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STANDARD for SAFETY

FIRE-DETECTION THERMOSTATS

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NOTE

Approval as an American National Standard covers the Requirements section, which consists of pages 6 to 22, inclusive, dated June 19, 1970. Future revisions of the Standard will be made by issuing revised or additional pages bearing their dates of issue. Pages dated June 19, 1970 should not be discarded when revised or additional pages are issued if it is desired to retain the approved text. Changes made subsequent to June 19, 1970 are not included in the approval.

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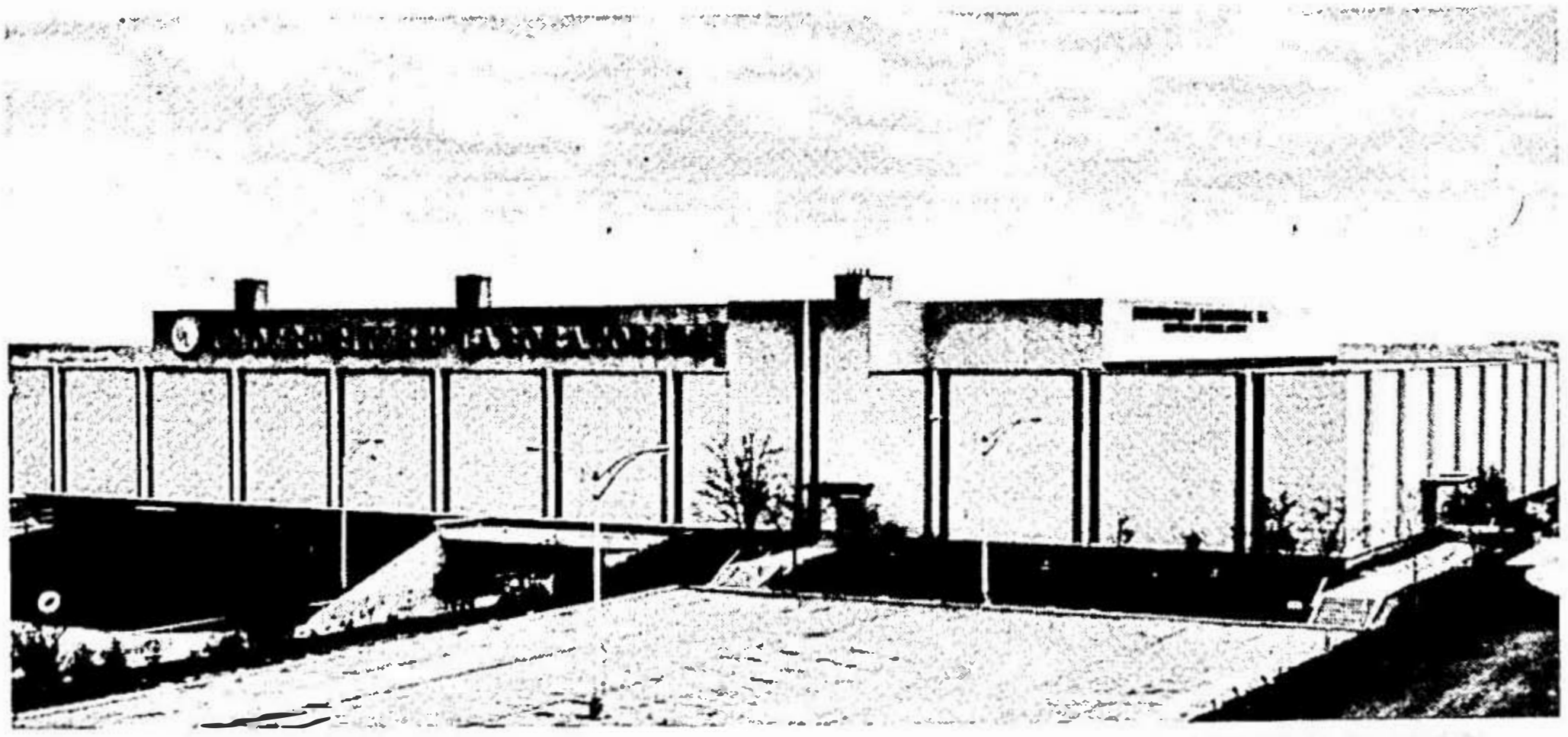

NORTHBROOK, ILLINOIS

UNDERWRITERS' LABORATORIES, INC.

AN INDEPENDENT NOT-FOR-PROFIT ORGANIZATION
TESTING FOR PUBLIC SAFETY

Underwriters' Laboratories, Inc., founded in 1894, is chartered as a not-for-profit organization without capital stock, under the laws of the State of Delaware, to establish, maintain, and operate laboratories for the examination and testing of devices, systems, and materials.

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An enumeration of all the Laboratories' Standards is given in a catalog of "Standards for Safety" and in each of the following publications:

Electrical Construction Materials List
Electrical Appliance and Utilization Equipment List
Hazardous Location Equipment List
Fire Protection Equipment List
Building Materials List
Gas and Oil Equipment List
Accident, Automotive, and Burglary Protection Equipment Lists
Marine Products List
Classified Products Index
Supplement to Lists and Indexes

A copy of the current issue of any of the above-mentioned publications may be obtained upon request.

OFFICES AND TESTING STATIONS

207 East Ohio Street, Chicago, Ill. 60611
333 Pfingsten Road, Northbrook, Ill. 60062
1655 Scott Boulevard, Santa Clara, Calif. 95050
1285 Walt Whitman Road, Melville, L.I., N.Y. 11746
2602 Tampa East Blvd., Tampa, Fla. 33619

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STANDARD

FOR

FIRE-DETECTION THERMOSTATS

FOREWORD

A. This Standard represents the judgment of Underwriters' Laboratories, Inc. as to the basic requirements for the construction and performance of the products to be listed under this classification. 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 listing of the manufacturer's product under this classification. Underwriters' Laboratories, Inc., however, assumes no responsibility for the effect of such observance or nonobservance by the manufacturer upon the relations between the manufacturer and any other party or parties arising out of the sale or use of the product or otherwise.

C. A product which complies with these requirements will not necessarily be acceptable if, when examined and tested, it is found to have other features which impair the result contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in these requirements may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be given recognition.

E. Many tests required by the Standards of Underwriters' Laboratories, Inc. are inherently hazardous. Underwriters' Laboratories, Inc. neither assumes nor accepts any responsibility for any injury or damage that may occur during or as the result of tests, wherever performed, whether performed in whole or in part by the manufacturer, and whether or not any equipment, facility, or personnel for or in connection with the test is furnished by the manufacturer.

REQUIREMENTS

SCOPE

1. These requirements cover fire-detection thermostats to be employed in ordinary indoor locations in accordance with the following Standards of the National Fire Protection Association:

NFPA No. 71
Central Station Protective Signaling Systems

NFPA No. 72A
Local Protective Signaling Systems

NFPA No. 72B
Auxiliary Protective Signaling Systems

NFPA No. 72C
Remote Station Protective Signaling Systems

NFPA No. 72D
Proprietary Protective Signaling Systems

NFPA No. 74
Household Fire Warning Systems

2. The thermostats covered by these requirements employ either normally open contacts or normally closed contacts. The requirements do not cover thermostats for journal-alarm nor unit-alarm devices.

GLOSSARY

3. The following definitions apply for the purposes of this Standard. Fire-detection thermostats may combine two or more of the following characteristics in one device, such as a fixed-temperature, spot-pattern type capable of repeated operation, or a rate-of-rise type also employing a fixed-temperature element.

Principles of Operation

4. A **fixed-temperature** type thermostat is designed to operate when the temperature of the thermoresponsive element reaches a predetermined value. 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.

5. A **rate-of-rise** type thermostat is designed to operate when the rate of temperature rise in the air surrounding the device reaches and maintains a predetermined value.

6. A **rate-compensation** type thermostat is designed to operate when the surrounding air reaches the predetermined temperature setting of the device at any rate of temperature rise.

Physical Configurations

7. A **spot-pattern** type thermostat is one in which the thermoresponsive element is a compact unit of small area.

8. A **line-pattern** type thermostat is one in which the thermoresponsive element is continuous along a line.

Operational Characteristics

9. A **self-restoring** thermostat is one capable of repeated operation. The sensing element returns automatically to the normal condition after cooling.

10. A **non-self-restoring** thermostat is so constructed that either the entire thermostat or the sensing element must be replaced when once operated.

Temperature Classification

11. Thermostats of the fixed-temperature spot-pattern type are classified as to temperature of operation as follows:

Temperature Classification	Temperature Rating Range, Degrees F	Maximum Ceiling Temperature, Degrees F	Color Code
Ordinary	135 to 170	100	Uncolored
Intermediate	175 to 225	150	White
High	250 to 300	225	Blue
Extra High	325 to 375	300	Red
Very Extra High	400 to 475	375	Green
Ultra High	500 to 575	475	Orange

CONSTRUCTION DETAILS

Mounting

12. A thermostat shall be provided with means for mounting.

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

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

15. A thermostat shall be supported independently of its connection to the installation wiring.

Adjustment

16. The thermoresponsive-element being readjusted after shipment from the factory. The means for calibration, if accessible or apparent, shall be modified, guarded, or sealed to effectively prevent manipulation by hand or ordinary tools subsequent to the factory calibration.

17. A calibration means considered to be not accessible or apparent is one not showing, one not exposed to manipulation by conventional tools, or one not readily displaced. The complete concealment of conventional tool-engaging means in a screw, such as a slot, recessed head, etc., by the use of solder or brazing material is considered adequate for the purpose of preventing manipulation so long as the calibration means cannot be changed readily by gripping with conventional tools and engagement or manipulation is prevented at all other locations.

Materials

18. If a sealing compound is used, its melting point shall be at least 15° F higher than the temperature rating of the thermostat.

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

20. A fusible alloy, if used as the operating member of a thermostat, shall be constructed so as not to be affected adversely by the conditions to which it will be exposed in service, as represented by the tests described in the Performance section of this Standard.

21. All exposed parts likely to be affected adversely by corrosion shall be protected by enameling, galvanizing, sherardizing, plating, or equivalent means.

22. A base for the support of live parts shall be of a strong, noncombustible, moisture-resistant insulating material such as porcelain, phenolic or cold-molded composition, or other material which is recognized as suitable for the support of live parts. The base shall be so constructed that it will withstand the most severe conditions liable to be met in service.

Contacts

23. A thermostat 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 thermostat circuit will not result in an alarm signal. This does not apply to thermostats employed for releasing-device service where opening of the circuit results in operation of the releasing device. Example: Fire doors, dampers, etc.

24. If the thermostat operates by making contact (not by fusing) between metal parts, there shall be a good wiping or scraping action between the parts unless the contact is made in a tightly closed housing which will prevent fouling by dust.

25. 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.

Current-Carrying Parts

26. A current-carrying part shall be of a nonferrous metal such as silver, copper, or copper alloy.

27. Electrical parts of a thermostat rated more than 30 volts shall be so located or enclosed as to afford protection to a person against accidental contact with uninsulated hazardous live parts.

28. Live screw heads or nuts on the underside of an insulating base designed for surface mounting shall be countersunk not less than ⅛ inch and shall be covered with a sealing compound; except that 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.

Terminals

29. A wire-binding screw shall be not smaller than No. 6 for connection of not more than one No. 14 Awg or smaller conductor. A terminal screw intended for connection of a conductor larger than No. 14 Awg shall be not smaller than No. 8.

30. Except as noted in the following paragraph, a terminal plate tapped for a wire-binding screw shall be of metal not less than 0.050 inch in thickness for a No. 8 or larger screw and not less than 0.030 inch in thickness for a No. 6 screw, and shall have not less than two full threads in the metal.

31. 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.

32. A wire-binding screw shall thread into metal.

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

Leads

34. If wire leads are used in lieu of terminal plates, the leads shall be not smaller than No. 18 Awg. The leads shall be not less than 6 inches in length and shall be provided with strain relief. A separate lead shall be provided for each incoming and outgoing wire.

Spacings

35. Except as noted in paragraph 37, the spacings in a thermostat shall be not less than those indicated in the following table. These values apply to the spacings between any uninsulated live-metal part and:

A. An uninsulated live-metal part of opposite polarity,

B. A metal enclosure including attached metal pieces and fittings for wiring connections,

C. An uninsulted grounded metal part other than the enclosure, and

D. The plane of the thermostat mounting surface.

Application		Minimum Spacing in Inches	
		0–150 Volts	151–300 Volts
At installation wiring terminals [a]	Through air	1/4	1/4
	Over surface	1/4	3/8
Other parts [b]	Through air	1/8	1/4
	Over surface	1/4	3/8

[a] Measured with No. 14 Awg wire connected to each terminal as in actual service.

[b] At the fixed parts of a rigidly clamped special factory-installed and -wired assembly of live parts and insulating separators (such as contact springs), the spacings may be less than those indicated, but not less than 1/16 inch for 150 volts or less and not less than 3/32 inch for 151–300 volts, through air and over surface.

36. If a short-circuit between uninsulated live-metal parts of the same polarity would affect adversely the normal signaling operation of the appliance, the spacing between such parts shall be not less than that required by paragraph 35.

37. With the following exceptions, a barrier or liner of insulating material, which is used to provide spacings, shall be of material such as impregnated fiber, phenolic composition, or the equivalent, and shall be not less than 1/32 inch in thickness

which is used in conjunction with not less than one-half the required spacing through air may be less than 1/32 inch, but shall be not less than 1/64 inch (minimum 0.013 inch) in thickness and so located that it will not be affected adversely by operation of the appliance in service, particularly arcing.

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

PERFORMANCE

Sensitivity

39. Installation spacing limitations of a thermostat shall be developed by tests in the thermostat testing oven or by fire tests. Refer to paragraphs 44–50 for the Oven Test and paragraphs 51–54 for the Fire Test.

40. Ordinary-degree thermostats shall be sufficiently sensitive to qualify for at least a 10-foot spacing limitation.

41. The sensitivity of a thermostat is expressed in terms of spacing limitations. Spacing limitations refer to the maximum distance permitted between thermostats mounted on smooth ceilings.

42. An ordinary-degree thermostat with spacings of 15 feet or less may be tested for sensitivity in the testing oven described in paragraph 44. If the device does not operate within two minutes, fire tests are to be conducted.

43. A thermostat is not acceptable if it fails to qualify for a 10-foot spacing; i.e., does not operate within two minutes in the Oven Test when subjected to the maximum temperature exposure attaining 250° F, does not operate when subjected to fire tests, or does not operate prior to the operation of automatic sprinklers under a prescribed temperature-rise condition.

Oven Test

44. A thermostat which operates in two minutes or less when subjected to one of the time-temperature conditions shown by Figure 1 is to be rated as to installation spacings based on the time-temperature exposure to which it was subjected. Thermostat samples shall be uniform in operation when mounted in the same position. They shall be tested in each of the different positions normally permitted by the design. Operation is considered uniform if the thermostats operate within the applicable temperature tolerance indicated in the tabulation under the Operating Temperature Test.

TIME-TEMPERATURE CURVES

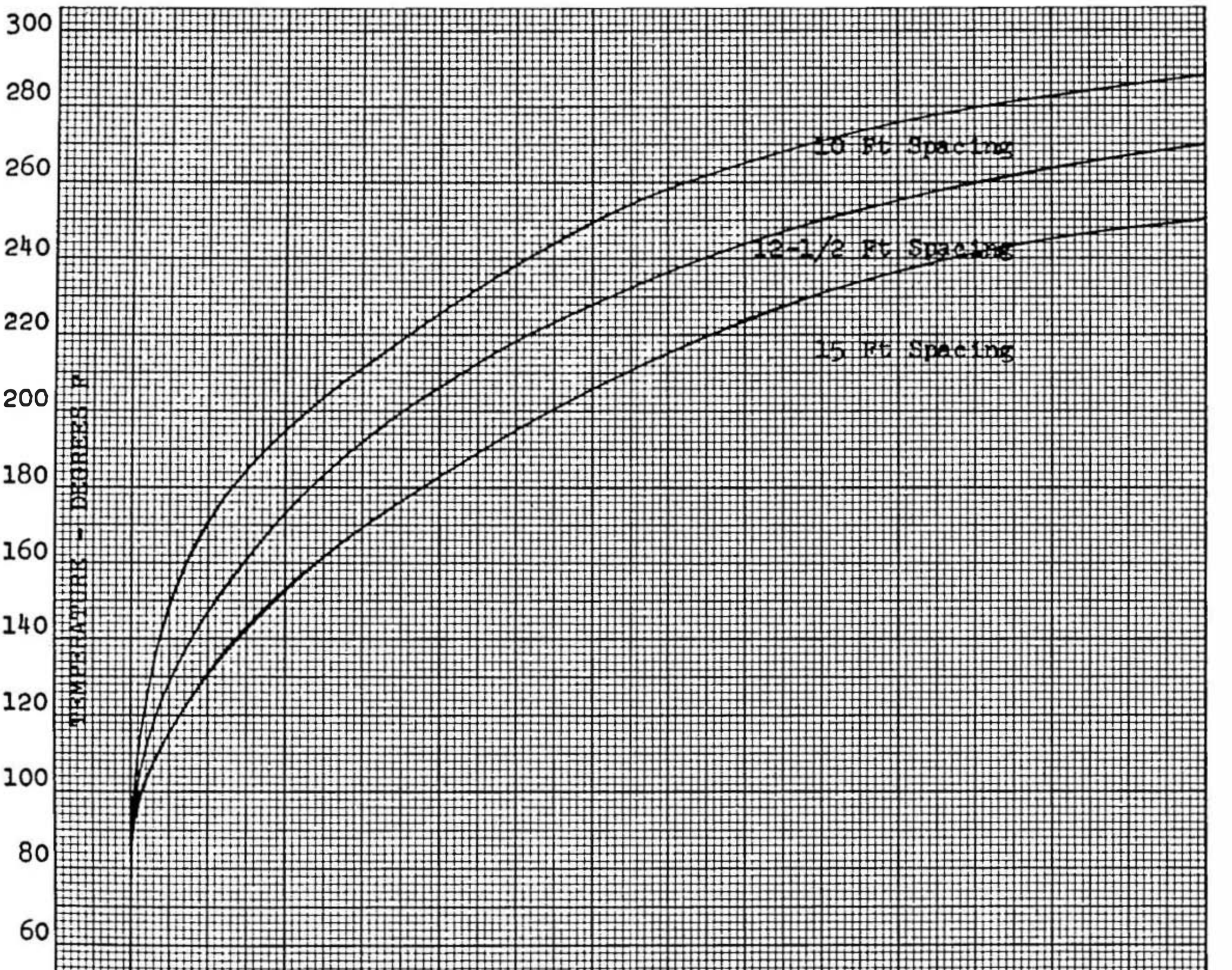

FIGURE 1

45. The test apparatus consists of an electrically heated forced circulated warm-air oven capable of producing time-temperature characteristic curves similar to those illustrated in Figure 1. Air is moved past the samples at a velocity of 230–245 feet per minute. The temperature in the oven is recorded by a thermocouple and calibrated potentiometer.

46. 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 sensitiveness or spacing classification is to be judged from data obtained in tests with the device mounted in the least favorable position.

47. The device is to be installed on the sample-mounting panel of the thermostat testing oven. Wire connections are to be made between the terminals and the indicating circuit of the testing oven.

48. Afer installation in the oven, the thermostat is to be subjected to the time-temperature conditions for 10-, 12½-, or 15-foot installation spacings illustrated by Figure 1.

49. To determine that the performance of a thermostat is uniform, 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 design of the thermostat, it may be necessary
grees and again when rotated 180 degrees from the original test position.

50. Performance under this time-temperature condition is to be studied to determine the responsiveness of the device, its uniformity, and its qualifications for a spacing limitation of 10, 12½, or 15 feet. The spacing limitation is to be based upon the performance with the samples located in the least favorable position on the sample-mounting panel.

Fire Test

51. To qualify for an installation spacing by fire tests, thermostats installed at the intended spacing shall operate prior to 160° F sprinklers installed on 10-foot spacings when both are simultaneously exposed to a controlled fire condition.

52. Fire tests are to be conducted in a 60- by 60-foot test room with a smooth ceiling at a height of approximately 15 feet 9 inches. The test room is to be equipped with automatic-sprinkler piping arranged to receive automatic sprinklers on a 10- by 10-foot spacing schedule. Sprinklers of the standard upright spray type are to be installed in the upright position with the deflectors approximately 7 inches below the ceiling, which is normal for sprinkler-piping installation. For each test, new automatic sprinklers in the ordinary-degree rating (160° F) are to be installed in the sprinkler piping. The same make sprinklers are to be utilized in all tests on thermostats. The thermostats are to be installed at their designated spacings in line with the sprinkler and fire-test pan. See Figure 2 for layout.

FIRE-TEST LAYOUT

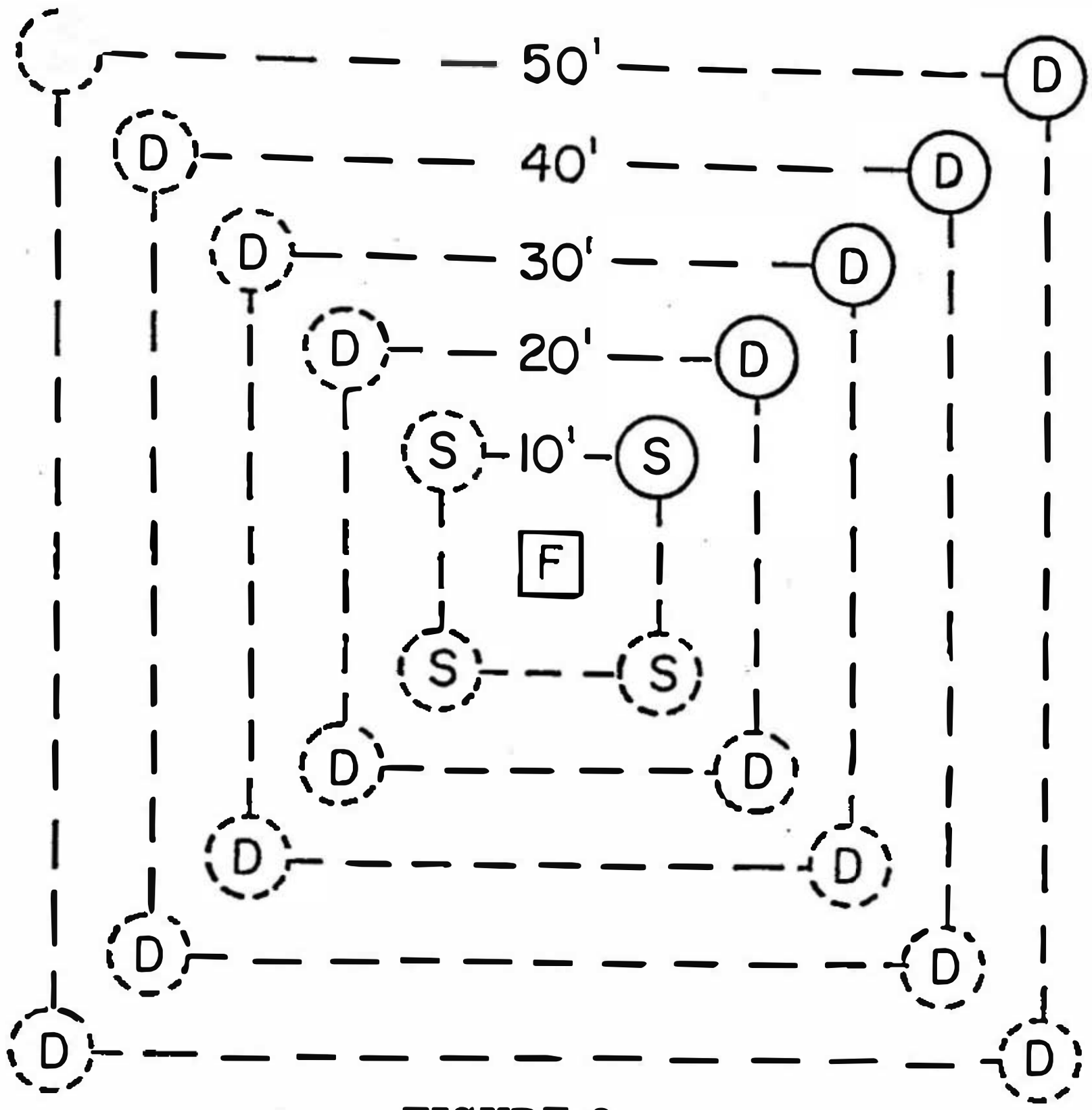

FIGURE 2

Legend:

F — Test fire, denatured alcohol, 190-proof. Pan located approximately 3 feet above floor.

S — Indicates normal sprinkler spacings on 10-foot schedules.

S — Sprinkler installed during Fire Test. Rated 160° F, standard upright spray type. Deflectors approximately 7 inches below ceiling.

D — Indicates normal detector spacing on various spacing schedules.

D — Detectors installed during Fire Test. Employed to determine maximum allowable spacing.

Test Room — 60 by 60 feet, with a 15-foot 9-inch smooth ceiling

53. The fire tests are to be produced by burning denatured alcohol consisting essentially 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 sufficient to operate the automatic sprinklers in two minutes, plus or minus 10 seconds, when installed on a 10- by 10-foot spacing schedule. Since temperature conditions in a test room may vary throughout the year, it is necessary to utilize different pan sizes in order to obtain the proper temperature-rise condition. This test condition develops a time-temperature curve similar to the 10-foot spacing curve shown by Figure 1.

54. The fire tests are to be conducted to develop information regarding the operating time of the thermostats when installed at their recommended spacing schedule as compared with the operating time of automatic sprinklers installed on a standard 10- by 10-foot spacing schedule. Operation of the thermostats prior to the sprinkler will qualify the device for the spacing on which it was installed. Since automatic sprinklers vary in their sensitivity, the particular sprinkler utilized in these tests is to be one which has average operating response under uniform temperature-rise conditions.

High-Temperature Exposure Test

55. **Thermostats shall not operate when subjected to high-temperature exposure tests, as follows, for 30 days, except that the minimum temperature differential between the thermostat rating and the test temperature shall be 10° F for the ordinary and intermediate ranges and 20° F for the high range and above.**

Temperature Classification	Temperature Rating Range, Degrees F	Test Temperature, Degrees F
Ordinary	135 to 170	125
Intermediate	175 to 225	165
High	250 to 300	240
Extra High	325 to 375	315
Very Extra High	400 to 475	390
Ultra High	500 to 575	490

56. **A thermostat shall withstand the high-temperature exposure and operate in an acceptable manner when subjected to the Rate-of-Rise Operation Test or the Operating Temperature Test, whichever is applicable.**

57. Five sample thermostats of each temperature rating are to be tested for their normal operating temperature (if capable of repeated operation), or rate-of-rise temperature, after which they are to be placed in an oven maintained at the temperature specified in paragraph 55. Connections are to be made between the devices and a power source, and means are to be provided for indicating operation of each of the devices under test.

58. The sample thermostats are to be removed from the oven after the 30-day period and allowed to remain at room temperature for 24 hours before being subjected to the Oven Test, the Operating Temperature Test, or the Rate-of-Rise Operation Test, whichever is applicable.

Corrosion Test

59. The sensitivity of fixed-temperature thermostats, after being subjected to corrosive atmospheres, shall not show a variation of more than 50 percent from the value obtained in the Oven Test on as-received samples. No false operation shall occur during the exposure. The sensitivity of thermostats operating on the rate-of-rise principle, after being subjected to corrosive atmospheres, shall not show a variation of more than 50 percent from the value obtained after being subjected to the Rate-of-Rise Operation Test on as-received samples. No false operation shall occur during the exposure to the corrosive atmospheres or at a temperature rise of 12° F per minute or less until a temperature of at least 130° F is reached (starting from a temperature of 85 to 90° F).

60. Samples of thermostats capable of repeated operation are to be tested first for sensitivity in the thermostat testing oven before the Corrosion Test. Samples of thermostats not capable of repeated operation are not to be tested for sensitivity before the Corrosion Test. Thermostats operating on the rate-of-rise principle are to be subjected to the Rate-of-Rise Operation Test before and after exposure to the corrosive atmospheres.

61. Five samples are to be exposed to salt spray (solution containing 20 percent sodium chloride by weight) at room temperature for 10 days.

62. Five samples are to be exposed to an atmosphere containing approximately one percent hydrogen sulphide by volume in air saturated with water vapor at room temperature for 10 days.

63. Five samples are to be exposed to an atmosphere containing approximately one percent sulphur dioxide and one percent carbon dioxide by volume in air saturated with water vapor at room temperature for 10 days.

64. After exposure to the corrosive atmosphere, the samples are to be removed from the test apparatus and allowed to remain in a normal atmosphere at room temperature for at least 24 hours, following which they are to be checked for sensitivity.

Operating Temperature Test

65. A fixed-temperature thermostat shall operate within the general limits, according to its rating as given in the following table, when subjected to an operating temperature test in heated water, oil, or air bath:

Rating	Operating Limits, Degrees F		Operating Tolerance, Degrees F
	Minimum	Maximum	
Ordinary	128	165	10
Intermediate	175	225	15
High	250	300	20
Extra High	325	400	20
Very Extra High	400	440	30
Ultra High	500	540	30

66. **Thermostats of any given temperature setting are expected to operate uniformly within the temperature tolerance range indicated in the above tabulation.**

67. Depending on their particular design, the thermostats are to be suspended in a water, oil, or air bath, the temperature of which is to be gradually increased at the rate of 1° F per minute until operation takes place. Each thermostat is to be individually connected through a signal lamp and current source, and the temperature of the bath at the instant of operation is to be recorded.

Vibration Test

68. **A thermostat shall be capable of withstanding vibration without false operation and without breakage or damage to the parts. All samples shall comply with the Oven Test, the Operating Temperature Test, or the Rate-of-Rise Test, whichever is applicable, following the test.**

69. Five thermostats are to be secured in a position of normal use on a mounting board and the board, in turn, securely fastened to a variable-speed vibration machine having an amplitude of 0.01 inch (total displacement of 0.02 inch). The frequency of vibration is to be varied from 10 cycles per second to 35 cycles per second in increments of 5 cycles per second until the resonant frequency is obtained. The samples are then to be vibrated at the maximum resonant frequency for a period of 4 hours. If no resonant frequency is obtained, the samples are to be vibrated at 35 cycles per second for a period of 120 hours. Each thermostat is to be individually connected to a lock-in circuit consisting of an indicating lamp and a power source as a means of indicating false operation during the test run.

70. Thermostats capable of repeated operation are to be tested first for sensitivity in the thermostat testing oven before the Vibration Test. Thermostats not capable of repeated operation are not to be tested for sensitivity before vibration. Upon completion of the Vibration Test, the samples are to be checked for sensitivity. Thermostats operating on the rate-of-rise principle are to be subjected, before and after vibration, to the Rate-of-Rise Operation Test.

71. This test is generally to be conducted only on thermostats of the ordinary-degree rating unless there is a reason to anticipate different behavior with those of other ratings.

Rate-of-Rise Operation Test

72. **Thermostats which operate on the rate-of-rise principle shall be calibrated so that the thermostats will function at the rate of rise for which they are intended, but shall not operate when subjected to a rate of temperature rise of 12° F per minute or less until a temperature of at least 130° F is reached (starting from a temperature of 85 to 90° F).**

73. Five samples of rate-of-rise thermostats are to be tested in the thermostat testing oven under various uniform temperature-rise conditions. Typical rates of rise of temperature, such as 12° F, 15° F, and 20° F per minute, and the intended (rated) temperature rate of rise, are to be employed. Each unit is to remain in the oven ambient at least five minutes prior to conducting a test run.

Humidity Test

74. Three thermostats shall comply with the requirements of the Oven Test, the Operating Temperature Test, or the Rate-of-Rise Operation Test, whichever is applicable, after having been exposed for 24 hours to moist air having a relative humidity of 85 percent plus or minus 5 percent, at a temperature of 30° C plus or minus 2° C (86° F plus or minus 3° F). The units shall be tested within five minutes after removal from the environment.

Low-Temperature Exposure Test

75. Three thermostats shall comply with the requirements of the Oven Test, the Operating Temperature Test, or the Rate-of-Rise Operation Test, whichever is applicable, after having been exposed for 24 hours to a temperature of −30° C plus or minus 2° C. The units shall be tested within five minutes after the contacts return to the normal position.

Electrical Tests

Overload Test

76. An alternating-current thermostat shall be capable of performing acceptably when subjected to an overload test of 150 percent of rated current while connected to a power supply of rated voltage and frequency, and controlling an inductive load of 60 percent power factor. For self-restoring thermostats the test shall consist of 50 operations at not more than 10 operations per minute of at least three samples. There shall be no electrical or mechanical failure of the device, undue burning, pitting, or welding of contacts, nor blowing of the ground fuse. For non-self-restoring thermostats the test shall consist of having three samples carry the current continuously for one hour without undue burning or opening of the contacts, nor blowing of the ground fuse.

77. The electrical contacts of an alternating-current thermostat are to be connected in the live supply line, and the dead-metal parts of the enclosure are to be connected through a 5-ampere fuse to ground.

78. A direct-current thermostat shall be capable of performing acceptably when subjected to an overload test of 150 percent of rated current while connected to a power supply of rated voltage and controlling an inductive load. For self-restoring thermostats, the test shall consist of 50 operations at approximately 10 operations per minute of at least three samples. There shall be no electrical or mechanical failure of the device, undue burning, pitting, or welding of contacts, nor blowing of the ground fuse. For non-self-restoring thermostats the test shall consist of having three samples carry the current continuously for one hour without undue burning or opening of the contacts, nor blowing of the ground fuse.

79. The electrical contacts of a direct-current thermostat are to be connected to the positive supply line, and the dead-metal parts of the enclosure are to be connected through a 5-ampere fuse to a grounded negative supply line.

80. For direct-current signaling circuits an equivalent inductive test load is to have the required direct-current resistance for the test current and the inductance (calibrated) to obtain a power factor of 0.6 when connected to a 60-cycle root-mean-square potential equal to the rated direct-current test voltage. When the inductive load has both the required direct-current resistance and the required inductance, the current measured with the load connected to an alternating-current circuit will be equal to 0.6 times the current measured with the load connected to a direct-current circuit when the voltage of each circuit is the same.

Endurance Test

81. Following the Overload Test, three samples of a self-restoring type of thermostat shall be subjected to an endurance test consisting of 500 operations at not more than 10 operations per minute, making and breaking rated current, while connected to a power supply of rated voltage and controlling an inductive load as described in paragraph 80. There shall be no electrical or mechanical failure of the device, nor undue burning, pitting, or welding of contacts, nor blowing of the ground fuse.

Dielectric Withstand Test

82. A thermostat shall be capable of withstanding without breakdown the application of a 60-cycle alternating potential, as indicated below, for a period of one minute between all live-metal parts and all dead-metal parts. The test potential shall be 500 volts for a thermostat rated at 50 volts or less, and shall be 1000 volts plus twice rated voltage for a thermostat rated at more than 50 volts.

83. To determine if a thermostat complies with the requirements of the preceding paragraph, it is to be stressed by means of a 500-volt-ampere or larger transformer, the output voltage of which can be regulated, and the wave form of the voltage should approximate a sine wave. The applied potential is to be increased gradually from zero until the required test value is reached, and is to be held at that value for one minute.

MANUFACTURING AND PRODUCTION TESTS

Rate-of-Rise Type

84. Each thermostat that operates on the rate-of-rise principle shall be subjected to calibration tests by the manufacturer before shipment to determine that:

A. The unit does not operate when the rate of temperature rise is 12° F per minute or less, until a temperature of at least 130° F is reached (starting from a temperature of 85 to 90° F), and

B. The unit does function at the rate of rise for which it was initially investigated.

Fixed-Temperature Type

85. Each assembled fixed-temperature self-restoring type of thermostat shall be subjected to a water bath, oil bath, or hot-air oven test by the manufacturer before shipment to determine that the unit functions to positively "make" or "break" the electrical contacts, depending upon whether it is of the open- or closed-circuit design.

86. For non-self-restoring type thermostats at least one sample of each temperature rating of each day's production shall be tested for operation.

MARKING

87. A thermostat shall be marked with the manufacturer's name or trade name, model designation or the equivalent, temperature rating, electrical rating, and the designation "DO NOT PAINT" or the equivalent. Except for the painting information, the marking may appear on the inside of the device if it can be examined readily upon removal of the mounting screws.

88. If a manufacturer produces thermostats at more than one factory, each thermostat shall have a distinctive marking by which it may be identified as the product of a particular factory.

89. In addition to the foregoing marking, spot-pattern thermostats of other than ordinary-degree rating shall bear distinctive color markings in accordance with the following:

Ordinary	No coloring
Intermediate	White
High	Blue
Extra High	Red
Very Extra High	Green
Ultra High	Orange

90. In lieu of the color markings, the temperature rating may be employed if the numerals are at least ⅜ inch high, applied on a contrasting background, and visible after installation.

APPENDIX A

THERMOSTAT TESTING OVEN

Construction

A-1. The testing oven consists of an oval-shaped stainless-steel box approximately 31 inches long by 10 inches wide by 16 inches high, made of No. 11-gage material. One of the curved end sections is hinged.

A-2. A section, 6 by 6 inches at the top, is fitted with a removable wooden cover. The thermostats to be tested are mounted, one at a time, on this cover.

A-3. Two glass windows, 4 by 6 inches in size, are provided in the sides of the oven for observation of the samples under test.

A-4. The interior of the oven is divided horizontally by a baffle over the heater chamber located in the central lower section. One end of the horizontal baffle is joined to a guide vane extending upward, at an angle of 72 degrees, into the oven chamber. The vane directs the air currents to insure greater uniformity of temperature in the oven.

A-5. Eight 1000-watt heating coils threaded into Edison screw-shell lampholders furnish the heat. They are so connected that six of the heating coils are controlled by means of two manually adjusted autotransformers. An auxiliary switch controls the other two heating coils for supplying additional heat when necessary.

A-6. An air current through the bank of heaters is created by means of a four-blade 5-inch fan located behind the heating coils and connected to a shaft which extends to the outside of the oven. A variable-speed motor is mounted on a bracket inside the lower cabinet and operates the fan through a pulley and belt arrangement. The speed of the motor is adjusted and the pitch of the fan blades is such that the velocity of the air current is 230-245 feet per minute over the sample under test.

A-7. Temperatures are measured by means of two No. 30-gauge wire thermocouples inserted through copper tubes extending to the inside of the test chamber and are located adjacent to the device under test and in the heating chamber. The air velocity is measured by a velometer installed in the oven.

A-8. The oven is mounted on a heavy-gage metal cabinet having dimensions of 36 by 24 by 31 inches high.

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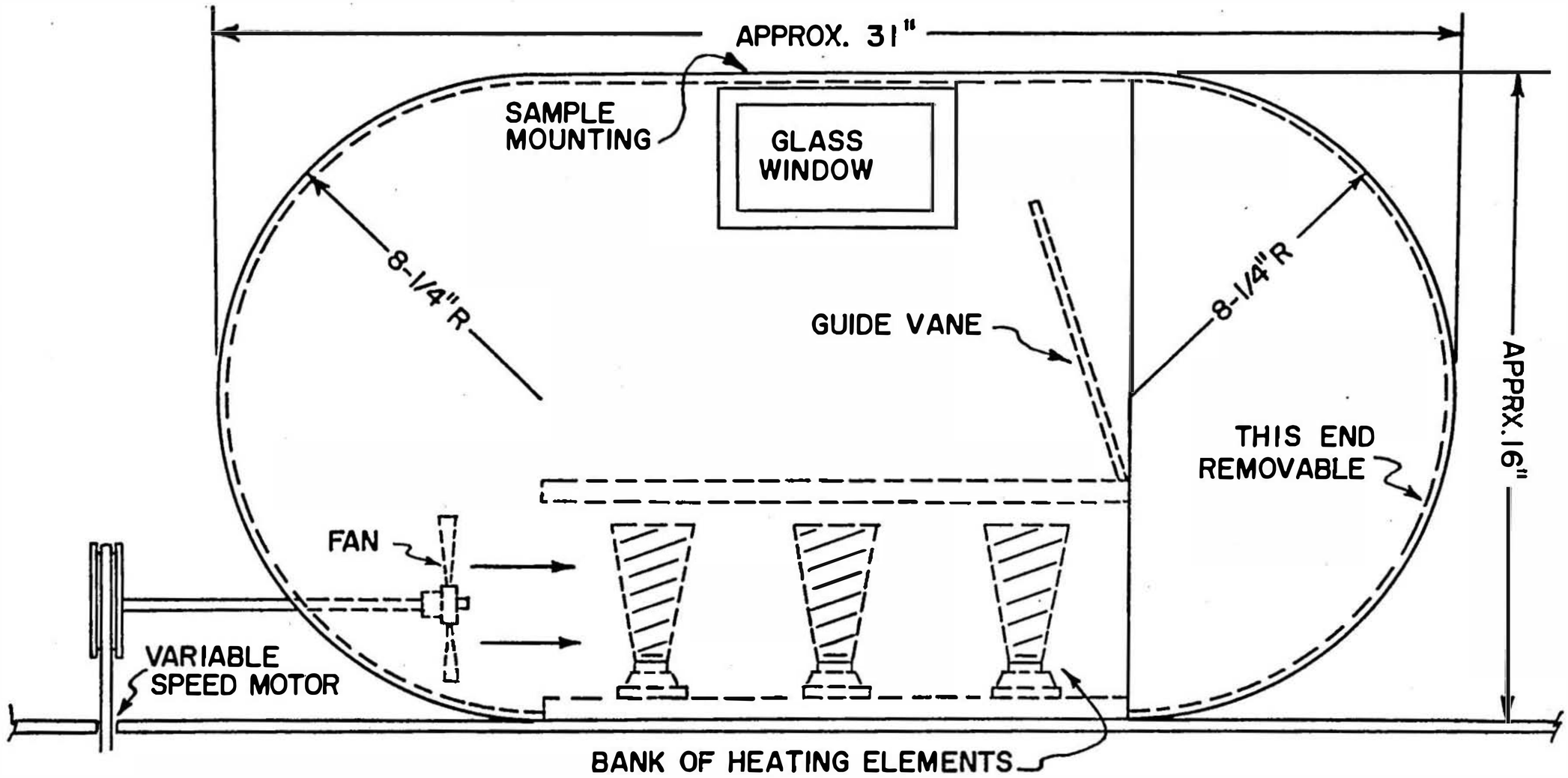

FIGURE 3

A-9. A control board is mounted on the cabinet adjacent to the testing oven. The control board incorporates five toggle switches and four indicating lights for operating the heating elements, air-flow fan, and a cooling fan. A small lamp is located on the control board to indicate operation of the thermostat under test. A toggle switch is used for turning on the temperature recorder and another is used for checking the temperatures in either the upper or lower portion of the thermostat oven. Two manually adjusted autotransformers are mounted on the control panel for controlling the heat developed by the heating coils. An air-flow indicator gauge is also incorporated on the control board for continuous indication of the air flow during the test run. In the event that the air flow tends to change during a test run, the speed of the fan is adjusted to keep the air velocity within the specified range.

Testing

A-10. The preparation for test consists of mounting the thermostat on the small removable wooden panel. Conduit-fitting mountings are accommodated on a special panel provided with a 3- by 3-inch conduit box fitted into the panel. Flush-mounted devices employ a plain wood panel. The test sample shall remain in the oven at least five minutes prior to starting each test run.

A-11. The heating coils are permitted to preheat for from 10 to 20 seconds prior to starting the test. The fan controlling the air flow is turned on and its speed adjusted to produce the required velocity. The temperatures are read every 10 seconds. The two autotransformers are adjusted as needed to obtain the desired rate of temperature rise. Normal oven temperatures at the start of the test are from 85 to 90° F.

A-12. Upon operation of the thermostat, the current applied to the bank of heaters is cut off and the oven is cooled to normal room temperature through the use of the cooling fan.

A-13. The standard 10-, 12½-, and 15-foot time-temperature curves are shown by Figure 1.