

**Underwriters Laboratories Inc.®**A not-for-profit organization dedicated to public safety
and committed to quality service**August 2, 1995****Revision pages for****Standard for****Household Fire Warning System Units****UL 985, Fourth Edition**

Attached to this transmittal notice is a revision of the fourth edition of UL 985.

A CHANGE ON A PAGE DATED AUGUST 2, 1995 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THESE NEW AND REVISED REQUIREMENTS ARE NOW IN EFFECT EXCEPT FOR THOSE PARAGRAPHS, SECTIONS, TABLES, AND FIGURES HAVING FUTURE EFFECTIVE DATES AS INDICATED IN THE SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM. TO RETAIN THE REQUIREMENTS IN EFFECT UNTIL AUGUST 3, 1998, DO NOT DISCARD THE PAGES REPLACED BY THOSE HAVING FUTURE EFFECTIVE DATES UNTIL THOSE DATES.

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

The new and revised requirements are substantially in accordance with UL's bulletin on this subject dated July 28, 1994. However, as there are proposed requirements in this bulletin that are still under consideration, this bulletin should not be discarded.

Attention is directed to the note on the title page of this standard outlining the procedure to be followed to retain the approved text of ANSI/UL 985-1994.

Revised and/or additional pages may be issued from time to time.

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

Page	Date
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2	—
3 – 5	August 2, 1995
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(Continued)

**Documents**

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August 2, 1995 – UL 985

Page	Date
11 – 16	July 29, 1994
17, 18	August 2, 1995
19 – 24	July 29, 1994
25, 26, 26A – 26D, 27, 28, 28A – 28D	August 2, 1995
29, 30	July 29, 1994
31, 32, 32A	August 2, 1995
33 – 40	July 29, 1994
41, 42	August 2, 1995
43, 44	July 29, 1994
45	August 2, 1995
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48, 48A	August 2, 1995
49, 50	July 29, 1994
51 – 58	August 2, 1995
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1

UL 985

Standard for

Household Fire Warning System Units

First Edition – January, 1973

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Fourth Edition

July 29, 1994

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated July 29, 1994. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

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Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest published set of revision pages.

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CONTENTS

FOREWORD

INTRODUCTION

1 Scope	7
2 General	8
3 Glossary	8
4 Instructions and Drawings	9
4A Compatibility Information	9

CONSTRUCTION

5 General	10
6 Frame and Enclosure	10A
7 Electric Shock	12
8 Ventilating Openings	13
9 Metal Covers and Doors	13
10 Glass Panels	13
11 Corrosion Protection	14
12 Insulating Material	14
13 Mounting of Electrical Components	15
14 Operating Mechanisms	16
15 Current-Carrying Parts	16
16 Servicing Protection	16

FIELD-WIRING CONNECTIONS

17 Primary Power Supply	17
18 Secondary Power Supply	17
19 Batteries	17

INSTALLATION WIRING CONNECTIONS

20 General	18
21 Field-Wiring Terminals	18
22 Field-Wiring Leads	18
23 Power-Supply Cord	19
24 Strain Relief	19
25 Internal Wiring	19

GROUNDING

26 Equipment Grounding	20
27 Polarity Identification	21

COMPONENTS

28 End-of-Line Devices	21
29 Printed Wiring Boards	21
30 Bushings	21

31	Coil Windings	22
32	Switches	22
33	Lampholders and Lamps	22
34	Protective Devices	23

SPACINGS

35	General	23
----	---------	----

PERFORMANCE

36	General	24
36A	Alarm Verification Feature (Optional)	25
37	Normal Operation Test	26
37A	Two-Wire Smoke Detector Compatibility Tests	26B
38	Electrical Supervision Test	26D
39	Undervoltage Operation Test	27
40	Overvoltage Operation Test	27
41	Voltage and Current Measurements	28
41A	Power-Limited Circuits	28
42	Jarring Test	28D
43	Temperature Test	29
43A	Charging Current Test	31
44	Overload Test	32
45	Endurance Test	32A
46	Variable Ambient Temperature Test	32A
47	Humidity Test	32A
48	Leakage Current Test	33
49	Electric Shock Current Test	33
50	Transient Test	37
51	Dielectric Voltage-Withstand Test	39
52	Component Failure Test	40
53	Audibility Test	40
54	Abnormal Operation Test	41

SHORT RANGE RADIO FREQUENCY DEVICES

55	General	41
56	Reference Level Determination	41
57	Interference Immunity	46
58	Frequency Selectivity	47
59	Time to Report Alarm	47
60	Inoperative Transmitter Reporting	48
61	Clash	48
62	Error (Falsing) Rate	49
63	Throughput Rate	50
64	Maximum Duration of Transmission	51
65	Battery Status Indication	51
66	Transmitter Stability Tests	52
67	Transmitter Accelerated Aging Test	52
68	Installation Instructions and User Manual	52

MANUFACTURING AND PRODUCTION TESTS

69 Production-Line Dielectric Voltage-Withstand Test	53
70 Production-Line Grounding-Continuity Test for High-Voltage, Cord-Connected Products	53
70A Interference Protection	54

INSTALLATION DRAWING

71 General	54
------------------	----

INSTRUCTIONS

72 General	55
------------------	----

MARKINGS

73 General	56
------------------	----

APPENDIX A

Standards for Components	A1
--------------------------------	----

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 employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the 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 household fire warning system control units intended to be installed in accordance with the National Fire Alarm Code, ANSI/NFPA 72, and the National Electrical Code, ANSI/NFPA 70.

Revised 1.1 effective August 3, 1998

1.2 A household fire warning system control unit consists of a unit assembly of electrical parts having provision for connection of power supply and initiating device circuits. Provision for connection of an indicating device circuit is also required unless an alarm sounding device is integral with the control unit. Additional terminals may be provided for the connection of supplementary devices, such as annunciators, remote switches, and the like. A secondary supply, such as a battery, may be provided integral with the control unit or provision may be provided for its connection to the control unit.

1.3 Provision for the connection to the control unit of at least one smoke detector is required unless reference is made on the installation diagram for the use of a self-contained smoke detector, such as a single- or multiple-station fire alarm device.

1.4 These requirements also apply to the use of combination systems, such as a combination fire-burglar alarm system control unit, which uses circuit wiring common to both systems. When common wiring is used for combination systems, it shall be connected in such a manner that internal fault conditions (shorts, opens, grounds) in the nonfire alarm (burglary) system circuit wiring, or faults between the fire and nonfire alarm system circuits, will not interfere with the supervision of the fire alarm system or prevent intended alarm signal transmission.

1.5 These requirements do not cover single- or multiple-station fire alarm devices, automatic fire detectors, or alarm indicating appliances, such as bells, horns, and the like. They do cover accessories which are external to the control unit and are dependent upon the control unit function, such as end-of-line devices, annunciators, and remote switches.

1.6 If a digital alarm communicator transmitter is used to transmit signals to a remote location and it is to be included as a component of the system, it shall comply with the applicable requirements in the Standard for Digital Alarm Communicator System Units, UL 1635. Otherwise the user must be notified that the off-premises transmission method has not been so investigated.

1.7 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, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the acceptable 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 cannot be judged to comply with this standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

1.7 revised August 2, 1995

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 need not comply with a specific requirement that:

- a) Involves a feature or characteristic not needed 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 recognized rating established for the intended conditions of use.

2.1.4 Specific components are recognized as being 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 for which they have been recognized.

2.2 Units of measurement

2.2.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

2.3 Undated references

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

3 Glossary

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

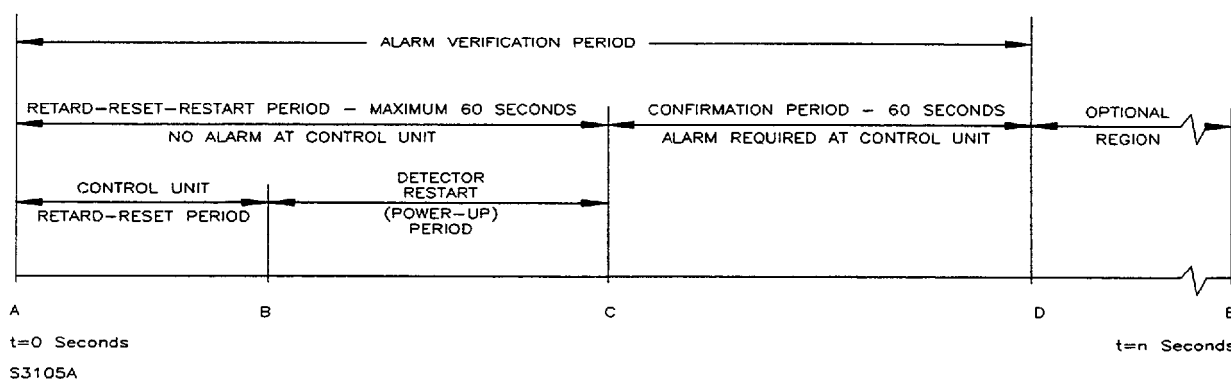
3.2 **ALARM SIGNAL** – An audible signal indicating an emergency fire condition requiring immediate action, as an alarm initiated from a manual box, smoke, or heat detector.

3.2.1 **ALARM VERIFICATION** – Operation of a control unit in conjunction with a related smoke monitoring head or an initiating device circuit in which an alarm signal from a smoke detector is confirmed one or more times over a predetermined period before the control unit will indicate an alarm. This predetermined period consists of an alarm retard-reset period and an alarm confirmation period. The alarm retard period is the delay time designed in the control unit while the alarm reset period is the power-up time for the detector. See Figure 3.1.

Added 3.2.1 effective August 3, 1998

3.3 **ANNUNCIATOR** – An externally-connected electrically-operated visual indicating device containing two or more identified targets or indicator lamps in which each target or lamp indicates the circuit condition and/or location.

Figure 3.1
Alarm verification – timing diagram



A — Smoke detector goes into alarm.

AB — RETARD-RESET PERIOD (Control Unit) — Control unit senses detector in alarm and retards (delays) alarm signal, usually by de-energizing power to the detector. Length of time varies with design.

BC — RESTART PERIOD (Detector Power-Up Time) — Power to the detector is reapplied and time is allowed for detector to become operational for alarm. Time varies with detector design.

AC — RETARD-RESET-RESTART PERIOD — No alarm obtained from control unit. Maximum period of time is 60 seconds.

CD — CONFIRMATION PERIOD — Detector is operational for alarm at point C. If detector is still in alarm at point C, control unit will alarm. If detector is not in alarm, system returns to standby. If the detector realarms at any time during the confirmation period the control unit will alarm.

DE — OPTIONAL REGION — Either an alarm can occur at control unit or restart of the alarm verification cycle can occur.

AD — ALARM VERIFICATION PERIOD — Consists of the retard-reset-restart and confirmation periods.

Added Figure 3.1 effective August 3, 1998

3.3.1 CIRCUITS, ELECTRICAL —

- a) High-Voltage — A circuit involving a potential of not more than 600 volts and having circuit characteristics in excess of those of a low-voltage power-limited circuit.
- b) Low-Voltage — A circuit involving a potential of not more than 30 volts ac rms, 42.4 volts dc or ac peak.
- c) Power-Limited — A circuit wherein the power and current are limited as specified in Tables 41A.1 and 41A.2.

Added 3.3.1 effective August 3, 1998

3.4 CONTROL UNIT ACCESSORY — A device or appliance externally connected to a control unit which is used to ensure the intended operation of a system or to provide supplementary signaling and/or annunciation. Examples of control unit accessories are annunciators, end-of-line resistors or diodes, auxiliary relays, and remote switches.

3.5 **DISTINCTIVE SIGNALS** — Signals obtained from different sounding appliances, such as bells, horns, sirens, and buzzers, or from a single appliance, such as an electronic horn, where a continuous signal is obtained under one condition and a pulsing signal under another.

3.6 **END-OF-LINE RESISTOR** — A resistor installed at the end of an initiating or indicating device circuit to limit the amount of supervisory current.

3.7 **FAULT** — An open or ground condition on any line extending from a control unit.

3.8 **INDICATING DEVICE** — Any audible signal used to indicate a fire, supervisory, or trouble condition. Examples of audible signal appliances are bells, horns, sirens, electronic horns, buzzers, and chimes.

3.9 INDICATING DEVICE CIRCUIT – Circuit to which indicating devices are connected.

3.10 INITIATING DEVICE – A manually- or automatically-operated device whose operation results in a fire alarm indication from the control unit. Examples of alarm signal initiating devices are thermostats, manual boxes, and smoke detectors.

3.11 INITIATING DEVICE CIRCUIT – Circuit to which automatic or manual initiating devices are connected.

3.12 TROUBLE SIGNAL – A visual or audible signal indicating a fault condition of any nature, such as an open or ground or other trouble condition, occurring in the device or connected wiring.

4 Instructions and Drawings

4.1 A copy or draft of the operating and installation instructions and related schematic wiring diagrams and installation drawings intended to be furnished with each product are to be used as a basis for the examination and testing of the control unit.

4.2 The instructions and drawings shall include such directions and information as deemed by the organization responsible for the product to be adequate for attaining the intended and safe installation, maintenance, and operation of the control unit. See Installation Drawing, General, Section 71, and Instructions, General, Section 72.

4.3 In addition to the information given in 4.1 and 4.2, the manufacturer shall provide an evacuation plan as specified in 72.2.

4A Compatibility Information

4A.1 General

4A.1.1 Compatibility between a two-wire smoke detector that receives its power from the initiating device circuit of a fire alarm 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.

Added 4A.1.1 effective August 3, 1998

4A.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) may be used 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 or heat detector) to place the system in alarm.

Added 4A.1.2 effective August 3, 1998

4A.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 device circuit by a connected detector shall 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.

Added 4A.1.3 effective August 3, 1998

4A.1.4 The connection of a two-wire smoke detector shall be restricted to the specific control units or initiating device circuits with which a compatibility evaluation has been made.

Added 4A.1.4 effective August 3, 1998

4A.1.5 A supplementary signaling device [such as an audible appliance, relay, or annunciator lamp (LED-type)] that is integral with a two-wire smoke detector, and that is also powered from an initiating device circuit of a fire alarm system control unit, may be used if its operation, including level of audibility and light output, is not inhibited under the maximum normal standby and alarm loading conditions specified in the detector and control unit installation wiring diagrams.

Added 4A.1.5 effective August 3, 1996

4A.2 Method of evaluation

4A.2.1 In accordance with 4A.1.1 – 4A.1.5, to determine whether any combination of control unit and smoke detector or detectors is compatible, and whether the detectors are the same model or a mixture of one or more models or types, the tests indicated in (a) – (h) are to be conducted:

- a) Operating voltage determination, as described in 37A.1.1 – 37A.1.3.
- b) Alarm threshold impedance, as described in 37A.2.1 – 37A.2.3.
- c) Maximum current limitation, as described in 37A.3.1 and 37A.3.2.
- d) Multiple detector alarm capacity, as described in 37A.4.1.
- e) Detectors with optional components, as described in 37A.5.1 and 37A.5.2.
- f) Dynamic load immunity, as described in 37A.6.1 and 37A.6.2.
- g) Electrical supervision, as described in 37A.7.1 and 37A.7.2.
- h) Detector reset, as described in 37A.8.1 – 37A.8.3.

Added 4A.2.1 effective August 3, 1996

4A.3 Changes affecting compatibility

4A.3.1 If the compatibility integrity of a previously installed compatible combination may 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.

Added 4A.3.1 effective August 3, 1996

CONSTRUCTION

5 General

5.1 A control unit shall be intended and constructed for use with recognized signal initiating and indicating devices, and other equipment intended for connection to it to form a household fire alarm system of the type indicated by the installation wiring diagram.

5.2 Except where indicated otherwise, the construction requirements specified for control units shall apply also to control unit accessories.

6 Frame and Enclosure

6.1 General

6.1.1 The frame and enclosure shall be sufficiently strong and rigid to resist total or partial collapse with attendant reduction of spacings, loosening or displacement of parts and development of other conditions which impairs its operation and increase the risk of fire, electric shock, or injury to persons.

6.1.2 All electrical parts of a control unit shall be enclosed to provide protection against contact with uninsulated live parts.

6.1.3 Space shall be provided within a terminal or wiring compartment for completing all wire connection as specified by the installation wiring diagram.

6.1.4 An enclosure shall have means for mounting, which shall be accessible without disassembling any operating part of the unit. Removal of a completely assembled panel or printed wiring board to mount the enclosure is not considered to be disassembly of an operating part.

6.1.5 A compartment enclosing electrical parts shall not be open to the floor or other support on which a unit rests.

6.2 Cast metal enclosures

6.2.1 The thickness of cast metal for an enclosure shall be as indicated in Table 6.1.

Exception: Cast metal having a thickness 1/32 inch (0.8 mm) less than that indicated in the table, if the surface under consideration is curved, ribbed, or otherwise reinforced, or if the shape or size, or both, of the surface is such that equivalent mechanical strength is provided, complies with this requirement.

Table 6.1
Cast metal electrical enclosures

Use, or dimensions of area involved	Minimum thickness			
	Die-cast metal, Inch (mm)		Cast metal of other than the die-cast type, Inch (mm)	
Area of 24 square inches (155 cm ²) or less and not having a dimension greater than 6 inches (152 mm)	1/16	1.6	1/8	3.2
Area greater than 24 square inches (155 cm ²) or having any dimension greater than 6 inches (152 mm)	3/32	2.4	1/8	3.2
At a threaded conduit hole	1/4	6.4	1/4	6.4
At an unthreaded conduit hole	1/8	3.2	1/8	3.2

6.2.2 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 not be fewer than 3-1/2 nor more than five threads in the metal, and the construction shall be such that a standard conduit bushing is capable of being attached.

6.2.3 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 fewer than five full threads in the metal, and there shall be a smooth, well-rounded inlet hole for the conductors which shall afford protection to the conductors equivalent to that provided by a standard conduit bushing.

6.3 Sheet metal enclosures

6.3.1 The thickness of sheet metal used for the enclosure of a control unit shall not be less than that indicated in Table 6.2.

Exception: Sheet metal two gage sizes smaller, if the surface under consideration is curved, ribbed, or otherwise reinforced, or if the shape or size, or both, of the surface is such that equivalent mechanical strength is provided, complies with this requirement.

FIELD-WIRING CONNECTIONS

17 Primary Power Supply

17.1 A household fire alarm control unit shall have provision for connection to a commercial light and power source normally available in a home. This shall be in the form of a permanent connection by means of wiring terminals or leads in a separate wiring compartment having provision for the connection of conduit or metal-clad cable, or by means of a power-supply cord and attachment plug.

17.2 Control units intended to be installed by other than a qualified electrician shall be powered from a power-limited power supply.

Revised 17.2 effective August 3, 1998

18 Secondary Power Supply

18.1 The use of a secondary power supply is optional. When a secondary power supply is provided, such as a battery, it shall be of sufficient capacity to supply the maximum power to the system for 24 hours in the intended standby condition and thereafter be able to operate the control unit for fire alarm signals for at least 4 minutes continuously.

Revised 18.1 effective August 3, 1998

18.2 When a standby battery is provided, the primary power supply shall be of sufficient capacity to operate the system under all conditions of loading with any standby rechargeable battery fully discharged (85 percent of its marked nominal rating) or nonrechargeable-type battery disconnected.

19 Batteries

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

19.2 If a standby battery is used, provision shall be made for an automatic test of the standby battery at least once every 4 hours. The test shall be conducted under a load sufficient to determine if the battery requires service, has been removed, or is disconnected. A battery requiring service is defined as a battery which is not capable of providing 4 minutes of alarm signaling during a power failure. If the automatic battery test determines that the battery requires service or is disconnected, an audible trouble signal shall be provided.

Revised 19.2 effective August 3, 1998

19.3 In all cases the marking on the unit shall also include battery replacement instructions for a nonrechargeable type battery which shall include a specified replacement period.

19.4 Batteries included as part of a control unit shall be located and mounted so that terminals of cells will not come in contact with uninsulated live parts of the control unit, with terminals of adjacent cells, or with metal parts of the enclosure as a result of shifting.

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

19.6 Access shall be available to the battery compartment to facilitate battery replacement without disassembly of any part of the control unit except for a cover or door.

19.7 Lead or terminal connections to batteries shall be identified with the proper polarity (plus or minus signs), and provided with strain relief.

19.8 If required by local, state or federal ordinances or regulations for disposal reasons, rechargeable type batteries shall be removable.

Added 19.8 effective August 3, 1999

INSTALLATION WIRING CONNECTIONS

20 General

20.1 A control unit intended for permanent connection shall be provided with wiring terminals or leads for the connection of conductors of at least the size required by the National Electrical Code, ANSI/NFPA 70-1993, corresponding to the electrical rating of the unit.

20.2 Duplicate terminals or leads, or equivalent means to achieve electrical supervision, shall be provided for each incoming and outgoing alarm-initiating-circuit connection. A common terminal may be used for connection of both incoming and outgoing wires, provided that the design and construction of the terminal does not permit an uninsulated section of a single conductor to be looped around the terminal and serve as two separate connections, thereby precluding supervision of the connection in the event that the wire becomes dislodged from under the terminal. A notched clamping plate under a single securing screw may be used, provided that separate conductors of an initiating circuit are intended to be inserted in each notch, but this arrangement shall be supplemented by additional marking in the wiring area or on the installation wiring diagram specifying the intended connections to the terminals.

21 Field-Wiring Terminals

21.1 The terminal parts to which wiring connections are made shall consist of binding screws with terminal plates having upturned lugs, or the equivalent, to hold the wires in position. Other terminal connections shall only be provided when found to be equivalent.

21.2 A wire-binding screw used at a field-wiring terminal shall be a No. 6 (3.5 mm) or No. 8 (4.2 mm) screw. A No. 6 screw shall only be used for the connection of a No. 14 AWG (2.1 mm²) or smaller conductor.

21.3 Except as noted in 21.4, 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) or larger screw, and not less than 0.030 inch (0.76 mm) thick for a No. 6 (3.5 mm) screw, and shall have not less than two full threads in the metal.

21.4 A terminal plate shall have the metal extruded at the tapped hole for the binding screw so as to provide two full threads in the metal. Other constructions shall be used if they are determined to provide equivalent security.

22 Field-Wiring Leads

22.1 Leads provided for field connections shall not be less than 6 inches (152 mm) long, shall be provided with strain relief, and shall not be smaller than No. 18 AWG (0.82 mm²). Rubber or thermoplastic insulation shall not be less than 1/32 inch (0.8 mm) thick.

36.3 The type of battery with which the control unit is intended to be used shall be connected to the control unit.

36.4 In a combination control unit, separate circuits shall be used for fire alarm initiating devices and other than fire alarm (burglary) devices.

36.5 If a control unit must be mounted in a definite position in order to function as intended, it is to be tested in that position.

36A Alarm Verification Feature (Optional)

36A.1 To reduce the effect of electrical and migratory smoke transients, a system control unit may have provision for an alarm verification feature for alarm signals received from smoke detectors or smoke monitoring heads. If used, the feature shall be:

- a) Integral in the control unit,
- b) A module that can be wired or plugged into a control unit,
- c) A separate entity that can be field wired to interface between the control unit and initiating device circuit, or
- d) Another arrangement determined to be equivalent.

Alarm verification shall be arranged on a per circuit (zone) basis, except it may be accomplished on a multiple circuit (zone) or system basis if the retard duration of the verification procedure is not more than 15 seconds.

Added 36A.1 effective August 3, 1998

36A.2 If an alarm verification feature is provided, the maximum retard-reset period before an alarm signal can be confirmed and indicated at the control unit, including any control unit reset time and the power-up time for the detector to become operational for alarm, shall not exceed 60 seconds. Any alarm during the 60-second alarm confirmation period following the retard-reset period shall result in an immediate alarm from the control unit. See Figure 3.1.

Added 36A.2 effective August 3, 1998

36A.3 The retard-reset period of alarm verification need not include the polling time of a multiplex system control unit if alarm verification is provided at the data gathering panel (DGP) to which the smoke detectors are connected, but shall include the polling time if the alarm verification is provided at the central receiving control unit.

Added 36A.3 effective August 3, 1998

36A.4 Alarm verification shall not be used in initiating device circuits intended for cross zone operation.

Added 36A.4 effective August 3, 1998

36A.5 Control units incorporating an alarm verification feature shall not be used with smoke detectors using an alarm verification feature.

Exception: This requirement does not apply to smoke detectors that use less than 10 seconds for signal processing time and do not reset themselves.

Added 36A.5 effective August 3, 1998

36A.6 Alarm verification shall apply to alarm signals from smoke detectors only, and not to alarm signals from other initiating devices, such as manual stations, heat detectors, water flow indicators, and the like, which may be connected to the same circuit. See 36A.1 for requirements covering alternative configurations.

Added 36A.6 effective August 3, 1998

37 Normal Operation Test

37.1 Fire alarm control unit

37.1.1 A household control unit shall be capable of operating reliably and uniformly for all conditions of its intended performance when used in conjunction with initiating devices and indicating devices to form a system combination of the type indicated by the installation wiring diagram and any supplementary information provided.

37.1.2 Indicating devices and initiating devices are to be connected to the control unit as specified by the installation wiring diagram to form a typical combination, and the control unit is then to be operated for each condition of its intended performance.

37.1.3 The initiating devices, thermostats, smoke detectors, manual boxes, and the like, used for testing are to be those specified by the installation wiring diagram of the control unit, except that substitute devices are only to be used if they produce equivalent signal indication and circuit loading. Substitute load devices are considered to be those which have been found by investigation to provide the same load conditions as those obtained with the devices intended to be used with the control unit in service.

37.1.4 A control unit is to be in the supervisory "standby" condition and prepared for intended signaling operation when it is connected to related devices and circuits as specified on the installation wiring diagram provided by the manufacturer. A "power on" visual indication is to be obtained.

37.1.5 The operation of any initiating device shall cause the control unit to operate related indicating devices so as to produce a clearly defined signal of the type for which the combination is designed.

37.1.5.1 An audible alarm indicating device shall produce a 3-pulse temporal pattern. The pattern shall consist of an "on" phase lasting 0.5 second ± 10 percent followed by an "off" phase lasting 0.5 second ± 10 percent, for three successive "on" periods, which is then followed by an "off" phase lasting 1.5 seconds ± 10 percent. The signal shall be repeated for a minimum of 4 minutes or until manually silenced. A single stroke bell or chime sounded at "on" intervals lasting 1 second ± 10 percent, with a 2-second ± 10 percent "off" interval after each third "on" stroke is acceptable.

Added 37.1.5.1 effective August 3, 1998

37.1.6 Operation of the test switch shall result in the same indication as operation of an initiating device.

37.1.7 An alarm signal of a household control unit initiated from a circuit containing heat detectors shall be maintained continuously (locked in) by the control unit until a resetting device in the control unit is operated manually. An alarm signal initiated from a circuit containing smoke detectors need not lock in. If both heat and smoke detectors are connected in the same initiating device circuit, lock-in is required. If a lock-in is provided for an alarm signal originating from a circuit to which only smoke detectors are connected, a switch to preclude the lock-in is not prohibited.

37.1.8 If the "off-normal" position of any normally preset mechanism or similar part of a control unit requires manual restoration in order to permit signaling performance of the control unit, such position shall be indicated by a visual or audible trouble signal.

37.1.9 The intended operation of a household control unit shall not depend upon any ground connection.

37.2 Combination control unit

37.2.1 In a combination control unit, such as a combination household fire-burglar alarm control unit, the following operation shall be obtained:

- a) A fire alarm signal shall take precedence or be clearly recognizable over any other signal even when the nonfire-alarm signal is initiated first.
- b) Distinctive alarm signals shall be obtained between fire alarm and other functions, such as burglar alarm. The use of a common sounding appliance for fire and burglar alarm complies with this requirement if distinctive signals are obtained.

Revised 37.2.1 effective August 3, 1998

37.3 Primary power supply

37.3.1 With the standby rechargeable battery fully discharged (85 percent of its marked nominal rating) or the nonrechargeable-type battery disconnected, the household control unit shall operate as specified in 37.1.1 – 37.2.1. There shall not be a change in the operation of the control unit. In the normal supervisory condition, the battery charger portion of the unit shall charge the rechargeable battery as intended; and in the alarm condition, the standby battery shall not be in a discharge mode of operation (a drain greater than 1 percent of its ampere-hour rating).

37.4 Alarm Verification

37.4.1 The maximum retard-reset-restart period of alarm verification of a system control unit, including any time delay due to system reset and power-up time of the smoke detector to become operational for alarm, shall not exceed 60 seconds. During the 60-second alarm confirmation period following the retard-reset-restart period, re-actuation of the same detector that initiated the alarm verification cycle, actuation of another smoke detector on the same circuit (zone), or a fire alarm from another zone shall result immediately in an alarm signal from the control unit.

Exception: When two or more protected premises units are connected to a central receiving unit, each zone panel (protected premises unit) may be configured to permit its own alarm verification feature.

Added 37.4.1 effective August 3, 1998

37.4.2 To determine the retard duration of the alarm verification feature (not including the power-up time of a smoke detector unless the detector is connected), a control unit is to be connected to a rated source of electrical supply as specified in 36.2. Each initiating device circuit provided with alarm verification is to be placed into alarm by a switch representing detector contacts, or by actuation of the specific detector to be used with the control unit, or by other means to produce an alarm. The time between initiation of the detector alarm and energization of the control unit alarm circuit is the retard period. The retard-reset period is to be determined by adding the maximum power-up time of the smoke detector(s), intended to be connected to the control unit as indicated in the control unit installation drawing, to the retard period.

Added 37.4.2 effective August 3, 1998

37.4.3 To determine that an alarm is obtained from the control unit during the 60-second alarm confirmation period, the control unit and initiating device circuit (or detector) are to be energized in the normal standby condition. The initiating device circuit (or detector) is then to be placed in alarm to actuate

the alarm verification cycle of the control unit and restored to the nonalarm condition. At the beginning, middle, and end of the alarm confirmation period, the initiating device circuit (or detector) is to be placed in alarm at which time the control unit is to alarm.

Added 37.4.3 effective August 3, 1998

37A Two-Wire Smoke Detector Compatibility Tests

37A.1 Operating voltage determination

37A.1.1 The voltage range determined during 37A.1.2 (a) – (e) shall not be below the minimum, nor above the maximum manufacturer's ratings specified for the control unit initiating circuit.

Added 37A.1.1 effective August 3, 1998

37A.1.2 For control unit-smoke detector compatibility considerations, the operating voltage of an initiating device circuit is determined while the control unit is operating at each of the conditions specified in (a) – (e) as follows:

- a) Rated primary and secondary input voltage and rated load conditions.
- b) Overvoltage condition of ac input, as described in 40.1, with no load on the control unit, the initiating circuit disconnected from the end-of-line device, and the standby power source disconnected.
- c) Overvoltage condition of the standby input voltage, as described in 40.1, with no load on the control unit, the initiating circuit disconnected from the end-of-line device, and the primary power source disconnected.
- d) Undervoltage condition of ac input, as described in 39.1, with maximum rated load connected to the control unit and standby power source disconnected.
- e) Primary ac supply disconnected, standby voltage adjusted to 85 percent of rated voltage, and maximum load connected to the control unit. See 39.3.

Added 37A.1.2 effective August 3, 1998

37A.1.3 The operating voltage of a two-wire smoke detector is considered compatible with an initiating device circuit if the detector's operating voltage range coincides with or overlaps the initiating circuit's rated voltage range at both the high and low end.

Added 37A.1.3 effective August 3, 1998

37A.2 Alarm threshold impedance

37A.2.1 The initiating circuit of a control unit shall be rated to indicate the maximum impedance that will reliably trip the circuit into the alarm condition.

Added 37A.2.1 effective August 3, 1998

37A.2.2 Compliance with 37A.2.1 is determined by connecting a variable resistor in parallel with the end-of-line device and slowly reducing the resistance until the control unit latches into the alarm condition.

Added 37A.2.2 effective August 3, 1998

37A.2.3 The test is to be repeated for 37A.1.2 (a) – (e). The lowest resistance setting recorded that will trip the alarm condition shall be equal to or greater than the rated value.

Added 37A.2.3 effective August 3, 1998

37A.3 Maximum current limitation

37A.3.1 Some two-wire smoke detectors that do not include internal current limitation are susceptible to damage during the alarm condition if the available initiating circuit current exceeds the detector maximum current ratings. A two-wire detector would be considered compatible with a control unit initiating circuit if the maximum available initiating circuit current does not exceed the maximum alarm current rating of the noncurrent limited detector, when the initiating circuit is loaded with a single detector, or equivalent impedance, in the alarm condition.

Added 37A.3.1 effective August 3, 1998

37A.3.2 Compliance with 37A.3.1 is determined by connecting a variable resistor and ammeter across the initiating circuit and reducing the resistance to not less than the minimum equivalent impedance of the detector in the alarm condition until maximum current is recorded. This test is repeated for 37A.1.2 (a) – (e). The maximum recorded current shall not exceed the manufacturer's ratings.

Added 37A.3.2 effective August 3, 1998

37A.4 Multiple detector alarm capacity

37A.4.1 A control unit initiating circuit intended to respond to or support more than one smoke detector in the alarm condition shall maintain a rated voltage as determined by 37A.1.2 (a) – (e) while connected to the minimum impedance that would be imposed by one or more detectors in the alarm condition.

Added 37A.4.1 effective August 3, 1998

37A.5 Detectors with optional components

37A.5.1 Some smoke detectors incorporate optional components such as relays and audible devices. These optional components are intended to operate during the alarm condition, and therefore, the initiating circuit shall maintain rated voltage during the alarm condition to provide intended operation of these optional components.

Added 37A.5.1 effective August 3, 1998

37A.5.2 If a control unit initiating circuit is intended to be used with a detector as described in 37A.5.1, the control unit shall be rated to indicate the minimum impedance during the alarm condition that will permit minimum rated alarm condition voltage during conditions 37A.1.2. (a) – (e).

Added 37A.5.2 effective August 3, 1998

37A.6 Dynamic load immunity

37A.6.1 A control unit having initiating device circuits intended for use with two-wire smoke detectors with pulsing normal operating current shall not false alarm due to the random pulsing load presented by the maximum number of detectors permitted to be connected to the circuit.

Added 37A.6.1 effective August 3, 1998

37A.6.2 The control unit is to be energized from a source of rated voltage and frequency and the maximum number of two-wire smoke detectors specified in the installation wiring diagram are to be connected to an initiating device circuit. The combination is to be operated in the normal supervisory condition for 30 days. During that time, no false alarms shall occur. The test is to be repeated for each type and combination of smoke detector specified on the installation wiring diagram.

Exception: A control unit that provides an alarm retard of 1 – 3 seconds on the initiating device circuit need not be subjected to the test if the two-wire detectors intended to be connected to the circuits have power pulse durations, in seconds, equal to or less than the reciprocal of the maximum number of detectors.

Added 37A.6.2 effective August 3, 1998

37A.7 Electrical supervision

37A.7.1 A control unit, while connected to the maximum number of two-wire detectors indicated on the installation wiring diagram, shall provide supervision of an open circuit beyond the last detector in the initiating device circuit. The trouble signal shall be the same with or without detectors connected.

Added 37A.7.1 effective August 3, 1998

37A.7.2 The control unit shall produce the same type of audible trouble signal when operated under conditions 37A.1.2 (a), (b), and (d).

Added 37A.7.2 effective August 3, 1998

37A.8 Detector reset

37A.8.1 If the initiating circuit contains a detector reset feature, the measured reset voltage shall be less than or equal to that specified for each compatible detector.

Added 37A.8.1 effective August 3, 1998

37A.8.2 In addition to the requirements in 37A.8.1, the circuit reset voltage shall be maintained for an amount of time sufficient to reset the detector.

Added 37A.8.2 effective August 3, 1998

37A.8.3 The circuit shall reset under maximum capacitive loading conditions. The maximum capacitance shall be determined by examining the capacitance produced by each detector as well as the maximum detectors which can be connected to the circuit. If different model detectors can be used on the initiating circuit at the same time, all such combinations shall be examined and the total capacitance calculated.

Added 37A.8.3 effective August 3, 1998

38 Electrical Supervision Test

38.1 The initiating device (detector) circuit and indicating circuit of a household control unit shall be electrically supervised so that a distinctive audible trouble signal will promptly indicate the occurrence of a single break (open) or single ground fault, which would prevent the intended operation for alarm signals by the control unit. Prior to the application of a fault the control unit shall be energized in the intended standby condition while connected to a rated source of voltage and frequency.

Revised 38.1 effective August 3, 1998

38.2 An initiating device circuit of a control unit using radio frequency (RF) transmission is to be supervised in accordance with 60.1.

Exception: Supervision is not required for an initiating device circuit extending not more than 3 feet (0.91 m) from the control unit or not more than 3 feet from a device (transmitter) that provides the required supervised transmission of an alarm at the control unit provided that a test feature or procedure is incorporated to test the operability of the circuit and the 3-foot distance does not include an intervening barrier such as a wall or ceiling. See 73.1(i).

38.3 An open in the primary supply of a household control unit shall be shown by de-energization of the "power on" indicator.

38.4 An open or ground fault in any circuit extending from a household control unit, other than the initiating device circuit, shall not affect the operation of the control unit except for the loss of the function extending from that circuit.

38.5 A single break or single ground fault in any initiating device or indicating device circuit or any circuit extending from the control unit, or interruption and restoration of any source of electrical energy connected to a control unit, shall not cause an alarm signal.

38.6 A fault condition, open ground, or short of other than a fire alarm circuit of a combination control unit shall not affect the fire-alarm signaling.

38.7 A trouble signal shall be distinctive from all alarm signals. In a combination system, both fire-alarm and nonfire-alarm circuits are not prohibited from using the same trouble signal.

38.8 If a silencing means, such as a switch, is provided to de-energize the audible trouble signal, its off-normal position shall be indicated by a trouble light.

39 Undervoltage Operation Test

39.1 A household control unit shall operate successfully for its intended signaling performance while energized at 85 percent of its rated voltage. If provided, a standby battery is to be disconnected during the test.

39.2 The control unit is to be subjected to rated voltage during the intended supervisory condition for at least 3 hours and then tested immediately for the intended signaling condition at the reduced voltage. The voltage is to be reduced by a means which will maintain a stable potential of the required value under the most severe conditions of intended loading.

39.3 When a standby battery is used with the control unit, the reduced voltage value to the control unit battery terminals (leads) is to be 85 percent of the marked rated nominal battery voltage.

39.4 If the maximum impedance of an initiating circuit extended from a control unit is required to be less than 100 ohms in order to obtain successful operation, the undervoltage operation test is to be conducted with the maximum impedance connected to the circuit. If no impedance limitation is indicated in the marking, 100 ohms is to be used in the initiating device circuit.

40 Overvoltage Operation Test

40.1 A household control unit shall be capable of withstanding 110 percent of its rated supply voltage continuously without damage during the intended standby condition and shall operate successfully for its intended signaling performance at the increased voltage.

40.2 The control unit is to be subjected to the increased voltage in the standby condition for approximately 16 hours (overnight) and then tested for its intended signaling performance. For this test zero line impedance is to be used in the initiating device circuit.

41 Voltage and Current Measurements

41.1 Input circuit

41.1.1 The input current of a control unit shall not exceed the marked rating of the control unit by more than 10 percent when the control unit is operated under conditions of intended use while connected to a rated source of supply.

41.2 Output circuit

41.2.1 The measured voltage of a household unit output circuit shall not be more than 130 percent of rated voltage at no load conditions and not less than 100 percent of rated voltage at maximum rated load conditions. The same proportionate limits shall be maintained at the output circuit when the supply voltage is varied between 85 and 110 percent of rating. The rated loads are to be connected with the control unit connected to a rated source of supply.

41.2.2 The measured voltages at the output circuits, with the minimum and maximum (rated) loads applied in turn, shall be compatible with the rating of the device or appliance intended to be connected to the circuit.

41.3 Volt-ampere capacity

41.3.1 *Deleted effective August 3, 1998*

41.3.2 *Deleted effective August 3, 1998*

41A Power-Limited Circuits

41A.1 General

41A.1.1 All field-wiring circuits that derive energy from power sources connected to a control unit shall be classified as a power-limited or nonpower-limited circuit. A circuit shall be considered nonpower-limited unless otherwise identified in the installation documentation and marking on the product.

Added 41A.1.1 effective August 3, 1998

41A.1.2 The power source (or sources) supplying a power-limited circuit shall be either:

- a) Inherently limited requiring no overcurrent protection, or
- b) Limited by a combination of a power source and overcurrent protection devices such that a power-limited circuit has electrical characteristics described in Table 41A.1 for ac circuits or Table 41A.2 for dc circuits.

Added 41A.1.2 effective August 3, 1998

Table 41A.1
Power source limitations for alternating current fire protective signaling circuits

Power source type	Circuit voltage $V_{\max}^a$ (volts)	Power source maximum nameplate ratings, VA (volt-amperes) Current (amps)	Current limitations $I_{\max}^b$ (amps)	Power limitations $(VA)_{\max}^c$ (volt-amperes)	Maximum overcurrent protection (amps)
Inherently limited power source (overcurrent protection not required)	0 to 20	$5.0 \times V_{\max}$ 5.0	8.0	—	—
	Over 20 to 30	100 $100/V_{\max}$	8.0	—	—
	Over 30 to 100	100 $100/V_{\max}$	$150/V_{\max}$	—	—
Not inherently limited power source (overcurrent protection required)	0 to 20	$5.0 \times V_{\max}$ 5.0	$1000/V_{\max}$	250^d	5.0
	Over 20 to 100	100 $100/V_{\max}$	$1000/V_{\max}$	250	$100/V_{\max}$
	Over 100 to 150	100 $100/V_{\max}$	1.0	N.A.	1.0

NOTE — Adapted from the National Electrical Code (NFPA 70), 1993 Edition, copyright National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

^a $V_{\max}$: Maximum output voltage regardless of load with rated input applied.

^b $I_{\max}$: Maximum output current under any noncapacitive load, including short circuit, and with overcurrent protection bypassed, if used. When a transformer limits the output current, $I_{\max}$ limits apply after 1 minute of operation. Where a current limiting impedance is used in combination with a nonpower-limited transformer or a stored energy source, such as a storage battery, in order to limit the output current, $I_{\max}$ limits apply after 5 seconds.

^c $(VA)_{\max}$: Maximum volt-ampere output after 1 minute of operation regardless of load, and with overcurrent protection bypassed, if used. Current-limiting impedance shall not be bypassed when determining $I_{\max}$ and $VA_{\max}$.

^d If the power source is a transformer, $(VA)_{\max}$ is 350 volt-amperes or less when $V_{\max}$ is 15 volts or less.

Added Table 41A.1 effective August 3, 1998

41A.1.3 With regard to 41A.1.2, means that may be used for current limiting include:

- Transformer winding impedance,
- A thermal link embedded within the winding overwrap of a transformer,
- Circuit components (resistors, regulators, transistors, and the like) that comply with the Temperature Test, Section 43, under $I_{\max}$ conditions, and
- Current limiting impedances determined to be suitable for the application (positive temperature coefficient varistor or the like).

Circuit component burnout, permanent (by soldered means or the like) or replaceable fuses, opening of conductors on printed wiring boards, or opening of internal wiring conductors, shall not be used as a means of current limiting.

Added 41A.1.3 effective August 3, 1998

Table 41A.2
Power source limitations for direct current fire protective signaling circuits

Power source type	Circuit voltage $V_{\max}^a$ (volts)	Power source maximum nameplate ratings,		Current limitations $I_{\max}^b$ (amps)	Power limitations $(VA)_{\max}^c$ (volt-amps)	Maximum overcurrent protection (amps)
		VA (volt-amps)	Current (amps)			
Inherently limited power source (overcurrent protection not required)	0 to 20	$5.0 \times V_{\max}$	5.0	8.0	—	—
	Over 20 to 30	100	$100/V_{\max}$	8.0	—	—
	Over 30 to 100	100	$100/V_{\max}$	$150/V_{\max}$	—	—
	Over 100 to 250	$0.030 \times V_{\max}$	0.030	0.030	—	—
Not inherently limited power source (overcurrent protection required)	0 to 20	$5.0 \times V_{\max}$	5.0	$1000/V_{\max}$	250^d	5.0
	Over 20 to 100	100	$100/V_{\max}$	$1000/V_{\max}$	250	$100/V_{\max}$
	Over 100 to 150	100	$100/V_{\max}$	1.0	N.A.	1.0

NOTE — Adapted from the National Electrical Code, ANSI/NFPA 70-1993, copyright National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

^a $V_{\max}$: Maximum output voltage regardless of load with rated input applied.

^b $I_{\max}$: Maximum output current under any noncapacitive load, including short circuit, and with overcurrent protection bypassed, if used. When a transformer limits the output current, $I_{\max}$ limits apply after 1 minute of operation. Where a current limiting impedance is used in combination with a nonpower-limited transformer or a stored energy source, such as a storage battery, in order to limit the output current, $I_{\max}$ limits apply after 5 seconds.

^c $(VA)_{\max}$: Maximum volt-ampere output after 1 minute of operation regardless of load, and with overcurrent protection bypassed, if used. Current-limiting impedance shall not be bypassed when determining $I_{\max}$ and $VA_{\max}$.

^d If the power source is a transformer, $(VA)_{\max}$ is 350 volt-amperes or less when $V_{\max}$ is 15 volts or less.

Added Table 41A.2 effective August 3, 1998

41A.1.4 The overcurrent protection device specified in 41A.1.2 shall be of the noninterchangeable type such that it cannot be renewed in the field with an overcurrent device having a higher current rating.

Added 41A.1.4 effective August 3, 1998

41A.1.5 If the product contains a float battery charger, the $V_{\max}$, $I_{\max}$, and $VA_{\max}$ are to be measured with both the ac power source and the battery connected to the product. If the circuit contains a battery transfer relay or a trickle charge battery circuit, the $V_{\max}$, $I_{\max}$, and $VA_{\max}$ are to be measured first with the product energized only from the ac power source and then measured a second time with the product energized solely from the battery. The battery used during these measurements is to have the largest capacity specified in the manufacturer's installation document and is to be charged for a period of time that will result in the battery being fully charged for this test.

Added 41A.1.5 effective August 3, 1998

41A.1.6 When measuring the $I_{\max}$ and $VA_{\max}$, all overcurrent protection devices of the control unit are to be short-circuited. However, current limiting devices are not to be bypassed and are to remain functional.

Added 41A.1.6 effective August 3, 1998

41A.2 Maximum voltage

41A.2.1 With the circuit energized only from its rated primary power source, the output voltage of the circuit under test is to be measured while the circuit is connected to full rated load and under open circuit conditions. The maximum voltage under these two conditions is to be considered $V_{\max}$. If the product incorporates a secondary source of supply, the test is to be repeated with the circuit energized solely from the secondary power source and with the primary source disconnected. The $V_{\max}$ value obtained from each power source is to be considered separately when applying the requirements in Tables 41A.1 or 41A.2.

Added 41A.2.1 effective August 3, 1998

41A.3 Maximum current

41A.3.1 In order to determine compliance with the $I_{\max}$ limitation, a variable load resistor is to be connected across the circuit. While monitoring the current through the load resistor, the load resistor is to be adjusted from open circuit to short circuit as quickly as possible and the highest current noted. The load resistor is then to be readjusted to produce the highest current obtained and the current through the load resistor is to be measured after 1 minute or after 5 seconds as determined by Tables 41A.1 or 41A.2.

Added 41A.3.1 effective August 3, 1998

41A.3.2 If the maximum current through the load resistor cannot be maintained for 5 seconds due to current limiting devices (opening of thermal link, power supply foldback, PTC varistor affect, and the like), the circuit load resistor is to be adjusted to a value that will produce a current just above the $I_{\max}$ value indicated in Tables 41A.1 or 41A.2. The results are acceptable if the $I_{\max}$ value stated in Tables 41A.1 or 41A.2 cannot be maintained for more than 5 seconds.

Added 41A.3.2 effective August 3, 1998

41A.3.3 If a transformer limits the value of $I_{\max}$, and if $I_{\max}$ cannot be maintained for 1 minute due to transformer burnout, a plot of current versus time is to be generated and the graph extrapolated to 1 minute. The results are acceptable if the extrapolated value of $I_{\max}$ at 1 minute does not exceed the $I_{\max}$ limitations as indicated in Tables 41A.1 or 41A.2.

Added 41A.3.3 effective August 3, 1998

41A.4 $VA_{\max}$ (not inherently limited circuits only)

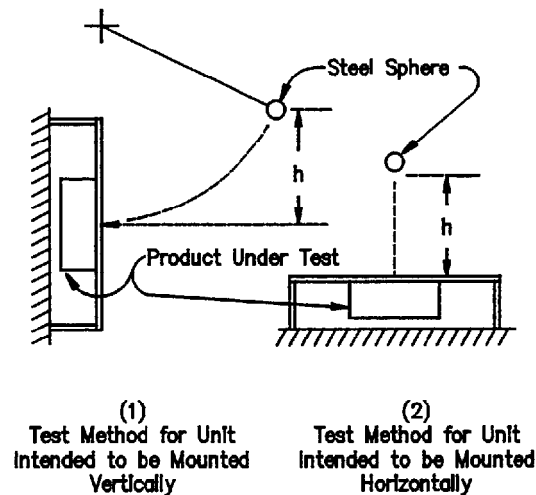
41A.4.1 The circuit is to be energized from a rated source of supply and then the circuit under test open-circuited. A variable load resistor, initially set to draw rated circuit current, is then to be connected across the circuit. The circuit voltage and current are to be recorded and the load is to be removed. The resistance of the load is then to be decreased, momentarily reconnected across the circuit while recording the voltage and current, and then removed. This procedure is to be repeated until the load resistance has been reduced to a short circuit. Using the recorded voltage and current, the maximum volt-ampere, $VA_{\max}$, output under each load condition is to be calculated. The load resistor is then to be adjusted to that value which produced the maximum volt-ampere, $VA_{\max}$, calculated and then connected to the circuit. After 1 minute, the voltage and current are again to be measured. The calculated volt-ampere, VA , output of the circuit after 1 minute shall not exceed the values specified in Tables 41A.1 or 41A.2, as appropriate.

Added 41A.4.1 effective August 3, 1998

42 Jarring Test

42.1 A household control unit and related accessories shall be capable of withstanding jarring resulting from impact and vibration such as experienced in use without causing signaling operation of any part and without affecting adversely the subsequent intended operation. See Figure 42.1.

Figure 42.1
Jarring test



IP110

42.2 The unit is to be mounted in a position of intended use at the center of a 6- by 4-foot (1.8- by 1.2-m), 3/4-inch (19.1-mm) thick plywood board which is secured in place at four corners. Three 3-foot-pound (4.1-J) impacts are to be applied to the center of the reverse side of the board by means of a 1.18-pound (0.54-kg), 2-inch (50.8-mm) diameter steel sphere swung through a pendulum arc from a height (h) of 2.54 feet (64.5 mm) to apply the 3-foot-pound impact.

43.9 The temperature of a copper coil winding is determined by the resistance method by comparing the resistance of the winding at the temperature to be determined with the resistance at a known temperature by means of the formula:

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

in which:

T is the temperature to be determined in degrees C,

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

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

t is the known temperature in degrees C.

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

43.11 To determine compliance with this test, a control unit is to be connected to a supply circuit of rated voltage and frequency and operated under the following conditions:

- a) Normal Standby – 16 hours – Constant temperatures.
- b) Alarm – 1 hour – Audible signal operating.
- c) Alarm – 7 hours – Audible signal silenced.

43A Charging Current Test

43A.1 General

43A.1.1 This test is to be conducted in conjunction with the Temperature Test, Section 43, on products provided with standby batteries. The product shall operate as intended during this test.

Added 43A.1.1 effective August 3, 1998

43A.2 Discharged battery

43A.2.1 The measured voltage of an output circuit with the battery discharged as specified in 43A.2.2 – 43A.2.4 shall not be less than 85 percent of the marked output circuit rating.

Added 43A.2.1 effective August 3, 1998

43A.2.2 The battery is first to be charged by applying AC input power to the product for 48 hours, during which the product is to be operated continuously with the normal standby load connected. AC input is then to be disconnected, and terminal voltage of the battery is to be measured one minute after disconnection.

Added 43A.2.2 effective August 3, 1998

43A.2.3 The battery is then to be discharged by maintaining the normal standby load connected to the output for a minimum of 24 hours, or the marked standby time, whichever is greater.

Added 43A.2.3 effective August 3, 1998

43A.2.4 At the conclusion of the discharge period, maximum (alarm) load is to be applied for 4 minutes. The battery terminal voltage of the discharge battery and the voltage of all output circuits is then to be measured.

Added 43A.2.4 effective August 3, 1998

43A.3 Charged battery

43A.3.1 The voltage of the charged battery as specified in 43A.3.2 shall be at least 95 percent of the voltage measured in 43A.2.2.

Added 43A.3.1 effective August 3, 1998

43A.3.2 At the conclusion of the test sequence described in 43A.2.2 – 43A.2.4, AC input power is to be reapplied to the product for 48 hours. During the charging, the product is to be operated continuously with the normal standby load connected. At the conclusion of the 48-hour recharge time, AC power is to be disconnected and the battery-terminal voltage measured after one minute.

Added 43A.3.2 effective August 3, 1998

43A.4 Discharged battery – second trial

43A.4.1 The measured voltage of all output circuits shall not be less than 85 percent of the marked ratings of the output circuits after the battery has been discharged as specified in 43A.2.3 and 43A.2.4 following the charging as specified in 43A.3.2.

Added 43A.4.1 effective August 3, 1998

44 Overload Test

44.1 Control unit

44.1.1 A household control unit shall be capable of operating in the intended manner after being subjected for 50 cycles of alarm signal operation at a rate of not more than 15 cycles per minute with the supply circuit maintained at 115 percent of rated voltage and frequency. Each cycle shall consist of starting with the control unit energized in the intended standby condition, initiation for an alarm, and restoration to intended standby.

44.1.2 Rated test loads are to be connected to those output circuits of the control unit which are energized from the control unit power supply, such as bells, buzzers, and the like. The test loads are to be those devices, or the equivalent, normally intended for connection. If an equivalent load is used for a device consisting of an inductive load, a power factor of 60 percent is to be used. The rated loads are established initially with the control unit connected to rated supply voltage and frequency, following which the voltage is raised to 115 percent of rating.

44.1.3 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 60 percent when connected to a 60 hertz, rms 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 is to 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.

44.2 Separately energized circuits

44.2.1 A household control unit shall be capable of operating in the intended manner after being subjected to 50 cycles of alarm signal operation at a rate of not more than 15 cycles per minute while connected to a source of rated voltage and frequency and 150 percent rated loads applied to output circuits which do not receive energy from the control unit. There shall not be electrical or mechanical failure of any of the components.

44.2.2 The test loads are to be set at 150 percent of rated current at rated voltage and frequency and 0.6 power factor.

45 Endurance Test

45.1 Control unit

45.1.1 A control unit shall be capable of operating in the intended manner after being subjected to 6000 cycles of signal operation at a rate of not more than 16 cycles per minute with the supply circuit at rated voltage and frequency and with rated devices or equivalent loads connected to the output circuits. There shall not be electrical or mechanical failure or evidence of failure of the control unit components. Each cycle is to consist of starting with the control unit in the intended standby condition, initiation for an alarm, and restoration to intended standby.

45.2 Operating device

45.2.1 An operating device, such as test switch, relay, and the like, supplied as part of a household control unit, or as an accessory, shall be capable of performing in the intended manner when operated for 6000 cycles at a rate of not more than 15 cycles per minute. When an electrical load is involved, the contacts of the device shall be caused to make and break the rated current at the rated voltage. The load is to represent that which the device is intended to control. The endurance tests of the devices may be conducted in conjunction with the endurance test of the control unit. There shall not be electrical or mechanical failure of the device, undue pitting, burning, or welding of the contacts.

46 Variable Ambient Temperature Test

46.1 A household control unit and related accessories shall be capable of operating in the intended manner when the temperature of the ambient air is any temperature over the range from 49 to 0°C (120 to 32°F).

46.2 The unit is to be maintained at each temperature for a sufficient length of time to ensure that thermal equilibrium has been reached, at least 3 hours, and then tested at that temperature for intended operation while connected to a source of rated voltage and frequency.

47 Humidity Test

47.1 A household control unit shall operate in the intended manner while energized from a rated source of voltage and frequency after having been exposed for 24 hours to moist air having a relative humidity of 85 ± 5 percent at a temperature of $30 \pm 2^\circ\text{C}$ ($86 \pm 3^\circ\text{F}$). The performance is to be determined with the control unit in the humidity ambient.

54 Abnormal Operation Test

54.1 A household control unit shall be capable of operating continuously under abnormal conditions without resulting in a risk of fire or electric shock. Leakage current measurements shall not exceed 0.5 milliamperes.

54.2 A unit is to be operated under the most severe abnormal conditions likely to be encountered in service while connected to a source of rated supply. There shall not be emission of flame or molten metal or any other manifestation of a risk of fire. Leakage current following the test is to be measured in accordance with the Leakage Current Test, Section 48.

54.3 In determining if a household control unit complies with the requirements with respect to circuit fault conditions, the fault condition is to be maintained continuously until constant temperatures are attained or until burnout occurs, if the fault does not result in the operation of an overload protective device.

54.4 If a product has provisions for connection to a telephone, telegraph, or outside wiring as covered by Article 800 of the National Electrical Code, ANSI/NFPA 70, the product shall comply with the overvoltage test described in the Standard for Telephone Equipment, UL 1459.

Added 54.4 effective August 3, 1998

SHORT RANGE RADIO FREQUENCY DEVICES

55 General

55.1 These requirements are applicable to control units and systems that utilize initiating, annunciating, and remote control devices that are not interconnected by a solid medium, such as cable, optical fiber, or the like.

55.2 The requirements specified in Sections 1 – 54 shall apply to short range radio frequency (RF) devices except that in the event of conflict, the requirements of this Section shall apply.

55.3 These requirements are applicable:

- a) To a system configuration consisting of multiple transmitters and a single receiver with the transmitters operating on a random basis and
- b) With modifications, to a system using such configurations as multiple receivers or a two-way interrogated response system.

55.4 For low power radio frequency devices initiating circuit transmitters that are powered by a primary battery shall serve only one initiating device.

Added 55.4 effective August 3, 1998

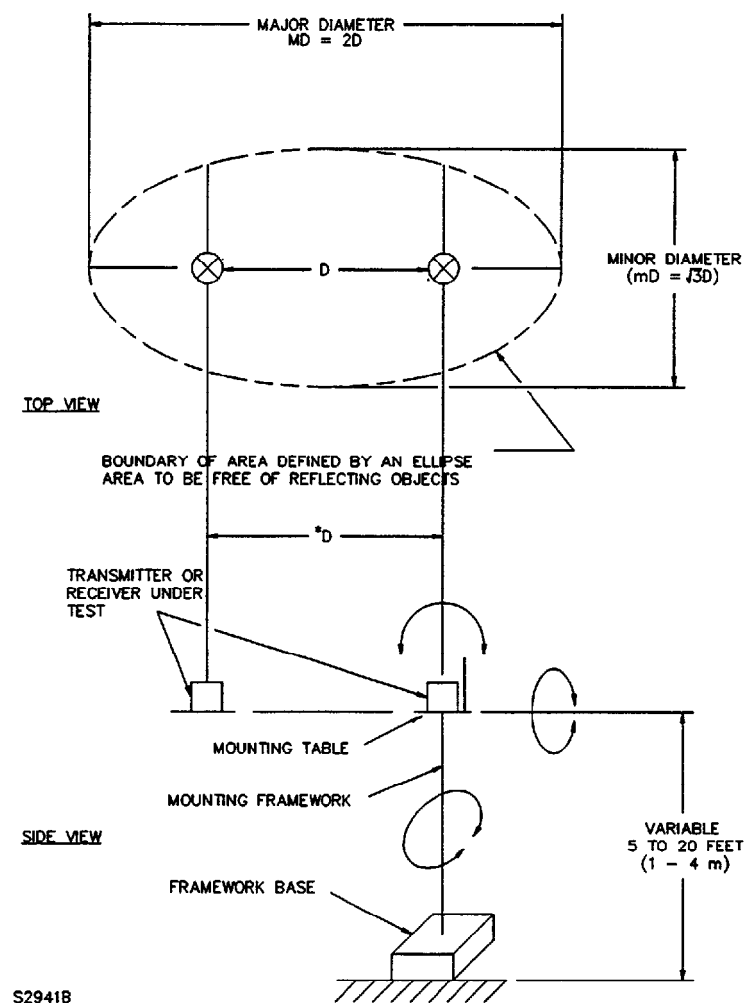
56 Reference Level Determination

56.1 Method 1

56.1.1 The reference level test is not intended to determine the actual service communication range of a transmitter/receiver combination. Rather, this data is utilized as a reference level for the testing specified in Sections 57 – 67. The range determined during the ideal conditions of this test is not to be considered representative of the actual range within a building structure. A transmitter/receiver combination shall operate for its intended signaling performance when tested in a configuration at minimum signal

strength, measured at the receiver, as specified by the manufacturer's installation instructions. The tests are to be conducted in an open, flat area characteristic of cleared, level terrain. Such test sites are to be void of buildings, electrical lines, fences, trees, or the like, free from underground cables, pipes, lines, or the like, except as required to supply and operate the equipment under test, and free of snow and water accumulations. The ambient radio noise level and other undesired signals are to be sufficiently low (see Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 10 kHz to 1 GHz, ANSI C63.4-1981) so as not to interfere with the measurements. Any large reflecting object, such as a metal fence or the like, is to be sufficiently far from the test site so as not to influence the test results. See Figure 56.1.

Figure 56.1
Test site and equipment arrangement



$D =$ For Method 1, manufacturer's maximum specified range, not less than 10 feet (3.05 m). Test site to comply with 56.1.1 within area defined by boundary in top view. If Method 2 is used, $D = 3$ meters (9.84 ft).

NOTE — Signal strength is measured at receiver.