3.1 电源要求,模拟在实际使用过程中遇到的最苛刻的条件下操作,在经过第 54 章节的绝缘耐压非正常测试后将不得有火焰或熔化金属的排放物,或任何其他表现火灾,或被击穿。

55.3 In determining that an alarm complies with the requirement with respect to circuit-fault conditions, the fault condition is to be maintained continuously until constant temperatures are attained, or until burnout occurs, when 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 a limited-life electrolytic capacitor represents typical fault conditions. See 72.3.2.

55.3 确定报警器符合电路故障条件的要求,故障条件要继续保持,直到达到稳定的温度到达或燃烧发生,当故障不能导致过载保护装置的操作,电源变压器的次级短路和有限寿命的电解电容器短路是典型的故障条件,具体见 72.3.2。

56 Overvoltage and Undervoltage Tests

56.1 Overvoltage test

56.1.1 An alarm other than one operating from a main battery power supply shall operate as intended in the standby condition at both maximum and minimum sensitivity settings and while performing its signaling function and connected to a supply source of 110 percent of rated value. When a nominal rated voltage value is specified, the overvoltage shall be 110 percent of the test voltage specified in 33.3.1. When an operating voltage range is specified, the overvoltage shall be either 110 percent of the high value of the voltage range or 110 percent of the test voltage specified in 33.3.1, whichever is higher. Sensitivity measurements at the increased voltage shall vary not more than specified in 34.4.1.

56 过压测试和低压测试

56.1 过压测试

56.1.1 报警器(电池作为主电源的除外)在最灵敏和最不灵敏的情况下,必须在预设的待机状态动作。同时在连接到1.1倍额定电压的电源,能够完成信号功能(比如报警)。若标称额定电压是固定的,过压是条款33.1 设定测试电压的1.1倍当工作电压是一个范围时,过压应该是工作电压范围上限的1.1倍,或者是条款33.1 设定测试电压的1.1倍,二者之中的最高者。在升高的电压下测得的灵敏度其变化不应超过条款34.1中的规定。

56.1.2 For alarms intended for connection in a multiple station configuration, the minimum number of alarms specified by the installation instructions are to be interconnected with zero line resistance between alarms and tested for their intended operation.

56.1.2 对于具有互联功能的报警器,用0 欧姆线将说明书规定最小数目报警器互连接,用于要求的测试。

56.1.3 For operation at the higher voltage, three alarms are to be subjected to the specified increased voltage in the standby condition for at least 16 hours, or as specified by the manufacturer, and then tested for their intended signaling operation and sensitivity.

56.1.3 过压测试时, 3 个测试样板在设定的电压下待机连续工作 16 小时,或者根据制造商的规格要求进行测试。然后用测试设定的信号动作和灵敏度。

56.2 Undervoltage test

56.2.1 An alarm shall operate for its intended signaling performance while energized from a supply of 85 percent of the test voltage specified by the manufacturer and while at both maximum and minimum sensitivity settings. For units powered from a primary battery, the test shall be conducted at the battery trouble signal voltage level. Sensitivity measurements at the reduced voltage shall vary not more than specified in 34.4.1 from the readings measured at rated voltage.

56.2 低压测试

56.2.1 报警器(电池作为主电源的除外)在最灵敏和最不灵敏的情况下, 同时在连接到 85 %额定电压的电源, 能够完成信号功能(比如报警). 若报警器以电池作为电源, 测试应在电池故障信号电平(电池低电压报警电压)条件下测试.在低压电压下测得的灵敏度与在额定电压下的读书相比,变化不应超过条款34.1中的规定.

56.2.2 For alarms intended for connection in a multiple station configuration, the maximum number of alarms specified by the installation instructions are to be interconnected with either 10 ohms resistance between alarms, or the maximum resistance specified in the installation instructions, and tested for intended operation.

56.2.2 对于具有互联功能的报警器,根据说明书规定所能互联的最大数目,用10 欧姆的电阻线互连.然后完成相应的测试.

56.2.3 When the alarm is provided with a standby battery the test is to be conducted at 85 percent of the charged battery voltage. When the standby battery provides a trouble signal requiring replacement at higher than 85 percent of the charged battery voltage, the test is to be conducted at the battery trouble signal voltage level.

56.2.3 如果报警器使用备用电池,测试电压是备用电池满电荷电压的85%.若备用电池具备低电压报警信号,并需要更换电池,且低电压信号电平高于电池满电荷电压的85%, 测试应在低电压信号电平进行.

56.2.4 For operation at the reduced voltage, three alarms are to be energized from a source of supply in accordance with 33.3.1, following which the voltage is to be reduced to 85 percent of the test voltage specified in 33.3.1 for AC operated alarms, or the battery trouble level voltage for battery operated alarms, and then tested for signaling operation and sensitivity.

56.2.4 低电压测试时, 3个样板进行测试.根据条款33.1, 对于AC机,选定规定85%的测试电压, 或者对于DC 机, 选定电池低电压信号电平进行.然后完成信号测试和灵敏度测试。

57 Dust Test

57.1 The sensitivity of an alarm shall not be reduced abnormally by an accumulation of dust, without an alarm or audible trouble signal being produced.

57 灰尘测试

报警器的灵敏度随着灰尘的积累,不应不正常地变不灵敏,不应有报警或故障信号产生.

57.2 To determine compliance with 57.1, a sample in its intended mounting position, is to be placed, de-energized, in an air tight chamber having an internal volume of at least 3 cubic feet (0.09 m³).

57.2 判定是否符合条款57.1: 样板安装在一个空气密闭的箱子内预设的安装位置, 断开电源; 该空气密闭的箱子内部容积至少是3立方英尺(0.09 m³).

57.3 Two ounces (0.06 kg) of cement dust, maintained in an ambient room temperature of 23 ±2°C (73.4±3°F) at 20 – 50 percent relative humidity and capable of passing through a 200 mesh screen, is to be circulated for 15 minutes by means of compressed air or a blower so as to completely envelop the sample in the chamber. The air flow is to be maintained at an air velocity of 50 fpm (0.25 m/s).

57.3 0.06kg 重并能够通过200目网筛的水泥灰尘, 保持在室温摄氏度23±2°C, 相对湿度20%-50%的密闭箱子中,用压缩空气或风箱使灰尘散布在密闭箱子中15分钟,确保灰尘包围住测试样板.气流保持在风速0.25 m/s.

57.4 Following the exposure to dust, the alarm is to be removed carefully, mounted in its intended position, energized from a source of supply in accordance with 33.3.1, and tested for sensitivity using gray smoke, unless a trouble signal or a false alarm is obtained. Sensitivity measurements following this test shall not vary by more than specified in 34.4.1. For those units whose sensitivity varies by more than 50 percent in the direction of high sensitivity, the unit shall be capable of being returned to its initial sensitivity value (plus or minus 0.25 percent per foot obscuration) after following the manufacturers specified cleaning procedure.

57.4 测试样板暴露在灰尘中后, 谨慎地从密闭箱子中取出样板;并安装在相应的测试位置, 根据条款33.1加上电源, 然后使用灰白烟(Gray smoke)进行灵敏度测试. 如果有故障信号或假报警, 则测试停止. 灵敏度读数的波动量不能超过条款34.4.1的规定. 对于那些测试样板的灵敏度变化在最灵敏方向位置超过50%时, 在完成制造商说明的清理程序后, 测试样板的灵敏度应能够恢复到初始值 (+/-0.25OBS) .

58 Static Discharge Test

58.1 The components of an alarm shall be shielded so that its operation is not adversely affected when subjected to static electric discharges. Operation of the trouble circuit during this test is not a failure when the subsequent operation of the alarm is not impaired. During the test a 5 second or less false alarm is permitted. The test is to be conducted in an ambient temperature of $23\pm 3^{\circ}\text{C}$ ($73\pm 5^{\circ}\text{F}$), at a relative humidity of 10 ± 5 percent, and a barometric pressure of not less than 700 mm of mercury (194 kPa).

58 静电放电测试

58.1 报警器的元件应被屏蔽,以确保测试样板在遭受静电放电时不会使样板操作不利地受到影响,如果在随后的报警器的动作运转没被损坏,那么测试中的故障线路动作不视为测试失败. 测试中5s 或少于5s 的假报警是可以接受的. 测试环境要求: 摄氏度 $23\pm 3^{\circ}\text{C}$ ($73\pm 5^{\circ}\text{F}$),相对湿度 5%---15%, 气压不低于700 mm 汞柱.

58.2 Each of two alarms is to be mounted in its intended mounting position and connected to a source of supply in accordance with 33.3.1. When an alarm is intended to be installed on a metal back box, the box is to be connected to earth ground. A 250 picofarad low leakage capacitor, rated 10,000 volts dc, is to be connected to two high-voltage insulated leads, 3 feet (0.9 m) long. A 1500 ohm resistor is to be inserted in series with one lead. The end of each lead is to be attached to a 1/2 inch (12.7 mm) diameter metal test probe with a spherical end mounted on an insulating rod. The capacitors are to be charged by touching the ends of the test leads to a source of 10,000 volts DC for at least 2 seconds for each discharge. One probe is to be touched to the alarm and the other probe is then to be touched to earth ground.

58.2. 测试样板两个, 每个样板将被安装在固定位置, 并根据条款33.3.1 连接电源. 当一个测试样板被确定安装到一金属壳的盒子上, 盒子要连接到大地. 一个额定电压是10KV, 容量250pF的低泄漏电容, 连接到两个高压绝缘的端子上; 此端子3英尺(0.9m)长. 一个1500 欧姆的电阻串联连接到一端. 每端和一个直径12.7mm的金属球形测试探头相连并固定在绝缘棒上. 每次放电前需将电容一端子接触到10KV DC 电源至少2秒.

58.3 Ten discharges are to be applied to different points on the exposed surface of the alarm, recharging the capacitors for each discharge. Five discharges are to be made with one lead connected to earth ground and the other lead probed on the alarm surface followed by five discharges with the polarity reversed. For an alarm intended to be serviced by the consumer, ten additional discharges shall be applied as described above except each lead shall be probed, in turn, on all internal parts subject to contact by the user.

58.3 十次放电施加到报警起外露表面不同的点上. 每一次放电都要再充电, 一端接地另一端接到报警器表面, 然后颠倒极性进行5次放电. 对于设计用于客户维护的报警器,应施加另外十次的放电, 测试方式如上除去极性颠倒外, 依次施加在用户可能接触到内部零件上.

58.4 Following the discharges, the alarm is to be tested for sensitivity. Sensitivity measurements shall be as specified in 34.4.1.

58.4 放电后, 进行灵敏度测试;灵敏度读数应符合条款34.4.1.

59 Vibration Test

59.1 An alarm shall withstand vibration without breakage or damage of parts. Following the vibration, the alarm shall operate for its intended signaling operation.

59 振动测试

59.1 报警器应承受振动,没有零件破损或破坏. 振动后,报警器能够完成预设的信号动作.

59.2 To determine compliance with 59.1, sensitivity measurements following the vibration shall vary not more than specified in 34.4.1.

59.2 判定是否满足条款59.1 :振动后灵敏度的读数变化不应超过条款34.4.1的规定.

59.3 Two samples, one at the maximum and one at the minimum sensitivity setting, are to be secured in their intended mounting position on a mounting board and the board, in turn, securely fastened to a variable speed vibration machine having an amplitude of 0.01 inch (0.25 mm). The frequency of vibration is to be varied from 10 to 35 cycles per second in increments of 5 cycles per second until a resonant frequency is obtained. The samples are then to be vibrated at the maximum resonant frequency for a period of 1/4 hour. In cases where no resonant frequency is obtained, the samples are to be vibrated at 35 cycles per second for a period of 4 hours.

59.3 两个测试样板, 一个设定在灵敏度最大值,一个设定在灵敏度最小值. 轮流固定到板上相应的位置,确保牢靠.然后板要牢靠地固定到一个可变速度的振动机器上.振动机的振幅是0.01英寸.振动的频率是每秒10-35 周期, 每秒5个周期的增量增加,直到达到谐振频率. 样板将在最大谐振频率振动15 分钟; 如果不能达到谐振频率,样板将在每秒35周期的条件下振动4 个小时.

59.4 For tests, amplitude is defined as the maximum displacement of sinusoidal motion from a position of rest or one-half of the total table displacement. Resonance is defined as the maximum magnification of the applied vibration.

59.4 对于测试中的振幅和谐振,定义如下:振幅是最大位移,正弦运动从停止位置开始,或者整个桌面位移的一半;谐振是指施加在样板上的最大振幅。

60 Jarring Test

60.1 An alarm shall withstand jarring resulting from impact and vibration such as experienced in service, without causing an alarm signal, without dislodgement of any parts, and without adversely affecting its subsequent operation. A momentary audible trouble signal, resulting from the jarring shall not occur unless the detector operation is not affected. Dislodgement of parts shall not occur unless the dislodged part(s) does not affect the operation of the unit, there are no high-voltage parts exposed, and the condition is visually obvious.

60 振动和冲击测试

60.1 报警器应能承受来自像正常使用中经历的冲击和振动,不能产生报警信号,不能有零件脱落,不能不利地影响后续的操作。测试中不应产生瞬间故障信号,除非报警器的操作不受影响。

零件在测试中不应脱落,除非脱落的零件不影响报警器操作并无高压零件暴露,且状况显而易见。

60.2 The alarm and any associated equipment are to be mounted in the orientation of intended use, see Figure 60.1, and flush to the center of a 6 by 4 foot (1.8 by 1.2 m), nominal 3/4-inch (19.1-mm) thick plywood board (cabinet grade red oak B-2) which is secured in place at four corners. A 3 foot-pound (4.08J) impact is to be applied to the center of the reverse side of this board by means of a 1.18 pound (0.54kg), 2-inch (50.8-mm) diameter steel sphere either swung through a pendulum arc from a height (h) of 2.54 feet (775 mm), or dropped from a height (h) of 2.54 feet (775 mm), to apply 3 foot-pounds (4.08 J) of energy. The board shall be preconditioned as noted below.

Revised 60.2 effective October 24, 2011

60.2 报警器及其相关配备根据使用位置固定到一胶合板中心,如图 60.1: 该胶合板 1.8 米长,1.2 米宽(1.8mX1.2m), 标称厚度为 19.1mm 厚, 确保四角牢固固定。4.08 焦耳的能量将通过 0.54kg 重, 直径为 50.8mm 的钢球体施加到胶合板反面的中心。钢球体可以像钟摆一样从 775mm 高的高度摆下, 或从 775mm 高的地方垂直落下来施加 4.08 焦耳的能量。

60.3 During this test, the alarm is to be in the standby condition and connected to a rated source of supply in accordance with 33.3.1. To ensure that the plywood board is not altered to accommodate connection to the supply, it is not prohibited to use connection means other than those intended whenever they would interfere with flush mounting of the alarm to the board. Following the test, sensitivity measurements shall vary not more than specified in 34.4.1.

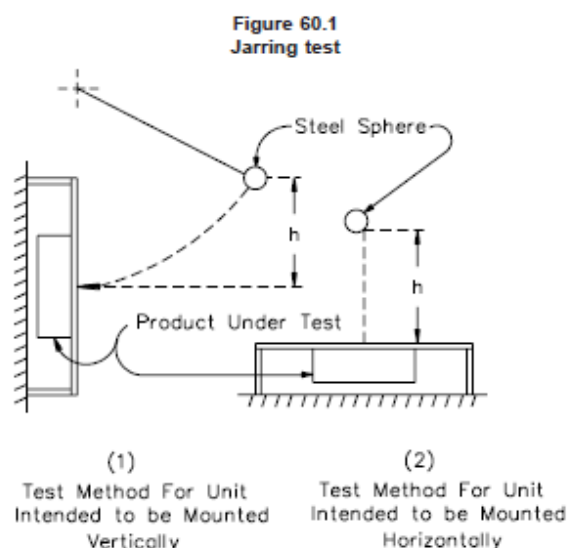
Revised 60.3 effective October 24, 2011

60.3 测试中,产品处于待机状态并根据条款33.3.1连接到额定的电源上。测试后,灵敏度的读数变化不应超过条款34.4.1 的规定。

60.4 The plywood shall be replaced at a minimum of once per year, or after the average impact value drops below the minimum value, whichever comes first. See 60.5 for impact value.

Added 60.4 effective October 24, 2011

60.4 胶合板最少每年更换一次, 或平均冲击值掉到下面的最小值以下, 无论哪一个先到都更换, 具体见60.5冲击值。



60.5 Before conducting reference tests, precondition the new plywood board by impacting the board five times before recording data. After installing a board, conduct 35 impacts. The impact force shall be recorded using a load cell temporarily mounted at the center of the backside of the board. The maximum average value shall be equal to or greater than 19 lbf (84.5 Newtons). Remove the load cell before mounting a test sample. Degradation of the board shall be monitored on a minimum of a bimonthly basis, unless the board is not in use. Prior to the first use of the board every other month (or if the board has not been used for a period exceeding 2 months) conduct a reference test averaging five impacts. The panel shall be replaced if the average impact value of the five impacts drops below 95 percent of the original value, or below 18 lbf (80.1 Newtons), whichever is greater.

Added 60.5 effective October 24, 2011

60.5 每次做测试，记录数据之前，新木板需要做五次冲击测试，安装了新板后，需要冲击35次，冲击力可使用临时安装在木板的背面的中心测力传感器记录，最大的平均数值应等于或大于**19 lbf (84.5牛顿)**，在安装测试样品之前，把测试传感器移走。监控木板是否降级至少两个月监控一次，除非木板没有用；每隔一个月在使用之前（或者木板没有使用超过2个月）需要做五次冲击测试，如果平均的冲击数值低于最初数值的**95%**，或者数值低于**19 lbf (84.5牛顿)**，都需要更换木板。

61 Corrosion Test

61.1 General

61.1.1 An alarm shall operate as intended after being subjected to the corrosive atmosphere tests described in 61.1.2 – 61.2.1. The samples are to be placed in the test chambers that are located in an ambient room temperature of 23+/-2°C (73.4 +/-3°F), maintained at 20 – 50 percent relative humidity, and are to be mounted in the intended position of use on a platform 2 inches (50.8 mm) above the bottom of the exposure chamber. The relative humidity inside the chamber during the test is to be 95 percent.

61 腐蚀测试

61.1 总体要求

61.1.1 报警器在承受到条款**61.1.2 – 61.2.1**描述的腐蚀空气后，应能按照设计要求正常工作。待测样板安装到测试箱相应的位置，高于箱子内部底部**50.8mm**；箱子周围环境温度是摄氏**23+/-2°C(73.4 +/-3°F)**，相对湿度保持在**20-50%**，箱子内部的相对湿度是**95%**。

61.1.2 Moist Hydrogen Sulfide-Air Mixture Exposure— Two samples, one at maximum and one at minimum sensitivity setting, are to be exposed to a moist hydrogen sulfide-air mixture in a closed glass chamber for a period of 10 days. The amount of hydrogen sulfide is to be equivalent of 0.1 percent of the volume of the chamber. A small amount of water (10 ml/0.003 m³ of chamber volume) is to be maintained at the bottom of the chamber for humidity.

61.1.2. 潮湿硫化氢混合气体腐蚀测试——待测样板两个，一个灵敏度设在最大值，另一个设为最小值；将放置在一个密闭的玻璃箱中**10天**，暴露在潮湿硫化氢混合气体中。硫化氢的量相当于箱子容量的**0.1%(1,000 PPM)**，少量的水（**10ml /箱子体积0.003 m³**）保持在箱子底部来确保湿度。

61.1.3 Moist Carbon Dioxide-Sulfur Dioxide-Air Mixture Exposure – Two samples, one at maximum and one at minimum sensitivity setting, are to be exposed to a moist carbon dioxide-sulfur dioxide-air mixture in a closed glass chamber for a period of 10 days. The amount of carbon dioxide is to be the equivalent of 1.0 percent, and the amount of sulfur dioxide is to be the equivalent of 0.5 percent of the volume of the chamber. A small amount of water (10 ml/0.003 m³ of chamber volume) is to be maintained at the bottom of the chamber for humidity.

61.1.3. 潮湿二氧化碳及二氧化硫混合气体腐蚀测试——待测样板两个，一个灵敏度设在最大值，另一个设为最小值；将放置在一个密闭的玻璃箱中**10天**，暴露在二氧化碳及二氧化硫混合气体混合气体中。二氧化碳的量相当于箱子容量的**1%(10,000 PPM)**，二氧化硫的量相当于箱子容量的**0.5%(5,000 PPM)**，少量的水（**10ml /箱子体积0.003 m³**）保持在箱子底部来确保湿度。

61.2 Test equipment

61.2.1 A typical test apparatus for the carbon dioxide-sulfur dioxide-moist air exposure test and the hydrogen sulfide-moist air exposure test consists of:

61.2 测试装置

61.2.1 典型的潮湿二氧化碳及二氧化硫及硫化氢混合气体暴露测试包括:

a) Compressed Gas Cylinders (Commercial Grade SO₂, Bone Dry Grade CO₂, C.P. Grade H₂S).

压缩空气筒（瓶）

b) Needle Valves (to adjust flow).

针型调整气阀（调节器流）

- c) Selector Valve (selects CO₂ or SO₂).
选择阀门
- d) Flowmeters (used in conjunction with stopwatch to measure gas volume).
流量计（与秒表连在一起测量气体容量）
- e) Gas inlets to exposure chamber.
气体进气口（进入测试箱）
- f) Glass exposure chamber with glass cover (holes in cover for gas inlet and outlet).
带有上盖的玻璃箱（盖子上有进气口和出气口）
- g) Small motor and fan blade. [1550 rpm motor with aluminum fan blade, ten 3-1/2 inch (88.9mm) wings providing air movement toward motor. Neoprene gasket used to seal shaft throughhole in glass cover.]
小马达和风扇叶轮（1,550转/分的马达，带有88.9mm长的铝质扇叶片），扇片产生的空气流动朝向马达。用橡胶片塞紧玻璃盖子上的出气孔。
- h) Support Platform (plastic egg-crate grid material).
支撑平台（如塑料蛋箱板栅材料）
- i) Test Sample. Normally two employed.
测试样板，通常情况：两个。

Different type chambers shall not be used unless the equivalent gas concentrations and water are maintained.

不能使用不同类型的箱子，除非气体浓度和水可以保持在相近水平。

61.2.2 The alarms are to be tested for sensitivity using gray smoke prior to exposure to the corrosive atmospheres.

Following the corrosive exposures described in 61.1.2 and 61.1.3, the alarms are to be dried in a circulating air oven at a temperature of 40°C (104°F) for a period of at least 24 hours, after which the alarms are to be tested again for sensitivity. When sensitivity measurements following the exposure to the corrosive atmospheres vary by more than the limits specified in 34.4.1 in the direction of high sensitivity there shall be no false alarm. The sensitivity shall not vary by more than the limits specified in 34.4.1 in the direction of low sensitivity. In no case, shall the sensitivity exceed the limits specified in the Sensitivity Test, Section 37.

61.2.2 待测样板在暴露在腐蚀气体前，要使用灰烟（gray smoke）进行灵敏度测试。在完成腐蚀气体暴露测试后（步骤如条款61.1.2 and 61.1.3），报警器放入温度为摄氏40°C的，空气流通的烤箱中至少24小时；然后再次测试灵敏度。灵敏度的读数在腐蚀测试后变化不应超过条款34.4.1所规定的限制，在最灵敏度方向不应产生假报警。在最不灵敏方向，读数变化不应超过条款34.4.1的规定。无论如何，灵敏度的测试不应超过37章节的要求限制。

61.2.3 Alarms are to be subjected to the corrosive atmospheres while de-energized so as not to produce an alarm signal. Battery operated alarms are to be tested with the batteries in place, and the leads to the clips disconnected for the same reason. After the exposure the leads are to be reconnected and the Sensitivity Test, Section 37, conducted.

61.2.3 报警器在腐蚀测试时，电源应被断开，以免产生报警信号。电池作为电源并和样板一块进行腐蚀测试时，同样的原因，也应断开电源。在腐蚀气体暴露测试后，连接端子，进行灵敏度测试。

62 Reduction in Light Output Test

62.1 The sensitivity of an alarm employing an LED as the functional light source shall not be reduced abnormally when the light output from the LED is reduced to 50 percent of normal or to the light level anticipated at the end of the Reliability Prediction described in Alarm Reliability Prediction, Section 4.

62 光输出衰减测试

62.1 灵敏度使用LED作为光源的报警器，当LED输出减少到正常值一半，或减少到LED亮度到产品可靠性预计寿命结束，如章节4所述的可靠性预计，其灵敏度不能反常地减少。

62.2 To determine compliance with 62.1, five samples calibrated to the minimum sensitivity, are to be subjected to the Sensitivity Test, Section 37, while connected to a source of rated voltage and frequency. Following this, the light output from the LED is to be reduced to 50 percent of intended output, or to the light level anticipated at the end of the reliability prediction, when less than 50 percent, by reducing the supply voltage to the alarm, or an equivalent method. (The level of reduction of light is to be determined initially by means of a light meter, review of curve sheets, or the equivalent.) The samples shall then be subjected to the Fire Tests, Section 44, and the Smoldering Smoke Test, Section 45.

62.2 确定是否符合条款62.2：5个测试样板调到最低灵敏度将用来做灵敏度测试（章节37），同时连接到额定的电压和频率。然后LED光输出减少到正常设计的50% 或减少到可靠性预计寿命结束点，当少于50% 时，可以降低报警器电压或者等同的方法。（光亮极度的判定，可以通过光测试计，审核曲线表或等同的方法）。样板然后跟据Section 44，进行火灾测试（Fire

test) 和章节45,进行阴燃(闷烟)测试。

63 Battery Tests

63.1 Where a replaceable battery is employed as the main source of power of a smoke alarm, it shall provide power to the unit under intended ambient conditions for at least 1 year (or whatever longer period specified by the manufacturer) in the standby condition, including novelty and weekly alarm testing, and then operate the alarm for a minimum of 4 minutes of alarm, followed by 7 days of trouble signal. See 36.3.1. Where a nonreplaceable battery is employed as the main source of power, it shall provide power to the unit under intended ambient conditions for at least 10 years in the standby condition, including novelty and weekly testing, and then operate the alarm for a minimum of 4 minutes of alarm, followed by 7 days of trouble signal.

63 电池测试

63.1 当电池作为报警器的主电源时, 电池提供的电源应在预计的环境下, 在待机状态下使报警器工作一年, 包括每周的PTT测试和偶尔的PTT;然后在7天的低电压故障信号后, 仍能进行至少4 分钟的报警。

63.2 Six samples of the battery, or sets of batteries when more than one is used for primary power, are to be tested under each of the following ambient conditions for a minimum of 1 year (longer time period if specified by the manufacturer, or 10 years if powering an alarm where the battery is not intended to be replaced) while connected to the alarm or a simulated load to which the battery is to supply power.

- a) Room Ambient – 23+/-3°C (73.4+/-5°F), 30 – 50 percent relative humidity, 760 mm Hg.
- b) High Temperature – 45°C (113°F).
- c) Low Temperature – 0°C (32°F).
- d) Humidity – 30 +/-2°C (86+/-3°F), 85+/-5 percent relative humidity.

63.2 6个电池测试样板, 或当超过一个电池作为主电源时, 需要6套测试样板; 将在如下环境条件下至少测试一年。同时电池连接到报警器上, 或用电池作为电源的模拟负载上。

- a. 室温摄氏23+/-3°C, 相对湿度30-50%, 气压760mm Hg
- b. 高温摄氏45°C
- c. 低温摄氏0°C
- d. 湿度: 摄氏30+/-2°C,RH 85+/-5%

63.3 For the test, either alarm samples or test loads simulating a maximum standby current drain are to be employed. The alarm load is to be the audible appliance intended to be used in the smoke alarm or an appropriate load simulating maximum alarm conditions. The batteries are to be tested in the mounting clips employed in the alarm.

63.3 关于测试, 报警器或模拟最大静态消耗电流测试负载作为测试样板.报警负载可以是实用于报警器中的发声装置或者是模拟最大报警状态时的装置.待测电池用装配夹固定在报警器中。

63.4 Terminals or jacks are to be provided on each test means to facilitate measurement of battery voltage, standby, and alarm currents. The measuring means is to be separated from the battery test means by a wiring harness or equivalent at least 3 feet (0.9 m) long.

63.4 需要提供端子或挂钩以便于电池电压,静态电流和报警电流的测量. 用不同方法测量电池时,测量装置通过3英尺长的电线或类似方法连接。

63.5 Prior to placing the battery test setups in the various ambient conditions, each battery is to be subjected to 25 cycles of alarm representing novelty testing. Each cycle is to consist of 5 seconds of alarm and at least 5 minutes between each application.

63.5 把待测电池在不同的测试条件下测试以前,每个电池需要经历25个周期的报警测试,来代表偶然的随机PTT 测试, 每个周期由5 秒报警, 两个测试之间的间隔是5分钟。

63.6 During the course of the test, the battery voltage and current in standby and alarm condition are to be recorded periodically. The alarm voltage is to be recorded 3 seconds after energization. The standby voltage and current are to be recorded prior to the alarm measurements. The smoke alarm is to be placed into an alarm condition weekly. The duration of the weekly alarm test signal is to be 3 seconds.

63.6 测试过程中,电池电压, 静态电流和报警电流要定期记录,上电3秒后,测试报警电压. 在报警测试前,记录静态电压和电流. 烟雾报警器每周进入报警状态一次, 每周报警测试信号持续3秒。

63.7 For batteries rated longer than one year, at the end of the specified test period, all batteries shall have a capacity capable of operating the alarm signal for a minimum of 4 minutes, followed by 7 days of trouble signal. To obtain the trouble signal level it is sometimes required to continue the test with the standby current drain for longer than the test

period. Batteries shall be subjected to the conditions described in 63.2 (b), (c), and (d) for the test period unless the alarm is marked to indicate the battery limitations for the condition involved. In no case shall the length of conditioning be less than one year.

63.7 在一年测试后,所有电池的容量能够在7天的低电压故障信号后并能完成最少4分钟的报警.为了达到低电压故障信号电平,有时需要在待机状态下继续工作,测试时间多于一年.电池应按照条款63.2 b, c, d 要求进行至少一年的测试, 除非报警器表明电池的限制.无论如何,测试时间不能少于6个月.

63.8 For batteries rated for one year only, at the end of the specified test period (1 year) all batteries shall have a capacity capable of operating the alarm signal for a minimum of 4 minutes, followed by 7 days of trouble signal. To obtain the trouble signal level it is sometimes required to continue the test with the standby current drain for longer than 1 year. Batteries shall be subjected to the conditions described in 63.2 (b), (c), and (d) for a minimum of 1 year unless the alarm is marked to indicate the battery limitations for the condition involved. In no case shall the length of conditioning be less than 6 months.

63.8 对于只用1年的电池,在规定的一年期间,所有的电池都必须有能力发出报警信号最少4分钟,低电压信号7天;有时,在待机的状态下,要超过1年才能获得低电压的报警,如果产品没有标注电池的限制使用情况,在63.2 (b)/ (c)/ (d)的情况下也最少需要工作1年;没有任何情况下,电池的使用寿命小于6个月;

64 Survivability Test

64.1 Two samples of the smoke alarm shall be exposed to a temperature of 121°C (250°F) for a period of 4 minutes. The units are to be removed from the test chamber and returned to room temperature. The units are then to be subjected to the Audibility Test, Section 65, and the Sensitivity Test, Section 37.

64.2 Following conditioning, the samples shall be capable of producing an audible output of 85 db (A), at 10 feet (3.05 m), and the sensitivity of each alarm shall not vary by more than specified in 34.4.1.

64 生存性测试

64.1 测试样板2个,暴露在摄氏121°C的高温箱中4分钟; 测试样板从箱子中移出,恢复到室温.测试样板根据 65章节进行声压测试(dB) 和根据章节37 进行灵敏度测试.

64.2 在进行以上条件测试后, 测试样板能够在3.05米距离产生不低于85dB的声压. 灵敏度的变化不应超过条款34.4.1的规定.

65 Audibility Test

65.1 General

65.1.1 Except as permitted in 65.2.1, the alarm sounding appliance, either integral with the smoke alarm or intended to be connected separately, shall be capable of providing for at least 4 minutes, a sound output equivalent to that of an omnidirectional source with an A-weighted sound pressure level of at least 85 decibels (db) at 10 feet (3.05 m) with two reflecting planes assumed. To determine compliance with this paragraph the method described in 65.2.1 – 65.3.2 is to be employed. It is appropriate for alarms to be tested with the horn duty cycle specified in 34.3 defeated and emitting a continuous tone.

65 声压测试

65.1 总则

65.1 除去条款65.2.1所允许的外, 报警器发声装置,不管是和烟雾报警器整合一体的, 还是和设计的和报警器分开连接的, 应能够产生至少4分钟, 声压相当于全方位声源产生的A计权声级85分贝以上的声音输出. 测试距离3.05米, 使用两个反射面. 判断是否符合此条款, 采用条款65.2.1 和65.3.2 的测试方法, 对于蜂鸣器循环发声并符合条款34.3 规定损坏的,可以测试连续声音模式.

65.2 Sound output measurement

65.2.1 The sound power output of the alarm shall be measured in a reverberation room using procedures outlined in ANSI ASA Standard S12.51 (Acoustics Determination of Sound Power Levels of Noise Sources using Sound Pressure Precision Method for Reverberation Rooms).

The sound power in each 1/3 octave band shall be determined using the comparison method. The A-weighting factor shall be added to each 1/3 octave band. The total power is to be determined on the basis of actual power. The total power is then to be converted to an equivalent sound pressure level for a radius or 10 feet (3.05 m) using the following formula:

$$L_p = L_w - 20 \log_{10} R - 0.6$$

where:

L_p is converted sound pressure level,

L_w is the sound power level measured in the reverberation room, and

R is the radius for the converted sound pressure level (10 feet).

An additional 6 db is to be added to allow for two reflecting planes.

65.2.1 revised October 24, 2008

65.2 声音输出测量

65.2.1 报警器声音功率输出应在混响室根据美国国家标准协会S12.31或者S12.32条款的规定进行测试。每1/3倍频带的声音功率输出应用比较的方式来确定。A计权因数应加到每1/3倍频带。

总功率然后转换成等痛的半径为3.05米的声压。考虑到两个反射面,另外加上6分贝。

65.2.2 Each alarm is to be mounted to a 3/4 inch (19.1 mm) plywood board measuring 2 by 2 feet (610 by 610 mm), supported in a vertical plane, and positioned at an angle of 45 degrees to the walls of the reverberation room.

65.2.2 每个报警器固定在3/4英寸厚,面积为2英尺X2英尺的胶合板上,用一个垂直板支撑,并与混响室的墙壁成45度夹角。

65.2.3 For this test an AC powered alarm is to be energized from a source of rated voltage and frequency. A battery powered alarm is to be energized from batteries under each of the following conditions along the trouble signal level curve illustrated in Figure 35.2, or equivalent:

65.2.3 对于用交流电(AC)作为电源的报警器,应用额定的电压和频率供电。对于用电池作为电源的报警器,应按以下条件电池故障信号曲线供电,如图35;或者等同的方法。

a) Nondischarged battery (a battery with some unknown shelf life, such as those purchased at a retail outlet) with enough added resistance to obtain a trouble signal (Point D of Figure 35.2), or the maximum resistance for the particular battery based on documented data, whichever is less.

不能放电的电池,需加上足够的阻抗来获得低电压故障信号,或者根据文件资料对特殊电池加上最大的阻抗,二者之中选取最小值。

b) Battery depleted to the trouble signal level voltage, no added resistance.

电池放电到故障信号时的电压,不需要增加阻抗。

c) Battery depleted to a voltage value between conditions A and B above which is evaluated to be the least favorable for sound output. For a straight line curve it is the midpoint voltage. For a nonlinear curve it is to be specified. The equivalent of a battery shall be identified as a voltage source with a series resistance adjusted to a level at which a trouble signal is obtained during the normal standby condition. The resistance and voltages used are to be those that were determined during the Circuit Measurement Test, Section 35.

电池放电到介于曲线条件A和条件B之间的电压值,在其上面找出最不利的电压点的声音输出。对于直线,选取中点作为电压测试点。对于非直线,测试电压点将待规定。等效电池应被确定为带有可调电阻的电源,在待机状态下可以调到低压故障信号电平。阻抗和电压依据S 35来确定。

65.2.4 At least two samples shall be tested. Units intended for multiple-station connection shall also be tested interconnected as multiple-stations with the maximum line resistance as defined in 56.2.2. For AC powered units employing a nonrechargeable standby battery, the measurement shall be made with the detector connected to a rated AC voltage source, and then with the AC power de-energized and energy obtained from a standby battery depleted to 85 percent of rated battery voltage, or at the voltage level at which a trouble signal is obtained. For an AC unit employing a rechargeable standby battery, the measurement is to be made using a fully recharged battery.

65.2.4 至少两个测试样板。若是用于多个联机的报警器,须根据条款56.2.2 用最大电阻线进行连接。对于使用交流电作为电源,非充电电池作为备份电源的报警器,先用交流电作为额定电压电源进行测试,然后断开交流电。使用备份电池作为电源,将电池电压放电到额定电池电压的85%或低电压故障信号电平。对于使用交流电作为电源,充电电池作为备份电源的报警器,测量时确保电池电压是充满的。

65.3 Alarm duration test

65.3.1 An alarm sounding appliance of an alarm powered by a primary or secondary battery that has been discharged to the trouble level condition shall provide the equivalent of 85 db at 10 feet (3.05 m) after 1 minute of continuous alarm operation and shall provide at least 82 db after 4 minutes. 65.3.2 To determine compliance with 65.3.1, a measurement shall be made under the following conditions. The ambient noise level is to be at least 10 db below the measured level produced by the signaling appliance. The alarm is to be mounted 1 foot (302 mm) from the microphone placed in a direct line with the alarm. The alarm is then to be energized in the alarm condition and the sound output is to be measured at 1 minute intervals, using a sound level meter employing the A-weighting network. A maximum of 3 db decrease from the original 1 minute reading, after 4 minutes shall determine compliance for a battery operated alarm that is providing a

trouble signal.

One meter for the purpose is a General Radio, Type 1551, sound level meter (Type II).

65.3 报警耐久测试。

65.3.1 报警器装置是由电池作为主电源或备用电源的，当电池放电到故障信号电平时，应在3.05米箱内连续报警1分钟后，声压输出相当于85分贝；在连续报警4 分钟后，声压输出至少82分贝。

65.3.2 确定是否满足条款65.3.1，测量应在如下条件下进行:环境噪音水平至少低于待测样板所产生的测量值10分贝.话筒和报警器在同一直线上，距离302mm，待测样板上电然后进入报警状态.声音输出采用A计权网络的测试仪测试,间隔为1分钟,在4分钟后确定电池工作在地电压故障状态，声压输出与最初1分钟时的读数相比最大下降不超过3分贝。

声压测试表型号是二型1551。

65.4 Supplementary remote sounding appliances

65.4.1 The sound output of a supplementary remote sounding appliance, intended to be installed in the same room as a user (such as a bedroom), shall not be less than 85 db unless the appliance is marked with the following, or equivalent, text to indicate the specific use:

THIS UNIT IS TO BE INSTALLED IN A ROOM OCCUPIED FOR SLEEPING.

Under no circumstances is the sound output to be less than 75 db.

65.4 附加的远程发生装置

65.4.1 附加的远程发生装置的声音输出，设计用于用户安装在同一房间(比如卧室),不应低于85分贝，除非有如下类似说明特殊用途：此装置将安装在卧室。无论如何，声压不得低于75分贝。

65.5 Low frequency alarm signal format

65.5 added April 16, 2012

65.5.1 A low frequency alarm shall have a fundamental frequency of 520 (F1) Hz $\pm 10\%$, with subsequent harmonic frequencies occurring at 1560 (F3), 2600 (F5) and 3640 (F7) Hz $\pm 10\%$ as determined by a Fast Fourier Transform (FFT) analysis of the audible alarm signal.

65.5.1 added April 16, 2012

65.5.2 The spectral analyses shall be performed in a reverberant room per the test setup as described in 65.2.2. The FFT measurement shall be a 30 second spectrum averaging of a 12.8 (kHz) frequency span of 2 (Hz) resolution, non-weighted.

65.5.2 added April 16, 2012

65.5.3 The maximum sound pressure level (dB) of any frequency within the FFT measurement shall be at least 5 dB less than the F1 sound pressure level (dB). The minimum sound pressure level (dB) of the odd harmonics shall not be less than 20 dB for F3, 30 dB for F5 and 50 dB for F7 of the fundamental F1 level.

65.5.3 added April 16, 2012

66 Tests of Thermoplastic Materials

66.1 General

66.1.1 Polymeric materials intended for the sole support of current carrying parts or as an enclosure of an alarm shall be subjected to the tests specified in 66.2 and 66.3. When possible, a complete alarm is to be used.

66 热塑性材料测试

66.1 总则

66.1.1 用于支撑或作为外壳的聚合材料应能承受条款66.2和66.3的规定。如果允许，整个报警器将用来做是实验。

66.2 Accelerated air-oven aging test

66.2.1 There shall not be warping or exposure of high-voltage uninsulated current-carrying parts so as to impair operation or provide access to uninsulated high-voltage parts when representative samples of a plastic material are aged for 7 days in a circulating-air oven maintained at 90°C (194°F), or 28 days at a temperature of 70°C (158°F), and at a relative humidity of 0 – 10 percent.

66.2 加速烘箱老化测试

66.2.1 经过测试后应无变形扭曲，或传输电流的非高压绝缘零件暴露，导致工作损坏；或者容易接触到非绝缘高压零件。测试条件如下：代表样板在保持摄氏90°C，空气流通循环的烤箱中七天，或者保持摄氏70°C，28天，相对湿度0-10%.

66.2.2 At least three representative samples are to be mounted on supports as intended in service and placed in the oven. At the end of the aging period indicated in 66.2.1, the samples are to be removed, permitted to cool, and then

examined for adverse distortion. Falling off of an alarm cover shall not occur during the test unless high-voltage parts are not exposed, operation for smoke is not affected, and the cover is replaceable as intended. Sensitivity measurements shall not vary by more than the limits specified in 34.4.1.

66.2.2 至少三个代表样板,按照实际应用的设计方式进行安装在烤箱中,按照条款66.2.1老化实验后,移出样板,可以冷却,然后检查是否有破坏性的变形.报警器外壳脱落是不能接受的,除非没有高压零件暴露.烟雾报警动作不受影响,及外壳根据设计是可替换的.灵敏度读数变化不应超过条款34.4.1的规定.

66.3 Flame test (3/4 inch)

66.3.1 When equipment is tested as described in 66.3.2 – 66.3.6, the material shall not flame for more than 1 minute after two 30-second applications of a test flame, with an interval of 1 minute between applications of the flame. The sample shall not be completely consumed. Exception: Parts that are molded from materials that are classed as 5VA, 5VB, V-0, V-2, by the vertical burning test described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, are not required to be subjected to the flammability test described in 66.3.2 – 66.3.6.

66.3 火焰测试 (3/4 英寸)

66.3.1 当报警器或测试样板按照条款66.3.1- 66.3.6 进行测试时,原材料在施加两次30秒的测试火焰后(两次测试火焰间隔是1分钟),燃烧时间不能超过1分钟.测试原材料不能完全烧毁.

以下情况例外: 零件是测定为5VA, 5VB, V-0, V-2的材料注塑而成, 材料等级(5VA, 5VB, V-0, V-2)是根据UL塑胶材料可燃性测试标准规定的竖直燃烧方法测定的.如满足上述要求,可以不进行条款66.3.2-66.3.6所要求的燃烧测试.

66.3.2 Three samples of the equipment are to be placed in a forced draft circulating air oven maintained at a uniform temperature not less than 10°C (18°F) higher than the maximum temperature of the material measured under normal operating conditions, and not less than 70°C (158°F) in any case. The samples are to remain in the oven for 7 days. After cooling to room temperature for a minimum of 4 hours, the samples are to be tested as described in 66.3.3 – 66.3.6. Exception: Testing is required on only three unconditioned test samples when both of the following conditions are met:

- a) The material does not exhibit a reduction in its flame-resistance properties as a result of long-term thermal aging and
- b) The thermal-aging program used for such determination included specimens having a thickness equal to or less than the wall thickness of the polymeric part.

66.3.2 三个待测样板放置在强制空气循环的烤箱中保持在一定的温度, 烤箱空气温度应高于报警器正常工作时所测得的塑胶材料的温度摄氏10°C, 无论如何, 烤箱空气温度不低于摄氏70°C.

待测样板放入烤箱中7天,在冷却到室温后至少4个小时后,进行条款66.3.3 – 66.3.6.的测试.

以下条件例外: 当以下两个条件都满足时,测试只要求三个无条件的样板:

- a) 材料在阻燃实验中没有减少,在长时间热力老化及
- b) 用于老化步骤来判定的实验样本的厚度等于或少于聚合零件的厚度.

66.3.3 Three samples of the part are to be subjected to the Flame Test described in 66.3.5. In the performance of the test, the equipment is to be supported in its normal operating position in a draft free location. Nonpolymeric portions are not to be removed and insofar as possible, the internal mechanism of the equipment is to be in place. The flame is to be applied to an inside surface of the sample at a location judged as capable of becoming ignited because of its proximity to a source of ignition. Each sample is to be tested with the flame applied to a different location.

Exception: Only three unconditioned test samples are required for testing when both of the following conditions are met:

- a) The material does not exhibit a reduction in its flame-resistance properties as a result of long-term thermal aging and
- b) The thermal-aging program used for such determination included specimens having a thickness equal to or less than the wall thickness of the polymeric part.

66.3.3 三个样板按照条款66.3.5 的要求进行火焰测试, 在测试进行中,样板像正常工作的状态自由摆放. 非聚合物材料不必移出, 内部的机构装置放在适当的位置. 火焰施加到样板内表面有可能成为产生火源的位置. 每个样板将被测试不同的几个点. 以下条件例外: 任意三个样板,同时满足以下两个条件.

- a) 材料在阻燃实验中没有减少,在长时间热力老化及
- b) 用于老化步骤来判定的实验样本的厚度等于或少于聚合零件的厚度.

66.3.4 With reference to 66.3.3, the sections judged capable of becoming ignited are to be those adjacent to coil windings, splices, open-type switches, or arcing parts.

66.3.4 关于条款66.3.3, 可能成为火源的部位: 靠近线圈的位置,结合部,开放式开关和放电零件.

66.3.5 The flame of a Bunsen or Tirrill burner having a tube with a length of 9.5+/-0.3 mm (0.374+/-0.12 inch) and an inside diameter of 100 ± 10 mm (3.94 ± 0.39 inches) is to be adjusted to have a 3/4 inch (19mm) height of yellow flame

with no blue cone. Two 30 second applications of the tip of the flame are to be made to each section of the equipment specified as indicated above, with 1 minute intervals between the applications. A supply of technical-grade methane gas is to be used with a regulator and meter for uniform gas flow.

Exception: Natural gas having a heat content of 1000 Btu/ft³ (37 MJ/m³ at 23°C) has been found to provide similar results and is appropriate for use.

66.3.5 火焰测试所用本生灯或梯利尔燃烧器的管长为9.5+/-0.3 mm, 内径为100+/-10 mm.将火焰调高至19 mm高的黄色火焰,没有蓝色的圆锥火焰.按照上述的火焰,施加到待测样板上,中间间隔1分钟.使用工业用的甲烷气体,并用调节阀和流量计来确保同一的气流.

以下例外: 在摄氏23°C, 能产生每立方米37MJ焦耳热量的天然气具有同样的效果, 也可以使用作为燃料气体。

66.3.6 When one sample from a set of three does not comply with 66.3.1, an additional set of three samples shall be tested. All samples from the second set shall comply with 66.3.1.

66.3.6 当一套三个中有一个不能满足条款66.3.1 要求时, 需要重新一套3个样板进行测试。必须满足条款66.3.1 的要求。

66.4 Flame test (5 inch)

66.4.1 When equipment is tested as described in 66.4.1 – 66.4.5, all of the following results shall be obtained:

- a) The material shall not continue to burn for more than 1 minute after the fifth 5-second application of the test flame, with an interval of 5 seconds between applications of the flame;
- b) Flaming drops or flaming or glowing particles that ignite surgical cotton 12 inches (305 mm) below the test specimen shall not be emitted by the test sample at any time during the test; and
- c) The material shall not be destroyed in the area of the test flame to such an extent that the integrity of the part is affected with regard to containment of fire or exposure of high voltage parts.

Exception: Parts that are molded from materials that are classed as 5VA by the five inch burning test described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, are not required to be subjected to the flammability tests described in 66.4.1 – 66.4.6.

66.4 火焰测试 (5 英寸)

66.4.1 待测样板按照条款66.4.1 和66.4.5 进行测试时, 以下结果必须全部满足。

- a) 火焰测试间隔为5秒一次, 在施加第五次5秒的火焰测试后, 材料持续燃烧不得超过1分钟。
- b) 将305毫米长的药棉放在测试样下面, 在测试的任何时间, 不应由从测试样板燃烧落下的物质或燃烧的物质排出以致点燃药棉。
- c) 在火焰测试区内及用于抑制火灾和防止高压零件外漏的材料, 不应被破坏。

以下条件例外: 零件由符合5VA等级的材料注塑而成, 该5VA等级的材料是根据UL94塑料材料可燃性标准测试判定的; 无需进行条款66.4.1 – 66.4.6.的测试。

66.4.2 Three samples of the complete equipment or three test specimens of the molded part shall be subjected to this test. Consideration is to be given to leaving in place components and other parts that influence the performance. The test samples are to be conditioned in a full draft circulating air oven for 7 days at 10°C (18°F) greater than the maximum use temperature and not less than 70°C (158°F) in any case. Prior to testing, the samples are to be conditioned for a minimum of 40 hours at 23.0+/-2.0°C (73.4+/-3.6°F) and 50+/-5 percent relative humidity. The flame is to be applied to an inside surface of the sample at a location judged as capable of becoming ignited because of its proximity to a source of ignition. When more than one part is near a source of ignition, each sample is to be tested with the flame applied to a different location.

Exception: Only three unconditioned test samples are required for testing when both of the following conditions are met:

- a) The material does not exhibit a reduction in its flame-resistance properties as a result of long-term thermal aging and
- b) The thermal-aging program used for such determination included specimens having a thickness equal to or less than the wall thickness of the polymeric part.

66.4.2 三个待测样板放置在强制空气循环的烤箱中保持在一定的温度, 烤箱空气温度应高于报警器正常工作时所测得的塑胶材料的温度摄氏10°C, 无论如何, 烤箱空气温度不低于摄氏70°C. 测试前, 待测样板放置在温度摄氏23.0+/-2.0°C (73.4+/-3.6°F), 相对湿度为50+/-5% 至少40个小时。火焰施加到样板内表面可能成为着火源的位置。如果超过一个零件接近着火源, 每个样板要在不同的位置进行测试。

以下条件例外: 任意三个样板,同时满足以下两个条件.

- a) 材料在阻燃实验中没有减少,在长时间热力老化及
- b) 用于老化步骤来判定的实验样本的厚度等于或少于聚合零件的厚度。

66.4.3 The three samples shall perform as described in 66.4.1. When one sample does not comply, the test is to be repeated on a set of three new samples with the flame applied under the same conditions as for the unsuccessful sample. All the new specimens shall comply with 66.4.1.

66.4.3三个样板进行条款66.4.1 的测试，如果有一个失败；一套3个新的样板用同样的条件进行测试。所有新的样板应符合条款66.4.1的要求。

66.4.4 The Bunsen or Tirrill burner with a tube length of 9.5+/-0.3 mm (0.374+/-0.12 inch), and an inside diameter of 100+/-10 mm (3.94 ±0.39 inches), is to be placed remote from the specimen, ignited, and adjusted so that when the burner flame is 5 inches (127 mm), the height of the inner blue cone is 1-1/2 inches (38 mm). The tube is not to be equipped with end attachments, such as stabilizers.

66.4.4 火焰测试所用本生灯或梯利尔燃烧器的管长为9.5+/-0.3 mm，内径为100+/-10 mm.将火焰调高至5英寸（127 mm），内焰为38mm高蓝色圆锥的火焰.按照上述的火焰,施加到待测样板上。管子端部没有安装附加装置，如稳定器。

66.4.5 When a complete enclosure is used to conduct the flame test, the sample is to be mounted as intended in service, as long as it does not impair the flame testing, in a draft-free test chamber, enclosure, or laboratory hood. A layer of surgical cotton is to be located 12 inches (305 mm) below the point of application of the test flame. The 5-inch (127-mm) flame is to be applied to any portion of the interior of the part judged as capable of being ignited (by its proximity to live or arcing parts, coils, wiring, or other possible sources of ignition) at an angle of 20 degrees from the vertical so that the tip of the blue cone touches the specimen. The test flame is to be applied to three different locations on each of the three samples tested. A supply of technical-grade methane gas is to be used with a regulator and meter for uniform gas flow. Exception No. 1: The flame is to be applied to the outside of an enclosure when the equipment is of the encapsulated type, or of a size that prohibits the flame being applied inside.

Exception No. 2: Natural gas having a heat content of 1000 Btu/ft³ (37 MJ/m³ at 23°C) has been found to provide similar results and is appropriate for use.

66.4.5 当一个完整的外壳来做试验时，只要不削弱火焰测试，可以像正常使用一样安装，可以装在测试箱子中，圈起来的试验区或实验室。305毫米长的药棉放在火焰测试点下方。5英寸的火焰加到任何可能成为着火源的位置（比如靠近火线，放电零件，线圈和布线 及其它），火焰与竖直面成20度夹角，确保蓝色圆锥火焰接触到测试样本。每个产品测试3个不同的地方。工业用的甲烷作为燃料，供气装置应有调节阀和流量表来控制气体流量。

特例1：如果待测样板是灌封密封或火焰不能进入样板内部的，火焰加在外部。

特例2：在摄氏23°C，能产生每立方米37MJ焦耳热量的天然气具有同样的效果，也可以使用作为燃料气体。

66.4.6 The flame is to be applied for 5 seconds and removed for 5 seconds. The operation is to be repeated until the specimen has been subjected to five applications of the test flame.

66.4.6 火焰施加到测试样板5秒，然后移开5秒。直到重复5次实验结束。

67 Replacement Test, Head and Cover

67.1 An alarm employing a cover that is intended to be attached or closed by a snap type action or a removable head shall withstand 50 cycles of removal and replacement, or opening and closing, as applicable, of the cover.

67.2 An alarm is to be installed as intended in service and the cover or head removed and replaced, or opened and closed, as specified by the manufacturer. The unit then is to be subjected to the Jarring Test, Section 60.

67 顶盖替换测试

67.1 当报警器的外壳或顶盖采用卡钩结构固定的类型或是可移除的类型时，根据情况,应能够承受50次的移除和替换试验,或开关实验.

67.2 报警器的外壳或顶盖,根据制造商的说明，在使用中是可移除并可替换的或可打开并能关闭的；该产品然后依据 S 60 进行振动和冲击实验(Jarring Test).

68 Battery Replacement Test

68.1 The battery clips and holders of a battery operated single station smoke alarm utilizing a battery that is intended to be periodically replaced shall withstand 50 cycles of battery removal and replacement, at a rate not to exceed 6 cycles per minute, without any reduction in contact or mounting integrity. During battery replacement, the alarm device shall not sound for more than 1 second. The test shall have no adverse effect on the operation of the detector. [See 43.1 (f).]

68.2 For this test an alarm is to be installed as intended in service and the battery(s) removed and replaced as specified by the manufacturer. The unit shall then be tested for its intended operation.

68 电池替换测试

68.1 单个(非联机)由电池供电的报警器的电池夹支撑架应能承受50次的电池移除和替换实验;

移除和替换的频率不超过每分钟6次; 不应产生任何接触不良和安装固定的牢靠性.在换电池时,报警声音不能超过1秒,该测试不应应对报警器产生有害的影响, 参见条款43.1(f).

68.2 有关该测试, 按照制造商的说明, 如在实际使用中一样进行安装报警器, 装卸电池.然后进行相关的动作测试.

69 Polarity Reversal Test

69.1 A smoke alarm shall operate as intended after being connected in each polarity. While energized under either polarity, the alarm shall comply with the requirements of the Electric Shock Current Test, Section 70. This includes high-voltage cord connected and fixed wiring (splice lead) types, battery types (main or standby), and multiple station interconnection leads. Each polarity is to be applied for at least 24 hours on all units unless a trouble signal or alarm signal is obtained. For battery operated alarms intended to be connected by a polarized clip assembly the reverse polarity is to be applied for a minimum of 1 second. A trouble or alarm signal is to be permitted under any incorrect polarity applied. A maximum 1-second alarm is permitted when the correct polarity is connected.

69 极性颠倒测试

69.1 每个报警器应该按照要求进行极性连接。在每个电极上电连接后, 报警器应满足章节69A电气冲击电流测试。包括高压线极性连接, 固定线连接, 电池电极连接(作为主电源或备份电源), 互连端子连接。每个电极至少施加24小时测试, 除非已产生故障信号。电池作为电源, 极性颠倒测试至少持续1秒。在任何接错极性的测试中, 产生故障信号是可以接受的。当极性连接正确, 最长1秒的报警是可以接受的。

69.2 Two samples are to be subjected to this test. Sensitivity measurements prior to and following the test are to be made in accordance with the Sensitivity Test, Section 37. Measurements following the polarity reversal shall vary not more than specified in 34.4.1.

69.2 待测样板两个, 测试前后需根据章节37测量灵敏度.极性颠倒测试后灵敏度读数变化不应超过条款34.4.1的规定.

70 Electric Shock Current Test

70.1 If the open circuit potential, between any part that may be contacted by the probe shown in Figure 70.1 either during normal operation or during operator servicing (servicing as defined in the operating or installation instruction) and either earth ground or any other exposed accessible part, exceeds 42.4 volts peak, the part shall comply with the requirements of 70.2 and 70.4.

70 电流冲击测试

70.1 在正常工作或维修时,在任意可被如图70.1所示的探针所接触到的零件和地以及任何可以接触到的零件之间, 如果存在开路电势且电压超过42.4V时, 零件应满足条款70.2和70.4的要求.

[illegible]

70.2当电阻连接在任意可被如图70.1所示的探针所接触到的零件和地以及任何可以接触到的零件之间,流过500欧姆电阻的连续电流不应超过表70.1的规定值.

Frequency, hertz ^a	Maximum current through a 500-ohm resistor, milliamperes peak
0 – 100	7.1
500	9.4
1000	11.0
2000	14.1
3000	17.3
4000	19.6
5000	22.0
6000	25.1
7000 or more	27.5

^a Linear interpolation between adjacent values may be used to determine the maximum allowable current corresponding to frequencies not shown. The table applies to repetitive nonsinusoidal or sinusoidal waveforms.

a) The value determined by the following equation:

$$T \leq \left(\frac{20\sqrt{2}}{l} \right)^{1.43}$$

in which:

T is the interval, in seconds, between the time that the instantaneous value of the current first exceeds 7.1 milliamperes and the time that the current falls below 7.1 milliamperes for the last time;

I is the peak current in milliamperes; and

b) 809 milliamperes, regardless of duration.

The interval between occurrences shall be equal to or greater than 60 seconds if the current is repetitive. Typical calculated values of maximum acceptable transient current duration are shown in Table 70.2.

70.3 按照条款 70.2连接500欧电阻, 通过电阻的瞬间电流时间不得超过以下要求:

a) 判定公式如下 :

$$T \leq \left(\frac{20\sqrt{2}}{I} \right)^{1.43}$$

T代表间隔,单位为秒;表示介于即刻电流第一次超过 7.1毫安时刻和最后即刻电流低于7.1毫安时刻之间的时间间隔.

I 代表峰值电流.

b) 如果电流高于809 毫安, 不需考虑持续时间.

如果电流是重复的, 时间间隔应大于或等于60秒. 最大可接受瞬间电流持续时间的典型计算值如表70.2

70.4 The maximum capacitance between the terminals of a capacitor that is accessible during operator servicing shall comply with the following equations:

70.4 在维修中可接触到两端子之间的电容的最大值应满足如下要求:

$$C = \frac{88,400}{E^{1.43}(\ln E - 1.26)} \quad \text{for } 42.4 \leq E \leq 400$$

$$C = 35,288 E^{-1.5364} \quad \text{for } 400 \leq E \leq 1000$$

in which:

C is the maximum capacitance of the capacitor in microfarads and

E is the potential in volts across the capacitor prior to discharge; E is to be measured 5 seconds after the capacitor terminals are made accessible, such as by the removal or opening of an interlocked cover, or the like.

Typical calculated values of maximum capacitance are shown in Table 70.3.

C 代表最大容值,单位为uF, E 代表在电容器放电前的电动势。

E 电动势是在接触到端子以后5秒钟测试, 比如打开外壳施, 接触外壳5秒后. 最大电容的典型计算值如表70.3 所示。

70.5 With reference to the requirements in 70.2 and 70.3, the current is to be measured while the resistor is connected between ground and each accessible part individually or all accessible parts collectively if the parts are simultaneously accessible. The current also is to be measured while the resistor is connected between one part or group of parts and another part or group of parts, if the parts are simultaneously accessible.

70.5 考虑到条款70.2 和70.3 的要求, 通过电阻的电流方式如下(端子是指可以接触或同时接触的端子):

- a) 一个零件对另一个零件端子之间测试电流
- b) 一个零件对另一组零件端子之间的电流
- c) 一组零件对另外一组零件端子之间的电流

Table 70.2
Maximum transient current duration

Maximum peak current (I) through 500-ohm resistor, milliamperes	Maximum duration (T) of waveform containing excursions greater than 7.1 milliamperes peak, seconds
7.1	7.22
8.5	5.58
10.0	4.42
12.5	3.21
15.0	2.48
17.5	1.99
20.0	1.64
22.5	1.39
25.0	1.19
30.0	0.919
40.0	0.609
50.0	0.443
60.0	0.341

Table 70.2 Continued

Maximum peak current (I) through 500-ohm resistor, milliamperes	Maximum duration (T) of waveform containing excursions greater than 7.1 milliamperes peak, seconds
70.0	0.274
80.0	0.226
90.0	0.191
100.0	0.164
150.0	0.092
200.0	0.061
250.0	0.044
300.0	0.034
350.0	0.027
400.0	0.023
450.0	0.019
500.0	0.016
600.0	0.013
700.0	0.010
809.0	0.0083

70.6 With reference to the requirements in 70.5, parts are considered to be simultaneously accessible if they can be contacted by one or both hands of a person at the same time. For the purpose of these requirements, one hand is to be considered to be able to contact parts simultaneously if the parts are within a 4- by 8-inch (102- by 203-mm) rectangle; and two hands of a person are considered to be able to contact parts simultaneously if the parts are not more than 6 feet (1.83 m) apart.

70.6 考虑到条款**70.5**，零件可能被一个人的一只手或双手同时接触到。对于以上要求，如果零件尺寸在**102mmx203mm**长方形内，视为一只手可以同时接触多个零件。如果零件不超过**1.83米**，可视为两只手可以同时接触。

Table 70.3
Electric shock – stored energy

Potential across capacitance prior to discharge, volts	Maximum capacitance, microfarads
1000	0.868
900	1.02
800	1.22
700	1.50
600	1.90
500	2.52
400	3.55
380	3.86
360	4.22
340	4.64
320	5.13
300	5.71
280	6.40
260	7.24
240	8.27
220	9.56
200	11.2
180	13.4
160	16.3
140	20.5
120	26.7
100	36.5

Table 70.3 Continued

Potential across capacitance prior to discharge, volts	Maximum capacitance, microfarads
90	43.8
80	53.8
70	68.0
60	89.4
50	124.00
45	150.00
42.4	169.00

70.7 Electric shock current refers to all currents, including capacitively coupled currents.

70.7 冲击电流包括针对所有电流，包括容性耦合电流。

70.8 If the product has a direct-current rating, measurements are to be made with the product connected in turn to each side of a 3-wire, direct current supply circuit.

70.8 如果产品有直流电流等级，测量时产品依次连接到3条线每个面，直流供电流线路。

70.9 Current measurements are to be made with any operating control, or adjustable control that is subject to user operation, in all operating positions, and either with or without a vacuum tube, separable connector, or similar component in place. These measurements are to be made with controls placed in the position that causes maximum current flow.

70.9 电流测试时，在所有的操作位置，有或没有真空管，可分离的连接器等类似零件。对于用户操作来说是受控或可调受控的。这种测量用于产生最大电流的位置。

71 Strain Relief Test

71.1 General

71.1.1 A cord or lead that relies upon a thermoplastic enclosure or part for strain relief is to be subjected to the applicable tests specified in 71.2.1 – 71.3.1 following exposure to the temperature conditioning test described in 66.2.1.

71 应变（张力）消除测试

71.1 总则

71.1.1 依靠热缩塑料材料来消除张力的电源线或端子线，要能承受条款71.2.1 – 71.3.1规定的测试后，还要进行条款66.2.1规定的温度暴露测试。

71.2 Power-supply cord

71.2.1 When tested in accordance with 71.2.2, the 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 with the connections within the alarm disconnected.

71.2.2 A 35 pound-mass (15.9 kg) weight is to be suspended on the cord and supported by the alarm so that the strain relief means are stressed from any angle that the construction of the alarm permits. The strain relief does not comply

when, at the point of disconnection of the conductors, there is such movement of the cord as to indicate that stress has resulted on the connections.

71.2 电源线

71.2.1 按照条款71.2.2测试时，提供到电源软线上的应变消除应能承受 1 5 6 N，1 分钟的拉力，不应产生位移变化。测试时电源线与报警器应断开。

71.2.2 重15.9公斤的物体悬挂在电源线上，另一端有报警器支撑；然后测试任何一角度。

如果有导体断开，电源线移动；则不符合要求。

71.3 Field-wiring leads

71.3.1 Each lead employed for field connections, including a battery clip lead assembly, shall withstand for 1 minute a pull of 10 pounds-force (44.5 N) without any evidence of damage or of transmittal of stress to internal connections. A connector used in the lead assembly shall withstand a pull of 5 pounds-force (22.3 N) without any evidence of damage, transmittal of stress to internal connections, or separation.

71.3 现场布线端子线

71.3.1 用于现场连接的端子，包括电池夹组件，应承受44.5N，1 分钟的拉力。不能有明显损坏或张力转移到内部连接上。用于端子的连接器应能承受22.3N的拉力，不应产生明显的损坏，张力转移到内部连接上或剥离。

72 Power Supply Tests

72.1 General

72.1.1 When a separate power supply is used to provide energy to one or more alarms, it is to be subjected to the test in 72.2.1 – 72.3.2.

72 电源供电测试

72.1 总则

72.1.1 当一个分离的电源对一个或多个报警器供电时，要进行条款72.2.1 – 72.3.2规定的测试；

72.2 Volt-amperes capacity

72.2.1 The volt-amperes capacity of the output circuit of a power supply that is separate from the alarms shall not be more than 100 volt-amperes and not more than 30 volts, 60 hertz rms, 42.4 volts peak or DC.

72.2.2 To determine compliance with the requirements of 72.2.1, a variable resistive load is to be connected to the output circuit of the power supply. With the power supply connected to a rated source of supply, the load is to be varied between open circuit to short circuit in an elapsed time of no less than 1-1/2 nor more than 2-1/2 minutes. Voltage and current measurements are to be recorded for each value and the maximum VA is to be calculated. When an overcurrent protective device is provided, it shall be shunted out during the test, when required.

72.2 功率负荷

72.2.1 单独供电的电源线路功率负荷输出不应超过100VA，并且交流电不超过30V, 60Hz 或42V峰值或DC42V.

72.2.2确定是否符合72.2.1：一个可变电阻连接到输出电源线路上。随着电源线连接到额定的电源上，附在电阻在开路和短路之间进行变化，所用时间不少于90秒和不多于150秒。电压和电流值分别在不同的点记录，然后计算最大的功率。当装置提供过流保护时，在测试中如果需要，应当断开。

72.3 Burnout test

72.3.1 There shall be no damage to the enclosure, charring or burning of the cheesecloth, nor emission of flame or molten metal when a power supply is operated under the conditions described in 72.3.2. While still in a heated condition following this test, the power supply shall comply with the requirements of the Leakage Current Test, Section 52, and the Dielectric Voltage-Withstand Test, Section 54.

72.3 燃尽测试

72.3.1当电源在条款72.3.2规定的条件下动作时，不应损坏外壳，碳化或点燃棉布；也不应产生火焰或金属熔化物泄漏出。该测试后，电源在较热的环境下，需满足章节52的漏电流要求和章节54耐压测试。

72.3.2 With the output shorted, the supply circuit of the power supply is to be connected to a rated source of voltage and frequency, with the enclosure grounded, and operated for at least 7 hours or until burnout occurs. A single layer of mercerized cotton cheesecloth is to be loosely draped over the device during the test. When accessible fuses are provided on the power supply, they are to be shunted out, and inaccessible fuses are to remain in the circuit.

72.3.2 供电电源连接到固定的电压和频率，输出短路，外壳接地；至少连续动作 7 小时或直至烧尽。单层丝光棉布较轻地盖在待测样板上，易接触的保险丝应当断开，不易接触的保留在线路中。

73 Fire Test (Heat Detector)

73.1 A heat detector, provided as part of a single station smoke alarm assembly, shall comply with the Standard for Heat Detectors for Fire Protective Signaling Systems, UL 521. It shall be sensitive enough to qualify for at least a 50 foot (15.2 m) spacing when subjected to the Fire Tests described in UL 521.

73.2 Two samples of the smoke alarm incorporating the heat detector shall be subjected to the Fire Tests described in the Standard for Heat Detectors for Fire Protective Signaling Systems, UL 521, while installed on a 50 foot (15.2 m) spacing.

73 火灾测试（热报警器）

73.1 热报警器，作为单个（非联机）烟雾报警器的一部分功能，应满足UL521的要求。至少能满足UL 521规定的15.2m 间距的灵敏度要求。

73.2 两个带有烟雾报警功能的热报警器样板，进行UL 521用于火灾保护的热报警器标准规定的实验。

74 Fire and Smoldering Smoke Tests

74.1 When the sensitivity of smoke alarms subjected to any one of the following tests exceeds the maximum value specified for that particular test then the same samples, adjusted to their minimum sensitivity setting, shall comply with the Fire Tests, Section 44, and the Smoldering Smoke Test, Section 45.

74 火灾和阴燃烟雾测试

74.1 当报警器的灵敏度在经过以下任何一测试后灵敏度超出最大值后，然后测试同一样板，将灵敏度调到最小值。应满足章节44的火灾测试和章节45的阴燃烟雾测试。

a) Undervoltage test, 56.1.1 – 56.1.3;

条款56.1.1 – 56.1.3, 低压测试

b) Overvoltage test, 56.2.1 – 56.2.4;

条款56.2.1 – 56.2.4, 过压测试

d) Jarring Test, Section 60;

章节60, 振动和冲击测试 (Jarring test)

e) Corrosion Test, Section 61;

章节61, 腐蚀测试

f) Vibration Test, Section 59;

章节59, 振动测试

g) Dust Test, Section 57;

章节57, 灰尘测试

h) Lamp Interchangeability Test (Photoelectric), Section 42;

章节42, 光电测试。

i) Reduction in Light Output Test, Section 62.

章节62, 光输出衰减测试

74.2 For 74.1 (a) and (b), the supply voltage to the alarms in the Fire Tests, Section 44, and the Smoldering Smoke Test, Section 45, shall be at the voltage indicated for the applicable test. For alarms employing a battery as the main power supply, the test voltage shall be at the trouble signal level, unless the minimum sensitivity is measured at rated battery voltage.

74.2 对于条款 74.1 的a 和 b 两个测试，电压按照条款章节 44 和 45 的规定上电。对于电池作为主电源的报警器，电池电压要调到低电压故障型号电平，除非最小灵敏度在电池而定电压状态下测试。

75 Accelerated Aging Test (Long-Term Stability Test)

75.1 This test is an alternate test method to the 90-day stability test requirements of 43.1 (a).

75.2 An alarm shall operate for its intended signaling performance after being subjected for 14 days to an ambient temperature of 66+/-3°C (150+/-6°F), 0 – 10 percent relative humidity, followed by 10 cycles of change of air velocity from 0 to 300+/-25 fpm (0 to 1.5+/-0.13 m/s). No false alarms shall occur during or following the aging or during exposure to the changes in air velocity.

75 加速老化测试（长期稳定性测试）

75.1 该测试是条款43.1(a) 90天稳定性测试的替代测试。

75.2 报警器应能承受14天，环境温度为摄氏66+/-3°C，0-10%相对湿度的测试后，信号动作正常。然后，加以十个周期的风速为300 +/-25 fpm的测试。在以上两个实验中，不应有报警信号产生。

75.3 Sensitivity measurements recorded before and after the exposures shall be in compliance with the Sensitivity Test,

Section 37, and shall not vary more than specified in 34.4.1.

75.4 Two samples, one at maximum and one at minimum sensitivity, or both at the sensitivity that is most affected by the test temperature (as determined during the Variable Ambient Temperature Test, Section 50) are to be placed in a circulating air oven and energized for a period of 14 days from a source of rated voltage and frequency. Following removal, the energized samples are to be permitted to cool to room temperature for at least 24 hours and subjected, in turn, to 10 cycles of the change of air velocity test described in 43.1 (d) and then to the Sensitivity Test, Section 37.

Batteries are not required to be subjected to the elevated ambient temperature.

75.3 记录测试前后的灵敏度, 满足章节37的要求, 读数变化不超过条款34.4.1的规定。

75.4 两个待测样板, 一个调至最大灵敏度, 一个调至最小灵敏度; 或两个样板均调至灵敏度最易受测试温度影响的点(根据章节50中, 可变的温度测试来确定)。待测样板放在空气循环的烤箱中, 按照额定的电压和频率上电连续持续14天。然后取出样板, 将上电的样板冷却至室温至少24小时。然后依次根据条款43.1(d) 进行10个周期的气流变化测试, 再根据章节37进行灵敏度测试。电池不需进行高温测试。

76 Drop Test

76.1 This test is to be conducted only on smoke alarms intended for transient use, such as a travel alarm, and is not to be conducted on alarms intended for stationary installation.

76 跌落测试

76.1 该测试仅适用于短暂移动使用的报警器, 对于固定安装的报警器不适用。

76.2 An alarm shall withstand five drops from a height of 7 feet (2.1 m) onto a tiled concrete floor without exposure of internal high-voltage parts and without affecting its intended operation and sensitivity. The sample is to be held so that each impact with the floor is at a different location on the alarm. Dislodgement of parts is not prohibited when:

- a) The dislodged part does not affect operation or sensitivity of the unit,
- b) The dislodged part is replaceable (such as a cover),
- c) There are no high-voltage parts exposed, and
- d) The condition is visually obvious.

76.2 报警器在经过2.1 米高度直接跌到混凝土地板上5次后, 不应有内部高压零件漏出, 灵敏度和相关动作不受影响; 测试时样板要手持, 确保每次以不同的点冲击到地板。如果如何以下条件, 零件脱落时可以接受的。

- a) 零件的脱落不影响动作或灵敏度。
- b) 脱落的零件是可以替换的
- c) 没有高压零件暴露出及
- d) 状况是非常明显的

76.3 Each of two alarms is to be raised to a height of 7 feet (2.1 m) and permitted to drop five times onto a concrete floor covered with a 1/8 inch (3.2 mm) thick uncushioned vinyl tile. Following the drops, the unit is to be examined for damage and tested for sensitivity. Sensitivity measurements, recorded after the drop test, shall vary not more than specified in 34.4.1.

76.3 两个测试样板, 每个举高到2.1 米后, 可以落到盖有3.2mm厚聚酯地板砖覆盖的混凝土地面上。跌落后, 检查是否有损坏和测试灵敏度。在跌落后灵敏度的读数变化不应超过条款34.3.1的规定。

77 Conformal Coatings on Printed-Wiring Boards

77.1 Low voltage printed-wiring boards

77.1.1 The following test program is to be utilized to determine the acceptability of a conformal coating in lieu of full electrical spacings for circuits at potential of 30 volts rms or less.

77.1.2 Eight samples of the printed-wiring board without electrical components installed, and coated with the conformal coating, shall be subjected to this test. Test leads are to be attached to the printed-wiring (prior to the application of the coating) so as to provide for convenient application of the specified test potential.

77.1.3 Four specimens are to be conditioned to room ambient by exposure to ambient air at a temperature of $23 \pm 2^\circ\text{C}$ (73, minus 3, $+4^\circ\text{F}$) and 50 ± 5 percent relative humidity for not less than 24 hours. Following the conditioning, the four samples shall be subjected to the Dielectric Voltage-Withstand Test, Section 54, for the 0 – 30 volt range. There shall not be indication of dielectric breakdown as a result of the test. All specimens shall be smooth, homogeneous, and free of heat deformation such as bubbles and pin holes, as determined by visual examination.

77.1.4 Four samples are to be exposed to ambient air at a temperature chosen from the applicable temperature index line shown in Figure 77.1 corresponding to the “in service” operating temperature of the coating. It is advised that the

aging temperature chosen from index line correspond to not less than 1000 hours of exposure. However, any value of temperature chosen shall correspond to not less than 300 hours of exposure. The samples are then to be subjected to the Dielectric Voltage-Withstand Test, Section 54, for the 0 – 30 volts range. All specimens shall be smooth, homogeneous, and free of defects such as bubbles and pin holes, as determined by visual examination. There shall not be crazing, chipping, or other visual evidence of deterioration or separation of the coating from the board after conditioning. There shall not be indication of a dielectric breakdown.

77.1.5 As a permitted alternative to the use of conformal coating for circuits at a potential of 30 volts rms (42.4 volts DC or AC peak) or less, and less than 100 volt-amperes, four samples of the printed wiring board shall be subjected to the following tests. The samples shall be conditioned in the environment described in the Humidity test, see 51. Following the conditioning, the four samples shall be subjected to the Dielectric voltage-withstand test, see 54, for the 0 – 30 volt range. There shall not be indication of dielectric breakdown as a result of the test.

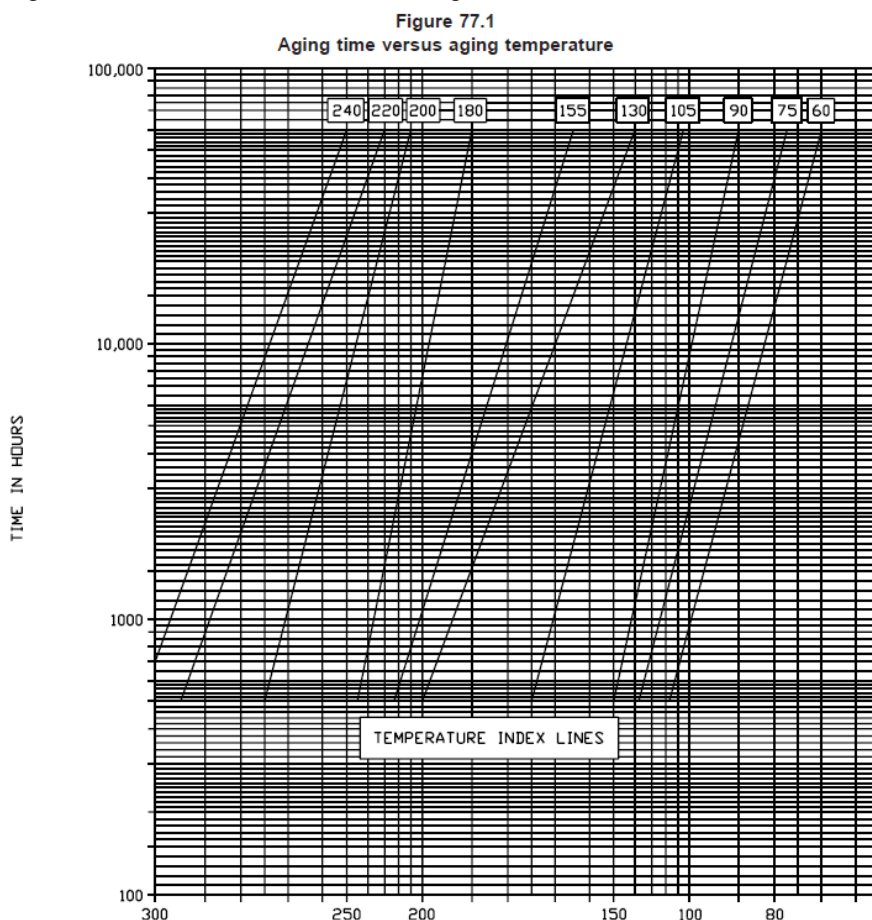
77.2 High voltage printed-wiring boards

77.2.1 The following test program is to be utilized to determine the acceptability of a conformal coating in lieu of full electrical spacing for circuits at potential greater than 30 volts rms. The test shall be performed between tracks on the printed-wiring board. The coating shall not be less than 0.008 inch (0.2 mm) thick.

77.2.2 Three samples of the printed-wiring board without electrical components installed, and coated with the conformal coating, shall be subjected to this test. Test leads are to be attached to the printed wiring board (prior to the application of the coating) for convenient application of the specified test potential. Each sample shall be subjected to a 5,000 volt AC dielectric voltage-withstand test potential for one minute.

- A 7 day heating-cooling cycling period, each cycle consisting of 4 hours "on" at 105°C (189°F) followed by 4 hours "off" at 25°C (77°F);
- A 7 day oven conditioning period of 100°C (212°F);
- A 7 day oven conditioning period at 85 percent relative humidity at 65°C (149°F); and
- A dielectric voltage-withstand test potential at 2,500 volts AC repeated 10 times.

There shall not be peeling or other deterioration of the coating material as a result of the conditioning.



77.2.3 A sample of the coated printed-wiring board, equipped with test leads, without electrical components installed, shall be subjected to this test. The sample shall be subjected to an atmosphere having a relative humidity of 93 ± 2 percent at a temperature of $32 \pm 2^\circ\text{C}$ (89°F , minus 3, $+4^\circ\text{F}$) for a period of 24 hours, followed by a 500 volt dielectric voltage-withstand test with the sample maintained in the conditioning atmosphere. There shall not be indication of a dielectric breakdown.

SMOKE ALARMS FOR USE IN RECREATIONAL VEHICLES

78 General

78.1 A smoke alarm intended for use in recreational vehicles shall comply with the requirements specified in Sections 79 – 82, in addition to the requirements specified in Sections 1 – 77 and 86 – 94, inclusive.

78.2 Smoke alarms intended for use in recreational vehicles shall be provided with a temporary alarm silencing means or be of a photoelectric type.

Added 78.2 effective October 24, 2011

78.3 All batteries included with smoke alarms intended for use in recreational vehicles shall at a minimum have a published operational specification range of minus 18°C to 54°C (0 to 130°F). Recommended replacement batteries shall also meet the temperature range.

Added 78.3 effective October 24, 2011

79 Variable Ambient Temperature and Humidity Test

79.1 There shall be no false alarms or adverse change in performance when two units, one at maximum and one at minimum sensitivity, are subjected, in turn, to each of the following conditions:

- a) Thirty days in air at $66 \pm 3^\circ\text{C}$ ($150 \pm 6^\circ\text{F}$).
- b) At least 72 hours at minus $35 \pm 2^\circ\text{C}$ (minus $17 \pm 4^\circ\text{F}$).
- c) Ten days in 93 ± 2 percent humidity at $61 \pm 2^\circ\text{C}$ ($142 \pm 4^\circ\text{F}$).

79.2 Sensitivity measurements, recorded in the environmental chamber smoke box, shall not vary more than specified in 34.4.1. During the sensitivity measurement, the environmental chamber is to be as close as possible to the test conditions specified in 79.1 (a), (b), and (c) (49°C for 66°C condition, 0°C for minus 35°C condition, and 85 percent relative humidity for the 93 percent relative humidity condition, respectively).

79.3 During each test condition, the alarm is to be connected to a source of rated voltage or battery.

80 Corrosion (Salt Spray) Test

80.1 A smoke alarm shall operate as intended and shall not false alarm after exposure for 48 hours to a salt spray in accordance with the procedure specified in the Standard for Salt Spray (Fog) Testing, ASTM B117-73.

80.2 Two alarms, one at maximum and one at minimum sensitivity, are to be subjected to the salt spray while in a de-energized condition. Following the exposure, the samples are to be removed, dried for at least 24 hours in an air circulating oven or air dried for at least 48 hours, and then subjected to the Sensitivity Test, Section 37.

80.3 It is not prohibited for sensitivity measurements following the exposure to vary by more than specified in 34.4.1 in the direction of high sensitivity under the following conditions:

- 1) the smoke alarm does not false alarm and
- 2) the sensitivity does not vary more than specified in 34.4.1 in the direction of low sensitivity.

In any case, the sensitivity shall not exceed the limits specified in the Sensitivity Test, Section 37.

81 Vibration Test

81.1 After vibration in accordance with 81.2, a smoke alarm shall not false alarm nor be adversely damaged. Sensitivity measurements shall not be greater than specified in 34.4.1 in the direction of low sensitivity, measurements greater than specified in 34.4.1 in the direction of high sensitivity are not prohibited. In no case shall the measurements exceed the limits specified in the Sensitivity Test, Section 37.

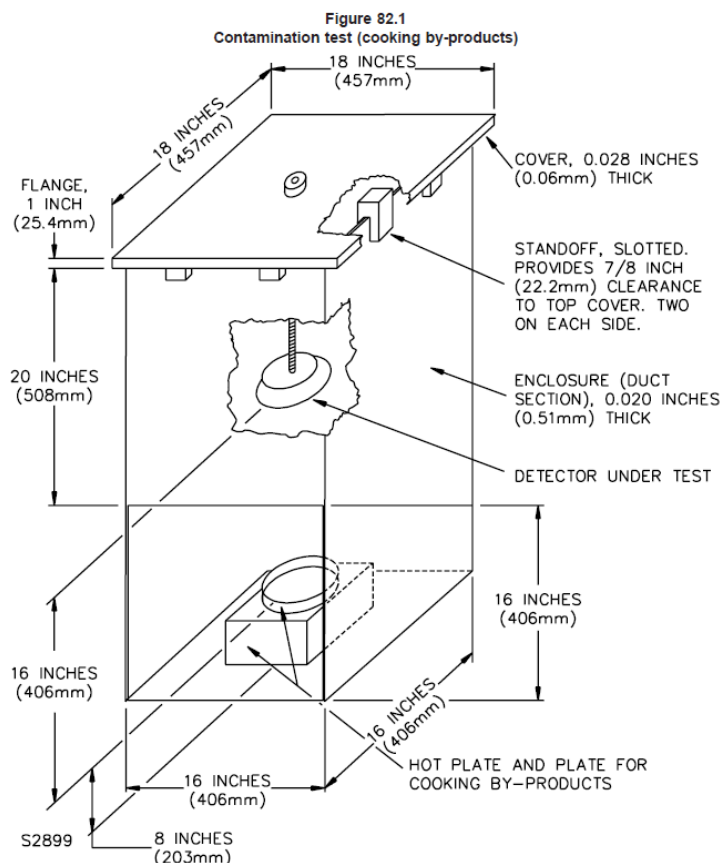
81.2 Two smoke alarms, one at maximum and one at minimum sensitivity, are to be subjected to vibration for 120 hours in accordance with the Vibration Test, Section 59. Sensitivity measurements are to be recorded before and after the test.

82 Contamination Test (Cooking By-Products)

82.1 After exposure in accordance with 82.2 – 82.5, a smoke alarm shall not false alarm or otherwise be adversely affected. Sensitivity measurements following the exposure shall not be greater than specified in 34.4.1 in the direction of low sensitivity, (measurements greater than specified in 34.4.1 in the direction of high sensitivity are not prohibited). In no case shall measurements exceed the limits of the Sensitivity Test, Section 37.

82.2 Two samples are to be subjected to the vaporization of a mixture of 50 grams of animal fat (lard), 50 grams of vegetable fat (Crisco), and 100 grams of beef gravy (Franco-American). The mixture is to be placed in an 8 inch (203 mm) diameter aluminum plate that is heated on an 8-1/2 inch (216 mm) diameter hotplate located on the bottom center of a galvanized sheet metal enclosure.

82.3 The enclosure is to measure 3 feet (914 mm) high, 16 inches (406 mm) square and have an open top and a 16 inch square opening at the bottom of one side. A sheet metal cover, 18 inches (457 mm) square, with 1 inch (25 mm) flanges, is to be supported at the enclosure top by 7/8 inch (20 mm) high standoffs. See Figure 82.1.



82.4 The alarm under test is to be supported on the end of a threaded 1/4 inch (61 mm) steel rod positioned so that the exposed face of the alarm is 12 inches (304 mm) below the enclosure cover and 16 inches (406 mm) above the aluminum plate. The alarm is not to be energized during the test.

82.5 Each sample is to be subjected to five complete vaporization exposures. Following the fifth exposure, each sample is to be removed, permitted to cool for at least 3 hours, and then tested for sensitivity as specified in the Sensitivity Test, Section 37.

SMOKE ALARMS FOR USE ON RECREATIONAL BOATS

83 General

83.1 A smoke alarm intended for use in recreational boats shall comply with requirements specified in 83 – 85, in addition to the requirements specified in 1 – 77 and 86 – 94, inclusive.

83.2 These requirements apply to the construction and performance characteristics for single station self contained battery operated alarms as well as alarms powered by the vessels installed DC system. These alarms may be used in stand alone operation or as part of an integrated multiple device system when installed.

83.3 These smoke alarms are intended to be installed in enclosed accommodation compartments where smoke from undetected fire may accumulate. These devices shall be wired in accordance with Fire Protection Standard for Pleasure and Commercial Motor Craft , NFPA 302, and AC and DC Electrical

Systems on Boats, ABYC E-11, and applicable regulations of the United States Coast Guard.

83.4 Smoke alarms intended for use in recreational boats shall be provided with a temporary alarm silencing means or be of a photoelectric type.

Added 83.4 effective October 24, 2011

83.5 All batteries included with smoke alarms intended for use in recreational boats shall at a minimum have a published operational specification range of minus 18° C to 54° C (0 to 130° F). Recommended replacement batteries shall also meet the temperature range.

Added 83.5 effective October 24, 2011

84 Sample Requirements

Table 84.1
Samples for performance tests

Number of samples ^a	Test
3	Sensitivity test, Section 37
3	Operation tests following conditioning, Section 85
3	Abnormal operation tests, Section 55
1	Salt-spray corrosion test, Section 80
3	Overvoltage and undervoltage tests, Section 56
3	Survivability test, Section 64
3	Audibility test, Section 65
^a The same 3 samples are to be used for each test. When only 1 sample is required it shall be any one of the previously tested samples.	

85 Operational Tests Following Conditioning

85.1 Immediately following each test condition, an alarm shall operate in accordance with the levels specified in Section 37. When specified by the manufacturer, it is not prohibited that the alarm be warmed up prior to a test or sensitivity check.

85.2 The same samples are to be used for each of the conditions in this section. The samples are to be energized (except for humidity) during each exposure. The three samples are to be placed in an air circulating oven maintained at 70 ±2°C (158 ±4°F) for 24 hours.

85.3 Immediately following the conditioning specified for high temperature and the sensitivity test, the same alarms are to be placed in a cold chamber maintained at minus 30 ±2°C (minus 22±4°F) for 24 hours.

85.4 The same three alarms used in the temperature tests are to be used in the vibration test as specified in section 81. The alarms, including all components, are to be mounted on a vibration table so as to simulate as closely as possible an actual installation on a boat in accordance with the device manufacturer's installation instructions. The means used for such mounting shall be rigid enough to reduce resonant frequencies of the mounting means. The vibration table is to produce vibration frequencies and amplitude specified as follows: The alarms are to be subjected to a variable frequency vibration along each of the three rectilinear orientation axes (horizontal, lateral, and vertical) for 4 hours in each plane (12 hours total) at peak to peak amplitude of 0.015 ±0.001 inches (0.40 ±0.05 mm). The frequency of vibration is to be continuously varied, at a uniform rate, from 10 to 60 to 10 hertz every 4 minutes.

85.5 For this test, peak to peak amplitude is defined as the maximum displacement of sinusoidal motion (total machine displacement).

85.6 The same three alarms are to be mounted on a shock machine in the same manner as described in the vibration conditioning. The samples are to be subjected to 5000 shock impacts of 10 g acceleration (98 m/s²) and having a shock duration of 20 – 25 milliseconds as measured at the base of the half-sine shock envelope.

85.7 The machine used for this conditioning is to be of the automatic cycling type capable of producing a half sine shock pulse at the acceleration level and duration specified. The acceleration and shock pulse duration is to be measured by a piezoelectric accelerometer mounted on the test machine platform on an axis parallel to the axis of motion.

85.8 The test samples are to be mounted so that the center of gravity of the sample is as close as possible to the geometric center of the machine platform.

85.9 Following the vibration and shock conditioning, the same three alarms are to be used for the humidity conditioning. The alarms are to be subjected to air at a relative humidity of 90 ±5 percent and a

temperature of $40 \pm 2^{\circ}\text{C}$ ($104 \pm 4^{\circ}\text{F}$) for 96 hours. The alarms are not to be energized during this condition.

85.10 Immediately following the above conditioning, the alarms are to be subjected to air at a relative humidity of 30 ± 5 percent and a temperature of $23 \pm 3^{\circ}\text{C}$ ($73 \pm 5^{\circ}\text{F}$) for 96 hours. The alarms are not to be energized during this conditioning.

MANUFACTURING AND PRODUCTION TESTS

86 General

86.1 To verify compliance with these requirements in production, the manufacturer shall provide the required production control, inspection and tests. The program shall include at least the Sensitivity Calibration Tests, Section 87, and the Photocell Illuminating Lamp Test (Photoelectric Smoke Alarms), Section 88, conducted on 100 percent of the production.

87 Sensitivity Calibration Tests

87.1 The sensitivity of each smoke alarm is to be checked, following the warm-up period specified by the manufacturer, using appropriate instruments to determine that the sensitivity levels are within the marked rating including tolerance, which is within the specified limits of the alarm. The test equipment is to verify the value or range of sensitivities marked on the alarm. The value of indication is to be in the form of percent per foot obscuration.

87.2 For the warm-up period, the alarms are to be energized from a source of supply in accordance with 33.3.1. In situations where the smoke alarm sensitivity is not within the manufacturer's specifications, the unit is to be corrected and retested. When a retested sample is still outside the specification, it is to be rejected.

87.3 A warm-up period is required for those alarms employing components whose characteristics vary during initial warm-up, such as solid-state devices operating at greater than 25 percent of rating, lamp filaments, resistors, and other components that affect sensitivity.

87.4 A warm-up period is not required when the alarm components are operated at not more than 25 percent of rating in the standby condition or when the individual components are burned-in prior to assembly.

88 Photocell Illuminating Lamp Test (Photoelectric Smoke Alarms)

88.1 The manufacturer is to provide facilities for measurement of all the photocell illuminating lamps, including any replacement lamps provided, to determine that the illumination output is uniform and within the specifications for the intended use.

89 Production Line Dielectric Voltage-Withstand Tests

89.1 Each alarm rated at more than 30 volts AC rms (42.4 volts DC or AC peak) shall withstand, without breakdown, as a routine production-line test, the application of an essentially sinusoidal AC potential of a frequency within the range of 40 – 70 hertz, or a DC potential, between high-voltage live parts and the enclosure, high-voltage live parts and exposed dead metal parts, and live parts of circuits operating at different potentials or frequencies. The test potential is to be:

- a) For an alarm rated at 250 volts AC rms or less – either 1000 volts (1414 volts, when a DC potential is used) applied for 60 seconds or 1200 volts (1697 volts, when a DC potential is used) applied for 1 second or
- b) For an alarm rated at more than 250 volts – either 1000 volts plus twice the rated voltage (1414 volts plus 2.828 times the rated AC rms voltage, when a DC potential is used) applied for 60 seconds or 1200 volts plus 2.4 times the rated voltage (1697 volts plus 3.394 times the rated AC rms voltage, when a DC potential is used) applied for 1 second.

Exception: A product, the housing of which is entirely comprised of polymeric materials, is not required to be subjected to this test when there are no exposed dead metal parts that become energized under fault conditions.

89.2 When the alarm employs high-voltage and low-voltage circuits, the test is to be conducted with the low-voltage circuit connected to the cabinet, chassis, or other dead metal parts so that the potential that is applied between the high-voltage live parts and dead metal parts is applied simultaneously between high-voltage live parts and low-voltage circuits.

89.3 A printed-wiring assembly or other electronic-circuit component that is damaged or short-circuited, by application of the test potential, is to be removed, disconnected, or otherwise rendered inoperative before the test. It is not prohibited for a representative subassembly to be tested instead of an entire unit.

89.4 A 500 volt-amperes or larger transformer, the output voltage of which is able to be varied, is to be used to determine compliance with 89.1. A 500 volt-amperes or larger transformer is not required when the high potential testing equipment used is such that it maintains the specified high potential voltage at the equipment for the duration of the tests.

89.5 The test equipment used for this test is to include a visible indication of application of the test potential and an audible or visible indication, or both, of breakdown. In the event of breakdown, manual reset of an external switch is to be required, or an automatic reject of the unit under test is to result. Other arrangements are to be evaluated and accepted when found to achieve the results contemplated.

89.6 Where the charging current through a capacitor or capacitor-type filter connected across the line, or from line to earth ground, is enough to prevent maintaining the specified AC test potential, the alarm is to be tested using a DC test potential in accordance with 89.1.

90 Production Line Grounding Continuity Tests

90.1 The manufacturer shall test each alarm that has a power-supply cord terminating in an attachment-plug employing a grounding pin to verify electrical continuity between the device and the grounding blade of the attachment-plug.

90.2 For this test, the manufacturer is to employ a resistance-indicating instrument with leads and terminals which determine the grounding circuit continuity.

90.3 When an investigation of the alarm has shown all exposed dead metal parts that become energized and all dead metal parts within the enclosure that are exposed to contact during servicing to be acceptably bonded to the frame and enclosure of the alarm, a test that determines the electrical continuity between the grounding blade and the frame or enclosure is satisfactory.

91 Smoke Alarm Shipment

91.1 The battery intended to be employed with the alarm shall be shipped from the factory with the alarm in the same package. To prevent unnecessary drain during shipment and storage, the battery shall not be connected in the alarm.

91.2 A nonrechargeable standby battery of an AC operated accessory to a single- or multiple-station smoke alarm is not required to be shipped with the unit when instructions on the unit specify the battery to be used by model number and manufacturer, as well as a source of purchase. A rechargeable standby battery shall be shipped with the unit in which it is to be employed.

MARKING

92 General

92.1 A smoke alarm shall be permanently marked with the following information unless specifically indicated that it appears on the installation wiring diagram. The marking shall be in a contrasting color, finish, or equivalent. Unless the letter height is specified, all markings shall be at least 3/64 inch (1.2 mm) high.

- a) Name or identifying symbol and address of the manufacturer or vendor.
- b) Model number and date of manufacture. The date of manufacture shall be non-coded and in the format YEAR (in 4 digits), MONTH (in letters), DATE (in 2 digits) located on the outside of the smoke alarm.
- c) Electrical rating, in volts, amperes, or watts, and frequency. Not required for battery operated alarms.
- d) Correct mounting position when a unit is intended to be mounted in a definite position. (It is not prohibited for this to appear in the installation instructions.)
- e) Identification of lights, switches, meters, and similar devices regarding their function unless their function is obvious.
- f) Maximum rating of fuse in each fuseholder and temperature rating of supplementary heat detector, when provided, in degrees Fahrenheit and Celsius.

g) Identification of spare lamps and batteries by part number, manufacturer's model number or equivalent. Located adjacent to the component.

h) Reference to an installation diagram and/or owner's manual.

i) For a smoke alarm that employs a radioactive material, the following information shall be indicated directly on the exterior of the unit:

1) The statement "CONTAINS RADIOACTIVE MATERIAL,"

2) Name or Radionuclide and quantity (no abbreviations), and

3) The statement, "U.S. NRC License No. XXX." (XXX – No. of License) or the name of the Licensee.

j) An alarm shall be marked on the outer surface of the enclosure with the following or equivalent notice: "Do Not Paint." The letters shall not be less than 1/8 inch (3.2 mm) high and shall be located so as to be readily visible after the alarm is mounted in its intended manner.

k) The following or equivalent qualifying statement on a battery-operated alarm where battery operation, under other than normal room temperature conditions during the long term (minimum 1 year) battery tests, is less than 1 year:

"CONSTANT EXPOSURES TO HIGH OR LOW TEMPERATURES OR HIGH HUMIDITY MAY REDUCE BATTERY LIFE."

Applicable wording shall be used.

l) Distinction between alarm and trouble signals on those units employing both.

m) For battery operated alarms employing replaceable batteries, reference to a source for battery replacement. (It is not prohibited for this to appear in the homeowner's manual.)

n) For a battery operated alarm employing replaceable batteries, the word "WARNING " and the following or equivalent marking shall be included on the unit: "Use Only Batteries Specified In Marking. Use Of A Different Battery Will Have A Detrimental Effect On Smoke Alarm Operation." The letter height shall be a minimum of 1/8 inch (3.2 mm) for "WARNING" and 3/64 inch (1.2 mm) for the rest of the notice.

o) For a smoke alarm employing a nonrechargeable standby battery the marking information described in 14.1, 14.3, and 14.4 shall be in letters not less than 1/8 inch (3.2 mm) high.

p) Test instructions and frequency. Not less than once per week for battery-powered alarms and not less than once per month for other than battery-powered alarms.

q) Maintenance instructions, such as cleaning, lamp and battery replacement.

r) Name and address of firm to whom alarm is to be sent for servicing.

s) Sealed units intended to be returned to the manufacturer for servicing shall be marked as follows on the outside of the alarm: "RETURN TO (+) FOR SERVICING," or equivalent. It is not prohibited for units on which the cover is removable, and that are also intended to be returned to the manufacturer for servicing, to have the marking on the inside of the alarm.

(+) Name and address of manufacturer or supplier.

t) An AC operated alarm without a standby battery shall be marked with the word "WARNING " and the following or equivalent wording: "UNIT WILL NOT OPERATE DURING POWER FAILURE." The marking shall be in a location on the unit that is visible after installation. The letter height shall be a minimum of 1/8 inch (3.2 mm).

u) The sensitivity setting for a smoke alarm having a fixed setting. For an alarm which is intended to be adjusted in the field, the range of sensitivity shall be indicated. The marked sensitivity shall be indicated as a percent per foot obscuration level. The marking shall include a nominal value plus tolerance.

v) For a battery operated smoke alarm employing a non-replaceable 10 year battery, the words "10 Year Battery. Replace Alarm After _____ " or equivalent marking shall be provided on the unit. The letter height shall be a minimum of 1/8 inch (3.2 mm) unless it is in a contrasting color, visible from 1.83 m (6 feet) after the unit has been installed as intended.

w) For a battery-operated smoke alarm employing a non-replaceable 10-year battery, a

statement indicating that the unit is sealed, with no serviceable parts, and that the maintenance and testing specified elsewhere on the marking must be performed.

x) For a battery operated smoke alarm employing a non-replaceable 10-year battery, a description of how to use the deactivation feature and indication that once deactivated the smoke alarm is incapable of being reactivated and must be replaced.

y) A detector guard shall be permanently marked with the following information in a contrasting color, finish, or equivalent:

1) Name or identifying symbol of the manufacturer or private labeler,

2) Model number and

3) A statement indicating that the guard is only to be used with detectors specified in the installation instructions of the guard or detector.

92.2 Information required to appear directly on the alarm shall be readily visible after installation. Except for 92.1 (j), the removal or opening of an enclosure cover not requiring a tool, or an equivalent arrangement to view the marking is not prohibited.

92.3 When markings are placed on the base (bottom) of an alarm intended for permanent installation, the word "CAUTION " and the following or equivalent marking in letters 1/8 inch (3.2 mm) high is to be provided on the outside or inside of the alarm: "Additional marking on back. Disconnect power."

92.4 Additional marking requirements are specified by 9.2.1, 11.6.4, 14.1, 14.3, 14.4, 19.2.1, 25.2, and 94.2.

92.5 For manufacturers producing alarms at more than one factory, each such assembly shall have a distinctive marking to identify each subassembly as the product of a particular factory.

92.6 With regard to the requirement in 8.5, a warning flag, hinged cover as described in 8.1 (inside or outside), or equivalent, shall be marked with the word "WARNING " and the following or equivalent text: "Smoke Alarm is Non-Operational." The letter height shall be a minimum of 3/8 inch (9.5 mm) unless it is in a contrasting color, visible from 6 feet (1.83 m).

Exception: Not required for supervised RF detectors.

93 Packaging Marking

93.1 The point-of-sale carton, in which a smoke alarm employing a radionuclide is packaged, shall be permanently marked on the exterior with the following information. The letter height shall be at least 3/64 inch (1.2 mm) high and shall be in contrasting color, finish, or equivalent.

a) Name of radionuclide and quantity (no abbreviations).

b) The statement, "U.S. NRC License No. XXX " (XXX – No. of License) or the name of the Licensee.

c) The following or equivalent statement:

"THIS SMOKE ALARM CONTAINS RADIOACTIVE MATERIAL AND HAS BEEN MANUFACTURED IN COMPLIANCE WITH U.S. NRC SAFETY CRITERIA IN 10 CFR 32.27. THE PURCHASER IS EXEMPT FROM ANY REGULATORY REQUIREMENTS."

93.2 Smoke alarms with replaceable battery warranties exceeding one year shall:

a) Include a disclaimer that indicates that the battery warranty period is not a performance claim, or

b) Have the performance claims of the manufacturer verified per 63, Battery tests.

INSTRUCTIONS

94 General

94.1 Each single and multiple station smoke alarm shall be provided with installation instructions which shall include the following information:

a) Typical installation drawing layouts for the unit(s) indicating recommended locations and wiring methods which shall be in accordance with the:

1) National Electrical Code, NFPA 70, Chapter 3 – Wiring Methods and Materials; and

2) National Fire Alarm Code, NFPA 72, Chapter 11 – Single- and Multiple-Station Alarms and Household Fire Alarm Systems.

Locations where smoke alarm installations are not recommended shall also be included.

b) Description of the operation, testing, and proper maintenance procedures for the unit(s). The frequency of testing shall be in accordance with NFPA 72, Chapter 10 – Inspection, Testing, and Maintenance.

c) Replacement parts, such as lamps or batteries, shall be identified in the instructions by a part number, manufacturer's model number, or the equivalent, and information included as to where a homeowner is able to obtain the part.

d) The following text:

"For your information, the National Fire Alarm Code, NFPA 72, reads as follows:

"11.5.1 *Required Detection."

"

*Where required by applicable laws, codes, or standards for a specific type of occupancy, approved single- and multiple-station smoke alarms shall be installed as follows:

(1) *In all sleeping rooms and guest rooms

(2) *Outside of each separate dwelling unit sleeping area, within 6.4 m (21 ft) of any door to a sleeping room, the distance measured along a path of travel

(3) On every level of a dwelling unit, including basements

(4) On every level of a residential board and care occupancy (small facility), including basements and excluding crawl spaces and unfinished attics

(5) *In the living area(s) of a guest suite

(6) In the living area(s) of a residential board and care occupancy

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e) Description of the various situations against which the smoke alarm may not be effective, for example:

1) Fires where the victim is intimate with a flaming initiated fire; for example, when a person's clothes catch fire while cooking;

2) Fires where the smoke is prevented from reaching the detector due to a closed door or other obstruction;

3) Incendiary fires where the fire grows so rapidly that an occupant's egress is blocked even with properly located detectors.

f) More detailed information on the alarm and trouble signals and an indication where false alarms or trouble signals are anticipated.

g) Identification of the homeowner's manual or instruction sheet by number or equivalent.

h) An indication that the device shall not be installed in locations where the normal ambient temperature is below 4.4°C (40°F) or exceeds 37.8°C (100°F), unless the alarm has been determined to be capable of being used at installation points with higher or lower ambient temperatures.

i) Reference to a source(s) of power limited cable for multiple station interconnection or connection of supplementary devices.

j) The manufacturer shall either provide information on an evacuation plan or include a copy of a separate booklet, or equivalent, which is published by the National Fire Protection Association, National Fire Prevention and Control Administration, or an equivalent agency. When the manufacturer provides information on an evacuation plan, it shall be in accordance with published information available from the National Fire Protection Association.

k) The following information:

- 1) Name and address of manufacturer or vendor.
- 2) Model number.
- 3) Electrical rating in volts, amperes or watts, and frequency. Not required for battery operated alarms.
- 4) Temperature rating of heat detector, when provided.
- 5) Test instructions and frequency.
- 6) Maintenance instructions such as cleaning and lamp and battery replacement.
- 7) Name and address of firm to whom alarm is to be sent for servicing.
- 8) The following notice: THIS EQUIPMENT SHOULD BE INSTALLED IN ACCORDANCE WITH THE NATIONAL FIRE PROTECTION ASSOCIATION'S STANDARD 72 (National Fire Protection Association, Batterymarch Park, Quincy, MA 02269).

l) For smoke alarm-transmitters intended to be installed with compatible audible signal receiver units, instructions shall include the limitations of use in typical single level and multilevel dwelling units as well as in apartment buildings where it is possible that adjacent apartments have similar systems.

m) For alarms also recognized for installation in recreational vehicles, the word "WARNING," and the following or equivalent text: "TEST SMOKE ALARM OPERATION AFTER VEHICLE HAS BEEN IN STORAGE, BEFORE EACH TRIP, AND AT LEAST ONCE PER WEEK DURING USE. An identical marking is to be provided by the recreational vehicle manufacturer that shall be permanent and located, visibly, within 24 inches (610 mm) of the smoke alarm."

n) Smoke alarms are not to be used with detector guards unless the combination has been evaluated and found suitable for that purpose.

o) For alarms powered by a non-replaceable battery, the instructions shall provide a description of the proper use of the battery activation and deactivation features. This information shall specify that each feature is intended for one time use only.

p) An indication that current studies have shown smoke alarms may not awaken all sleeping individuals, and that it is the responsibility of individuals in the household that are capable of assisting others to provide assistance to those who may not be awakened by the alarm sound, or to those who may be incapable of safely evacuating the area unassisted.

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94.2 It is not prohibited that the instructions be incorporated on the outside of the unit, on a separate sheet, or as part of a manual. When not included directly on the device, the instructions or manual shall be referenced in the marking information on the unit.

94.3 The material shipped with the alarm, including the package, instructions, or user's manual, shall not include information other than that specified in 94.1, such as manufacturer's claims on the operation of the alarm which have not been substantiated by the performance tests included in this standard, or that are not covered in Household Fire Warning Equipment, ANSI/NFPA 74, or other applicable NFPA standards of the National Fire Protection Association.

SUPPLEMENT SA - SMOKE ALARM RELIABILITY PREDICTION

SA1 Instructions for Determining a Reliability Prediction for Smoke Alarms

SA1.1 Make a list of every component in the alarm.

SA1.2 By circuit analysis or experimentation, determine the effect of any failure mode (short or open) of each component on the smoke alarm operation and the rationale for the decision. This determines that a component is to be identified as critical, conditionally critical, or noncritical.

SA1.3 A component is identified as noncritical when all failure modes of the component result in a trouble signal, or have no effect on the intended operation of the smoke alarm for alarm and trouble signals, and do not affect the alarm sensitivity.

a A trouble signal is indicated by energization of an audible signal, energization of a separate visual

indication (amber or orange), or de-energization of a power-on light. When a visual indication is relied on to denote a trouble condition, it shall have a documented predicted failure rate of not greater than 2.5 failures per million hours.

SA1.4 A component is identified as critical when two or more failure modes of the component, which affect the intended operation or the sensitivity of the smoke alarm, do not result in a trouble signal.

SA1.5 A component is identified as conditionally critical when only one failure mode of the component affects the intended operation or the sensitivity of the smoke alarm, and does not result in a trouble signal.

SA1.6 Make a list of all critical and conditionally critical components in the alarm.

SA1.7 For each critical and conditionally critical component, the expected failure rate, based upon a minimum confidence factor of 60 percent, shall be determined from either the screening burn-in or published component reliability data method.

SA1.8 For each conditionally critical component, the expected failure rate shall be determined by calculating only the failure rate for the mode meeting the conditions of SA1.5 or by applying a 0.75 multiplying factor to the value determined by the PARTS COUNT or PARTS STRESS ANALYSIS method described in MIL-HDBK 217B.

SA2 Methods of Determining Failure Rate

SA2.1 PARTS COUNT METHOD – When using this method the failure rate is to be determined as follows, using Section 3 of MIL-HDBK 217B :

- Employ generic failure rate from Tables SA2.1 – SA2.6 which most closely approximates the component employed.
- Determine the quality factor multiplier for each component from Tables SA2.7 – SA2.9.
- Multiply each generic failure rate by its associated quality factor multiplier to obtain the final failure rate for the component. See sample calculation, Table SA2.10.
- Add all individual failure rates of critical and conditionally critical components to obtain the overall failure rate for the alarm.

Note: Mil-specification numbers in Tables SA2.4 and SA2.5 are provided for reference only to determine general component type.

Table SA2.1
Generic failure rate for standard bipolar digital devices (TTL and DTL) in failures per million hours

Circuit complexity	Failure rate
1 to 20 gates ^a	0.029
21 to 50 gates	0.062
51 to 100 gates	0.094
101 to 500 gates	0.38
Greater than 500 gates	6.0
Memories, less than or equal to 1000 bits	0.30
Memories, 1001 to 4000 bits	0.70
Memories, 4001 to 8000 bits	1.2

^a Assume 1 gate is equivalent to four transistors.

Table SA2.2
Generic failure rate for standard bipolar beam lead and ECL, bipolar and MOS linear, and all other MOS devices in failures per million hours

Circuit complexity	Failure rate
1 to 20 gates ^a	0.048
21 to 50 gates	0.19
51 to 100 gates	0.31
101 to 500 gates	1.4
Greater than 500 gates	23
Linear, less than or equal to 32 transistors	0.052
Linear, 33 to 100 transistors	0.12
Memories, less than or equal to 1000 bits	1.2
Memories, 1001 to 4000 bits	2.7
Memories, 4001 to 8000 bits	4.5

^a Assume 1 gate is equivalent to four transistors.

Table SA2.3
Generic failure rate for discrete semiconductors in failures per million hours

Part type		Failure rate
Transistors	Silicon NPN	0.18
	Silicon PNP	0.29
	GePNP	0.41
	GeNPN	1.1
	FET	0.52
	UJT, PUT ^a	1.7
Diodes	Silicon, general purpose	0.12
	Germanium, general purpose	0.28
	Zener and avalanche	0.16
	Thyristor	0.16
	Silicon microwave detector	2.2
	Ge microwave detector	5.6
	Silicon microwave mixer	3.0
	Ge microwave mixer	10.0
	Varactor, step	1.5

^a A lower failure rate (0.16 failures/10⁶ hrs) shall be assigned only when the construction of the device is comparable to that of a thyristor.

Table SA2.4
Generic failure rate for resistors in failures per million hours

Resistors, fixed			Failure rate
Construction	Style	Mil-R-Spec. (reference only)	
Composition	RCR	39008	0.002
Composition	RC	11	0.01
Film	RLR	39017	0.015
Film	RL	22884	0.075
Film	RNR	55182	0.017
Film	RN	10509	0.017
Film, power	RD	11804	0.96
Wire wound, accurate	RBR	39005	0.056
Wire wound, accurate	RB	93	0.28
Wire wound, power	RWR	39007	0.033
Wire wound, power	RW	26	0.17
Wire wound, chassis mount	RER	39009	0.062
Wire wound, chassis mount	RE	18546	0.31
Resistors, variable			
Wire wound, trimmer	RTR	39015	0.066
Wire wound, trimmer	RT	27208	0.33
Wire wound, precision	RR	12934	2.7
Wire wound, semi-precision	RA	19	2.3
Wire wound, semi-precision	RK	39002	2.3
Wire wound, power	RP	22	2.3
Non-wire wound, trimmer	RJ	22097	4.6

Table SA2.4 Continued

Resistors, fixed			Failure rate
Construction	Style	Mil-R-Spec. (reference only)	
Composition (common pot)	RV	94	
Factory preset and sealed			0.46
Field variable			3.7

Table SA2.5
Generic failure rate for capacitors in failures per million hours

Dielectric	Style	Mil-C-Spec. (reference only)	Failure rate
Paper/plastic	CHR	39022	0.0006
Paper/plastic	CPV	14157	0.0006
Paper/plastic	CQR	19978	0.0006
Paper/plastic	CQ	19978	0.006
Mica	CMR	39001	0.0032
Mica	CM	5	0.032
Mica	CB	10950	0.58
Glass	CYR	23269	0.011
Ceramic	CKR	39014	0.022
Ceramic	CK	11015	0.22
Tantalum, solid	CSR	39003	0.026
Tantalum, nonsolid	CLR	39006	0.034
Tantalum, nonsolid	CL	3965	0.34
Aluminum, oxide	CU	39018	0.23
Aluminum, dry electrolyte	CE	62	0.41
ceramic, variable	CV	81	1.1
piston, variable	PC	14409	0.11

Table SA2.6
Generic failure rate for miscellaneous parts in failures per million hours

Part type	Failure rate
Pulse transformers	0.0027
Audio transformers	0.0066
Power transformer and filters	0.021
RF transformers and coils	0.022
Connectors	0.45
Connections	
solder, reflow lap to printed-circuit boards	0.00012
solder, wave to printed-circuit boards	0.00044
other hand solder connections (e.g., wire to terminal board)	0.0044
crimps	0.0073
welds	0.002
wirewraps	0.000037
Coaxial connectors	0.63
Toggle switches	0.57

Table SA2.6 Continued

Part type	Failure rate
Push button switches	0.38
Sensitive switches	0.90
Rotary switches	1.4
General purpose relays	0.30
High current relay	1.0
Latching relays	0.29
Reed relays	0.26
Meters and bimetal	5.7
Two sided printed-wiring boards	0.0024
Multilayer printed-wiring board	0.30
Quartz crystals	0.20
Thermistor	
beads	0.10
discs	0.31
Fuses	0.10
Neon lamps	0.20
Photocells	0.02
Light emitting diodes (LED)	
General use (indicator light)	0.20
Light source of photoelectric detectors	2.50 ^a

^a This is the maximum value permitted and is based on the failure rate of half light output. LED's having projected lower failure rates at half light output are usually employed. The reliability is to be evaluated on data supplied by LED manufacturer.

Table SA2.7
Quality factors for Tables SA2.1 and SA2.2

Quality level or screen class	Description	Quality factor
A	Mil-M-38510, Class A	0.5
B	Mil-M-38510, Class B	1
B-1	Mil-Std-883A, Method 5004, Class B	2.5
B-2	Vendor equivalent of Mil-Std-883A, Method 5004, Class B	5
C	Mil-M-38510, Class C	8
D	Commercial (or non-Mil Standard) part with no screening beyond the manufacturer's regular quality assurance practices	75
E	Screening procedure per Table SA5.1	8

Table SA2.8
Quality factor for Table SA2.3

Part class	Quality factor
JANTXV	0.1
JANTX	0.2
JAN	1.0
Commercial grade	1.0

Table SA2.9
Quality factor for Tables SA2.4 and SA2.5

Failure rate level (established reliability parts)	Quality factor
L	1.5
M	1.0
P	0.3
R	0.1
S	0.01

NOTE – For nonestablished reliability parts the quality factor equals 1.5. The quality factor for all miscellaneous parts equals 1.0.

Table SA2.10
Detector reliability prediction – parts count method sample calculation

Component	Generic failure rate (A)	Quality factor multiplier (B)	Failure rate failures/ 10 ⁶ hrs A times B
Composition resistor	0.01	1	0.01
Composition resistor	0.01	1	0.01
Composition resistor	0.01	1	0.01
Film resistor	0.075	1	0.075
Film resistor	0.075	1	0.075
Wire wound resistor, power	0.17	1	0.17
Capacitor, plastic	0.006	1	0.006
Capacitor, plastic	0.006	1	0.006
Capacitor, tantalum, solid	0.026	1	0.026
Capacitor, dry electrolyte	0.41	1	0.41
Transistor, silicon NPN	0.18	0.3	0.06
Transistor, silicon NPN	0.18	0.3	0.06
Thyristor (SCR)	0.16	1	0.16
Diode, silicon	0.12	1	0.12
Diode, silicon	0.12	1	0.12
Relay, reed	0.26	1	0.26
Relay, general purpose	0.30	1	0.30
Connector	0.45	1	0.45
Printed-wiring board	0.0024	1	0.0024
Switch, push button	0.38	1	0.38
Potentiometer, factory preset	0.46	1	0.46
LED (indicator lamp)	0.20	1	0.20
Total Detector Failure Rate			3.371

SA2.2 PARTS STRESS ANALYSIS METHOD^b – The failure rate is calculated using the procedure in MIL-HBK-217B, Section 2. Calculations and supporting data on rating of components for the determination are required for review. See also Table SA2.11 and Figure SA2.1 for equations and tabulation sheets.

^b When a Mil-Spec component is required in a smoke alarm and it does not employ a specific marking to that effect, it is required that the alarm manufacturer provide documentation to verify that the component is Mil-Spec graded. The documentation shall be in the form of a shipping order, invoice, or equivalent, provided by the component vendor.

SA2.3 SCREENING BURN-IN METHOD – This method is required for the evaluation of custom integrated circuit "chips" although it is also able to be applied to any other component of an alarm,

including generic "chips." The evaluation shall consist of a burn-in test program to determine the numerical failure rate coupled with a minimum quality assurance screening program for all production units. Refer to Sections SA4 – SA6.

SA2.4 ALTERNATE METHOD (GENERIC DEVICES ONLY) – An alternate for generic components only shall consist of the burn-in test program to determine the numerical failure rate coupled with the component manufacturer's standard screening program which is employed for the device family_c of the component. The condition of acceptance of the limited screening shall include the following:

- A test sample lot shall be screened in accordance with the component manufacturer's standard program and then subjected to the burn-in test described in Sections SA4 – SA6.
- The component manufacturer shall provide failure rate data on the particular device being tested or the device family_c from a second source, such as field failure rate data or a separate burn-in test.
- A comparison of the burn-in test data from (a) and (b) shall be made and results from (a) shall not be worse than those in (b) by one order of magnitude (10:1).

cSimilar devices manufactured under same process and design rules.

SA2.5 PUBLISHED RELIABILITY DATA – It is appropriate to employ this method for the evaluation of generic integrated circuit "chips" as well as any other component of an alarm, except for a custom "chip." The evaluation is derived by the use of generic failure rate data from industry and military recognized publications on component reliability based on field accumulated data. Examples of such publications include "Micro-Circuit Device Reliability," "Linear/Interface Data and Micro-Circuit Device Reliability," "Digital Generic Data." Devices evaluated by this method shall comply to the identification program in SA4.3, and minimum screening program of Table SA5.1.

SA2.6 It is not prohibited for the overall failure rate of the components of an alarm to be evaluated by any combination of two or more of the failure rate determination methods described in SA2.1, SA2.2, SA2.3, SA2.4, and SA2.5..

Table SA2.11
Parts stress analysis method references

Type device	Applicable equation	MIL-HDBK-217B 9/20/74 page reference
Monolithic bipolar and MOS digital SIL/MSI devices < 100 gates or 400 transistors	$\lambda_p = \pi_L \pi_Q (C_1 \pi_T + C_2 \pi_E)$	2.1.1-1
Monolithic bipolar and MOS linear devices	$\lambda_p = \pi_L \pi_Q (C_1 \pi_{T2} + C_2 \pi_E)$	2.1.2-1
Monolithic bipolar and MOS digital LSI devices ≥ 100 gates or 400 transistors	$\lambda_p = \pi_L \pi_Q (C_1 \pi_T + C_2 \pi_E)$	2.1.3-1
Monolithic MOS and bipolar memories	$\lambda_p = \pi_L \pi_Q (C_1 \pi_T + C_2 \pi_E)$	2.1.4-1
Hybrid devices	$\lambda_p = \lambda_0 (\pi_T \times \pi_E \times \pi_Q \times \pi_F)$	2.1.7-1
Transistors group I general purposes	$\lambda_p = \lambda_0 (\pi_E \times \pi_A \times \pi_Q \times \pi_{Q2} \times \pi_C)$	2.2.1-1
Transistors group II field effect transistors	$\lambda_p = \lambda_0 (\pi_E \times \pi_A \times \pi_Q \times \pi_C)$	2.2.2-1
Transistors group III unijunction	$\lambda_p = \lambda_0 \times \pi_E \times \pi_Q$	2.2.3-1
Diodes, group IV general purpose	$\lambda_p = \lambda_0 (\pi_E \times \pi_Q \times \pi_A \times \pi_{Q2} \times \pi_C)$	2.2.4-1
Diodes, group V zeners	$\lambda_p = \lambda_0 (\pi_E \times \pi_A \times \pi_Q)$	2.2.5-1
Diodes, group VI thyristors	$\lambda_p = \lambda_0 \times \pi_Q \times \pi_E$	2.2.6-1
Diodes, group VII microwave detectors and mixers	$\lambda_p = \lambda_0 \times \pi_E \times \pi_Q$	2.2.7-1
Diodes, group VIII varactor step recovery tunnel	$\lambda_p = \lambda_0 \times \pi_E \times \pi_Q$	2.2.8-1
RCR and RC insulated fixed composition	$\lambda_p = \lambda_0 \times (\pi_E \times \pi_R \times \pi_Q)$	2.5.1-1
RLR, RL, RNR, RN fixed film insulated	$\lambda_p = \lambda_0 \times (\pi_E \times \pi_R \times \pi_Q)$	2.5.2-1
RD/P power film	$\lambda_p = \lambda_0 \times (\pi_E \times \pi_R \times \pi_Q)$	2.5.2-5
RBR and RB fixed wire wound	$\lambda_p = \lambda_0 \times (\pi_E \times \pi_R \times \pi_Q)$	2.5.3-1
RWR and RW power type fixed wire wound	$\lambda_p = \lambda_0 \times (\pi_E \times \pi_R \times \pi_Q)$	2.5.3-3
RER and RE power type, chassis mounted fixed wire wound	$\lambda_p = \lambda_0 \times (\pi_E \times \pi_R \times \pi_Q)$	2.5.3-5
RTH bead and disc type thermistors	Read direct from Table	2.5.4-1
RTR and RT variable lead screw activated wire wound	$\lambda_p = \lambda_0 \times (\pi_E \times \pi_R \times \pi_Q \times \pi_V)$	2.5.5-1
RR precision wire wound potentiometers	$\lambda_p = \lambda_0 \times \pi_{TAPS} \times \pi_Q (\pi_R \times \pi_V \times \pi_C \times \pi_E)$	2.5.5-3
RA and RK (not ER) semi-precision wire wound potentiometers	$\lambda_p = \lambda_0 \times \pi_{TAPS} (\pi_R \times \pi_V \times \pi_Q \times \pi_E)$	2.5.5-7
RP high power wire wound potentiometers	$\lambda_p = \lambda_0 \times \pi_{TAPS} \times \pi_Q (\pi_R \times \pi_V \times \pi_C \times \pi_E)$	2.5.5-13
RJ non-wire wound trimmers	$\lambda_p = \lambda_0 \times \pi_{TAPS} (\pi_R \times \pi_V \times \pi_Q \times \pi_E)$	2.5.6-1
RV composition potentiometers	$\lambda_p = \lambda_0 \times \pi_{TAPS} (\pi_R \times \pi_V \times \pi_Q \times \pi_E)$	2.5.6-5
OPV paper and plastic film, Est. Rel.; CHR metallized paper, Est. Rel.; CQ& CQR paper and plastic film, ER & NON-ER	$\lambda_p = \lambda_0 (\pi_E \times \pi_Q)$	2.6.1-1
CM mica molded; CMR mica dipped, Est. Rel.	$\lambda_p = \lambda_0 (\pi_E \times \pi_Q)$	2.6.2-1

Table SA2.11 Continued

Type device	Applicable equation	MIL-HDBK-217B 9/20/74 page reference
CB button mica	$\lambda_p = \lambda_D (\pi_E) (\pi_Q)$	2.6.2-3
CYR glass capacitors, Est. Rel.	$\lambda_p = \lambda_D (\pi_E \times \pi_{CV} \times \pi_Q)$	2.6.3-1
CK ceramic, general purpose; CKR ceramic, general purpose, Est. Rel.	$\lambda_p = \lambda_D (\pi_E \times \pi_Q)$	2.6.4-1
CC ceramic, temperature compensating	$\lambda_p = \lambda_D (\pi_E) (\pi_Q)$	2.6.4-5
CSR solid tantalum electrolytic, Est. Rel.	$\lambda_p = \lambda_D (\pi_E \times \pi_{GR} \times \pi_Q)$	2.6.5-1
CLR nonsolid tantalum, Est. Rel.; CL nonsolid tantalum, NON Est. Rel.	$\lambda_p = \lambda_D (\pi_E \times \pi_Q)$	2.6.5-3
CU aluminum oxide electrolytic	$\lambda_p = \lambda_D (\pi_E) \times \pi_Q$	2.6.6-1
CE aluminum, dry electrolyte	$\lambda_p = \lambda_D (\pi_E) \times \pi_Q$	2.6.6-3
CV variable ceramic capacitors	$\lambda_p = \lambda_D (\pi_E) \times \pi_Q$	2.6.7-1
PC variable, piston type tubular trimmer	$\lambda_p = \lambda_D (\pi_E) \times \pi_Q$	2.6.8-1
Transformers	$\lambda_p = \lambda_D (\pi_E \times \pi_F)$	2.7-1
Motors high speed	$\lambda_p = (\lambda_E + \lambda_W) \pi_E$	2.8.1-1
Blowers	$\lambda_p = \lambda_E + \lambda_W$	2.8.2-1
Relays	$\lambda_p = \lambda_D (\pi_E \times \pi_C \times \pi_{CYC} \times \pi_F)$	2.9-1
Switches, snap-action toggle or pushbutton	$\lambda_p = \lambda_D (\pi_E \times \pi_C \times \pi_{CYC})$	2.10-1
Basic sensitive switches	$\lambda_p = \lambda_D (\pi_E \times \pi_{CYC})$	2.10-2
Rotary, ceramic or glass wafer silver alloy contacts	$\lambda_p = \lambda_D (\pi_E \times \pi_{CYC})$	2.10-3
Connectors	$\lambda_p = \lambda_D (\pi_E \times \pi_F) + N \lambda_{CYC}$	2.11-1

NOTE: — π_Q multiplier same as for JAN Class C when Table SA5.1 screening is conducted

SA3 Maximum Smoke Alarm Failure Rates

SA3.1 The overall failure rates for the alarm shall not be greater than as indicated in Table SA3.1.

Table SA3.1
Smoke alarm failure rates

Method of failure rate computation	Maximum alarm failure rate (failures per million hours)
Parts count	3.5
Parts stress analysis	4.0
Screening burn-in	4.0
Published reliability data	4.0
Any combination of above	Lower failure rate number

SA4 General

SA4.1 The evaluation and criteria for acceptance of microelectronic devices consists of a two part procedure:

- Part I consists of a quality assurance screening program either by the component vendor or detector manufacturer, to assure uniformity of production.
- Part II includes a determination of a failure rate for the device supplemented by a one time burn-in test.

SA4.2 Although this program is oriented primarily to custom integrated circuit "chips," it is also applied for other microelectronic devices.

SA4.3 Components that comply to the requirements of this program shall be distinctively marked for identification purposes. The detector manufacturer shall maintain on file, accessible to an inspector, copies of the purchase and shipping orders for all alarms and "chips" so that a comparison of the tally of alarms shipped to the quantity of screened devices procured from the component vendor is able to be performed.

SA5 Quality Assurance Screening Program

SA5.1 The following minimum screening program (see Table SA5.1) is to be established by either the component manufacturer (vendor) or the alarm manufacturer. When the screening program is conducted by the component manufacturer, each lot or shipment to the alarm manufacturer is to be accompanied by a certificate of compliance with the Quality Assurance Screening Program.

SA5.2 The test methods and conditions referenced in Table SA5.1 are based on MIL-STD-883B dated July 31, 1977 and its most current revisions.

Table SA5.1
Minimum screening program

Hermetic packages	
1. Internal visual (Method 2010.1, condition B modified)	100 percent ^a
2. Bond strength (Method 2011)	Sample basis ^a
3. Stabilization bake (Method 1008C, 150°C, 24 hours)	100 percent ^b
4. Temperature cycling (Method 1010C, minus 55°C to 150°C, 10 cycles)	100 percent ^c
5. Seal (fine leak, Method 1014B, 5x10 ⁻⁸ CC/sec)	100 percent ^d
6. Seal (gross leak – 1014B fluorocarbon)	100 percent
7. Functional electrical, 25°C	100 percent
8. External visual, Method 2009	100 percent
9. Quality conformance	AQL 1.5 percent per MIL-STD 105 Level II
a) Functional electrical, 25°C [Run last, after b), c), and d)] b) Temperature cycling (Method 1010C, minus 55°C to 150°C, 10 cycles) c) Seal (Fine leak, Method 1040B, 5x10 ⁻⁸ CC/sec) ^e d) External visual, Method 2009	
Plastic packages	
1. Internal visual (Method 2010.1, condition B modified)	100 percent ^a
2. Bond strength (Method 2011)	Sample basis ^a
3. Temperature cycling (Method 1010C, minus 55°C to 150°C, 10 cycles)	100 percent ^{c,f}

Table SA5.1 Continued

Hermetic packages	
4. Functional electrical test, 25°C	100 percent
5. External visual, Method 2009	100 percent
6. Quality conformance	AQL 1.5 percent per MIL-STD 105 Level II
a) Functional electrical test, 25°C [run last, after b) and c)] b) Temperature cycling (Method 1010C, minus 55°C to 150°C, 10 cycles) c) External visual, Method 2009	
^a Modified procedures or sample lot sizes are to be submitted for review. ^b Stabilization bake is not required when the production process includes equivalent conditioning. ^c Thermal Shock, Method 1011.1, Condition B or C, is not prohibited as a substitute. ^d Reduced to 1.5 percent AQL when vendor's first lot of 25,000 units shows statistical justification. ^e Not required when justified by the reject rate in item 5. ^f Not required when the sample lot used in the burn-in test is subjected to 100 cycles of the temperature cycling and no devices fail as a result of the temperature cycling. The manufacturer shall then perform an annual audit of the device package type. A method of performing This audit is by choosing samples from the same package type and subjecting them to the Temperature Cycling or Thermal Shock (Methods 1010C or 1011.1, Conditions B or C, MIL-STD-883D, April 9, 1979). Records shall be maintained for inspection.	

SA6 Determination of Failure Rate Number Supplemented by Burn-In Test

SA6.1 General

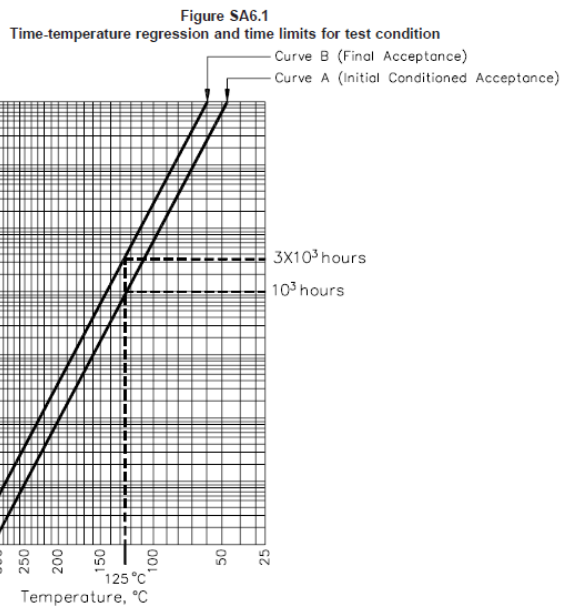
SA6.1.1 The objective of this part is to determine a numerical failure rate for the device to be employed in the overall reliability calculation of the alarm. The method employs Arrhenius calculations and activation energy tables to correlate elevated temperature operation to a failure rate of 38°C (100°F) (maximum installation ambient temperature of the alarm).

SA6.2 Determination sequence

SA6.2.1 The following step-by-step procedure is to be employed in determining the failure rate number:

- Estimate numerical failure rate.
- Choose test temperature for acceptance test.
- Using chosen test temperature, refer to curves in Figure SA6.1 to determine related test time for initial conditional acceptance and final acceptance.
- Using the equation in SA6.5.1 and the initial conditioning test time determined in (c) calculate the failure rate of the device for conditional acceptance.
- Sample lot size to be used in temperature test is determined from Table SA6.1. This table lists initial sample lot sizes based on expected failure rates in percent per 1000 hours at a 60 percent confidence level and number of devices that fail during the test, the latter listed as accept numbers. When a different temperature is employed, lot sizes are derived from a table of Summation of Terms of Poisson's Exponential Binomial Limit^a a 60 percent confidence level.
- Using the Arrhenius equation and the final test time determined in (c), calculate the failure rate of the device for final acceptance.

^aReliability Handbook by W. Grant Ireson



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Table SA6.1
Sample lot size for burn-in test

Accept number (C)	Failure rate — percent per 1000 hours															
	0.10	0.15	0.20	0.30	0.70	1.00	1.50	2.00	3.00	4.00	5.00	6.00	7.00	8.00	10.00	12.00
0	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
1	11	12	15	18	22	27	31	36	44	54	66	81	100	125	160	200
2	15	17	21	26	31	39	48	59	73	90	110	135	170	215	280	360
3	20	22	27	34	40	50	62	77	96	120	150	185	235	295	390	510
4	27	30	36	45	54	67	83	102	128	160	200	250	315	395	520	690
5	32	35	42	53	63	79	99	125	155	195	245	305	385	485	630	840
6	36	40	48	60	73	91	113	140	175	220	275	340	425	540	700	930
7	41	45	54	68	83	103	128	158	195	245	305	375	465	585	760	1010
8	45	50	60	76	93	115	143	175	215	265	325	395	490	615	800	1070
9	50	56	67	84	103	128	160	195	240	295	360	435	535	665	870	1160
10	55	62	75	93	115	143	175	215	260	315	380	455	555	685	910	1220
11	60	68	82	101	125	155	190	230	280	335	400	480	580	710	950	1280
12	65	74	89	109	135	165	200	240	290	345	410	490	590	720	970	1320
13	70	79	95	116	145	175	210	250	300	355	420	500	600	730	990	1360
14	75	85	102	124	155	185	220	260	310	365	430	510	610	740	1010	1420
15	80	91	109	132	165	200	240	280	330	385	450	530	630	760	1040	1480

SA6.3 Test calculations and procedures

SA6.3.1 Figure SA6.1 illustrates basic curves which represent burn-in test conditions of a device of 1000 hours for initial conditional acceptance and is continued to 3000 hours for final acceptance when tested at an elevated temperature of 125°C (251°F).

SA6.3.2 It is not prohibited that the elevated test temperature and related time periods (using the illustrated curves) be increased or decreased except the minimum chosen temperature for the burn-in test shall not be less than 100°C (212°F).

SA6.3.3 The following examples illustrate the use of the curves in Figure SA6.1 for calculations of final and initial conditional acceptance at temperatures other than 125°C (251°F):

a) Example 1 – Assuming a test temperature of 150°C (302°F):

1) Time for Initial Conditional Acceptance– 167 hours (using Curve A).

2) Time for Final Acceptance – 650 hours (using Curve B).

b) Example 2 – Assuming a test temperature of 100°C (212°F):

1) Time for Initial Conditional Acceptance– 5700 hours (using Curve A).

2) Time for Final Acceptance – 25,000 hours (using Curve B).

SA6.4 Test conditions

SA6.4.1 Appropriate sockets or other mounting means shall be provided to make firm electrical contact to the terminals of devices under test in the specified circuit configuration. The mounting means shall be constructed so that they do not remove internally dissipated heat from the device by conduction, other than that removed through the device terminals and the required electrical contacts, which shall be maintained at or above the specified ambient temperature. The apparatus is to provide for maintaining the specified biases at the terminal of the device under test and, when specified, monitoring of the input excitation. When the device incorporates on board elements which directly drive such things as the smoke alarm horn, battery pulse test or beacon LED of a photoelectric smoke alarm, these shall be pulsed during the test for a number of cycles equivalent to the operation life of the intersection of curve B, Figure SA6.1, with the 38°C (100°F) line.

SA6.4.2 Power supplies and current-setting resistors shall be capable of maintaining the specified operating conditions, as minimal throughout the testing period with normal variations in their source voltages, and ambient temperatures. The test equipment is preferably to be arranged so that only natural convection cooling of the devices occurs. When test conditions result in significant power dissipation, the test apparatus is to be arranged so as to result in the average power dissipation for each device whether devices are tested individually or in a group. The test circuits are not required to compensate for normal variations in individual device characteristics and shall be arranged so that the existence of failed or abnormal (for example open, or short) devices in a group does not negate the effect of the test for other devices in the group.

SA6.5 Failure rate number calculation

SA6.5.1 The following equation is to be used in determining the initial conditional and final failure rates for the device in concert with the burn-in test. Extrapolations are made from the chosen elevated test temperature to the 38°C (100°F) smoke detector operating condition by use of the Arrhenius Equation. in which:

$$\lambda = A_e \left(\frac{-E}{kT} \right)$$

λ is the failure rate per million hours

A is the constant

E is the activation energy in electron volts (ev) (varies between 0.65 ev to 1.1 ev for a large number of integrated circuits). Documentation shall be provided to support value employed.

When documentation is not provided, value of 0.65 ev is to be used.

K is Boltzman's constant (8.62×10^{-5} ev/°K).

T is the absolute temperature in degrees Kelvin.

Example:

a) Numerical failure rate $\lambda_2 = 0.1$ Failure per 10^6 hours.

b) Test ambient temperature is 125°C (257°F).

c) Required test time from Figure SA6.1 for conditional acceptance is 1000 hours and for final acceptance is 3000 hours.

d) Using the equation in SA6.5.1 and assuming an Activation Energy (E) of 0.65 ev, the following calculations are performed:

$$\lambda_1 = A_e \left(\frac{-E}{kT} \right) \text{ for } 125^\circ\text{C}$$

$$\lambda_2 = A_e \left(\frac{-E}{kT} \right) \text{ for } 38^\circ\text{C}$$

Then:

$$\frac{\lambda_1}{\lambda_2} = \ln^{-1} \left[\frac{-E}{K} \left(\frac{1}{T_1} - \frac{1}{T_2} \right) \right]$$

in which:

λ_2 is 0.1 failure per 10^6 hours

E is 0.65 eV

K is 8.62×10^{-5} eV/°K

T_1 is 398°K

T_2 is 311°K

Then

$$\lambda_1 = \lambda_2 \ln^{-1} \left[\frac{-0.65}{8.62 \times 10^{-5}} \left(\frac{1}{398} - \frac{1}{311} \right) \right]$$

in which:

λ_1 is 20×10^{-6} failures/hour.

λ_1 is 20 failures/ 10^6 hour.

λ_1 is 0.02 failure/1000 hour.

λ_1 is 2.0 percent/1000 hour.

e) Referring to Table SA6.1, the following sample lot size for the appropriate Accept Number (C – the number of failures or less), is usable at the conditional acceptance point (1000 hours). For 2.0 percent/1000 hours:

C = 0 N = 47

C = 1 N = 109

C = 2 N = 155

From the equation and Table SA6.1, with no failures from a sample lot size of 47 at a test ambient of 125°C, the failure rate is 0.1 Failure/ 10^6 hours at the conditional acceptance point of 1000 hours. It is possible for the failure rate to be less at the final acceptance point of 3000 hours.

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APPENDIX A

Standards for Components

Standards under which components of the products covered by this standard are evaluated include the following:

Title of Standard – UL Standard Designation

Control Units and Accessories for Fire Alarm Systems – UL 864

Flexible Cord and Fixture Wire – UL 62

Fuseholders, Class CC – UL 4248-4

Fuseholders, Class G – UL 4248-5

Fuseholders, Class H – UL 4248-6

Fuseholders, General Requirements – UL 4248-1

Motors, Overheating Protection for – UL 2111

Plastic Materials for Parts in Devices and Appliances, Tests for Flammability of – UL 94

Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape – UL 510

Printed-Wiring Boards – UL 796

Switches, Snap, General-Use – UL 20

Transformers, Low Voltage, General Purpose – UL 5085-2

Transformers, Low Voltage, General Requirements – UL 5085-1

Tubing, Extruded Insulating – UL 224

Wire Connectors – UL 486A-486B

Wires and Cables, Thermoplastic-Insulated – UL 83

Wires and Cables, Thermoset-Insulated – UL 44