

UL 521

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Heat Detectors for Fire Protective Signaling Systems

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UL Standard for Safety for Heat Detectors for Fire Protective Signaling Systems, UL 521

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New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Recognition and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover heat detectors for fire protective signaling systems intended to be installed in ordinary indoor and outdoor locations in accordance with the Standard for Automatic Fire Detectors, NFPA 72E.

1.2 Heat detectors covered by these requirements employ either normally open contacts or normally closed contacts, provide an electronic signal, or consist of a heat-sensitive cable. The requirements do not cover heat detectors for journal-alarm or unit-alarm devices.

1.3 Deleted October 3, 2002

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 generally 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. Heat detectors may combine two or more of the following characteristics in one device, such as a fixed-temperature, a spot-type capable of repeated operation, or a rate-of-rise type also employing a fixed-temperature element.

3.2 COMPONENT, LIMITED-LIFE – A component that is expected to fail and be periodically replaced and the failure of which is supervised, if failure of the component affects the intended operation, sensitivity, or both. Typical examples of such components include incandescent lamps, electronic tube heaters, and functional heating elements.

3.3 COMPONENT, RELIABLE – An electrical 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 fewer failures per million hours as determined for a "Ground Fixed" (GF) environment by MIL-HDBK 217B, or equivalent (see Supplement SA).

3.4 ELECTRONIC-TYPE HEAT DETECTOR – A device that uses electronic circuitry to respond to an abnormal high temperature or rate of temperature rise.

3.5 FIXED-TEMPERATURE TYPE HEAT DETECTOR – A device that will respond when its operating element becomes heated to a predetermined level. The temperature of the air surrounding the device at the moment of operation will vary, depending on the rate at which the temperature is rising.

3.6 HEAT DETECTOR – A device that detects an abnormal high temperature or rate of temperature rise.

3.7 HEAT-SENSITIVE CABLE – A line-type device whose sensitive element comprises two current-carrying wires held separated by a heat-sensitive insulation that softens at the rated temperature, thus allowing the wires to make electrical contact.

3.8 LINE-TYPE HEAT DETECTOR – A device in which detection is continuous along a path.

3.9 NONRESTORABLE HEAT DETECTOR – A device whose sensing element is intended to be destroyed by the process of detecting a fire.

3.10 RATE-COMPENSATION HEAT DETECTOR – A device that will respond when the temperature of the surrounding air reaches the predetermined level, regardless of the rate of temperature rise.

3.11 RATE-OF-RISE HEAT DETECTOR – A device that will respond when the temperature rises at a rate exceeding a predetermined amount.

3.12 RESTORABLE HEAT DETECTOR – A device whose sensing element is not destroyed during intended service by the processes of detecting a fire. Restoration may be manual or automatic.

3.13 SELF-RESTORING HEAT DETECTOR – A restorable detector whose sensing element is intended to be returned to normal automatically.

3.14 SPOT-TYPE HEAT DETECTOR – A device whose detecting element is concentrated at a particular location.

3.15 TWO-WIRE DETECTOR – A detector that signals over and obtains its power from the initiating device circuit of a fire alarm system control unit. Additional terminals or leads may be provided for annunciation or control of supplementary functions.

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4 Installation and Operating Instructions

4.1 A copy of the installation and operating instructions and related schematic wiring diagrams and installation drawings shall be used as a guide in the examination and test of the detector. For this purpose, a printed edition is not required. The information may be included in a manual or technical bulletin.

4.2 The instructions and drawings shall include such directions and information as deemed by the manufacturer to be necessary for installation, testing, maintenance, operation, and use of the detector.

5 Compatibility Information

5.1 General

5.1.1 Compatibility between a two-wire electronic heat detector that receives its power from the initiating device circuit of a fire alarm system control unit is dependent upon the interaction between the circuit parameters, such as voltage, current, frequency, and impedance, of the detector and the initiating device circuit.

5.1.2 A detector that does not receive its power from the initiating device circuit of a control unit (conventionally a detector having four or more wires for field connection or a heat detector with dry contacts) may be employed with any electrically compatible fire alarm system control unit without the need for compatibility consideration as its connection does not impose any load on the initiating circuit. Under an alarm condition, the four-wire detector acts as a switch (similar to a manual station) to place the system in alarm.

5.1.3 As a two-wire detector obtains its power from the initiating device circuit of a system control unit, its operation is dependent on the characteristics of the circuit to which it is connected as the detector imposes a resistive and capacitive load on the circuit. Similarly, the load imposed upon the initiating circuit by a connected detector must not prevent alarm response by a control unit to a detector in alarm, nor prevent a trouble response to an open circuit after the last detector.

5.1.4 The connection of a two-wire electronic heat detector is restricted to the specific control units with which a compatibility evaluation has been made.

5.1.5 A supplementary signaling device [such as an audible appliance, relay, or annunciator lamp (LED)] that is integral with a two-wire heat detector and that is also powered from an initiating device circuit of a fire alarm system control unit shall not be used if its operation, including level of audibility and light output, is inhibited by the operation limitation of the initiating device circuit.

5.2 Method of evaluation

5.2.1 In accordance with 5.1.1 – 5.1.5, to determine whether any combination of control unit and electronic heat detector or detectors is compatible, whether the detectors are the same model or a mixture of one or more models or types, the tests indicated in (a) and (b) are to be conducted:

a) The Dynamic Load Immunity Test, Section 41.

b) The Two-Wire Smoke Detector Compatibility Tests in the Standard for Control Units for Fire-Protective Signaling Systems, UL 864.

For the test in (b), a load representing the maximum number of detectors intended to be connected to the control unit initiating device circuit, whether one model or a mixture of several models, is to be employed.

5.3 Changes affecting compatibility

5.3.1 To maintain compatibility integrity after installation of a compatible combination that can be affected by replacement detectors or a modification of either the detectors or the control unit, the product that is changed shall be assigned a different model number, or change in compatibility identification marking.

5.3.2 A compatibility identifier marking consists of any six-digit or less alphanumeric combination, such as a date code, part number, model number, or the like used to identify the latest revision that has not resulted in a new model number, but that impacts compatibility.

6 Temperature Designation

6.1 Heat detectors of the fixed-temperature spot type are designated according to temperature of operation as indicated in Table 6.1.

Table 6.1
Temperature rating

Temperature rating	Temperature rating range,	
	°F	(°C)
Low	100 – 134	37.8 – 56.7
Ordinary	135 – 174	57.2 – 78.9
Intermediate	175 – 249	79.4 – 120.6
High	250 – 324	121 – 162.2
Extra High	325 – 399	163 – 203.8
Very Extra High	400 – 499	204 – 259.4
Ultra High	500 – 575	260 – 302

6.2 Low-degree rated heat detectors apply only to self-restoring type detectors. Low-degree heat detectors are intended only for installation in controlled ambient conditions, such as in a computer room.

CONSTRUCTION

GENERAL

7 Mounting

7.1 A heat detector shall be provided with means for mounting.

7.2 The mounting means shall be electrically insulated from current-carrying parts of the device.

7.3 The intended means of mounting shall not result in any distortion of the device so as to alter the operating temperature adjustment.

7.4 A heat detector shall be supported independently of its connection to the installation wiring.

8 Servicing and Maintenance Protection

8.1 The thermoresponsive element adjustment shall not be capable of being readjusted after shipment from the factory. The means for calibration, if accessible or apparent, shall be modified, guarded, or sealed such that the means for calibration are not subject to manipulation by hand or ordinary tools subsequent to the factory calibration.

8.2 A calibration means is considered 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, recessed head, and the like, 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 at all other locations.

8.3 An uninsulated live part of a high-voltage circuit and moving parts that can cause risk of injury to persons within the enclosure shall be located, guarded, or enclosed to reduce the risk of unintentional contact by persons performing service functions that may be performed with the equipment energized.

8.4 An electrical component that may require examination, adjustment, servicing, or maintenance while energized shall be located and mounted with respect to other components and with respect to grounded metal parts so that it is accessible for service without subjecting the user to a risk of electric shock from adjacent uninsulated live parts.

9 Materials

9.1 If a sealing compound is used, its melting point shall be at least 15°F (8.3°C) higher than the temperature rating of the thermostat, but not less than 149°F (65°C).

9.2 Diaphragms and spring parts shall be made of a nonferrous material such as phosphor bronze, nickel silver, or the equivalent. If ferrous materials are employed, they shall be hermetically sealed or plated so as not to be affected by corrosion.

9.3 A fusible alloy, if used as the operating member of a heat detector, shall not be affected by the conditions to which it will be exposed in service, as represented by the tests described in the Performance section of this standard.

9.4 All exposed parts that could be affected by corrosion shall be protected by enameling, galvanizing, sherardizing, plating, or equivalent means.

9.5 Polymeric materials of a detector shall be constructed to resist the abuses likely to be encountered in service. The degree of resistance to abuse inherent in the detector shall preclude total or partial collapse with the attendant reduction of spacings, loosening or displacement of parts, and other serious defects, which alone or in combination result in an increase in the risk of fire, electric shock, or injury to persons.

FIELD-WIRING CONNECTIONS

10 Leads

10.1 If wire leads are used in lieu of wiring terminals, the leads shall not be smaller than No. 18 AWG (0.82 mm²). The leads shall not be less than 6 inches (152 mm) in length, shall be provided with strain relief, and shall employ a minimum 1/32-inch (0.8-mm) wall of insulation, or the equivalent. A separate lead shall be provided for each incoming and outgoing wire of a spot-type heat detector having normally open contacts. For a heat sensitive cable, the stripped ends of each wire shall be used for field connections. See 12.2.1.

11 Terminals

11.1 A wire binding screw shall not be smaller than No. 6 (3.5 mm diameter) for connection of not more than one No. 14 AWG (2.1 mm²) or smaller conductor. A terminal screw intended for connection of a conductor larger than No. 14 AWG shall not be smaller than No. 8 (4.2 mm diameter).

11.2 A terminal plate tapped for a wire binding screw shall be of metal not less than 0.050 inch (1.27 mm) thick for a No. 8 (4.2 mm diameter) or larger screw, not less than 0.030 inch (0.76 mm) thick for a No. 6 (3.5 mm diameter) screw and shall have not less than two full threads in the metal.

Exception: A terminal plate may have the metal extruded at the tapped hole for the binding screw so as to provide two full threads. Other constructions may be employed if they provide equivalent strength.

11.3 A wire binding screw shall thread into metal.

11.4 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 will be prevented from turning or shifting in position if such motion may result in reduction of spacings below the minimum required values. See Spacings – Electrical, General, Section 14. This may 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.

11.5 In a heat detector of the normally open-contact type, a separate terminal screw shall be provided for each incoming and outgoing wire.

COMPONENTS – ELECTRICAL

12 General

12.1 Insulating material

12.1.1 Material for the support of live parts shall be nonflammable and moisture-resistant insulating material such as porcelain, phenolic or cold-molded composition, or other material determined to comply with requirements for the support of live parts.

12.1.2 The insulation of coil windings of relays, transformers, and the like shall resist the absorption of moisture.

12.2 Current-carrying parts

12.2.1 A current-carrying part shall be of a non-ferrous metal such as silver, copper, or copper alloy.

12.2.2 Electrical parts of a heat detector rated more than 30 volts shall be located or enclosed so as to reduce the risk of unintentional contact with uninsulated live parts.

12.2.3 Live screwheads or nuts on the underside of an insulating base intended for surface mounting shall be countersunk not less than 1/8 inch (3.2 mm) and shall be covered with a sealing compound.

Exception: If such parts are staked, upset, or prevented from loosening by an equivalent means, they may be insulated from the mounting surface by material other than sealing compound.

13 Contacts

13.1 A heat detector having normally closed contacts and intended for fire alarm service shall be capable of being used in conjunction with a system control unit, transmitter, or similar system component by which its alarm operation is indicated, so that an open-circuit fault in the heat detector circuit will not result in an alarm signal. This does not apply to heat detectors employed for releasing-device service where opening of the circuit results in operation of the releasing device, as in the case of fire doors and dampers.

13.2 If the heat detector operates by making contact (not by fusing) between metal parts, there shall be a wiping, scraping, or spring action between the parts unless the contact is made in a tightly closed housing that will prevent fouling by dust.

13.3 If contacts are not of the fusible or mercury type, the contacts shall have tips of silver, gold, or other material having similar conductivity and durability.

SPACINGS – ELECTRICAL

14 General

14.1 The spacings in a heat detector shall not be less than those indicated in Table 14.1. These values apply to the spacings between any uninsulated live part and:

- a) An uninsulated live part of opposite polarity,
- b) A metal enclosure including attached metal pieces and fittings for wiring connections,
- c) An uninsulated grounded metal part other than the enclosure, and
- d) The plane of the heat detector mounting surface.

14.2 Enamel insulated wire is considered to be the same as an uninsulated live part in determining compliance with the spacing requirements.

14.3 If a short circuit between uninsulated live parts of the same polarity would affect the intended signaling operation of the device, the spacing between such parts shall be not less than that required by 14.1.

Table 14.1
Minimum spacings

Point of application	Voltage range	Minimum spacings ^{a,b}			
		Through air,		Over surface,	
		inch	(mm)	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	0 – 30	1/32	0.8	1/32	0.8
Over 100 volt-amperes	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 used where spacings would otherwise be 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 may be used 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 will not be adversely affected by arcing. Insulating material having a thickness less than that specified may be used if it is determined to be suitable 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 No. 16 AWG (1.3 mm²).

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

^d Spacings less than those indicated, but not less than 1/64 inch (0.4 mm), are acceptable 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).

PERFORMANCE

GENERAL

15 Test Units and Data

15.1 General

15.1.1 Heat detectors that are fully representative of production units are to be used for each of the following tests unless otherwise specified. The temperature and sensitivity settings provided on the samples for testing will define the production temperature ratings and sensitivities.

15.2 Component reliability data

15.2.1 Data on detector components, for example, capacitors, resistors, solid-state devices, and the like shall be provided for evaluation of the components for the intended application. If a Mil-Spec. is referenced, a copy of the specification is to be provided for review.

15.2.2 The data required by 15.2.1 shall include the following or equivalent information:

- a) General description of the detector manufacturer's quality assurance (QA) program. This data shall include incoming inspection and screening, in-process quality assurance, burn-in data, and testing. This applies to complete and partial assemblies as well as individual components.
- b) Component Fault Analysis. Effect of failure, open and short, of capacitors and limited life components on operation of a detector.
- c) Maximum supplier's ratings for each component as well as the actual maximum operating values (voltage and current) in the detectors.
- d) A description of component screening and burn-in test data for solid-state devices or integrated circuits that operate at greater than the limits described in note b of Table 38.1.
- e) General calibration procedure of test instruments employed by the manufacturer in the calibration of a detector.
- f) A general description of the circuit operation under standby, alarm, and trouble conditions.

15.3 Miscellaneous data

15.3.1 The following information shall be provided:

- a) Identification of all the insulating, thermoplastic, and metallic materials in the construction of each detector to be tested;
- b) Mounting position and spacing allocation desired for the detector;
- c) Rate of temperature rise setting for a rate-of-rise type heat detector;
- d) Final form of marking to be applied and its location;

e) Description of the oven to be used by a manufacturer in conducting the manufacturing and production tests at the factory; and

f) Special applications for a low-degree rated heat detector.

15.3.2 Electronic heat detectors shall be provided with a control panel, monitoring instrument, or equivalent to monitor operation of the detector.

16 Test Voltages

16.1 Unless specifically noted otherwise, the test voltage at rated frequency of a heat detector shall be as specified in Table 16.1.

Table 16.1
Test voltages

Nameplate voltage rating ^a	Test voltage ^b
110 to 120	120
220 to 240	240
Other	Marked nameplate rating
^a The voltage rating shall be applied at the voltage waveform(s) specified in the markings.	
^b Detectors rated at frequencies other than 60 hertz are to be tested at their rated nameplate voltage and frequency.	

17 Test Samples

17.1 The samples specified in Table 17.1 are to be provided for testing.

Table 17.1
Test samples

Type detector	Rating	Number of samples or footage
Electronic	Low and ordinary degree	25
	Each additional rating	15
Fixed temperature	Low and ordinary degree	
	Non resettable	50
	Resettable	25
	Each additional rating	15
Rate-of-rise	Each sensitivity setting	55
Combination FT and ROR	Each fixed temperature rating	15
	Each rate-of-rise sensitivity setting	55
Heat sensitive cable	Each temperature rating	250-foot

18 Sensitivity-Spacing Allocation

18.1 Installation spacing limitations of a heat detector shall be developed by tests in the testing oven or by fire tests. See the Oven Test, Section 19, and the Fire Test, Section 20.

18.2 The sensitivity of a heat detector is expressed in terms of spacing limitations. Spacing limitations refer to the maximum distance permitted between heat detectors mounted on smooth ceilings at a specific height. See 20.2.

18.3 Low-degree rated and ordinary-degree rated heat detectors shall be sufficiently sensitive to qualify for at least a 15-foot (4.57-m) spacing limitation. Only low-degree rated and ordinary-degree rated heat detectors shall be employed in determination of spacings. Spacing limitations for intermediate-degree and higher rated heat detectors are based on spacings obtained for the highest ordinary-degree rating within the subgroup shown in Table 18.1.

Table 18.1
Heat detectors

Temperature rating	Temperature rating range, °F (°C)	Maximum installation temperature, °F (°C)	Temperature range subgroups – °F (°C)			
			Group A	Group B	Group C	Group D
Low	100 – 134 (37.8 – 56.7)	20°F (11.1°C) below rating	100 – 108 (37.8 – 42.2)	109 – 117 (42.8 – 47.2)	118 – 126 (47.8 – 52.2)	127 – 134 (52.8 – 56.7)
Ordinary	135 – 174 (57.2 – 78.9)	100 (37.8)	135 – 144 (57.2 – 62.2)	145 – 154 (62.8 – 67.8)	155 – 164 (68.3 – 73.3)	165 – 174 (73.9 – 78.9)
Intermediate	175 – 249 (79.4 – 120.6)	150 (65.6)	175 – 194 (79.4 – 90)	195 – 214 (90.6 – 101.1)	215 – 234 (101.7 – 112.2)	235 – 249 (112.8 – 120.6)
High	250 – 324 (121 – 162.2)	225 (107.2)	250 – 269 (121 – 131.7)	270 – 289 (132.2 – 142.8)	290 – 309 (143.3 – 153.9)	310 – 324 (154.4 – 162.2)
Extra High	325 – 399 (163 – 203.8)	300 (148.9)	325 – 344 (163 – 173.3)	345 – 364 (173.9 – 184.4)	365 – 384 (185 – 195.6)	385 – 399 (196.1 – 203.8)
Very Extra High	400 – 499 (204 – 259.4)	375 (190.6)	400 – 424 (204 – 217.8)	425 – 449 (218.3 – 231.7)	450 – 474 (232.2 – 245.6)	475 – 499 (246.1 – 259.4)
Ultra High	500 – 575 (260 – 302)	475 (246.1)	500 – 519 (260 – 270.6)	520 – 539 (271.1 – 281.7)	540 – 559 (282.2 – 292.8)	560 – 575 (293.3 – 302)

18.4 Low-degree rated and ordinary-degree rated heat detectors with spacings of 15 feet (4.57 m) may be tested for sensitivity in the testing oven described in 19.4 – 19.11. If the device does not operate within 2 minutes, the Fire Test, Section 20, is to be conducted.

18.5 A heat detector does not comply if it fails to qualify for a 15-foot (4.57-m) spacing; for example, does not operate:

- a) Within 2 minutes in the Oven Test, Section 19, when subjected to the maximum temperature exposure attaining 205°F (96.1°C) or
- b) When subjected to the Fire Test, Section 20.

TESTS

19 Oven Test

19.1 A heat detector that operates in 2 minutes or less when subjected to the time-temperature condition shown by Figure 19.1 is eligible for a 15-foot (4.57-m) installation spacing. Heat detector samples shall be uniform in operation when mounted in the same position. They shall be tested in each of the different positions permitted by the design. Operation is considered uniform if the heat detectors operate within the applicable temperature range indicated in the tabulation under the Operating Temperature Test, Section 22. See Table 22.1.

19.2 Performance under this time-temperature condition is to be studied to determine the responsiveness of the device, its uniformity, and its qualifications for a 15-foot (4.57-m) spacing. The spacing limitation is to be based upon the performance with the samples located in the least favorable position on the sample-mounting panel.

19.3 To verify uniform performance of a heat detector, the test is to be repeated four times using a different sample for each test, but each of the five samples is to be installed on the sample-mounting panel in the same position. Depending upon the construction of the heat detector, it may be necessary to repeat the oven tests with test samples rotated 90 degrees and 180 degrees from the original test position.

19.4 The testing oven is to consist of an oval stainless steel container approximately 31 inches (787 mm) long and 10 inches (254 mm) wide by 16 inches (406 mm) high, made of material with a minimum thickness of 0.108 inch (2.74 mm). One of the curved end sections is to be hinged. See Figure 19.2.

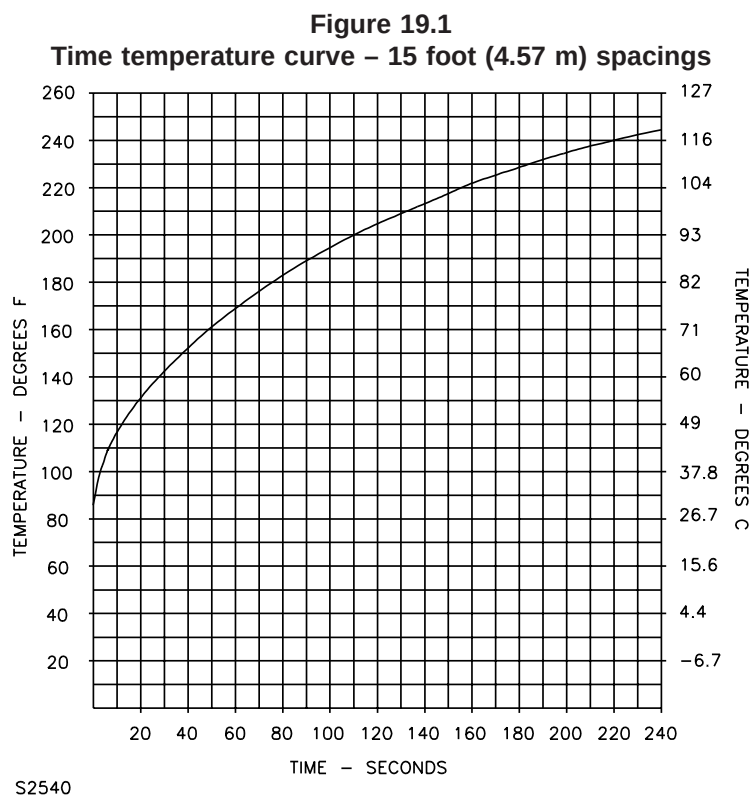
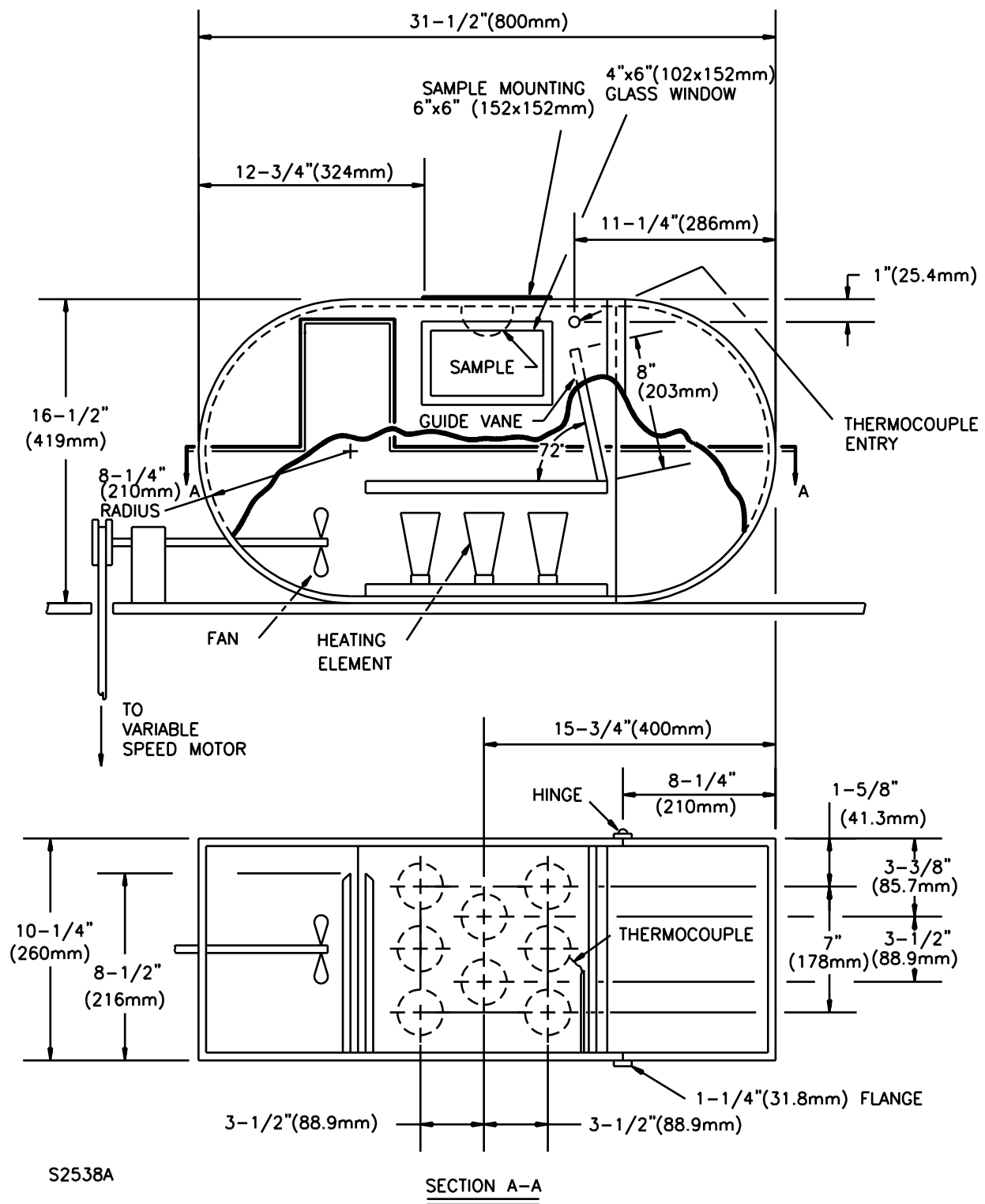


Figure 19.2
Heat detector testing oven



19.5 A section 6 by 6 inches (152 by 152 mm) at the top is to be fitted with a removable wooden cover. The heat detectors to be tested are mounted one at a time on this cover.

19.6 Two glass windows, 4 by 6 inches (102 by 152 mm) in size, are to be provided in the sides of the oven for observation of the samples under test.

19.7 The interior of the oven is to be divided horizontally by a baffle over the heater chamber located in the central lower section. One end of the horizontal baffle is to be joined to a guide vane extending upward at an angle of 72 degrees into the oven chamber. The vane is to direct the air currents to ensure greater uniformity of temperature in the oven.

19.8 Eight 1000-watt cone-shaped heating coils threaded into Edison-base lampholders are to furnish the heat. They are to be connected so that six of the heating coils are controlled by means of a data acquisition and control instrument. The other two heating coils are for supplying additional heat when necessary.

19.9 An air current through the bank of heaters is to be created by means of a four-blade 5-inch (127-mm) fan located behind the heating coils and connected to a shaft that extends to the outside of the oven. A variable-speed motor is to be mounted on a bracket inside the lower cabinet and is to operate the fan through a pulley and belt arrangement. The speed of the motor is to be adjusted and the pitch of the fan blades is to be such that the velocity of the air current is 230 – 245 feet per minute (1.17 – 1.24 m/s) over the sample under test.

19.10 Temperatures are to be measured by means of a type J thermocouple inserted through a tube extending to the inside of the test chamber, located in the same plane as the device under test, on the upstream side. The air velocity is to be measured prior to testing by a velometer inserted in the oven at a point approximately 1-1/4 inches (31.8 mm) from the top of the oven in the same location as the heat detector. The velocity is to be measured with the detector removed.

19.11 The time and temperature build-up during the test is to be monitored and controlled by a data acquisition and control instrument.

19.12 In certain devices, variations in operation are possible with the device installed in different positions with respect to the direction of air flow. In such cases, the sensitivity or spacing designation is to be determined from data obtained in tests with the device mounted in the least favorable position.

19.13 For heat sensitive cable a 3-foot (0.91-m) length, concentrically wound in a coil having a maximum diameter of 4 inches (102 mm), is to be used.

19.14 Preparation for test consists of mounting the heat detector on the small removable wooden panel. Conduit-fitting mountings are to be accommodated on a special panel provided with a 3 by 3 inch (76.2 by 76.2 mm) conduit box fitted into the panel. Flush-mounted devices employ a plain wood panel. The test sample is to remain in the oven at least 5 minutes prior to the start of each test run.

19.15 Wire connections are to be made between the terminals or leads of the heat detector and an indicating circuit consisting of an incandescent lamp connected to a 6-volt direct current (dc) source or the equivalent. The lamp current is to be approximately 50 milliamperes under closed circuit conditions.

19.16 After installation in the oven, the heat detector is to be subjected to the time-temperature condition illustrated in Figure 19.1. Oven temperature at the start of the test is to be 85 – 90°F (29.4 – 32.2°C).

19.17 Upon operation of the heat detector, the current applied to the bank of heaters is to be cut off and the oven is to be cooled to room temperature by use of the external cooling fan.

20 Fire Test

20.1 To qualify for an installation spacing by fire tests, four highest ordinary-degree rated and four highest low-degree rated heat detectors installed in the least favorable position as determined from the Oven Test, Section 19, and at the intended spacing, shall operate within 130 seconds. The temperature profile of the fire is to be monitored by a type J thermocouple located at the 10-foot (3.05-m) spacing, 7 inches (178 mm) below the ceiling, and on the same diagonal as the detectors. The temperature profile shall be within the limits shown in Figure 20.1. At least two trials are to be conducted.

20.2 Fire tests are to be conducted in a 60 by 60 foot (18.3 by 18.3 m) test room with a smooth ceiling at a height of 15 feet, 9 inches (4.80 m). The heat detectors are to be installed at their designated spacings in line with the sprinkler and fire test pan. See Figure 20.2 for the layout.

20.3 The fire tests are to be produced by burning denatured alcohol consisting of 190 proof ethanol to which 5 percent methanol has been added as a denaturant in steel pans of a size necessary to produce a temperature rise within the limits shown in Figure 20.1. Since temperature conditions in a test room may vary throughout the year, it is necessary to use different pan sizes in order to obtain the intended temperature-rise condition. This test condition develops a time-temperature curve similar to the 15-foot (4.57-m) spacing curve shown by Figure 19.1.

20.4 The fire tests are to be conducted to develop information regarding the operating time of the heat detectors when installed at their recommended spacing schedule as compared with the operating time of automatic sprinklers installed on a standard 10 by 10 foot (3.05 by 3.05 m) spacing schedule. Operation of the heat detectors within 130 seconds will qualify the device for the spacing on which it was installed.

20.5 For a heat sensitive cable, a 20-foot (6.1-m) length is to be installed on the ceiling to form a 90-degree angle, with two legs, each 10 feet (3.05 m) long located at 90 degrees. The fire source is to be located at a 45-degree angle from the point of intersection of the two legs.