UL 539

STANDARD FOR SAFETY

Single and Multiple Station Heat Alarms

UL Standard for Safety for Single and Multiple Station Heat Alarms, UL 539

Eighth Edition, Dated June 23, 2022

Summary of Topics

This revision of ANSI/UL 539 dated January 14, 2025 includes alignment of Maximum Ambient Temperature of Heat Alarms with NFPA 72: Table 7.1 and 7.2A.

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated November 1, 2024.

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CAN/ULC 589:2025
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ULSE Inc.
ANSI/UL 539
Eighth Edition

Standard for Single and Multiple Station Heat Alarms

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ANSI/UL 539-2025

NATIONAL STANDARD OF CANADA
STANDARDS COUNCIL OF CANADA
CONSEIL CANADIEN DES NORMES
NORME NATIONALE DU CANADA

Commitment for Amendments

This Standard is issued jointly by ULSE Inc. (ULSE) and ULC Standards. Amendments to this Standard will be made only after processing according to the Standards writing procedures by ULSE and ULC Standards.

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Comments or proposals for revisions on any part of the Standard may be submitted at any time. Proposals should be submitted via a Proposal Request in the On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com/.

This ANSI/UL Standard for Safety consists of the Eighth Edition including revisions through January 14, 2025.

The most recent designation of ANSI/UL 539 as an American National Standard (ANSI) occurred on January 14, 2025. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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PERFORMANCE

Preface

This is the common ULSE and ULC Standard for Single and Multiple Station Heat Alarms. It is the First edition of CAN/ULC 589, and the Eighth edition of ANSI/UL 539.

This common Standard was prepared by ULSE Inc., ULC Standards, and the Joint ULSE/ULC Task Group. The efforts and support of the Joint Task Group are gratefully acknowledged.

This Standard was formally approved by the ULC Standards Committee on Fire Alarm And Life Safety Equipment And Systems and ULSE Technical Committee on Smoke Detectors and Alarms.

Only metric SI units of measurement are used in this Standard. If a value for measurement is followed by a value in other units in parentheses, the second value may be approximate. The first stated value is the requirement.

In Canada, there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

Annexes A and C, are identified as normative, forms mandatory parts of this Standard.

Annexes B and D, identified as informative, is for informational purposes only.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

Level of Harmonization

This Standard is published as an identical standard between ULSE and ULC Standards. An identical standard is a standard that is the same in technical content except for conflicts in Codes and Governmental Regulations. Presentation shall be word for word except for editorial changes.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard shall be based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision shall be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

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INTRODUCTION

1 Scope

1.1 These requirements cover heat-actuated, single and multiple station heat alarms intended for indoor installation in accordance with:

a) In Canada:

1) The National Building Code of Canada,

2) The National Fire Code of Canada,

b) In the United States:

3) The National Fire Alarm and Signaling Code, NFPA 72

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this standard shall comply with the requirements for that component.

2.2 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.

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

2.4 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.

3 Units of Measurement

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

4 Referenced Publications

4.1 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.

4.2 The following publications are referenced in this Standard:

ASTM International

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*

ASTM MNL 12, *Manual on the Use of Thermocouples in Temperature Measurement*

Binational

CSA C22.2 No. 153/UL 310, *Electrical Quick-Connect Terminals*

CSA Group

CSA 22.1, *Canadian Electrical Code, Part I, Safety Standard for Electrical Installations*

CSA C22.2 No. 0.17, *Evaluation of Properties of Polymeric Materials*

CSA C22.2 No. 65, *Standard for Wire Connectors*

CSA C22.2 No. 158, *Terminal Blocks*

Department of Defense

MIL-STD-1916, *DoD Preferred Methods for Acceptance of Product*
(MIL STD 105, *Sampling Procedures and Tables for Inspection by Attributes)*

MIL-HDBK 217F, *Reliability Prediction of Electronic Equipment*
(MIL-HDBK 217B, *Reliability Prediction of Electronic Equipment)*

MIL-STD 750E, *Test Methods for Semiconductor Devices*

MIL-STD 883H, *Test Methods Standard Microcircuits*
(MIL-STD 883K, *Test Methods Standard Microcircuits)*
(MIL-STD 883D, *Test Methods Standard Microcircuits)*
(MIL-STD 883B, *Test Methods Standard Microcircuits)*

IEC

IEC 61000-4-5, *Electromagnetic Compatibility (EMC) Part 4-5: Testing and Measurements Techniques – Surge Immunity Test*

NFPA

NFPA 70, *National Electrical Code*

NFPA 72, *National Fire Alarm and Signaling Code*

NRCC

National Building Code of Canada

National Fire Code of Canada

UL Standards

UL 94, *Tests for Flammability of Plastic Materials for Parts in Devices and Appliances*

UL 486A-486B, *Wire Connectors*

UL 486E, *Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors*

UL 746E, *Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used in Printed Wiring Boards*

UL 1059, *Terminal Blocks*

5 Glossary

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

5.2 ALARM SIGNAL – An audible signal that lasts at least two complete cycles of the temporal pattern to indicate an emergency fire condition.

5.3 COMPONENT, LIMITED LIFE – A component that is expected to fail and be periodically replaced and whose failure is supervised when failure of the component affects the intended operation, heat sensitivity, or both. Typical examples of such components include incandescent lamps, electronic tube heaters, functional heating elements, and batteries. See also Component Failure, 28.4.

5.4 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 and determined for a “Ground Fixed” (GF) environment by MIL-HDBK 217F, or equivalent.

5.5 HEAT ALARM, SINGLE STATION – A self-contained fire alarm device comprising of a heat sensor, an alarm sounding device, and a stored energy source (wound spring or battery) incorporated in one integral package.

5.6 LOW BATTERY TROUBLE POINT – Any combination of battery voltage and series resistance that results in an audible trouble signal from a battery-operated alarm.

5.7 MANUFACTURER'S PUBLISHED INSTRUCTIONS – Published installation and operating documentation provided for each product or component. The documentation includes directions and necessary information for the intended installation, maintenance, and operation of the product or component.

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5.8 MECHANICALLY-OPERATED-TYPE – A heat alarm having a temperature sensitive bimetal or eutectic element and a spring-wound-type mechanism with clapper mounted within a bell housing. The snap action of the bimetal or melting of the eutectic element releases the spring mechanism resulting in a bell-type sound.

5.9 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 milliampere.

5.10 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 min of operation or

b) A power of more than 15 watts is deliverable into an external resistor connected between the two points.

5.11 TROUBLE SIGNAL – A visible or audible signal intended to indicate a fault or trouble condition.

5.12 UNCONDITIONED AREA – Enclosed spaces without continuous climate controls where an individual spends time. (Examples include attached garages, crawl spaces and attics associated with a family living unit, cottages and cabins with combustible fuel appliances and/or fireplaces, barns, etc.)

5.13 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 extra-low-voltage circuit.

6 Manufacturer's Published Instructions

6.1 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 heat alarm. For this purpose, a printed edition is not required.

6.2 The manufacturer's published instructions shall include directions and information deemed by the manufacturer to be required for proper and safe installation, testing, maintenance, operation, and use of the heat alarm.

7 Temperature Classification

7.1 Single and multiple station heat alarms are classified as to their temperature of operation. See Table 7.1.

Table 7.1
Temperature Classifications

Temperature classification	Rating range °C	(°F)
Low	46 – 57	(115 – 134)
Ordinary	57 – 79	(135 – 174)
Intermediate	79 – 107	(175 – 225)

7.2 The maximum rating of a heat alarm shall not exceed 107 °C (225 °F).

7.2A The maximum installation temperature of a heat alarm shall be a minimum of 11.1 °C (20 °F) below its operating temperature rating.

8 Alarm Reliability Prediction (Electrically-operated)

8.1 The maximum failure rate for heat alarm units shall be 4.0 failures per million hours as calculated by a full part stress analysis prediction as described in of MIL-HDBK 217F or 3.5 failures per million hours as calculated by a simplified parts count reliability prediction as described in MIL-HDBK 217F, 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.

8.2 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.

8.3 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 heat alarm.

8.4 A custom integrated circuit used in a heat 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.

9 Batteries

9.1 General

9.1.1 When a battery or set of batteries is used as the main source of power of a single or multiple station heat alarm, it shall comply to the requirements of the Battery Tests, Section 66.

9.1.2 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.

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

9.1.4 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.

9.1.5 Connections of external wiring to a battery-operated single or multiple-station heat 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.

9.2 Battery connections

9.2.1 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.

9.2.2 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 6.6 N (1.5 lb) 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.

9.2.3 Each lead of a clip-lead assembly used as part of a battery operated alarm shall be a minimum of 22 AWG (0.32 mm^2) stranded wire with a minimum 0.4 mm (1/64 in) insulation.

9.3 Battery removal/deactivation indicator

9.3.1 Removal of a battery from a battery-operated (or AC with battery back-up) heat alarm shall result in a readily apparent and prominent indication. The indication shall consist of at least one of the following:

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;

c) A swing-out or pull-out battery compartment that is resistant to being closed unless it has a battery in place;

d) An audible or audible and tactile trouble signal on an AC powered smoke alarm with battery back-up;

e) An arrangement to render the unit resistant to reinstallation; or

f) A local audible, local audible and tactile, or local visual indication at the control panel.

9.3.2 When a warning flag, or equivalent, is employed to comply with the requirement of 9.3.1, it shall be marked as required in 73.2, Marking.

CONSTRUCTION

10 Mounting

10.1 A heat alarm shall be provided with a means for mounting either to a ceiling or wall.

10.2 The means for mounting shall not result in any distortion of the heat alarm that alters its operating characteristics.

MECHANICALLY OPERATED HEAT ALARMS

(Note: These requirements apply specifically to mechanically-operated alarms only)

11 Calibration

11.1 Any means for calibration or adjustment shall be guarded or sealed to reduce the risk of manipulation by hand or ordinary tools. A thermal responsive element adjustment, if provided as part of a unit, shall not be adjustable after shipment from the factory.

11.2 A calibration means is considered to be not accessible or apparent when it is not showing, not exposed to manipulation by conventional tools, or not readily displaced. The complete concealment of conventional tool-engaging means in a screw, such as a slot and a recessed head, by the use of solder or brazing material is considered to prevent manipulation if the calibration means cannot be changed by gripping with conventional tools and engagement or manipulation is prevented.

12 Materials

12.1 Diaphragms and spring parts shall be made of nonferrous material, such as phosphor bronze, nickel, silver, or of ferrous materials. If ferrous materials are used, they shall be hermetically sealed or plated to protect against corrosion.

12.2 A heat sensing element, provided that it is used as the operating member of a heat alarm, shall be protected against conditions it is likely to be exposed to when in service, as represented by the tests described in Sections 25 – 71 of this standard.

12.3 All exposed parts whose required performance can be impaired by corrosion shall be protected by enameling, galvanizing, sherardizing, plating, or other means determined to be equivalent.

13 Operating Mechanisms

13.1 The moving parts of a heat alarm shall have sufficient play at bearing surfaces to protect against binding.

13.2 A gear train driving spring shall be securely anchored at each end. The spring winding means shall be provided with a positive stop to limit the winding or shall withstand the maximum force likely to be applied without impairing the operation of the mechanism.

14 Mechanical Assembly

14.1 Any servicing or restoration operations intended to be made by the user shall be simple and capable of being accomplished with ordinary hand tools.

14.2 A heat alarm shall be so constructed that parts will not become displaced during or after installation.

14.3 An obstruction means, such as a wire mesh screen, shall be provided to protect against the entry of foreign bodies or materials into sounding devices that could prevent their operation. The maximum size of the openings shall be 3.2 mm (1/8 in). The obstruction means is to be attached securely in place. See the Vibration Test, Section 38.

15 Power Supervisory Feature

15.1 A means shall be provided on a unit to automatically indicate that operating power is not available. The indication may be in the form of a flag, target, sight glass, change in mounting position of the heat alarm, or other means determined to be equivalent.

ELECTRICALLY OPERATED HEAT ALARMS

16 Remote Accessories

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

17 Supplementary Signaling Features

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

18 Servicing and Maintenance Protection

18.1 General

18.1.1 An uninsulated live part of a high-voltage circuit and hazardous moving parts within the enclosure shall be located, guarded, or enclosed to reduce the risk of accidental contact by persons performing service functions with the equipment energized.

18.1.2 Manual switching devices may be located or oriented with respect to uninsulated live parts or hazardous moving parts so that manipulation of the mechanism can be accomplished in the normal direction of access if uninsulated live parts or hazardous moving parts are not located in front (in the direction of access) of the mechanism, or not located within 150 mm (5.9 in) of any side or behind the mechanism, unless guarded.

18.1.3 In determining compliance with 18.1.2 only uninsulated live parts in circuits above 30 Vrms shall be considered.

18.1.4 An electrical component that requires examination, replacement, adjustment, servicing, or maintenance with the alarm energized shall be located and mounted with respect to other components and 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 or unintended contact to adjacent hazardous moving parts.

18.1.5 Other arrangements of location of components and/or guarding shall be also acceptable where electrical components are accessible for service as indicated by 16.1, Remote accessories.

18.1.6 The following shall not be considered uninsulated live parts:

a) Coils of controllers, relays, and solenoids, and transformer windings, when the coils and windings are provided with insulating overwraps;

b) Enclosed motor windings;

c) Terminals and splices with suitable insulation and

d) Insulated wire.

18.2 Sharp edges

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

19 Enclosure

19.1 General

19.1.1 The enclosure of a heat 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.

19.1.2 Enclosures for individual electrical components, outer enclosures, and combinations of the two shall be evaluated in determining compliance with the requirement of 19.1.1.

19.1.3 All electrical parts of a heat 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.

19.1.4 The enclosure of a heat 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.

19.1.5 When the heat alarm 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.

19.2 Cast metal enclosures

19.2.1 The thickness of cast metal for an enclosure shall be as indicated in Table 19.1, Cast metal enclosures. Cast metal having a thickness 0.8 mm (1/32 in) less than that indicated in Table 19.1 shall be used only when the surface under consideration shall be curved, ribbed, or otherwise reinforced, or when the shape of the surface, size of the surface, or both, are such that equivalent mechanical strength is determined to be provided.

Table 19.1
Cast-metal Enclosures

Use, or dimensions of area involved	Minimum thickness			
	Die-cast metal,		Cast metal other than die-cast,	
	mm	(in)	mm	(in)
Area of 155 cm^2 (24 square inches) or less and having no dimension greater than 152 mm (6 in)	1.6[a]	(1/16)	3.2	(1/8)
Area greater than 155 cm^2 (24 square inches) or having any dimension greater than 152 mm (6 in)	2.4	(3/32)	3.2	(1/8)
At a threaded conduit hole	6.4	(1/4)	6.4	(1/4)
At an unthreaded conduit hole	3.2	(1/8)	3.2	(1/8)

[a] The area limitation for metal 1.6 mm (1/16 in) thick may be obtained by the provision of reinforcing ribs subdividing a larger area.

19.2.2 If threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, or if an equivalent construction is used, there shall be not less than 3.5 nor more than 5 threads in the metal, and the construction shall be such that a standard conduit bushing can be properly attached.

19.2.3 If 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 3.5 full threads in the metal, and there shall be a smooth, rounded inlet hole for the conductors that shall afford protection to the conductors equivalent to that provided by a standard conduit bushing.

19.3 Sheet metal enclosures

19.3.1 The thickness of sheet metal used for the enclosure of an alarm shall not be less than that indicated in Table 19.2, Sheet metal enclosures. If sheet metal of two gauge size 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 determined to be provided.

Table 19.2
Sheet Metal Enclosures

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

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

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

19.3.4 A closure for a hole larger than 34.9 mm (1-3/8 in) diameter shall have a thickness equal to that required for the enclosure of the device or a standard knockout seal shall be used. Such plates or plugs shall be securely mounted. See 23.1.1, Mounting of components.

19.3.5 A knockout in a sheet metal enclosure shall be secured and shall be capable of being removed without undue deformation of the enclosure.

19.3.6 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, Section 24.

19.4 Nonmetallic enclosures

19.4.1 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 19.2, Sheet metal enclosures or Table 19.3, Thickness of glass covers. See also the Tests of Thermoplastic Materials, Section 60.

19.4.2 The continuity of any grounding system intended for an alarm connection shall not rely on the dimensional integrity of the nonmetallic material.

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

a) Enclosures containing parts including a risk of fire – minimum flammability rating of 5VA or V-0 and compliance with the Flame Test 127 mm (5 in) as described in 60.3.1 – 60.3.6.

b) Enclosures containing power limited circuits with a voltage not exceeding 30 volts AC, 42.4 volts-peak, or 60 volts DC – minimum flammability rating of:

1) V-2, or

2) HB and successful completion with the Flame test – 19-mm (3/4-in), as described in 60.2.1 – 60.2.6;

c) Enclosures containing 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 19 mm (3/4 in), as described in 60.2.1 – 60.2.6.

d) Enclosures containing circuits powered by batteries with energy limited to 15 watts – minimum flammability rating of HB.

19.4.4 For 19.4.3, Flammability ratings are defined in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

19.5 Ventilating openings

19.5.1 Ventilating openings in an enclosure including 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 will permit passage of a rod having a diameter of 3.6 mm (9/64 in) for circuits greater than 30 V rms (42.4 V peak). An enclosure for a fuse(s) or other overload protective device provided with ventilating openings shall afford adequate protection against the emission of flame or molten metal. Openings provided for the cleaning of internal parts shall be arranged to prevent damage to functional internal components during such cleaning operations. For units equipped with a cover, the requirements of this paragraph apply with the cover open for circuits greater than 30 V rms (42.4 V peak).

19.5.2 Except as noted in 19.5.3, perforated sheet metal used for expanded metal mesh shall not be less than 1.0 mm (0.039 in) in average thickness, 1.2 mm (0.047 in) when zinc coated.

19.5.3 When the indentation of the guard enclosure does not alter the clearance between uninsulated live parts and grounded metal so as to reduce spacings below the minimum values required, 0.5 mm (0.02 in) expanded metal mesh or perforated sheet metal 0.61 mm (0.024 in) when zinc coated can be used under the following conditions:

a) The exposed mesh on any one side or surface of the product has an area of not more than 465 cm^2 (72 in^2) and has no dimension greater than 305 mm (12 in) or

b) The width of an opening so protected is not greater than 88.9 mm (3.5 in).

19.5.4 The wires forming a screen protecting high-voltage current-carrying parts shall not be smaller than 16 AWG (1.3 mm^2) and the screen openings shall not be greater than 3.2 cm^2 (1/2 in^2) in area.

19.6 Covers

19.6.1 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 for silencing an audible signal device or operation of any other component of a heat alarm that requires such action in connection with its intended performance.

Exception: This requirement does not apply to the battery replacement aspect of a heat alarm employing a battery as the main or standby supply.

19.6.2 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.

19.6.3 When a heat 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 19.6.3 (bb) for supplementary marking.

Exception: These requirements do not apply when the heat 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.

19.6.4 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" « MISE EN GARDE » and the following or equivalent marking is located on the cover of an alarm employing high-voltage circuits: "Circuit Fuse(s) Inside – Disconnect Power Prior To Servicing" « Fusible(s) à L'intérieur – Déconnecter avant de procéder à L'entretien ».

19.6.5 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.

19.7 Glass panels

19.7.1 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 19.3, Thickness of Glass Covers.

19.7.2 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 become a fire hazard or distort and