UL 864

STANDARD FOR SAFETY

Control Units and Accessories for Fire Alarm Systems

UL Standard for Safety for Control Units and Accessories for Fire Alarm Systems, UL 864

Eleventh Edition, Dated October 9, 2023

Summary of Topics

This revision of ANSI/UL 864 dated October 25, 2024 has been issued to add exception for components in Monitoring Integrity, 27.3.

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

The revised requirements are substantially in accordance with Proposal(s) on this subject dated August 2, 2024.

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

Commitment for Amendments

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

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

This ANSI/UL Standard for Safety consists of the Eleventh Edition including revisions through October 25, 2024. The most recent designation of ANSI/UL 864 as an American National Standard (ANSI) occurred on October 25, 2024. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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

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Preface

This is the common ULSE and ULC Standard for Control Units and Accessories for Fire Alarm Systems. It is the fifth edition of CAN/ULC 527 and the Eleventh edition of UL 864.

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

This Standard was formally approved by the ULC Standards Committee on Fire Alarm and Life Safety Equipment and Systems and UL Standard Technical Panel on Fire Protection Signaling Equipment.

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

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

Annexes A, B and C are identified as informative and are for informational purposes only.

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

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INTRODUCTION

1 Scope

1.1 This Standard covers requirements as related to the following:

a) Discrete electrical control units and accessories for fire alarm systems including smoke control, releasing, Building System Information Unit (BSIU), and emergency communication systems;

b) Electrically- and electronically-operated amplifiers that provide speech communication and distinctive sounds in conjunction with fire protective signaling systems; and

c) Commercial stationary and fixed power supplies for fire-protective signaling systems, having input and output ratings of not more than 600 V, direct- and alternating-current, (DC and AC).

1.2 This Standard covers requirements for control units, fire alarm systems and control unit accessories to be employed in ordinary (nonhazardous) indoor and outdoor locations in accordance with the following standards as applicable:

a) CSA C22.1, Canadian Electrical Code, Part I, Safety Standard for Electrical Installations

b) NBC, National Building Code of Canada

c) NFPA 12, Standard for Carbon Dioxide Extinguishing Systems

d) NFPA 12A, Standard for Halon 1301 Fire Extinguishing Systems

e) NFPA 13, Standard for the Installation of Sprinkler Systems

f) NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection

g) NFPA 16, Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems

h) NFPA 17, Standard for Dry Chemical Extinguishing Systems

i) NFPA 17A, Standard for Wet Chemical Extinguishing Systems

j) NFPA 70, National Electrical Code

k) NFPA 72, National Fire Alarm and Signaling Code

l) NFPA 92, Standard for Smoke, Control Systems

m) NFPA 750, Standard for Water Mist Fire Protection Systems

n) NFPA 2001, Standard for Clean Agent Fire Extinguishing Systems

o) NFPA 2010, Standard for Aerosol Fire Extinguishing Systems

p) ULC-S524, Standard for the Installation of Fire Alarm Systems.

1.3 The products covered by this standard are intended to be used in combination with other appliances and devices to form a commercial fire alarm system. These products provide all monitoring, control, and indicating functions of the system. An installation document(s) provided with the product describes the various products needed to form a fire alarm system and their intended use and installation.

1.4 This Standard does not cover replacement parts for fire alarm systems that consist of products or subassemblies of complete products manufactured in accordance with previous editions of their respective standards.

1.5 This standard does not cover:

a) Manual boxes, automatic fire detectors, manual releasing stations, other initiating devices (e.g. carbon monoxide, and other similar gas sensors) notification appliances not provided as part of the product; and

b) In the United States only: Abort stations.

1.6 This Standard does not cover devices such as fans, dampers, motors, etc., which perform smoke control functions.

1.7 The term “product” as used in this Standard refers to all items of equipment covered by the Scope.

1.8 These requirements do not include determination of compliance with:

a) In Canada only: The rules and regulations of Innovation, Science and Economic Development Canada.

b) In the United States only: The rules and regulations of the Federal Communications Commission (FCC).

2 Components

2.1 A component of a product covered by this standard shall comply with the requirements for that component. Refer to Annex C for a list of standards covering components used in the products covered by this Standard.

Exception: A component shall not be required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard; or

b) Is superseded by a requirement in this standard.

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

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

3 Units of Measurement

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

4 Reference Publications

4.1 Where reference is made to other publications, such reference shall be considered to refer to the latest edition and all amendments published to that edition up to the time when this Standard was approved.

4.2 The following publications are referenced in this Standard:

ASA S3.41, *Audible Emergency Evacuation (E2) and Evacuation Signals with Relocation Instructions (ESRI)*

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

ASTM D396, *Standard Specification for Fuel Oils*

ASTM E11, *Standard Specification for Woven Wire Test Sieve Cloth for Test Sieves*

ASTM E230/E230M, *Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples*

Code of Federal Regulations (CFR) 47, Part 15

CSA C22.1, *Canadian Electrical Code, Part I, Safety Standard for Electrical Installations*

CSA C22.2 No. 0.1, *General Requirements for Double Insulated Equipment*

CSA C22.2 No. 0.15, *Adhesive Labels*

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

CSA C22.2 No. 0.4, *Bonding of Electrical Equipment*

CSA 6.19, *Residential Carbon Monoxide Alarming Devices*

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

CSA C22.2 No. 66.1, *Low Voltage Transformers – Part 1: General Requirements*

CSA C22.2 No. 66.2, *Low Voltage Transformers – Part 2: General Purpose Transformers*

CSA C22.2 No. 66.3, *Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers*

CSA-C22.2 No. 94, *Special Purpose Enclosures Industrial Products*

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

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

CSA 60065, *Audio, Video, and Similar Electronic Apparatus – Safety Requirements*

CSA-E60384-1, *Fixed Capacitors for Use in Electronic Equipment – Part 1: Generic Specification*

CSA C22.2 No. 60950-1A and 1B, *Information Technology Equipment – Safety – Part 1: General Requirements, with Amendments 1 and 2*

CSA-C22.2 No. 62368-1, *Audio/Video, Information and Communication Technology equipment – Part 1: Safety requirements*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3 : Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-20, *Electromagnetic compatibility (EMC) – Part 4-22: Testing and measurement techniques – Radiated emissions and immunity measurements in fully anechoic rooms (FARs)*

IEEE Y32.9, *Graphic Symbols for Electrical Wiring and Layout Diagrams Used in Architecture and Buildings Construction*

ISO 9001, *Quality Management Systems-Requirements*

MIL-HDBK-338, *Military Handbook: Electronic Reliability Design Handbook*

MIL-STD-750F, *Department of Defense Test Method Standard: Test Methods for Semiconductor Devices*

MIL-STD 883H, *Test Method Standard for Microcircuits*

NBC, *National Building Code of Canada*

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*

NFPA 70, *National Electrical Code*

NFPA 72, *National Fire Alarm and Signaling Code*

NFPA 90A, *Standard for Installation of Air-Conditioning and Ventilating Systems*

NFPA 2001, *Standard for Clean Agent Fire Extinguishing Systems*

NFPA 2010, *Standard for Fixed Aerosol Fire Extinguishing Systems*

RSS-Gen, *Innovation, Science, and Economic Development Canada Radio Standards Specification*

Title 46, *Shipping, Chapter I-Coast Guard, Dept. of Transportation*

UL 38, *Manual Signaling Boxes for Fire Alarm Systems*

UL 50, *Enclosures for Electrical Equipment, Non-Environmental Considerations*

UL 268, *Smoke Detectors for Fire Alarm Systems*

UL 268A, *Smoke Detectors for Duct Application*

UL 310, *Electrical Quick-Connect Terminals*

UL 464, *Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories*

UL 486A-486B, *Wire Connectors*

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

UL 497A, *Secondary Protectors for Communications Circuits*

UL 497B, *Protectors for Data Communication and Fire Alarm Circuits*

UL 521, *Heat Detectors for Fire Protective Signaling Systems*

UL 746C, *Polymeric Materials – Use in Electrical Equipment Evaluations*

UL 1012, *Power Units Other Than Class 2*

UL 1059, *Terminal Blocks*

UL 1097, *Double Insulation Systems for Use in Electrical Equipment*

UL 1449, *Surge Protective Devices*

UL 1480, *Speakers for Fire Alarm and Signaling Systems, Including Accessories*

UL 1638, *Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories*

UL 1971, *Signaling Devices for the Hearing Impaired*

UL 2034, *Single and Multiple Station Carbon Monoxide Alarms*

UL 2043, *Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces*

UL 2075, *Gas and Vapor Detectors and Sensors*

UL 60950-1, *Information Technology Equipment – Safety – Part 1: General Requirements*

UL 62368-1, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

ULC-S102, *Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies*

ULC-S524, *Installation of Fire Alarm Systems*

ULC 525, *Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories*

ULC 526, *Visible Signaling Devices for Fire Alarm Systems, Including Accessories*

ULC S528, *Manual Stations for Fire Alarm Systems, Including Accessories*

ULC 529, *Smoke Detectors for Fire Alarm Systems*

ULC 530, *Heat Actuated Fire Detectors for Fire Alarm Systems*

ULC 536, *Inspection and Testing of Fire Alarm Systems*

ULC 538, *Single and Multi-Criteria Carbon Monoxide Alarms for Non-Residential Applications*

ULC 541, *Speakers for Fire Alarm and Signaling Systems, Including Accessories*

ULC 559, *Equipment for Fire Signal Receiving Centres and Systems*

ULC 588, *Gas and Vapor Detectors and Sensors*

5 Glossary

5.1 For the purpose of this standard, the following definitions apply:

5.2 ACCESS CODE – A unique alpha/numeric or similar set of characters that, when entered into a software-controlled control unit, grants access to one or more levels of system operation.

5.3 ACKNOWLEDGE – Action taken to confirm that a message or signal has been received, such as pressing a button.

5.4 ACTIVE MULTIPLEX SYSTEM – A system employing a communication method characterized by simultaneous or sequential transmission, or both, and reception of multiple signals, including a means for positively identifying each signal. Employs devices such as transponders and transceivers to transmit status signals of each initiating device within a prescribed time interval so that lack of receipt of such signal is to be interpreted as a trouble signal.

5.5 ADVERSE CONDITION – Any condition occurring in a circuit or communication path that interferes with the proper signaling or interpretation of status-change signals or both. Conditions include radio frequency interference.

5.6 AIR-HANDLING SPACE – Space used for environmental air-handling purposes other than ducts or plenums. The space over a hung ceiling used for environmental air-handling is an example.

5.7 ALARM CONDITION – The state of the control unit wherein an alarm response is generated and all required signaling and activations occur.

5.8 ALARM VERIFICATION (STATUS CHANGE CONFIRMATION) – A feature of automatic fire-detection and alarm systems to reduce unwanted alarms wherein smoke detectors report alarm conditions for a minimum period of time, or confirm alarm conditions for a given period of time after reset, in order to be accepted as a valid alarm initiation.

5.9 ANNUNCIATOR – A system component containing one or more indicator lamps, alphanumeric displays, or other equivalent means in which each indication provides status information about a circuit, condition, or location.

In Canada only: As specified in the National Building Code of Canada.

5.10 AUTHORITY HAVING JURISDICTION (AHJ) – The government body responsible for the enforcement of any part of this Standard or the official or agency designated by that body to exercise such a function.

5.11 BUILDING – Any structure used or intended for supporting or sheltering any use or occupancy.

5.12 CHANNEL – A path for voice, data, or signal transmission. This may utilize the modulation of light, radio frequency, current, or voltage within a frequency band or other technologies.

5.13 CIRCUIT CLASSIFICATIONS:

a) Hazardous Voltage Circuit – A circuit involving a potential of not more than 300 volts nominal and having characteristics in excess of those of a non-hazardous voltage circuit.

b) Non-hazardous voltage Circuit – A circuit involving a potential of not more than 30 volts alternating current (AC) rms, 42.4 volts direct current (DC) or peak.

c) Power-Limited Circuit – A circuit wherein the power is limited as specified in Table 73.1 and Table 73.2.

5.14 CIRCUIT TYPES:

a) Ancillary Circuit – A circuit which connects a control unit and/or transponder to ancillary devices, located within the protected premises.

b) Communications Circuit – A circuit or path connecting subsidiary/satellite station(s) to supervising station(s) over which signals are carried.

c) External Circuits – Circuits or wiring leaving the product.

d) Initiating Device Circuit – Circuit to which automatic or manual initiating devices are connected where the signal received does not identify the individual device operated.

e) Input Circuit – A circuit connected directly to conventional field devices and employed to provide a control unit and/or transponder with field device status information.

f) Notification Appliance Circuit – A circuit or path directly connected to a notification appliance.

g) Output Circuit – A circuit connected directly to field devices and employed to provide an alert signal, alarm signal or other output functions.

NOTE: The following are considered typical examples of control unit outputs and may utilize conventional field devices, active field devices, or supporting field devices (For data communications link operations):

1) Signaling circuits – visual and/or audible tone and voice circuits used to notify occupants;

2) Releasing device circuits energized by the control unit;

3) Remote visual display circuits;

4) Smoke control circuits;

5) Non-extinguishing and non-water based releasing circuits;

6) Other ancillary circuits powered by the fire alarm system; and

7) Power circuits.

h) Polarity Reversal Circuit – Direct-current circuit employed where an alarm condition results in a polarity reversal on a communications or transmission line.

i) Signaling Line Circuit (SLC) – A circuit or path between any combination of circuit interfaces, control units, or transmitters over which multiple-system input signals or output signals, or both, are carried.

j) Supplementary-Device Circuit – A circuit provided by a product for controlling a device, the operation of which is supplementary to the primary initiating and indicating devices of the control unit.

In Canada only:

NOTE: A supplementary-device circuit is referred to as an ancillary circuit which connects a control unit and/or transponder to ancillary devices, located within the protected premises.

5.15 COMBINATION SYSTEM – A system within the scope of this standard whose components might be used, in whole or in part, with other systems.

5.16 COMPATIBLE – The correct electrical, electronic, or mechanical interaction between a series of system components that depend on individual unique characteristics and are connected together to meet the requirements of this Standard (e.g., control unit and/or transponder and field devices).

5.17 CONTROL UNIT – A component which provides the control and logic processing for a fire alarm system.

5.18 CONTROL UNIT ACCESSORY – A device or appliance externally connected to a control unit that is employed to assure proper 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, remote switches, fault isolators and the like.

5.19 CONTROL UNIT, PROTECTED PREMISES – A unit that directly or indirectly monitors the status of initiating devices, processes any status-change signals, and performs logical control to generate output signals required by the system type.

5.20 CONTROL UNIT, SUPERVISING STATION – A unit that directly or indirectly receives status-change signals from one or more protected-premises control units and performs processing and logical control to generate output signals required by the system type.

5.21 CONTROL UNIT SYSTEM TYPES –

a) Auxiliary – A system that uses the municipal fire alarm system for transmitting an alarm of fire to the public fire service communications center. Fire-alarm signals transmitted from the premises are received at the public fire service communications center on the same equipment and by the same method as alarms transmitted manually from the fire alarm boxes located on the street.

b) Central Station – A system in which status-change signals at a protected premises are automatically transmitted to a central supervising station where competent and experienced personnel take appropriate action in response to a received signal. The central supervising station is controlled and operated by a person, firm, or corporation whose business includes the furnishing, maintaining, or monitoring of supervised fire alarm systems.

c) Local – A system located at the protected premises which indicates alarm, trouble and supervisory conditions via notification appliances within the protected premises.

d) Marine – A local protected premises system that is intended to be installed aboard a commercial vessel.

e) Proprietary – Local control unit installed at the protected premises with provision for connection via a transmission channel to a Proprietary Receiving Unit. A system in which status change signals occurring at the protected premises are automatically transmitted to an on-premise supervising station where trained, competent personnel take appropriate action in response to a received signal. The protected property may be contiguous or non-contiguous but must be under one ownership.

f) Releasing – A local protected premises system that also initiates release of an extinguishing agent upon the detection of an alarm condition.

g) Remote Station – A system in which status change signals occurring at a protected premises are transmitted to a supervising station at a public fire services communications center, a fire station, or a similar governmental agency that has a public responsibility for taking prescribed action to ensure response upon receipt of a fire alarm signal. Trouble and supervisory signals may be transmitted to a supervising station at a different location.

h) Smoke Control – A system which, during an alarm condition, provides selective and overriding control of mechanical fans, dampers, and the like to produce airflow and pressure differences across smoke barriers to limit and direct smoke movement. A system is categorized as either or both of the following types:

1) Dedicated – A system which is normally inactive and is used exclusively for the purpose of smoke control.

2) Nondedicated – A system which provides the building heating-ventilating-air conditioning (HVAC) function under normal conditions and provides a smoke control objective during a fire alarm condition.

5.22 DATA COMMUNICATION LINK (DCL) – The data channel between control units and/or transponders, annunciators, active field devices and supporting field devices of a distributed type system or a remote receiving equipment control unit.

5.23 DEGRADED MODE CAPABILITY – A feature where, under conditions of partial data communication link failure, control units and/or transponders, which remain connected to each other, are capable of receiving inputs and activating outputs in the areas served by the control units and/or transponders which remain in communication with each other.

5.24 DERIVED CHANNEL – A circuit that uses the local leg of the public switched network as an active multiplex channel while simultaneously allowing that leg's use for normal telephone communications.

5.25 DEVICE TYPES:

a) Active Field Device – A field device that can be uniquely identified by a control unit and/or transponder to determine its presence and operating status, and which may be commanded to operate or to change its operating parameters independently of other field devices that share a common circuit.

b) Addressable Device – A fire alarm system component with discrete identification that can have its status individually identified or that is used to individually control other functions.

c) Analog Initiating Device (Sensor) – An initiating device that transmits a signal indicating varying degrees of conditions as contrasted with a conventional device, which can only indicate an alarm/no alarm condition.

d) Ancillary Device – A device which has a life-safety application, and is connected to the fire alarm system, but is not part of the fire alarm system.

e) Conventional Field Device – A field device that is usually connected to a control unit and/or transponder on a common wiring circuit with other devices so that all devices on the circuit provide a common status change information (e.g. fire alarm detection or signaling). Such devices cannot be uniquely identified by a control unit and/or transponder unless there is only one device on the circuit. (Refer to active field device).

f) Emergency Control Function Interface Device – A fire alarm or signaling system component that directly interfaces with the system that operates the emergency control function.

g) End-Of-Line Device – A device installed at the end of a circuit for the purpose of monitoring the circuit for fault conditions.

h) Field Device – A device located remotely from, but connected electrically to, a control unit and/or transponder to transmit or receive status change information (e.g. fire alarm detection or signaling).

i) Initiating Device – A manually or automatically operated device, the normal intended operation of which results in signal indication from the product/system. Examples of alarm-initiating devices are thermostats, manual boxes, smoke detectors, water-flow switches, and proof sensors. Examples of supervisory signal-initiating devices are water-level indicators, sprinkler-system valve-position signals, pressure supervisory transmitters, and water-temperature switches.

j) Long-Range Radio-Frequency Devices – Any device that communicates between a protected premises and a subsidiary station, supervising station, or another protected premises using a private radio network.

k) Manual Abort Device – A self-restoring control unit accessory that allows manual initiation of the abort feature of the fire alarm control unit.

l) Manual Release Device – A device that allows manual initiation of the manual release feature.

m) Prerecorded Message Device – An automatically- or manually-actuated device intended to translate a pre-recorded message stored on a tape or other medium into an electronic signal that when amplified and introduced into speakers produces vocal or tonal information.

n) Short-Range Radio Frequency Device – Any device that communicates with control/receiving equipment at the protected premises by low-power radio signals in accordance with:

1) In Canada only: RSS-Gen

2) In the United States only: CFR 47, Part 15

NOTE: Short-range radio frequency device links are commonly referred to as wireless device links and may be subject to the requirements of Innovation, Science, and Economic Development Canada Radio Standards Specification.

o) Signaling Device – A component that provides audible, tactile, or visible outputs or any combination thereof.

p) Supplementary Device – A device that has not been investigated to this Standard intended to be connected to a supplementary device circuit.

q) Supporting Field Device – An active field device that monitors and/or controls other field devices on a separate circuit and reports the status of the separate circuit to the control unit.

5.26 DIGITAL ALARM COMMUNICATOR RECEIVER (DACR) – A system component that accepts and displays signals from digital alarm communicator transmitters (DACTs) sent over the public switched telephone network.

5.27 DIGITAL ALARM COMMUNICATOR SYSTEM (DACS) – A system in which signals are transmitted from a digital alarm communicator transmitter (DACT), located remote from the supervising station, through the public-switched telephone network to a digital alarm communicator receiver (DACR).

5.28 DIGITAL ALARM COMMUNICATOR TRANSMITTER (DACT) – A system component to which initiating devices or groups of devices are connected. The DACT seizes the connected telephone line, dials a pre-selected number to connect to a DACR, and transmits signals indicating a status change.

5.29 DIGITAL ALARM RADIO RECEIVER (DARR) – A system component that receives and decodes radio signals.

5.30 DIGITAL ALARM RADIO SYSTEM (DARS) – A system in which signals are transmitted from a digital alarm radio transmitter (DART) located remote from the supervising station through a radio channel to a digital alarm radio receiver (DARR).

5.31 DIGITAL ALARM RADIO TRANSMITTER (DART) – A system component to which initiating devices or a group of devices are connected.

5.32 DIGITIZED VOICE – A pre-recorded, digitally stored voice message that may be activated in the event of an emergency or other conditions.

5.33 DISPLAY – The visual representation of output data or status information, other than printed copy.

5.34 In Canada only:

DISPLAY AND CONTROL CENTRE (DCC) – Equipment used for the status display of required input zones (as specified in the sections: Annunciator and Zone Indication, and Central Alarm and Control Facility, of the National Building Code of Canada) and for the manual control of a fire alarm system, which may include manual control for emergency voice alarm and emergency telephone functions. The display and control centre may be located remotely from a fire alarm control unit and/or transponder.

5.35 DISTRIBUTED TYPE SYSTEM – A system consisting of two or more control units and/or transponders, one of which operates as the display and control center.

5.36 DRIFT COMPENSATION – A feature of a smoke detector or control unit that monitors and automatically maintains alarm sensitivity.

5.37 EMERGENCY CONTROL FUNCTION – Building, fire, and emergency control functions that are intended to increase the level of life safety for occupants in order to control the spread of the harmful effects of fire or other dangerous products.

5.38 EMERGENCY TELEPHONE – A feature of a fire alarm system, which provides two-way voice communication between each floor area and a display and control center and/or the equipment at a central alarm and control facility.

5.39 EMERGENCY VOICE/ALARM COMMUNICATIONS – Dedicated manual or automatic facilities for originating and distributing voice instructions, as well as evacuation signals pertaining to a fire emergency, to the occupants of a building.

5.40 ENDPOINT (DCLN) – The end of the pathway where a single addressable field device is connected.

5.41 EVACUATE POWER – Rated output power for a square wave used for evacuation purposes.

5.42 EVACUATION – The withdrawal of occupants from a building.

5.43 EVENT – Status change that requires visual indication or visual and audible indication as applicable.

5.44 FAULT – An open, ground, or short-circuit condition on any line extending from a product.

5.45 FAULT ISOLATOR – A device or feature used to limit the consequences of a wire to wire short or the consequences of low-parallel-resistance faults between lines of a transmission path.

NOTE: A fault isolator may be a physically separate field device or it may be incorporated into another device apart from the control unit such as a smoke detector or a smoke detector base.

5.46 FIELD WIRING – Conductors to be installed by others to connect a product to source(s) of supply, devices, other products, and loads.

5.47 FIRE ALARM SYSTEM – A combination of interconnected devices consisting of at least a control unit, a manual station and an audible signal device, designed to warn the building occupants of an emergency fire condition.

5.48 FIRE COMMAND CENTER – The principal attended or unattended location where the status of the detection, alarm communications, and control systems is displayed and from which the system can be manually controlled.

5.49 FIREFIGHTER'S SMOKE CONTROL STATION (FSCS) – A product that includes monitoring and overriding control capability over smoke control systems and equipment for the use of the fire department.

5.50 FIRE SIGNAL RECEIVING CENTER – A unit or centre that directly or indirectly receives status change signals from one or more protected-premises signal transmitting units and performs processing and logical control to generate output signals required by the system type while monitored at all times by trained personnel designated by the owners of the protected properties.

5.51 FIXED EQUIPMENT – Any equipment product that is intended to be permanently connected electrically to the wiring system.

5.52 GAUGES – Wherever they appear in this standard, the abbreviations MSG, GSG, and AWG mean, respectively, Manufacturers' Standard Gauge for Steel Sheets, Galvanized Sheet Gauge, and American Wire Gauge. Reference to sheet metal by gauge number is intended only as auxiliary information. Sheet metal of the indicated gauge number may not be used if the forming processes have reduced the thickness of the sheet to a point below the specified minimum thickness.

5.53 GATEWAY – A device that is used in the transmission of digital or analog data from the fire alarm control unit to other building-systems control units, equipment, or networks, and/or from other building-system control units to the fire alarm system.

5.54 GENERAL ALARM – An alarm signal transmitted throughout the protected premises.

5.55 GROUNDED CONDUCTOR – A conductor employed to connect the intentionally grounded circuit of a wiring system to a grounding electrode.

5.56 GROUND FAULT – A circuit impedance to ground sufficient to result in the annunciation of a trouble condition.

5.57 GROUNDING CONDUCTOR – A conductor employed to connect non-current-carrying parts of equipment, raceways, and enclosure to a grounding electrode at the service which is, in turn, connected to earth ground or to some conducting body which serves in place of earth ground.

5.58 HEAT DETECTOR – A fire detector designed to operate at a predetermined temperature or rate of temperature rise.

5.59 INPUT ZONE – An area or field device within a building which initiates annunciator indication as required by government laws, codes or standards, or other parts of this Standard.

5.60 INSTALLATION LOCATIONS:

a) Damp – A location protected from sun, rain, and water, but may be subject to moisture. Such locations may include basements, barns, cold-storage warehouses, greenhouses, indoor swimming facilities, and the like. They may also include partially protected locations under canopies, marquees, roofed open porches, and the like.

b) Dry – A location with a controlled ambient that is not subject to dampness or wetness.

c) Wet – A location subject to rain (or the spray of noncorrosive and nonflammable liquids) that may become saturated with water or that is unprotected from the weather.

5.61 INTERCOM – Two-way voice-communication equipment intended for fire-emergency use.

5.62 KEYPAD – A means of manually controlling the product. Provided with a visual-indicating device containing identified targets or indicator lamps, alphanumeric displays, or other equivalent means, in which each indication provides status information about a circuit, condition, and/or location.

5.63 LEG FACILITY – That part of the communication channel that connects each protected building or premises to the trunk facility.

5.64 In the United States only:

LIFE SAFETY NETWORK – A type of combination system that transmits emergency communication system and fire data to another life safety system.

5.65 LOCAL AREA NETWORK (LAN) – A local area high speed communication network that spans a single or group of buildings that does not form part of the public communications network.

5.66 MANUAL STATION – A field device designed to initiate a signal when operated manually.

5.67 MESSAGE(S) – Communicated data that contains specific information relating to the status of the product and is transmitted via a wired or wireless pathway from an origin to a destination.

5.68 MONITORING FOR INTEGRITY – A means whereby a fault condition which could interfere with the operation of a circuit in a fire alarm system is detected.

NOTE: Monitoring for integrity may be referred to as electrical supervision in other Codes and Standards.

5.69 MULTIPLEX – A signaling method using wire path, cable carrier, radio, or combinations of these facilities characterized by the simultaneous and/or sequential transmission and reception of multiple signals in a communication channel including means for positively identifying each such signal.

5.70 MULTI-CHANNEL SELECT ZONE SYSTEM – An emergency voice communication system capable of providing more than three separate audio signals simultaneously to selected zones.

5.71 NONVOLATILE MEMORY – A storage device not alterable by the interruption of the power to the memory; for example, ROM, FLASH, PROM, EPROM, and EEPROM.

5.72 NOTIFICATION APPLIANCE – A component that provides audible, tactile, or visual outputs or any combination thereof.

5.73 OFF-HOOK – To make connection with the public-switched telephone network in preparing to dial a telephone number.

5.74 ON-HOOK – To disconnect from the public switched telephone network.

5.75 OPEN FAULT – A circuit impedance increase sufficient to prevent normal operation.

5.76 OPERATOR – Individual(s) responsible to access and operate the product and/or system.

5.77 OPERATOR INTERFACE – Providing one or more displays and/or means of controls for manually operating the product/system. This interface may be, but is not limited to, a Graphical User Interface (GUI) such as a computer screen, a Liquid Crystal Display (LCD), a Human-Machine Interface (HMI), or other audible/visible/tactile indicators.

5.78 PATH (PATHWAY) – Any conductor, optic fiber, radio carrier, or other means for transmitting information between two or more units and/or locations.

5.79 PORTABLE EQUIPMENT – A product that is easily carried or conveyed by hand. When intended to be connected to a hazardous voltage circuit, the product is provided with a power supply cord for connection to the supply circuit.

5.80 POSITIVE ALARM SEQUENCE – An automatic sequence that results in an alarm signal, even when manually delayed for investigation, unless the system is reset.

5.81 POWER SUPPLY – A source of electrical operating power including the circuits and terminations connecting it to the dependent product/system components.

5.82 POWER SUPPLY-BATTERY CHARGER – A power supply that serves the dual function of providing operating power and charging storage batteries. The power supply is usually permanently connected to storage batteries, and the power supply-battery combination is intended to provide all of the electrical operating power required by the equipment to which the combination is connected, when the equipment is operating in its intended manner.

5.83 PRE-ANNOUNCE TONE – An attention-getting signal to alert occupants of the pending transmission of a voice message.

5.84 PRE-SIGNAL ALARM – An arrangement where the operation of an automatic detector or initial operation of a manual station actuates only a selected indicating-device or devices for the purpose of notifying key personnel who then have the option of initiating a GENERAL ALARM.

5.85 PRIMARY BATTERY (NON-RECHARGEABLE BATTERY) – Any battery which by design or construction is not intended to be recharged.

5.86 PRIVATE-RADIO FREQUENCY SYSTEM – A radio system under the control of the supervising station or other company where only private access to the system is permitted.

5.87 PROPERTY:

a) Contiguous Property – A single owner or single user protected premises on a continuous plot of ground, including any buildings thereon, that is not separated by a public thoroughfare, transportation right-of-way, property owned or used by others, or body of water not under the same ownership.

b) Non-contiguous Property – An owner or user protected premises, where two or more protected premises, controlled by the same owner or user, are separated by a public thoroughfare, body of water, transportation right-of-way, or property owned or used by others.

5.88 PROPRIETARY FIRE ALARM SYSTEM – An on-site facility in which the system is monitored at all times by trained personnel designated by the owners of the protected properties.

5.89 PROTECTED PREMISES – The physical location protected by a fire alarm system.

5.90 RELEASING DEVICE (NON-EXTINGUISHING AND NON-WATER BASED) – Products intended to support loads in connection with releasing automatic or manual operating devices. Examples include solenoids, relays, and actuators, holder/release devices, and devices intended to actuate the locking or unlocking of exits.

5.91 RELEASING DEVICE SERVICE – The control of building safety systems by the fire alarm system (e.g. sprinkler pre-action systems and extinguishing systems). Examples of items which may be controlled include elevators, smoke control and venting systems, fire doors, and extinguishing systems.

5.92 REMOTE ACCESS – A connection between a remote device and a system that enables bi-directional data communications that is not associated with fire signal receiving centre/supervising station unit service.

5.93 REMOTE CONNECTION – A connection on the control unit or transponder which provides status information to remote receiving equipment or a fire signal receiving center.

5.94 REMOTE RECEIVING EQUIPMENT – Control units and/or transponders that receive information from control units and/or transponders in other buildings.

5.95 RESET – A control function that attempts to return a system or device to its normal non-alarm state.

5.96 RESPONSE TIME – The time lapse from the occurrence of an alarm or supervisory input status change or trouble condition to activation of system outputs.

5.97 RISK OF ELECTRIC SHOCK – A risk of electric shock is determined to exist within a circuit unless that circuit meets one of the following criteria:

a) The circuit is supplied by an isolating source such that the maximum open-circuit voltage potential available to the circuit is not more than 30 V AC rms, 42.4 V DC, or 42.4 V peak; or

b) The circuit is supplied by an isolating source such that the current available through a 1500 Ω resistor connected across any potential in the circuit (including to ground) does not exceed 5 mA.

5.98 RISK OF FIRE – A risk of fire is determined to exist within a circuit unless that circuit meets both of the following criteria:

a) The circuit is supplied by a power source such that the maximum open-circuit voltage potential available to the circuit is not more than 30 V AC or 42.4 V DC or peak; and

b) The circuit in which the power available to the circuit is limited to a value less than 15 W.

5.99 SATELLITE/SUBSIDIARY STATION – A normally unattended location capable of being manned, but removed from the supervising station and linked to the supervising station by communication

channel(s). This location interconnects signal-receiving equipment or communications channel(s) from protected buildings or premises to the supervising station.

5.100 SECONDARY POWER SOURCE – Provides power when the primary power source fails.

5.101 SEQUENTIAL DISPLAY – Any visual indicating means which is not capable of displaying all events simultaneously.

5.102 SHORT CIRCUIT FAULT – A circuit impedance decrease sufficient to prevent normal operation.

NOTE: Short-range radio frequency device links are commonly referred to as wireless device links and may be subject to the requirements of Innovation, Science, and Economic Development Canada Radio Standards Specification.

5.103 SIGNALING – Operation of audible and/or visual devices for the purpose of indicating an alert signal or an alarm signal condition.

5.104 SIGNALING LINE CIRCUIT INTERFACE – A system component that connects a signaling line circuit to any combination of initiating devices, initiating-device circuits, notification appliances, notification appliance circuits, system control outputs, and other signaling line circuits.

5.105 SIGNALING TYPES:

a) Alarm Signal – A signal indicating an emergency condition requiring immediate action such as a signal indicative of a fire.

b) Alert Signal – An audible signal to advise designated persons of a fire emergency.

c) Coded Signal – Signal pulsed in a prescribed code for each round of transmission which conveys information to identify the location from which the status-change signal originated.

d) Delinquency Signal – A signal indicating the need for action in connection with a guard tour.

e) 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.

f) Evacuation Signal – Distinctive signal intended to be recognized by the occupants as requiring evacuation of the building.

g) Guard Tour Supervisory Service Signal – A supervisory signal monitoring the performance of guard patrols.

h) Noncoded Signal – Signal from a notification appliance that does not give information on the location of the initiating device which is in the alarm condition.

i) Supervisory Signal – A visual and audible indication of the active status of equipment that has been installed for the protection of life and property.

j) Trouble Signal – An indication of a fault condition of any nature, such as a circuit break or ground or other trouble condition occurring in the device or wiring associated with a protective signaling system.

5.106 SIGNAL TRANSMITTING UNIT – A communication device that transmits signals from the protected premises to the fire signal receiving centre/supervising station.

5.107 SITE SPECIFIC DATA – Alterable data required for the control unit to operate in a defined system configuration (e.g., labelling, zoning, alarm organization).

5.108 SMOKE CONTROL SYSTEM – An engineered system that utilizes mechanical fans and dampers to produce airflows and pressure differences across smoke barriers to limit and direct smoke movement.

5.109 SMOKE DETECTOR – A fire detector designed to operate when the concentration of airborne combustion products exceed a pre-determined level.

5.110 SOFTWARE – Programs, instructions, procedures, data, and the like that are executed by a central processing unit of a product and which influences the functional performance of that product. For the purpose of this standard, software is one of two types:

a) Executive Software – Control and supervisory program which manages the execution of all other programs and directly or indirectly causes the required functions of the product to be performed.

b) Site-Specific Software – Program that is separate from, but controlled by, the executive software which allows inputs, outputs, and system configuration to be selectively defined to meet the needs of a specific installation.

5.111 SPECIFIC TROUBLE INDICATION – A trouble signal which consists of a common trouble signal and a specific visual indication which identifies the failed circuit or item of equipment, or operational malfunction.

5.112 SPEECH POWER – Rated output power while delivering audio frequency signals over the product's rated frequency band within the constraints of the distortion limits specified in this standard.

5.113 STAND ALONE CAPABILITY – An optional feature where, under conditions of data communication link failure, control units and/or transponders are capable of receiving inputs and activating outputs in the area served by that control unit and/or transponder.

5.114 STANDBY BATTERY – Batteries used to provide a secondary power source.

5.115 STATIONARY EQUIPMENT – Any product that is intended to be fastened in place or located in a dedicated space and is provided with a power-supply cord for connection to the supply circuit.

5.116 STATUS CHANGE INDICATION – An indication that results from the change of state of an input circuit from normal to activated.

5.117 STORAGE BATTERY (RECHARGEABLE BATTERY) – Any battery which, by design or construction, is intended to be recharged.

5.118 SUPERVISING STATION – A facility that receives signals and at which personnel are in attendance at all times to respond to these signals.

5.119 SUPERVISING STATION SIGNAL PROCESSING EQUIPMENT – Computer based information technology equipment located at a supervising station, subsidiary station, or remotely located in the signaling path which receives, processes and displays alarm, supervisory and trouble signals for central station, remote station or proprietary services.

5.120 SUPPLEMENTARY – Refers to equipment or operations not required by this standard.

5.121 SUPPLEMENTARY DISPLAY – Refers to a display not required by this standard.

In Canada only:

NOTE: A supplementary display is referred to as an ancillary display.

5.122 SWITCHED-TELEPHONE NETWORK – An assembly of communications facilities and central-office equipment operated jointly by authorized service providers that provides the General public with the ability to establish transmission channels via discrete dialing.

5.123 THREE CHANNEL SELECTIVE ZONE SYSTEM – An emergency voice communication system capable of providing three separate audio signals simultaneously to selected zones.

5.124 TONE GENERATOR – A device intended to generate an electronic signal that, when amplified and introduced into speakers, produces a non-prerecorded, non-vocal, audible signal recognizable as indicating an evacuation condition.

5.125 TRANSMISSION INTERFACE UNIT – A device that provides means to transmit fire alarm system control unit status to remote transmitting, receiving and proprietary fire protective signaling systems equipment.

5.126 TRANSMITTER – A system component that provides an interface between a protected premises unit and the transmission channel.

5.127 TRANSPONDER – A component in a distributed type system, which is capable of receiving inputs and activating outputs and that communicates the status of such devices to the fire alarm system.

5.128 TRUNK FACILITY – The part of the communications channel that connects two or more leg facilities to a central supervising or satellite station.

a) Primary Trunk Facility – The part of a communication channel that connects all leg facilities to a central supervising or satellite station.

b) Secondary Trunk Facility – The part of a communication channel that connects two or more, but not all, leg facilities to a primary trunk facility.

5.129 TWO-STAGE SYSTEM – A system in which an alert signal sounds on any fire-input activation in conjunction with selective alarm signals.

5.130 USER – An individual who operates or services the product.

5.131 VOICE ALARM – General alarm or selective alarm signal by means of live paging and may also include automatic voice messaging.

5.132 WIDE AREA NETWORK (WAN) – A high speed communication network that spans beyond a group of buildings that includes part of the public communications network.

5.133 WIRE-TO-WIRE FAULT – A wire-to-wire (short circuit) fault is determined to be a resistance of 0.1 Ω or less across the circuit.

5.134 ZONE – A defined area within the protected premises. A zone defines an area from which a status indication can be received or an area in which a form of control can be executed.

a) Input Zone – An area or field device within a building which initiates annunciator indication as required by government laws, codes or standards, or other parts of this Standard.

b) Notification Zone – An area covered by notification appliances that are activated simultaneously.

6 Information for Assessment

6.1 The following documentation may be required to determine compliance:

a) Schematic diagrams of all circuits;

b) Bill of materials;

c) Component layout drawings;

d) Assembly drawings;

e) Component specifications;

f) Marking to be applied to the product as required in Sections 62 – 64, Markings;

g) Installation wiring diagram/instructions as required in Section 65, Installation Wiring Diagram/Instructions;

h) Operating instructions as required in Section 66, Operating Instructions;

i) Least favorable system response time calculations showing compliance with the timing requirements of this Standard for any system configuration as described in the Installation Instructions; and

j) Software Integrity information as defined in 10.2.

SOFTWARE

7 General

7.1 Any product that is dependent upon software program(s) to achieve proper operation shall meet all the requirements in this section.

7.2 Where compliance with this standard is dependent upon the proper selection of software features and parameters which are field programmable, one of the following shall be met:

a) The software shall not permit any product operation or contain any programming options that are prohibited by this standard;

b) The software shall be partitioned and identified in the field programming software as complying or not complying with (a); or

c) A summary as described in 65.24 shall be provided in the front of the programming manual describing all programming options and parameters that have the potential for conflicting with the requirements in this standard and stating the proper program selections that would be in accordance with this standard.

Additionally, information shall also appear throughout the manual where the specific feature or option appears describing the requirements of this standard.

7.3 A release level shall identify the executive software of a product. A new release level shall be assigned due to any changes in the executive software.

7.4 With the executive software resident in the product, the release level of the software shall be visibly marked on the product or shall be capable of being displayed on a visual annunciator provided as part of the unit.

7.5 All software shall be resident in nonvolatile storage devices that are sealed against atmospheric contaminants and not subject to mechanical wear of the storage medium. Integrated circuits and sealed hard disk drives are examples of storage devices that meet this requirement.

Exception: Software and data that is of a supplementary nature or software used to initially program the product.

7.6 Where the design of the product requires that status-change signals be stored in memory in order for the signal to be displayed by the control unit, the software shall have sufficient capacity to store not less than the following number of concurrent status changes:

a) Protected premises unit – Total number of initiating-device circuits plus initiating devices connected to all signaling line circuits up to a maximum of 10 or 10 % of the total, whichever is greater.

b) In the United States only: Supervising station unit – 10 % of the total number of transmitters on all transmission channels up to a maximum of 500.

7.7 Where status-change signals are stored in memory and the memory capacity is not capable of storing all possible signals simultaneously, the software design shall prohibit the overflow condition causing corruption of existing stored data or causing the control unit to perform in a degraded mode with regard to the status changes which are stored in memory.

7.8 Software within a fire alarm control system that interfaces to software in another system to provide required functions shall be functionally compatible and the compatibility shall be indicated in the installation instructions of one or both of the compatible systems. This does not apply to supplementary functions.

8 User Access and Programming

8.1 The executive program shall not be accessible for change, modification, or addition by the user, nor shall program execution depend upon site specific programming by the user.

8.2 Site-specific programming is not prohibited from being performed at the factory or in the field. When the product permits programming in the field, the extent of the programming shall be limited to the following:

a) Assignment and mapping of protected premises output circuits where there is a procedure or product feature that allows the programmer or AHJ to readily verify and review all programming. Mapping of input circuits to a supervising station transmitter output circuit is not permitted and shall be automatically accomplished by the executive program;

b) Setting of parameters and variables that relate only to topics influenced by use and installation of the product; and

c) In the United States only: Actuation of the supervising-station receiver output circuits (audible visual, recording) shall be automatically accomplished by the executive program without user input.

8.3 A security means shall be provided to restrict unauthorized access to site specific programming. The restriction shall be by physical means or use of access code or special tool. An access code shall provide a minimum of 1000 possible combinations. The security means shall not be the same as the access

means provided to enable the products operational controls or features. The use of different passwords meets the intent of this requirement.

In Canada only:

NOTE: Refer to A5.2.3.

8.4 Initial site-specific programming or any subsequent reprogramming of a protected premises unit shall require manual actuation of the security means at the protected-premises unit. Once activated, programming may be completed on-site or downloaded from an off-site location.

In the United States only:

Exception No. 1: For a proprietary system intended to protect only contiguous properties, program downloading from the supervising station without manual actuation at the protected premises unit is permitted.

Exception No. 2: The telephone numbers associated with a DACT are permitted to be reprogrammed from an off-site location without manual actuation at the protected-premises unit.

8.5 When the proper operation of a product is adversely affected due to actuation of the security means or during any reprogramming, the product shall produce a visual trouble signal.

8.6 In the United States only: A protected premises unit connected to a supervising station receiver shall transmit a trouble signal.

9 Software Monitoring

9.1 The execution of the software shall be monitored. The monitoring means or watchdog shall initiate a trouble signal if routines associated with the required functions of the program are not executed.

9.2 The function of the monitoring or watchdog, and the trouble signal shall not be prevented by a failure in the execution of the Software.

9.3 The trouble signal shall result for any occurrence of the following malfunctions:

a) The system does not execute its program due to a hardware or software fault.

b) The memory function of the microprocessor does not function or is corrupted.

c) Rotation ceases, or fails to start when required, in a system that incorporates memory-storage devices having rotating elements.

Exception: Supervision is not required when malfunction of the memory-storage device results only in loss of supplementary information or features, and when the system is still capable of indicating the nature and location of any status change.

9.4 Memory for assignment of and allocation of ancillary functions and/or operations shall be protected as detailed in Section 8, User Access and Programming.

9.5 The executive software of a control unit, upon which any mandatory requirements are predicated, shall be stored in memory in a format so as not to be accessible for modification. When required, executive software shall be replaced in accordance with the manufacturer's instructions.

10 Software Integrity

10.1 The software design shall cause the product to operate as intended and shall not contain known critical defects which result in interruption of product operation, operation not intended by the design of the product, or which is inconsistent with the requirements of this standard.

10.2 With regards to 10.1, evidence of software integrity shall be any of the following:

a) Software development using a documented process, which includes the test procedures, with anticipated test results, specified in 10.4 and which complies with the requirements of ISO 9001.

b) Examination of the software operation by the manufacturer with a test and verification program that is documented with a test plan and test results which, at a minimum, includes verification of the items specified in 10.4.

10.3 Documentation for 10.2 (a) and (b) shall include a description of the test methods used, test result(s), and identification of test equipment.

10.4 The test program specified in 10.2 shall include performance-based testing of the functions as follows:

a) Confirmation of proper operation of all circuits of each applicable type, style and class, verified as described.

1) Supervised initiating device circuits:

i) Subjecting the circuit to fault conditions (short, open, ground) and verifying that the condition is detected and the system responds as required.

ii) Verify the circuit will detect and respond to an alarm or, if applicable, supervisory condition, and that the system responds as required.

iii) Verify that the alarm verification cycle completes correctly.

2) Supervised output (notification appliance, master box, releasing, etc.) circuits:

i) Subjecting the circuit to fault conditions (short, open, ground) and verifying that the condition is detected and the system responds as required.

ii) Verify the circuit activates correctly when commanded by the system.

iii) Verify that the output signal is recognizable and complies with all timing requirements.

3) Communication and transmission circuits:

i) Subjecting the circuit to fault conditions (short, open, ground) and verifying that the condition is detected and the system responds as required.

ii) Verify that messages are transmitted correctly in response to system stimuli.

iii) Verify that incorrect messages are processed appropriately.

4) Signaling line circuits:

i) Subjecting the circuit to fault conditions (short, open, ground) and verifying that the condition is detected and the system responds as required.

ii) Verify that a minimum of at least 1 message, per type, is transmitted correctly as required.

iii) Verify that incorrect messages are processed appropriately.

iv) Verify that mismatches between the actual devices on a circuit and the expected devices on a circuit are detected and reported correctly.

b) Confirmation of proper operation of visual annunciators and displays:

1) Verify that at least 1 event, per type, intended for the display and/or annunciator is successfully routed to and displayed by the display and/or annunciator.

2) Verify that events not intended for the display and/or annunciator are not displayed.

c) Confirmation of proper operation of manual controls:

1) Verify that all key presses are processed.

2) Verify that all key presses and menu selections generate the expected action.

3) Verify that incorrect entries are rejected and do not cause abnormal system operation.

d) Confirmation of proper operation of all programming options:

1) Verify that programming options cause the operation intended.

2) Verify that incorrect entries are processed appropriately.

e) Confirmation of proper operation of intelligent devices that are controlled by the panel:

1) Verify that the panel correctly controls the device as designed.

10.5 The testing information specified in 10.2 (b) and (c) shall be submitted for review for any new products and whenever functions are added to the software of an existing product.

11 Compare Program (Optional)

11.1 Where a compare program is provided, 11.2 – 11.6 shall apply.

11.2 A means shall be provided to identify the revision number or version of the installed site specific data.

11.3 The process of comparing presently installed site specific data to a revised or incremented version must occur prior to downloading to a control unit or transponder.

11.4 The compare program shall provide an accurate means of identifying all system changes, additions, and deletions. Changes to be identified shall include: system timer settings, hardware, customer defined location messages, and site specific input to output correlations.

11.5 The compare program or method of comparing site specific data shall produce a detailed report that clearly identifies all system changes and can be stored and/or printed at a later date. Refer to 11.6 for report specifics.

11.6 The compare program, or method of comparing site specific data report shall include the following summary:

a) Project name, executive software version, site specific data revision number, including time and date stamp, plus last update time and date;

b) Control unit and/or transponder summary to include additions, deletions, and changes to installed hardware, timer and default settings;

c) Active device summary to include device additions, deletions, and changes including customer programmable messages; and

d) Programming or correlation summary that identifies all programming additions, deletions, and changes.

12 In Canada Only: Field Detection Device Activity Report

12.1 This section shall not apply to Fire Alarm Control Units that operate solely with Conventional Field Devices.

12.2 Where a Field Detection Device Activity Report of system events is available (and maintained by the control panel's software), the Field Detection Device Activity Report extraction process (ACCESS LEVEL 3 or less) shall provide, as a minimum:

a) Time Stamp of Event (Date, Month, Year, Time of Day in h/min);

b) Annunciator Label/LCD Text Displayed (Specific location of Device within building);

c) Zone Identifier, or Device Type and Address (Smoke, Heat, Manual, Duct, Waterflow, Tamper, etc.); and,

d) Type of Event (Fire Alarm, Supervisory, Trouble, etc.)

NOTE: All information will be shown in plain text format (without encryption).

INTERCONNECTED FIRE ALARM CONTROL UNITS AND ACCESSORIES

13 General

13.1 The interconnections of fire alarm control units and/or control unit accessories intended to function as a single system shall be monitored for integrity in accordance with Section 23, Circuits.

13.2 The faults required by 13.1 shall not affect the intended synchronization of visual or audible notification appliances.

13.3 Each interconnected control unit shall have the capability of being monitored separately for alarm, trouble, and supervisory conditions, as applicable.

13.4 Unless interconnected control units located at a protected premises are intended to be installed such that the display annunciation at each unit can be simultaneously observed, alarm, supervisory, and trouble conditions, as well as reset, alarm silence, or trouble silence actuation originating at any unit shall be annunciated at each control unit and non-supplementary operator interface.

13.5 The time periods for processing and activation of signals between interconnected units shall comply with 22.3.2, 30.2.1.2, and 34.2.1.1, as applicable.

13.6 The programming of initiating, notification, and signaling points of the interconnected/networked system shall comply with Sections 7 – 12, Software.

13.7 Relays or modules providing signaling between interconnected fire alarm control units shall be arranged to produce a trouble signal at the interconnected unit(s) when all power to the relay or module is removed.

13.8 The operation of relays or other modules providing alarm, supervisory, or trouble (or the like) output signaling shall operate as described for one of the following categories:

a) Common – Operates for all of the signals relative to its type (such as alarm, trouble, supervisory).

b) Zone – Operates for specific zone/circuit input signals (non-programmable).

c) Programmable – Operates for any signals for which it is programmed.

13.9 The function of the relay or output module shall be clearly defined in the installation wiring diagram/instructions for the product.

13.10 Interconnected fire alarm units shall be arranged to function as a single system with respect to the resetting of alarm signals and not require the simultaneous operation of multiple reset switches or the disconnection of any wiring or equipment to reset the alarm system.

LOCAL AREA NETWORKS AND/OR WIDE AREA NETWORKS (LAN/WAN)

14 General

14.1 The following equipment relating to LAN/WAN shall be in compliance with all applicable requirements of this Standard:

a) Fire related equipment that is critical to processing or transporting required fire alarm data, for example repeaters, switches, bridges, routers and protocol translators; and

b) Non-fire related equipment that allows access to LAN/WAN communication circuits installed to prevent the impairment of fire equipment from non-fire equipment, for example barriers, gateways, or system isolation components and other related equipment.

14.2 Where LAN/WAN is dedicated to fire processing, it shall comply with 14.1.

14.3 Where the LAN/WAN is shared by other premises operating systems, (including Local and Wide Area Networks – LAN/WAN) operation shall be in accordance with the following in addition to 14.1:

a) All programming and system configurations shall assure a fire alarm system priority in accordance with Section 24, Signal Priority;

b) All programming and system configurations shall assure a fire alarm system response time in accordance with 22.3, System Response;

c) Short circuit faults, open circuit faults, or ground faults in the non-fire system equipment or the connections between the non-fire system equipment and the fire alarm products shall not impair the required operation of the fire alarm system or prevent the required alarm, supervisory, or trouble annunciation and signaling;

d) The monitoring for integrity as described in 72.2.1, shall continue to be met during the period the system is used for non-fire purposes, for example General paging;

e) Non-fire functions shall not impair any required operation of the fire alarm system;

f) Fire alarm visual displays and local audibles shall be distinctive and clearly recognizable over any other signal even when a non-fire alarm signal is initiated first, and shall be in accordance with Table 20.3;

g) Fire alarm signaling output circuit operation shall have priority over any other signal even when a non-fire alarm signal is initiated first, and be in accordance with 23.5, Signaling/Notification Appliance Circuit Operation;

h) A trouble signal shall be indicated as required in 20.2, Trouble Signals, if the response time is exceeded; and

i) Failure of any equipment that is critical to the operation of the fire alarm system shall indicate a trouble at the fire alarm control unit and/or display and control center within 90 s as required in 20.2, Trouble Signals.

j) In Canada only: System bandwidth shall be monitored to confirm that all fire alarm communications of the fire alarm system shall meet the requirements of Table 22.1.

14.4 To determine compliance with 14.3, the operation, removal, replacement, failure, or maintenance procedure on any hardware or software network components, or circuit not performing any of the fire alarm system functions shall not cause loss of any of the fire alarm functions, including supervision, or prevent required alarm, supervisory, or trouble signaling, or actuation.

14.5 Communication of alarm, supervisory, and trouble signals shall be in a highly reliable manner to prevent degradation of the signal in transit. Reliability of the signal shall be in accordance with 34.5.7.6.

DEGRADED AND STAND-ALONE OPERATION

15 General

15.1 Where distributed systems utilize control units and transponders provided with stand alone capability and/or degraded mode capability, each control unit and transponder shall have signal silence, reset and trouble silence switches with visual indicators, degraded mode capability and stand alone capability indicators, which become active only in degraded and stand alone modes.

15.2 Where distributed systems utilize control units and transponders provided with stand alone capability and/or degraded mode capability, each control unit and transponder shall operate in accordance with 15.3 and 15.4 within 300 s. Upon restoration of communication, control units and transponders shall return to normal operation within 300 s.

15.3 Stand alone and degraded mode operation, enabled through pre-programmed software, shall maintain communication to all control units and transponders remaining connected and communicating using the data communication link. Any control unit or transponder not able to communicate by degraded mode shall default to operations in stand alone mode.

NOTE: Where multiple faults cause the network to be severed, it is intended for each portion of the network to function as intended within the capacities of each section.

15.4 In stand alone and degraded mode operation, the activation of an alarm input shall cause the segment of the system remaining in communication to:

a) Operate the alert signals and alarm signals in accordance with the system operating sequence; and

b) Operate local relays in control units and transponders connected to ancillary devices in accordance with the system operating sequence.

POWER SUPPLIES

16 General

16.1 Each product shall be supplied by at least two independent power sources (one primary and one secondary), each of which is able to separately power the product.

In Canada only:

Exception No. 1: Wireless products complying with 19.1, 23.8 and Section 97 are not prohibited from using a primary battery as the sole source of power.

In the United States only:

Exception No. 2: Products complying with 19.1 are not prohibited from using a primary battery as the sole source of power.

16.2 The interruption and restoration of any source of electrical energy connected to a product shall not cause an alarm signal.

16.3 A main power supply loss-restoration cycle shall not result in an abnormal operation. Rectifiers and battery chargers whether integral with the product or assembled for separate installation are considered elements of the product and are subject to the same requirements.

16.4 Transfer of the operating power to the secondary power source or return to the primary operating power source shall not cause the loss of any system status signaling condition.

16.5 A visual “power-on” indication, visible after the product is installed, is to be present on all products employing an operator interface. A unique character presentation on a display device meets the intent of this requirement.

17 Primary Power Source

17.1 All primary power source(s) shall be monitored for the presence of voltage at the point of connection to the product such that, after reaching the voltages specified in 17.3, the following shall occur:

a) A specific trouble indication shall be annunciated at the protected premise for all products located at a protected premises;

b) A trouble signal shall be transmitted for:

1) In Canada only: Products intended to interconnect to a transmission interface shall have capability to delay the loss of primary power specific trouble transmission up to 3 h;

2) In the United States only: Remote station, central station, and proprietary-type protected premises units after a delay of 60 to 180 mins;

Exception: Products are not prohibited from providing capability of selecting that the primary power failure trouble signal transmission be delayed other time periods, including no delay, provided the delays above are also included.

c) Primary power failure transmission is not required if primary power is restored within the delay time.

1) In the United States only: Either an audible- or visual-only trouble signal, or both, shall be annunciated at the supervising station for supervising station equipment.

Exception: The primary power source of constantly attended supervising-station equipment, when the fault condition is obvious to the operator on duty.

17.2 The requirement of 17.1 does not apply to the following circuits:

a) A power supply for supplementary equipment;

b) The neutral of a three-, four-, or five-wire AC or DC supply source.

17.3 Operating power of the product shall automatically be transferred to the secondary power source within 10 s without required signals being lost, interrupted, or delayed by more than 10 s and while maintaining compatibility of connected equipment when each of the following conditions occur:

a) Total instantaneous loss of primary power.

b) Degradation of primary power to the point of transfer to secondary power.

17.4 Transfer to the secondary power source shall not occur below 85 nor above 90 % of rated voltage. Restoration of the primary operating source to a value of not more than 90 % of rated voltage shall result in the transfer of product operation to the primary operating source within 30 min.

Exception No. 1: A lower transfer cutout voltage is not prohibited when operation of the product is not impaired and compatibility of connected appliances is maintained.

Exception No. 2: Restoration of the primary power source of a smoke control system to a value of not more than 90 % of rated voltage shall result in the transfer of product operation to the primary power source within 15 min.

In the United States only:

Exception No. 3: The transfer for equipment located at a supervising or subsidiary station shall occur within 60 s and required signals shall not be lost, interrupted, or delayed more than 90 s after occurrence of the indicated conditions.

17.5 For units employing a rechargeable battery as the secondary power source, that does not utilize a transfer cutout scheme (such as a float-type battery charger), the trouble indication required by 17.1 shall occur as described in 18.6.

17.6 For units employing an uninterruptible power source, a trouble signal shall be initiated when the uninterruptible power source system switches from the primary power source to the secondary power source.

17.7 In Canada only: When a control unit and its accessories require two or more supply circuits, the installation wiring drawing required by Section 65, Installation Wiring Diagram/Instructions, shall detail grouping, identification and warning markings of the disconnecting means as required by CSA C22.1, Fire Alarm Systems, Smoke Alarms, Carbon Monoxide Alarms, and Fire Pumps.

17.8 In Canada only: Loss of any operating primary power supply to an emergency power supply shall result in:

a) A specific trouble indication;

b) Immediate (less than 1 s) automatic transfer to the emergency power supply; and,

c) Where a building emergency supply system is provided, the transfer to a building emergency supply system shall be in accordance with the National Building Code of Canada, Emergency Power for Fire Alarm Systems.

18 Secondary Power Source(s)

18.1 All secondary power source(s), other than those used solely to sustain time and date functions or volatile memory, shall be monitored for the presence of voltage at the point of connection to the product such that loss of voltage shall result in:

a) The annunciation of an audible and visual trouble signal at the protected premises for any product located at the protected premises;

b) The transmission of an off premise trouble signal for remote station, central station, and proprietary-type protected premises units; and

c) In the United States only: The annunciation of either an audible- or visual-only trouble signal, or both, at the supervising station for supervising-station equipment.

18.2 The system shall produce the same alarm, supervisory, and trouble operation signals and indications, excluding the alternating current (AC) power indicator, when powered solely from its secondary power source as when the product is connected to its primary power source.

Exception: Amplifiers for an emergency audio announcement and paging alarm system are not required to remain energized when they automatically re-energize for alarm and failure of an amplifier results in an audible trouble signal when an alarm is present on the system.

18.3 Standby batteries, other than those used solely to sustain time and date functions or volatile memory or microcontroller functionality pertaining to fail-safe fire door release devices, shall be rechargeable.

18.4 If non-rechargeable standby batteries are used to sustain microcontroller functionality in a fail-safe fire door release device that is not also an extinguishing or water-releasing device, the following shall apply:

a) A Standby battery voltage levels shall be monitored by the device. The standby battery voltages shall be observed at least once every:

1) In Canada only: 90 s;

2) In the United States only: 200 s;

b) A trouble signal shall be annunciated should the standby battery capacity fall below the level at which the standby battery is able to provide 24 h of normal operation in the absence of primary power. The trouble signal shall persist for no fewer than 30 d, or until the battery has been replaced.

c) Any failure of the standby batteries, including removal, or voltage drop below that which is required to operate the circuitry, shall result in the release of the door. Should failure occur while primary power is still functional, the device shall execute the normal release sequence, and a trouble signal shall be annunciated. Should the failure occur during a loss of primary power, the door shall immediately release.

d) The device manual shall state that replacement of the standby batteries is to be performed whenever the standby battery has failed, or a standby battery replacement trouble code is generated.

e) The standby battery shall be capable of providing no less than 24 h of power to the circuitry that it powers during a loss of primary power.

18.5 Products employing rechargeable batteries as the secondary power source shall monitor the integrity of the battery-charging circuit.

18.6 With regards to 18.5, products employing voltage-controlled charging methods shall initiate a trouble signal when the charging voltage decreases below the marked nominal rated battery voltage.

19 Primary Batteries

19.1 Primary batteries are permitted when all of the following conditions are met:

a) The capacity of the primary batteries shall be monitored for integrity. The batteries shall be monitored while loaded by:

1) The operating mode of the product requiring the most power; or

2) A load equivalent to the operating mode of the product requiring the most power.

b) A required battery trouble status signal shall be transmitted to the receiver and indicated at the fire alarm operator interface for a minimum of 7 d before the battery capacity of the transmitter/transceiver/product has depleted to a level insufficient to maintain proper non-alarm operation of the transmitter/transceiver/product.

c) The battery trouble signal annunciation at the receiver/control unit is not prohibited from initially being delayed up to 4 h.

d) The battery trouble signal shall be retransmitted at intervals not exceeding 4 h or the product locks in the signal to the control unit until the battery is replaced.

Exception: Transmitter/transceiver/receiver combinations utilizing two-way communication where all of the following conditions are met:

1) The transceiver/receiver acknowledges receipt of the change of status signal to the corresponding transceiver/transmitter; and

2) The receiver/control unit annunciates the current trouble status of the corresponding input or output RF device after manual reset of the receiver/control unit.

e) Batteries (of the transmitter/transceiver/product) shall be capable of operating the transmitter/transceiver/product, including the initiating device (if powered by the same battery), for not less than 1 year of normal signaling service before the battery depletion threshold specified in 19.1(b) is reached.

f) Annunciation of the battery trouble status signal at the fire alarm operator interface shall be distinctly different from alarm, supervisory, tamper, and initiating circuit trouble signals. It shall consist of an audible and visual signal that shall identify the affected transmitter/transceiver/product.

g) The audible trouble signal of the fire alarm operator interface is not prohibited from being silenceable when provided with an automatic feature to resound the signal at intervals not exceeding 4 h.

h) The battery trouble status signal shall persist at the fire alarm operator interface until the depleted battery has been replaced.

i) Any mode of failure of a primary battery in a device shall not affect any other device.

j) Where a single battery failure affects the intended operation of the transmitter/transceiver/product, each transmitter/transceiver/product shall serve only one device and shall be individually identified at the fire alarm operator interface.

k) A transmitter/transceiver/product shall be permitted to serve more than one device when all the following are met:

1) Multiple batteries are used;

2) A single battery failure does not affect the operation of transmitter/transceiver/product;

3) Each battery shall be individually monitored for battery depletion as described in 19.1(a);

4) Each battery upon reaching depletion shall cause the transmitter/transceiver/product to transmit a low battery trouble signal as described in 19.1(b); and,

5) Each transmitter/transceiver/product shall be individually identified at the fire alarm operator.

ON PREMISE

20 Control Unit Visual Display

20.1 General

20.1.1 Each input zone of a control unit shall be annunciated for normal to activated status change.

Exception: A product having a single input zone does not require specific zone annunciation.

20.1.2 A printout shall not be acceptable as the only means of annunciation.

20.1.3 Fire alarm signals, supervisory signals, trouble signals, and other signals shall result in distinctly different annunciation.

20.1.4 Visual displays and associated controls shall have the capability of being located and grouped for viewing and operation by one person from one location.

20.1.5 Alarm, supervisory, and trouble signals shall be indicated at the following locations:

a) In Canada only: Display and Control Centre (DCC), and annunciators, if provided.

b) In the United States only: Operator interface at the protected premises for local-type service and building fire command center for emergency voice/alarm communications systems.

20.1.6 In Canada only: Visual displays shall provide indication of system activity by means of discrete indicators or discrete text messages on an electronic display in accordance with Table 20.1 or Table 20.2.

20.1.7 In Canada only: A visual display utilizing illumination state for status change indication shall observe indication sequence Options A or B, as shown in Table 20.1.

20.1.8 In Canada only: A visual display utilizing illumination state for trouble shall observe indication sequence Options A or B, as indicated in Table 20.2.

20.1.9 In Canada only: The following requirements shall apply to all visual displays for the control unit, display and control centre, and remote annunciator:

a) Where colour is used, colour shall be in accordance with Table 20.3;

b) Where colour is used, the colour red shall be limited for indication of zones/devices in alarm and those circuits used for an alarm signal and an alert signal;

c) Where a common colour is used for functions identified in Table 20.3, separate indicators shall be provided; and

d) Label designations shall comply with Table 20.4 and Table 20.5 or its equivalent.

20.1.10 In Canada only: A means shall be provided to clearly indicate that the displayed information is either:

a) A fire alarm signal;

b) Life safety emergency condition;

c) Fire supervisory signal;

d) Property and building safety;

e) Trouble; or

f) Other conditions.

20.1.11 Non-electrical visual annunciation integral with a switch shall include obvious distinct indications for all switch positions. Utilization of the switch position does not meet the intent of complying with this requirement.

In Canada only:

Table 20.1
Visual Display Status Change Indication by Illumination State

Status or status change	Indication sequences			
	Non-latching		Latching	
	Option A	Option B	Option A	Option B
Normal	Off	Off	Off	Off
Normal to Achieved	Flashing or Steady	Flashing	Steady On	Flashing
Acknowledged Activated	Not Applicable	Steady On	Not Applicable	Steady On
Activated to Normal	Off	Off	Steady On	Steady On
Reset System to Normal	Off	Off	Off	Off

NOTES:

1) Status change indication by change in the intensity of illumination is not acceptable.

2) Option A to be applied when acknowledge feature is not used, and Option B to be applied when acknowledge feature is used and event acknowledge control is provided.

In Canada only:

Table 20.2
Visual Display Trouble by Illumination State

Trouble states	Indication sequences			
	Non-latching		Latching	
	Option A	Option B	Option A	Option B
Normal	Off	Off	Off	Off
Normal to Activated	Flashing or Steady	Flashing	Flashing or Steady	Flashing
Acknowledged Activated	Not Applicable	Steady	Not Applicable	Steady
Activated to Normal	Off	Off	Flashing or Steady	Flashing or Steady
Acknowledged Return to Normal	Not Applicable	Not Applicable	Not Applicable	Steady
Reset to Normal	Not Applicable	Not Applicable	Off	Off
NOTE: Option A to be applied when acknowledge feature is not used, and Option B to be applied when acknowledge feature is used and event acknowledge control is provided.				

In Canada only:

Table 20.3
Visual Indicators – Colour Code

Function	Red	Yellow	Green	Other colour (blue, white, etc.)
Alarm Inputs	Mandatory	Not permitted	Not permitted	Not permitted
Alarm Signal	Mandatory	Not permitted	Not permitted	Not permitted
Alert Signal	Mandatory	Not permitted	Not permitted	Not permitted
Page Select	Not permitted	Not permitted	Optional	Optional
Signal Circuit fault	Not permitted	Mandatory	Not permitted	Not permitted
Ancillary Device 'on'	Not permitted	Optional	Optional	Optional *
Ancillary Device 'off'	Not permitted	Optional	Optional	Optional *
Telephone Call-in	Not permitted	Not permitted	Optional *	Optional
Telephone Select	Not permitted	Not permitted	Optional *	Optional
Telephone Circuit Fault	Not permitted	Mandatory	Not permitted	Not permitted
Inhibit	Not permitted	Mandatory	Not permitted	Not permitted
Preannounce	Not permitted	Optional	Optional	Optional
Supervisory Inputs	Not permitted	Mandatory	Not permitted	Not permitted
Carbon Monoxide	Not permitted	Optional	Not permitted	Optional
Power – on	Not permitted	Not permitted	Mandatory	Not permitted
Trouble Signal	Not permitted	Mandatory	Not permitted	Not permitted
Alarm Signal Silence	Not permitted	Mandatory	Not permitted	Not permitted
Automatic Alarm Signal Activation Timer	Not permitted	Optional	Optional	Optional

Table 20.3 Continued on Next Page

Table 20.3 Continued

Function	Red	Yellow	Green	Other colour (blue, white, etc.)
Automatic Alarm Signal Timer Cancelled (Acknowledged)	Not permitted	Mandatory	Not permitted	Not permitted
Discharge	Optional	Optional	Not permitted	Optional
Pre-discharge	Optional	Optional	Not permitted	Optional
Emergency and building events	Not permitted	Optional	Not permitted	Optional
Smoke control	Refer to 31.3.6.			

In Canada only:

Table 20.4
Label Designations

Label designations in English[c]	Label designations in French[c]	Description of function
Acknowledge	Accusé De Réception	Event Acknowledge Control
Alarm	Alarme	Alarm Status Indication
Alarm Signal	Signal D'alarme ou Signal D'Alme	Alarm Signal Status Indication
Alarm Signal Activation or Alarm Signal ON	Activation Du Signal D'alarme ou Act. Sign. Alme.	Alarm Signal (Evacuation) Control
XXX[a] Alarm Signal Activation or XXX[a] Alarm Signal ON	XXX[a] Activation Du Signal D'alarme ou XXX[a] Act. Sign. Alme	Circuit Or Area Evacuation Manual Control
XXX[a] Alert Signal Activation or XXX[a] Alert Signal ON	XXX[a] Activation Du Signal D'alerte ou XXX[a] Act. Sign. Alerte	Circuit Or Area Alert Manual Control
XXX[a] By-pass	XXX[a] Dérivation	Ancillary Bypass
XXX[a] ON	XXX[a] Sous Tension	Ancillary Device Indication
XXX[a] OFF	XXX[a] Hors Tension	Ancillary Device Indication
Automatic Alarm Signal Timer Active or Automatic Alarm Signal Timer ON or Automatic Alarm Signal (followed by equivalent status)	Temporisateur Du Signal D'alarme Automatique Activé ou Temp. Signal Alme Autom. Act. ou Min. Signal Alme Autom. Act.	Automatic Alarm Signal "Evacuation" Timer Running
Automatic Alarm Signal Cancel or Automatic Alarm Signal Stop, or Automatic Alarm Signal (followed by equivalent status)	Annulation Du Passage Automatique Au Signal D'alarme ou Ann. passage autom. signal alme	Cancel Automatic Alarm Signal "Evacuation"
Automatic Alarm Signal Timer Cancelled or Automatic Alarm Signal Stopped, or Automatic Alarm Signal (followed by equivalent status)	Passage Automatique Au Signal D'alarme Annulé ou Min. signal Alme autom. ann.	Automatic Alarm Signal “Evacuation” Cancelled Indication
Building Safety or Bldg Safety	Sécurité Du Bâtiment ou Sécurité Du Bat	Common Indication Associated With Property And Building Safety
XXX[b]	XXX[b]	Specific Indication Associated With Property And Building Safety
Emergency and building events	Événements Liés Aux Urgences Et Aux Bâtiments ou Urg. ou Urg. Bat	Common Indication Associated With Emergency And Building Events
XXX[b]	XXX[b]	Specific Indication Associated With Emergency And Building Events

Table 20.4 Continued on Next Page

Table 20.4 Continued

Label designations in English[c]	Label designations in French[c]	Description of function
Fire Drill	Fire Drill Exercice D'incendie	Fire Drill Manual Control
XXX[b]	XXX[b]	Emergency Or Building Event Manual Control
XXX[a] Bypass or Disable	XXX[a] Dérivation ou Désactiver	Bypass or Disable of Input or
Activate XXX[a] or equivalent followed by XXX[a]	Activer XXX[a]	Initiate Manual Control Function
Page Inhibited	Radiomessage Interdit	Paging Inhibited Indication
Page Select XXX[a]	Sélection De Radiomessagae XXX[a]	Manual Control For Group Or Individual Paging
Power ON or Power	Sous Tension ou Marche	Primary Power Indication
Pre-announce	Pré-Annonce	Indication Of The Pre-Announcement Tone
XXX[a] Pre-discharge	XXX[a] Pré-Décharge	Extinguishing Agent Pre-Discharge Indication
Ready to Page	Prêt À Demander	System Ready To Page
XXX[a] Discharge or XXX[a] Release	XXX[a] Libération – ou XXX[a] Déclenchement	Extinguishing Agent Discharge Indication
Releasing Service Signal Silence	Arrêt Du Signal De Déclenchement D'extinction ou Arr. Sign. Ext. Arr. Sign. Décl. Ext.	Manual Signal Silence Control For Releasing Device Service
Remote Connection Bypass or equivalent	Dérivation De Raccordement À Distance ou Dér. Racc. Dist.	Bypass Connection For Fire Service Response
Reset or System Reset	Réarmement – ou Réarmement Du Système ou Réarm. SYST.	System Reset Manual Control
Signal Circuit Trouble	Défectuosité De Circuit D'avertisseurs ou Déf. Cct Avert.	Signal Circuit Fault Indication
Signal Silence – or Deactivate Alarm Signals	Arrêt Du Signal – ou Arrêt Du Signal D'alarme ou Arr. Signal Arr. Signal Alme	Alarm Signal Manual Deactivation
Signal Silence Inhibit	Arrêt Du Signal Neutraliser ou Arr. Signal Neutr.	Prevent Silence Of Signal For A Preset Time
Supervisory	Supervision	Common Indication Associated With Supervisory Inputs
XXX[a]	XXX[a]	Specific Indication Associated With Supervisory Inputs
Supervisory Signal Silence	Arrêt Du Signal De Supervision ou Arr. Sign. Sup.	Manual Signal Silence Control For Supervisory Signal
Telephone Call-in	Appel Téléphonique ou Appel Tel.	Common Telephone Call-In Indication
XXX[a] Telephone Call-in	XXX[a] Appel Téléphonique ou XXX[a] Appel Tél.	Specific Telephone Call-In Indication
XXX[a] Telephone Trouble	XXXv Défectuosité De Téléphonique ou XXX[a] Déf. TÉL.	Telephone Circuit Fault Indication
XXXv Telephone Select	XXX[a] Sélection De Téléphone ou XXX[a] Sél. TÉL.	Telephone Circuit Manual Control
Trouble	Défectuosité	Common Trouble signal Indicator
XXX[a] Trouble	XXX[a] Défectuosité	Specific, Circuit Or Area Trouble signal Indicator
Trouble Silence	Arrêt Du Signal De Défectuosité ou Arr. Sign. Déf.	Trouble Silence Manual Control

Table 20.4 Continued on Next Page

Table 20.4 Continued

Label designations in English[c]	Label designations in French[c]	Description of function
Visual Indicator Test or Lamp Test	Essai Des Indicateurs Visuels ou Essai Ind. Visuel	Visual Indicator Test Manual Control (Lamp Test)
Miscellaneous Terms		
Emergency		Urgence
For replacement only – complies with ULC 527-xx		Pour remplacement seulement – conforme à la norme ULC 527-xx
Neutral		Neutre
[a] Replace XXX with location and/or device specific description.		
[b] For examples, refer to B.1(d).		
[c] Refer to Table 20.5 for English and French abbreviation alternatives to the applicable designations.		

In Canada only:

Table 20.5
Abbreviations for the Label Designations

Designated term[a]	Abbreviation	
	English	French
Acknowledge	Ack	Acc
Activate	Act	Act
Alarm	Alm	Alme
Automatic	Auto	Autom
Building	Bldg	Bat
Bypass or Disable	Bypass or Dis	Dér or Désact
Circuit	Ckt	Cct
Emergency	Emg	Urg
Fault	Flt	Déf
Pre-announce	Pre-ann	Pré-ann
Releasing	Rel	Decl.
Signal	Signal	Sig
Silence	Sil	Neutr
Supervisory	Sup	Sup
System	Sys	Syst
Telephone	Tel	Tél
Timer	Tmr	Temp
Trouble	Tbl	Déf
[a] The individual designated term used in Table 20.4 may be abbreviated as indicated. The abbreviation is permitted to be applied to the entire label designation or portion of the label designation.		

20.2 Trouble signals

20.2.1 A trouble signal shall be indicated by:

a) In Canada only: A visual and audible signal.

b) In the United States only: A distinctive audible signal.

20.2.2 When an intermittent signal is used, it shall sound at least once every 10 s with a minimum on-time duration of 0.5 s.

20.2.3 When a common audible signal is to be employed, distinction shall be achieved visually.

20.2.4 In Canada only: A separate discrete indicator shall be provided for the common systems trouble signal.

20.2.5 In Canada only: A separate indication shall be provided for system ground fault indication.

NOTE: The system trouble and ground fault indicators are not required at remote equipment without an operator interface, such as booster power supplies and signal extenders.

20.2.6 A trouble signal may be common to several supervised circuits except where specific trouble indications are required in accordance with this Standard.

20.2.7 In Canada only: The audible trouble signal shall produce a sound level not less than 70 dBA at 1 m from the control unit with the door closed.

20.2.8 The activation of a self-restoring trouble signal and its restoration to normal shall be automatically indicated as described in 20.2.1 and 20.2.6. Deactivation of the trouble signal annunciation is acceptable for a trouble restoration signal.

20.2.9 The activation of a latching trouble signal shall be automatically indicated as described in 20.2.1 and 20.2.6.

20.2.10 Restoration of a latching trouble signal shall be indicated as described in 20.2.1 and 20.2.6 after activation of a manual reset.

20.2.11 The trouble signal annunciation of a fault condition shall occur within:

a) In Canada only: 90 s;

b) In the United States only: 200 s

20.2.12 An audible trouble signal that has been silenced shall be automatically reactivated every 24 h or less, and once reactivated, shall operate until it is manually silenced or acknowledged. The cycle shall continue until the trouble condition is corrected and the product is restored to the normal supervisory condition.

20.3 Supervisory signals

20.3.1 The signal indication resulting from the operation of a product for supervisory signals shall include distinctive audible and visual signals for both the activated state and the restoration-to-normal conditions of the supervisory initiating devices. Cancellation of the signal is acceptable annunciation for the restoration signal.

20.3.2 The product shall be capable of providing latching and non-latching supervisory signaling capability and the installation wiring diagram/instructions for the product shall include instructions for selecting the respective operation.

20.3.3 Supervisory signals shall be distinctive in sound from other signals used by the signaling system and this sound shall not be used for any other purpose other than to also indicate a system trouble condition. When the same sound is used for both supervisory and trouble signals, distinction between signals shall be indicated by a visible means and silencing of a trouble signal shall not prevent subsequent sounding of supervisory signals.

20.3.4 When an intermittent audible signal is used, it shall sound at least once every 10 s with a minimum on time duration of 0.5 s.

20.3.5 In Canada only: The audible supervisory signal shall produce a sound level not less than 70 dBA at 1 m from the control unit with the door closed.

20.3.6 Supervisory signal and actuation shall occur within 10 s of initiation of an activated state while the system is operating in its normal, quiescent state.

20.3.7 A coded supervisory signal shall consist of not less than two complete rounds of the number transmitted to indicate a supervisory off normal condition and not less than one complete round of the number transmitted to indicate restoration of the supervisory condition to normal.

20.3.8 A supervisory signal that has been silenced shall be automatically reactivated at the operator interface(s) every 24 h or less, and once reactivated, the audible and visual annunciation shall operate until it is manually silenced or acknowledged. The cycle shall continue until the supervisory is corrected and the product is restored to the normal supervisory condition.

20.4 Display

20.4.1 Systems shall be capable of simultaneously displaying all zones having a status change unless they include a sequential display in accordance with 20.5, Sequential Display.

20.5 Sequential display

20.5.1 Where a multiple-line sequential display is used, it shall comply with the following:

a) Separate lines shall be provided for each event;

b) Allow for a minimum of 28 characters for the description of each event location;

c) A visual indication showing deactivated (silenced) alarm notification appliances as required by 21.2.3, Trouble Silence;

d) In Canada only: Simultaneous display of a minimum of 8 input zones. For systems of less than 8 input zones, all zones shall be displayed;

Exception: Where a sequential display is used in conjunction with a display capable of displaying all alarm or supervisory input zones simultaneously, then 20.5.1(c) shall not apply but the rest of the requirements of this subsection shall apply.

e) An indication for each type (such as fire alarm, fire trouble, sprinkler supervisory) of active non-displayed status changes shall be continuously visible during all activated states;

f) When concurrent signals are received, they shall be indicated as follows in descending order of priority:

1) In Canada only: Refer to 24.3 for signal priority. For the purposes of this requirement, the summary display line may group the categories as follows:

i) Life Safety – fire alarm (1) and life safety emergency condition (2);

ii) Supervisory / Property – fire supervisory signal (3) and property and building safety (4);

iii) Trouble (5); and

iv) Other (6).

2) In the United States only:

i) Signals associated with life safety.

ii) Signals associated with property safety.

iii) Trouble signals associated with life and/or property safety.

iv) All other signals.

g) Prior to any manual operation, the display shall be as follows:

1) The display shall indicate the initial status change for the highest priority type signal.

2) In Canada only: Display format shall be: Event type, followed by event location or event sequence, followed by event type, followed by event location. When event sequence is indicated, events shall be sequentially numbered within each priority. Indication of time of event shall not be acceptable in lieu of sequential number(s).

h) The non-displayed status changes shall be capable of being displayed only by manual operation(s);

i) Provide a means to manually return to the first event in order of priority as indicated in Section 24, Signal Priority. This operation shall only affect its associated display;

j) The display control means, shall not interfere with the normal operation of the fire alarm system control unit; and

k) Screen saving feature, if applicable, shall be disabled during an alarm condition.

20.6 Annunciator

20.6.1 The annunciator functioning as an operator interface (separate from the control unit) shall comply with the following:

a) All control unit requirements;

Exception No. 1: System signals may provide required annunciation in whole or in part. Where controls are provided, associated annunciation is required.

Exception No. 2: Supplementary annunciators and keypads shall comply with the requirements in 20.7, Supplementary Display.

b) Interconnections to annunciators shall comply with the monitoring for integrity requirements of Section 23, Circuits;

c) A means shall be provided for testing visual indicators that are not supervised;

In the United States only:

Exception: A means may not be provided for testing visual indicators that are considered reliable in accordance with 54.5.1(c).

d) In Canada only: A system common trouble condition shall be indicated at the annunciator;

e) Where an audible trouble signal is provided, the annunciator shall provide a means to silence the local audible trouble signal while the visual indication remains “on” until the trouble condition has been corrected. The means to silence shall be self-restoring;

f) Visual display requirements of 20.4, Display;

g) In Canada only: A minimum of one annunciator or control unit shall have the capability to display all required trouble indications. These trouble indications need not be displayed simultaneously, except as required in Section 27, Voice Alarm Feature and Section 28, Emergency Telephone Feature.

20.6.2 When multiple circuits for keypads or annunciators are employed, the monitoring for integrity faults shall be applied independently to each circuit.

20.6.3 A computer workstation used as the annunciator shall comply with all the requirements of 20.6.1 if it is intended to be used as the only means of annunciation or if failure of the computer or its associated components, such as monitor, pointing, or storage device, inhibit the normal operation of the fire alarm system.

20.6.4 In Canada only: When a computer workstation is included in a fire alarm system and a separate control unit and annunciator provide all of the required display functions, then it shall comply with all the requirements of 20.6.1, except that an enclosure other than the computer enclosure itself is not required. In addition, the power supply and communication connection shall be attached to the product to prevent accidental removal Interconnecting wiring between a stationary computer and the computer's keyboard, video monitor, touch screen, or mouse pointing type device and are not required to be monitored for integrity providing:

a) Complete disconnection of the interconnecting cable is visually indicated so as to be obvious to the user or the disconnection does not affect the required system operation except for loss of the faulted function; and

b) The interconnecting cable(s) does not exceed 2.5 m.

20.6.5 In the United States only: When a computer workstation is included in a fire alarm system then it shall comply with all the requirements of 20.6.1. Interconnecting wiring between a stationary computer and the computer's keyboard, video monitor, touch screen, or mouse pointing type device are not required to be monitored for integrity providing:

a) Complete disconnection of the interconnecting cable is visually indicated so as to be obvious to the user or the disconnection does not affect the required system operation except for loss of the faulted function; and

b) The interconnecting cable(s) does not exceed 2.5 m.

20.6.6 In the United States only: Manual fire alarm activation at the keypad is permitted when:

a) The activation cannot occur inadvertently (such as by leaning up against the keypad or other similar action); and

b) The operation is not intended to be used in lieu of a manually-activated box.

20.7 Supplementary displays

20.7.1 Supplementary displays, including LED displays, LCD displays or computers shall be considered;

a) In Canada only: Only ancillary devices and shall comply with 23.4, Supplementary-Device Circuits.

b) In the United States only: Only supplementary devices and are not required to comply with the monitoring for integrity requirements of Section 23, Circuits.

20.7.2 If control functions are part of the supplementary display, these controls will only affect the supplementary display, and shall not affect the operation of the fire alarm control unit.

21 Manual Controls

21.1 General

21.1.1 All manual controls shall comply with the following:

a) Be clearly marked for intended function;

In Canada only: Clearly marked in accordance with Table 20.4 and Table 20.5;

b) Be secured against operation by unauthorized personnel by one of the following:

1) A key-lock type, with the key removable only in the normal position;

2) Located inside of a locked enclosure;

3) Access limited by a software security code providing a minimum of 1000 combinations and with a maximum 30-min time-out feature after the last activity; or

4) Arranged to provide equivalent protection against unauthorized use.

c) Where applicable, space shall be provided for field labeling; and

d) In Canada only: Physically protected within a locked cabinet or equivalent.

Exception: For supplementary displays these controls need not be physically protected in a locked cabinet, or equivalent.

21.1.2 The operation of any manual-switching part of a product to other than its normal or activated position while the system is in the normal supervisory condition shall be indicated by a trouble signal, when the abnormal position of the switch interferes with normal operation of the system.

21.1.3 To determine if a switching part of a product complies with 21.1.2, the investigation shall start with the representative system combination in the normal supervisory condition; the system shall then be operated for signals with the manual-switching part in each position.

21.1.4 In Canada only: Required manual controls as described in 21.2, Required Manual Controls, and 21.3, Optional Manual Controls, shall be in accordance with Table 21.1.

In Canada only:

Table 21.1
Requirements for Manual Controls

Manual control function	Required	Dedicated control required	References
Signal Silence	Yes	Yes	21.2.2
Trouble Silence	Yes	Yes	21.2.3
Visual Indicator Test	Yes	No	21.2.5
Reset	Yes	Yes	21.2.1
Alarm Signal (Evacuation) Control	Yes	Yes*	21.2.4
Supervisory Signal Silence	Optional	No	21.3.1
Acknowledge	Optional	No	21.3.2
Automatic Alarm Signal Cancel	Yes (Two-stage only)	No	25.2
Remote Connection By-Pass	Optional	No	21.3.2.1, 22.2
Ancillary Device By-Pass	Optional	No	23.4.2
Ancillary Device Circuit Manual Control	Optional	No	21.3
Output Control Function Bypass	Optional	No	21.3
Output Control Function Manual Operation	Optional	No	21.3
Input Circuit & Output Circuit Manual Control	Optional	No	21.3
Fire Drill	Optional	No*	21.3.4
Voice alarm and emergency telephone features			
All Call	Yes (if voice alarm included)	Yes	Section 27
Activation Of Selective Voice / Tone Circuits	Refer to Article 3.2.6.7 of the National Building Code of Canada	No	Section 27
Microphone Press To Talk	Yes (if voice alarm included)	Yes	Section 27
Selection of Voice Alarm Circuits for Page	Refer to Article 3.2.6.7 of the National Building Code of Canada	No	Section 27
Selection Of Emergency Telephone Circuits	Refer to Article 3.2.6.7 of the National Building Code of Canada	No	Section 28
Activation Of Pre-recorded Voice	Optional	No	21.3
NOTE: Additional control switches needed for a specific application may be included, provided they are supervised for abnormal position in accordance with 20.1.7 and 21.1.2.			
* These two functions can share the same manual control provided separate unique actions are necessary to activate the respective function. The marking for the manual control shall identify the unique action.			

21.1.5 In Canada only: The display and control centre shall comply with the following:

a) All of the requirements of 20.6, Annunciator;

b) Where manual controls are used, they shall meet the requirements of this section;

c) Where a fire alarm system is capable of multiple display and control centres and either allows only one display and control centre to be in control at any one time, or incorporates voice alarm features, the following shall also apply:

1) Controls as defined in this section, and Section 27, Voice Alarm Feature, can only be operated from one location at any given time;

2) Indication shall be continuously displayed at all display and control centres as to which is in control, either by a dedicated indicator or a text message where alphanumeric displays are used;

3) Complete loss of communication to the display and control centre shall not inhibit other communicating display and control centres from being able to gain control; and

4) Ability to request, grant, or deny system control with provision for fail-safe auto-transfer from one command centre to another shall be provided.

NOTE: This requirement is not intended to apply to display and control centres provided only for maintenance and service purposes.

21.2 Required manual controls

21.2.1 Reset

21.2.1.1 System reset shall comply with the following:

a) Reset shall return all non-active latching circuits and timers to normal condition. If any input circuit or site-specific program control function is still in the activated state, the system response shall remain, or programmed sequence reinitiated;

b) An indication that the system is restoring to its normal condition if the restoration time to normal exceeds 200 s;

c) The control shall be clearly marked “System Reset”, “Reset” or equivalent; and

d) Reset function shall not override the signal silence inhibit feature.

21.2.2 Signal silence

21.2.2.1 Any manual or automatic means for turning off activated alarm notification appliances/signal device (silencing) shall comply with the following requirements:

a) When an alarm signal deactivation means is actuated, the control shall be capable of simultaneously deactivating both audible and visible notification appliances.

b) In Canada only:

1) Silenced fire alarm signaling devices shall automatically reactivate only upon activation of a subsequent alarm from a different fire alarm input zone.

NOTE: Activation of multiple alarm initiating devices located within the same fire alarm input zone does not constitute a subsequent alarm.

2) There shall be a means to reactivate the alarm signals and visible signaling devices.

NOTE: The means for reactivating the alarm signals and visible signaling devices can be the same as the means for silencing, but 21.2.2.1 (a) and (b) shall be maintained as not to confuse the operator.

c) In the United States only: After deactivating notification appliance/output circuit(s) or zone(s) resulting from an alarm in one alarm initiating device circuit, addressable alarm initiating device circuit, or addressable fire alarm initiating device, a subsequent alarm in any other system fire alarm initiating device circuit, addressable alarm initiating device circuit, or addressable initiating device shall cause all previously activated notification appliance/output circuit(s) or zone(s) to reactivate.

Exception No. 1: When a system is intended to provide signaling service to two or more physically separated buildings or zones, reenergization of the notification appliance/output circuits only on a zone basis meets the intent of the requirement. Specifics covering installation constraints shall be clearly detailed in the control unit installation wiring diagram/instructions.

Exception No. 2: Systems are not prohibited from having provision to automatically disable reenergizing alarm notification/output circuits due to subsequent activation of other addressable smoke detectors of the same type located in the same room or space as the initial activated device. Specifics covering installation constraints shall be clearly detailed in the control unit installation wiring diagram/instructions.

d) Alarm signal deactivating of activated notification appliances/signaling devices of a control unit/system shall be indicated by a constantly displayed and identified visual indicator.

e) An alarm signal deactivating means left in the activated state when there is no alarm shall activate an audible trouble signal until the means is restored to normal.

f) When any alarm signal deactivating means for an individual circuit/zone of a multiple-circuit control unit/system is activated, there shall be an indication of the related deactivated notification/output circuit(s) or zone(s) by an identified lamp(s) or other visual annunciation, and operation of the alarm notification appliances/signaling devices by any other notification appliance/signal device circuit having its alarm deactivation means in the normal position shall not be prevented. The activation of the alarm signal deactivating means during an alarm condition shall not result in resetting any actuated circuit other than the notification appliance/output circuit(s) or zone(s) being deactivated.

g) The alarm condition shall be indicated and maintained by a lamp or other visual indicator with the deactivating means activated.

h) When alarm signal deactivation can be accomplished in a selective manner, the visual indicator(s) referenced in (a) shall distinguish notification appliance circuit(s) or zone(s) that have been deactivated from notification appliance circuit(s) or zone(s) that are still energized.

21.2.3 Trouble silence

21.2.3.1 An audible trouble signal that has been silenced at the protected premises shall:

a) Automatically reactivate the audible trouble signal at the operator interface every 24 h or less until trouble signal conditions are restored to normal; and

b) The audible signal shall operate until it is manually silenced or acknowledged.

21.2.3.2 A means for silencing a trouble signal sounding appliance shall comply with all the following requirements:

a) The trouble condition shall be continuously displayed by a visual indicator;

b) Actuation of the trouble silence means shall not prevent subsequent trouble signals from re-initiating a trouble signal;

c) A means that is left in the “silence” position, when there is no trouble activated state, shall cause the audible trouble signal to sound until the means is restored to normal; and

d) The visible indicator shall be located and identified so that the user will recognize the signal as soon as it is activated.

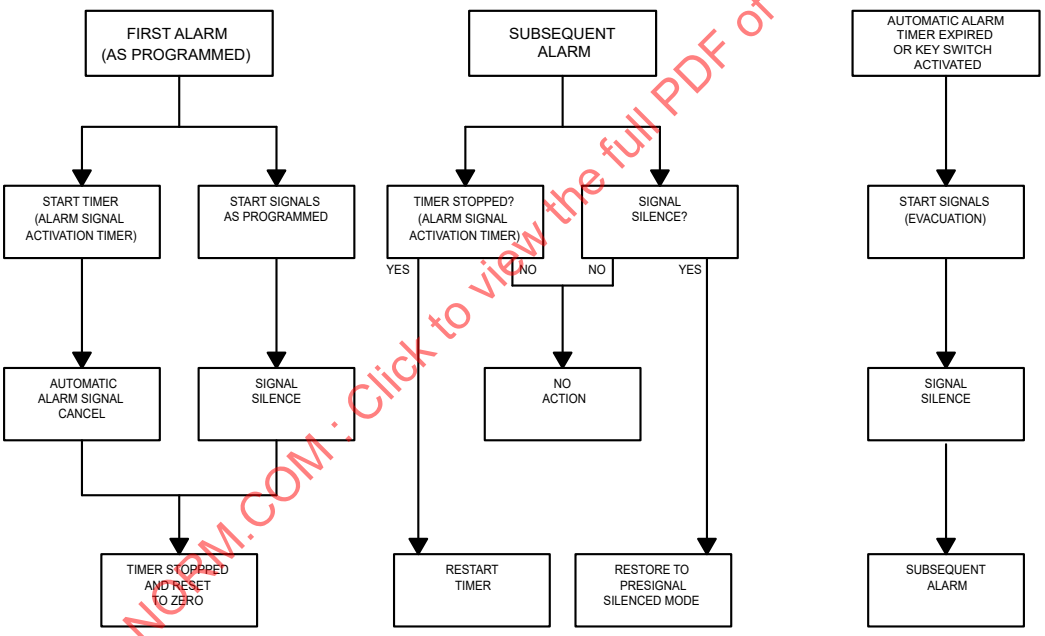
21.2.3.3 In Canada only: Where multiple display and control centres are provided in accordance with 21.1.5(c), this manual control shall be permitted to perform the trouble silence function at each individual display and control centre even if that display and control centre is not in control of the entire fire alarm system. A manual control which can perform the trouble silence function at all display and control centres simultaneously from any display and control centre in the fire alarm system, even if that display and control centre is not in control of the entire fire alarm system, is also permitted.

21.2.4 In Canada only: Alarm signal (evacuation) control

21.2.4.1 Activation of the manual alarm signal (evacuation) control shall result in an alarm condition when the system is in the normal stand by condition or the first stage of a two-stage system. Refer to Figure 21.1.

Figure 21.1

Automatic Alarm and Subsequent Alarm Functions



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21.2.5 Visual indicator test control

21.2.5.1 Where provided, a visual indicator test control shall comply with the following:

a) Energize all required event indications;

b) Activate all character locations where alphanumeric displays are used;

c) Where multiple display and control centres are provided, this manual control shall be permitted to perform the visual indicator test function for the individual display and control centre even if that display and control centre is not in control of the entire fire alarm system; and

d) The visual indicator test manual control is permitted to be accessible through multiple sequential commands/actions.

21.3 Optional manual controls

21.3.1 Supervisory signal silence

21.3.1.1 A means for silencing a supervisory signal sounding appliance shall comply with all the following requirements:

a) The supervisory condition is continuously displayed by a visual indicator.

b) Actuation of the supervisory signal silence means shall not prevent subsequent supervisory signal signals from re-initiating a supervisory signal.

c) A means that is left in the “silence” position when there is no supervisory activated state, shall cause the audible supervisory signal to sound until the means is restored to normal.

21.3.1.2 A supervisory signal that has been silenced shall be automatically reactivated at the operator interface(s) every 24 h or less, and once reactivated, shall operate until it is manually silenced or acknowledged. The cycle shall continue until the supervisory is corrected and the product is restored to the normal supervisory condition.

21.3.2 Acknowledge

21.3.2.1 In Canada only: Event acknowledge control shall change status event visual indicator from flashing to steady state as per 20.1.6 and may also silence the control unit and display and control centre local audible device.

21.3.2.2 In the United States only: The event acknowledge control, when activated, indicates that the operator has received a signal. Where the acknowledge control also silences the operator interface local audible signal the requirements of 21.2.4 and 21.3.1 shall also apply.

21.3.3 Disable

21.3.3.1 Activation of the controls for any disable function shall cause:

a) In Canada only: A specific trouble indication.

b) In the United States only: A trouble signal.

21.3.4 Fire drill

21.3.4.1 Operation of the fire drill feature shall result in a specific indication on the control unit and activate the alarm signals.

21.3.4.2 The drill function shall be cancelled if an alarm input is received during the fire drill sequence.

Exception No. 1: Where the drill function remains active during an alarm condition, all required alarm response functions shall operate and all required alarm signals are activated as intended.

Exception No. 2: Drill-initiated signaling outputs are permitted to remain in a higher state of signaling (e.g. alarm vs. alert vs. silent).

22 Functions

22.1 Emergency control/ancillary function

22.1.1 Controls provided specifically for the purpose of manually overriding any automatic building and fire control functions intended to increase the level of life safety for occupants or control the spread of the harmful effects of fire (fire safety function), shall provide visible indication of the status of the associated control circuits.

22.2 In Canada only: Remote connection functions

22.2.1 The remote connection feature provided for interconnection with the premises transmission interface unit of a remote receiving equipment system, or for direct interconnection where no separately installed transmission interface unit is involved, shall include a disconnect means for the purpose of inhibiting alarm input status change transmissions to the remote location. Operation of the disconnect means shall result in a specific trouble indication at the control unit and shall alter the state of the interconnecting circuit to transmit a trouble signal to the remote receiving equipment system.

NOTE: The transmission interface unit of the remote receiving equipment is considered an accessory to the remote receiving equipment and shall meet the requirements of ULC-S559, refer to A10.3.2.1.

22.3 System response

22.3.1 The operation of any initiating device shall cause the system to produce a clearly defined signal of the type for which the system(s) is designed.

22.3.2 The time periods for processing and activation of signals in a worst case loaded system consistent with the product installation wiring diagram/instructions shall be as follows:

a) Automatic processing and activation of the following shall not be greater than 10 s from the initiation of an alarm or supervisory condition, or operation of a manually-activated switch:

1) Alarm notification appliances/signaling devices;

2) Local alarm and/or supervisory signal annunciation and/or actuation;

3) In Canada only: The pre-programmed emergency announcement is activated after the expiration of the signal silence inhibit period;

4) In the United States only: Pre-programmed emergency audio announcement;

5) Commencement of programmed delays;

6) Other local emergency control functions associated with the protected premises when the emergency control function interface device is integral with the fire alarm system, and/or

7) Output to separate emergency control function interface device(s).

b) In Canada only: Audible Signaling Devices and Visible Signaling Devices within the same manually initiated fire alarm zone shall not be greater than 5 s from the initiation of manually initiated fire alarm zone.

c) When there is an occurrence of an adverse condition, fault, or the restoration to normal, trouble signals and their restoration to normal shall be annunciated, including actuation of pre-programmed relays, open collector outputs, and similar functions, within:

1) In Canada only: 90 s;

2) In the United States only: 200 s;

Exception: The initial battery trouble signal annunciation from a battery-operated product that complies with 19.1.

d) In Canada only: Refer to Table 22.1 for subsequent input operation.

Table 22.1
Maximum System Response Time

Output	First input operation (S)	Subsequent input operation (S)
Audible Signaling Devices and Visible Signaling Devices within the same manually initiated fire alarm zone	5	Not applicable
Audible Signaling Devices and Visible Signaling Devices	10	10
Interconnection to Signal Transmitting unit	10	Not applicable
Releasing Device Service Start of Sequence	10	Not applicable
Annunciation	10	10
Ancillary Circuit	10	30
Trouble Signal	90	90

NOTES:

1) For the purposes of testing for response time, the determination of input operation shall be the operation of a contact device or the operation of the means to indicate a latched-in alarm condition of a smoke detector (e.g. operation of local LED).

2) Output circuits shall operate within the specified time under worst case loading conditions.

3) For voice alarm systems, also refer to Section 27, Voice Alarm Feature.

4) Subsequent input operations shall be performed one at a time after each input operation of the type has concluded

23 Circuits

23.1 General

23.1.1 All means of interconnecting equipment, devices, and appliances shall be monitored for integrity of the interconnecting conductor(s) and/or equivalent path(s) so that the occurrence of a single ground, single open, or adverse condition shall automatically result in a trouble signal.

Exception: Pathways required to operate with a specific Class designation in accordance with 23.2, Classification.

23.1.2 In the United States: Where two or more fire alarm systems are interconnected, the interconnecting pathways shall be defined by class A, B, and/or X in the product installation wiring diagram/instructions consistent with the operation of the particular pathway during the specified fault conditions specified in 23.2.1, 23.2.2 and 23.2.7.

23.1.3 The requirement in 23.1.1 does not apply to the following circuits:

a) Trouble signal circuits;

b) Interconnection between equipment within a common enclosure;

c) A circuit for supplementary system components / ancillary circuits when a short-circuit, an open, or a ground fault in no way affects the normal operation of the control unit/system except for omission of the supplementary function(s) (when necessary to comply with the above requirement, overcurrent protective devices provided for ancillary / supplementary circuit protection shall be non-interchangeable type such that it shall not be renewed in the field in an overcurrent device having a higher current rating);

d) Conductors for ground detection, where a single ground does not prevent the required normal operation of the system;

e) In the United States only: A non-interfering shunt circuit, when a fault condition of the circuit wiring results only in the loss of the non-interfering feature operation; and

f) The circuit connections extended to additional fire alarm control unit equipment when these wiring connections are intended to be located in the same room of each other, enclosed within conduit or equivalently protected against mechanical injury and made within:

1) In Canada only: 18 m;

2) In the United States only: 20 ft / 6.1 m;

23.1.4 The utilization of a double loop or redundant conductors or circuits to avoid electrical supervision is not acceptable.

23.1.5 A single open or a single ground on any circuit shall not cause an alarm signal.

In the United States only:

Exception: A single open is not prohibited from resulting in an alarm condition for products intended only for marine applications.

23.1.6 The operation of a product shall not depend upon any ground connection, except for those required for connection to ground fault detection circuit(s).

23.1.7 In the United States only: A multiple ground fault or short-circuit fault on initiating device, notification appliance, and/or signaling line circuit(s) intended for connection to limited-energy cable, that would prevent required alarm operation, shall result in a trouble signal or alarm signal.

23.1.8 Where power to a device or appliance is supplied over a separate pathway from the input/initiating device, signaling device/notification appliance, and/or data communication link(s)/signaling line circuit(s), the operation of the power pathway shall meet the performance requirements of the input/initiating device, signaling device/notification appliance, and/or data communication link(s)/signaling line circuit(s) and the power circuit shall be defined by the applicable class in the product installation wiring diagram/instructions consistent with the operation of the particular power pathway during the specified fault conditions described in 23.2, Classification.

Exception: Operation of the power pathway as defined for other classes are permitted to be utilized and included in the product installation wiring diagram/instructions.

23.2 Classification

23.2.1 Pathways designated Class A shall operate as follows:

a) A redundant path/channel is included.

b) Operational capability continues past a single open, and the single open fault shall result in the annunciation of a trouble signal.

c) Operational capability in a radio frequency and/or wireless pathway/channel continues during a single fault consisting of each of the following applied separately:

1) Application of an adverse condition at a transceiver/repeater other than the device under test;

2) Blocking one transmission path/channel while in use at the device under test for sending and/or receiving signals; and

3) Blocking one path/channel at the control unit receiver/transceiver while that channel is in use for receiving signals from and/or sending signals to the device under test.

The fault shall result in the annunciation of a trouble signal when two paths/channels are no longer available.

d) Each transceiver and/or repeater in a radio frequency and/or wireless pathway/channel is powered by one of the following means:

1) Both a primary source in accordance with Section 17, Primary Power Source, and a secondary source accordance with Section 18, Secondary Power Source(s);

2) Multiple primary batteries meeting 19.1(k).

e) Conditions that affect the intended operation of the required paths are annunciated as a trouble signal.

f) Operational capability is maintained during the application of a single ground fault.

g) A single ground condition shall result in the annunciation of a trouble signal.

h) Where operational capability is to be maintained during a fault, the operational capability shall be restored within the following timeframe after application of the fault;

1) In Canada only: 90 s;

2) In the United States only: 200 s;

Exception No. 1: Requirements 23.2.1 (f) and (g) shall not apply to non-conductive pathways (e.g. wireless or fiber).

Exception No. 2: Requirement 23.2.1(b) shall not apply to radio frequency/wireless pathways.

23.2.2 Pathways designated as Class B shall operate as follows:

a) A redundant path is not included.

b) Operational capability stops at a single open.

c) Conditions that affect the intended operation of the path are annunciated as a trouble signal.

d) Operational capability is maintained during the application of a single ground fault.

e) A single ground condition shall result in the annunciation of a trouble signal.

f) Each transceiver and/or repeater in a radio frequency and/or wireless pathway/channel is powered by one of the following means:

1) Both a primary source in accordance with Section 17, Primary Power Source, and a secondary source accordance with Section 18, Secondary Power Source(s);

2) Multiple primary batteries meeting 19.1(k).

g) Where operational capability is to be maintained during a fault, the operational capability shall be restored within the following timeframe after application of the fault;

1) In Canada only: 90 s;

2) In the United States only: 200 s.

Exception: Requirements 23.2.2 (d) and (e) shall not apply to non-conductive pathways (e.g. wireless or fiber).

23.2.3 Pathways designated as Class C shall operate at follows:

a) One or more pathways are included.

b) Operational capability is verified via end-to-end communication.

c) The integrity of individual paths is not required to be monitored.

d) A loss of end-to-end communication shall result in the annunciation of a trouble signal.

e) Each transceiver and/or repeater in a radio frequency and/or wireless pathway/channel is powered by one of the following means:

1) Both a primary source meeting Section 17, Primary Power Source, and a secondary source meeting Section 18, Secondary Power Source(s);

2) Multiple primary batteries meeting 19.1(k).

Exception: The end device on the pathway.

23.2.4 Pathways designated as Class D shall perform the circuit's intended operation in the event of a pathway failure. Annunciation of the pathway failure is not required.

23.2.5 A pathway shall be designated as Class E when it is not monitored for integrity.

23.2.6 A pathway designated as Class N/data communication link(s) Style N (DCLN) shall perform as follows:

a) It includes two or more pathways where operational capability of the primary pathway and a redundant pathway to each device shall be verified through end-to-end communication;

Exception: When only one end field device is served, only one pathway shall be required.

b) A loss of intended communications between endpoints shall be annunciated as a trouble signal;

c) A single open, ground, short, or combination of faults on one pathway shall not affect any other pathway;

d) Conditions that affect the operation of the primary pathway(s) and redundant pathway(s) shall be annunciated as a trouble signal when the system's minimal operational requirements cannot be met; and

e) Non-endpoint field devices shall have provisions for connection of at least two separate pathways.

23.2.7 Pathways designated as Class X shall operate as follows:

a) Pathways designated as Class X shall operate as follows:

b) Operational capability continues past a single open, and the single open fault shall result in the annunciation of a trouble signal.

c) Operational capability in a radio frequency and/or wireless pathway/channel continues during a single fault consisting of each of the following applied separately and result in the annunciation of a trouble signal:

1) Application of an adverse condition at a transceiver/repeater other than the device under test;

2) Blocking one transmission path/channel while in use at the device under test for sending and/or receiving signals; and

3) Blocking one path/channel at the control unit receiver/transceiver while that channel is in use for receiving signals from and/or sending signals to the device under test.

d) Each transceiver and/or repeater in a radio frequency and/or wireless pathway/channel utilizes frequency hopping spread spectrum technology or equivalent means to ensure the reliability of pathways.

e) Each transceiver and/or repeater in a radio frequency and/or wireless pathway/channel is powered by one of the following means:

1) Both a primary source meeting Section 17, Primary Power Source, and a secondary source meeting Section 18, Secondary Power Source(s);

2) Multiple primary batteries meeting 19.1(k).

f) Operational capability continues past a single short circuit, and the single short-circuit fault shall result in the annunciation of a trouble signal.

g) Operational capability continues past a combination open fault and ground fault.

h) Conditions that affect the intended operation of the path are annunciated as a trouble signal.

i) Operational capability is maintained during the application of a single ground fault.

j) A single ground condition shall result in the annunciation of a trouble signal.

k) Where operational capability is to be maintained during a fault, the operational capability shall be restored within the following timeframe after application of the fault;

1) In Canada only: 90 s;

2) In the United States only: 200 s.

Exception No. 1: Requirements 23.2.7 (f), (g), (i) and (j) shall not apply to non-conductive pathways (e.g. wireless or fiber).

Exception No. 2: Requirement 23.2.7(b) shall not apply to radio frequency/wireless pathways.

23.3 Input/initiating device circuits

23.3.1 The following shall be considered control unit inputs and may utilize conventional field devices:

a) Fire alarm inputs shall include all devices and input circuits that indicate a fire condition, including but not limited to: Manual stations, automatic initiating devices, water flow indicators, etc.;

b) Life safety emergency alarm condition inputs that indicate a non-fire related risk to life such as gas detection, medical emergencies, etc.;

c) Supervisory inputs shall be all devices or input circuits that supervise equipment that has been installed for the protection of life and property, including but not limited to sprinkler shut-off valves, pressure indicators, releasing circuit disconnect means, etc.;

d) Property and building safety inputs shall be all devices or circuits that form part of the building's sub-systems intended to make the building safer in the event of a fire and may include but not limited to: fan status, dampers, motors, elevators, telephones, etc.;

e) Trouble inputs including failure of equipment, circuit fault condition, or operational malfunction related to fire alarm system function; and

f) Other inputs which may be monitored but are not regulated by this Standard.

23.3.2 Each input / initiating device circuit identified in 23.3.1 (a) – (d) shall meet the operational requirements of 23.1, General, and the requirements of Class A and/or B in 23.2, Classification.

In the United States only:

Exception: Initiating-device circuits of products intended only for marine application.

23.3.3 In Canada only: An open circuit fault shall result in a specific trouble condition.

Exception: A single zone control unit does not require a specific trouble indication.

23.3.4 Detection and annunciation of a ground fault is not required for an initiating device circuit extending not more than 1 m (3 ft) from a primary battery-operated wireless device provided the 1 m (3 ft) distance does not include an intervening barrier such as a wall or ceiling.

Exception: Detection and annunciation of a ground fault is not required for initiating device circuit wiring installed in non-metallic conduit extending not more than 6 m (20 ft) from a primary battery-operated wireless device.

23.4 Supplementary-device circuits

23.4.1 A supplementary-device circuit shall be arranged so that a single short-circuit, open, or ground fault in no way affects the normal operation of the control unit/system except for omission of the supplementary-device feature (when necessary to comply with the above requirement, overcurrent protective devices provided for supplementary-device circuit protection shall be non-interchangeable type such that it shall not be renewed in the field in an overcurrent device having a higher current rating);

In Canada only:

Exception: Wiring in metallic conduit interconnecting separately enclosed items of a control unit, or a control unit and its accessories, located in the same room, and interconnected by runs not exceeding 18 m, is considered equipment wiring and need not comply with 23.4.1.

In the United States only:

Exception: The circuit connections extended to additional fire alarm control unit equipment when these wiring connections are intended to be made within 20 ft (6 m) of each other and are enclosed within conduit or equivalently protected against mechanical injury.

23.4.2 In Canada only: Supplementary-device circuit by-pass shall result in a trouble signal.

23.5 Signaling/notification appliance circuit operation

23.5.1 Each signaling/notification appliance circuit shall be defined by class in the product installation wiring diagram/instructions consistent with the operation of the particular circuit during the specified fault conditions described in 23.1, General.

23.5.2 Each Notification Appliance Circuit shall be designated depending on their performance as:

a) Class A;

b) Class B; or

c) In the United States only: Class X.

23.5.3 Detection and annunciation of a ground fault is not required for a signaling/notification appliance circuit extending not more than 1 m (3 ft) from a primary battery-operated wireless device provided the 1 m (3 ft) distance does not include an intervening barrier such as a wall or ceiling.

23.5.4 Detection and annunciation of a ground fault is not required for signaling/notification appliance circuit wiring installed in non-metallic conduit extending not more than 6 m (20 ft) from a primary battery-operated wireless device.

23.5.5 In Canada only: Signaling circuit performance shall be in accordance with 23.5.6 – 23.5.8.

Exception: Refer to operation as described in 23.5.3 and 23.5.4.

23.5.6 In Canada only: An open circuit fault, or a short circuit fault, or operation of an overcurrent protective device, provided for the purpose, shall result in specific trouble indication specific to the circuit;

Exception: A control unit having a single output circuit does not require a specific trouble signal.

23.5.7 Detection of faults is not required while the circuit is in use for signaling purposes.

23.5.8 Fault detection and indication shall be maintained during the time a circuit is used for purposes not related to fire safety (i.e., general paging).

23.5.9 In Canada only: A fault isolator used in a signaling circuit is not required to isolate the signaling circuit when the circuit is in the non-actuated condition.

23.5.10 A single open, single ground, or wire-to-wire short-circuit fault on the physical (metallic and fiber optic) conductors of one alarm notification appliance circuit or zone shall not affect the operation of any other signaling/notification appliance circuit or zone for more than:

a) In Canada only: 30 s;

b) In the United States only: 200 s.

23.5.11 A single open, single ground, or wire-to-wire short-circuit fault as applicable, on the physical (metallic and fiber optic) conductors of one alarm notification appliance circuit or zone shall not affect the operation of any other signaling/notification appliance circuit or zone under both of the following separate conditions:

a) The fault is first present during the normal standby condition followed by activation of the same alarm notification circuit or zone;

b) The fault is applied after the signaling/notification appliance circuit or zone is activated.

Exception: Signaling/notification appliance circuits which do not have notification appliances connected directly to the circuit or zone and which are monitored for integrity as indicated in 23.1, General.

23.5.12 Pathways intended for use with addressable signaling/notification appliances shall additionally meet the requirements in 23.6.2 – 23.6.8.

23.5.13 A circuit fault, or operation of an overcurrent protective device, provided for the purpose, shall result in:

a) In Canada only: specific trouble indication;

b) In the United States only: trouble indication;

Exception: A control unit having a single signaling circuit does not require a specific trouble signal.

23.5.14 Detection of faults is not required while the circuit is in use for signaling purposes.

23.5.15 Monitoring for integrity and trouble annunciation shall be maintained during the time a circuit is used for purposes not related to life or fire safety.

23.5.16 Signaling/notification appliance circuits intended for evacuation shall have the capability of producing the standard alarm evacuation signal consisting of the three-pulse temporal pattern and shall be synchronized on a system basis. The temporal pattern of the alarm signal shall be in accordance with:

a) In Canada only: Acoustic Measurement and Terminology, National Building Code of Canada; or

b) In the United States only: ASA S3.41

23.5.17 In the United States only: A system shall have the capability of providing at least one regulated Notification Appliance Circuit/Signaling Circuit, as defined in this subsection.

23.5.18 A coded alarm signal shall consist of not less than three complete rounds of the number transmitted and each round shall consist of not less than three impulses.

23.5.19 For a coded control unit intended for connection only to non-coded initiating devices, the alarm signal shall either be locked in or the system shall complete the required number of rounds of alarm signal activation without interruption due to restoration of an initiating device or fault on the initiating device circuit or signaling line circuit.

23.6 Data communications link/signaling line circuit

23.6.1 Each data communications link / signaling line circuit shall be defined by class in the product installation wiring diagram/instructions consistent with the operation of the particular circuit during the specified fault conditions specified in this subsection.

23.6.2 In Canada only: Each data communications link / signaling line circuit shall be designated as DCL A, B, C and N, depending on their performance. Refer to Table 23.1.

In Canada only:

Table 23.1
Performance of Data Communications Link (DCL)

Abnormal operating condition in a link at the same location[a]	Data Communication Link (DCL) styles				
	DCLA	DCLB	DCLC	DCLN (Per pathway)	DCLN (Endpoint connected via single pathway)
Single Open	S	T	S	S	T
Single Ground	S	S	b	c	c
Wire to Wire Short	T	T	S1	S	T
Wire to Wire Short & Ground	T	T	S1	S	T
Open and Ground	S	T	S	S	T
Loss of Communication	T	T	T	d	d

LEGEND

T = Trouble indication at the control unit.

S = Trouble indication at the control unit and alarm receipt capability during abnormal operation.

S1 = Trouble indication at the control unit and alarm receipt capability Beyond the isolated fault section of the link) during abnormal operation.

[a] The abnormal operating conditions (faults) are to be applicable for the circuits / pathways technology (e.g., ground fault and wire-to-wire fault is not applicable to optical fibre and wireless technology pathways).

[b] Systems utilizing data communication link(s) Style C (DCLC) do not require detection of a single ground on the data communication link provided they meet the requirements of 23.6.6. All the field devices on the circuit may be shown in trouble condition while the system resolves the fault condition.

[c] Systems utilizing data communication link(s) Style N (DCLN) do not require detection of a single ground on the data communication link provided the DCL meets the requirements of 23.6.7.

[d] For loss of communication, refer to 23.6.7 (b) and (d).

23.6.3 In the United States only: Each data communications link / signaling line circuit shall be designated as Class A, Class B, Class N, or Class X, depending on their performance described in 23.1, General.

23.6.4 A fault in the data communications link shall not cause an alarm condition.

23.6.5 In Canada only: A ground fault on a data communications link / signal line circuit shall produce at least one common visual ground fault indication and common trouble signal.

23.6.6 In Canada only: Systems utilizing data communication links / signal line circuits Style C do not require detection of a single ground on the data communication link provided:

a) A ground fault on any input circuit or output circuit is indicated in accordance with above; and

b) The presence of any second ground fault on the data communications links / signal line circuits would not prevent the transmission of data.

23.6.7 In Canada only: A pathway designated as data communication links / signal line circuits Style N (DCLN) shall perform as follows:

a) It includes two or more pathways where operational capability of the primary pathway and a redundant pathway to each device shall be verified through end-to-end communication;

Exception: When only one end field device is served, only one pathway shall be required.

b) A loss of intended communications between endpoints (DCLN) shall be annunciated as a trouble signal;

c) A single open, ground, short, or combination of faults on one pathway shall not affect any other pathway;

d) Conditions that affect the operation of the primary pathway(s) and redundant pathway(s) shall be annunciated as a trouble signal when the system's minimal operational requirements cannot be met; and

e) Non-endpoint field devices shall have provisions for connection of at least two separate pathways.

23.6.8 In Canada only: For distributed type systems utilizing multiple data communications links / signal line circuits, a fault on one data communications links / signal line circuits or failure of a transponder or supporting field device shall not adversely affect the proper operation of the remaining data communications links / signal line circuits. Such a fault and/or failure shall result in an audible and specific visual indication of the failure. Upon correction of the fault, the current status shall be displayed.

23.6.9 In the United States only: Any data communication links / signal line circuits pathway shall have the capability, either inherent or by use of external devices, to prevent a wire to wire fault from affecting the entire pathway.

Exception No. 1: This does not apply to interconnected fire alarm control units.

Exception No. 2: Data communication links/signal line circuits pathways limited to a single zone.

23.6.10 Where digital communications are used, the inability of a product to send or receive digital signals over a signaling line circuit shall result in a trouble signal.

23.6.11 In the United States only: A single open, single ground, or wire-to-wire fault on the physical (metallic or fiber optic) conductors of a signaling line circuit for use with addressable notification / signaling appliances or modules shall not affect operation of more than one notification / signaling zone.

Exception: Riser conductors installed in accordance with the survivability from attack by fire requirements in NFPA 72. Specifics covering the installation constraints shall be clearly detailed in the control unit's installation wiring diagram/instructions.

23.7 Fault isolators

23.7.1 Integral status indication – if the fault isolator incorporates an integral visual indication of its status, then this indication shall be yellow.

23.7.2 Connection of ancillary devices – where the fault isolator provides for connections to ancillary devices (e. g. remote indicators) open or short circuit failures of these connections shall not prevent the correct operation of the fault isolator.

23.7.3 Monitoring of detachable fault isolators – if a fault isolator is detachable (i.e., it is attached to a mounting base), its removal shall result in a trouble signal.

23.7.4 Manufacturer's adjustments – it shall not be possible to change the manufacturer's setting except by special means (e.g., the use of a special code or tool) or by the breaking or removal of a seal.

23.7.5 On-site adjustments – if there is provision for on-site adjustment of the fault isolator, then for each setting, the fault isolator shall comply with the requirements of this part of the standard. Access to the means of adjustment shall be possible only by the use of a code or a special tool.

23.8 Low-power radio-frequency signaling

23.8.1 These requirements cover the operation of products and systems that utilize initiating, annunciating, and remote control devices that provide signaling by means of low-power radio-frequency (RF), with the transmitters operating on a random basis or using two-way interrogate/response signaling.

23.8.2 The requirements in 23.8.3 – 23.8.13 are based upon all required annunciation occurring at the receiver/control unit in a local application. When the receiver/control unit functions as a protected premises unit with off premise signaling, the unit shall comply with all the local annunciation requirements in 23.8.3 – 23.8.13. In addition, as a minimum, a common alarm, supervisory, and trouble signal, as applicable, shall be transmitted to the supervising station. Where more specific signals are transmitted, such as zone or device information, only the initial change of status signal of each type for each zone or device shall be transmitted.

23.8.3 A primary battery shall comply with 19.1 when a primary battery is used.

23.8.4 A fire alarm signal from a RF initiating device shall latch at the receiver/control unit until manually reset, and shall identify the particular RF initiating device in alarm.

23.8.5 When a receiver/transceiver/control unit activates RF appliance(s) such as relays or notification appliances, the activated appliance shall remain locked-in until manually reset at the receiver/control unit.

23.8.6 A low-power radio-frequency system combination intended to provide supervisory service shall be arranged so that the occurrence of an activated state of the supervisory device shall be annunciated by a supervisory signal and identify the affected device. The supervisory signal and affected device identification shall latch at the receiver/control unit until either manually reset or the restoration signal is processed as indicated in 23.8.7.

23.8.7 Restoration from activated state to the normal supervisory condition of the supervisory device shall result in the receiver/control unit either canceling the previously annunciated supervisory signal or annunciating the status change audibly and visibly identifying the affected device.

23.8.8 To provide higher priority to alarm and supervisory signals than to other signals, alarm and supervisory signals shall be periodically repeated at intervals not exceeding 60 s until the initiating device is returned to its non-alarm condition. Receiver/transceiver/control unit activating RF appliances shall automatically repeat alarm and supervisory signal transmissions at intervals not exceeding 60 s or until confirmation that the output appliance received the signal. The duty cycle of the transmission shall be not more than 15 % measured over a 1 min interval.

Exception: Transmitter/transceiver/receiver combinations utilizing two-way communication where all the following conditions are met:

a) The transceiver/receiver acknowledges receipt of the change of status signal to the corresponding transceiver/transmitter; and

b) The receiver/control unit annunciates the current trouble status of the corresponding input or output RF device after manual reset of the receiver/control unit.

23.8.9 A receiver/control unit shall annunciate a latching trouble signal and identify an inoperative transmitter/product in the system within:

a) In Canada only: 90 s.

b) In the United States only: 200 s.

23.8.10 Additional assurance of successful transmission capability shall be provided by one of the following methods:

a) Transmitting the normal supervisory status transmission at a reduced power level of at least 3 dB;

b) Either increasing the minimum signal strength or reducing the maximum ambient radio-frequency noise levels used in the product-specific field test procedure by at least 3 dB;

c) Increasing the minimum signal to noise ratio used in the product-specific field test procedure by the equivalent of at least 3 dB; or

d) By another equivalent means.

23.8.11 The audible tamper signal of the receiver/control unit is not prohibited from being silenceable when provided with an automatic feature to resound the signal at intervals not exceeding 4 h. Both of the following actions shall cause the annunciation of a tamper signal at the receiver/control unit additionally identifying the affected device within 200 s.

a) Removal of an initiating-device transmitter, RF appliance receiver or retransmission device from its installed location, including displacement of a removable surface such as a ceiling tile.

b) Removal of a cover exposing a transmitter primary battery.

23.8.12 In Canada only: The response times shall comply with Table 22.1.

23.8.13 Reception of any unwanted (interfering) transmission by a retransmission device (repeater), or by the receiver/control unit that exceed the maximum specified ambient noise level or minimum signal-to-noise ratio (refer to 97.2.1 and 97.2.2) for a continuous period of 20 s or more shall result in an audible trouble signal indication at the receiver/control unit. This indication shall identify the specific trouble condition (interfering signal) as well as the device(s) affected (repeater and/or receiver/control unit).

24 Signal Priority

24.1 Control unit inputs shall be classified by priority as indicated in 24.2 and/or 24.3. The control unit may provide the capability of selecting other priorities, based on building specific emergency requirements, as long as the primary priority identified in 24.2 and/or 24.3 is available.

24.2 In the United States only: Signals shall be processed as follows in descending order of priority:

a) Signals associated with life safety.

b) Signals associated with property safety.

c) Supervisory signals and trouble signals associated with life and/or property safety.

d) All other signals.

24.3 In Canada only: Control unit inputs shall be classified by priority as indicated in Table 24.1. The control unit may provide the capability of selecting other priorities, based on building specific emergency requirements, as long as the primary priority identified in Table 24.1 is available.

In Canada only:

Table 24.1
Control Unit Priority

Input	Priority level
Fire alarm signals	1
Signals related to life safety emergency conditions	2
Fire supervisory signals	3
Signals associated with property and building safety	4
Trouble signals associated with fire alarm, life and/or property safety	5
Other	6
NOTE: Refer also to Annex B.	

25 Operational Features (Optional)

25.1 Two-stage feature

25.1.1 First-stage and second-stage inputs shall comply with the requirements of Section 23, Circuit. Refer to A10.6.1.1 for examples of two-stage system operation.

25.1.2 Control units shall be capable of providing an alert signal and an alarm signal to designated circuits.

25.1.3 A first stage to second-stage automatic alarm signal activation timer shall be provided. A normal to activated state status change of an alarm input zone shall start the timer.

25.1.4 The timer shall be nullified if the automatic alarm signal cancel feature is manually operated or if the fire alarm is silenced within the run time of the timer (e.g. generally within 5 min).

NOTE: Where the alarm sequence display follows Option B in Table 20.1, a dedicated automatic alarm signal cancel switch is required.

25.1.5 If the alarm signal activation timer has timed out at the moment of alarm silence, then a subsequent alarm from another zone shall initiate the alert signal and alarm signal as programmed.

25.1.6 Subsequent alarm from another input zone shall initiate the alert signal and alarm signal as programmed, and shall restart the automatic alarm signal activation timer as outlined in Figure 21.1.

25.1.7 If the automatic timed operation of an alarm evacuation signal is adjustable, access for adjustment shall be in accordance with 8.3.

25.2 Automatic alarm signal timer cancel feature – two-stage systems

25.2.1 The automatic alarm signal cancel feature, if provided, shall prevent the timed automatic initiation of the second-stage of a two-stage system.

25.2.2 Automatic alarm signal cancel control shall comply with the following:

a) Activation of automatic alarm signal cancel control shall prevent the automatic time-out from alert (first stage) into alarm (second-stage).

In Canada only: This control shall be clearly marked in accordance with Table 20.4 and Table 20.5 or equivalent;

b) Activation of the automatic alarm signal cancel control shall result in a specific indication and shall not silence any signaling;

c) Activation of the automatic alarm signal cancel control shall not prevent reactivation of the timer for subsequent alarms. Reactivation of the timer shall result in the timer operating for a full time interval;

d) Where the alarm sequence display follows Option B in Table 20.1 a dedicated “automatic alarm signal cancel” switch is required; and

e) Automatic alarm signal cancel control shall be self-restoring. Refer to Figure 21.1.

25.3 Positive alarm sequence

25.3.1 Positive alarm sequence shall be used only for alarm signals from automatic fire detection devices.

25.3.2 All system evacuation signals associated with the activated initiating device and any off premise signaling shall be activated immediately and automatically when:

a) The alarm signal from an automatic fire detection device is not acknowledged within 15 s of annunciation at the operator interface of the system;

b) The system is not manually reset within 180 s of the acknowledgment described in 25.3.2(a);

c) When a second automatic fire detector selected for positive alarm sequence is actuated before the system is reset as described in 25.3.2(b); or

d) When any other fire initiating device reporting to the system/control unit is actuated.

25.3.3 The system shall provide a means for bypassing the positive alarm sequence.

25.4 Automatic drift compensation and/or smoke detector sensing chamber supervision

25.4.1 Where automatic drift compensation of sensitivity or chamber supervision for contamination of a smoke detector is provided, the system shall annunciate an audible and visual trouble condition, identifying the affected detector, when service is required. For automatic drift compensation, the trouble signal shall be activated when the limit of compensation is reached. For systems utilizing sensing chamber supervision, the trouble signal shall be activated before the chamber clean-air reference value changes by more than 50 % of the shift necessary to indicate an alarm signal.

25.4.2 After automatic drift compensation has occurred, the sensitivity of the smoke detector shall be within ±1.65 %/m (0.5 %/ft) obscuration of the initial sensitivity when tested as described in 25.4.3 – 25.4.6.

25.4.3 The compensation shall not adversely affect the operation of the smoke detector. The magnitude of each compensation step shall not change the clean-air reference value by more than 5 % of the shift necessary to indicate an alarm signal. The summation of compensation steps over a 24 h period shall not change the clean-air reference value by more than 50 % of the shift necessary to indicate an alarm signal.

25.4.4 Two samples of each smoke detector and one sample of the product shall be subjected to the conditions described in 25.4.5 – 25.4.6. One sample of the smoke detector shall be set at the maximum production clean air setting and the highest production gain, while the other shall be set at the lowest production clean air setting and the lowest production gain.

25.4.5 While the product is energized from a source of supply, each smoke detector shall be subjected to the sensitivity test described in the sensitivity test in the following:

a) In Canada only: ULC 529.

b) In the United States only: UL 268.

25.4.6 The product sensitivity setting for the low gain smoke detector shall be the least (minimum) sensitivity value and the sensitivity setting for the high gain detector shall be the most (maximum) sensitivity setting. The measured sensitivities shall be within the rated limits for the detector.

25.4.7 A simulated method of contamination is then to be introduced into each detector and the product/detector combination allowed to compensate. The process is to be repeated, increasing the contamination within the detector, until the detector is at the point where the maximum amount of compensation has been provided. The sensitivity test described in 25.4.5 is to be repeated. This sensitivity shall be within ±1.65 %/m (0.5 %/ft) obscuration of the initial sensitivity measurement for the same detector.

25.5 Calibrated detector sensitivity testing

25.5.1 The product/control unit shall correctly interpret the sensitivity of fire detectors and either display the sensitivity of each device upon command or annunciate a trouble condition identifying the specific detector(s) that are not within their required sensitivity limits.

25.5.2 When initiated automatically, the specific or range of test interval(s) shall be indicated in the product/control unit's installation wiring diagram/instructions.

25.5.3 When the product/control unit displays the sensitivity in values other than %/m (%/ft) obscuration, the correlated values to %/m (%/ft) obscuration shall be either included in the product/control unit's marking or installation instructions.

25.5.4 Samples of the system shall be subjected to the confirmation testing described in 25.6.1 and 25.6.2.

25.6 Calibrated smoke detector sensitivity confirmation testing

25.6.1 When the product is intended to correctly interpret the sensitivity of the smoke detectors as required in 25.5.1 – 25.5.4, samples of the each smoke detector shall be subjected to the sensitivity test described in the following:

a) In Canada only: ULC 529.

b) In the United States only: UL 268.

25.6.2 The measurements shall be within ±1.65 %/m (0.5 %/ft) obscuration of the values displayed on the product or at the point of annunciation of a trouble condition when the detector is not within the required sensitivity limits, ±1.65 %/m (0.5 %/ft) obscuration.

25.6.3 While the product is energized from a source of supply in accordance with Table 68.1 two samples of each smoke detector shall be subjected to the sensitivity test. One sample of the smoke detector shall be set at the maximum production clean air setting and the highest production gain, while the other shall be set at the lowest production clean air setting and the lowest production gain.

25.7 Pre-signal

25.7.1 When a system annunciates the initial alarm signal only in a constantly attended location, and manual activation is required for a general alarm evacuation signal, subsequent actuation of alarm initiating devices on another initiating zone of the system shall result in the activation of the general alarm evacuation signal.

25.7.2 Any off premise signaling, when employed, shall activate upon the initial alarm signal.

25.8 Smoke detector alarm verification (status change confirmation)

25.8.1 To reduce the effect of electrical and migratory smoke transients, a system is not prohibited from having provision for a smoke detector alarm verification feature for alarm signals received from smoke detectors or smoke monitoring heads. When employed, 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 product that can be field wired to interface between the control unit and initiating device circuit; or

d) An equivalent arrangement.

25.8.2 Smoke detector alarm verification shall be arranged on a per circuit (zone) basis.

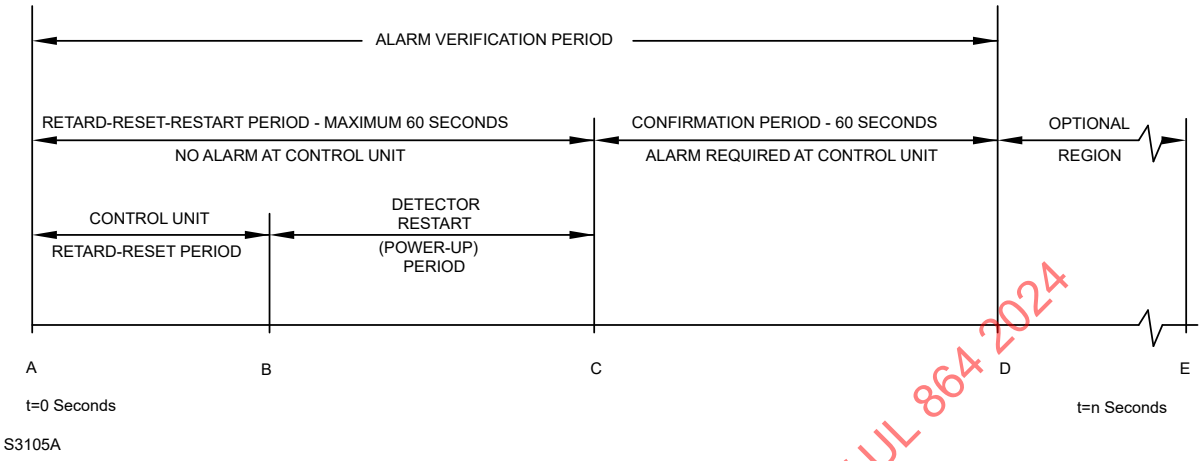
Exception: When smoke detector alarm verification is to be accomplished on a multiple circuit (zone) or system basis, the retard-reset-restart period duration shall not exceed 30 s. Alarms from devices other than smoke detection shall not be delayed by more than 10 s when this option is employed.

25.8.3 When a smoke detector alarm verification feature is provided, the maximum retard-reset-restart period of alarm verification of a system, 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 s. During the minimum 60-second alarm confirmation period following the retard-reset-restart period, re-actuation of the same detector that initiated the smoke detector alarm verification cycle, actuation of another smoke detector on the same circuit (zone), or an alarm from another zone shall result immediately in an alarm signal from the control unit. Refer to Figure 25.1.

Exception: When two or more protected-premises units are connected to a supervising station unit or when two or more local-type control units are networked together, it is acceptable to configure each protected premises unit or local unit to permit its own smoke detector alarm verification feature.

Figure 25.1

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.

AC – Retard-Reset-Restart Period – No alarm obtained from control unit. Maximum permissible time is 60 s.

AD – Alarm Verification Period – Consists of the retard-reset-restart and confirmation periods.

BC – Detector Restart (Power Up) Period – Power to the detector is reapplied and time is allowed for detector to become operational for alarm. Time varies with detector design.

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 re-alarms 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.

25.8.4 The retard-reset period of smoke detector alarm verification is not required to include the polling time of a multiplex system when alarm verification is provided at the same unit to which the smoke detectors are connected, but shall include the polling time when the alarm verification is provided at a remote unit.

25.8.5 Smoke detector alarm verification shall not be used in initiating-device circuits intended for cross-zone operation.

25.8.6 Products incorporating a smoke detector alarm verification feature shall not be used with smoke detectors employing a smoke detector alarm verification feature.

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

25.8.7 Smoke detector 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 similar devices) which are capable of being connected to the same circuit.

25.8.8 To determine the retard-reset duration of the smoke detector alarm verification feature (not including the power-up time of a smoke detector), a product/control unit is to be connected to a rated source of electrical supply as specified in the general performance tests section covering test voltages. Each initiating device circuit provided with smoke detector alarm verification is to be placed into alarm by a switch representing detector contacts, by actuation of the specific detector to be employed with the product/control unit, or by equivalent means. The time between initiation of the detector alarm and energization of the product/control unit alarm circuit is the retard-reset period. The retard-reset-restart period is to be determined by adding the maximum power-up time of the smoke detector(s), intended to be connected to the product/control unit as indicated in the product/control unit installation wiring diagram/instructions, to the retard-reset period.

25.8.9 To determine that an alarm is obtained from the product during the 60 s minimum alarm confirmation period, the product/control unit and initiating device circuit are to be energized in the normal standby condition. The initiating device circuit is then to be placed in alarm to actuate the alarm verification cycle of the product/control unit and restored to the non-alarm condition. At the end of the alarm confirmation period, the initiating device circuit is to be placed in alarm at which time the product is to alarm.

25.9 Alarm silence/signal silence inhibit feature

25.9.1 The signal silence inhibit feature, if provided, shall prevent the silencing of the alarm signal and alert signal for a preset time from the initial alarm.

25.9.2 Timing shall be in accordance with:

a) In Canada only: Article 3.2.4.6, Silencing of Alarm Signals, NBCC.

b) In the United States only: The manufacturer's specification.

25.9.3 Access for the adjustment of the time period shall be in accordance with 8.3.

25.9.4 This feature shall only apply to the first alarm input status change.

25.9.5 Reset function shall not override this feature.

25.9.6 Live voice paging or automated voice messaging shall not override this feature.

25.10 Automatic signal silence feature

25.10.1 The automatic signal silence feature, if provided, shall allow the automatic silencing of an alarm signal and/or an alert signal after a preset time in accordance with:

a) In Canada only: Article 3.2.4.6, Silencing of Alarm Signals, NBCC; or

b) In the United States only: The standard alarm evacuation signal shall be repeated for a period not less than 3 min.

25.10.2 In Canada only: Access for the adjustment of the time period shall be available only to authorized personnel.

25.10.3 Alarm signal deactivating of activated notification appliances of a control unit/system shall be indicated by a constantly displayed and identified visual indicator.

25.10.4 Actuation of the automatic timed cut-off shall not prevent subsequent alarms from reinitiating an alarm signal and/or an alert signal.

25.11 In the United States only: Multiple detector operation

25.11.1 Alarm activation that requires the activation of two automatic detection devices shall not utilize the alarm verification feature or any other time delay.

25.11.2 Guidelines, instructions, and restrictions [such as spacing, alarm verification feature, and/or other time delay(s)] for the installation and use of a system employing multiple detector operation shall be included in the installation wiring diagram/instructions.

25.12 Remote access

25.12.1 A system is permitted to be provided with remote access capability for the following purposes:

a) Testing (including acknowledge, silence, system reset, operation of emergency control functions, device location label revisions, activation of outputs and indicators, simulated activation of inputs for cause and effect testing, sending or activating voice announcements, disabling/enabling inputs, disabling/enabling outputs, disabling/enabling off premise transmitters and other control commands only for the portions of the system under test);

b) Maintenance;

c) Diagnostics;

d) Software Revision;

e) Where permitted, remotely acknowledging, silencing, and resetting of the system during normal operations.

25.12.2 A remote communications session for diagnostics is permitted to be initiated remotely where the system complies with all of the following:

a) A continuous remote communications session is terminated within 1 h of remote operator inactivity (no manual actions taken at the remote connection point).

b) There is a means to terminate the remote communications session at the remote location at any time.

c) There is a means to terminate the remote communications session at the system control unit at any time. The terminating means shall be permitted to be via an on-premise connected device (e.g., smartphone, tablet, PC or other device) and application, provided the connection and the user of the application are authenticated.

d) The remote communications session does not control or affect the required operation of the system.

e) Remote diagnostics communications sessions shall be authenticated and shall utilize encryption algorithms with a minimum of 128 bits of security.

25.12.3 A remote communications session for testing, maintenance, or software revision is permitted where the system complies with all of the following:

a) The remote communications session is initiated by activation of a security means, in accordance with 8.3 at the protected premises signaling system control unit that results in a trouble signal. The activation of the security means shall be permitted to be via an on-premise connected device (e.g., smartphone, tablet, PC or other device) and application, provided the connection and the user of the application are authenticated.

b) A continuous remote communications session is terminated within 1 h of remote operator inactivity (no manual actions taken at the remote connection point).

c) There is a means to terminate the remote communications session at the remote location at any time.

d) There is a means to terminate the remote communications session at the system control unit at any time. The disconnection means shall be permitted to be via the on-premise connected device if used to meet the requirements of (a).

e) The remote communications session does not control or affect the required operation of any portion of the system that is not in a test mode.

25.12.4 Systems meeting the requirements of 25.12.1(e) shall comply with all of the following:

a) A local operator interface shall be provided.

b) The remote operator interface shall display all alarm, supervisory, and trouble signals.

c) The remote connection shall be monitored for integrity so that any adverse condition affecting the performance of the connection is visibly and audibly annunciated at the remote and local operator interfaces within 200 s.

26 Building System Information Unit (BSIU) Processing Equipment Software

26.1 General

26.1.1 Requirements in 26.1 – 26.4 describe the methods for evaluation of the software utilized in BSIUs. These sections apply to equipment for use at the protected premises for the purpose of display and control of the fire alarm, smoke control and mass notification system(s).

26.1.2 BSIU processing equipment meeting all the conditions specified in 26.1 – 26.4 need not be subjected to Sections 36 – 61, Sections 72 – 103 and Sections 104 – 105.

26.1.3 The product shall comply with the following:

a) Sections 68 – 81, Performance Details and Specifics;

b) 20.2, Trouble Signals;

c) 7.1 – 8.3 and Section 10, Software;

d) 20.7, Supplementary Displays;

e) 22.3, System Response;

f) 29.2, Combination Systems, Mass Notification System Interconnection;

g) 29.3.1, 29.3.3, 29.3.4, and 29.3.10 Combination Systems, Carbon Monoxide Signaling;

h) Section 30, Releasing Device Service; and

i) 76.2.1 – 76.2.2, Releasing device – non-extinguishing and non-water based.

26.2 Operation

26.2.1 A system meeting, but not exceeding the specifications of 26.4.1(a), shall be submitted for evaluation. The BSIU system shall be interconnected with the compatible fire alarm controls units identified in the BSIU system's installation instructions.

26.2.2 When a BSIU is interconnected to a fire alarm system, releasing system, smoke control or mass notification system, the audible change of status notification on those systems may be suppressed by the BSIU when the following requirements are met:

a) Failure of any part of the BSIU configuration which affects BSIU fire alarm, releasing, smoke control or mass notification operation shall result in the fire alarm control unit automatically audibly annunciating new change of status signals.

Exception: Interconnecting wiring between a stationary computer and the computer's keyboard, video monitor, touch screen, or mouse type device are not required to be monitored for integrity when:

1) A complete open in the interconnecting cable is visually indicated so as to be obvious to the user or the open does not affect the required system operation except for loss of the faulted function; and

2) The interconnecting cable(s) does not exceed 8 ft.

b) A fault or adverse condition on interconnecting wiring in the BSIU configuration which affects BSIU system fire alarm, smoke control or mass notification operation shall result in the fire alarm control unit automatically audibly annunciating new change of status signals.

c) When the proper operation of the BSIU is adversely affected due to actuation of the security means or during any reprogramming, the fire alarm control unit shall automatically audibly annunciate new change of status signals.

26.3 Display information

26.3.1 The display content information at the BSIU shall provide the equivalent content on the interconnected fire alarm control unit, mass notification control unit, or Firefighter's Smoke Control Station (FSCS).

26.3.2 Systems serving two or more zones shall visually identify the zone of origin and/or point addressable device of the status change.

26.3.3 Non-electrical visual annunciation integral with a switch shall include obvious distinct indications for both the normal and activated position of the switch. Utilization of the switch position does not meet the intent of complying with this requirement.

26.3.4 Controls provided specifically for the purpose of manually overriding any automatic building and fire control functions intended to increase the level of life safety for occupants or control the spread of the harmful effects of fire or other dangerous products (emergency control function), shall provide visible indication of the status of the associated control circuits.

26.3.5 Any manual means for turning off activated occupant signaling devices (silencing) shall comply with 32.2.3.2 – 32.2.3.3 and 21.2.3.

26.3.6 An alarm signal visual display status shall be maintained continuously (locked in) until a resetting device in the control unit/BSIU system is operated manually.

26.3.7 A means for silencing a supervisory signal sounding appliance shall comply with 32.2.4.3 – 32.2.4.4 and 21.3.1.

26.3.8 When a common audible, as part of the operator interface, is employed for alarm annunciation for all types of signals, distinction shall be achieved visually.

26.3.9 When a common audible, distinct from alarm, is employed for trouble annunciation for all types of signals, distinction shall be achieved visually.

26.3.10 Firefighter's Smoke Control Station display/operation shall comply with 31.3, Firefighter's Smoke Control Station (FSCS).

26.4 Operation during abnormal conditions

26.4.1 All other BSIU operations outside the scope of this standard shall not impair the required operations of the fire alarm signaling system.

26.4.2 Short circuits or open circuits in the BSIU equipment or in the wiring between the BSIU equipment and the fire alarm system shall not impede or impair the monitoring for integrity of the interconnected fire alarm system as described in Section 23, Circuits, nor impede or impair any fire alarm signal transmissions or operations.

26.4.3 Single ground faults in the BSIU equipment or in the wiring between the BSIU equipment and the fire alarm system shall not impede or impair the monitoring for integrity of the fire alarm system, or impede or impair any fire alarm, supervisory or trouble signal transmissions or operation.

26.4.4 Single ground faults shall be reported at the fire alarm control system as trouble signals when they occur on the wiring interconnecting the BSIU equipment with the fire alarm system.

Exception: Where multiple ground faults on the wiring interconnecting the BSIU equipment with the fire alarm system do not impede or impair the monitoring for integrity of the fire alarm system, or impede or impair any fire alarm, supervisory or trouble signal transmissions or operation.

26.4.5 The required operation of the fire alarm equipment shall not be impaired by any failure of the BSIU equipment hardware, software or circuits, or by any maintenance procedure, including removal or replacement of defective equipment or powering down of the BSIU equipment.

26.5 Combination systems

26.5.1 A distinction between signals associated with fire protection and signals of other types, such as burglary or energy management monitoring shall be made.

26.5.2 In combination systems, fire alarm signals shall be distinctive, clearly recognizable, and shall be in accordance with:

a) 20.4.1(f); and

b) In Canada only: 20.1.10

26.5.3 The BSIU shall meet the timing requirements in 26.1.3(g) during least favorable system loading conditions when the BSIU controls non-life safety building systems such as lighting, access control, security and environmental conditions or other software, such as an internet browsing, is running.

26.6 Installation information

26.6.1 The installation instructions for the BSIU software shall include the following information:

a) The minimum system configuration(s) consisting of the following:

1) Operating system and, where applicable, revision level;

2) Microprocessor manufacturer, type(s)/family, and minimum clock speed;

3) Minimum disk storage;

4) Minimum memory requirements;

5) Minimum display requirements;

6) Minimum user interface requirements (such as mouse, keyboard, touch screen, etc.);

7) Required features (such as media needs (DVD, etc.), drivers, etc.);

8) Required input/output functionality (such as serial ports, USB ports, and network cards); and

9) System software release level.

b) Identify compatible fire alarm control units and mass notification control units, and Firefighter's Smoke Control Station to which the BSIU may be interconnected.

c) Specify that the BSIU is to be located within the same room as the fire alarm control unit to which the BSIU is interconnected where a BSIU provides control of the interconnected fire alarm control unit or suppresses audible change of status notification at the fire alarm control unit.

d) Specify that the BSIU shall not be permitted to perform fire alarm system control features that cannot be accomplished by the interconnected fire alarm control unit within the same room where a BSIU provides control of the interconnected fire alarm control unit.

e) Specify that the source of power for the BSIU equipment shall be within the rated range of the BSIU.

f) Specify the BSIU equipment including all peripheral equipment (such as display, keyboard, etc.) shall meet the requirements of:

1) In Canada only:

i) CSA-C22.2 No. 60950-1; or

ii) CSA-C22.2 No. 62368-1.

2) In the United States only:

i) UL 60950-1; or

ii) UL 62368-1

g) Specify that the BSIU system is not permitted to initiate and process live voice paging.

h) Specify that no other software other than the operating system software, anti-virus/security protection software, and other software specified in the installation instructions shall be installed on the BSIU.

27 Voice Alarm Feature

27.1 General

27.1.1 This section covers the performance of emergency voice/ alarm communication systems (EVACS).

27.1.2 Emergency voice/ alarm communication systems may be arranged to provide the following operation:

a) A single channel system to allow full selectivity, on a per zone basis, of voice paging or an alarm signal, but not both simultaneously;

b) A single channel all-call system for voice paging or an alarm signal;

c) A two channel system to allow simultaneous full selectivity, on a per zone basis, for voice paging and an alarm signal;

d) A three channel system designed to allow an alert signal, the alarm signal and voice instructions to be selectively and simultaneously transmitted to any signaling zone(s); or

e) A multi-channel system designed so that multiple signals can be selectively and simultaneously transmitted to any zone or zones. The multiple signals shall include, but not be limited to:

1) An alert signal;

2) An alarm signal;

3) Voice instructions; or

4) Other signals.

27.1.3 Microphone and/or telephone handset cables shall be monitored for integrity such that loss of the connection results in a trouble signal.

Exception: Microphone and telephone handset cables located within a key locked cabinet are not required to comply with this requirement.

27.1.4 All required annunciation shall be at a fire emergency voice/alarm communication control system.

27.1.5 Where a combination of or multiple control locations are employed, the following shall also apply:

a) Controls can only be operated from one location at any given time;

b) Indication shall be:

1) In Canada only: Continuously displayed at all display and control centres as to which is in control, either by a dedicated indicator or a text message where alphanumeric displays are used; or

2) In the United States only: identified by a visible indication at the location in control. When a control location is indicating that it is not in control, it shall not act as if it is in control.

c) Complete loss of communication to the display and control centre shall not inhibit other communicating display and control centres from being able to gain control; and

d) Ability to request, grant, or deny system control with provision for fail-safe auto-transfer from one command centre to another shall be provided.

27.1.6 Manual controls shall comply with 21.1, General.

27.1.7 Systems or equipment arranged to stop or reduce ambient noise shall comply with monitoring for integrity requirements in 27.3, Monitoring Integrity, 33.3, Monitoring for Integrity, Section 23, Circuits, and with the other applicable requirements of this standard.

27.1.8 The audio inputs shall operate in the following priority:

a) Emergency live voice paging;

b) Emergency automated voice messaging;

c) Alarm signal operation; and

d) Alert signal operation if provided.

27.1.9 In Canada only: Emergency live voice paging shall be inhibited until after the time out of the alarm signal silence inhibit period as described in 25.9, Alarm Silence/Signal Inhibit Feature.

27.1.10 Emergency voice communication systems shall visually indicate the status of each speaker zone.

27.1.11 The status indication must continuously and distinctly indicate when a zone is:

a) Off (not active);

b) Active with a page;

c) Active with a signal other than a page; or

d) Selected for a pending action.

27.1.12 Other indications in addition to the following are not prohibited:

a) Visual indication of active speaker zones (zones are to be considered "on" when an evacuation signal, pre-announce tone, recorded message, or live voice message is being reproduced by the speakers of that zone, regardless of whether it was automatically or manually activated);

b) The activated state of all control switches (this includes zone select, manual evacuation, all-call, and page controls); and

c) In Canada only:

1) Visual indication of an alert signal, when applicable; and

2) Where simultaneous operation of an alert signal and an alarm signal is used, visual indication on a per-signaling zone basis shall be provided to indicate type of signal on each circuit.

27.1.13 In Canada only: Where LEDs are used to indicate the distinct status of a zone, the colors of the LEDs must comply with Table 20.1.

27.1.14 Non-electrical visual annunciation integral with a switch shall include obvious distinct indications for both the non-activated and activated position of the switch.

27.1.15 Utilization of the switch position does not meet the intent of complying with this requirement.

27.2 Functional sequence

27.2.1 In response to an initiating of a fire alarm emergency signal the voice/alarm communication shall be capable of providing the following functions:

a) Manual activation of an evacuation signal or recorded message on an all-call basis. Additionally, manual activation by zone is permitted.

b) If a previously initiated recorded message is interrupted by live voice instructions, upon releasing of the microphone, the previously initiated recorded messages to the selected notification zones shall have the capability of not resuming play automatically.

c) In Canada only: Paging feedback capabilities:

1) Operation of any manual control for alert signal, alarm signal, digitized voice message, or live voice paging selection of associated output circuit(s) or zone(s), shall provide an indication, within 2 s that the control has been depressed and is awaiting execution. This indication may include, but not limited to one or more of the following indications:

i) Audible;

ii) Tactile; or

iii) Visible.

2) Activation of a manual control to select an alert signal, alarm signal or digitized voice message on an associated output circuit(s) or zone(s) shall result in a visual indication the associated output circuit(s) or zone(s) is playing the selected signal or message.

3) Activation of manual controls for live voice paging to an associated output circuit(s) or zone(s) shall result in:

i) A visual indication that the output circuit(s) or zone(s) is ready to receive live voice paging; and

ii) An alert signal, alarm signal or a digital voice message continuing to play until the microphone push to talk switch has been depressed and live voice paging to an output circuit(s) or zone(s) is active.

4) Activation of the microphone's "push to talk" manual control or equivalent shall result in a "system ready to page" indication that the selected live voice paging output circuit(s) or zone(s) are ready to output live voice paging.

NOTE: The "system ready to page" indication shall be in accordance with, or equivalent to, Table 20.4.

5) Activation of the microphone "press to talk" manual control or equivalent, where an optional pre-announce signal is utilized, shall result in:

i) The output circuit(s) or zone(s) initiating the pre-announce signal in a maximum of 2 s; or

ii) A pre-announce visual indication, which may be, or combined with, the "system ready to page" of (c)(4) to indicate the pre-announce signal is active. Live voice paging to an output circuit(s) or zone(s) that is active with an alert signal, alarm signal or digitized voice message may incorporate an optional delay in transfer of output circuit(s) or zone(s) from live voice paging back to alert signal, alarm signal or digitalized voice message. The transfer back shall:

A) Not exceed a maximum of 5 s after release of the microphone "press to talk" manual control or equivalent; or

B) Result in a visual indication, that the alert signal, alarm signal or digitized voice message is active on the output circuit(s) or zone(s).

NOTE: The optional delay serves to prevent inadvertent transfer from live voice paging during momentary release of the live voice paging switch

d) In the United States only:

1) Automatic activation of an evacuation signal to any or all zones in the system, consisting of a minimum of two cycles of the standard alarm evacuation signal consisting of the three-pulse temporal pattern detailed in 23.5.16, followed by a recorded evacuation message to any or all zones in the system.

Exception: Products intended to be constantly attended with capability of a 30 s response need not provide automatic response.

2) Automatic pre-announce tone (either separately produced or part of a prerecorded message) of 1 – 3 s duration followed by a recorded message to any or all zones in the system. The pre-announce tone/prerecorded message combination shall be repeated a minimum of three times. Preempting of the pre-announce tone with a predetermined time delay is not prohibited.

Exception: Products intend to be constantly attended by trained operators with capability of a 30-second response need not provide automatic response.

3) When provided in addition to that described in (d)(2) other functional sequences are not prohibited.

27.2.2 When provision is made for the manual selection of evacuation signaling zones for the purpose of initiating tonal, prerecorded voice, or live voice evacuation messages and/or signals, the manual selections shall override automatic zone selections. Likewise, manually initiated sources (tone generator, prerecorded message, or live voice) shall have the capability to take precedence subsequent over automatically initiated sources.

Exception: Notification appliances required to provide special fire suppression notification shall have the capability to override the voice/alarm communication signaling as described in 27.2.3.

27.2.3 For systems providing live-voice communication, manual paging shall have the capability of automatically having precedence over all other evacuation signals, pre-announce signals and prerecorded messages, whether previously or subsequently initiated.

Exception: Notification appliances required to provide special fire suppression notification shall have the capability to override the ECS/MNS signaling as described in 27.2.3.

27.2.4 A fire emergency voice/alarm communication control system shall be configurable to have a dedicated notification zone to cover the area served by the suppression system with the capability of being muted by one of the following means:

a) An intelligent communication interface between the fire alarm suppression system and the fire emergency voice/alarm communication control system to mute the fire emergency voice/alarm communication control system speaker zone when special suppression notification appliances are active in the suppression area;

b) Use a contact interface to mute the fire emergency voice/alarm communication control system speaker zone to allow the special suppression notification appliances to take priority; or

c) A mechanical manual release, such as a pressure switch, etc., to interface with the fire emergency voice/alarm communication control system that would mute the respective speaker zone.

27.2.5 Products utilizing a low – frequency signal tone for the pre-announce signals required by 27.2.1 or the audible alarm signal tone required by 23.5.16 or 23.5.18 shall comply with the signal format described in the section for Determination of Low Frequency Signal Format in the UL 464/ULC 525.

27.2.6 The signal components for the low frequency audio needed to meet 34.2.5.8 from tone generation to the output speaker shall be described in the installation instructions for the product.

27.3 Monitoring integrity

27.3.1 Failure of any component in the audio chain (such as amplifiers, preamplifiers, malfunction of a pre-recorded message device, displacement of a pre-recorded message medium, primary tone generators, and interconnected wiring) resulting in the loss of emergency signaling capability shall cause an audible trouble signal. Compliance is to be verified with the system in the normal supervisory condition and repeated with the system in the alarm condition.

Exception No. 1: This requirement does not apply to amplifiers and tone generators that are enclosed as integral parts and provide signals to a single speaker.

Exception No. 2: Wiring internal to a mechanically protected enclosure is not required to be supervised.

Exception No. 3: This requirement does not apply to individual electronic components that are part of a rigidly clamped assembly which comply with Section 9, Software Monitoring, or 54.5, Capacitors, or, if not covered in Section 9 or 54.5, are deemed reliable according to MIL-HDBK-338, or equivalent such that the failure rate is equal to or less than 0.5 failures per million hours of operation.

27.3.2 Emergency voice/alarm and/or two-way telephone/intercom communication systems sharing components, circuitry and installation wiring with non-fire systems shall comply with Section 29, Combination Systems.

28 Emergency Telephone Feature

28.1 Two-way telephone equipment, when operating in a common-talking (for example, conference or party-line) or selective-talking mode, shall be capable of communication with at least;

a) In Canada only: two instruments on-line simultaneously; or

b) In the United States only: five.

28.2 Two-way telephone communication service is not prohibited from being arranged so that alarm initiation is required before telephone communication can begin.

28.3 A telephone station provided for reporting a fire shall be arranged so that its use will automatically produce all of the signaling functions required of a manual fire alarm station and not require operator response for alarm initiation. Similarly, a station provided for reporting other emergencies shall automatically produce the signaling functions required by the emergency systems. A station for reporting a fire and for reporting other emergencies shall be equipped with a selection lever or equivalent means by which to initiate the signals appropriate for the condition (fire or emergency).

28.4 Provide a visual and audible indication at the display and control center incoming-call from a remote telephone. Acknowledgement or selection of the incoming-call shall silence the audible.

28.5 Remote telephones consisting of a permanently installed jack and a portable handset shall automatically initiate the call-in signal on plug-in of the handset.

28.6 In Canada only: Visual indicators shall be in accordance with Table 20.3.

28.7 Provide separate selectable control circuit for each zone and the display for emergency telephone type control units (control units incorporating the emergency telephone feature) shall be capable of simultaneously displaying the status of all outputs capable of being manually controlled. Indication shall confirm output circuit operation.

28.8 All manual control switches shall comply with 21.1.

28.9 An open circuit fault, ground fault, wire to wire short, or operation of an overcurrent protective device provided for the purpose, shall result in:

a) In Canada only: A specific trouble indication specific to the circuit.

b) In the United States only: A trouble indication.

28.10 In the United States only: When a station is configured as a hands-free or handset station, it shall either be protected against unauthorized use in accordance with UL 38, or employ a jack for connection of a portable handset.

28.11 Provide for a tone at the remote telephone to indicate that the system is operable or in use.

28.12 Lockable telephone enclosures shall have an alternate means of gaining access without the use of a key.

29 Combination Systems

29.1 General

29.1.1 When a fire alarm system is intended to share components, equipment, circuitry, or installation wiring with non-fire equipment and the non-fire alarm equipment complies with this standard or complies with one of the standards shown in 29.1.2, the requirements of 29.1.3 – 29.1.5 shall apply.

29.1.2 With respect to 29.1.1, the following standards apply:

a) In Canada only:

1) ULC S576;

2) ULC S304;

3) ULC/ORD-C1076;

4) UL 2524.

b) In the United States only:

1) UL 2572

2) UL 2017;

3) UL 2610;

4) UL 2525;

5) UL 2524.

29.1.3 It shall be permitted to attach the non-fire alarm equipment to fire alarm circuits when the following requirements are met:

a) The fire alarm equipment and circuits shall continue to meet the circuit requirements of Section 23, Circuits, with the non-fire alarm equipment attached.

b) Failures of the non-fire alarm equipment that affect the operation of the fire alarm system shall be detected and reported at the fire alarm control unit.

c) The non-fire equipment shall be compatible with the fire alarm equipment or it shall have a contact closure interface for the connected load.

d) In the United States only: The installation document of the fire product shall specify that all wiring, including that to the non-fire alarm equipment, shall be installed in accordance with the requirements of NFPA 72.

29.1.4 When the non-fire alarm equipment is connected to the fire alarm system through separate wiring, opens and short circuits shall not impair the operation of the fire alarm system.

29.1.5 Single ground faults which impede or impair the monitoring for integrity of the fire alarm system, or impede or impair any fire alarm, supervisory or trouble signal transmissions or operation shall be reported at the fire alarm control system as trouble signals when they occur on the wiring interconnecting the non-fire alarm equipment with the fire alarm system.

29.1.6 When a fire alarm system is intended to share components, equipment, circuitry, or installation wiring with non-fire equipment, and that equipment does not comply with either this standard or any of the standards shown in 29.1.2, the requirements of 29.1.7 and 29.1.8 shall apply.

29.1.7 Short circuits or open circuits in the non-fire equipment or in the wiring between the non-fire equipment and the fire alarm system shall not impede or impair the monitoring for integrity of the fire alarm system as described in Section 23, Circuits, nor impede or impair any fire alarm signal transmissions or operations.

29.1.8 Single ground faults in the non-fire alarm equipment shall not impede or impair the monitoring for integrity of the fire alarm system, or impede or impair any fire alarm, supervisory or trouble signal transmissions or operation.

29.1.9 The required operation of the fire alarm equipment shall not be impaired by any failure of the non-fire alarm equipment hardware, software or circuits, or by any maintenance procedure, including removal or replacement of defective equipment or powering down of the non-fire equipment.

29.1.10 The monitoring for integrity as described in the Section 23, Circuits, shall continue to be met during the period the combination system is used for non-emergency purposes.

29.1.11 Emergency control or other non-fire functions shall have the capability of not interfering with any required operation of the fire alarm system.

29.1.12 In combination systems, fire alarm signals shall be distinctive, clearly recognizable, and shall be indicated as in Section 24, Signal Priority.

29.1.13 Signals from fire extinguisher monitoring devices are permitted to be annunciated as supervisory signals.

29.1.14 In the United States only: Where the fire alarm control unit is intended to be connected to a life safety network, the following shall apply:

a) The interconnecting path shall be monitored for integrity as described in the Section 23, Circuits.

Exception: Relays or appliances that provide fail-safe operation (activate, release, unlock) on loss of power or a fault or adverse condition on the interconnecting path that affects operation.

b) Non-fire alarm data transmitted to the fire alarm system shall not impair the operation of the fire alarm system.

29.1.15 Controls permitted to adjust volume levels of non-emergency or other signals, such as background music or building paging, shall be overridden by the fire alarm system to deliver emergency signals at a preset volume setting.

29.1.16 All equipment which affect the operation of the fire alarm system, other than as described in 29.2, Mass Notification System Interconnection, shall meet the requirements of this Standard.

29.2 Mass notification system interconnection

29.2.1 Where an interface is utilized to interconnect a separate mass notification system to the fire alarm system, any abnormal condition that would prevent reliable emergency operation of any interfaced system shall be annunciated both audibly and visibly as a trouble signal at the affected control location.

29.2.2 When the fire alarm system has been activated, and mass notification has been given priority over the fire alarm system, the following shall apply:

29.2.3 The signal described in 29.2.2 shall be capable of being sent to a supervising station.

29.2.4 After the mass notification system relinquishes control, the fire alarm system shall automatically restored to normal operation when an active fire alarm signal is not present, or the fire alarm system shall operate based on the active fire alarm signal present.

29.3 Carbon monoxide signaling

29.3.1 Signals from Carbon monoxide detectors and carbon monoxide detection systems transmitted to a fire alarm system shall have the capability of annunciation as a carbon monoxide single and multiple station alarm signal.

Exception: In addition, the signals are permitted to be capable of annunciation as supervisory signals. Carbon monoxide signals annunciated as supervisory signals shall not activate notification appliances/signaling devices in the pattern described in 29.3.2.

29.3.2 Where the combination system activates carbon monoxide audible alarm signals, the system shall be capable of signaling the following patterns:

a) A single and tone pattern consisting of four cycles of 100 ms ±10 % "on" and 100 ms ±10 % "off," followed by 5 s ±10 % "off."

b) After the initial 4 min of signaling, the five-second "off" time shall be permitted to be changed to 60 s ±10 %.

c) The signal shall be repeated in compliance with 29.3.2(a) and 29.3.2(b) until the alarm is reset or the alarm signal is manually silenced.

29.3.3 The operator interface for the system shall distinctly annunciate carbon monoxide single and multiple station alarm and trouble condition(s).

29.3.4 Priority and display of the signaling shall be in accordance with Section 24, Signal Priority.

Exception: Carbon monoxide signals, either alarm or supervisory, shall be permitted to take precedence over fire related supervisory and trouble signals.

29.3.5 The circuit and pathways to carbon monoxide initiating/ input devices and notification appliances/signaling devices shall be monitored for integrity in the same manner as fire alarm circuits and pathways described in Section 23, Circuits.

29.3.6 The faults on non-fire, other than carbon monoxide, equipment and wiring described in 29.1, General, shall not impede or impair the monitoring for integrity the carbon monoxide portion of the system or impede or impair any carbon monoxide signal transmissions or operations.

29.3.7 Carbon monoxide detectors interconnected with the fire alarm system by low-power radio frequency pathways shall meet the requirements of Section 97, Short-Range Radio Frequency (RF) Devices Test.

29.3.8 Carbon monoxide detectors shall meet the requirements in:

a) In Canada only:

1) ULC-S588;

2) ULC-S538.

b) In the United States only: UL 2075.

29.3.9 Carbon monoxide single and multiple station alarms shall meet the requirements in:

a) In Canada only: CSA 6.19.

b) In the United States only: UL 2034.

29.3.10 Carbon monoxide single and multiple station alarms interconnected to fire alarm equipment shall be annunciated as supervisory signals at the system required operator interface(s). The fire alarm equipment shall not activate notification appliances / signaling devices in the pattern described in 29.3.2, unless they are used to provide local CO audible alarm to the occupants affected by the CO condition.

NOTE: Where multiple faults cause the network to be severed, it is intended for each portion of the network to function as intended within the capacities of each section.

29.3.11 In stand alone and degraded mode operation, the activation of an alarm input shall cause the segment of the system remaining in communication to:

a) Operate the alert signals and alarm signals in accordance with the system operating sequence; and

b) Operate local relays in control units and transponders connected to ancillary devices in accordance with the system operating sequence.

29.4 In Canada only: Smoke single and multiple station alarms, carbon monoxide single and multiple station alarms, smoke detectors and carbon monoxide detectors in suites of residential occupancy

29.4.1 The control unit intended for connection to smoke single and multiple station alarms in suites of residential occupancy shall have the capability of:

a) Annunciating smoke single and multiple station alarms as supervisory inputs; and

b) Actuating specific outputs based upon supervisory inputs from smoke single and multiple station alarms.

29.4.2 Where smoke detectors are used in lieu of smoke single and multiple station alarms in suites of residential occupancy, the control unit shall have the capability of:

a) Annunciating smoke detectors as supervisory inputs; and

b) Actuating specific outputs based upon supervisory inputs from smoke detectors.

29.4.3 Where multi-sensor detection device or carbon monoxide detection device are used in lieu of carbon monoxide single and multiple station alarms in suites of residential occupancy, the control unit shall have the capability of:

a) Annunciating multi-sensor detection device or carbon monoxide detection device as life safety emergency inputs or supervisory inputs; and

b) Actuating specific outputs based upon life safety emergency inputs or supervisory inputs from multi-sensor detection device or carbon monoxide detection device.

29.4.4 Priority shall be in accordance with Table 24.1.

30 Releasing Device Service

30.1 General

30.1.1 Optional features which provide releasing device service shall comply with the requirements of this document and function in accordance with recognized standards for the respective building safety system being controlled.

30.1.2 Requirements in 30.2, Operation, covers the performance requirements for control units intended to interface with systems which release an extinguishing agent.

30.2 Operation

30.2.1 General

30.2.1.1 The operation of any initiating device shall cause the control unit to produce a clearly defined signal and applicable release actuation.

30.2.1.2 The time periods for automatic processing and activation of signals in a worst-case loaded releasing device service control unit shall be as follows:

a) The required output functions shall be executed not greater than 10 s from the operation of abort or manual release device or initiation of an alarm condition;

b) The required output functions shall be executed no greater than 10 s from the initiation of a supervisory condition; and

c) Trouble signals and their restoration to normal shall be annunciated within the time period indicated in 20.2.12 of the occurrence of the fault condition.

30.2.1.3 A product / control unit acceptable for releasing device service shall provide for the connection of releasing actuating device(s), such as squibs, valves, solenoids and the like.

30.2.1.4 Circuits extending to releasing actuating devices shall be monitored such that:

a) In Canada only: A short circuit fault, an open circuit fault, or operation of an overcurrent protective device, provided for the purpose, shall result in a specific trouble indication for the circuit. A single ground fault shall be detected and annunciated in accordance with 20.2.5.

b) In the United States only: A trouble signal indicates the occurrence of any of the following:

1) Single ground;

2) Single open; or

3) An adverse condition or fault that prevents the required operation of the system.

30.2.1.5 The electrical continuity of each releasing actuating device shall be monitored for integrity.

30.2.1.6 In the United States only: A multiple ground fault or short-circuit fault on releasing circuit(s) intended for connection to limited energy cable, that would prevent required operation, shall result in a trouble signal or alarm signal.

30.2.1.7 An automatic delay provided prior to release operation by a control unit shall be a maximum of 60 s, timed from a release initiation condition.

30.2.1.8 A product shall not activate releasing devices when the primary power is de-energized and all secondary power sources, other than those used solely to sustain time and date functions or volatile memory, are reduced from rated voltage to zero.

30.2.1.9 Where networked control units are employed for a single releasing device service application, such that initiating / input devices, abort stations, or control switches on one unit controls releasing devices on another unit, a trouble condition or manual disconnect function occurring at any one unit involved in the releasing function(s) shall be visibly and audibly annunciated at each of the other interconnected control units involved in the releasing function.

30.2.1.10 A system shall audibly and visually annunciate a trouble condition when the standby source is solely powering the product and is depleted to 85 % of its nominal marked voltage, unless the installation instructions indicate that a mechanical manual release is to be additionally employed when the system:

a) Is intended for the release of Halon 1301 as described in NFPA 12A, and/or clean agents as described in NFPA 2001;

b) Employs batteries as its standby operating power source; and

c) Is provided with a manual release circuit.

30.2.1.11 Releasing service fire alarm systems used for fire suppression-releasing service (non-water based) shall have the capability to disconnect releasing circuit(s) and shall meet the requirements of the following:

a) The disconnect means shall be a physical switch and not be accomplished using software;

b) Software disconnects, even if activated by dedicated buttons or key switches, shall not be permitted as a method to secure a suppression system from inadvertent discharge; and

c) Operation of a disconnect means or disable function that prevents the operation of the release circuits shall cause a supervisory signal.

30.2.2 Releasing indication signals

30.2.2.1 Alarm, trouble, supervisory, pre-discharge, and discharge/release shall provide specific indication and status at the annunciator for the releasing control unit.

30.2.2.2 The visual annunciation shall be capable of displaying all zones having a status change. The visual displays shall meet the requirements of Section 20, Control Unit Visual Display.

30.2.2.3 Control units intended for the release of releasing agents that may be hazardous to occupants shall have provision for a pre-discharge signaling circuit.

30.2.2.4 All releasing signals produced by the control unit shall be distinct from alert signals and alarm signals used in the building.

30.2.2.5 Systems intended for the release of Halon 1301 as described in Halon 1301 Fire Extinguishing Systems, NFPA 12A, and/or clean agents as described in Clean Agent Fire Extinguishing Systems, NFPA 2001, shall have provision for a pre-discharge notification appliance circuit.

30.2.2.6 All evacuation signals produced by the system shall have the capability of complying with the 23.5.16.

30.2.2.7 A means for deactivating (silencing) activated alarm, pre-discharge, or discharge notification appliances / signaling devices shall comply with 21.2.3.

30.2.2.8 An alarm, pre-discharge (unless the system has progressed to a discharge condition) and discharge signal of a system shall be maintained continuously (locked in) by the system until a resetting device in the system is operated manually.

30.2.2.9 The signal indication resulting from the operation of a product for supervisory signals shall comply with 20.3.

30.2.2.10 The activation of the predischarge, or discharge signal silencing means during release sequence shall not result in resetting a circuit intended for connection to releasing devices or heating, ventilation and air conditioning (HVAC) equipment.

30.2.2.11 In Canada only: Where signal silence controls are provided for selective or zoned application (at or remote from the control unit), a separate manual signal silence control shall be marked accordingly to Table 20.4 and Table 20.5 or its equivalent, and shall be specific for each releasing device service area.

30.2.2.12 A pre-discharge or discharge sequence of a control unit shall be latched until manually reset at the control unit.

30.2.3 Abort feature

30.2.3.1 An abort feature, when provided, shall be a non-latching input circuit that suspends the intended sequence leading to release of the extinguishing agent.

30.2.3.2 An abort feature shall not have any effect on signaling circuits.

30.2.3.3 Activation of the abort feature shall only inhibit the release of the fire suppression agent.

30.2.3.4 A control unit employing an abort feature shall, at a minimum, have the capability of providing an abort time delay preventing the immediate actuation of the releasing device(s). The abort time delay function shall have the capability of providing a delay of 60 s and operate as follows:

a) The abort time delay period shall start from the actuation of the manual abort device;

b) The abort time delay shall override the automatic time delay described in 30.2.1.7; and

c) Cumulative abort time delays, resulting from the operation of two or more manual abort devices connected into the same releasing device zone, shall be defaulted to a maximum of 60 s.

Exception: The actuation of the releasing device can be delayed for as long as the manual abort device is activated. Deactivation of the manual abort device shall default to the actuation of the releasing device within 10 s providing the abort time delay period has elapsed.

30.2.3.5 A circuit, to which a manual abort device is connected, shall be supervised and comply with the requirements of Section 23, Circuits, except the circuit shall be non-latching.

30.2.3.6 Actuation of a manual abort device during normal supervisory condition shall result in a supervisory or trouble audible and visual annunciation at the control unit and may be a common indication with 30.2.3.5.

30.2.3.7 Operation of a manual abort device while the control unit is in the alarm condition shall result in an audible and distinct visual annunciation of the abort condition at the control unit.

30.2.3.8 Manual abort devices are not considered control unit accessories. The requirements for manual releasing devices are included in:

a) In Canada only: ULC-S528.

b) In the United States only: UL 38.

30.2.4 Manual release feature

30.2.4.1 The circuit into which a remote manual release device is connected shall comply with the requirements of Section 23, Circuits.

30.2.4.2 The manual release feature shall override any pre-discharge delays resulting in an immediate release or start of the manual release delay period. The delay period shall be capable of being set to a time of 30 s or less from activation of the manual release device to actuation of the releasing device(s). The manual release feature is not required to override an abort function while the manual abort device is manually activated. The operating instructions for the control unit shall describe whether the operation of the manual release device will override an activated manual abort device.

Exception: Products intended to be installed in accordance with NFPA 12A, NFPA 2001, NFPA 750, and NFPA 2010, shall have provision for the manual release to override actuated abort switches.

30.2.4.3 Manual release devices are not considered control unit accessories. The requirements for manual releases devices are included in:

a) In Canada only: ULC-S528.

b) In the United States only: UL 38.

30.2.5 Cross-zone initiation

30.2.5.1 A system employing a cross-zone initiating function shall require an alarm condition on more than one initiating zone before the release condition is activated.

30.2.5.2 Actuation of one initiating-device circuit shall result in energization of intended alarm evacuation signals.

30.2.5.3 A system employing a cross-zone initiating function shall not utilize the alarm verification feature or any other time delay other than that indicated in 30.2.1.7.

30.2.6 Single-zone multiple-detector (counting zone) initiation

30.2.6.1 A system employing single-zone, multiple-detector initiating functions shall require more than one detector in the same initiating circuit to operate before the release condition is activated.

30.2.6.2 Operation of one detector connected to a single-zone multiple-detector initiating zone shall result in energization of intended alarm evacuation signals.

30.2.6.3 A system employing a single-zone multiple detector initiation function shall not utilize the alarm verification feature or any other time delay other than that indicated in 30.2.1.7.

30.2.7 Combination single-zone multiple-detector and cross-zone initiation

30.2.7.1 When a multiple-detector/cross-zoning configuration is employed, the operation shall comply with any combination of 30.2.5.1 – 30.2.5.3 and 30.2.6.1 – 30.2.6.3.

30.2.7.2 Operation of one initiating device shall result in energization of intended alarm evacuation signals.

31 Smoke Control

31.1 General

31.1.1 Requirements in 31.2 – 31.4 cover the performance requirements of control equipment intended to control the flow of smoke.

31.2 Power supplies

31.2.1 A visual "power on" indication (visible after the product is installed) is to be present on all firefighter's smoke control stations and/or operator interfaces used for smoke control. A unique character presentation on a display device meets the intent of this requirement.

31.2.2 The smoke control system shall be designed so that loss of primary power for a period of up to 15 min will result in the components automatically performing their function upon restoration of power.

31.2.3 A product intended only for smoke control applications is not required to provide a secondary power source.

31.2.4 When a product is supplied by at least two independent power supplies (one primary and one secondary) or is supplied by primary battery(ies), the product shall comply with Sections 16 – 19.

Exception: The standby time shall be a minimum of 15 min.

31.3 Firefighter's smoke control station (FSCS)

31.3.1 Means shall be provided to indicate the complete status of the system in an easy to understand manner and, for manual override of an automatic smoke control sequence, via a firefighter's smoke control station (FSCS), which can be any of the following:

a) The local control panel;

b) The building's main control center;

c) A separate annunciator; or

d) The equivalent.

31.3.2 The controls used for the purpose of initiating a smoke control sequence, manually overriding an automatic smoke control sequence or control of the annunciation, shall comply with 21.1.1(b).

31.3.3 The FSCS shall provide manual control of all components or zones in a smoke control system, and shall have the highest priority over all other automatic or manual control equipment with the exception of electrical or personnel protection devices. The commands shall provide for on-auto-off or equivalent operation.

Exception No. 1: The controls for equipment only controlled from the FSCS are not required to employ an "auto" position.

Exception No. 2: FSCS fan control capability is not required to bypass hand-off-auto or start/stop switches located on motor controllers of nondedicated smoke control system fans where:

a) The use of such a motor controller switch to turn a fan on or off results in an indication at the FSCS; and

b) The installation instructions stipulate such motor controllers are accessible only to authorized personnel.

31.3.4 A building diagram or equivalent shall be provided that clearly indicates the type and location of all smoke control equipment (fans, dampers, etc., either individually or by zone), as well as the building areas affected and shall either be part of the FSCS or on a separate drawing with instructions to mount adjacent to the FSCS.

31.3.5 The current status of smoke control components, controlled by the FSCS either on an individual or zone basis, shall be visually indicated at the FSCS. Means shall be provided for positive feedback (or "proof") of fan operation, including all fans used for smoke control having capacities in excess of 57 m^3/min (2000 ft^3/min), damper position where warranted by the complexity of the system, and/or smoke control functions.

31.3.6 The status indicators may be of any color and each status indicator shall be clearly and individually identified relative to their function. Color used to identify a smoke control function shall be consistent.

In Canada only:

NOTE: If the smoke control functions are combined with the fire alarm system status display, red visual indicators for smoke control cannot be used. Refer to Table 20.3.

31.3.7 Provision shall be included on the FSCS for testing the visual indicators. The test means shall be self-restoring.

31.4 Operation

31.4.1 The recognition of a fire condition shall cause the system to activate the smoke control strategy for which the combination is designed.

31.4.2 The time periods for processing and activation of signals in a worst-case loaded system shall be as follows:

a) Automatic processing and beginning smoke control strategies shall not be greater than 10 s from the actuation of a manual command or initiation of a fire alarm condition.

b) If there is an occurrence of the an adverse condition, fault or the restoration to normal, trouble signals and their restoration to normal shall be annunciated within:

1) In Canada only: 90s;

2) In the United States only: 200s;

Exception: The initial batter-trouble signal annunciation from a battery-operated product that complies with the requirements in 19.1.

31.4.3 Where the fire alarm control unit is separate from the smoke control system, the interconnecting wiring shall be monitored for integrity in accordance with the Section 23, Circuits. Audible and visual trouble signals shall be indicated at the FSCS. Refer to Figure 31.1.

Exception No. 1: Monitoring is not required when the installation instructions indicate that the wiring connection are to be made within 6.1 m (20 ft) and are to be enclosed in conduit (or equivalently protected against mechanical injury).

Exception No. 2: Ground-fault annunciation is not required where normal operation is not affected by a single ground-fault.

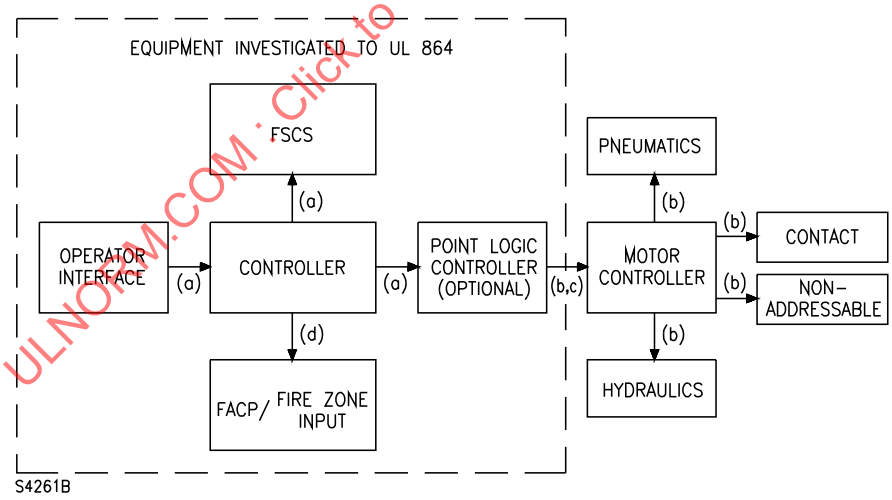
31.4.4 Output circuits of controllers and transponders that are pneumatic, hydraulic, dry contact, or non-addressable are not required to be electrically supervised for open circuit faults, short circuit faults or ground faults. The products controlled by these output circuits are required to comply with Section 29, Combination Systems.

31.4.5 Interconnecting wiring between the FSCS, addressable controllers, transponders, point logic controllers, and operator interfaces intended to control smoke control functions shall be monitored for integrity in accordance with the Section 23, Circuits. Audible and visual trouble annunciation shall be indicated at the FSCS and, when employed, operator interface(s). Refer to Figure 31.1.

Exception: Ground-fault annunciation is not required where operation is not affected by a single ground fault.

Figure 31.1

Typical Smoke Control System



a) Monitored as specified in 31.4.5.

b) Monitored as specified in 31.4.7 and 31.4.8.

c) Non-addressable output such as 0 – 10 V, 4 – 20 mA, contact closure, etc.

d) Monitored as specified in 31.4.3.

31.4.6 Output circuits of controllers and transponders that are pneumatic, hydraulic, dry-contact, or non-addressable are not required to be monitored as indicated in 31.4.5. The products controlled by these output circuits are required to comply with 31.4.7.

31.4.7 When the system is in the smoke control condition, the failure of any fan, damper, and/or zone to reach its intended operating status shall result in both an audible and visual trouble signal at the FSCS. When there is a failure to receive position confirmation, the visual annunciation shall indicate the specific component/zone that did not reach its intended operating status and shall be received within:

a) In Canada only: 90s;

b) In the United States only: 200s;

31.4.8 Dedicated smoke control systems shall employ an automatic weekly self-test function. The self-test shall automatically command activation of each associated function. An audible and visual trouble signal shall be annunciated at the FSCS identifying any function that fails to operate within the required time period. The self-test function is not required for non-dedicated systems.

31.4.9 When multiple input signals are received from more than one smoke zone to initiate different automatic smoke control sequence(s), the smoke control system shall continue automatic operation in the mode determined by the first signal received.

31.4.10 The smoke control system shall not activate an automatic smoke control sequence as a result of a signal input generated by the activation of a manual fire alarm pull station.

Exception: A smoke control sequence for stairwell pressurization or other application where the sequence is the same for any input signal received.

31.4.11 The following descending order of priority shall be followed in processing smoke control commands:

a) Manual activation and deactivation commands issued at the FSCS.

b) Manual activation and deactivation commands at other than the FSCS.

c) Initial automatically actuated smoke control sequence. The system does not need to override any manual activation or deactivation functions in place prior to the automatic control sequence.

d) All other manual or automatic operation used for normal building operation.

31.4.12 Where carbon monoxide detection or a dedicated carbon monoxide system initiates a ventilation response, a smoke control response of the fire alarm system shall take precedence over the response of the carbon monoxide detectors during a fire alarm condition.

32 In the United States Only: Marine Application

32.1 General

32.1.1 All equipment forming the system shall be evaluated to the requirements specified in 32.1 General, and 32.2 Signaling. Products forming a part of a system shall be evaluated in conjunction with the complete system. In addition, products for marine use shall additionally be investigated to the requirements of Section 103, Environmental Tests for Marine Applications.

32.1.2 A means shall be provided to conduct a field test on each individual initiating zone.

32.1.3 A test means shall be provided for testing each individual initiating zone circuit for the presence of ground(s). The product(s) shall provide the capability of electrically isolating the fire alarm control system from the electrical system of the ship.

32.1.4 A means shall be provided for silencing energized audible notification appliances connected to the notification circuits, while maintaining the alarm signals from energized visual notification appliances.

32.1.5 Microprocessor- or computer-based systems, after complete loss of power, shall automatically operate on supply power resumption.

32.2 Signaling

32.2.1 General

32.2.1.1 The operation of any initiating device shall cause the system to produce a clearly defined signal of the type for which the combination is designed.

32.2.1.2 The time periods for processing and activation of signals in a worst-case loaded system shall be as follows:

a) Automatic processing and activation of the alarm or supervisory notification appliances shall not be greater than 10 s from the initiation of an alarm or supervisory condition.

b) Trouble signals and their restoration to normal shall be annunciated within 200 s of the occurrence of the adverse condition, fault, or the restoration to normal.

Exception: The initial battery trouble signal from a battery-operated product that complies with the requirements in 19.1.

32.2.1.3 Alarm signals, supervisory signals, and trouble signals shall be indicated at the operator interface for the control unit.

32.2.1.4 Fire-alarm signals, supervisory signals, trouble signals, and other signals shall be distinctly annunciated.

32.2.2 Display information

32.2.2.1 Systems serving two or more zones shall visually identify the zone of origin of the status change.

32.2.2.2 The visual annunciation shall be capable of displaying all zones having a status change. Where all zones or status changes are not displayed simultaneously, all the following conditions apply:

a) The display shall indicate the initial status change for the highest priority type signal.

b) An indication for each type (alarm, trouble, supervisory) of active non-displayed status changes shall be continuously visible during any activated condition.

c) A visual indication showing deactivated notification appliance circuits as required by 32.2.3.2.

d) The non-displayed status changes shall be capable of being displayed only by manual operation(s).

e) The display controls shall not interfere with the normal operation of the unit.

f) When concurrent signals are received, they shall be indicated as follows in descending order of priority:

1) Signals associated with life safety;

2) Signals associated with property safety;

3) Supervisory signals and trouble signals associated with life and/or property safety;

4) All other signals.

32.2.2.3 Non-electrical visual annunciation integral with a switch shall include obvious distinct indications for both the non-activated and activated position of the switch. Utilization of the switch position does not meet the intent of complying with this requirement.

32.2.3 Alarm signals

32.2.3.1 An alarm input signal shall automatically actuate alarm notification appliance circuits necessary for evacuation and/or relocation.

a) Any manual or automatic means for turning off (silencing) activated alarm notification appliances shall comply with the following requirements:

b) Alarm signal deactivating of activated notification appliances of a control unit/system shall be indicated by a constantly displayed and identified visual indicator.

c) An alarm signal deactivating means left in the activated state when there is no alarm shall activate an audible trouble signal until the means is restored to normal.

d) When any alarm signal deactivating means of a multiple-circuit control unit/system is activated, there shall be an indication of the related deactivated notification circuit(s) or zone(s) by an identified lamp(s) or other visual annunciation, and operation of the alarm notification appliances by any other notification appliance circuit having its alarm deactivation means in the normal position shall not be prevented.

e) An alarm signal deactivation switch shall be either:

1) A key-lock type, with the key removable only in the normal position;

2) Located inside of a locked enclosure, with the key removable only in the locked position;

3) Access limited by a software security code providing a minimum of 1000 combinations and with a maximum 30 min time-out feature after the last activity; or

4) Arranged to provide equivalent protection against unauthorized use.

f) The activation of the alarm signal deactivating means during an alarm condition shall not result in resetting any actuated circuit other than the notification appliance circuit(s) or zone(s) being deactivated.

g) The alarm condition shall be indicated and maintained by a lamp or other visual indicator with the deactivating means activated.

h) When alarm signal deactivation can be accomplished in a selective manner, the visual indicator(s) referenced in Annex A shall distinguish notification appliance circuit(s) or zone(s) that have been deactivated from notification appliance circuit(s) or zone(s) that are still energized.

i) After deactivating notification appliance circuit(s) or zone(s) resulting from an alarm in one alarm initiating device circuit, addressable alarm initiating device circuit, or addressable fire alarm initiating device, a subsequent alarm in any other system fire alarm initiating device circuit, addressable alarm initiating device circuit, or addressable initiating device shall cause all previously activated notification appliance circuit(s) or zone(s) to reactivate.

Exception No. 1: When a system is intended to provide signaling service to two or more physically separated zones, re-energization of the notification appliance circuits only on a zone basis meets the intent of the requirement. Specifics covering installation constraints shall be clearly detailed in the control unit installation wiring diagram/instructions.

Exception No. 2: Systems are not prohibited from having provision to automatically disable reenergizing alarm notification circuits due to subsequent activation of other addressable smoke detectors of the same type located in the same room or space as the initial activated device. Specifics covering installation constraints shall be clearly detailed in the control unit installation wiring diagram/instructions.

32.2.3.2 An alarm signal of a system shall be maintained continuously (locked in) by the system until a resetting device in the control unit/system is operated manually.

32.2.3.3 An alarm signal that has been deactivated shall:

a) Automatically activate an audible and visible alarm signal at the operator interface(s) every 24 h or less until alarm signal conditions are restored to normal; and

b) The audible and visible alarm signal shall operate until it is manually silenced or acknowledged.

32.2.4 Supervisory signals

32.2.4.1 The signal indication resulting from the operation of a product for supervisory signals shall include distinctive signals for both the activated state and the restoration-to-normal conditions of the supervisory initiating devices. Cancellation of the signal is acceptable annunciation for the restoration signal.

Exception: For products whose operations provide, in addition to the above, the capability of selecting non-automatic distinctive restoration-to-normal supervisory signals (locking in the supervisory signals until manually reset), the installation wiring diagram/instructions for the product shall include instructions for selecting the respective operation.

32.2.4.2 Supervisory signals displayed at the system shall be distinctive in sound from other signals used by the signaling system and this sound shall not be used for any other purpose other than to also indicate a system trouble condition. When the same sound is used for both supervisory and trouble signals, distinction between signals shall be indicated by a visible means and silencing of a trouble signal shall not prevent subsequent sounding of supervisory signals.

32.2.4.3 A means for silencing a supervisory signal sounding appliance shall be provided and shall comply with all the following requirements:

a) Limiting access by being:

1) Key operated with the key removable only in the normal position;

2) Located within a locked cabinet;

3) Limited by a software security code providing a minimum of 1000 combinations and with a maximum 30-min time-out feature after the last activity; or

4) Arranged to provide equivalent protection against unauthorized use.

b) The supervisory condition is indicated and maintained by a lamp or other visual indicator.

c) A means that is left in the “silence” position, when there is no supervisory activated state, shall cause the audible supervisory signal to sound until the means is restored to normal.

32.2.4.4 A supervisory signal that has been deactivated shall:

a) Automatically reactivate the audible and visible supervisory signal at the operator interface(s) every 24 h or less until supervisory signal conditions are restored to normal; and

b) The audible and visible supervisory signal shall operate until it is manually silenced or acknowledged.

33 Releasing Device (Non-Extinguishing and Non-Water Based)

In Canada only:

NOTE: Non-Extinguishing and Non-Water Based Releasing Device is considered as an ancillary device.

33.1 Power supplies

33.1.1 A visual "power on" indication (visible after the product is installed) is to be present on products employing an operator interface. A unique character presentation on a display device meets the intent of this requirement.

33.1.2 A product intended only as a releasing device is not required to provide a secondary power source, when the product actuates the intended releasing operation for each of the following conditions:

a) Total instantaneous loss of primary power;

b) Degradation of primary power to 85 % of rated voltage.

Exception: A lower cutout voltage is not prohibited when operation of the product is not impaired and compatibly of connected appliances is maintained.

33.1.3 When a product is supplied by at least two independent power supplies (one primary and one secondary) or is supplied by primary battery(ies), the product shall comply with Sections 16 – 19.

Exception: Products arranged to unlock within ten min after loss of primary power.

33.2 Operation

33.2.1 The recognition of a life safety or fire condition shall cause the product to activate the action for which the product is designed.

33.2.2 The operation of any initiating device shall cause the system to produce a clearly defined signal and release actuation of the type for which the combination is designed.

33.2.3 The time periods for processing and activation of signals or actions in a worst-case loaded system shall be as follows:

a) Automatic processing and actuation or start of an automatic delay described in 33.2.4 shall not be greater than 10 s from the actuation of a manual command or initiation of an input circuit.

b) Trouble signals and their restoration to normal shall be annunciated in accordance with 20.2.

Exception No. 1: Actuation of the intended product operation is permitted in lieu of the monitoring for integrity described in 33.2.3(b).

Exception No. 2: The initial battery-trouble signal annunciation from a battery-operated product that complies with the requirements in 19.1.

33.2.4 An automatic delay provided prior to release operation by a system shall be a maximum of 60 s, timed from a release initiation condition.

33.2.5 Non-electrical visual annunciation integral with a switch shall include obvious distinct indications for both the non-activated and activated position of the switch. Utilization of the switch position does not meet the intent of complying with this requirement.

33.3 Monitoring for integrity

33.3.1 All wiring between the releasing device and any other interconnected product shall be monitored for integrity in accordance with the Section 23, Circuits.

Exception No. 1: Monitoring is not required when the installation instructions indicate that these wiring connections are located in the same room of each other, are enclosed within conduit or equivalently protected against mechanical injury and are intended to be made within;

a) In Canada only: 18 m;

b) In the United States only: 6.1 m (20 ft);

Exception No. 2: Ground-fault annunciation is not required where normal operation is not affected by a single ground-fault.

Exception No. 3: Actuation of the intended product operation is permitted in lieu of the monitoring for integrity described in this requirement.

33.3.2 A multiple ground fault or short-circuit fault on a wiring circuit between the releasing device and any other interconnected product that is intended for connection to limited energy cable, that would prevent required operation, shall result in a trouble signal or alarm signal.

IN THE UNITED STATES ONLY: OFF PREMISE OPERATION

34 Remote Station, Central Station, and Proprietary Services

34.1 General

34.1.1 The requirements in 34.1 – 34.5 cover products intended for remote station, central station, and proprietary services. The requirements in 34.1 and 34.2 cover products located at the protected premises. The requirements in 34.1, 34.3, and 34.5 cover the transmission path between the protected premises and the supervising station or subsidiary station, any subsidiary station and its communication path, and the signal receiving, processing, display, and recording equipment at the supervising station. When the supervising or subsidiary station is integral or collocated at the protected premises with the protected-premises control unit, the requirements in 34.1, 34.3, and 34.5 apply.

34.1.2 The operation of any initiating device shall cause the system to produce a clearly defined signal of the type for which the combination is designed.

34.2 Protected premises units

34.2.1 General

34.2.1.1 The time periods for processing and activation of signals in a worst-case loaded system shall be as follows:

a) Automatic processing of alarm or supervisory signals and start of transmission to a supervisory station receiver shall not be greater than 10 s from the initiation of an alarm or supervisory condition.

b) Transmission of trouble signals and their restoration to normal shall be started within 200 s of the occurrence of the adverse condition, fault, or the restoration to normal. Annunciation of trouble signals at the protected premises shall also occur within 200 s of the occurrence of the faults indicated in 34.2.2.1.

Exception No. 1: The initial battery trouble signal from a battery-operated product complying with the requirements of 19.1.

Exception No. 2: Off premise primary power failure trouble signal transmission for products employing a digital alarm communicator transmitter (DACT) as described in 17.1.

Exception No. 3: Failure of DACT communication path as indicated in 34.5.3.2.12.

34.2.1.2 Alarm, supervisory, and trouble signals shall be indicated at the protected premises for systems serving two or more zones when the off premise signal does not include zone of origin status change information. Where all zones or status changes are not displayed simultaneously, the display information shall comply with 20.4.1.

34.2.1.3 Alarm signals transmitted to the supervising station shall have the capability of including the actuated device address or the zone identification.

34.2.1.4 Alarm, supervisory, delinquency, and trouble status changes occurring at protected premises control unit(s) shall be transmitted to the supervising station in a manner that allows distinction of signaling type.

34.2.1.5 Each protected premises unit intended for remote station type service shall have provision for transmitting supervisory and trouble conditions to a separate location from that of alarm signals.

Exception: Provision for transmitting supervisory and trouble conditions to a separate location from that to which alarm signals are transmitted is not required to be provided when the control unit is prominently marked where visible after installation with the following or equivalent statement: "Not Suitable For Remote Station Protected Premises Service Where Separate Transmission Circuits Are Required For Fire, Supervisory (When Applicable), And Trouble Signals".

34.2.2 Trouble signals

34.2.2.1 The activation of a self-restoring trouble signal and its restoration to normal shall be automatically processed as described in 34.2.1.2 and 34.2.2.3.

34.2.2.2 The activation of a latching trouble signal shall be automatically processed as described in 34.2.1.2 and 34.2.2.3. Restoration of a latching trouble signal shall be processed as described in 34.2.1.2 and 34.2.2.3 after activation of a manual reset.

34.2.2.3 An audible and visual trouble signal shall be annunciated at the protected premises for the occurrence of the following fault and/or adverse conditions:

a) Primary power, secondary power, and primary battery power source monitoring of the protected-premises equipment as required in Sections 16 – 19;

b) DACT-type communication system monitoring described in 34.5.3.2.6 and 34.5.3.2.12.

34.2.3 Supervisory signals

34.2.3.1 The signal indication resulting from the operation of a product for supervisory signals shall automatically include distinctive signals for both the activated state and the restoration-to-normal conditions of the supervisory initiating devices. Cancellation of the signal is acceptable annunciation for the restoration signal.

Exception: For products whose operation provide, in addition to the above, the capability of selecting nonautomatic distinctive restoration-to-normal supervisory signals (locking in the supervisory signals until manually reset), the installation wiring diagram/instructions for the product shall include instructions for selecting the respective operation.

34.2.3.2 The activation of a smoke detector mounted in air distribution systems and used solely for closing dampers or equipment shutdown as described in the Standard for Installation of Air-Conditioning and Ventilating Systems, NFPA 90A, is not prohibited from annunciating a supervisory signal at the supervising station.

34.2.4 Guard tour supervisory signals

34.2.4.1 A system utilized for guard tour supervisory signals shall comply with either 34.2.4.2 or 34.2.4.3.

34.2.4.2 A non-exception reporting system shall operate with the following signals either manually or automatically recorded:

a) The operation of each station intended to transmit a signal.

b) Where intermediate stations that do not transmit a signal are employed in conjunction with stations that transmit a signal, a distinct signal shall indicate the beginning and end of each tour of a guard, and a station that transmits signals shall be provided at intervals not exceeding ten stations.

c) Intermediate stations that do not transmit a signal shall be capable of operation only in a fixed sequence.

34.2.4.3 An exception reporting system shall operate with the following signals either manually or automatically recorded. Delinquency signals shall additionally be visually and audibly annunciated.

a) The guard shall initiate a start signal. When a start signal is not transmitted at least once every 24 h for systems during which tours are continuously conducted, a delinquency signal shall be annunciated.

b) A delinquency signal when a tour station is not actuated within 15 min after the predetermined actuation time.

c) A finish signal within a predetermined interval after each completed tour of the premises.

34.2.5 Off premise signaling

34.2.5.1 The transmission and/or communication path shall operate as described for the specific type of transmission and/or communication path as specified in 34.5, Transmission and Communication Paths.

34.2.5.2 Where a proprietary protected premises unit is co-located with or integral with the supervising station, the requirements of Section 23, Circuits, shall apply in lieu of the requirements specified in 34.5, Transmission and Communication Paths.

34.2.5.3 Relays or modules providing signaling for off premise transmission of trouble signals shall be arranged to produce a trouble signal at the supervising station when all power to the relay or module is removed.

34.2.5.4 A multiple ground fault or short-circuit fault on conductors extending from a circuit intended for connection to limited energy cable, that would prevent required alarm operation, shall result in a trouble or alarm signal.

34.2.5.5 Digital alarm radio transmitters (DART) utilizing private signal transmission facilities and radio alarm transmitters (RAT) shall be arranged to check for the fault conditions specified in 23.1.1 and those indicated in 34.2.5.5(a) and 34.2.5.5(b) such that within 200 s of the occurrence of a fault condition either an audible trouble shall be annunciated at the protected premises or a trouble signal transmission shall have commenced.

a) Any external antennas and related connecting cable; and

b) Interconnections between elements of the transmitting equipment located in separate enclosures.

34.2.5.6 Where the elements of the equipment described 34.2.5.5 are physically separate, provision shall be made such that the interconnecting wiring or cabling is capable of being mechanically protected.

34.2.5.7 Protected premises equipment shall be permitted to provide supplementary transmission of real time data from the fire alarm system to off premise equipment. Any information transmitted shall be consistent with the data generated by the system.

34.2.5.8 With respect to 34.2.5.7, each of the following shall not affect the required operation or response of the fire alarm control unit:

a) Transmission of the supplementary data off premise;

b) A wire-to wire or single ground fault on the transmission circuit (metallic) when separate from required off premise signaling; and

c) A single open fault or adverse condition on the transmission path, when separate from required off premise signaling.

34.3 Supervising station units

34.3.1 General

34.3.1.1 The time periods for processing and activation of signals in a worst case loaded system shall be as follows:

a) Alarm, trouble and supervisory signals, and their restoration to normal, shall be received, displayed, and recorded at the supervising station consistent with the communication and transmission methods utilized. Refer to Transmission and Communication Paths, 34.5.

b) The maximum time from the occurrence of a fault or adverse condition in any transmission and/or communication path or equipment, or the restoration of the fault or adverse condition to normal until it is displayed and recorded at the supervising station, shall be consistent with the communication and transmission methods utilized. Refer to Transmission and Communication Paths, 34.5.

c) A fault or adverse condition on interconnecting wiring which affects operation, or malfunction of equipment located within the supervising or subsidiary station, which are required to be monitored for integrity, shall result in an audible and visual trouble annunciation at the constantly attended supervising station's operator interface within 200 s of the occurrence. Restoration to normal shall also be indicated within 200 s.

Exception No. 1: Either an audible or visual only trouble signal is acceptable for mechanisms that are part of the supervising station equipment.

Exception No. 2: Cancellation of the trouble signal is acceptable for the restoration signal for mechanisms that are part of the supervising station equipment.

Exception No. 3: The primary power source of constantly attended supervising station equipment when the fault condition is obvious to the operator on duty.

Exception No. 4: Interconnecting wiring addressed by 34.4.2(i) for the main system configuration of a redundant supervising station receiving unit.

34.3.2 Display and recording

34.3.2.1 The supervising station shall have:

a) A recording device consisting of either printer or magnetic medium or other nonvolatile electronic memory capable of being viewed or printed; and

b) Two additional means, one of which shall be an audible signal, capable of indicating the receipt of a status change signal.

34.3.2.2 Status change signals shall include alarm, trouble, supervisory, and guard tour supervisory signals as well as their restoration to normal.

34.3.2.3 A supervising station providing the option of turning off the audible signal associated with each status change, shall provide a visual annunciation which is constantly displayed indicating the off-normal silenced condition of the audible signal.

34.3.2.4 The following information shall be recorded and displayed for each status-change signal:

a) Identification of the type of signal to show whether it is an alarm, supervisory, guard tour supervisory, or trouble signal;

b) Identification of the status change to differentiate between the initiation of an alarm, supervisory, delinquency, or trouble, or a restoration or return to normal from one or more of these conditions; and

c) Identification of the point of origin of each status-change signal.

34.3.2.5 All status-change signals shall be automatically and permanently recorded and displayed in a form which will expedite prompt operator interpretation in accordance with any one of the following:

a) Where a visual display is used that automatically provides status-change information for each individual signal, including type and location of occurrence, any form of automatic recording is acceptable. The recorded information shall include the content described above. The visual display shall show status information content at all times and shall be distinctly different after the operator has manually acknowledged each signal. Each visual status change shall also be accompanied by continuous operation of an audible indication that will alert the operator to a signal status change. The audible indication shall either cease or change in form upon acknowledgment. Failure to acknowledge a signal shall not prevent subsequent signals from being recorded.

b) When a visual display is not provided, signal content information shall be automatically recorded on duplicate permanent visual recording instruments. One recording instrument shall be used for recording all incoming signals, while the other printer shall be used for recording only alarm, supervisory, guard tour supervisory, and trouble signals. The receipt of each signal requiring operator attention shall be accompanied by an audible indication that shall persist until manually acknowledged. The acknowledgment shall be recorded. Failure to acknowledge a signal shall not prevent subsequent signals from being recorded. Restoration of the signaling device to its prior or normal condition shall be recorded.

c) When a visual display is used in conjunction with a single recording device, the signal content information and acknowledgment shall be both displayed and recorded. The method of recording and display or indication of received signals shall provide all of the following conditions:

1) Each incoming signal requiring action to be taken by the operator shall result in an audible signal and not less than two independent methods of identifying the type, condition, and location of the status change.

2) Each incoming signal shall be automatically recorded. The record shall provide the type of signal, condition, and location, in addition to the time and date the signal was received.

3) Failure to acknowledge or act upon an incoming signal shall not prevent subsequent signals from being received, indicated or displayed, and recorded.

4) Each incoming signal shall initiate an audible signal that persists until manually acknowledged.

5) When a single display that does not permit viewing of all received signals concurrently is used, the display shall either:

i) Retain each signal on the visual display until manually acknowledged (the display shall also indicate when additional signals are waiting to be displayed); or

ii) Sequentially display each received signal in a scrolling manner until each signal is manually acknowledged (each signal shall be displayed a minimum of 2 s and a maximum of 5 s during each scroll).

6) When concurrent signals are received, the signals shall be displayed either:

i) In the following descending order of priority:

A) Signals associated with life safety;

B) Signals associated with property safety;

C) Supervisory or associated life and/or property safety trouble signals; and

D) All other signals; or

ii) Pending types (fire alarm, fire trouble, fire supervisory, etc.) of signals are identified and displayed. Access to any of the specific type queues shall be provided. The signals within each specific type queue shall be displayed in order of receipt, with the oldest signal first.

7) When multiple status changes are received for the same point prior to operator acknowledgment, the system is not prohibited from displaying only the most recent change of status for that point, provided prior to acknowledgement of the current status, all the subsequent status changes for that point since the last status change acknowledgment for that point are presented to the operator in a form that allows the prompt operator interpretation of the condition.

8) Means shall be provided for the operator to redisplay any alarm, supervisory, trouble, guard tour supervisory, or other signals which have been acknowledged but for which a restoration to normal signal has not been received.

Exception: Systems other than those intended for proprietary type service are not required to prioritize signals and are not required to have the means to redisplay acknowledged but not yet restored signals.

34.3.2.6 Silencing of an audible, status-change indication signal, which is common to several circuits, shall result in reenergization of the audible signal upon receipt of a subsequent status-change signal.

34.3.2.7 Where a visual indication is required in 34.3.2.5 to identify a status-change signal and location from which the signal originated, any one of the following or equivalent means is required.

a) Supervised single lamp circuit including a common lamp test switch;

b) Unsupervised reliable light-emitting diode (LED) including a common lamp test switch. Reliability data to be provided by manufacturer as specified in Exception (c) of 54.5.1;

c) Unsupervised parallel lamp circuits (at least two lamps);

d) Unsupervised single lamp circuit with supplementary recording of type, condition, and location of signal received;

e) Two recorders;

f) Liquid-crystal display or equivalent with test means and one recorder;

g) Unsupervised single lamp circuit plus common alarm lamp plus a common lamp test switch;

h) Monitor/CRT complying with the requirements in this standard; and

i) Video terminal complying with the requirements of Supervising Station Signal Processing Equipment, 34.4.

34.3.2.8 In lieu of a common lamp test switch [refer to 34.3.2.7 (a), (b), (g)] an equivalent means to readily identify a burned out lamp shall be employed. A common lamp test switch shall be either common to all lamps or a particular group of lamps.

34.3.2.9 To facilitate the prompt receipt of fire alarm signals, when multiple simultaneous status changes of any type occur within the system, the product shall comply with either of the following requirements:

a) The system shall be able to record, within 90 s, as simultaneous status changes:

1) Not less than 50 status changes for systems of 500 or more initiating devices circuits; or

2) Not less than 10 % of the total number of initiating devices or initiating-device circuits connected, whichever number is smaller.

Exception: For one-way private-radio frequency systems, not less than twelve simultaneous status changes shall be recorded within 90 s.

b) The system shall record fire alarm signals at a rate not slower than one every 10 s when any number of status changes occur at any rate without loss of any signals.

34.3.2.10 Multiple operator interfaces for the same supervising station shall be arranged to provide segregation of signals or responsibilities for operator action regarding status-change signals.

34.3.2.11 When the supervising station equipment is duplicated with automatic switch over, the switch over shall be accomplished in not more than 30 s, without loss of any signals.

34.3.2.12 Trouble signals indicating the faults described in Section 71, Monitoring for Integrity, and annunciated separately from the supervising station receiving unit's operator interface, shall comply with the requirements in 20.2, Trouble Signals.

34.3.3 Monitoring integrity

34.3.3.1 The requirements in 34.3.3.2 – 34.3.3.4 apply to circuits other than transmission and communication paths utilized by supervising and subsidiary station units.

34.3.3.2 All means of interconnecting equipment, devices, and appliances within the supervising or subsidiary station shall be monitored for integrity of the interconnecting conductors or equivalent path and shall meet the requirements of 34.3.1.1(c).

Exception No. 1: The circuit of an alarm notification appliance intended to be installed in the same room with the supervising station control unit when the notification appliance circuit conductors are to be installed in conduit or have equivalent protection against mechanical injury.

Exception No. 2: The circuit of a printer in the supervising station is not required to be monitored for integrity regarding single open, single ground, wire-to-wire short faults, or printer malfunction.

Exception No. 3: Interconnecting wiring between a stationary computer and the computer's keyboard, video monitor, touch screen, or mouse type device are not required to be monitored for integrity when:

a) A complete open in the interconnecting cable is visually indicated so as to be obvious to the user or the open does not affect the required system operation except for loss of the faulted function; and

b) The interconnecting cable(s) does not exceed 8 ft.

Exception No. 4: Supplementary circuits interconnecting supplementary devices are not required to be monitored for integrity when adverse conditions or wire-to-wire faults do not interfere in any manner with the display and recording of signals.

34.3.3.3 A supplementary-device circuit is considered to be a circuit provided for controlling a device, the operation of which is supplementary to the operation of the supervising station. Supplementary devices usually include additional printers, audible signaling appliances, pilot lamps, and the like applied so as to produce duplication of the required signals.

34.3.3.4 Circuits interconnected to the receiving unit which may control the operation of the receiving unit are not considered supplementary and such circuits and devices are to be investigated with regard to their suitability of application and service in connection with the design and performance of the overall system.

34.4 Supervising station signal processing equipment

34.4.1 This section describes alternate methods for the evaluation of supervising station signal processing equipment meeting the conditions specified in 34.4.2. This section does not apply to equipment intended for use at the protected premises such as control units, annunciators, and the like.

34.4.2 Supervising station signal processing equipment meeting all the conditions specified in 34.4.2 (a) – (u) need not be subjected to Construction, Sections 36 – 61, and Performance Tests, Sections 68 – 103.

a) Data processing equipment and office appliance and business equipment used as supervising station signal processing equipment shall comply with UL 60950-1.

b) The manufacturer specifies the minimum system configuration(s) consisting of the following:

1) Operating system and, where applicable, revision level;

2) Microprocessor manufacturer, type(s)/family, and minimum clock speed;

3) Minimum disk storage;

4) Minimum memory requirements;

5) Required features [such as media needs (DVD, etc.), drivers, etc];

6) Required input/output functionality (such as serial ports, USB ports, and network cards);

7) System software release level; and

8) Interconnection of redundant equipment including any operator interfaces, signal inputs, and outputs to automation equipment, where applicable.

c) A system meeting, but not exceeding the specifications of (b), shall be submitted for evaluation.

d) All supervising station signal processing equipment shall be completely duplicated with provision for automatic switchover to the backup system within 30 s without loss of any signals. The backup computer shall have equivalent or greater capabilities of the primary, such as memory, speed, data storage, and the like.

e) Failure of any part of the main system configuration, shall result in automatic switchover to the backup system without loss of any signals and shall be indicated by an audible or obvious visual indication at the constantly attended supervising station's operator interface, all within 30 s.

f) Confirmation of switchover without loss of any signals in (e) and (i) shall include, but not limited to:

1) The initiation of a failure on the main system immediately after the main system sends an acknowledgement for receipt of a change of status signal from a protected premises unit;

2) The initiation of a failure on the main system prior to receipt of a change of status from a protected premises unit.

g) Failure of any part of the backup system configuration shall be indicated by an audible or obvious visual indication at the constantly attended supervising station's operator interface, all within 200 s.

h) A fault tolerant system is permitted to be used in lieu of complete duplication of the system where the system is capable of the following:

1) Employs multiple power supplies, disk drives, processors, and controllers, each backing up and checking on the process of others.

2) In the event of any component failure, the other modules take over the function performed by the failed components without affecting the operation of the computer.

3) In addition to the duplicated hardware, a fault-tolerant system includes the necessary software to keep the system operational.

i) A fault or adverse condition on interconnecting wiring in the main system configuration which affects system operation shall result in automatic switchover to the backup system within 30 s without loss of any signals, and shall be indicated by an audible or obvious visual indication at the constantly attended supervising station's operator interface.

Exception: Interconnection between equipment within a common enclosure or when the wiring connections are intended to be made within 20 ft (6.1 m) and are enclosed within conduit or equivalently protected against mechanical injury.

j) A fault or adverse condition on interconnecting wiring in the backup system configuration or between the main system and backup system which affects system operation shall be indicated by an audible or obvious visual indication at the constantly attended supervising station's operator interface within 200 s.

Exception: Interconnection between equipment within a common enclosure or when the wiring connections are intended to be made within 20 ft (6.1 m) and are enclosed within conduit or equivalently protected against mechanical injury.

k) The supervising station signal processing equipment shall additionally meet the applicable requirements of the following:

1) Sections 7 – 12, Software

2) Section 13, Interconnected Fire Alarm Control Units and Accessories, General

3) Sections 16 – 19, Power Supplies

4) 20.2, Trouble Signals

5) Section 23, Circuits

6) Section 29, Combination Systems

7) 34.1 – 34.3

8) 35.2, Protected Premises Units

9) 54.5, Capacitors

10) 59.3, Sharp Edges

11) 59.4, Stability

12) Section 68, Performance Tests – General

13) 71.2, Monitoring for Integrity – Components

l) The installation instructions shall specify that in addition to the main power supply and secondary power supply that are required to be provided at the supervising station, the system shall be provided with an uninterruptable power supply (UPS) with sufficient capacity to operate the computer equipment for a minimum of 4 h. If more than 4 h is required for the secondary power supply to supply the UPS input power, the UPS shall be capable of providing input power for at least that amount of time.

m) The installation instructions shall specify that in order to perform maintenance and repair service, a means for disconnecting the input to the UPS while maintaining continuity of power to the automation system, when applicable, shall be provided.

n) A power conditioner used with the system shall comply with the applicable requirements in UL 1012.

o) The installation instructions shall specify that the source of power for the equipment shall be within the rated voltage range of the signal processing equipment.

p) The installation instructions shall specify that the equipment be protected by supply line transient protection complying with UL 1449. The transient voltage surge suppressors for single-phase, 120/220 V AC systems shall have a marked rating of 330 V or less. The transient voltage surge suppressors for 3-phase, 480 V AC or higher-rated systems shall have a marked rating of 400 V or less.

q) The installation instructions shall specify that all ports of the signal processing equipment that are connected to communication circuits contained within the central-station building and not connected to the telecommunications network shall be protected by isolated loop circuit protectors for communication circuits. These protectors shall comply with the requirements in UL 497B. The transient protectors shall have a marked rating of 50 V or less.

Exception No. 1: When all of the equipment connected to the signal processing equipment is located in the same room as the signal processing equipment and is not connected to the telecommunications network, isolated loop circuit protection is not required.

Exception No. 2: Transient voltage surge protection is not required for fiber optic circuits.

r) The installation instructions shall specify that communication circuits and network components connected to the telecommunications network shall be protected by secondary protectors for communication circuits. These protectors shall comply with UL 497A. These protectors shall be used only in the protected side of the telecommunications network. The transient protectors shall have a marked rating of 150 V or less.

s) The installation instructions shall indicate that equipment be installed in a temperature controlled environment. A temperature controlled environment is defined as one that can be maintained between 13 – 35 °C (55 – 95 °F) by the HVAC system. Twenty-four hour of standby power shall be provided for the HVAC system. The standby power system for the HVAC system may be supplied by an engine driven generator alone. A standby battery is not required to be used. A maintenance contract that provides for restoring operation of the HVAC system within 24 h, 7 d/week shall be in place.

t) The installation instructions shall specify that supervising station processing control equipment or the enclosure housing the control equipment be provided with a permanent means for connection to the branch-circuit supply which shall include provision for installing the supply conductors in conduit.

u) The installation instructions shall specify that no other software other than the operating system software and anti-virus/security protection software shall be installed on the primary and backup computer/servers.

34.5 Transmission and communication paths

34.5.1 General

34.5.1.1 This section describes the requirements for the transmission path(s) between the protected premises and remote subsidiary or supervising station(s), and the communication path(s) between remote subsidiary station(s) and the supervising station.

34.5.1.2 Dual control, where utilized, shall provide for redundancy in the form of a standby circuit or other alternate means of transmitting signals over the primary trunk portion of the transmission path. The system shall have the capability of either using the same methods of signal transmission over separate routes, or employing different methods of signal transmission.

34.5.1.3 Dual control transmission equipment shall be monitored for integrity as follows:

a) When dedicated transmission equipment, which is available full time and whose use is limited to fire alarm signaling purposes, is utilized, a test signal shall be initiated and completed a minimum of once an hour.

b) When public-switched telephone network facilities are utilized, a test signal shall be initiated and completed a minimum of once every 24 h.

34.5.1.4 A successful signal transmission sequence of any other type within the same required period is considered to comply with the intent of 34.5.1.3.

34.5.1.5 A single open or a single ground on any transmission or communication circuit shall not cause an alarm signal, or affect the required operation of the fire alarm system, other than the loss of the faulted circuit.

34.5.1.6 The utilization of a double loop or redundant conductors or circuits to avoid electrical supervision does not meet the intent of these requirements.

34.5.1.7 When redundant equipment is employed for signal receiving, transmitting, or processing switch over shall be accomplished in not more than 30 s with no loss of signals during this period. The switch over shall be displayed and recorded at the supervising station.

34.5.2 Active multiplex

34.5.2.1 Alarm, trouble, and supervisory signals, and their restoration to normal shall be received, displayed, and recorded at the supervising station in not greater than 90 s from the time they are transmitted from the protected premises.

34.5.2.2 The occurrence of a fault condition, as described in 34.5.2.3, either singly or in combination, on the transmission or communication path that prevents the transmission of any status-change signal shall be:

a) Automatically indicated and recorded at the supervising station. The display and record shall identify the affected portions of the system, including trunk, or leg, or both; and

b) Shall not inhibit or delay receipt of change of status signals over any other paths except those that are intended to be dependent on the affected path. A fault condition on one leg facility shall not inhibit normal service on any other trunk or other leg facility.

34.5.2.3 A fault condition is defined as one of the following:

a) Single open;

b) Single ground;

c) Wire-to-wire short; or

d) Multi-frequency noise on the leg facility comprised of either a single frequency or multiple frequencies, which impairs intended operation of bridging networks, but which are isolated from the leg or secondary trunks by rejection through an isolating bridge.

34.5.2.4 Restoration of normal service to the affected portions of the system shall be automatically recorded and displayed at the supervising station. The first status change of any initiating circuit, or initiating device directly connected to a signaling circuit, or any combination that occurred at any of the affected protected premises units during the service interruption shall also be displayed and recorded.

34.5.2.5 Active multiplex systems shall be designated in the product installation wiring diagram/instructions based upon the transmission capability of the system under various fault conditions. The systems shall be designated as follows:

a) A Type 1 system shall have dual control as described in 34.5.1.2 – 34.5.1.4. A fault condition, either singly or in combination, on a trunk or leg facility shall not inhibit the transmission of signals from any other trunk or leg facility, except those normally dependent on the portion of the faulted transmission channel. A fault condition, either singly or in combination, on a leg facility shall not inhibit normal service on any trunk or other leg facility. When public switched telephone network facilities are employed, they shall be used only as the alternate path for transmitting signals, except for derived channel with no more than 32 leg facilities.

b) A Type 2 system shall operate as described for Type 1, except that dual control as described in 34.5.1.2 – 34.5.1.4 is not required.

c) A Type 3 system shall automatically indicate and record at the supervising station the occurrence of a fault condition, either singly or in combination that interferes with the ability of the trunk or leg facility to transfer change of status signals from the protected premises to the supervising station.

34.5.2.6 While the system is operating under the maximum specified loading, the maximum end-to-end operating time from the occurrence of a fault or adverse condition in any trunk or leg facility until it is displayed and recorded at the supervising station shall not exceed 90 s for Type 1 and Type 2 systems and 200 s for Type 3 systems.

34.5.3 Digital alarm communicator system (DACS)

34.5.3.1 General

34.5.3.1.1 All signals exchanged in a digital alarm communicator system (DACS) shall be by digital code or equivalent. Signal repetition, digital parity check, or some equivalent means of signal verification shall be used.

34.5.3.2 Digital alarm communicator transmitter (DACT)

34.5.3.2.1 A digital alarm communicator transmitter (DACT) shall have provision for seizing the telephone line (going off-hook) at the protected premises, disconnecting an outgoing or incoming telephone call, and preventing use of the telephone line for outgoing telephone calls until the signal transmission to a digital alarm communicator receiver (DACR) has been completed.

34.5.3.2.2 A DACT shall have provision for satisfactorily obtaining an available dial tone, dialing the number of the digital alarm communicator receiver, obtaining verification that the receiver is ready to receive signals, transmit the signal, and receive acknowledgment that the receiver has accepted that signal. In no event shall the time from going off-hook to on-hook exceed 90 s per attempt.

34.5.3.2.3 Concurrent status changes occurring at a DACT shall be prioritized before the DACT goes off-hook and are transmitted to the digital alarm communicator receiver (DACR). The priority levels of signals shall be as follows:

a) Signals associated with life safety;

b) Signals associated with property safety;

c) Supervisory signals and trouble signals associated with life and property safety; and

d) All other signals.

Exception: When all concurrent status changes can be transmitted within 90 s, the transmissions are not required to be prioritized.

34.5.3.2.4 A DACT shall have means to reset and retry if the first attempt to complete a signal transmission sequence is unsuccessful. Additional attempts shall be made until the signal transmission sequence has been completed to a minimum of five and a maximum of ten attempts. A failure to complete the sequence in conjunction with one status change condition shall not prevent subsequent attempts to transmit any other status changes.

34.5.3.2.5 The DACT shall have provision for calling a second digital communicator receiver number should the signal transmission sequence to the first called number be unsuccessful. Refer to 34.5.3.2.4.

34.5.3.2.6 When the maximum number of attempts to complete the sequence is reached, an audible and visual indication of the failure shall be energized at the protected premises.

34.5.3.2.7 A DACT that provides both fire and security protected premises services is not prohibited from suppressing the audible indication required in 34.5.3.2.6 during the period when the burglary protection is completely armed.

34.5.3.2.8 A DACT shall have provision for two separate transmission paths. The DACT shall be capable of selecting the operable transmission path in the event of failure of the other.

Exception: Where a DACT is connected to a telephone line that is monitored for integrity so that the fault conditions indicated in 34.5.2.2 – 34.5.2.6 are annunciated within 200 s at the supervising station, a second transmission path is not required.

34.5.3.2.9 The primary transmission path shall be a telephone line connected to the public-switched network. The secondary transmission path shall be any of the following:

a) A one-way private-radio frequency alarm signaling system utilized in accordance with 34.5.5.1 – 34.5.5.11.

b) A two-way private radio frequency alarm signaling system utilized in accordance with 34.5.4.1 – 34.5.4.7.

c) A transmission means complying with 34.5.7.1.

Exception: In addition to the above capability, a telephone line (number) shall be permitted to be used as the second transmission means. Each DACT shall be programmed to call a second DACR line (number) when the signal transmission sequence to the first called line (number) is unsuccessful. The DACT shall be capable of selecting the operable means of transmission in the event of failure of the other means. Where two telephone lines (numbers) are used, it shall be permitted to test each telephone line (number) at alternating 6 h intervals.

34.5.3.2.10 The first transmission attempt shall utilize the primary means of transmission.

Exception: Where the primary transmission path is known to have failed.

34.5.3.2.11 Simultaneous change of status reporting over both transmission paths is permitted when redundant signals are suppressed at the supervising station.

34.5.3.2.12 Failure of the DACT transmission paths, due to a loss of line voltage, shall result in an audible and visual trouble signal at the protected premises and the transmission of a trouble signal to the associated supervising station receiver over the operable path. The transmission shall be initiated within 4 min of occurrence of the fault. When public cellular telephone service is used, loss of cellular service shall be considered a transmission path failure.

34.5.3.2.13 A DACT shall automatically initiate and complete a test signal transmission sequence to its associated receiver at least once every 6 h. Both transmission paths shall be tested at intervals not exceeding 6 h. The test signal sent when the protected premises system is in the normal supervisory condition shall be distinctively different from the test signal sent when the protected premises system is in an abnormal or activated condition. Retransmission of the previously reported abnormal or activated conditions does not meet the intent of the test signals being distinctly different.

Exception: When a DACT has provisions for being programmed to call a telephone number that is call forwarded to the line of the DACR, the test frequency shall be reduced to at least once every 4 h.

34.5.3.2.14 A successful signal transmission sequence of any other type within the same 6-h period is considered to meet the intent of 34.5.3.2.13 when the product/system complies with all of the following:

a) The associated receiver is capable of automatically annunciating delinquencies.

b) Both transmission paths are used over the period.

c) The protected premises equipment and/or transmitter are in the normal supervisory condition.

34.5.3.3 Digital alarm communicator receiver (DACR)

34.5.3.3.1 Failure to receive a test signal from each associated DACT as specified in 34.5.3.2.13 shall be treated as a trouble signal and shall result in the automatic display and recording of such at the supervising station.

Exception: A DACR intended only for central station service is not required to automatically annunciate, display, and record delinquency signals when marking on the product or in the installation wiring diagram/instructions clearly indicate the need to manually track the signaling performance of each DACT and failure to receive a signal from a DACT over the applicable period is to be handled as a trouble signal.

34.5.3.3.2 Test signals indicating a normal supervisory condition at the protected premises need only be recorded rather than both recorded and displayed.

34.5.3.3.3 The DACR shall have provision for connection to at least two separate incoming telephone lines.

34.5.3.3.4 When the connection time to a DACT exceeds an average of 30 s, the installation wiring diagram/instructions shall provide specific guidelines for establishing loading or the unit shall automatically switch the signal to a separate line not included in the hunt group.

34.5.3.3.5 Failure of any transmission path connected to a DACR that is due to loss of line voltage shall result in a visual and audible trouble annunciation at the supervising station within 200 s.

34.5.4 Two-way private-radio frequency multiplex

34.5.4.1 The occurrence of an adverse condition to a communication or transmission path that interferes with the proper transmission or receipt of status change of signals at the supervising station:

a) Shall be automatically displayed and recorded at the supervising station. The display and recording shall identify the affected portions of the system, including trunk, or leg facility, or both; and

b) Shall not inhibit or delay receipt of change of status signals over any other paths, except those that are intended to be dependent on the affected path.

34.5.4.2 The transmission and communication paths shall be supervised so that when the signal strength received at any receiver is below the minimum specified signal strength, the condition and affected portion of the system shall be displayed and recorded at the supervising station.

34.5.4.3 The occurrence of continuous radio-frequency noise in excess of the specified maximum ambient noise level or signal-to-noise ratio (refer to 98.2, Reference Signal Level) on the radio-frequency path between a transmitter, repeater, or subsidiary/supervising station receiver for a continuous period of 20 s or more shall be automatically displayed and recorded at the supervising station. The display and recording shall identify the affected portions of the radio-frequency signaling system.

34.5.4.4 Restoration of normal service to the affected portions of the system shall be automatically recorded and indicated. The first status change of any initiating circuit, or initiating device directly connected to a signaling circuit, or any combination that occurred at any of the affected protected premises units during the service interruption shall also be displayed and recorded.

34.5.4.5 While the system is operating under the maximum specified loading, the time from beginning an alarm, supervisory, or trouble transmission until it is displayed and recorded at the supervising station shall not exceed 90 s.

34.5.4.6 Two-way radio-frequency multiplex systems shall be designated in the product installation wiring diagram/instructions based upon the transmission capability of the system under the following fault conditions.

a) Type 4 systems shall have redundant means of the transmission and/or communication paths between the protected premises and the supervising station, as well as redundant RF receivers at the supervising station. Malfunction of any of the equipment, other than the protected premises transponder, shall not interfere with the receipt of signals at the supervising station.

b) Type 5 systems will not employ redundant transmission and/or communication paths, or RF receivers at the supervising station.

34.5.4.7 While the system is operating under the maximum specified channel loading, the time from the occurrence of:

a) An adverse condition that will prevent the transmission of any change of status signal;

b) The malfunction of any transmitting and receiving equipment, including transmitting and receiving antennas, and interconnecting cables, in the entire transmission path until a trouble is displayed and recorded at the supervising station, shall not exceed 200 s. The display and recording shall identify the affected portions of the radio-frequency system.

34.5.5 One-way private-radio frequency

34.5.5.1 Status-change signals from a radio alarm transmitter shall be received by at least two independently-powered, independently-operating, and separately-located radio repeaters or radio alarm supervising station receivers, or by one of each. At least two separate paths shall be provided from the radio alarm transmitter to the ultimate radio alarm supervising station receiver.

34.5.5.2 One-way private-radio frequency systems shall be monitored to verify that at least two independent one-way radio frequency paths, as required in 34.5.5.1, are utilized for each radio transmitter during each 24-h period. The occurrence of a failure to receive a signal by either path shall be automatically displayed and recorded at the supervising station. The information shall identify the radio transmitter, and the radio repeater/receiver(s) that did not receive the signal.

Exception: A one-way private-radio-frequency system intended only for central station service is not required to automatically annunciate, display, and record 24 h delinquency signals when marking on the product or in a user's manual clearly indicate the need to manually track the signaling performance of each radio transmitter and failure to receive a signal from a radio transmitter over a 24-h period is to be handled as a trouble signal.

34.5.5.3 A test signal sent when the protected premises system is in the normal supervisory condition shall be distinctly different from the test signal sent when the unprotected premises system in an abnormal or activated condition. Retransmission of previously reported abnormal or activated conditions does not meet the intent of the test signals being distinctly different.

34.5.5.4 A successful signal transmission sequence of any type within the 24-h period is considered to comply with the intent of 34.5.5.2 when the associated supervising station is capable of automatically annunciating 24-h delinquencies and the protected premises equipment and/or transmitter are in the normal supervisory condition.

34.5.5.5 Acceptable test signals are not required to be displayed but shall be recorded at the supervising station.

34.5.5.6 The occurrence of continuous radio-frequency noise in excess of the specified maximum ambient noise level or signal-to-noise ratio (refer to 98.2, Reference Signal Level) on the radio-frequency path between a transmitter, repeater, or subsidiary/supervising station receiver for a continuous period of 20 s or more shall be automatically displayed and recorded at the supervising station. The display and recording shall identify the affected portions of the one-way radio-frequency signaling system.

34.5.5.7 The radio-frequency paths shall be supervised so that when the radio transmitter signal strength received at the radio repeater stations or subsidiary/supervising station receivers is below the minimum specified signal strength, the condition and affected portion of the system shall be displayed and recorded at the supervising station.

34.5.5.8 A one-way radio alarm system shall transmit change of status conditions to comply with the end-to-end time parameters specified in 98.8.4. A minimum of three transmission sequences shall occur in the first 30 s. The parameters shall be evaluated while the system is operating under the maximum

specified channel loading and with 25 radio transmitters actively in alarm and reporting to the same repeater(s) and receiver(s) on the same transmission path(s).

34.5.5.9 The time period over which a single change of status is transmitted shall not exceed 7.5 min (450 s).

34.5.5.10 The malfunction of any transmitting and receiving equipment, including transmitting and receiving antennas, and interconnecting cables, in the entire transmission path shall be displayed and recorded within 200 s at the supervising station.

34.5.5.11 Radio transmitters at the protected premises shall be arranged to check all antennas and related connecting cable and interconnections between elements of the transmitting equipment located in separate enclosures, such that within 200 s of the occurrence of a fault condition either an audible and visual trouble shall be annunciated locally, or, when possible, a trouble signal shall be transmitted so that display and recording at the supervising station will occur within an additional 200 s.

34.5.5.12 One-way radio-frequency systems shall be designated in the product installation wiring diagram/instructions based upon the transmission capability of the system under various fault conditions. The systems shall be designated as follows:

a) A Type 6 system is not required to have more than one radio-frequency supervising station.

b) A Type 7 system shall use more than one radio-frequency supervising station. A fault condition on more than one repeater that results in any radio transmitters no longer being supervised shall be indicated and recorded at the affected supervising station.

34.5.6 Direct-connect non-coded systems

34.5.6.1 Alarm, trouble, and supervisory signals, and their restoration to normal, shall be received, displayed, and recorded at the supervising station in not greater than 90 s from the time they are transmitted from the protected premises.

34.5.6.2 The maximum time from the occurrence of a fault or adverse condition in any transmission and/or communication path or equipment, or the restoration of the fault or adverse condition to normal until it is displayed and recorded at the supervising station shall not exceed 200 s.

34.5.6.3 The transmission and/or communication path between the protected premises and the supervising station, except for circuits wholly within the protected premises or the supervising station shall operate for alarm and supervisory signals under either of the following conditions:

a) A system shall operate during the occurrence of a single open or a single ground fault. The circuit shall be self-adjusting in the event of the aforementioned fault and shall be self-restoring when the break or fault is corrected.

b) A system shall operate during a single ground fault. The circuit shall normally be isolated from ground except for a ground detecting means, which shall indicate the ground fault automatically and operate an audible trouble signal. The ground detecting means is not required when the presence of a second ground fault will be indicated by either an audible trouble signal or an alarm signal.

34.5.7 Performance based technologies

34.5.7.1 Transmission technologies that operate on principles different from the transmission technologies covered in 34.5.1.1 – 34.5.6.1 shall meet the requirements of 34.5.7.2 – 34.5.7.6.

34.5.7.2 The communications path(s) shall be monitored for integrity in accordance with the following:

a) Where only one communication is used, both of the following requirements shall be met:

1) Any failure of the communications path shall be annunciated at the supervising station within 60 min of a fault that affects the communication between the transmitter at the protected premises and the receiver at the supervising station.

2) Failure to complete a signal transmission from the transmitter at the protected premises to the receiver at the supervising station shall result in a trouble annunciation at a required operator interface at the protected premises.

b) Where two or more different technologies are used the requirements of both of the following shall be met:

1) Each communications path shall be monitored for integrity.

2) Failure of any communications path shall be annunciated at the supervising station within not more than 6 h. of the failure.

3) Failure to complete a signal transmission from the protected premises to the supervising station shall result in a trouble annunciation at a required operator interface at the protected premises.

34.5.7.3 A single communication technology is permitted to be used to create multiple paths provided the multiple paths comply with 34.5.7.2(b).

34.5.7.4 Alarm, trouble, and supervisory signals, and their restoration to normal, shall be received, displayed, and recorded at the supervising station in not greater than 90 s from the time they are transmitted from the protected premises.

34.5.7.5 Where a transmitter shares a transmission or communications channel with other transmitters; each transmitter shall have a unique identifier.

34.5.7.6 Communication of alarm, supervisory, and trouble signals shall prevent degradation of the signal in transit by means of one of the following:

a) Signal repetition: Multiple transmissions repeating the same signal;

b) Parity check: A mathematical check sum algorithm of a digital message that verifies correlation between transmitted and received message; or

c) A means that provides a certainty of 99.99 % that the received message is identical to the transmitted message.

35 Auxiliary Service

35.1 General

35.1.1 The requirements in 35.2 and 35.3 cover the operation requirements for products intended for auxiliary service. The requirements in 35.2, Protected Premises Unit, covers products located at the protected premises. The requirements in 35.3, Supervising and Subsidiary Station Units, covers products located at the supervising station or subsidiary station including the communication path, and the signal receiving, processing, display, and recording equipment.

35.2 Protected premises units

35.2.1 General

35.2.1.1 Alarm signal annunciation for protected premises units serving two or more zones, and trouble signals shall be indicated at the protected premises. Where all zones or status changes are not displayed simultaneously, the display information shall comply with 20.5, Sequential Display.

35.2.1.2 The time periods for processing and activation of signals in a worst-case loaded system shall be as follows:

a) Automatic processing and activation of the master box or shunt circuit shall not be greater than 10 s from the initiation of an alarm condition.

b) Trouble signals and their restoration to normal shall be annunciated at the protected premises within 200 s of the occurrence of the adverse condition, fault, or the restoration to normal.

Exception: The initial battery trouble signal from a battery-operated product that complies with the requirements of 19.1.

35.2.2 Alarm signals

35.2.2.1 The operation of any initiating device shall cause the system to automatically activate the master box or shunt circuit.

35.2.2.2 An alarm signal of a control unit/system shall be maintained continuously (locked in) by the protected premises unit until a resetting device in the protected premises unit is operated manually.

35.2.3 Auxiliary signaling circuit

35.2.3.1 Interconnections between the auxiliary protected premises control unit and the local energy type box shall be monitored for single open and single ground faults such that a trouble signal shall be annunciated at the protected premises for the fault condition.

35.2.3.2 A trouble signal shall persist at the protected premises until an actuated local energy box is manually reset.

35.2.3.3 The shunt-type connections of an auxiliary protected premises control unit is not required to be monitored for integrity.

35.2.3.4 A trouble signal shall be annunciated at the protected premises when any portion of the system.

35.3 Supervising and subsidiary station units

35.3.1 Transmission and communication paths and supervising and subsidiary station equipment intended for auxiliary service shall comply with the applicable requirements in this standard and in the Public Fire Alarm Reporting Systems chapter in National Fire Alarm and Signaling Code, NFPA 72.

CONSTRUCTION

36 General

36.1 A product shall use materials that have been determined to comply with the requirements for the particular use, as indicated by the performance requirements of this standard.

36.2 Metals, when required to meet the requirements of this standard, shall not be used in such combination as to cause galvanic action that will increase the risk of fire, electric shock, injury to persons, or impair the operation of a product associated with the safety of life and/or property protection.

36.3 Where breakage or deterioration of a part such as an enclosure, a frame, a guard, or the like can result in a risk of injury to persons, the part shall be constructed to meet the demand or expected loading conditions.

36.4 The requirement in 36.3 applies also to those positions of a part adjacent to a moving part identified to involve a risk of injury to persons.

36.5 Products intended to be installed in air-handling spaces shall comply with the requirements in UL 2043.

36.6 With respect to construction requirements, products that currently meet the following requirements only needs to be evaluated to 36.7:

a) In Canada only:

1) CSA-C22.2 No. 60950-1;

2) CSA C22.2 No. 60065; or

3) CSA C22.2 No. 62368-1;

b) In the United States only:

1) UL 60950-1;

2) UL 60065; or

3) UL 62368-1.

36.7 Products that meet the requirements in the standards identified in 36.6, need only to be evaluated to the following with respect to the construction requirements:

a) Section 38, Operating Controls;

b) 39.1.1, Enclosing of electrical parts;

c) 39.1.3, Provision for installation wiring entry by means of conduit;

d) 43.2.2.5, Protection of field wiring connections;

e) 44.1, Other Field Wiring Connections – General;

f) 44.2.2, Sufficient size of field wiring compartment;

g) 44.2.5, Access to field wiring connections;

h) 44.6, Field-Wiring Leads;

i) 46.1 – 46.3, Protective Devices;

j) 46.4 – 46.7 Protective Device;

k) Section 51, End-of-Line Devices.

l) Section 53, Coil Windings;

m) 54.5, Capacitors; and

n) Section 55, Batteries.

37 In Canada Only: Product Assembly

37.1 Each component shall be capable of being installed without requiring alteration, cutting, drilling, threading, welding, soldering, critical alignment, or similar tasks by the installer.

NOTE: This is not intended to prevent installers from cutting specific wire entrance ways as required at the installation site.

38 In Canada Only: Operating Controls

38.1 A product with manual controls located within the enclosure shall be provided with a false front or be similarly arranged so that access to the controls will not result in exposure of live parts to unintentional contact or exposure of product parts to unintentional damage. Refer to Section 41, Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving.

39 Enclosures

39.1 General

39.1.1 All electrical parts of a product shall be enclosed to provide protection of internal components and prevent contact with uninsulated live parts.

39.1.2 In Canada only: The enclosure of a product shall be provided with means for mounting of the product in its intended position. The mounting means shall be accessible without disassembly of any components of the product. Removal of a complete assembly is not considered to be disassembly of a component. There shall be at least 12.5 mm of free space around a keyhole opening intended for mounting, and no live parts shall be located less than the minimum spacing requirements indicated in Section 48, Spacings.

39.1.3 The enclosure of a product shall have provision for installation wiring entry by means of conduit openings in accordance with 39.3, Polymeric Materials, and 39.2, Metallic Material.

39.1.4 Enclosure parts fastened with adhesive meeting 42.6 – 42.9 shall comply with the test requirements in Section 92, Mechanical Strength Test for Metal Enclosures and Guards and Enclosure Parts Secured with Adhesive.

39.2 Metallic metal

39.2.1 An enclosure of metal shall have a minimum thickness as specified in Table 39.1, Table 39.2 or Table 39.3 or shall comply with the test requirements in Section 92, Mechanical Strength Test for Metal Enclosures and Guards and Enclosure Parts Secured with Adhesive.

Table 39.1
Cast-Metal Electrical Enclosures

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

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

Table 39.2
Minimum Thickness of Sheet Metal for Electrical Enclosures of Carbon or Stainless Steel

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness			
Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length		Uncoated		Metal coated	
cm	(in)	cm	(in)	cm	(in)	cm	(in)	mm [MSG]	(in) [MSG]	mm [GSG]	(in) [GSG]
10.2	(4.0)	Not limited		15.9	(6.25)	Not limited		0.51	(0.020)	0.58	(0.023)
12.1	(4.75)	14.6	(5.75)	17.1	(6.75)	21.0	(8.25)	[24]	[24]		
15.2	(6.0)	Not limited		24.1	(9.5)	Not limited		0.66	(0.026)	0.74	(0.029)
17.8	(7.0)	22.2	(8.75)	25.4	(10.0)	31.8	(12.5)	[22]	[22]		
20.3	(8.0)	Not limited		30.5	(12.0)	Not limited		0.81	(0.032)	0.86	(0.034)
22.9	(9.0)	29.2	(11.5)	33.0	(13.0)	40.6	(16.0)	[20]	[20]		
31.8	(12.5)	Not limited		49.5	(19.5)	Not limited		1.07	(0.042)	1.14	(0.045)
35.6	(14.0)	45.7	(18.0)	53.3	(21.0)	63.5	(25.0)	[18]	[18]		
45.7	(18.0)	Not limited		68.6	(27.0)	Not limited		1.35	(0.053)	1.42	(0.056)
50.8	(20.0)	63.5	(25.0)	73.7	(29.0)	91.4	(36.0)	[16]	[16]		
55.9	(22.0)	Not limited		83.8	(33.0)	Not limited		1.52	(0.060)	1.60	(0.063)
63.5	(25.0)	78.7	(31.0)	88.9	(35.0)	109.2	(43.0)	[15]	[15]		
63.5	(25.0)	Not limited		99.1	(39.0)	Not limited		1.70	(0.067)	1.78	(0.070)
73.7	(29.0)	91.4	(36.0)	104.1	(41.0)	129.5	(51.0)	[14]	[14]		
83.8	(33.0)	Not limited		129.5	(51.0)	Not limited		2.03	(0.080)	2.13	(0.084)
96.5	(38.0)	119.4	(47.0)	137.2	(54.0)	167.6	(66.0)	[13]	[13]		
106.7	(42.0)	Not limited		162.6	(64.0)	Not limited		2.36	(0.093)	2.46	(0.097)
119.4	(47.0)	149.9	(59.0)	172.7	(68.0)	213.4	(84.0)	[12]	[12]		
132.1	(52.0)	Not limited		203.2	(80.0)	Not limited		2.74	(0.108)	2.82	(0.111)
152.4	(60.0)	188.0	(74.0)	213.4	(84.0)	261.6	(103.0)	[11]	[11]		
160.0	(63.0)	Not limited		246.4	(97.0)	Not limited		3.12	(0.123)	3.20	(0.126)
185.4	(73.0)	228.6	(90.0)	261.6	(103.0)	322.6	(127.0)	[10]	[10]		

Table 39.2 Continued on Next Page

Table 39.2 Continued

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness			
Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length		Uncoated		Metal coated	
cm	(in)	cm	(in)	cm	(in)	cm	(in)	mm [MSG]	(in) [MSG]	mm [GSG]	(in) [GSG]

[a] A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal that is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and that has sufficient torsional rigidity to resist the bending moments which may be applied via the enclosure surface when it is deflected. Construction that is considered to have equivalent reinforcing may be accomplished by designs that will produce a structure that is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes:

1) A single sheet with single formed flanges (formed edges),

2) A single sheet which is corrugated or ribbed, and

3) An enclosure surface loosely attached to a frame, for example, with spring clips.

[b] The width is the smaller dimension of a rectangular sheet metal piece which is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.

[c] For panels which are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 12.7 mm (1/2 in) wide.

Table 39.3
Minimum Thickness of Sheet Metal for Electrical Enclosures of Aluminum, Copper, or Brass

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness,	
Maximum width,[b]		Maximum length,[c]		Maximum width,[b]		Maximum length,			
cm	(in)	cm	(in)	cm	(in)	cm	(in)	mm	(in)
7.6	(3.0)	Not limited		17.8	(7.0)	Not limited			
8.9	(3.5)	10.2	(4.0)	21.6	(8.5)	24.1	(9.5)	0.58	(0.023)
10.2	(4.0)	Not limited		25.4	(10.0)	Not limited			
12.7	(5.0)	15.2	(6.0)	26.7	(10.5)	34.3	(13.5)	0.74	(0.029)
15.2	(6.0)	Not limited		35.6	(14.0)	Not limited			
16.5	(6.5)	20.3	(8.0)	38.1	(15.0)	45.7	(18.0)	0.91	(0.036)
20.3	(8.0)	Not limited		48.3	(19.0)	Not limited			
24.1	(9.5)	29.2	(11.5)	53.3	(21.0)	63.5	(25.0)	1.14	(0.045)
30.5	(12.0)	Not limited		71.1	(28.0)	Not limited			
35.6	(14.0)	40.6	(16.0)	76.2	(30.0)	94.0	(37.0)	1.47	(0.058)
45.7	(18.0)	Not limited		106.7	(42.0)	Not limited			
50.8	(20.0)	63.5	(25.0)	114.3	(45.0)	139.7	(55.0)	1.91	(0.075)
63.5	(25.0)	Not limited		152.4	(60.0)	Not limited			
73.7	(29.0)	91.4	(36.0)	162.6	(64.0)	198.1	(78.00	2.41	(0.095)
94.0	(37.0)	Not limited		221.0	(87.0)	Not limited			
106.7	(42.0)	134.6	(53.0)	236.2	(93.0)	289.6	(114.0)	3.10	(0.122)
132.1	(52.0)	Not limited		312.4	(123.0)	Not limited			
152.4	(60.0)	188.0	(74.0)	330.2	(130.0)	406.4	(160.0)	3.89	(0.153)

[a] A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal which is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and which has sufficient torsional rigidity to resist the bending moments which may be applied via the enclosure surface when it is deflected. Construction that is considered to have equivalent

Table 39.3 Continued on Next Page

Table 39.3 Continued

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness,	
Maximum width,[b]		Maximum length,[c]		Maximum width,[b]		Maximum length,			
cm	(in)	cm	(in)	cm	(in)	cm	(in)	mm	(in)
reinforcing may be accomplished by designs that will produce a structure which is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes: 1) A single sheet with single formed flanges (formed edges), 2) A single sheet which is corrugated or ribbed, and 3) An enclosure surface loosely attached to a frame, for example, with spring clips. [b] The width is the smaller dimension of a rectangular sheet metal piece which is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet. [c] For panels which are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 12.7 mm (1/2 in) wide.									

39.2.2 Where threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, or where a construction that is determined to be equivalent is used, there shall not be less than 3-1/2 nor more than 5 threads in the metal, and the construction shall be such that a standard conduit bushing can be attached.

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

39.2.4 At any point where conduit or metal-clad cable is to be attached to the enclosure, sheet metal shall be of such thickness or shall be so formed or reinforced that it will have stiffness at least equivalent to that of an uncoated flat sheet of steel having a minimum thickness of 0.81 mm (0.032 in).

39.2.5 A product constructed in such a manner as to be supported by rigid conduit shall be provided with conduit hubs, or the equivalent, having not less than 5 full threads.

39.3 Polymeric materials

39.3.1 Polymeric materials used as an enclosure shall comply with the applicable portion of the associated country's standard covering polymeric materials, and also with the additional requirements specified in this standard;

a) In Canada only: CSA-C22.2 No. 0.17-00.

b) In the United States only: UL 746C.

39.3.2 Polymeric material that is not used as an enclosure, but that is attached to or exposed on the outside of a product such as a viewing window, shall have flammability characteristics as shown in Table 39.4.

Table 39.4
Flammability Characteristics of Polymeric Material

Polymeric material area/dimensions	Flammability rating
4 cm^3 (0.24 in^3) maximum and 61 mm (2.4 in) maximum length	None
Greater than 4 cm^3 (0.24 in^3) and less than 0.19 m^2 (2 ft^2), 1.83 m (6 ft) maximum length	HB, V-2, V-1, V-0, or 5V
Greater than 0.19 m^2 (2 ft^2) and less than 0.93 m^2 (10 ft^2), 1.83 m (6 ft) maximum length	V-1, V-0, or 5V
Greater than 0.93 m^2 (10 ft^2), or longer than 1.83 m (6 ft)	In Canada only: Maximum flame spread rating of 200 as specified in ULC-S102 and Assemblies, or radiant panel as specified in CSA C22.2 No. 0.17. In the United States only: Maximum flame spread rating of 200 as specified in UL 723, or radiant panel as specified in UL 94.

39.3.3 Conductive coatings applied to nonmetallic surfaces such as the inside surface of an enclosure, shall comply with the appropriate requirements in the associated country's standard covering polymeric materials, unless flaking or peeling of the coating cannot result in the reduction of spacings or the bridging of live parts.

a) In Canada only: CSA-C22.2 No. 0.17-00.

b) In the United States only: UL 746C.

39.3.4 A polymeric enclosure intended for connection to a rigid metallic conduit system shall comply with the requirements for polymeric enclosure rigid metallic conduit connections in the associated country's standard covering enclosures:

a) In Canada only: CSA-C22.2 No. 94.

b) In the United States only: UL 50.

39.3.5 The continuity of a conduit system shall be provided by metal-to-metal contact and not rely on a polymeric material and shall comply with the requirements for polymeric enclosure bonding in the associated country's standard covering enclosures:

a) In Canada only: CSA-C22.2 No. 94.

b) In the United States only: UL 50.

39.4 Covers

39.4.1 An enclosure cover shall be hinged, sliding, pivoted or similarly attached to provide access to fuses or any other over current-protective device, the intended protective functioning of which requires renewal or resetting, or when it is necessary to open the cover in connection with the normal operation of the unit.

Exception: In lieu of providing a hinged, sliding, or pivoted cover, supervision of the enclosure cover by means of a tamper feature is suitable when its operation results in either a trouble or alarm signal. This applies only when the cover provides access to overcurrent devices such as fuses or circuit breakers or other indicators that are not used on a continuing basis.

39.4.2 Normal operation referenced in 39.4.1 is determined to be operation of a switch for testing or for silencing an audible signal appliance or operation of any other component of a unit which requires such action in connection with its intended performance.

39.4.3 A hinged cover is not required when the only fuse(s) enclosed is intended to provide protection to portions of internal circuits used on a separate printed-wiring board or circuit subassembly, to prevent circuit damage resulting from a fault. The use of such a fuse(s) is suitable when the following (or other wording that has been determined to be equivalent) is indicated as a marking on the outside of the cover: “Circuit Fuse(s) Inside – Disconnect Power Prior To Servicing”.

39.4.4 Glass covering an observation opening shall be tempered and secured in place so that it cannot be displaced and shall provide mechanical protection for the enclosed parts. The thickness of a glass cover shall not be less than that indicated in Table 39.5.

Table 39.5
Thickness of Glass Covers

Maximum size of opening				Minimum thickness,	
Length or width		Area			
mm	(in)	cm^2	(in^2)	mm	(in)
102	(4)	103	(16)	1.6	(1/16)
305	(12)	929	(144)	3.2	(1/8)
over 305	(over 12)	over 929	(over 144)	Refer to a	

[a] 3.2 mm (1/8 in) or more, depending upon the size, shape, and mounting of the glass panel.

39.4.5 A glass panel for an opening having an area of more than 929 cm^2 (144 in^2), or having any dimension greater than 305 mm (12 in), shall be supported by a continuous groove not less than 4.8 mm (3/16 in) deep along all four edges of the panel, or other means that have been determined to be an equivalent arrangement.

39.4.6 A transparent material other than glass used for the cover of an observation opening shall not introduce a risk of fire, distort, nor become less transparent at the temperature to which it is intended to be subjected under either normal or abnormal service conditions. Refer to 39.3.2.

39.5 Battery compartments

39.5.1 A compartment for vented storage batteries shall have a total volume at least twice the volume occupied by the batteries. Ventilating openings shall be provided and so located as to permit circulation of air for dispersion of gas while the battery is being charged at the highest rate permitted by the means incorporated in the control unit.

39.5.2 The interior of a storage battery compartment shall be protected so that it will be resistant to detrimental action by the electrolyte.

39.6 Enclosure openings

39.6.1 General

39.6.1.1 An enclosure intended for recessed mounting and whose front panel is to be flush with the surface of the wall shall have no openings that vent into concealed spaces of a building structure, such as into hollow spaces in the wall, when the product is mounted as intended.

Exception: Products supplied solely from power-limited sources and controlling only power-limited loads.

39.6.1.2 The requirement in 39.6.1.1 does not apply to an opening for a mounting screw or nail or for a manufacturing operation (such as paint drainage) when:

a) An opening for non-mounting purposes does not have a dimension greater than 6.75 mm (17/64 in) or an area greater than 35.5 mm^2 (0.055 in^2); and

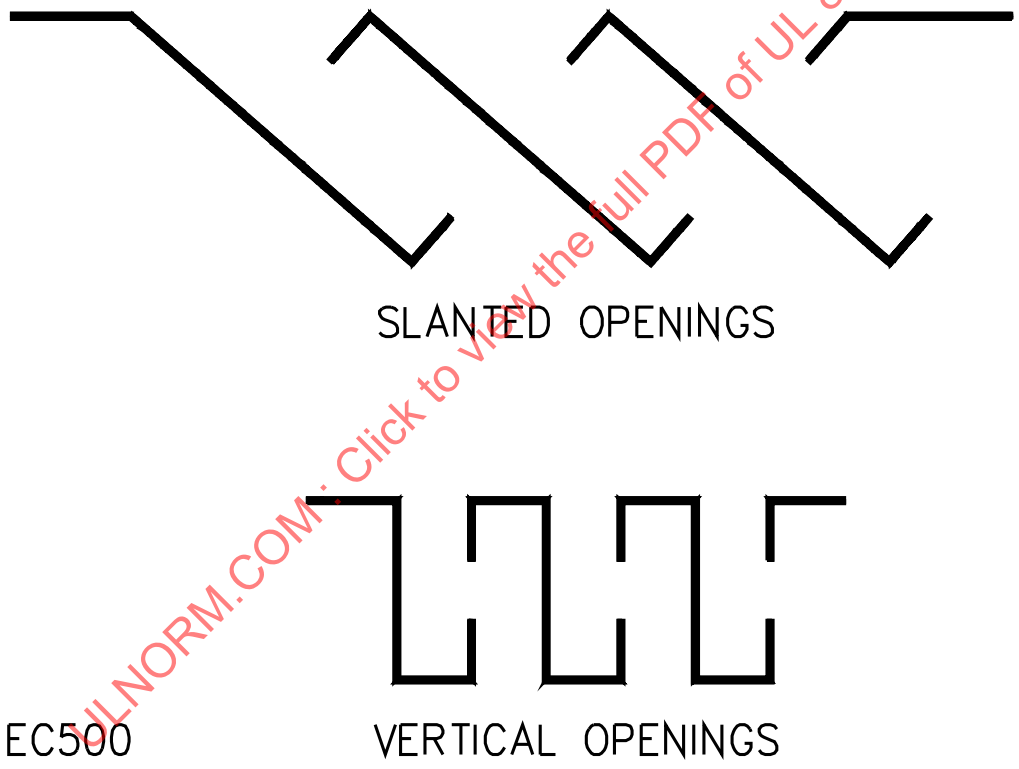
b) An opening for mounting does not have a dimension greater than 19.05 mm (0.75 in) or an area greater than 430 mm^2 (0.7 in^2) and there are no more holes than are needed to mount the product.

39.6.2 Enclosure top openings

39.6.2.1 An opening directly over an uninsulated live part involving a risk of fire, electric shock, or electrical-energy/high-current levels, shall not exceed 5.0 mm (0.20 in) in any dimension unless the configuration is such that a vertically falling object cannot fall into the unit and contact an uninsulated live part. Refer to Figure 39.1 for examples of top-cover designs complying with the intent of the requirement.

Figure 39.1

Cross-Sections of Top-Cover Designs



39.6.3 Enclosure side openings

39.6.3.1 An opening in the side of the enclosure shall:

a) Not exceed 4.8 mm (0.19 in) in any dimension;

b) Be provided with louvers shaped to deflect an external falling object outward (refer to Figure 39.2 for examples of louver designs complying with the requirement); or

c) Be located and sized so that objects which are present cannot drop into the unit and fall (with no horizontal velocity) onto uninsulated live parts involving a risk of fire, electric shock, or electrical-energy/high-current levels, or parts involving injury to persons (refer to Figure 39.3).

Figure 39.2

Louvers

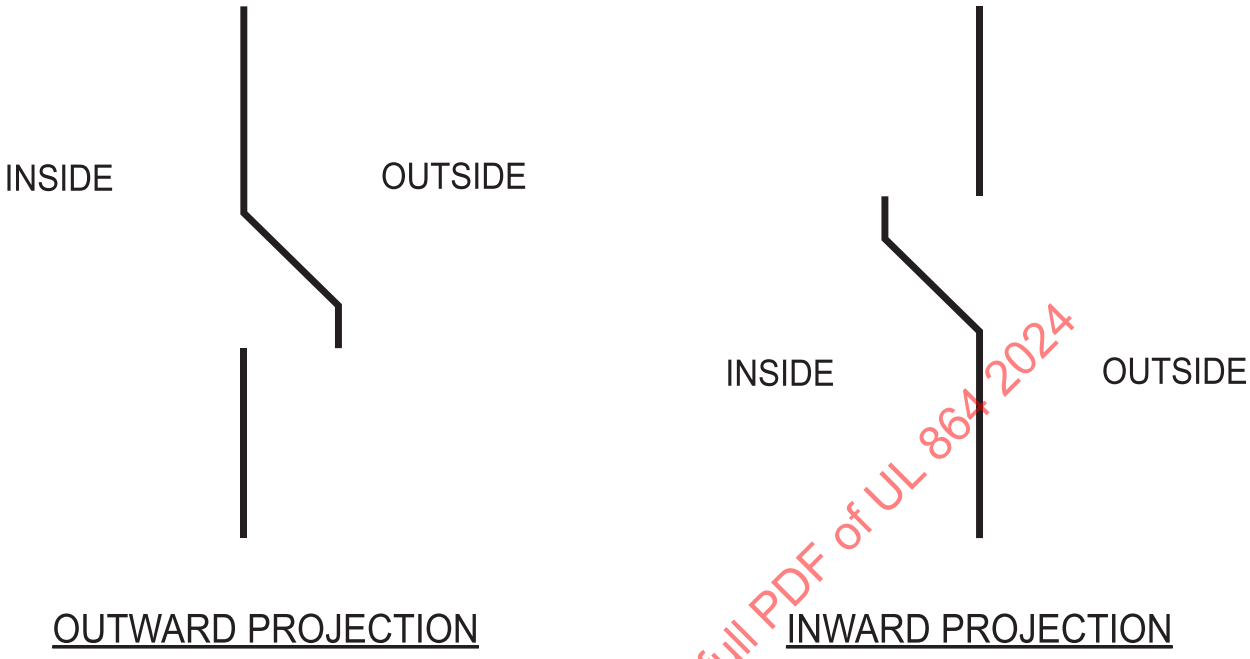


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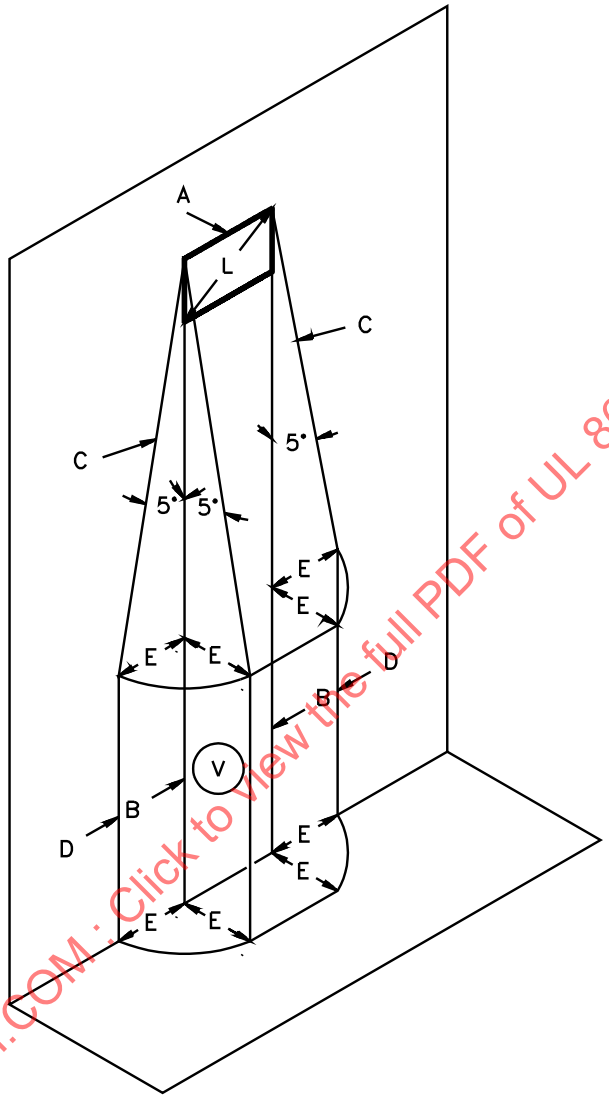
Figure 39.3

Example of Enclosure Side Opening



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A – Enclosure side opening.

B – Vertical projection of the outer edges of the side opening.

C – Inclined lines that project at a 5° angle from the edges of the side opening to point located E distance from B.

D – Line which is projected straight downward in the same plane as the enclosure side wall.

E – Projection of the opening (not to be greater than L).

L – Maximum dimension of the enclosure side opening.

V – Volume in which bare parts at uninsulated live parts are not located.

39.6.3.2 When a portion of a side panel falls within the area traced out by the 5° angle in Figure 39.3 that portion of the side panel shall be investigated as a bottom enclosure in accordance with 39.6.4, Enclosure Bottom Openings.

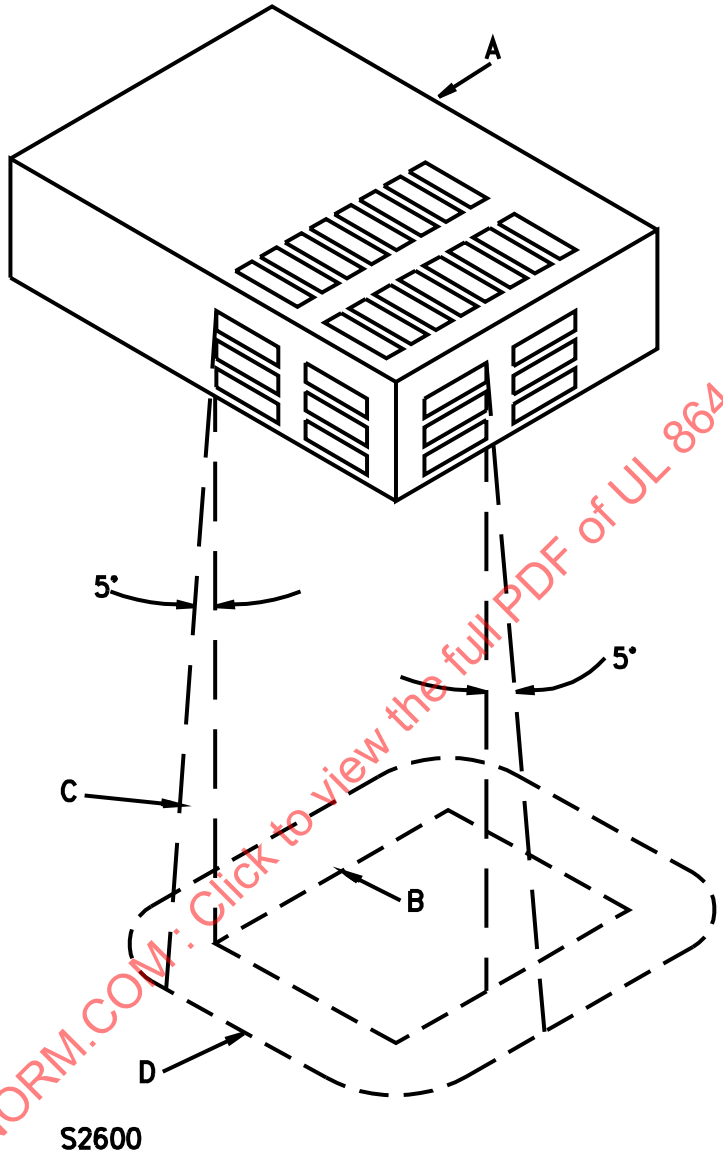
39.6.4 Enclosure bottom openings

39.6.4.1 The bottom of an enclosure shall consist of a complete or partial bottom enclosure under a component, groups of components, or assemblies, as shown in Figure 39.4 that complies with the ventilation opening requirements in 39.6.4.2 and 39.6.4.3 unless a test demonstrates that the bottom enclosure provided contains flames, glowing particles or similar burning debris when all combustible material in the interior is ignited.

Exception: Openings without limitation on their size and number are permitted in areas that contain only wires, cables, plugs, receptacles, and impedance- and thermally-protected motors.

Figure 39.4

Enclosure Bottom



A – The entire component under which an enclosure (flat or dished with or without a lip or other raised edge) of noncombustible material is to be provided. The sketch is of an enclosed component with ventilation openings showing that the enclosure is required only for those openings through which flaming parts are to be emitted. When the component or assembly does not have its own noncombustible enclosure, the area to be protected is the entire area occupied by the component or assembly.

B – Projection of the outline of the area of A that requires a bottom enclosure vertically downward onto the horizontal plane of the lowest point on the outer edge D of the enclosure.

C – Inclined line that traces out an area D on the horizontal plane of the enclosure. Moving around the perimeter of the area B that requires a bottom enclosure, this line projects at a 5° angle from the line extending vertically at every point around the perimeter of A and is oriented to trace out the largest area; except that the angle shall be less than 5° when the enclosure bottom contacts a vertical enclosure or side panel, or when the horizontal extension of the enclosure B to D exceeds 152 mm.

D – Minimum outline of the enclosure, except that the extension B to D is not required to exceed 152 mm, flat or dished with or without a tip or other raised edge. The bottom shall either be flat or formed in any manner when every point of area D is at or below the lowest point on the outer edge of the enclosure.

39.6.4.2 Ventilation openings provided in the bottom of an enclosure under materials that are not rated V-1 or less flammable meet the intent of the requirements when the openings are constructed so that materials do not fall directly from the interior of the unit. Other bottom-opening constructions that comply with the intent of the requirements are those that incorporate a perforated metal plate as described in Table 39.6 or a galvanized or stainless-steel screen having a 14 by 14 mesh per 25.4 mm (1 in) constructed of wire with a minimum diameter of 0.4 mm (1/64 in). Other constructions are to be used only when they comply with the Section 93, Ignition Test Through Bottom-Panel Openings.

Table 39.6
Perforated Metal Plates

Minimum thickness		Maximum diameter of holes		Minimum spacing of holes centre-to-centre	
mm	(in)	mm	(in)	mm	(in)
0.66	(0.026)	1.14	(0.045)	1.70	(0.67)
–	–	–	–	[36 holes per cm^2]	([233 holes per in^2])
0.66	(0.026)	1.19	(0.047)	2.36	(0.093)
0.81	(0.032)	1.91	(0.075)	3.18	(0.125)
–	–	–	–	[11 holes per cm^2]	([72 holes per in^2])
0.91	(0.036)	1.60	(0.063)	2.77	(0.109)
0.91	(0.036)	1.98	(0.078)	3.18	(0.125)

39.6.4.3 The bottom of the enclosure under areas containing only materials rated V-1 or less flammable shall have openings no larger than 40 mm^2 (1/16 in^2).

39.6.4.4 The enclosure of a product not energized from a Class 2 supply or containing other than Class 2 circuits, shall be of a material and constructed so as to prevent the emission or propagation of flame, molten metal, flaming or flowing particles, or flaming drops originating from the product. The evaluation of fire hazard confinement shall include direct expulsion of material by explosion of a component based on the maximum energy available to the component. Refer to also 54.5, Capacitors. The maximum energy available to a product shall include the energy from an integral or externally located emergency power supply battery.

39.6.4.5 In determining compliance with 39.6.4.4, all elements that contribute to confinement of fire hazard, including enclosures of individual components, shall be considered.

39.6.4.6 An enclosure shall be considered to comply with 39.6.4.4 if it complies with the following tests, as applicable:

a) Section 91, Abnormal Operation Tests;

b) 39.3.1;

c) Section 40, Internal Materials; and

d) 39.6.1 and 39.6.2.

40 Internal Materials

40.1 Polymeric materials used within an enclosure shall be evaluated in accordance with the associated country's standard covering polymeric materials:

a) In Canada only: CSA-C22.2 No. 0.17-00.

b) In the United States only: UL 746C.

Exception: Unrated resistors, capacitors, semiconductors, integrated circuit packages, optical isolators, and similar electrical components meet the intent of the requirement when they are mounted on a material with a minimum flammability rating of V-1.

40.2 All combustible material used within an enclosure shall be V-2, HF-2 or better.

Exception No.1: Motors, relays, capacitors, semiconductors, transformers, switches, insulating tubing or tape, and other electrical elements are exempt from the above requirement when they comply with the flame test applicable to the component. Meter faces and cases (when determined capable for mounting live parts) and indicator lamps or jewels, or both, are exempt from flammability requirements. The following requirements apply to parts that are isolated either by at least 0.5 in (12.5 mm) of air, or a solid barrier of V-1 or less-flammable material from uninsulated electrical parts that involve a risk from electrical energy-high current levels:

a) Gears, cams, belts, bearings, strain-relief bushings applied over PVC jacketed cords, and other small parts that contribute negligible fuel to a fire is not required to be investigated.

b) Tubing for air or fluid systems, and foamed plastics, shall not be more flammable than HB. Foamed plastics classed HBF in accordance with the associated country's standard covering flammability of polymeric materials, are determined as complying with this requirement.

1) In Canada only: CSA-C22.2 No. 0.17-00.

2) In the United States only: UL 94.

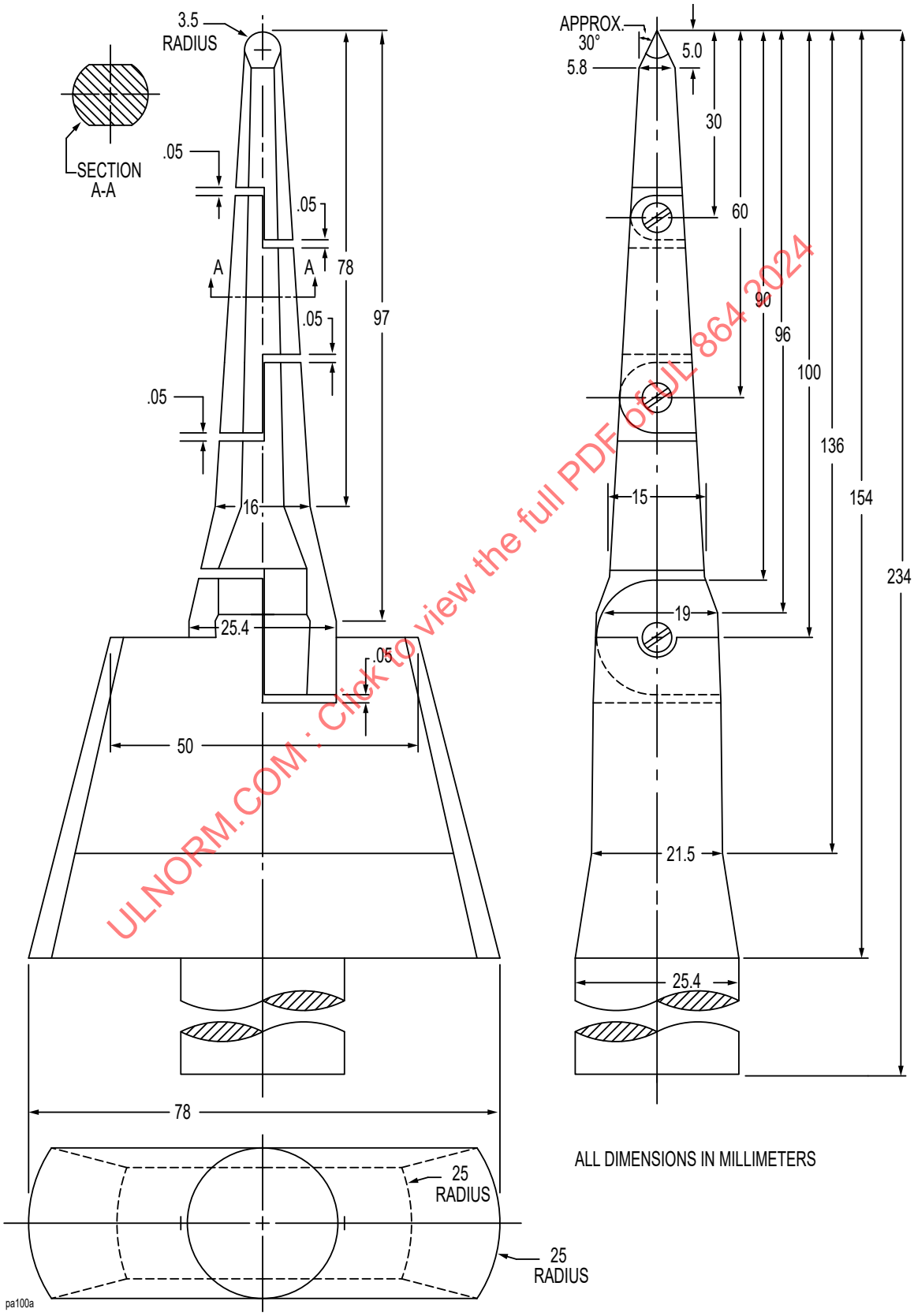
Exception No. 2: Combustible material used within an enclosure is not prohibited from being HB when the power sources to the enclosure meet the criteria for no risk of fire as defined in 5.98.

41 Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts

41.1 To reduce the risk of unintentional contact and electric shock from an uninsulated live part or film-coated wire, and injury to persons from a moving part, an opening in an enclosure shall have a minor dimension less than 25.4 mm (1 in), and such a part or wire shall not be contacted by the probe illustrated in Figure 41.1.

Figure 41.1

Articulate Probe with Web Stop



41.2 The probe illustrated in Figure 41.1 shall be applied to any depth that the opening will permit. The probe shall be rotated or angled before, during, and after insertion through the opening to any position that is required in order to examine the enclosure. The probe illustrated in Figure 41.1 shall be applied in any possible configuration and, when necessary, the configuration shall be changed after insertion through the opening.

41.3 The probe illustrated in Figure 41.1 shall be used as a measuring instrument to evaluate the accessibility provided by an opening, and not as an instrument to evaluate the strength of a material. It shall be applied with the minimum force required to determine accessibility.

41.4 During the examination of a product to determine whether it complies with the requirement in 41.1, a part of the enclosure that is to be opened or removed by the operator without using a tool (to attach an accessory, to make an operating adjustment, or for other reasons) shall be opened or removed.

42 Mechanical Assembly

42.1 All parts of a product shall be mounted in position and prevented from loosening or turning when such motion may adversely affect the performance of the product, or may increase the risk of fire, electric shock, and/or injury to persons incident to the operation of the product.

42.2 A switch, fuseholder, lampholder, attachment-plug receptacle, motor-attachment plug, or other similar component shall be mounted securely and shall not turn.

Exception No. 1: When the turning of a switch is possible, all four of the following conditions shall be met:

a) The switch shall be of a plunger, slide, or other type that does not tend to rotate when operated. A toggle switch is determined to be subject to forces that tend to turn the switch during intended operation of the switch;

b) The means for mounting the switch makes it unlikely that operation of the switch loosens it;

c) The spacings are not reduced below the minimum required values when the switch rotates; and

d) The intended operation of the switch is by mechanical means rather than by direct contact by persons.

Exception No. 2: When rotation does not reduce spacings below the minimum required value, a lampholder of the type in which the lamp cannot be replaced, such as a neon pilot or indicator light in which the lamp is sealed in a nonremovable jewel, complies with the intent of the requirement.

42.3 Friction between surfaces shall not be used for securing the position of the parts specified in 42.2.

42.4 A rotating part that by loosening presents a risk of fire, electric shock, electrical-energy/high-current levels, or injury to persons, shall be assembled so that the direction of rotation tends to tighten the means that hold the rotating part in place.

Exception: A keyed part, a press fit, a part locked in place with a pin, or means that have been determined to be equivalent, can be used to hold a rotating part in place.

42.5 Except as indicated in 42.6 – 42.9, all subassemblies, modules, and printed-wiring boards shall be held in their intended place in the product by mechanical means.

42.6 An adhesive that is relied upon to:

a) reduce a risk of fire, electric shock, or injury to persons,

b) limit access to a manual control, or

c) avert dislodgement of a part/module affecting normal operation of the product shall comply with the requirements for adhesives in UL 746C. The durability shall be representative of a minimum of 30 years of service at the maximum rated prevailing ambient installation temperature.

42.7 The requirement in 42.6 applies to an adhesive used to secure a part, including a nameplate, which may, if loosened or dislodged:

a) Energize an accessible dead metal part,

b) Make a live part accessible,

c) Reduce spacings below the minimum required values,

d) Short-circuit live parts,

e) Make a limited-accessible control accessible, or

f) Affect the normal operation of the product.

42.8 Whether the conditions specified in 42.7 (a) – (f) can occur is to be considered with respect to both:

a) A part inside or outside of the device; and

b) A part on the outside of the device that may affect equipment in which the device is to be installed.

42.9 Parts secured using adhesive are to be installed in the product prior to leaving the factory.

43 Branch-Circuit Connection

43.1 General

43.1.1 Control units and accessories shall be provided with a means for permanent connection to the branch-circuit supply.

Exception: Video display terminals, other operator interface products, and printers installed within a supervising station that may be repositioned for normal use or maintenance.

43.2 Permanently connected

43.2.1 General

43.2.1.1 A product intended for permanent connection to the branch-circuit supply shall have provision for installing the supply conductors in rigid metallic conduit.

Exception: An enclosure without provisions for connection to rigid metallic conduit is acceptable when the installation instructions specifically indicate which sections of the enclosure may be drilled for the connection.

43.2.1.2 A knockout or other supply-connection opening located where temperatures in excess of 60 °C (140 °F) have been measured during the Section 78, Component Temperature Test, and not having qualifying marking as specified in 62.14, shall be sealed by welding or the equivalent or be permanently marked adjacent to the opening with:

a) “Do Not Use”.

b) In Canada only: « Ne pas utilizer ».

43.2.2 Field wiring compartment

43.2.2.1 The location of a terminal box or compartment, in which branch-circuit connections to a permanently-wired product are to be made, shall be such that the connections can be readily inspected without disturbing the wiring or the product after the product has been installed as intended.

43.2.2.2 A terminal compartment intended for connection of a supply raceway shall be attached to the product so that it does not turn.

43.2.2.3 The field-wiring compartment area of a product shall be of sufficient size for completing all wiring connections as specified by the installation wiring diagram.

43.2.2.4 Where damage to field-wiring insulation may be caused by internal components or sharp edges in the wiring compartment, insulating or metal barriers having smooth, rounded edges shall be provided or the following or equivalent wording marked in the wiring area:

a) “CAUTION – When Making Installation, Route Field Wiring Away From Sharp Projections, Corners, and Internal Components”.

b) In Canada only: « Lors de la pose, acheminer le câblage extérieur de manière à éviter les arêtes vives, les coins et les composants internes.»

43.2.2.5 The wiring terminals of a product intended for mounting in an outlet box shall be located or protected so that, upon installation, the wiring in the outlet box is not forced against the terminals or other sharp edges so as to damage the conductor insulation, and/or the terminals or stripped leads do not come into contact with the walls of the outlet box.

43.2.3 Field wiring terminals and leads

43.2.3.1 A permanently connected product shall be provided with wiring terminals or leads for the connection of conductors having an ampacity not less than 125 % of the current input of the product when connected to a power-supply voltage in accordance with 68.4.

43.2.3.2 The free length of a lead inside a terminal box or compartment shall be 150 mm (6 in) or more, provided with strain relief, shall not be smaller than 0.82 mm^2 (18 AWG), and rated for the intended application.

Exception: The lead shall be less than 150 mm (6 in) long when it is evident that the use of a longer lead results in a risk of fire or electric shock.

43.2.3.3 A field-wiring terminal shall be kept from turning or shifting in position by means other than friction between surfaces. This shall be accomplished by two screws or rivets, by square shoulders or mortises, by a dowel pin, lug or offset, by a connecting strap or clip fitted into an adjacent part, or by some other method determined to be the equivalent.

43.2.3.4 A field-wiring terminal shall comply with the requirements in 44.4, Field-Wiring Terminals (General Application), for field-wiring terminals (general application) except a wire-binding screw shall not have a diameter smaller than 4.2 mm (No. 8).

43.2.4 Identified terminals and leads

43.2.4.1 A permanently-connected product rated 125 or 125/250 V (3-wire) or less, and using a lampholder of the Edison screw-shell type, or a single-pole switch or overcurrent protective device other than an automatic control without a marked-off position, shall have one terminal or lead identified for the connection of the grounded conductor of the supply circuit. This terminal or lead shall be electrically connected to screw shells of lampholders and shall not be connected to switches or overcurrent protective devices of the single-pole type other than automatic controls without a marked-off position.

43.2.4.2 A terminal intended for the connection of a grounded supply conductor shall be of or plated with metal that is white in color and shall be distinguishable from the other terminals, or identification of that terminal shall be shown in some other manner, such as on an attached wiring diagram.

43.2.4.3 A lead intended for the connection of a grounded power-supply conductor shall be finished white or gray color and shall be distinguishable from the other leads.

43.2.5 Strain relief

43.2.5.1 A means of strain relief shall be provided for the field supply leads of a product to prevent any mechanical stress from being transmitted to terminals and internal connections. Inward movement of the leads provided with a ring-type strain relief or means determined to be the equivalent shall not damage internal connections or components, or result in a reduction of electrical spacings.

43.2.5.2 Each lead used for field connections or an internal lead subjected to movement or handling during installation and servicing shall be capable of withstanding for 1 min a pull of 4.54 kg (10 lbs) without any evidence of damage or of transmitting the stress to internal connections.

43.3 Cord-connected product

43.3.1 Cord and plugs

43.3.1.1 A product shall be provided with a length of 1.5 – 4.5 m (5 – 15 ft) flexible cord and a grounded attachment plug when intended for connection to a line voltage branch-circuit supply. Refer to Table 43.1 and Table 43.2.

Exception No. 1: A length of flexible cord of Type S, or cord determined to be equivalent, not exceeding 7.5 m (25 ft).

Exception No. 2: The length of the power-supply cord on an appliance intended for a special installation, such as dedicated equipment intended to be mounted near a receptacle may be less.

Exception No. 3: A polarized attachment plug, rather than a grounded attachment plug, when the product has no accessible dead-metal parts likely to be energized.

Exception No. 4: An attachment plug is not required to be polarized or grounded when there are no accessible dead-metal parts likely to be energized and no single-pole devices in primary circuits.

Exception No. 5: Double insulated equipment shall not be grounded.

a) Refer to:

1) In Canada only: CSA C22.2 No. 0.1

2) In the United States only: UL 1097

Table 43.1
Grounding, Polarization, and Double Insulation (DI) Scheme Requirements

Product	Attachment plug
Connected to branch circuit with accessible dead metal	Grounding or insulation scheme of DI
Connected to branch circuit with no accessible dead metal	Grounding, polarization, or insulation scheme of DI
Connected to branch circuit with no accessible dead metal and no single-pole devices in primary circuits	Non-grounding, grounding, polarization, or insulation scheme of DI

Table 43.2
Power Supply Cords

Type of appliance	Type of cord
Table-model products (for use on a table, desk, and the like) that are not frequently moved	SV, SP-2, SP-3
Products that are intended for use on desks, counters, or tables and are moved frequently	SV, SP-2
Hand-held products	TS[a], SV[b]
Floor-mounted products	SJ, S
Wall-mounted products	SV[c], SP-2[c], SP-3[c], SJ, S

[a] A tinsel cord shall be used when all of the following conditions are met:

1) The cord is no longer than 2.4 m (8 ft);

2) The cord is attached to the product directly or by means of a plug intended for that purpose;

3) The product rating is not higher than 50 W; and

4) The intended use of the appliance requires an extremely flexible cord.

[b] Type SV and similar cords shall be used when each conductor is made up of 0.01 mm^2 (36 AWG) strands.

[c] Type SV, SP-2, SP-3, and similar cords shall be used only when the cord is no longer than 1.5 m (5 ft).

43.3.1.2 The flexible cord shall have a voltage rating not less than the rated voltage of the product, and shall have an ampacity that is not less than the current rating of the product.

43.3.1.3 The flexible cord on a cord-connected unit shall be as indicated in Table 43.2 or shall be of a type at least as serviceable for the particular application. Table 43.3 specifies cord types determined to be equivalent to those specified in Table 43.2.

Table 43.3
Equivalent Cords

Basic cord type	Equivalent types
TS	TST
SP-2	SPE-2, SPT-2
SP-3	SPE-3, SPT-3
SV	SVE, SVO, SVOO, SVT, SVTO, SVTOO
SJ	SJE, SJO, SJOO, SJT, SJTO, SJTOO
S	SE, SO, SOO, ST, STO, STOO

43.3.1.4 The current rating of the attachment plug shall not be less than 125 % of the product nameplate rating.

43.3.1.5 The voltage rating of the attachment plug shall correspond to the rated voltage of the product. When a product is intended for use on two or more different values of voltage by field alteration of internal connections, the attachment plug provided with the product shall be rated for the voltage for which the product is wired when shipped from the factory.

43.3.1.6 The flexible cord shall be attached permanently to the product and means shall be provided to physically secure the attachment plug or plug-in transformer to the power receptacle so as to prevent accidental removal.

Exception: For monitors and other operator interface products, a detachable power-supply cord without physical securing means is suitable.

43.3.2 Strain relief

43.3.2.1 A power-supply cord shall be provided with strain-relief means to keep tension on the cord from being transmitted to terminals, splices, or wiring within the product. The strain-relief means provided shall comply with Section 90, Strain-Relief Test.

43.3.2.2 Means shall be provided so that the flexible cord cannot be pushed into the product through the cord entry hole when such displacement results in damage to the cord or exposure of the cord to a temperature higher than that for which the cord is rated or can reduce spacings, such as to a metal strain-relief attachment, below the minimum required values.

43.3.2.3 A metal strain-relief clamp or band (without auxiliary protection) has been determined to be suitable with Type SJ, S, SJT, ST or similar jacketed cords. A metal strain-relief clamp or band has been determined to be suitable with Type SV, SP-2, SPT-2, or SVT cords only when nonconducting auxiliary mechanical protection is provided over the cord.

43.3.2.4 A knot shall not be used to provide strain relief.

43.3.2.5 When tested in accordance with 90.1.1 – 90.1.3, the strain-relief means provided on the flexible cord shall be capable of withstanding for 1 min, a pull of 15.9 kg (35 lbs) applied to the cord, with no evidence of stress on the interior connections.

43.3.3 Bushings

43.3.3.1 At the point at which a supply cord passes through an opening in a wall, barrier, or the overall enclosure, there shall be a bushing or a determined equivalent that shall be secured in place, and shall have a smooth, well-rounded surface against which the cord tends to bear. When other than a jacketed cord is used and the wall or barrier is of metal, an insulation bushing shall be provided.

43.3.3.2 When the cord hole is in porcelain, phenolic composition, or another rated nonconducting material, a smooth, well-rounded surface is determined equivalent to a bushing.

43.3.3.3 Ceramic materials and some molded compositions are capable of being used for insulating bushings.

43.3.3.4 Vulcanized fiber is not prohibited from being used when the bushing is not less than 1.2 mm (3/64 in) thick and is formed and secured in place so that it will not be affected adversely by conditions of ordinary moisture.

43.3.3.5 A separate soft-rubber, neoprene, or polyvinyl chloride bushing shall only be used on a supply cord where the cord enters the frame of a motor or the enclosure of a capacitor that is physically attached to a motor when the bushing is:

a) Not less than 1.2 mm (3/64 in) thick; and

b) Located so that it will not be exposed to oil, grease, oil vapor, or other substances that tend to have a deleterious effect on the compound used.

43.3.3.6 A bushing of any of the materials specified in 43.3.3.5 on a supply cord anywhere in a product is acceptable when it is used in conjunction with a type of cord for which an insulating bushing is not required. The edges of the hole in which such a bushing is used are required to be free from burrs, fins, and other conditions that could damage the bushing.

43.3.3.7 At any point in a product, a bushing of the same material as, and molded integrally with, the supply cord is capable of being used on a Type SP-2 or heavier cord, when the thinnest section is not less than 1.6 mm (1/16 in) thick at the point where the cord passes through the enclosure.

43.3.3.8 An insulated metal grommet to be used in place of an insulating bushing meets the intent of the requirement, when the insulating material used is not thinner than 0.8 mm (1/32 in) and completely fills the space between the grommet and the metal in which the grommet is mounted.

44 Other Field Wiring Connections

44.1 General

44.1.1 A product shall be provided with wiring terminals or leads for the connection of conductors of at least the size required by the associated country's standard covering installation, corresponding to the rating of the circuit.

a) In Canada only: CSA C22.1, Section on Fire Alarm Systems, Smoke Alarms, Carbon Monoxide Alarms, and Fire Pumps.

b) In United States only: NFPA 70.

44.1.2 All field-wiring connections shall be contained in either an enclosed field wiring compartment integral with the product or in a separate outlet box to which the product is to be mounted.

44.1.3 Duplicate terminals or leads, or an equivalent arrangement, shall be provided for circuits of products intended to be connected to initiating-device circuits, notification appliance circuits, or non-addressable signaling line circuits of a control unit; one for each incoming and one for each outgoing wire. It is not prohibited that a common terminal be used in lieu of duplicate terminals when the terminal is intended to prevent the looping of an unbroken wire around or under a terminal screw in a manner that may permit the looped wire to remain unbroken during installation, thereby precluding supervision in the event the wire becomes dislodged from under the terminal. To avoid this potential, a notched clamping plate under a single securing screw, where separate conductors are intended to be inserted in each notch, is an equivalent arrangement. When duplicate terminals or leads are not used and there is no provision to prevent looping an unbroken wire around or under one terminal, the information in 65.15 shall be included in the installation wiring diagram/instructions.

44.2 Field-wiring compartment

44.2.1 There shall be adequate space within a terminal or wiring compartment to permit the use of a standard conduit bushing when a bushing is required for installation.

44.2.2 The field-wiring compartment area of a product to which connections are to be made is to be of sufficient size for completing all wiring connections as specified by the installation wiring diagram.

44.2.3 Where it is possible for damage to field-wiring insulation to be caused by internal components or sharp edges in the wiring compartment, insulating or metal barriers having smooth, rounded edges shall be provided or the following (or wording determined to be the equivalent) marked in the wiring area:

a) “CAUTION – When Making Installation, Route Field Wiring Away From Sharp Projections, Corners And Internal Components.”

b) In Canada only: « MISE EN GARDE – Lors de la pose, acheminer le câblage extérieur de manière à éviter les arêtes vives, les coins et les composants internes. »

44.2.4 The wiring terminals of a product intended for mounting in an outlet or junction type box shall be located or protected so that, upon installation:

a) The wiring in the outlet box is not forced against the product, product’s terminals, or sharp edges so as to damage the conductor insulation or product’s unprotected components, and/or

b) A product with exposed wiring terminals shall be held in its intended mounting location inside the box by mechanical means.

44.2.5 An outlet box or compartment in which field wiring connections are to be made shall be arranged to provide access to the field wiring connections. The removal of screws, or an equivalent arrangement, to view the field wiring connections, is considered to comply with this requirement.

44.3 In the United States Only: Power limited circuits

44.3.1 When the design of the product is such that the product either requires or permits power-limited circuit conductors to occupy the same enclosure as electric light, power, Class 1, or non-power-limited fire-protective signaling-circuit conductors, or medium-power network-powered broadband communications-circuit conductors, both of the conditions in (a) and (b) shall be met:

a) The enclosure shall provide one or more cable openings into the enclosure. When a single opening is provided, a continuous and firmly fixed nonconductor, such as flexible tubing, shall be provided. This is required so that the power-limited conductors are segregated from electric light, power, Class 1 conductors, non-power-limited fire-protective signaling conductors, and medium-power network-powered broadband communications-circuit conductors. The installation document of the product shall completely detail cable entry routing of all conductors into the product.

b) The product shall be constructed so that, with all field-installed wiring connected to the product, either:

1) A minimum 6.4 mm (1/4 in) is provided between all power-limited conductors and all electric light, power, Class 1 conductors, non-power-limited fire-protective signaling conductors, or medium-power network-powered broadband communications-circuit conductors, or

2) For circuit conductors operating at 150 volts or less to ground where the power-limited conductors are installed using Types FPL, FPLR, FPLP, or equivalent cables, a minimum 6.4 mm (1/4 in) separation is provided between these power-limited cable conductors extending beyond the jacket and all electric light, power, Class 1 conductors, non-power-limited fire-protective signaling conductors, and medium-power network-powered broadband communications-circuit conductors. Compliance with this requirement shall be achieved by specific wire routing configurations that are detailed in the installation

document, or when a wire routing scheme will not maintain the required separation, barriers, or nonconductive sleeving shall be used to provide separation.

44.4 Field-wiring terminals (general application)

44.4.1 A field-wiring terminal to which field-wiring connections are made shall comply with the requirements in:

a) In Canada only:

1) 44.4.2 – 44.4.5;

2) CSA C22.2 No. 153;

3) CSA C22.2 No. 65;

4) UL 486E; or

5) CSA C22.2 No. 158, rated for field-wiring (FW) Code 2 applications and also suitable for the voltage, current, wire range, and wire type of the intended application.

b) In the United States only:

1) 44.4.2 – 44.4.5;

2) The field-wiring requirements in UL 310;

3) UL 486A-486B;

4) UL 486E; or

5) UL 1059, rated for field-wiring (FW) Code 2 applications and also suitable for the voltage, current, wire range, and wire type of the intended application.

44.4.2 Nonferrous soldering lugs or solderless (pressure) wire connectors shall be used for 5.3 mm^2 (10 AWG) and larger wires. When the connectors or lugs are secured to a plate, the plate thickness shall not be less than 1.3 mm (0.050 in) thick. Securing screws of plated steel have been determined to meet the requirements.

44.4.3 A wire-binding screw used at a wiring terminal shall not be smaller than 4.2 mm (No. 8) diameter. Plated screws are not prohibited.

Exception: A 3.5 mm (No. 6) diameter screw is appropriate for use for the connection of a 2.1 mm^2 (14 AWG) and a 2.8 mm (No. 4) diameter screw is appropriate for use for the connection of a 0.65 mm^2 (19 AWG) or smaller conductor.

44.4.4 Terminal plates tapped for wire-binding screws shall:

a) Have not less than two full threads in the metal (the terminal plate metal may be extruded to provide the two full threads) and shall have upturned lugs, clamps, or the equivalent, to hold the wires in position. Other constructions may be used if they provide equivalent thread security of the wire-binding screw.

b) Be of a nonferrous metal not less than 1.3 mm (0.050 in) thick when used with a 4.2 mm (No. 8) diameter or larger screw, and not less than 0.76 mm (0.030 in) thick when used with a 3.5 mm (No. 6) diameter or smaller screw.

44.4.5 When two or more conductors are intended to be connected by wrapping under the same screw, a nonferrous intervening metal washer shall be used for each additional conductor. A separator washer is not required when two conductors are separated and intended to be secured under a common clamping plate. When the wires protrude above terminal barriers, the nonferrous separator shall include means, such as upturned tabs or sides, to retain the wire.

44.5 Field wiring terminals (qualified application)

44.5.1 Any of the following terminal configurations are suitable for connection of field wiring when all of the conditions in 44.5.2 are met:

a) Telephone-Type Terminals – Nonferrous terminal plates using a narrow, V-shaped slot for securing of a conductor in a special post design (requires a special tool for wire connection);

b) Solderless Wrapped Terminals – Solderless, wrapped, nonferrous terminals which require a special tool and terminal post design;

c) Quick-Connect Terminals – Nonferrous, quick-connect (push-type) terminals consisting of male posts permanently secured to the device and provided with compatible, female connectors for connection to field wiring. These require a special tool for crimping of field wires. Mating terminals shall be shipped with the control unit with instructions for their installation;

d) Push-In Terminals – Nonferrous (screwless), push-in terminals of the type used on some switches and receptacles. Solid conductors are pushed into slots containing spring-type contacts. The leads are removable by means of a tool inserted to relieve the spring tension on the conductor. Push-in terminals are not to be used with aluminum conductors. The marking adjacent to the terminal shall indicate that copper conductors only are to be used; and

e) Other Terminals – Other terminal connections are not prohibited when determined to be equivalent to (a) − (d) and are limited to the same restrictions.

44.5.2 Any of the terminal configurations listed in 44.5.1 are appropriate for connection of field wiring provided all of the following indicated conditions are met.

a) When a special tool is required for connection, it shall be provided, and its use indicated on the installation wiring diagram by name of the manufacturer and the model number or equivalent.

b) The range of wire sizes shall be indicated on the installation wiring diagram. The minimum permissible wire size to be used shall not be less than 0.13 mm^2 (26 AWG).

c) The wire size to be used shall be rated for the current-carrying capacity of the circuit application.

d) Removal of a lead for testing or routine servicing, including detection, location, and correction of installation wiring faults, is prohibited.

e) A means for testing for an open and a ground fault on the circuit(s) to which the wiring is connected shall be incorporated into the control unit or indicated on the installation wiring diagram.

f) The terminal assembly shall comply with the Section 89, Tests on Special Terminal Assemblies.

44.6 Field-wiring leads

44.6.1 General

44.6.1.1 Leads provided for splice connections shall be minimum 153 mm (6 in) long.

Exception: The free-lead length is not prohibited from being less than 153 mm (6 in) long when it is evident that the use of a longer lead results in damage to the lead insulation or product, or in a risk of fire, electric shock, or injury to persons.

44.6.1.2 A means of strain relief shall be provided for the field wiring leads, and all internally connected wires which are subject to movement in conjunction with the installation, operation, or servicing of a product to prevent any mechanical stress from being transmitted to terminals and internal connections. Inward movement of the leads provided with a ring-type strain relief or means determined to be the equivalent shall not damage internal connections or components, or result in a reduction of electrical spacings.

44.6.1.3 Each lead used for field connections or an internal lead subjected to movement or handling during installation and servicing shall be capable of withstanding for 1 min a pull of 4.54.kg (10 lbs) without any evidence of damage or of transmitting the stress to internal connections.

44.6.2 Hazardous voltage circuits

44.6.2.1 A lead provided for field connection to a hazardous voltage circuit shall not be smaller than 0.82 mm^2 (18 AWG), and rated for the intended application.

44.6.3 In the United States only: Power-limited circuits

44.6.3.1 A lead provided for field connection to a power-limited non-hazardous voltage circuit, shall be no smaller than 0.32 mm^2 (22 AWG), and rated for the intended application.

Exception: Solid copper leads as small as 0.13 mm^2 (26 AWG) are to be used only when:

a) The current does not exceed 1 ampere for lengths up to 61 cm (2 ft) or 0.4 ampere for lengths up to 3.05 m (10 ft);

b) There are two or more conductors and they are covered by a common jacket or the equivalent;

c) The assembled conductors comply with the strain-relief requirement specified in the Section 90, Strain-Relief Test; and

d) The installation instructions indicate that the lead shall not be spliced to a conductor larger than 0.82 mm^2 (18 AWG).

44.7 Cords and plugs

44.7.1 Cords and cord connectors shall not be used for products not intended to be moved or relocated, or where the desirability of the product being readily detachable has not been demonstrated.

44.7.2 Cords and cord connectors shall be rated for the current and voltage used.

45 Internal Wiring

45.1 General

45.1.1 The wiring and connections between parts of a product shall be protected or enclosed, or they shall be in a cord or cable that has been evaluated and determined to be rated for the application.

45.1.2 Internal wiring shall be routed and secured so that the wires and electrical connections are not subjected to stress or mechanical damage.

45.1.3 A hole in a wall within the overall enclosure of a product through which insulated wires pass, shall be provided with a bushing or shall have smooth, rounded surfaces.

45.1.4 Internal wiring shall be evaluated and determined to be rated for the application, with respect to temperature, voltage, ampacity, and exposure to oil, grease, solvents, acids, and other conditions of service to which the wiring is subjected.

45.1.5 When it is possible that internal wiring is to be exposed to moisture, including any condensation resulting from operation of the product, the wiring shall be evaluated and determined to be rated for such exposure.

45.1.6 Vibration, impact, flexing, or other movement of wires during intended use, including user servicing, shall not reduce the wire insulation or the wire termination integrity.

45.1.7 A lead or a cable assembly connected to a part mounted on a hinged cover shall be long enough to permit the full opening of the cover without applying stress to the lead or the connections. The lead shall be secured, or equivalently arranged, to reduce the risks of abrasion of the insulation and jamming of the leads between parts of the enclosure.

45.1.8 Metal clamps and guides used for routing stationary internal wiring shall be provided with smooth, well-rounded edges. Auxiliary nonconducting mechanical protection shall be provided:

a) Under a clamp at which pressure is exerted on a conductor having thermoplastic insulation less than 0.8 mm (1/32 in) thick and no overall braid; and

b) On any wire(s) that is subject to motion.

45.1.9 Wires shall be routed away from sharp edges (such as those found on screw threads, burrs, and fins), moving parts, and similar hazards, which tend to damage the wire insulation.

45.1.10 Insulated wires bunched and passed through a single opening in a metal wall within the enclosure of the product are not prohibited when the other requirements of this standard are met.

45.1.11 Supplementary insulation shall be applied to internal wiring that involves a risk of electric shock and is exposed during user servicing.

45.1.12 Internal wiring of circuits that operate at different potentials shall be separated by barriers or shall be segregated unless the conductors of the circuits of lower voltage are provided with insulation for the highest voltage.

45.1.13 Clamping, routing, or equivalent means that ensures permanent separation may accomplish segregation of insulated conductors.

45.2 Splices and connections

45.2.1 All splices and connections shall be mechanically secure and shall be investigated and determined to provide intended electrical continuity. A soldered connection shall be made mechanically secure before being soldered. Consideration shall be given to vibration when investigating electrical connections. Pressure-wire connectors have been determined to comply with the requirements.

45.2.2 A splice shall be provided with insulation determined to be the equivalent to that of the wires involved when permanence of spacing between the splice and other metal parts is incapable of being maintained.

45.2.3 In determining whether or not splice insulation consisting of coated-fabric, thermoplastic, or another type of tape or tubing complies with the aforementioned requirements, a comparison is to be made of factors such as mechanical strength, dielectric properties, and heat- and moisture-resistant characteristics. Thermoplastic tape wrapped over sharp edges does not comply with the intent of this requirement.

45.2.4 When stranded internal wiring is connected to a wire-binding screw, there shall not be loose strands of wire that contact other uninsulated live parts or dead-metal parts. This shall be accomplished by use of pressure-terminal connectors, soldering lugs, crimped eyelets, soldering all strands of the wire together, or other means that have been determined to be equivalent.

45.3 Connectors and receptacles

45.3.1 A receptacle or connector of the multiple-pin type shall be suitable for the current and voltage to which it is to be subjected.

46 Protective Devices

46.1 A fuseholder, overcurrent protective device (other than an automatic control without a marked off position), the center contact of a screwshell-base lampholder, an interlock, and a manual on-off switch with a marked off position shall be connected to the ungrounded side of the line when used in a hazardous voltage circuit.

46.2 A fuseholder shall be of either the cartridge-enclosed or plug-fuse type. The use of plug fuses is to be limited to equipment rated at not more than 125 or 125/250 volts.

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

46.4 In the United States only: All external circuits intended to be connected to nonpower-limited wire shall contain either current-limiting or overcurrent protection to prevent fault currents in excess of the current rating for the gauge wire size permitted by NFPA 70, or as specified in the installation wiring diagram/instructions. The overcurrent protection provided shall be as specified in Article 240, Overcurrent Protection, NFPA 70. Refer to 72.3.4.

46.5 In Canada only: Overcurrent protective devices shall be of the replaceable or resettable type for connection to field wiring circuits.

Exception: AC Mains field wiring circuits.

46.6 In Canada only: Overcurrent protective devices provided for the protection of control unit equipment and accessories, as well as extended circuits (including circuits interconnecting and supplying control unit accessories) shall be coordinated for the maximum instantaneous and continuous fault currents which may occur. Refer to also requirements for Primary Power Source, 17.7 and 17.8; Section 23, Circuits; 20.5, Sequential Displays; and Section 55, Batteries.

46.7 The operation of an overcurrent protective device shall result in a trouble signal on operation, except for devices protecting trouble signal circuits and circuits performing supplementary functions.

Exception No. 1: Fuses protecting the primary input of smoke control equipment not utilizing a secondary power source.

In the United States only:

Exception No. 2: Either an audible- or visual-only trouble signal at the operator interface is acceptable for mechanisms that are part of the supervising station equipment.

46.8 In Canada only: If an overcurrent protective device is provided in the operating or trouble supply circuit of a control unit (refer to 9.2.7), it shall have a rating not less than 150 % of the maximum instantaneous load current unless a delayed action type overcurrent protective device is used in which case it shall have a rating not less than 150 % of the maximum continuous load current. Refer to also 55.1.6.

47 Current-Carrying Parts

47.1 Except as noted in 47.2, current-carrying parts shall be of silver, copper, a copper alloy, stainless steel, aluminum, or other nonferrous material intended for the application.

47.2 Plated steel meets the intent for some secondary-circuit or primary-circuit parts (such as capacitor terminals) when a glass-to-metal seat is necessary and for leads or threaded studs of semiconductor devices. Blued steel or steel with an equivalent corrosion resistance meets the intent for the current-carrying arms of mechanically or magnetically-operated leaf switches, and within a motor and motor governor including the motor terminals, or when the temperature is in excess of 100 °C (212 °F) during the intended operation.

47.3 Bearings, hinges, and the like shall not be used as current-carrying parts.

48 Spacings

48.1 A product shall provide maintained spacings between uninsulated live parts and the enclosure or dead-metal parts, and between uninsulated live parts of opposite polarity. The spacings shall not be less than those indicated in Table 48.1.

In Canada only:

Exception No. 1: On printed-wiring boards having a flammability classification of V-0 in accordance with the CSA 22.2 No. 0.17, spacings (other than spacings to dead metal traces, between primary and secondary circuits, and at field wiring terminals) are not specified between traces of different potential connected in the same circuit when:

a) The spacings are adequate to comply with the requirements in 91.8, Evaluation of Reduced Spacings on Printed-Wiring Boards; or

b) An analysis of the circuit indicates that no more than 12.5 mA of current is available between short-circuited traces having reduced spacings.

In the United States only:

Exception No. 2: On printed-wiring boards having a flammability classification of V-0 in accordance with UL 94, spacings (other than spacings to dead metal traces, between primary and secondary circuits, and at field wiring terminals) are not specified between traces of different potential connected in the same circuit when:

a) The spacings are adequate to comply with the requirements in 91.8, Evaluation of reduced spacings on printed-wiring boards; or

b) An analysis of the circuit indicates that no more than 12.5 mA of current is available between short-circuited traces having reduced spacings.

Table 48.1
Minimum Spacings

Point of application	Minimum spacings				
	Voltage range	Through air		Over surface	
	V	mm	(in)	mm	(in)
To walls of enclosure:					
Cast metal enclosures	0 – 300	6.4	(1/4)	6.4	(1/4)
Sheet metal enclosures	Power or non-power limited 0 – 50	6.4	(1/4)	6.4	(1/4)
	Power limited 51-300	6.4	(1/4)	6.4	(1/4)
	Non-power limited 51-600	12.7	(1/2)	12.7	(1/2)
Installation wiring terminals:[a]					
With barriers	0 – 30	3.2	(1/8)	4.8	(3/16)
	31 – 150	3.2	(1/8)	6.4	(1/4)
	151 – 300	6.4	(1/4)	9.5	(3/8)
Without barriers	0 – 30	4.8	(3/16)	4.8	(3/16)
	31 – 150	6.4	(1/4)	6.4	(1/4)
	151 – 300	6.4	(1/4)	9.5	(3/8)
Rigidly clamped assemblies:[b]					
Class 2, Power Limited	0 – 30	–	–	–	–
Non Class 2, Power Limited	0 – 30	1.2	(3/64)	1.2	(3/64)
	31 – 150	1.6	(1/16)	1.6	(1/16)
	151 – 300	2.4	(3/32)	2.4	(3/32)
	300 – 600	9.5	(3/8)	12.7	(1/2)
Other parts					
	0 – 30	1.6	(1/16)	3.2	(1/8)
	31 – 150	3.2	(1/8)	6.4	(1/4)
	151 – 300	6.4	(1/4)	9.5	(3/8)
	300 – 600	9.5	(3/8)	12.7	(1/2)

[a] Measurements are to be made with solid wire of adequate ampacity for the applied load connected to each terminal. In no case shall the wire be smaller than 0.82 mm^2 (18 AWG).

[b] Rigidly clamped assemblies include such parts as contact springs on relays or cam switches, printed-wiring boards, and the like.

48.2 The through-air and over-surface spacings at an individual component part are to be determined on the basis of the volt-amperes used and controlled by the individual component. The spacing from one component to another, however, and from any component to the enclosure or to other uninsulated dead metal parts, shall be determined on the basis of the maximum voltage and total volt-ampere rating of all components in the enclosure.

48.3 The spacing requirements in Table 48.1 do not apply to the inherent spacings inside motors, except at wiring terminals, or to the inherent spacings of a component which is provided as part of the control unit. Such spacings are determined on the basis of the requirements for the component. The electrical clearance resulting from the assembly of a component into the complete device, including clearances to dead metal or enclosures, shall be as specified in Table 48.1.

48.4 The “To-walls-of-enclosure” spacings indicated in Table 48.1 are not to be applied to an individual enclosure of a component part within an outer enclosure.

48.5 An insulating liner or barrier of vulcanized fiber, varnished cloth, mica, phenolic composition, or similar material used where spacings would otherwise be insufficient, shall be minimum 0.71 mm (0.028 in) thick; except that a liner or barrier that is minimum 0.33 mm (0.013 in) thick meets the intent when used in conjunction with a minimum of one-half of the through-air spacing required. The liner shall be located so that it will not be affected adversely by arcing.

48.6 Insulating material having a thickness less than that specified in 48.5 meets the intent when it has been determined to have equivalent mechanical and electrical properties.

48.7 Film-coated wire is identified as a bare current-carrying part in determining compliance of a device with the spacing requirements, but the coating is suitable as turn-to-turn insulation in coils.

48.8 The spacings within snap switches, lampholders, and similar wiring devices supplied as part of a unit are determined under other requirements for such devices and is not required to comply with the requirements of Table 48.1. Refer to Section 36.

48.9 The spacings between an uninsulated live part and a wall or cover of a metal enclosure, a fitting for conduit or metal-clad cable, and a metal piece attached to a metal enclosure, where deformation of the enclosure is liable to reduce spacings, shall be:

a) Not less than those indicated in Table 48.1 for parts at potential of 300 V or less; and

b) Not less than twice those indicated in Table 48.1 or parts at potential of more than 300 V.

48.10 If barriers are used to obtain the required spacings, they shall:

a) Comply with Section 49, Insulating Materials;

b) Be not less than 0.71 mm (0.028 in) thick if, without the barrier, the spacings would be less than half those specified;

c) Be not less than 0.33 mm (0.013 in) thick if spacings without the barrier would be not less than half those specified; and

d) Be reliably held in place.

NOTE 1: Adhesives used to hold barriers in place may be subject to investigation to assure adequate life under conditions of normal use.

NOTE 2: Insulating materials having a thickness less than that specified may be used if upon investigation they are found to have mechanical and electrical properties adequate for all conditions of service.

48.11 “Through Air” spacing between parts shall be considered to be the shortest distance measured around any insulating barriers between them, except that any joint in a barrier shall be treated as an air gap in the barrier, unless the joint has been shown to have an effective dielectric strength equivalent to that of the barrier.

48.12 “Over Surface” spacing between parts shall be considered to be the shortest distance measured along the surface of the insulating material between them, provided that the following is not included:

a) The width or depth of a groove in insulating material that is less than 0.79 mm (0.031 in); and

b) The distance measured around an insulating barrier that is not integral with its supporting base and not otherwise jointed to it so that the dielectric strength of the joint is effectively equivalent to that of the barrier.

NOTE: The intent of 48.12(b) is to ensure that barriers that are not part of the base are joined to the base in such a manner that the joint provides equivalent dielectric strength.

48.13 Spacings on printed wiring boards may be less than those indicated in Table 48.1 provided the minimum spacings of Table 48.2 are maintained and a coating in compliance with Section 50, is utilized.

Table 48.2
Minimum Over Surface Spacings on Printed Wiring Boards

Voltage range (V)[b]	Energy available (VA)	Spacing		Coating program
		mm	(in)	
0 – 15	Non-Class 2, Power Limited	0.2	(0.008)	I (50.3)
16 – 30	Non-Class 2, Power Limited	0.4	(0.016)	I (50.3)
31 – 300	Non-Class 2, Power Limited	0.8	(0.031)	II (50.3)

[a] The minimum spacings are required between live parts of opposite polarity. Spacings between live parts and dead metal shall comply with Table 48.1.

[b] RMS volts for sinusoidal waveform. The equivalent peak voltage should be used for non-sinusoidal waveforms.

48.14 The requirements for conformal coating of printed circuit boards specified in 48.13 need not apply if the product withstands the requirements of Section 79, Dielectric Voltage-Withstand Test.

49 Insulating Material

49.1 Uninsulated live parts involving risk of fire, electric shock, or electrical-energy/high-current levels shall be mounted on porcelain, phenolic composition, or other material that has been determined acceptable for the application.

49.2 Vulcanized fiber is not prohibited from being used for insulating bushings, washers, separators, and barriers, but not as the sole support for uninsulated live parts when shrinkage, current leakage, or warp age introduces a risk of fire, electric shock, or injury to persons. Thermoplastic materials used for the direct or indirect support of uninsulated live parts involving a risk of fire, electric shock, or electrical-energy/high-current shall comply with the requirements in the associated country's standard covering polymeric materials;

a) In Canada only: CSA-C22.2 No. 0.17-00.

b) In the United States only: UL 746C.

49.3 Molded parts shall have the mechanical strength and rigidity to withstand the stresses of actual service.

49.4 An insulating liner shall be investigated and determined to be rated for the purpose. Barriers shall be held in place by a means more secure than friction between surfaces. The elasticity of tubing shall not be depended upon to hold the tubing in place. Heat-shrink tubing has been determined to meet this requirement where a sharp edge or point is not involved.

50 Printed-Wiring Boards

50.1 Printed-wiring boards shall be suitable for the application. The securing of components to the board shall be made in the intended manner and the spacings between circuits shall comply with the requirements of Section 48, Spacings. The board shall be reliably mounted so that deflection of the board during installation or servicing shall not result in damage to the board or in developing a risk of fire or electric shock.

50.2 All printed-wiring boards shall have a minimum flammability rating of V-2, rated for direct support of current-carrying parts, and be suitable for the soldering process used.

50.3 Conformal coatings shall be allowed for use on printed wiring boards only when:

a) The acceptability of the combination has been investigated for flammability in accordance with:

1) In Canada only: CSA-C22.2 No. 0.17.

2) In the United States only: UL 94.

b) The dielectric property after environmental, humidity, and thermal conditioning in accordance with:

1) In Canada only: CSA-C22.2 No. 0.17.

2) In the United States only: UL 746E.

50.4 Conformal coatings on printed wiring board shall be removed for the following tests:

a) Section 79, Dielectric Voltage-Withstand Test;

b) Section 81, Variable Ambient Temperature and Humidity Tests; and

c) 91.8, Evaluation of Reduced Spacings on Printed Wiring Boards.

Exception: Conformal coatings shall not to be removed provided that manufacturing is subjected to a quality control program so that uniform quality of the coating process, the coating material and the base material is assured and the separation distances under consideration are effectively protected.

51 End-of-Line Devices

51.1 An end-of-line device shall be constructed as follows:

a) In Canada only: End-of-line devices are considered to be control unit accessories. They shall be constructed so as to be securely fastened with no means to open circuit, short to an adjacent circuit node, or cause a risk of electric shock. Mounting on an outlet box cover with terminals, or an equivalent arrangement, has been determined as complying with the intent of this requirement.

b) In the United States only: Where the circuit in which the end-of-line device is to be connected is intended for connection by conduit or metal-clad cable, the device shall be arranged for mounting inside of a metal box to which such connection can be made. Mounting on an outlet box cover with terminals or leads provided for field connection, or an equivalent arrangement, has been determined as complying with the intent of this requirement.

c) Where the end-of-line device is intended to be installed inside a back box, splice leads, or terminals suitable for making field connections, shall be provided. Splice leads shall have a diameter of not less than 0.82 mm^2 (18 AWG). The exposed live parts of the assembly, except for the connection portion of the terminal, shall be covered with insulating tubing or the equivalent.

d) Where the end-of-line device is intended to be installed inside a product, such as a fire alarm control unit or accessory:

1) Splice leads or terminals suitable for making field connections shall be provided. Splice leads shall have a diameter not less than 0.82 mm^2 (18 AWG). The exposed live parts of the assembly, except for the connection portion of the terminal, shall be covered with insulating tubing or the equivalent; or

2) It shall be provided with terminations compatible with the product's provisions for field wiring connections. When installed per the manufacturer's installation instructions, it shall be securely fastened with no means to open circuit, short to an adjacent circuit node, or cause a risk of electric shock. To avoid damage to the body of the end-of-line device during installation, the device shall be either supplied pre-formed or forming instructions shall be included in the installation instructions.

52 Voltage-Dropping Resistors

52.1 A carbon composition resistor shall not be used as a line voltage-dropping resistor in the supply circuit of a product, where the circuit voltage exceeds 30 Vrms.

53 Coil Windings

53.1 Relays, transformers, and similar devices used in hazardous voltage circuits shall be evaluated and rated for the intended purpose or comply with the applicable requirements for the component (refer to Annex C).

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

53.3 Film-coated wire is not required to have an additional treatment to prevent moisture absorption.

54 Components

54.1 Switches

54.1.1 A switch provided as part of a product shall have a current and voltage rating not less than that of the circuit which it controls when the device is operated under any condition of intended service.

54.2 Lampholders and lamps

54.2.1 Lampholders and lamps shall be rated for the circuit in which they are employed when the product is operated under any condition of intended service.

54.2.2 Except for circuits operating at 30 volts, root-mean-square (rms), 42.4 volts direct current (DC) or 42.4 volts peak, or less, a lampholder shall be installed so that uninsulated live parts other than a screw shell will not be exposed to contact by persons removing or replacing lamps.

54.2.3 The color coding of lamps or equivalent indicators employed as part of a product shall not be the sole means of identifying the function of the indicator.

Exception: Lamps and indicators used by service personnel for diagnostic purposes, provided that they are identified in the product's installation instructions/manual.

54.3 Operating mechanisms

54.3.1 Operating parts, such as light-duty relays and similar devices, shall be protected against fouling by dust or by other material that may adversely affect their intended operation, by individual protection or dust-tight cabinets. A relay employing contacts having a wiping action does not require any special protection against fouling by dust.

54.3.2 The assembly of an operating mechanism included as a part of a control unit or accessory shall be such that it will not be adversely affected by any condition of intended operation.

54.3.3 Moving parts shall have sufficient play at bearing surfaces to prevent binding.

54.3.4 Provision shall be made to prevent adjusting screws and similar adjustable parts from loosening under the conditions of actual use.

54.3.5 Manually-operated parts shall withstand the stresses to which they will be subjected in operation.

54.3.6 An electromechanical device shall be constructed to provide reliable and positive electrical and mechanical performance under all conditions of intended operation.

54.4 Across-the-line components

54.4.1 Components such as capacitors and EMI filters, connected across the hazardous voltage supply circuit of a product, shall be rated for the purpose or comply with the applicable requirements for the component. Refer to Annex C.

54.4.2 A component is considered to be across the hazardous voltage supply circuit when, in a shorted condition, a current of more than 1 ampere passes through it when the product is in any condition where the individual components have reached ultimate operating temperatures. The current through the component can be limited to 1 ampere or less by a fixed impedance or a protective device rated 1 ampere or less.

54.4.3 A capacitor is also considered to be across the-line when it is used under either of the following conditions:

a) For hazardous voltage supply-line bypass in equipment provided with a terminal or connection intended to be grounded; or

b) For antenna blocking or hazardous voltage supply-line bypass in equipment provided with one or more external antenna terminals that may be grounded.

54.5 Capacitors

54.5.1 Opening or shorting of capacitors shall either have no adverse effect on normal operation or be indicated by a trouble signal.

Exception: Where it is not practical to have a component failure indicated, a reliable component shall be used. The reliability of the component may be based on de-rating or on reliability data recorded for the particular component. Suitable sources are:

a) The capacitor derating parameters specified in Table 54.1;

b) MIL-HDBK-338, Military Handbook: Electronic Reliability Design Handbook; and

c) Component reliability data based on actual performance in a similar application, such that the failure rate is equal to or less than 0.5 failures per million hours of operation.

Table 54.1
Capacitor Derating Parameters

Type	Derating Parameter	Derating Level*
Mica, film, glass	Normal operating voltage	60 %
	Temperature from maximum limit	10 °C (50 °F)
Ceramic	Normal operating voltage	60 %
	Temperature from maximum limit	10 °C (50 °F)
Electrolytic aluminum	Normal operating voltage	80 %
	Temperature from maximum limit	20 °C (68 °F)
Electrolytic tantalum	Normal operating voltage	60 %
	Temperature from maximum limit	20 °C (68 °F)
Solid tantalum	Normal operating voltage	60 %
	Maximum operating temperature	85 °C (185 °F)
* % of derated value to the rated normal operating voltage.		

54.5.2 If failure of a capacitor could introduce a fire hazard, the investigation of the product for confinement of fire hazard shall include all possible modes of capacitor failure based on the maximum energy available to the capacitor. Where protection against fire hazards by the enclosure is incomplete (refer to 39.6.4.4 – 39.6.4.6), the capacitor shall comply with the requirements of 54.5.3 – 54.5.5, as applicable.

54.5.3 If an electrolytic capacitor is conductively connected back to a supply through a rectifier, such a capacitor shall comply with the requirements of Section 91, Abnormal Operation Test, if its failure could result in a fire hazard including risk of fire by expulsion of parts through the product openings.

54.5.4 Electrolytic capacitors connected directly across both sides of a supply circuit not energy limited to 100 VA or less, or connected between either side of such a supply circuit and earth ground or exposed metal parts that may be grounded in normal use shall comply with the requirements of 54.4, Across-the-Line Components.

54.5.5 An isolation capacitor connected between an accessible metal part (refer to Section 38, Operating Controls, and Section 57, Servicing Protection) and a part involving shock hazard shall comply with the requirements of 54.4, Across-the-Line Components.

55 Batteries

55.1 Rechargeable storage-type used as secondary power source

55.1.1 A storage battery shall have sealed cells, or cells with spray trap vents, and shall be maintained in the charged state.

55.1.2 Batteries shall be located and mounted so that terminals of cells are prevented contacting terminals of adjacent cells or with metal parts of the battery enclosure as a result of shifting of the batteries.

55.1.3 The mounting arrangement for the batteries shall permit access to the cells for testing and maintenance, or the product shall provide integral meters or readily accessible terminal facilities for the connection of meters for determining battery voltage and charging current.

55.1.4 A conditioning charge shall be limited so that, with the maximum rate of charge that can be obtained, the battery gases do not adversely affect any part of the product. The trickle and fast charge rates of a battery shall not exceed the battery manufacturer's recommended rates.

55.1.5 The battery shall be protected against excessive loading or charging current by a fuse or other overcurrent protective device.

55.1.6 In Canada only: If short circuiting of a battery could result in a hazard to operating or service personnel, the battery shall be protected by an overcurrent protective device having a rating not more than 200 % and not less than 150 % of the maximum rated load.

55.1.7 In Canada only: If short circuiting of a battery could introduce a fire hazard, this condition shall be included in the evaluation of the product for confinement of fire hazards. Refer to 39.6.1 – 39.6.4 Enclosures Openings.

55.1.8 The voltage and ampere-hour capacity rating, and the recharge time of emergency power supply storage batteries shall be suitable for the intended application as detailed in Section 75, Battery Tests.

55.1.9 A compartment for other than permanently sealed type batteries shall be protected against the detrimental action of the electrolyte. Ventilating openings shall be provided and located to permit circulation of air and dispersion of gas while the battery is being charged at the highest rate permitted by the charging circuit. Whenever the adequacy of ventilation is not obvious, the determination shall be made by measurement of gas concentration as described in 39.5, Battery Compartments.

55.1.10 In Canada only: If discharge of an emergency power supply battery beyond its end-of-discharge terminal voltage (determined as described by 74.2.1 would result in damage to the battery or control unit, or would reduce the required battery life, or would result in abnormal operation of the control unit either during the discharge period or on re-energization by the main power supply, the arrangement shall be such that the battery is automatically disconnected from the load prior to such occurrence, and automatically returned to normal on restoration of the main power supply.

55.1.11 If the specified battery maintenance procedure (refer to Section 65, Installation Wiring Diagram/Instructions) involves measurement of conditions (i.e. charging current, float voltage, etc.), the means for such measurements, excluding meters if the required portable meters are specified, shall be integral to the control unit and shall not require disconnection of a circuit unless such action results in a trouble signal. Refer to also Section 57, Servicing Protection, and Section 89, Tests on Special Terminal Assemblies.

55.2 Primary dry-cell batteries

55.2.1 When a battery or set of batteries is used as the main source or the non-rechargeable standby source of power of a product intended for fire signaling, it shall meet the requirements of the Section 75, Battery Tests.

55.2.2 Batteries shall be located and mounted to reduce the risk of terminals of cells coming in contact with uninsulated live parts, terminals or adjacent cells, or metal parts of the enclosure as a result of shifting.

55.2.3 Ready access shall be available to the battery compartment to facilitate battery replacement, without damage to the product components or disassembly of any part of the product, except for a cover or similar parts.

55.2.4 Removal of the product from a mounting support to replace a battery shall be permitted only where the connected wiring is not subjected to flexing or stress and the mounting of the product is supervised.

55.2.5 Lead or terminal connections to batteries shall be identified with the proper polarity (plus or minus signs), and strain relief provided for any leads. The polarity shall be indicated on the product either adjacent to the battery terminals or leads.

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

55.2.7 Each lead of a clip lead assembly used as part of a battery operated product shall be suited for the intended application, shall be minimum 0.21 mm^2 (26 AWG) stranded wire size with minimum 0.4 mm (1/64 in) insulation and provided with strain relief.

55.3 Lithium batteries

55.3.1 A lithium battery(ies) shall comply with the requirements in UL 1642.

55.3.2 A lithium battery shall be protected from abnormal charging currents during use as required in UL 1642.

Exception: A circuit that obtains power solely from a lithium battery (for example, a circuit in which the lithium battery serves as the sole power source as opposed to serving as a secondary power source) is not required to be subjected to the abnormal charging current requirements in UL 1642.

56 Grounding for Products Containing Circuits with Voltages Greater Than 30 Vrms (42.4 Vdc)

56.1 A product which involves circuits with voltages greater than 30 Vrms (42.4 Vdc) shall have provision for the grounding of all exposed dead metal parts that might become energized from circuits involving a risk of electric shock.

Exception: Metal parts as described in (a) – (d):

a) Adhesive-attached metal-foil markings, screws, handles, etc., which are located on the outside of the enclosure and isolated from electrical components or wiring by grounded metal parts so that they are not liable to become energized.

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

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

d) Panels and covers which are insulated from electrical components and wiring by an insulating barrier of vulcanized fiber, varnished cloth, phenolic composition, or similar material that is a minimum of 0.8 mm (1/32 in) thick.

56.2 On fixed equipment, the provision of a knockout or other opening in a metal enclosure for the connection of metal-clad cable, conduit, metal raceway, or the like is permitted as a means for grounding.

56.3 When a product is provided with means for separate connection to more than one power supply, each such connection shall be provided with a means for grounding.

56.4 All dead-metal parts that are accessible during intended use or user servicing, and that are capable of becoming energized from circuits involving a risk of electric shock, shall be connected together and to the grounding means.

Exception: Metal parts as described in the Exception to 56.1.

56.5 The following circuits of fire alarm system circuits shall be bonded to ground under the indicated conditions:

a) Alternating current circuits less than 50 volts:

1) Where supplied by transformers if the transformer supply system exceeds 150 volts to ground.

2) Where supplied by transformers if the transformer supply system is ungrounded.

3) Where installed as overhead conductors outside of buildings.

b) Alternating current circuits of 50 volts and over:

1) Where the system can be so grounded that the maximum voltage to ground on the ungrounded conductors does not exceed 150 volts.

2) Where the system is nominally rated 240/120 volts, 3-phase, 4-wire in which the midpoint of one phase is used as a circuit conductor.

c) Direct-current circuits operating at 51 – 300 volts.

Exception: In the United States only: Power-limited direct-current fire alarm circuits having a maximum current of 0.030 amperes.

56.6 All bonding to ground connections shall be by a positive means, such as by clamping, riveting, brazing, welding, or by being a bolted or screwed connection. The bonding connection shall penetrate nonconductive coatings such as paint. Bonding around a resilient mount shall not rely on the clamping action of rubber or similar material.

56.7 A bolted or screwed connection that incorporates a star washer or serrations under the screw head for penetrating nonconductive coatings is identified as complying with 56.6.

56.8 Where the bonding means depends upon screw threads, the use of two or more screws or two full threads of a single screw engaging metal is in compliance with 56.6.

56.9 A field-wiring terminal intended solely for connection of an equipment-grounding conductor shall be capable of securing a conductor of the size specified in Table 56.1.

Table 56.1
Bonding Wire Conductor Size

Rating of overcurrent device amp	Size of bonding conductor[a]			
	Copper wire		Aluminum wire	
	mm^2	(AWG)	mm^2	(AWG)
15	2.1	(14)	3.3	(12)
20	3.3	(12)	5.3	(10)
30	5.3	(10)	8.4	(8)
40	5.3	(10)	8.4	(8)
60	5.3	(10)	8.4	(8)
100	8.4	(8)	13.3	(6)
200	13.3	(6)	21.2	(4)

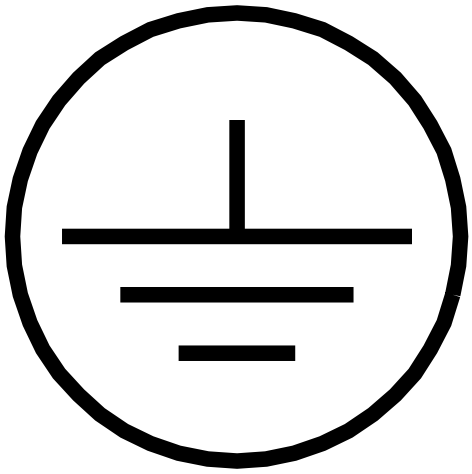
[a] Or equivalent cross-sectional area.

56.10 The size of a copper or aluminum conductor used to bond an electrical enclosure shall be based on the rating of the branch-circuit overcurrent device by which the equipment will be protected. The size of the conductor shall be in accordance with Table 56.1.

56.11 Splices shall not be used in wire conductors used for bonding.

56.12 A wire-binding screw or a pressure wire connector intended for the connection of an equipment-grounding conductor shall have a green-colored head or shall be plainly identified as such by being marked “G,” “GR,” “GND,” “Ground,” “Grounding,” or the like, or with the Symbol 5019 graphic from IEC Publication 60417-1 shown in Figure 56.1 or by a marking on the wiring diagram provided on the product. The wire-binding screw or pressure wire connector shall be located so that it is not able to be removed during intended servicing of the product. When used alone, the Symbol 5019 graphic from IEC 60417-1 shall be defined in the installation instructions provided with the equipment.

Figure 56.1
International Electrical Symbol



56.13 The surface of an insulated lead intended solely for the connection of an equipment-grounding conductor shall be green with or without one or more yellow stripes, and no other lead shall be so identified.

56.14 The grounding conductor in a flexible cord shall be green with or without one or more yellow stripes. The grounding conductor shall be secured to the frame or enclosure of the product by means of a screw, rivet, or similar equipment that is not removable during intended servicing not involving the supply cord. Solder shall not be used alone for securing the grounding conductor. The grounding conductor shall be connected to the grounding terminal of an attachment plug.

56.15 When a means for grounding is provided on the product, even though it is not required, it shall comply with the requirements in 56.1 – 56.14.

56.16 Metal-to-metal hinge-bearing members for doors or covers are considered to meet the requirement for bonding the door or cover to ground, when a multiple bearing pin type (piano-type hinge) is used.

Exception: Slip-joint or similar, hinge-bearing members are not required to comply with this requirement when the resistance between the two parts connected by the bonding element is not more than 0.1 Ω. The resistance shall be determined by a resistance-measuring instrument. When unacceptable results are recorded, an alternating or direct current of at least 20 amperes from a power supply of not more than 12 volts shall be passed between the two parts connected by the bonding element. The resulting drop in potential and the test current shall be measured between the two points. The resistance in Ω shall be determined by dividing the drop in potential in volts by the current in amperes.

57 Servicing Protection

57.1 General

57.1.1 Uninsulated live parts of hazardous voltage circuits, hazardous moving parts, sharp corners and projections shall be formed, located, guarded, or enclosed so as to prevent contact by persons during servicing such as relamping, fuse or rod replacement, battery replacement, adjusting controls, and routine maintenance.

57.2 Trained service personnel

57.2.1 When the linear distance from a component requiring servicing or an operating switch and any uninsulated current-carrying parts of hazardous voltage circuits is less than 152 mm (6 in), then protection by properly applied insulating tape, barriers, or equivalent, shall be provided.

Exception: Products complying with the Electric Shock Current Test, Section 80.

57.2.2 Insulating barriers, or equivalent required by 57.1 shall be permanently and prominently marked with the cautionary marking;

a) “CAUTION – Hazardous voltage” or equivalent.

b) In Canada only: « MISE EN GARDE: Tension dangereuse » .

57.2.3 In lieu of the minimum 152 mm (6 in) requirement only for serviceable components, the product shall comply with one of the following:

a) An interlock shall be provided on the cover to de-energize all live parts in the enclosure; or

b) The following permanent and prominent marking shall be provided on the cover front:

1) “CAUTION – De-Energize Unit Prior To Servicing.”

2) In Canada only: « MISE EN GARDE : Mettre l’unité hors tension avant l’entretient ».

57.2.4 Uninsulated live parts or moving parts involving a risk of injury shall be located, guarded, or enclosed so as to reduce the risk of contact by persons during servicing conditions such as relamping, changing fuses, adjusting controls, and operating switches.

57.2.5 The means of access to a compartment containing live parts at hazardous potential not intended to be serviced with the equipment energized shall be marked in accordance with 57.2.3. Any removable barrier or guard provided to shield a live part at hazardous potential shall be marked in accordance with 62.28. A removable cover, guard or shield providing access to components connected to a voltage supply that is over 2500 V (peak) shall be hinged, chained or otherwise permanently attached, or shall be provided with an interlock in accordance with 57.2.6.

57.2.6 An interlock that is relied on for protection from electric shock shall be arranged so that:

a) It cannot be reset inadvertently;

b) If it can be actuated intentionally so as to restore power to the de-energized parts, the re-closing or replacement of the cover, door, panel or grille will automatically restore the interlock to a position in which it will perform as intended when the cover, door, panel or grille is next opened or removed; and

c) A trouble signal will result when the interlock operates.

57.2.7 Provision shall be made for the automatic discharge of the energy stored in capacitors if the safety of an area to which service personnel have access is dependent upon de-energizing the equipment, unless the equipment is marked with a clear instruction specifying the time required for discharge to a potential less than 30 V (rms) or 42.4 V (peak) if the time for self-discharge to this value is greater than 5 s.

58 Antenna Terminal Discharge Assembly

58.1 Each terminal provided for the connection of an external antenna shall be conductively connected to the supply circuit grounded conductor. The conductive connection shall have a maximum resistance of 5.2 megohms, a minimum wattage rating of 1/2 watt, and shall be effective with the power switch in either the on or off position.

Exception No. 1: The conductive connection need not be provided when:

a) Such a connection is established in the event of electrical breakdown of the antenna isolating means;

b) The breakdown does not result in a risk of electric shock; and

c) In a construction using an isolating power transformer, the resistance of the conductive connection between the supply circuit and chassis does not exceed 5.2 megohms.

Exception No. 2: A component comprised of a capacitor with a built-in shunt resistor that complies with the requirements for antenna-isolating capacitors is to be rated a minimum of 1/4 watt.

58.2 The maximum value of 5.2 megohms specified in 58.1 is to include the maximum tolerance of the resistor value used; that is, a resistor rated 4.2 megohms with 20 % tolerance or a resistor rated 4.7 megohms with a 10 % tolerance.

59 Protection Against Injury to Persons

59.1 General

59.1.1 When the operation and maintenance of a product by the user involves a risk of injury to persons, protection shall be provided to reduce the risk.

59.1.2 When investigating a product with regard to 59.1.1, determination shall be given to foreseeable misuse of the product.

59.1.3 An accessory that is made available or recommended by the manufacturer for use with the basic product shall be included in the evaluation of the product.

59.1.4 The suitability of a guard, a safety release, an interlock and similar devices, and whether such a device is required, is to be determined from an investigation of the complete product, its operating characteristics, and the risk of injury to persons. The investigation is to include evaluation of the results of breakdown or malfunction of any one component, but not more than one component at a time, unless one event contributes to another. When the investigation shows that breakdown or malfunction of a component results in a risk of injury to persons, the component shall be investigated for reliability.

59.1.5 A risk of injury to persons is possible when one or more of the following conditions exist:

a) Power-operated moving parts such as gears and linkages are accessible during intended operation or maintenance and are capable of causing a cut or laceration.

b) Sharp edges, burrs, or projections are present during use or servicing.

c) The stability of a product is such that it is capable of causing injury to persons (refer to Stability, 59.4).

d) There is a possibility that a part of the body is endangered or that clothing is capable of being entangled by a moving part.

59.2 Telescoping antenna

59.2.1 A telescoping type antenna terminating in an end that is capable of constituting a risk of puncture shall be provided with a minimum 6 mm (0.231 in) diameter button or ball on the end that complies with the Antenna End-Piece Secureness Test, Section 100.

59.3 Sharp edges

59.3.1 An enclosure, edge, frame, projection, guard, opening, handle, or similar construction shall be smooth and free from sharp edges that are capable of injury to persons during intended maintenance and use.

Exception: A sharp edge that must be exposed to enable the product to perform its intended function.

59.3.2 For edges where the degree of sharpness cannot be determined by inspection, compliance with 59.3.1 is determined by the test procedure in UL 1439.

59.4 Stability

59.4.1 Under all conditions of servicing and intended use, a fully assembled product shall not become physically unstable to the degree that creates a risk of injury to operators or service personnel.

59.4.2 A product shall not tip over when tilted 10° from its intended, upright position, while all doors, covers, gates, drawers, and similar parts are in place and closed, and all casters and jacks, when provided, are in their most unfavorable position.

Exception: For fixed or stationary equipment without casters where specialized handling is required to transport the product, this test is to be performed after the equipment is installed as intended.

59.4.3 The requirements in 59.4.4 – 59.4.8 apply to all freestanding products. A freestanding product is defined as one that is floor standing and not intended to be secured to other units or to the floor or other parts of the building.

59.4.4 In conducting the tests described in 59.4.5 – 59.4.7, the equipment shall be installed as intended. All casters and jacks, when provided, are to be placed in their most unfavorable positions, and wheels are to be locked or blocked. However, when casters are being used only to transport the product, and jacks are lowered after installation, then the jacks (and not the casters) are to be used in their most unfavorable position for the test, consistent with reasonable leveling of the product.

59.4.5 A freestanding product that has an external surface (work top or ledge) at a height not exceeding 1.00 m (39 3/8 in) from the floor and that is prone to being stepped on or sat upon, shall not tip over when a continuous downward force of 800 N (179.8 lbf) is applied to that surface at the point of maximum moment. For this test, all doors, covers, gates, drawers, and similar parts shall be in place and closed.

59.4.6 With regard to the requirement in 59.4.5, delicate parts such as keyboards, control panels, or spools are not determined as prone to being stepped on or sat upon.

59.4.7 A freestanding product more than 1.00 m (39 3/8 in) high and weighing more than 25.0 kg (55.1 lbs) shall not tip over when a force equal to 1/5 the weight of the unit but not more than 250 N (56.2 lbf) is applied in any direction, except upward, at a height not exceeding 2.00 m (78-3/4 in) from the floor. For this test, all doors, drawers, frames, and the like that can be opened for operator or serviceman servicing are to be opened and in the most unfavorable position. Separate tasks are to be performed when operator and service extensions are different or when special stabilizers are used in accordance with 59.4.8.

59.4.8 A stabilizing means is not prohibited from being used to improve stability when doors, drawers, and the like are opened. The stabilizing means shall be automatic in operation or interlocked when associated with user use. For service personnel, where it is not automatic in operation, a conspicuous marking shall be provided to caution the personnel on its use. Refer to 62.24.

60 Corrosion Protection

60.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other means that have been determined to be equivalent, when corrosion of unprotected parts results in a risk of fire, electric shock, injury to persons, or impairment of operation of a product.

Exception No. 1: Surfaces of sheet-steel and cast-iron parts within an enclosure are not required to be protected against corrosion when oxidation of the metal due to exposure to air and moisture is not likely to weaken the parts to result in a condition of risk. The thickness of metal and temperature are also to be evaluated.

Exception No. 2: Bearings, laminations, or minor parts of iron or steel, such as washers, screws, and similar equipment, are not required to be protected against corrosion.

61 Location Considerations

61.1 Products intended for use in either indoor/wet or outdoor/wet or damp installations shall be subjected to the tests indicated in 82.2.1.1 – 82.4.7, and 91.5 with the intended product installed, unless indicated otherwise.

61.2 The internal temperature of a product that requires a heater and/or an air conditioner to comply with the tests indicated in 82.2.1.1 – 82.4.7 with the intended product installed shall be monitored by the premises fire alarm system and a specific fault shall be indicated when the temperature limits are exceeded.

61.3 Except as indicated in 61.4, holes for conduit for outdoor use enclosures shall be threaded unless the holes are located below the lowest termination point or other live part within the enclosure.

61.4 If knockouts or unthreaded holes are provided, there shall be provision for drainage of the enclosure.

61.5 Products intended for outdoor use, shall be marked to indicate the rated ambient air temperature. Refer to 62.7 and 62.8.

61.6 Failure of components associated with controlling the environment within an enclosure, such as a cooling fan motor, which would result in product temperatures exceeding those in Table 78.1 and Table 78.2 shall be indicated by an audible trouble signal.

Exception: Either an audible- or visual-only trouble signal at the operator interface is acceptable for mechanisms that are part of the supervising station equipment.

MARKINGS

62 General

62.1 A product shall be plainly and permanently marked where it will be visible after installation with the following information:

a) Name or trademark (registered) of manufacturer.

b) Model number or other designation method determined to be equivalent.

c) Electrical ratings, in volts, amperes, or watts, and frequency for a cord-connected product.

d) Use of the product. For a control unit, this shall consist of the word commercial followed by protected-premises control unit or supervising-station control unit. For products other than a control unit, this shall consist of a specific use description such as annunciator, DACT interface, monitor module, end-of-line device, or other appropriate wording. In addition, separately shipped parts or components of a complete product shall be identified as a subassembly.

e) For a control unit, the type of fire alarm system supported by the product, such as local, local with shunt-type connection to master box, auxiliary, remote station (protected premises unit), remote station (receiving unit), proprietary (protected-premises unit), proprietary (receiving unit), central station (protected-premises unit), central station (receiving unit) releasing, marine, emergency communication, relocation, or smoke control.

f) In the United States only: Reference to the applicable National Fire Protection Association Installation Standard for each type of control unit, such as NFPA 12, NFPA 12A, NFPA 13, NFPA 15, NFPA 16, NFPA 17, NFPA 17A, NFPA 92, NFPA 2001, NFPA 2010, and/or NFPA 72.

g) For a control unit, the type of fire alarm signals intended to be processed by the product (such as manual fire alarm, automatic fire alarm, supervisory, water flow alarm).

h) Type of signaling for the control unit; coded and/or non-coded, reverse polarity, multiplex, digital alarm communicator, radio frequency (RF), etc.

i) Each light, switch, meter, and similar part shall be marked adjacent to the component to indicate the intended function.

j) Reference to an installation wiring diagram, when not attached to the unit, by drawing number and issue date and/or revision level.

k) The identification of primary batteries for low-power radio transmitters by part number or manufacturer model number, located adjacent to the component.

l) For a primary battery-operated, low-powered radio transmitter, the following marking shall be included on the unit:

1) “WARNING”

2) In Canada only: « AVERTISSEMENT »

m) For a primary battery-operated, low-powered radio transmitter, the following marking shall be included on the unit:

1) “Use Only Batteries Specified in Marking. Use of a Different Battery May Have A Detrimental Effect On Product Operation.”

2) In Canada only: « Utilisez uniquement les piles spécifiées dans le marquage. L'utilisation d'une batterie différente peut avoir un effet néfaste sur le fonctionnement du produit. »

n) Compatibility identifier, consistent with 65.20(f), for products that provide initiating circuits intended to be used with two-wire smoke detectors.

62.2 Unless the correct wiring connections are evident, installation wiring terminals or wire leads shall be marked to indicate the connections. When connections are not indicated on the unit, the terminals or leads shall be numbered, colored, or otherwise indicated, and markings on the unit shall correlate with the installation wiring diagram/instructions.

62.3 Marking on the product shall specifically identify all power-limited circuits by terminal designation.

Exception: When the product is of a modular construction and compliance with 62.3 cannot be achieved or would be inappropriate, marking on the product shall identify all modules and the associated circuits that are power-limited.

62.4 Identification of the executive software release level resident in the product as required by 7.4.

62.5 A unit intended for permanent connection to a wiring system other than a metal-enclosed system shall be marked to indicate the system(s) for which it is intended. The marking shall be located so that it will be visible when power connections are being made to the unit.

62.6 When a manufacturer produces product model at more than one factory, each unit shall have a distinctive marking to identify it as the product of a particular factory.

62.7 A product shall be marked for its intended installation environment (indoor or outdoor) and location (dry, damp, or wet).

62.8 Products intended for installation in ambients constantly more than 25 °C (77 °F) or intended for outdoor use, shall be marked to indicate the rated ambient air temperature.

62.9 There shall be legible and durable marking for each replaceable fuse indicating the ampere rating (and voltage rating when more than 125 volts) of the fuse to be used for replacement. The marking shall be located so that it is obvious which fuse or fuseholder is referenced.

62.10 The following marking shall be included on a control unit, separate module, or interface which incorporates an alarm verification feature. The markings shall consist of the following or equivalent wording:

a) “WARNING”

b) “THIS UNIT INCLUDES AN ALARM VERIFICATION FEATURE THAT WILL RESULT IN A DELAY OF THE SYSTEM ALARM SIGNAL FROM THE INDICATED CIRCUITS. THE TOTAL DELAY (CONTROL UNIT PLUS SMOKE DETECTORS) SHALL NOT EXCEED 60 SECONDS. NO OTHER SMOKE DETECTOR SHALL BE CONNECTED TO THESE CIRCUITS UNLESS APPROVED BY THE LOCAL AUTHORITY HAVING JURISDICTION.”

Circuit (zone)	Control unit delay, s	Smoke detector	
		Model	Delay, s
			See note (a)

[a] Include detector data or the following or equivalent statement: “The delay (power-up/start-up) time marked on the installation wiring diagram of the smoke detector or on the installed smoke detector(s) is to be used.”

c) In Canada only: « AVERTISSEMENT: CE POSTE EST MUNI D’UNE FONCTION DE VÉRIFICATION D’ALARME QUI ENTRÎNER UN RETARD DU SIGNAL DU SYSTÈME D’ALARME DANS LES CIRCUITS INDIQUÉS. LE RETARD TOTAL (POSTE DE CONTRÔLE PLUS LES DÉTECTEURS DE FUMÉE) NE DOIT PAS DÉPASSER 60 SECONDES. AUCUN AUTRE DÉTECTEUR DE FUMÉE NE PEUT ÊTRE RELIÉ À CES CIRCUITS (ZONES) SAUF SUR APPROBATION DE L’AUTOITÉ COMPÉTENTE LOCALE. »

Circuit (zone)	Retard du poste de controle (s)	Détecteur de fumée	
		Modéle	Retard, en secondes
			Se reporter à la remarque

REMARQUE : Inclure les données du détecteur. Utiliser le temps de retard (mis sous tension/démarrage) indiqué sur le schéma de câblage de l’installation du détecteur de fumée ou sur le ou les détecteurs de fumée installés.

62.11 The subassemblies of a product, intended to be shipped separate from the product, shall be marked with the name or trademark of the manufacturer, model number or other designation determined to be equivalent, and reference to the installation wiring diagram by drawing number and issue date and/or revision level if not attached to the subassembly. When the product completely consists of subassemblies that are to be shipped separately, a minimum of one of the subassemblies that will be used in each product configuration shall be marked with the information required by 62.1 (c) – (h) and (m), 62.7, and 62.8.

62.12 The marking on an end-of-line device shall include the name or trademark of the manufacturer and model number. This marking is not prohibited from being on a tag secured to the device.

62.13 Accessories other than the end-of-line devices shall be marked with the name or trademark of the manufacturer, model number, electrical rating in volts, amperes or watts, and frequency for a cord-connected product, and reference to the installation wiring diagram when not attached to the product.

62.14 When, during the temperature test, the temperature on a lead intended to be field installed or on a surface of the wiring compartment which the lead might contact is more than the 60 °C (140 °F), the product shall be marked with the following statement or the equivalent, at or near the points where field connections will be made and located so that it will be readily visible during installation. “For Field Connections, Use Wires Suitable For At Least __°C (__°F).” The temperature value to be used in the preceding statement shall be in accordance with Table 62.1.

Table 62.1
Temperature for Marking

Temperature attained in terminal box or compartment		Temperature in marking	
°C	(°F)	°C	(°F)
61 – 75	(142 – 167)	75	(167)
76 – 90	(168 – 194)	90	(194)

62.15 In accordance with the Exception to 96.1, cord-connected products provided with an electromagnetic radiation suppression filter and having a leakage current in excess of 0.5 or 0.75 milliamperes (whichever applies) but less than 2.5 milliamperes, shall be marked with the following:

a) “WARNING”

b) “To reduce the risk of electric shock, this product is provided with a grounding type power supply cord. Connect product to a grounded receptacle.”

c) In Canada Only:

1) « AVERTISSEMENT »

2) « Pour réduire les risques de choc électrique, ce produit est pourvu d'un cordon d'alimentation avec mise à la terre. Branchez le produit à une prise mise à la terre. »

62.16 When the construction of a unit is such that replacing lamps or fuses or resetting circuit breakers may expose persons to the risk or unintentional contact with normally enclosed hazardous voltage parts, the unit shall be marked to indicate plainly that such servicing is to be performed only while the unit is electrically disconnected from the branch-circuit supply. The marking shall be adjacent to every door or cover that requires opening before exposing the hazardous voltage parts.

62.17 With reference to the requirement in 39.4.3, a cover shall be marked with the following or equivalent: “Circuit fuses inside only – contact service representative for replacement or repair.” The marking shall be located on or adjacent to the cover.

62.18 When the construction of a unit is such that improper routing of field wiring will expose wire insulation to rough or sharp edges or subject internal components to damage, a marking shall be provided in the wiring area to indicate plainly that wiring is to be routed away from sharp projections, corners, and internal components.

62.19 Field-wiring terminal connections to which permanent leads are connected, such as those not intended to be removed for testing or servicing, shall be marked adjacent to the terminals.

62.20 A product whose surface temperatures exceed the limit specified in Table 78.2 shall be marked with the following:

a) “CAUTION”

b) “Hot Surface – Avoid Contact.”

1) The marking shall be located on or adjacent to the surface in question.

c) In Canada only:

1) « MISE EN GARDE »

2) « Surface chaude – éviter tout contact. »

62.21 A product tested using the manufacturer’s instructions for voltage adjustment as indicated in the Exception to 78.6 shall be provided with a marking, as follows:

a) Adjacent to the cord or supply compartment, to warn the user that internal adjustments must be made when the product is installed or moved; and

b) Showing the adjustments that must be made for various voltages.

62.22 The marking shall either be on the outside or inside of the overall enclosure of the product where visible at the points of adjustment.

62.23 When push-in terminals are used, the following shall be marked adjacent to the terminals: “Do Not Use Aluminum Conductors”.

62.24 A product requiring a stabilizing means as specified in 59.4.8 shall be marked with the following or a statement determined to be equivalent, and the marking shall be located where it is visible to service personnel:

a) “CAUTION – To reduce risk of possible injury due to instability, actuate stabilizer before the drawer, gate, or similar part is extended;” and

b) In Canada only : « MISE EN GARDE – pour réduire le risque de blessure en cas d’instabilité, actionner le stabilisateur avant d’ouvrir le tiroir, le portail ou élément semblable. »

62.25 A cautionary marking shall comply with all of the following requirements:

a) The marking shall be permanently attached.

b) The marking shall not be attached to parts removable by hand.

c) The marking shall not be attached to parts likely to be replaced during maintenance or servicing.

Exception: The requirement in (c) is not applicable when the marking is integral with the replacement part.

d) The marking shall have lettering that complies with the following requirements:

1) The cautionary signal word (such as “DANGER”, “WARNING”, or “CAUTION”) shall be in letters not less than 2.8 mm (7/64 in) high.

2) The other words shall be in letters not less than 2.4 mm (3/32 in) high and contrasting in color to the background.

3) When molded or stamped in a material not having a contrasting background color, the letters shall have a height of not less than 2.8 mm (7/64 in) and a raised (or lowered) depth of not less than 0.51 mm (0.020 in).

62.26 The removal or opening of an enclosure cover or the removal of not more than one mounting screw, or an equivalent arrangement to view the marking, is determined as complying with the requirement regarding visibility after installation.

62.27 In Canada only: Abbreviations and symbols shall be in accordance with CSA-Z234.1, Metric Practice Guide, and ANSI Y32.9, Standard for Graphic Symbols for Electrical Wiring and Layout Diagrams Used in Architecture and Building Construction.

62.28 A removable barrier or guard provided to protect against contact with live parts at hazardous potential shall be marked with the following warning:

a) “WARNING: ELECTRICAL SHOCK HAZARD”; and

b) In Canada only : « AVERTISSEMENT: RISQUE DE CHOC ELECTRIQUE »; or

c) “WARNING: ELECTRICAL SHOCK HAZARD FROM MULTIPLE SOURCES”; and

d) In Canada only : « AVERTISSEMENT: RISQUE DE CHOC ÉLECTRIQUE DE MULTIPLES SOURCES ».

62.29 In Canada only: Control units, transponders, display and control centres and annunciators shall be marked with the following statement:

a) “WARNING: RADIO FREQUENCY FROM TRANSMITTING DEVICES MAY IMPAIR INTENDED OPERATION OF THE CONTROL UNIT. MAINTAIN A MINIMUM OF 30 CM BETWEEN TRANSMITTING DEVICES AND CONTROL UNIT.”; and

b) « AVERTISSEMENT : LES RADIOFRÉQUENCES ÉMISES PAR LES DISPOSITIFS DE TRANSMISSION PEUVENT NUIRE AU FONCTIONNEMENT PRÉVU DU POSTE DE CONTRÔLE. MAINTENIR UNE DISTANCE D’AU MOINS 30 CM ENTRE LES DISPOSITIFS DE TRANSMISSION ET LE POSTE DE CONTRÔLE. »

62.30 The marking shall be located where it is visible to the operator after accessing the operating controls.

62.31 In Canada only: A “Caution” or “Warning” notice shall be provided in both English and French languages in situations where hazards such as electric shock could cause personal injury, or where identified as required elsewhere in this Standard. Symbols used in lieu of, or in combination with, label designation text shall be in accordance with 62.27.

62.32 In Canada only: Fire Alarm Control Units shall be marked with instructions on a permanently affixed label, clearly visible to personnel servicing or testing the equipment, describing the procedure to obtain the Field Detection Device Activity Report and the minimum equipment required. These instructions shall include:

a) A reference to the appropriate section or page of the FACU Installation and Operation instructions which describes the procedure, and/or

b) The step-by-step procedure to harvest the information from the FACU.

NOTE: A "clearly visible" label may be conspicuously located on the inside of the dead front or access door and would not be required to be affixed to the outside of the FACU access door.

63 In Canada Only: Replacement Parts

63.1 Replacement parts that do not comply with the current edition of this Standard shall be manufactured in accordance with the editions of this Standard that they were previously in compliance with and shall be marked with the following:

“For Replacement Only – Complies with ULC 527-xx” (where xx represents the edition of the Standard that they were previously in compliance with)

64 Permanence of Marking

64.1 Markings that are affixed to the outside of a unit, or are cautionary and located inside a unit, shall be sufficiently durable as to resist the deleterious effects of handling, cleaning agents, and similar action, anticipated in the intended use.

64.2 A marking that is required to be permanent shall be molded, die-stamped, paint-stenciled, stamped or etched metal that is permanently secured, indelibly stamped lettering on a pressure-sensitive label secured by adhesive that, upon investigation, is determined to be acceptable for the application. Ordinary usage, handling, storage, and similar usage of a product are to be considered in the determination of the permanence of a marking.

64.3 Adhesive labels shall comply with the requirements of:

a) In Canada only: CSA C22.2 No. 0.15.

b) In the United States only: UL 969.

INSTRUCTIONS

65 Installation Wiring Diagram / Instructions

65.1 An installation wiring diagram shall be provided with each product (other than an end-of-line device) illustrating the field-connections to be made. The drawing shall be attached to the unit or, when separate, shall be referenced in the marking attached to the unit by the name or trademark of the manufacturer, drawing number, and issue date and/or revision level. When separate, a copy shall be supplied with each individual product or with each single shipment when multiples of the same products are shipped directly to an end customer in a single shipment.

65.2 The information referenced in 65.1 and containing the details required in 65.6 – 65.17 shall be made available by one or more of the following means:

a) Marking attached to the product;

b) Separate printed instructions;

c) Electronic instructions within the basic product software; and

d) Electronic media such as CD-ROM, thumb drive, website, etc. or equivalent.

65.3 When the installation information is provided as described in 65.2 (b), (c), and/or (d), it shall be referenced in the product marking by:

a) Name of trademark of manufacturer;

b) Drawing number, <URL address>, and/or the equivalent identification; and

c) Issue date, revision level, and/or release date.

65.4 The drawing shall show the installation terminals or leads to which field connections are to be made as they would appear when viewed during an installation. The terminal numbers on the unit shall agree with the numbers on the drawing.

65.5 The information specified in 65.6 – 65.13 shall be included in the installation wiring diagram.

65.6 The following information shall be marked on the installation wiring diagram/instructions for the applicable circuits to which field connections are made. In addition, each circuit shall be marked to indicate that the circuit is “Supervised” or is “Not Supervised.”

a) MAIN SUPPLY CIRCUIT – Volts, frequency, and maximum current input or specific power supply with which it is intended to be used. A terminal for the connection of a grounded conductor shall be properly identified.

b) RECHARGEABLE BATTERY CIRCUIT – Voltage, maximum circuit current, maximum amp-hour capacity, type of suitable battery, and expected standby operating time(s).

c) INITIATING DEVICE CIRCUIT – The following information shall be indicated:

1) Reference to the type of devices to be used as well as their intended connection;

2) Initiating devices having integral trouble contacts shall be shown connected to the initiating device circuit such that transfer of the contacts do not impair alarm signaling from any other initiating device;

Exception: Initiating devices signaling a trouble condition caused by electrical disconnection of the device, or by removing the device from its plug-in base.

3) The maximum line impedance, wire gauge related to power capacity requirement, transmission loss limitations, circuit length, and/or equivalent; and

4) Maximum current, voltage, and frequency.

d) NOTIFICATION APPLIANCE CIRCUIT – The following information shall be included:

1) The type of signaling devices and their connection shall be indicated. When the circuit is intended for the connection of a polarized appliance, the field connections to which the appliance is to be wired shall be marked with plus or minus (+, -) symbols, or equivalent, to indicate the proper field connection.

2) Maximum current, voltage, and frequency.

3) The maximum line impedance, wire gauge related to power capacity requirement, transmission loss limitations, circuit length, and/or equivalent.

4) Each circuit shall be identified by the one of the rating designations shown in Table 95.1. Circuits identified as special application shall describe by manufacturer’s name and model designation the specific appliance(s) and device(s), along with the maximum number, intended to be connected to the circuit.

5) Maximum RMS operating current for any single notification appliance that may be connected to the circuit, where synchronized notification appliances may not be employed.

6) Each circuit shall identify whether synchronized notification appliances are permitted to be connected. When synchronized notification appliances are to be employed, the maximum number that may be connected per circuit shall additionally be specified.

e) SUPPLEMENTARY CIRCUITS – Maximum current, voltage, and frequency.

f) SIGNALING LINE CIRCUIT – Maximum current, voltage, and frequency. The maximum line impedance, wire gauge related to power capacity requirement, transmission loss limitations, circuit length, and/or equivalent. The instructions shall describe by manufacturer's name and model designation of the specific appliance(s) intended to be connected to the circuit.

g) REVERSE POLARITY COMMUNICATIONS LINE CIRCUIT – Maximum current, voltage, and frequency, and the following, or equivalent wording, shall appear.

1) For a remote-station receiving unit: "INTENDED FOR CONNECTION TO A POLARITY REVERSAL CIRCUIT OF A CONTROL UNIT AT THE PROTECTED PREMISES HAVING COMPATIBLE RATINGS."

2) For a remote-station unit at the protected premises: "INTENDED FOR CONNECTION TO A POLARITY REVERSAL CIRCUIT OF A REMOTE STATION RECEIVING UNIT HAVING COMPATIBLE RATINGS." In lieu of the above, a drawing of typical connection may be shown which provides equivalent information.

h) MUNICIPAL BOX CONNECTION – The type of connection, either series (local energy) or shunt, and the resistance value of the trip coil, the trip current and the maximum voltage and frequency. When a shunt-type connection is indicated, the following notation shall be added adjacent to the terminals: "THE SHUNT CONNECTION IS RECOGNIZED ONLY AS A SUPPLEMENTARY SIGNALING UNIT AS PART OF A LOCAL CONTROL UNIT AND IS NOT RECOGNIZED AS AN AUXILIARY CONTROL UNIT CONNECTION PER NFPA 72."

i) COMMUNICATIONS CIRCUITS – Maximum current and voltage. The maximum line impedance, wire gauge related to power capacity requirement, transmission loss limitations, circuit length, and/or equivalent.

Exception: Standard protocols identified as RS-232, RS-485, IP, DAC, etc., do not require maximum current and voltage ratings.

j) POWER OUTPUT CIRCUITS – Each circuit shall be identified as either "Regulated" or "Special Application". Regulated circuits shall have a single voltage rating and maximum load current rating. Special application circuits shall describe by manufacturer's name and model designation the specific appliance(s) intended to be powered by the circuit.

k) LIMITED-ENERGY CIRCUITS – Connections to circuits that may be connected to limited energy cable shall be identified as "Power-Limited Circuit" or the equivalent. Specific field-wire routing instructions when required by 44.3.1 shall be included.

l) Where extra terminals are provided to which field connections are not intended, the marking NC or equivalent shall be employed.

m) RELEASING-DEVICE CIRCUITS – The voltage, frequency, and maximum current. The maximum line impedance, wire gauge related to power capacity requirement, transmission loss limitations, circuit length, and/or equivalent. The instructions shall also describe by manufacturer's name and model designation the specific releasing device(s) intended to be connected to the circuit.

n) RELAY, OPEN COLLECTOR, (and similar) OUTPUT CIRCUITS – The operation of the relay/open collector and similar outputs shall be designated as "Common", "Zone", or "Programmable" and described as specified in 13.8. The loading for the circuit, in current, voltages, frequency, and power factor, if applicable, shall also be provided.

o) Designation of manufacturers' recommended wire type for use with the product.

p) Identify all compatible devices by manufacturer and model designation, or by the parameters necessary to determine compatibility.

q) Identify system configuration(s) to meet the maximum time requirements in accordance with 22.3, System Response.

r) Identify system configuration to meet the extended alarm 12 h period when combination systems include carbon monoxide signaling. Refer to 75.2.5.

s) Voice amplifier electrical ratings – signal input voltage and impedance; output voltage; speech power; evacuate power; low frequency cutoff; and high frequency rolloff in decibels/octave.

65.7 In regards to the requirements in 65.6 (c) – (f), unfiltered half- and full-wave rectified voltages shall be identified.

65.8 A notation shall be included that covers a wiring method which shall be in accordance with the section on Fire Alarm Systems, Smoke Alarms, Carbon Monoxide Alarms, and Fire Pumps.

65.9 Initiating-device, notification-appliance, and signaling line circuits shall be designated by class or by both class and style, consistent with the circuit's capabilities as described in 23.2 – 23.5. Communication and transmission paths shall be designated by type, consistent with the path's capabilities as described in 34.3.1.1 for active multiplex; 34.5.4.1 – 34.5.4.7 for two-way private-radio frequency multiplex; and 34.5.5.1 – 34.5.5.12 for one-way private-radio frequency systems.

65.10 Impedance values for testing at which ground faults are annunciated shall be specified.

65.11 Where a product must be mounted in a definite position to function properly, a description of the correct mounting position shall be indicated.

65.12 Any restrictions to the location of units with respect to environmental conditions, clearances for enclosure doors, and distance from floor and/or ceiling shall be detailed.

65.13 For a unit provided with field-wiring terminals as described in 44.5.1 and 44.5.2:

a) When a special tool is required for connection, its use shall be indicated by name of manufacturer and model number or other designation method that has been determined to be equivalent;

b) The range of wire sizes shall be indicated on the installation wiring; and

c) When means for testing for an open and a ground fault on the circuit to which the wiring is connected is not incorporated into the unit, the means shall be indicated.

65.14 Products utilizing radio-frequency signaling shall include at least the following:

a) The minimum signal strength and the maximum ambient noise level shall be indicated;

b) Specific test equipment or specific test method to be used to determine appropriate levels of signal strength and ambient noise level; and

c) Instructions to test the system for operation upon completion of installation.

65.15 In conjunction with 65.6 (c), (d), and (f), when duplicate terminals are not provided to facilitate supervision of the installation wiring connections, and there is no provision to prevent looping an unbroken wire around or under a terminal, the following markings or equivalent text shall be included:

a) “CAUTION”

b) In Canada only: « MISE EN GARDE »

c) “FOR SYSTEM SUPERVISION – FOR TERMINALS ___ AND ___, DO NOT USE LOOPED WIRE UNDER TERMINALS. BREAK WIRE RUN TO PROVIDE SUPERVISION OF CONNECTIONS.”

d) In Canada only: « POUR LA SUPERVISION DU SYSTEME – POUR LES BORNES – ET – , NE PAS ENROULER LE FIL SOUS LES BORNES. POUR ASSURER LA SUPERVISION ELECTRIQUE DES RACCORDEMENTS, IL FAUT COUPER LES FILS. »

Exception: This requirement does not apply for circuits that provide supervision without the need for duplicate terminals.

65.16 The blanks are to be filled in with the applicable terminal identification.

65.17 When the product consists completely of subassemblies that are to be shipped separately, the installation document for a minimum of one of the subassemblies that will be used in each product configuration shall list the subassemblies necessary to form a minimum control unit needed for each type(s) of control unit configuration and the optional subassemblies which are permitted.

65.18 The installation wiring diagram/instructions for a product that provides initiating circuits intended to be used with two-wire smoke detectors shall include the following information:

a) Maximum rated operating voltage range of the initiating circuit.

b) Minimum (if applicable) and maximum number of detectors including detector name, model number and compatibility identifier.

c) When a product is intended to handle more than one detector in the alarm condition, the installation wiring diagram shall so indicate.

d) When a product is intended to handle detectors with optional features, the installation wiring diagram shall so indicate.

e) A stipulation that detectors of different models are not to be mixed or matched on a system, unless the system is specifically intended to be installed in that configuration. When mixing is permitted, specific limitations shall be included.

f) Compatibility identifier number consisting of any six-digit or less alphanumeric combination (such as a date code, part number, or model number) used to identify the latest revision that has not resulted in a new model number, but that impacts compatibility.

65.19 Description of the product operation. This shall include, as applicable, the following:

a) Normal standby;

b) Alarm;

c) Alarm test;

d) Alarm silence;

e) Alarm reset;

f) Trouble;

g) Trouble silence;

h) Activated position of switches; and

i) Functions of lights or switches.

65.20 Description of the maintenance and testing procedures of the system. This shall include, as applicable, the following:

a) Fuse replacement.

b) Primary battery replacement (reference to a specific replacement part which must be used with the product shall be indicated; instructions to replace batteries periodically; the period specified shall not be greater than the useful life of the battery, which has been determined by test).

c) Rechargeable battery maintenance and replacement (where a rechargeable battery is used, proper maintenance and testing procedures shall be described).

d) Maintenance recommendations.

e) In Canada only: All test and maintenance Instruction codes and software necessary to provide test and inspection requirements of ULC-S536.

f) In the United States only: Description of the testing procedures of the system (this shall include periodic testing recommendations).

65.21 In the United States only: Units employing the multiple detector operation described in 25.11.1 – 25.11.2 shall include guidelines for installing of a minimum of two detectors in each protected space and to reduce the detector installation spacing to 0.7 times the linear spacing in accordance with NFPA 72.

65.22 For products utilizing an automatic smoke detector sensitivity test feature, the installation instructions shall specify the extent of the range of time intervals between activations of the automatic test feature.

65.23 The installation instructions for a control unit for releasing service shall describe whether the operation of the manual release will override an activated abort switch.

65.24 Where the field-programmable software of a product contains both complying as well as noncomplying features or parameters as permitted in 7.2, the following (or equivalent presentation) shall be included in the front of the programming manual or the beginning of the program section of the installation manual:

a) In Canada only:

NOTICE TO USERS, INSTALLERS, AUTHORITIES HAVING JURSIDICTION, AND OTHER INVOLVED PARTIES			
This product incorporates field-programmable software. In order for the product to comply with the requirements in ULC 527, certain programming features or options must be limited to specific values or not used at all as indicated below.			
Program feature or option	Permitted in ULC 527 (Y/N)	Possible settings	Settings permitted in ULC 527

b) In the United States only:

NOTICE TO USERS, INSTALLERS, AUTHORITIES HAVING JURSIDICTION, AND OTHER INVOLVED PARTIES			
This product incorporates field-programmable software, in order for the product to comply with the requirements in UL 864, certain programming features or options must be limited to specific values or not used at all as indicated below.			
Program feature or option	Permitted in UL 864 (Y/N)	Possible settings	Settings permitted in UL 864

65.25 The installation document for products intended for smoke control applications shall include an explanation of the concepts and requirements for smoke control, consistent with the NFPA 92, and specifically how the manufacturer's smoke control equipment can be used to accomplish the intended smoke control functions. The following as applicable shall be included:

a) Concepts and requirements for smoke control strategy;

b) Delineation of the specific control equipment intended to be employed to form smoke control systems;

c) Wiring diagram(s) showing intended interconnection of the equipment, including guidelines for connection to general HVAC equipment, if separate, as well as to equipment for any required end-to-end verification process;

d) Examples for implementing the system in various applications, such as a warehouse and a high rise application; and

e) Programming of the system for the applicable strategies, including an automatic weekly test for dedicated type systems.

65.26 In the United States only: Where supervising station signal processing equipment meets the requirements of 34.4, Supervising Station Signal Processing Equipment, the instruction manual shall have a section which specifically describes the system configuration. This section shall include the following equipment requirements for the receiving system:

a) Minimum computer/server specifications;

1) Operating system class, minimum revision level and/or kernel type and revision level.

2) For PC-based systems and servers, the microprocessor manufacturer, type(s)/family, and the minimum speed of the microprocessor for which the software is designed to work. For systems using minicomputers, the basic system model or family as well as the microprocessor make and its speed designation for which the software is designed to operate.

3) Minimum disk storage space required.

4) Minimum internal memory size.

5) Required features (such as media needs, drivers, etc.

6) Required input/output functionality (such as serial ports, USB ports, and network cards).

7) Minimum release level of the system software.

b) Minimum supervising signal processing system configuration, including list of components constituting minimum system configuration for redundant/non-redundant systems (including video terminals, printers, computers, watchdog timers, and similar equipment), and compatible protected premises units/transmitters and, if applicable, automation systems.

c) Environmental controls – Hardware shall be located in an environment where the temperature is maintained between 13 – 35 °C (55 – 95 °F) or at a level within the temperature rating range of the equipment, whichever is greater. The environment shall also be maintained within the humidly range rating of the equipment.

d) HVAC standby power – The HVAC system shall have 24 h of standby power. The standby power for the HVAC shall be provided by the central-station's engine-driven generator(s). When the central-station chooses to do so, it may provide the standby power for the HVAC system by an uninterruptible power supply (UPS), or similar equipment.

Exception: When the hardware is rated for use in environments with temperatures between 0 °C (32 °F) and 49 °C (120 °F), standby power is not required for the HVAC system.

e) Source of power –

1) The supervising station processing control equipment or the enclosure housing the control equipment shall have with a permanent means for connection to the branch circuit supply which shall include provision for installing the supply conductors in conduit.

2) Hardware shall be powered by a UPS that complies with NFPA 72.

3) In order to perform maintenance and repair service, a means for disconnecting the input to a UPS and output from a UPS while maintaining continuity of power supply to the automation system shall be provided.

4) When a power conditioner is being used, it shall comply UL 1012. In order to perform maintenance and repair service, a means for disconnecting the input to a power conditioner and output from a power conditioner while maintaining continuity of power to the automation system shall be provided.

5) All sources of power for the signal processing equipment shall be within the rated voltage range of the equipment.

f) Supply-line transient protection – Hardware shall be protected by transient voltage surge suppressors that comply with UL 1449. The transient voltage surge suppressors for single-phase, 120/220 V AC systems shall have a marked rating of 330 volts or less. The transient voltage surge suppressors for 3-phase, 480 V AC or higher-rated systems shall have a marked rating of 400 volts or less.

g) Signaling line transient protection –

1) The communication circuits contained within the central-station building and not connected to the telecommunications network shall be protected by isolated loop circuit protectors. These protectors shall comply with UL 497B, and shall have a marked rating of 50 volts or less.

2) Communication circuits connected to the telecommunications network shall be protected by secondary protectors for communication circuits. These protectors shall comply with UL 497A, and shall have a marked rating of 150 volts or less. These protectors shall be used only in the protected side of the telecommunications network.

h) Minimum system configuration – List of components constituting minimum system configuration for required redundancy and/or fault tolerant systems (including CRTs, printers, computers, watchdog timers, and similar equipment).

i) Software version – Instructions on how to display the software release version.

j) A stipulation that no other software other than the operating system software and anti-virus/security protection software shall be installed on the primary and backup computer/servers.

65.27 Details on rechargeable standby power calculations, including:

a) Maximum battery amp hour capacity supported by any integral charger;

b) Normal Standby load and time period(s);

c) Alarm load and time period(s); and

d) Incorporate safety margin into the calculated amp hour rating of 20 %.

65.28 Consistent with 7.8, indication of compatible version of the software employed in compatible systems, by part number and revision level.

65.29 In accordance with 27.2.6, the signal components from signal generation to and including output speaker utilized to meet the low frequency signal tone need to be specified.

65.30 Where BSIU software meets the requirements of 26.1 – 26.2, the information specified in 26.4 shall be included in the installation instructions.

65.31 The following information shall be included where a control unit/accessory controls or determines the special application mode/configuration sensitivity threshold(s) for smoke detectors in accordance with 95.5.2.4 – 95.5.2.6:

a) The statement: “Detectors [Sampling ports] set to the special application sensitivity are not suitable for use in areas where cooking appliances may be used. If cooking appliances are used within the protected space, a normal application detector or normal application mode or configuration must be used for that area.”

b) A warning to users that the special application mode of operation is not for general use and maybe more prone to false alarms if used in unsuitable environments.

c) A list of examples of suitable and unsuitable environments for the detector, consistent with the requirements in 65.31(a).

Exception: This information need not be included when It is provided in the installation instructions of the interconnected smoke detector.

d) A description of potential nuisance alarm sources.

Exception: This information need not be included when It is provided in the installation instructions of the interconnected smoke detector.

e) A description of the method to configure the detector's special application sensitivity.

f) A description of the method to provide a visual indication with identifiable markings for detectors operating in the special application mode in accordance with 95.5.2.7.

66 Operating Instructions

66.1 A control unit that is not intended to have an operator in attendance shall be provided with simple operating instructions. These instructions shall be on the cabinet front or on a separate sheet that can be framed and located adjacent to the control unit.

66.2 When separate from the control unit, the instructions shall include the model number of the control unit and be referenced in the control unit marking by number and issue number and/or date.

66.3 The instructions shall include a capsule description of pertinent conditions applicable to the particular control unit as described in 65.19 and 65.20.

66.4 In addition to the requirements in 66.1 – 66.3, a blank space shall be provided on the instruction sheet to fill in the name, address, and telephone number of the local service representative to contact in the event of trouble.

66.5 Where the instructions appear on a separate sheet, a notation shall be added on the bottom that the instructions are to be framed and placed adjacent to the control unit for ready reference.

66.6 Operating instructions are not required for a remote station, proprietary, or central station protected premises unit that has no user operating controls and where all signals are annunciated at the receiving unit.

66.7 In addition to the requirements in 66.1 – 66.6, and 62.32, instructions describing the procedure to obtain the Field Detection Device Activity Report and the minimum equipment required.

67 In the United States Only: International Languages

67.1 A product is not prohibited from providing manuals, markings, labels, displays, and controls in a language other than American English. All information necessary to safely operate the panel shall be provided in the language(s) supported.

67.2 Warning label(s) and marking(s), in the minimum base language, shall be permanently attached to the product as described in 62.1 and 62.26.

67.3 In addition to 67.2, where the product supports multiple languages, additional language warning label(s) and marking(s) are not prohibited from being separately provided with the product when the placement of the warning label(s) and marking(s) are described in the installation instructions. Where field-installed, each warning label(s) must have a guide mark to ensure proper location, or permanently placed on top of like labels in/on the equipment as described in 62.1 and 62.26.

67.4 Operator instructions mounted next to the control panel, as described in Section 66, Operating Instructions, shall include a capsule description of pertinent conditions, in the language of the equipment.

67.5 Programming and installation instructions. If the programming and installation instructions are provided in multiple languages, then all language versions shall be provided as required by 65.1.

67.6 All required marking must be translated into each language provided.

PERFORMANCE TESTS

68 General

68.1 Products fully representative of production shall be used for each test.

68.2 Voltage, current and temperature dependent tests shall be conducted on representative samples at maximum ratings.

68.3 Functional tests shall be conducted on samples representative of all combinations of features and options.

68.4 Unless otherwise specified, the test voltage for each test of a product is to be as indicated in Table 68.1 at the rated frequency of the product:

Table 68.1
Test Voltages

	Product rated voltage, nameplate	Test voltage
60 cycle, 50/60 cycle	110 – 120	120
	220 – 240	240
Rated frequency	Other	Maximum marked rating
DC	Battery circuit	Marked nominal battery voltage
50 cycle	110 – 120	120
	220	220
	240	240

68.5 Different samples may be used for each test unless stated otherwise.

68.6 Products, together with the associated input and output devices shall be interconnected in accordance with the manufacturer's instructions (refer to Section 65, Instructions Wiring Diagram / Instructions) to form the representative test sample. The input and output devices shall be those specified by the product manufacturer as compatible with the product except that substitute devices may be used if they produce equivalent actuation of the product and equivalent circuit loading.

68.7 Products that meet the requirements of the following standards are not required to be evaluated to the requirements identified in 68.8:

a) In Canada only:

1) CSA-C22.2 No. 60950-1; or

2) CSA C22.2 No. 60065; or

3) CSA C22.2. No. 62368-1.

b) In the United States only:

1) UL 62368-1;

2) UL 60950-1; or,

3) UL 60065.

68.8 Products that meet the requirements of the standards identified in 68.7 are not required to be evaluated to the following:

a) 50.3, Evaluation of Conformal Coatings on Printed Wiring Boards.

b) Section 79, Dielectric Voltage-Withstand Test.

c) Section 80, Electric Shock Current Test.

d) Section 89, Tests on Special Terminal Assemblies.

e) 91.2, Abnormal Operation Tests – Operation.

f) 91.4, Abnormal Operation Tests – Electronic Components.

g) 91.6, Abnormal Operation Tests – Transformer Burnout.

h) 91.7, Abnormal Operation Tests – Communication Circuits.

i) Section 92, Mechanical Strength Test for Metal Enclosures and Guards and Enclosure Parts Secured with Adhesive.

j) 39.3.1.

k) Section 40, Internal Materials.

l) Section 93, Ignition Test Through Bottom-Panel Openings.

m) Section 98, Leakage Current Test.

68.9 When a product must be mounted in a definite position in order to function as intended, it shall be tested in that position.

68.10 All measurements are to be made with a true RMS meter or an oscilloscope.

69 Maximum Rated Load

69.1 A product shall operate as intended and without the risk of fire, electric shock, or injury to persons with all external circuits connected to maximum rated load.

69.2 Maximum rated load is that value of impedance which causes rated current to flow in the external circuit or the maximum number of specific devices or appliances, as specified in the installation instructions/wiring diagram, connected to the external circuit, with the input voltage to the product adjusted to the value determined by 68.4.

69.3 Units that are provided with connectors for the installation of accessories or with open card slots, or both, shall be subjected to the tests in this standard with such connectors or card slots, or both, loaded to the maximum rated output capability for the unit specified by the manufacturer.

70 Normal Operation

70.1 Test samples as detailed in Section 68, General, shall be actuated for all functions provided by the system type, and by the incorporated features and options. The resultant sequence of operation shall be in accordance with the normal operation test requirements and 70.3.

70.2 When the emergency power supply is a battery, normal operation on main power supply shall be obtained with the battery disconnected or in any state of discharge.

70.3 A product shall be capable of operating for all conditions of its intended performance when used in conjunction with initiating devices, notification appliances, power supplies, and interconnected equipment to form a system of the service specific type indicated in the marking and shown in the installation wiring diagram/instructions.

70.4 To determine compliance with 70.3, initiating devices, notification appliances, interconnected equipment, and power-supply circuits are to be connected to the product as specified by the installation wiring diagram/instructions to form a typical system, and the system operated for each condition of its intended performance.

70.5 The items in 70.5 (a) – (d) used for testing are to be those specified by the installation wiring diagram/instructions of the product. Substitute devices, unless otherwise indicated, are not prohibited from being used where they produce equivalent circuit loading and actuation of the product.

a) Initiating devices (fire alarm boxes, heat detectors, smoke detectors, sprinkler supervisory switches, feedback (or “proof”) sensors, and similar devices);

b) Notification appliances Bells, strobes, speakers, and similar appliances or parts);

c) Releasing devices (solenoids and valves); and

d) Interconnected equipment (control-unit accessories, other control units, annunciators, releasing devices, door-hold release devices, emergency exit locks, HVAC equipment, supplementary devices, and the like).

70.6 During the tests in Sections 68 – 103, Performance Tests, each power-supply circuit shall be supplied from a source of rated frequency and voltage as specified in 68.4.

71 Monitoring for Integrity

71.1 General

71.1.1 Samples as detailed in Section 68, General, shall be tested for the required trouble signal of fault conditions.

71.1.2 Supervision of extended circuits required by Section 23, Circuits, shall include the circuits used for the provision of supply from the control unit to the associated peripheral equipment. A reduction of supply voltage to a value less than the minimum value required for normal operation shall be considered a loss of supply and result in a type of trouble signal (common or specific) required for the associated control circuit. Refer to 17.1 – 17.3.

71.1.3 To determine if a product complies with those requirements that specify the application of a circuit fault, adverse condition, or malfunction of specified equipment/components, the investigation is to start with the representative system combination in the normal supervisory condition. The fault condition is then to be separately introduced, the results noted, the fault removed, and the system restored to the normal supervisory condition before the next fault is introduced.

71.1.4 The tests shall be performed in both alarm and standby modes and repeated for operation on emergency power supply batteries (AC fault condition). The control unit shall be capable of normal operation after testing.

71.2 Components

71.2.1 When the activated position of any normally preset mechanism or similar part of a product requires manual restoration in order to permit normal signaling performance of the system, such position shall be indicated by a trouble signal.

In the United States only:

Exception: Either an audible- or visual-only trouble signal at the operator interface is acceptable for mechanisms that are part of the supervising station equipment.

71.2.2 The operation of any manual-switching part of a product to other than its normal or activated position while the system is in the normal supervisory condition shall be indicated by a trouble signal, when the activated position of the switch interferes with normal operation of the system.

In the United States only:

Exception No. 1: Either an audible- or visual-only trouble signal at the operator interface is acceptable for mechanisms that are part of the supervising station equipment.

Exception No. 2: Operation of a disconnect switch or disable function affecting the operation of a releasing circuit shall cause a supervisory signal.

71.2.3 To determine if a switching part of a product complies with 71.2.1 and 71.2.2, the investigation is to start with the representative system combination in the normal supervisory condition; the system is then to be operated for signals with the manual-switching part in each position.

72 Electrical Ratings Test

72.1 General

72.1.1 Circuit classifications of a product shall comply with the limits specified in 5.13.

72.2 Power input circuits

72.2.1 With the product energized from rated voltage and connected to maximum rated load, the input current of the product shall not exceed the marked rating of the product when the product is operated under all conditions of intended use.

72.2.2 Where the operating voltage of a product is specified at two or more discrete values, the requirement in 72.2.1 shall be applied at each voltage rating.

72.2.3 Where the input to the product is specified as a voltage range, the input current rating shall be a single value that is equal to or greater than the measured input current obtained at any voltage within the range.

72.3 Other external circuits

72.3.1 All external circuits shall be electrically rated to permit proper installation of the product using wiring methods permitted by:

a) In Canada only: CSA C22.1.

b) In the United States only: NFPA 70.

72.3.2 The actual measured values of any circuit shall not exceed the rating for that circuit.

72.3.3 The electrical rating of a circuit shall indicate the maximum circuit voltage under any operating condition including an open circuit and the maximum circuit current (or wattage for an audio product) under any condition of normal operation.

72.3.4 Where a circuit fault condition will cause a circuit current in excess of the normal current rating, either:

a) The maximum fault current shall be indicated; or

b) The minimum size wire capable of handling the fault current shall be indicated.

72.3.5 There shall be coordination between the maximum fault current and the overcurrent or current limiting protection required in Section 46, Protective Devices.

73 In the United States Only: Power-Limited Circuits Test

73.1 General

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

73.1.2 The power source (or sources) supplying a power-limited circuit shall be either inherently limited requiring no overcurrent protection or limited by a combination of a power source and overcurrent protection devices such that a power-limited circuit has electrical characteristics as described in Table 73.1 or Table 73.2.

Table 73.1
Power Limitations for AC Circuits

Circuit voltage V_{max}[a]		Inherently limited power source (overcurrent protection not required)			Not inherently limited power source (overcurrent protection required)		
		0 – 20	over 20 – 30	over 30 – 100	0 – 20	over 20 – 100	over 100 – 150
Power limitations VA_{max}[b] (volt-amps)		–	–	–	250[d]	250	–
Current limitations I_{max}[c] (amps)		8.0	8.0	$150/V_{max}$	$1000/V_{max}$	$1000/V_{max}$	1.0
Maximum overcurrent protection (amps)		–	–	–	5.0	$100/V_{max}$	1.0
Power source maximum nameplate ratings	VA (volt-amps)	$5.0 \times V_{max}$	100	100	$5.0 \times V_{max}$	100	100
	Current (amps)	5.0	$100/V_{max}$	$100/V_{max}$	5.0	$100/V_{max}$	$100/V_{max}$

NOTE – Reproduced in part from the NFPA 70, copyright National Fire Protection Association, Quincy, MA 02269.

[a] V_{max} is the maximum output voltage regardless of load with rated input applied.

[b] VA_{max} is the maximum volt-ampere output after 1 min 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}.

[c] I_{max} is the maximum output current under any noncapacitive load, including short circuit, and with overcurrent protection bypassed if used. If a transformer limits the output current, I_{max} limits apply after 1 min of operation. If a current-limiting impedance, determined to be suitable for the purpose, is used in combination with a nonpower-limited transformer or a stored energy source, such as a storage battery to limit the output current, the limits apply after 5 s of operation.

[d] If the power source is a transformer, VA_{max} is 350 or less when V_{max} is 15 or less.

Table 73.2
Power Limitations for DC Circuits

Circuit voltage V_{max} [a]		Inherently limited power source (overcurrent protection not required)				Not inherently limited power source (overcurrent protection required)		
		0 – 20	over 20 – 30	over 30 – 100	over 100 – 250	0 – 20	over 20 – 100	over 100 – 150
Power limitations VA_{max} [b] (volt-amps)		–	–	–	–	250[d]	250	–
Current limitations I_{max} [c] (amps)		8.0	8.0	$150/V_{max}$	0.030	$1000/V_{max}$	$1000/V_{max}$	1.0
Maximum overcurrent protection (amps)		–	–	–	–	5.0	$100/V_{max}$	1.0
Power source maximum nameplate ratings	VA (volt-amps)	$5.0 \times V_{max}$	100	100	$0.030 \times V_{max}$	$5.0 \times V_{max}$	100	100
	Current (amps)	5.0	$100/V_{max}$	$100/V_{max}$	0.030	5.0	$100/V_{max}$	$100/V_{max}$

Note – Reproduced in part from the NFPA 70, copyright National Fire Protection Association, Quincy, MA 02269.

[a] V_{max} is the maximum output voltage regardless of load with rated input applied.

[b] VA_{max} is the maximum volt-ampere output after 1 min 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}.

[c] I_{max} is the maximum output current under any non-capacitive load, including short circuit, and with overcurrent protection bypassed if used. If a transformer limits the output current, I_{max} limits apply after 1 min of operation. If a current-limiting impedance, determined to be suitable for the purpose, is used in combination with a nonpower-limited transformer or a stored energy source, such as a storage battery to limit the output current, I_{max} limits apply after 5 s of operation.

[d] If the power source is a transformer, VA_{max} is 350 or less when V_{max} is 15 or less.

73.1.3 Relative to 73.1.2, acceptable means for current limiting include:

a) Transformer winding impedance;

b) Thermal link embedded within the winding overwrap of a transformer;

c) Circuit components (resistors, regulators, transistors, and similar devices) which comply with the temperature test under I_{max} condition; and

d) Suitable current-limiting impedances (positive temperature coefficient varistor, and the like).

73.1.4 Relative to 73.1.2, the following are not acceptable means of current-limiting:

a) Circuit component burnout;

b) Permanent or replaceable fuses;

c) Opening of conductors on printed-wiring boards; and

d) Opening of internal wiring conductors

73.1.5 The overcurrent protection device specified in 73.1.2 shall be of the non-interchangeable type such that it shall not be renewed in the field with an overcurrent device having a higher current rating.

73.1.6 When conducting I_{max} and VA_{max} measurements, 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 be allowed to remain functional.

73.1.7 Where the product contains a float battery charger, V_{max}, I_{max}, and VA_{max} measurements are to be conducted with both AC and battery connected to the product. If the product contains a battery transfer

relay or contains a trickle charge battery circuit, measurements of V_{max}, I_{max}, and VA_{max} are to be conducted with the product first energized only from the AC power source and then repeated with the product energized solely from the battery. The battery used during these measurements is to have the largest capacity as specified in the manufacturer's installation document.

73.1.8 The loads referenced in 73.2.1 – 73.4.1 shall be resistive.

73.2 Maximum voltage

73.2.1 With the product 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 recorded under these two conditions is to be considered V_{max}. Where the product incorporates a secondary source of supply, the test is to be repeated with the product energized solely from the secondary power source and with the primary power source disconnected. The V_{max} value obtained from each power source is to be considered separately when applying the requirements of Table 73.1 or Table 73.2.

73.3 Maximum current

73.3.1 In order to determine compliance with the I_{max} limitation, a variable load resistor initially set to draw rated current is to be connected across the circuit. The current through the load resistor is to be noted and the load removed. The resistance of the load shall then be incrementally decreased, momentarily reconnected across the circuit while noting the current, and then removed. The method is to be repeated until a short-circuit condition is obtained. The load resistor is then to be readjusted to a value capable of producing and maintaining a current equal to the maximum permitted in Table 73.1 and Table 73.2. The load resistor is then to be connected to the circuit and the current through the load resistor measured after 1 min or after 5 s as determined from in Table 73.1 and Table 73.2.

73.3.2 The maximum current measurement is to be the rms value for circuits that are constantly energized and the peak value for circuits that pulse the output. The measurement of the time period starts when the output is initially energized with the load specified in 73.3.1 and continues until the current is continuously below the I_{max} value indicated in Table 73.1 and Table 73.2. The time period is to include any momentary period where the output current temporarily drops below the required I_{max} value limit.

73.3.3 Where a transformer limits the value of I_{max}, and when I_{max} cannot be maintained for 1 min due to transformer burnout, a plot of current versus time is to be generated and the graph extrapolated to 1 min. The results satisfy the requirement of the test when the extrapolated value of I_{max} at 1 min does not exceed the I_{max} limitations as indicated in Table 73.1 and Table 73.2.

73.3.4 Where a transformer does not limit the current of I_{max}, and when the maximum current through the load resistor cannot be maintained for 5 s due to current-limiting devices (opening of thermal link power supply foldback, PTC varistor effect, and similar devices) the current load resistor shall be adjusted to a value which will produce a current just above the I_{max} value indicated in Table 73.1 and Table 73.2. The results are in compliance when the I_{max} value stated in Table 73.1 and Table 73.2 cannot be maintained for more than 5 s.

73.4 VA_{max} (not inherently limited circuits only)

73.4.1 In order to determine VA_{max}, the product is to be energized from a rated source of supply and 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 recorded, and the load removed. The resistance of the load is then to be incrementally 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 volt-ampere

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 calculated and then connected to the circuit. After 1 min, the voltage and current are again to be measured. The results of this test are acceptable if the calculated volt-ampere output of the circuit after 1 min does not exceed the value specified in Table 73.1 and Table 73.2 as appropriate.

74 In Canada Only: Power Source Limitations for Class 2 Circuits Test

74.1 General

74.1.1 All field-wiring circuits that derive energy from power sources connected to a control unit shall be classified as Class 2 or non-energy-limited circuit. A circuit shall be considered non-energy-limited unless otherwise identified in the installation documentation and marking on the product.

74.1.2 The power source (or sources) supplying a Class 2 circuit shall either utilize overcurrent protection, be energy limited requiring no overcurrent protection, or limited by a combination of a power source and overcurrent protection devices such that a Class 2 circuit has electrical characteristics as described in Table 74.1.

74.1.3 The overcurrent protection device specified in Table 74.1 shall be of the non-interchangeable type such that it cannot be renewed in the field with an overcurrent device having a higher current rating.

Table 74.1
Power Source Limitations for Class 2 Circuits

Circuit	Overcurrent protection provided[a]				Overcurrent protection not provided[a]		
Circuit voltage V_{max} (V)[b]	**0 – 20**	**over 20 – 30**	**over 30 – 60**	**over 60 – 150**	**0 – 20**	**over 20 – 30**	**over 30 – 60**
Maximum overcurrent protection (amps)	5	$100/ V_{max}$[b]	$100/ V_{max}$[b]	$100/ V_{max}$[b]			
Maximum I_{max}[c] (amps) supplied from primary battery(ies)[d].	–	–	–	–	7.5	5	–
Maximum I_{max}[c] (amps) supplied from current limiting device[e] .	–	–	–	$100/ V_{max}$[b]	5	$100/ V_{max}$[b]	$100/ V^{maxb}$

[a] Class 2 circuits with a V_{max} of 60 V or less shall have the current limited by either overcurrent protection rated as indicated for the V_{max}, or the current is supplied from:

(i) primary batteries that under short-circuit will not supply a current exceeding the currents indicated after 1 min;

(ii) a Class 2 circuit transformer;

(iii) a device having characteristics that will limit the current under normal operating conditions or under fault conditions to a value not exceeding the current indicated for the V_{max}, or

(iv) a device having a Class 2 output. Class 2 circuits with a Vmax exceeding 60 V shall have the current limited by an overcurrent protection rated a maximum of $100/V_{max}$ amps and in addition a current limiting means, other than overcurrent protection, which will limit the current under normal operating conditions or under fault conditions to a value not exceeding $100/V_{max}$.

[b] V_{max}: Maximum output voltage regardless of load, including open circuit, with rated input applied.

[c] I_{max}: Maximum output current (amps) under any non-capacitive load, including short-circuit, and with overcurrent protection bypassed, when used.

[d] A primary battery for Class 2 power sources consists of one or more cells electrically connected under the same cover with each cell producing an electrical current by an electrochemical reaction that is not reversible, that is, non-rechargeable.

[e] A device having energy-limiting characteristics may consist of a series resistor of suitable rating, an inherent high impedance in the source, or other similar device.

74.1.4 When conducting I_{max} measurements 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 be allowed to remain functional.

74.1.5 Where the product contains a float battery charger, V_{max} and I_{max}, measurements are to be conducted with both AC and battery connected to the product. If the product contains a battery transfer relay or contains a trickle charge battery circuit, measurements of V_{max} and I_{max}, are to be conducted with the product first energized solely from the AC power source and then repeated with the product energized solely from the battery. The battery used during these measurements is to have the largest capacity as specified in the manufacturer's installation document.

74.1.6 The loads referenced in 74.2, Maximum Voltage, and 74.3, Maximum Current, shall be resistive.

74.2 Maximum voltage

74.2.1 With the product 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 recorded under these two conditions is to be considered V_{max}. Where the product incorporates a secondary source of supply, the test is to be repeated with the product energized solely from the secondary power source and with the primary power source disconnected. The V_{max} value obtained from each power source is to be considered separately when applying the requirements of Table 74.1.

74.3 Maximum current

74.3.1 In order to determine compliance with the I_{max} limitation, a variable load resistor initially set to draw rated current is to be connected across the circuit. The current through the load resistor is to be noted and the load removed. The resistance of the load shall then be incrementally decreased, momentarily reconnected across the circuit while noting the current, and then removed. The method is to be repeated until a short-circuit condition is obtained. The load resistor is then to be readjusted to a value capable of producing and maintaining a current equal to the maximum permitted in Table 74.1. The load resistor is then to be connected to the circuit and the current through the load resistor measured.

75 Battery Tests

75.1 General

75.1.1 This test is to be conducted in conjunction with Section 78, Component Temperature Test, on products provided with emergency power supply batteries.

75.2 Discharged battery

75.2.1 The terminal voltage of a battery discharged as specified in 75.2.2 – 75.2.5 shall not be less than 85 % of the marked nominal battery voltage.

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

75.2.3 The battery is then to be discharged by maintaining the normal standby load connected to the output for the applicable period specified in (a), (b), or (c):

a) 4 h, where secondary (standby) power is intended to be used in conjunction with an engine-driven generator;

b) 24 h; or

c) A longer than 24-h period as described in the installation document of the product.

75.2.4 For products which normally have no status change signaling operations during the discharge period, the normal standby load shall be the quiescent current of the product plus any specified normal supervisory power supply loads not automatically disconnected upon transfer to secondary power. For products which will normally have status-change signaling occurring throughout the discharge period such as, DAC and performance based communication, signal receiving centers, and RF repeaters, and which draw more operating current when signaling then while in the quiescent mode, the normal standby load shall be a steady state load equal to the signaling current of the product plus any specified normal supervisory power supply loads not automatically disconnected upon transfer to secondary power.

75.2.5 At the conclusion of the normal standby discharge period, all products operating alarm notification appliances used for evacuation or to direct aid to the location of an emergency, with the exception of emergency voice/alarm communications systems, shall have the maximum rated alarm load applied for the following amount of time as required by the intended use, or any longer period as described by the manufacturers installation instructions:

a) 2 h;

NOTE: Minimum per NBC High Rise.

b) 1 h;

NOTE: Minimum per NBC Group B, C and D Occupancies.

c) 30 min;

NOTE Minimum per NBC all other systems.

d) 15 min; and/or

NOTE: Minimum per National Fire Alarm and Signaling Code, NFPA 72, Emergency Communication System.

e) 5 min.

NOTE: Minimum per NBC a building not equipped with an annunciator, and National Fire Alarm and Signaling Code, NFPA 72, General Evacuation.

Exception: Where a combination system includes carbon monoxide signaling, after the 5 min of carbon monoxide alarm, the maximum carbon monoxide single and multiple station alarm load shall continue to be applied for a period of not be less than 12 h. The 5 s "off" time of the carbon monoxide single and multiple station alarm signal shall be permitted to be changed to 60 s ±10 %. Additionally, the 12 h period is permitted to be eliminated when the product's installation instructions stipulate:

a) The system be monitored by:

b) In Canada only: A fire signal receiving centre with emergency response.

c) In the United States only: A supervising station with emergency response, both aspects meeting the National Fire Alarm and Signaling Code, NFPA 72.

d) The 12 h carbon monoxide single and multiple station alarm period is met by a self-powered wireless signaling device meeting:

e) UL 464/ULC 525, or by a CO detector with integral sounder meeting UL 464/ULC 525 sound output.

75.2.6 The terminal voltage of the discharged battery shall then be measured.

75.3 Charged battery

75.3.1 The terminal voltage of a battery charged as specified in 75.3.2 shall be at least 95 % of the voltage measured in 75.2.2.

75.3.2 At the conclusion of the test sequence described in 75.2.2 – 75.2.5, AC input power is to be reapplied to the product for 48 h. During charging, the product is to be operated continuously with normal standby load connected. At the conclusion of the 48 h recharge time, AC power is to be disconnected and battery terminal voltage measured after 1 min.

75.4 Discharged battery – second trial

75.4.1 The terminal voltage of a battery shall not be less than 85 % of the marked nominal battery voltage after the battery has been discharged as specified in 75.2.3 and 75.2.5 following charging as specified in 75.3.2.

76 Standby Operating Power Test for Releasing Devices

76.1 Releasing device service – extinguishing agents and water suppression

76.1.1 While connected to each releasing device specified in the installation document, products controlling devices for release of an extinguishing agent shall be capable of activating the releasing device after 24 h of operation of the standby source of power with which it is provided. When the primary AC power to the product is momentarily reconnected prior to operation for extinguishant release, the resulting internal electrical transients shall not cause false operation of the release mechanism or circuitry.

76.1.2 Where the system configuration employs cross-zone release or single-zone, multiple-detector actuation, the standby operating source shall be capable of supplying an additional 5 min alarm signal immediately followed by the capability of releasing the extinguishing agent.

76.1.3 Where a continuous load, such as that created by solenoid release valves, motor mechanisms, and the like, is specified, the standby operating source shall maintain at least 85 % of the rated operating voltage to the releasing devices after 60 s energization of the release circuit. If voltage is less than 85 % of rated level when 60 s have elapsed, the maximum time during which the standby operating source maintains the minimum operating voltage (85 % of rated voltage) shall be specified in the installation document.

76.2 Releasing devices – non-extinguishing and non-water based

76.2.1 When required to provide a secondary power source as described in 33.1, Power Supplies, and while connected to each releasing device specified in the installation document, or equivalent load, products controlling devices for release shall be capable of activating the releasing device after 24 h of operation of the standby source of power with which it is provided. When the primary AC power to the product is momentarily reconnected prior to operation for release, the resulting internal electrical transients shall not cause false operation of the release mechanism or circuitry.

76.2.2 Where a continuous load, such as that created by motor mechanisms, and the like, is specified, the standby operating source shall maintain at least 85 % of the rated operating voltage to the releasing devices after 60 s energization of the release circuit. If voltage is less than 85 % of rated level when 60 s have elapsed, the maximum time during which the standby operating source maintains the minimum operating voltage (85 % of rated voltage) shall be specified in the installation document.

77 Variable Voltage Operation Test

77.1 The product, when connected to maximum rated load as described in 69.2, and subjected to the input voltage conditions described in 77.2 – 77.4, shall operate as intended and without risk of fire or electric shock during all conditions of intended use. At each input voltage, all conditions of intended use are to be maintained until constant temperatures of its parts are reached, or a minimum of 2 h.

77.2 The product is to be subjected to the following variable voltage conditions:

a) 110 % of the rated primary input voltage specified in 68.4, General. The secondary power source is to be connected to rated voltage;

b) 110 % of the marked rated nominal standby battery voltage or rated secondary power input voltage specified in Section 68, General. The primary input voltage is to be disconnected;

c) 85 % of rated primary input voltage specified in Section 68, General, or at some lower level of transfer voltage as specified in 97.3.3. The standby battery or, when provided, a secondary power source shall be disconnected; and

d) 85 % of the marked rated nominal standby battery voltage or rated secondary power input voltage specified in 68.4, General. The primary input voltage is to be disconnected.

77.3 In conducting the reduced voltage test, the voltage is to be reduced by a means that will maintain a stable potential of the required value under the most severe conditions of normal loading.

77.4 The reduced voltage tests are to be made with the maximum line impedance as indicated in the installation wiring diagram connected to all external circuit(s).

77.5 The increased voltage tests are to be made with zero-line impedance in each external circuit.

77.6 In those cases where different components or units of a combination system obtain power from separate sources, each source is to be independently varied while the system is tested for its normal operation.

77.7 A product intended to be used with a standby battery shall have sufficient capacity to maintain a charged battery under all conditions of intended operation, including sufficient capacity to operate the product with the battery disconnected or fully discharged. In any operating mode, the battery charger shall be capable of maintaining the battery in the charged condition when the product input is at a maximum of 85 % of rated voltage or at some lower level of transfer voltage as determined according to 97.3.3.

77.8 A charged battery is defined as a battery having the capacity to maintain the product in the normal supervisory and alarm conditions for the time period required in Section 75, Battery Tests.

77.9 A releasing-device control unit or local control unit acceptable for release of an extinguishing agent is to be tested for operation at the lower voltage specified in 77.2(c). With the maximum number of releasing actuating devices connected, each releasing actuating device shall operate properly and completely upon actuation.

77.10 An audio amplifier shall deliver not less than 60 % nor more than 170 % of its rated output power (80 – 130 % of rated output voltage) when the power-supply input voltage is subjected to the variable voltage conditions described in 77.2. The 1 kHz signal described in 97.6.2 is not to be adjusted.

77.11 When the power-supply input voltage is established at the variable voltage conditions described in 77.2, the 1 kHz signal described in 97.6.2 is to be varied, as needed, so that the rated output voltage is

delivered to the load. The amplifier shall comply with the requirement of 94.1.2.1 and 94.1.2.2 at the variable voltage conditions described in 77.2.

78 Component Temperature Test

78.1 A product, when operated under any normal condition of intended use and at maximum rated load, shall not reach a temperature at any point high enough to:

a) Result in a risk of fire or risk of electric shock;

b) Adversely affect any materials in the product; or

c) Exceed the temperature rises at specific points as specified in Table 78.1 and Table 78.2.

Exception: A component with a temperature exceeding that indicated in Table 78.1 may be used when reliability data at the higher temperature is provided by the manufacturer to justify its use.

78.2 All values for temperature rise apply to equipment intended for use with ambient temperatures normally prevailing in occupiable spaces which usually are not higher than 25 °C (77 °F). When equipment is intended specifically for use with a prevailing ambient temperature constantly more than 25 °C (77 °F), the test of the equipment is to be made with the higher ambient temperature, and the allowable temperature rises specified in Table 78.1 and Table 78.2 are to be reduced by the amount of the difference between that higher ambient temperature and 25 °C (77 °F).

Table 78.1
Maximum Temperature Rises – Electronic Components

Component or device	Normal standby (i.e., any long term fire or smoke control condition of operation or any non-fire or non-emergency operating condition)		Alarm condition (i.e., short term operating condition of fire, smoke control, or emergency signaling)	
	°C	(°F)	°C	(°F)
a) Components				
1) Capacitors[a]	25	(77)	40	(104)
2) Resistors[b]				
Carbon	25	(77)	50	(122)
Wire-wound	50	(122)	125	(257)
Other	25	(77)	50	(122)
b) Solid-State Devices	Refer to c			

[a] In lieu of complying with these temperature limits, a component shall meet the derating parameters specified in Table 54.1 or the component reliability assessment specified in 54.5.1, Exception (b) or (c).

[b] In lieu of complying with these temperature limits, a resistor shall not dissipate more than one-half of its maximum power rating under the test conditions specified or component reliability data based on actual performance in a similar application, or MIL-HDBK-338, or equivalent, such that the failure rate is equal to or less than 0.5 failures per million hours of operation.

[c] The temperature of a solid-state device (such as a transistor, SCR, or integrated circuit) shall comply with one of the following:

1) Not exceed the temperature limits specified in both (i) and (ii):

i) 50 % of its rated junction temperature, or storage temperature when not rated for junction temperature, during the normal standby condition and during any non-fire or emergency signaling condition.

Table 78.1 Continued on Next Page

Table 78.1 Continued

Component or device	Normal standby (i.e., any long term fire or smoke control condition of operation or any non-fire or non-emergency operating condition)		Alarm condition (i.e., short term operating condition of fire, smoke control, or emergency signaling)	
	°C	(°F)	°C	(°F)
ii) 75 % of its rated junction temperature, or storage temperature when not rated for junction temperature, under the alarm condition or any other short term condition of operation which produces the maximum temperature dissipation of the component. For reference purposes, 0 °C (32 °F) shall be determined as 0 %. For integrated circuits, the loading factor shall not exceed 50 % of its rating under the normal standby condition and 75 % under any condition of operation. 2) Not exceed 100 % of its rating under any condition of normal use and the component is subjected to one of the following: i) For integrated circuits the component complies with the requirements of MIL-STD 883H, Test Method Standard for Microcircuits. For all other solid state devices (such as diodes, transistors, SCR's, LEDs) the component complies with the requirements of MIL-STD-750F. ii) A quality control program established by the manufacturer consisting of inspection and testing of all pertinent parameters of 100 % of components either on an individual basis, as part of an assembly, or the equivalent. iii) Each assembled production unit is subjected to a burn-in test under the condition which results in the maximum temperatures for 24 h, while connected to a source of rated voltage and frequency in an ambient of at least 49 °C (120 °F), followed by an operation test for normal signaling performances. iv) Component reliability data based on actual performance in a similar application, or MIL-HDBK-338," or equivalent, such that the failure rate is equal to or less than 0.5 failures per million hours of operation.				

Table 78.2
Maximum Temperature Rises – Materials and Component Parts

Materials and component parts	°C	(°F)
1) Varnished cloth insulation	60	(140)
2) Fuses		
A) Class G, J, L, and CC:		
Tube	100	(212)
Ferrule or blade	85	(185)
B) Others	65	(149)
3) Fiber used as electrical insulation	65	(149)
4) Wood and similar combustible material	65	(149)
5) Any point on or within a terminal box on a permanently wired unit (refer to 62.8)	65	(149)
6) A surface upon which a permanently wired unit is mounted in service, and surfaces that are adjacent to the unit when it is mounted	65	(149)
7) Enclosure surfaces:		
A) Surfaces subject to contact during intended use or maintenance:		
Metallic	35	(95)
Non-metallic	60	(140)
B) Other Surfaces:		
Metallic	45	(113)
Non-metallic	70	(158
8) Class 105 (formerly Class A Circuit) insulation systems on windings of relays, solenoids, magnets, transformers, and similar parts:		

Table 78.2 Continued on Next Page

Table 78.2 Continued

Materials and component parts	°C	(°F)
Thermocouple method	65	(149)
Resistance method	85	(185)
9) Class 130 (formerly Class B Circuit) insulation systems on windings of relays, solenoids, magnets, transformers, and similar parts:		
Thermocouple method	85	(185)
Resistance method	105	(221)
10) Class 155 insulation systems on windings of relays, solenoids, magnets, transformers, and similar parts:		
Thermocouple method	110	(230)
Resistance method	120	(248)
11) Class 180 insulation systems on windings of relays, solenoids, magnets, transformers, and similar parts:		
Thermocouple method	125	(257)
Resistance method	135	(275)
12) Phenolic composition used as electrical insulation or as a part whose malfunction is capable of resulting in a risk of fire, electric shock, injury to persons or risk from electrical-energy/high-current levels[a].	125	(257)
13) Insulated conductors, appliance wiring material	Refer to b	
14) Sealing compound	22 °C (72 °F) less than melting point	
15) Printed-wiring board	Refer to c	

[a] The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and determined to meet the requirements for use at higher temperatures.

[b] 25 °C (77 °F) less than the established temperature rating of the wire.

[c] Temperatures on the surface of any printed-wiring board shall not exceed the temperature limits of the board.

78.3 Temperature measurements on equipment intended for recessed mounting are to be made with the unit installed in the intended manner on or against the black painted surface of an enclosure of 19.1 mm (3/4 in) wood such that the walls of the enclosure make a close fit with the product and extending approximately 50.8 mm (2 in) on the top, sides and rear, and the front extended to be flush with the product cover.

78.4 A product shall be connected to a supply circuit of rated voltage. A product having a single frequency rating is to be tested at that frequency. A product rated AC/DC or DC – 60 Hz is to be tested at both direct current and 60-Hz alternating current. A product rated 25 – 60 Hz or 50 – 60 Hz is to be tested on 50-Hz alternating current.

78.5 A product that is rated for use at more than one voltage or for a range of voltages shall be tested at each supply voltage.

78.6 A product that is rated for use at more than one voltage, or a range of voltages, and contains a tapped transformer or other means of being adapted to different supply voltages shall be tested at the most unfavorable combination of supply voltage and voltage adjustment.

Exception: The product is to be tested while connected according to the manufacturer's instructions when the product is marked according to 62.21.

78.7 For the purpose of prescreening, thermocouples consisting of wires not larger than 24 AWG 0.21 mm^2) and not smaller than 30 AWG (0.05 mm2), and an infrared temperature probe or the equivalent, are

not prohibited from being employed to identify those components and/or materials in which compliance with 78.1 is questionable and, therefore, requiring the measurements indicated in 78.8.

78.8 Temperatures are to be measured by thermocouples except the change-of-resistance method shall be used for coil and winding temperatures where the coil is inaccessible for mounting of thermocouples (for example, a coil immersed in sealing compound or where the coil wrap includes thermal insulation or more than two layers [0.8 mm (1/32 in) maximum in total thickness] of cotton, paper, rayon, or the like.

78.9 Whenever temperature measurements by thermocouples are necessary, thermocouples consisting of 0.05 mm^2 (30 AWG) iron and constantan wire and a potentiometer-type instrument are to be used. The thermocouple wire is to conform with the requirements in the Tolerances on Initial Values of EMF versus Temperature tables in ASTM E230/E230M.

78.10 The temperature of a copper coil winding is determined by the change-in-resistance method, wherein the resistance of the winding at the temperature to be determined is compared 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 °C;

R is the resistance in Ω at the temperature to be determined;

r is the resistance in Ω at the known temperature; and

t is the known temperature in °C.

78.11 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.

78.12 The circuit of a current-regulating resistor or reactor provided as part of a product is to be adjusted for the maximum resistance or reactance at rated load.

78.13 Component temperature is to be determined while the product is operated under the following conditions:

a) Normal supervisory condition (i.e. any long term fire or smoke control condition of operation or any non-fire or non-emergency operating condition) until constant temperatures occurs. If the product is intended to charge standby batteries, this test shall be conducted while connected to a discharged battery (as defined in 75.2.1 – 75.2.6).

b) Alarm condition (i.e. any short term operating condition of fire, smoke control, or emergency signaling which produces the maximum component temperature dissipation) under maximum rated load conditions until constant temperatures occur.

78.14 A temperature is determined to be constant when three successive readings taken at intervals of 10 % of the previously elapsed duration of the test, but not less than 5 min intervals, indicate no change.

78.15 In a product having provision for multiple zones, all initiating circuits shall be actuated during the alarm condition.

78.16 A product which is intended to provide coded impulse signals is to be operated by a testing device, such as a timer switch, at a rate of 120 impulses per min; except that, if the signal impulses are produced normally by a device which is a part of the product, the test impulses are to be at the maximum rate permitted by the design.

78.17 When a time-limit cutout is provided as part of the product, and is not intended to limit the time of alarm-signal operation, it is to be shunted out of the circuit for the duration of the test.

79 Dielectric Voltage-Withstand Test

79.1 A product shall withstand for 1 min without breakdown, the application of an essentially sinusoidal AC potential of a frequency within the range of 40 – 70 Hz, or a DC potential, between live parts and the enclosure, between live parts and exposed dead-metal parts (refer to 79.2), and between live parts of circuits operating at different potentials or frequencies (refer to 79.3). The test potential is to be:

a) For circuits rated 30 V AC rms (42.4 V DC or AC peak) or less – 500 V AC (707 V, when a DC potential is used);

b) For circuits rated greater than 30 and equal to or less than 150 V AC rms (42.4 and 212 V DC) – 1000 V AC (1414 V, when a DC potential is used); and

c) For circuits rated more than 150 V AC rms (212 V DC) – 1000 V AC plus twice the rated voltage (1414 V plus 2.828 times the rated AC rms voltage, when a DC potential is used). Refer to 79.4 – 79.6.

79.2 Exposed dead-metal parts are non-current-carrying metal parts that are capable of becoming energized and are accessible from outside of the enclosure of a product.

79.3 For the application of a potential between live parts of circuits operating at different potentials or frequencies, the voltage is to be the applicable value specified in 79.1, based on the highest voltage of the circuits under test. Electrical connections between the circuits are to be disconnected before the test potential is applied.

79.4 Where the charging current through a capacitor or capacitor-type filter connected across-the-line, or from line-to-earth ground is sufficient to prevent maintenance of the specified AC test potential, the capacitor or filter is to be tested using a DC test potential in accordance with 79.1.

79.5 The test potential shall be obtained from any convenient source having sufficient capacity to maintain the specified voltage. The output voltage of the test apparatus is to be monitored. The method of applying the test voltage is to be such that there are no transient voltages that result in instantaneous voltage being applied to the circuit exceeding 105 % of the peak value of the specified test voltage. The applied potential is to be:

a) Increased from 0 at a uniform rate so as to arrive at the specified test potential in approximately 5 s; and then

b) Maintained at the test potential for 1 min without an indication of a breakdown.

79.6 Manual or automatic control of the rate of rise is allowed.

79.7 A printed-wiring assembly or other electronic circuit component that is capable of short-circuiting (or being damaged by) the test potential, is to be removed, disconnected, or otherwise rendered inoperative before the test. A representative subassembly is then to be tested instead of an entire unit.

80 Electric shock current test

80.1 A shock hazard from contact with a live part is considered to exist if the open circuit potential of the part to earth ground or any other exposed accessible part exceeds 42.4 V (peak) and the available current or stored energy exceeds the values specified in 80.2, 80.3 and 80.5.

80.2 To qualify as a nonhazardous part, the continuous current flow through a 500 Ω resistor connected between the part and earth ground or any other exposed accessible part shall not exceed the values specified in Table 80.1.

Table 80.1
Maximum Acceptable Continuous Current

Frequency (Hz)[a]	Maximum acceptable current through a 500 Ω resistor (mA) peak
0 – 100	7.1
500	9.4
1000	11.0
2000	14.1
3000	17.3
4000	19.6
5000	22.0
6000	25.1
7000 or more	27.5

[a] Linear interpolation between adjacent values may be used to determine the maximum acceptable current corresponding to frequencies not shown. The Table applies to repetitive non-sinusoidal or sinusoidal waveforms.

80.3 To qualify as a nonhazardous part, the duration of a transient current flowing through a 500 Ω resistor connected between the part and earth ground or other exposed accessible part shall not exceed the following:

a) The value determined by the following equation:

$$T \leq \left(\frac{20\sqrt{2}}{I} \right)^{1.43}$$

where:

I = The peak current in milliamperes (mA); and

T = The interval, in seconds, between the time that the instantaneous value of the current first exceeds 7.1 mA and the time that the current falls below 7.1 mA for the last time; or

b) 809 mA, regardless of duration.

80.4 The interval between occurrences shall be equal to or greater than 60 s if the current is repetitive. Typical calculated values of maximum acceptable transient current duration are shown in Table 80.2.

Table 80.2
Maximum Acceptable Transient Current Duration

Maximum peak current (I) through 500 Ω resistor (mA)	Maximum acceptable duration (T) of waveform containing excursions more than 7.1 mA (peak) (s)	Maximum peak current (I) through 500 Ω resistor (mA)	Maximum acceptable duration (T) of waveform containing excursions more than 7.1 mA (peak) (ms)
7.1	7.26	30.0	919
8.5	5.58	40.0	609
10.0	4.42	50.0	443
12.5	3.21	60.0	341
15.0	2.48	70.0	274
17.5	1.99	80.0	226
20.0	1.64	90.0	191
22.5	1.39	100.0	164
25.0	1.19	150.0	92
–	–	200.0	61
–	–	250.0	44
–	–	300.0	34
–	–	350.0	27
–	–	400.0	23
–	–	450.0	19
–	–	500.0	16
–	–	600.0	12
–	–	700.0	10
–	–	809.0	8.3

80.5 The stored energy of a capacitor shall be considered nonhazardous if the maximum capacitance between the accessible terminals of the capacitor does not exceed the values given by the following equations:

$$C = \frac{88{,}400}{E^{1.43}(\ln E - 1.26)} \; for \; 42.4 \leq E \leq 400$$

$$C = 35{,}288E^{-1.5364} \; for \; 400 \leq E \leq 1000$$

where:

C = The maximum capacitance of the capacitor in microfarads; and

E = The potential in volts across the capacitor prior to discharge. *E* is to be measured 5 s after the capacitor terminals are made accessible, such as by the removal or opening of an interlocked cover, or the like.

80.6 Typical calculated values of maximum capacitance are shown in Table 80.3.

Table 80.3
Electric Shock – Stored Energy

Potential across capacitance prior to discharge (V)	Maximum acceptable capacitance (µF)	Potential across capacitance prior to discharge (V)	Maximum acceptable capacitance (µF)
1000	0.868	200	11.2
900	1.02	180	13.4
800	1.22	160	16.3
700	1.50	140	20.5
600	1.90	120	26.6
500	2.52	100	36.5
400	3.55	90	43.8
380	3.86	80	53.8
360	4.22	70	68.0
340	4.64	60	89.4
320	5.13	50	124.0
300	5.71	45	150.0
280	6.40	42.5	169.0
260	7.24	–	–
240	8.27	–	–
220	9.56	–	–

80.7 With reference to the requirements of 80.2 and 80.3 the current is to be measured while the resistor is connected between ground and each accessible part individually, and all accessible parts collectively, if the parts are simultaneously accessible. The current also is to be measured while the resistor is connected between one part or group of parts and another part or group of parts, if the parts are simultaneously accessible.

80.8 With reference to the requirements of 80.7, parts are considered to be simultaneously accessible if they can be contacted by one or both hands of a person at the same time. For the purpose of these requirements, one hand is considered to be able to contact parts simultaneously if the parts are within a 100 by 200 mm rectangle; and two hands of a person are considered to be able to contact parts simultaneously if the parts are not more than 1800 mm apart.

80.9 Electric shock current refers to all currents, including capacitively coupled currents.

80.10 If the product has a direct-current rating, measurements are to be made with the product connected in turn to each side of a 3 wire, direct current supply circuit.

80.11 Current measurements are to be made with any operating control, or adjustable control that is subject to user operation, in all operating positions, and either with or without a plug-in device, separable connector, or similar component in place. These measurements are to be made with controls placed in the position that causes maximum current flow.

81 Variable Ambient Temperature and Humidity Test

81.1 General

81.1.1 A product shall operate in the intended manner for all conditions of intended use at the test ambient conditions specified in 81.2, Low Temperature Test; 81.3, High Temperature Test; and 81.4, Humidity Test.

In the United States only:

Exception: Test ambient of 13 ±2 °C and 35 ±2 °C are permitted to be used and the humidity test is not required to be conducted when all the following conditions are met:

a) The equipment is intended only for use as proprietary or central station supervising stations;

b) The installation instructions indicate:

1) That the equipment is to be installed in an environment constantly maintained between the ambient conditions indicated above; and

2) The heating and cooling systems for the controlled environment are supplied by a secondary power source capable of sustaining the systems for a minimum standby time of 24 h; and

c) The equipment is marked with the ambient temperature limitations.

81.1.2 The unit is to be energized from a source of rated voltage and frequency and connected to maximum rated load as described in Section 68, General.

81.1.3 Where a product has a marked rated input voltage expressed in a range of values rather than a single value, each test ambient is to be conducted with the unit energized at the voltage where the unit consumes the maximum power.

81.2 Low temperature test

81.2.1 An indoor dry product (intended for indoor use/dry locations) shall operate as intended following exposure to air at the lower of the following temperatures:

a) 0 ±2 °C; or

b) The lowest ambient operating temperature specified in the product's marking.

81.2.2 The unit is to be maintained in the normal supervisory condition at the test ambient until thermal equilibrium has been reached (4 h minimum).

81.2.3 An indoor damp and wet product (intended for indoor use) shall operate as intended following exposure to 20 cycles of temperature and humidity cycling. A temperature cycle consists of a change from a temperature of 25 ±5 °C at a humidity of 95 ±2 % relative humidity to the lower temperature indicated in 81.2.1 for a period of 30 min, and back to a temperature of 25 ±5 °C at a humidity of 95 ±2 % relative humidity. The rate of change shall be 2 ±1 °C per min.

81.2.4 An outdoor damp and wet product (intended for outdoor use) shall operate as intended following exposure to 20 cycles of temperature and humidity cycling. A temperature cycle consists of a change from an ambient of 25 ±5 °C at a humidity of 95 ±2 % relative humidity to the lower of the temperatures

indicated in Items (a) or (b) for a period of 30 min, and back to a temperature of 25 ±5 °C at a humidity of 95 ±2 % relative humidity. The rate of change shall be 2 ±1 °C per min.

a) -40 ±2 °C; or

b) The lowest ambient operating temperature specified in the product's marking.

81.2.5 For the test method, the product is to be placed in a position of intended use in an air-circulating environmental chamber. The environmental chamber is to be maintained at the appropriate temperature and humidity indicated in 81.2.2 – 81.2.4. At the completion of the exposure, while at the low temperature, the product is to be operated for all conditions of intended use.

81.3 High temperature test

81.3.1 An indoor dry product (intended for indoor use/dry locations) shall operate as intended following exposure to air at the higher of the following temperatures:

a) 49 ±2 °C; or

b) The highest ambient operating temperature specified in the product's marking.

81.3.2 The unit is to be maintained in the normal supervisory condition at the test ambient until thermal equilibrium has been reached (4 h minimum).

81.3.3 An indoor damp and wet product (intended for indoor use in damp or wet locations) shall operate as intended following exposure to 20 cycles of temperature and humidity cycling. A temperature cycle consists of a change from a temperature of 25 ±5 °C at a humidity of 95 ±2 % relative humidity to the higher temperature indicated in 81.3.1 for a period of 30 min, and back to a temperature of 25 ±5 °C at a humidity of 95 ±2 % relative humidity. The rate of change shall be 2 ±1 °C per min.

81.3.4 An outdoor damp and wet product (intended for outdoor use in damp or wet locations) shall operate as intended following exposure to 20 cycles of temperature and humidity cycling. A temperature cycle consists of a change from an ambient of 25 ±5 °C at a humidity of 95 ±2 % relative humidity to the higher of the temperatures indicated below for a period of 30 min, and back to a temperature of 25 ±5 °C at a humidity of 95 ±2 % relative humidity. The rate of change shall be 2 ±1 °C per min.

a) 66 ±2 °C; or

b) The highest ambient operating temperature specified in the product's marking.

81.3.5 For the test method, the product is to be placed in a position of intended use in an air-circulating environmental chamber. The environmental chamber is to be maintained at the appropriate temperature and humidity as indicated in 81.3.1 – 81.3.4.

81.3.6 While still at the high temperature ambient, the unit shall be maintained at the maximum load conditions of intended use (including alarm condition), other than normal supervisory, for a minimum of 2 h or until constant temperature of its parts is reached. The conditions of intended use shall be permitted to be maintained simultaneously. At the completion of the exposure, while at the high temperature ambient, the product is then to be operated for all conditions of intended use.

81.4 Humidity test

81.4.1 An indoor dry product (intended for indoor use/dry locations) shall operate in the intended manner after having been exposed for 24 h to moist air having a relative humidity of 93 ±2 % at a temperature of

32 ±2 °C. At the completion of the exposure, while at the high humidity, the product is then to be operated for all conditions of intended use.

81.4.2 An indoor or outdoor, damp or wet product (intended for indoor or outdoor use, damp or wet locations) shall operate as intended during and after exposure for 240 h to air having a relative humidity of 95 ±3 % and a temperature of 60 ±2 °C. At the completion of the exposure, while at the high humidity, the product is then to be operated for all conditions of intended use.

82 Outdoor-Use Test

82.1 General

82.1.1 A product intended for either indoor/wet or outdoor/wet or damp installations shall be subjected to the tests indicated in 82.2.1.1 – 82.4.7, unless indicated otherwise.

82.2 Corrosion tests

82.2.1 General

82.2.1.1 A product shall operate as intended following the tests specified in 82.2.2.1 – 82.2.4.2. Voice amplifiers shall meet the requirements of 94.1.2.1 and 94.1.2.2

82.2.1.2 Parts and sections of the product that are not intended to be exposed to weather shall be protected from exposure to the corrosive atmosphere's representative of intended use.

82.2.1.3 The samples are not to be energized during these tests.

82.2.1.4 Two different samples of the product are to be used for each test exposure (total of six samples).

82.2.2 Salt spray test

82.2.2.1 The apparatus and test method for salt spray (fog) testing shall be in accordance with the Standard Practice for Operating Salt Spray (Fog) Apparatus, ASTM B117.

82.2.2.2 The test samples are to be suspended vertically in the test chamber for 240 h (10 d).

82.2.3 Hydrogen sulphide (H_2S) test

82.2.3.1 The test samples are to be supported as intended in service in a closed chamber having openings for gas inlet and outlet for 240 h (10 d). The chamber is to be maintained at room temperature during the test. A small amount of water is to be maintained at the bottom of the chamber.

82.2.3.2 An amount of hydrogen sulphide equivalent to 1 % of the volume of the test chamber is to be introduced into the chamber each working day. Prior to each reintroduction of the gas, the chamber is to be purged of the residual gas-air mixture from the exposure of the previous working day.

82.2.4 Sulphur-dioxide/carbon-dioxide (SO_2-CO_2) test

82.2.4.1 The test samples are to be supported as intended in service in a closed chamber having openings for gas inlet and outlet for 240 h (10 d). The chamber is to be maintained at room temperature during the test. A small amount of water is to be maintained at the bottom of the chamber.

82.2.4.2 An amount of sulphur dioxide equivalent to 1 % of the volume of the test chamber and an equal volume of carbon dioxide are to be introduced into the chamber each working day. Prior to each reintroduction of the gas, the chamber is to be purged of the residual gas-air mixture from the exposure of the previous working day.

82.3 Dust test

82.3.1 The intended operation of a product intended for outdoor use shall not be impaired by an accumulation of dust.

82.3.2 A sample in its intended mounting position is to be placed de-energized in an airtight chamber having an internal volume of at least 0.09 m^3 (3 ft^3).

82.3.3 Approximately 0.06 kg of cement dust, maintained in an ambient room temperature of approximately 23 ±2 °C at 20 – 50 relative humidity and capable of passing through a 200-mesh screen (refer to ASTM E11, is to be circulated for 15 min by means of compressed air or a blower so as to completely envelop the sample in the chamber. The airflow is to be maintained at an air velocity of approximately 0.25 m/s.

82.3.4 Following the exposure to dust, the product is to be removed, mounted in its intended position, energized from a source of supply in accordance with, Section 70, Normal Operation, and examined for its intended operation.

82.4 Water spray test

82.4.1 The section of equipment shall withstand a rain exposure for 1 h without producing a risk of electric shock or affecting the intended operation. The test shall not result in wetting of live parts.

82.4.2 The product is to be de-energized and tested under the conditions most likely to cause the entrance of water into the enclosure. Each exposure is to be for 1 h and, when more than one exposure is required, drying of the unit prior to the second or subsequent exposure is not required.

82.4.3 Field-wiring connections are to be made in accordance with the wiring method specified for the product. Openings intended to terminate in conduit are to be sealed. Openings intended for the entry of a conductor(s) for a non-hazardous voltage circuit are not to be sealed unless seals are provided as a part of the product.

82.4.4 Products employing polymeric material(s) as all or part of the enclosure shall be subjected to the mould stress-relief distortion test as described in the following standards prior to conducting this test:

a) In Canada only: CSA-C22.2 No. 0.17.

b) In the United States only: UL 746C.

82.4.5 Following each 1 h exposure, the product is to be examined to determine that no electrical parts are wetted and that there is no accumulation of water within the enclosure.

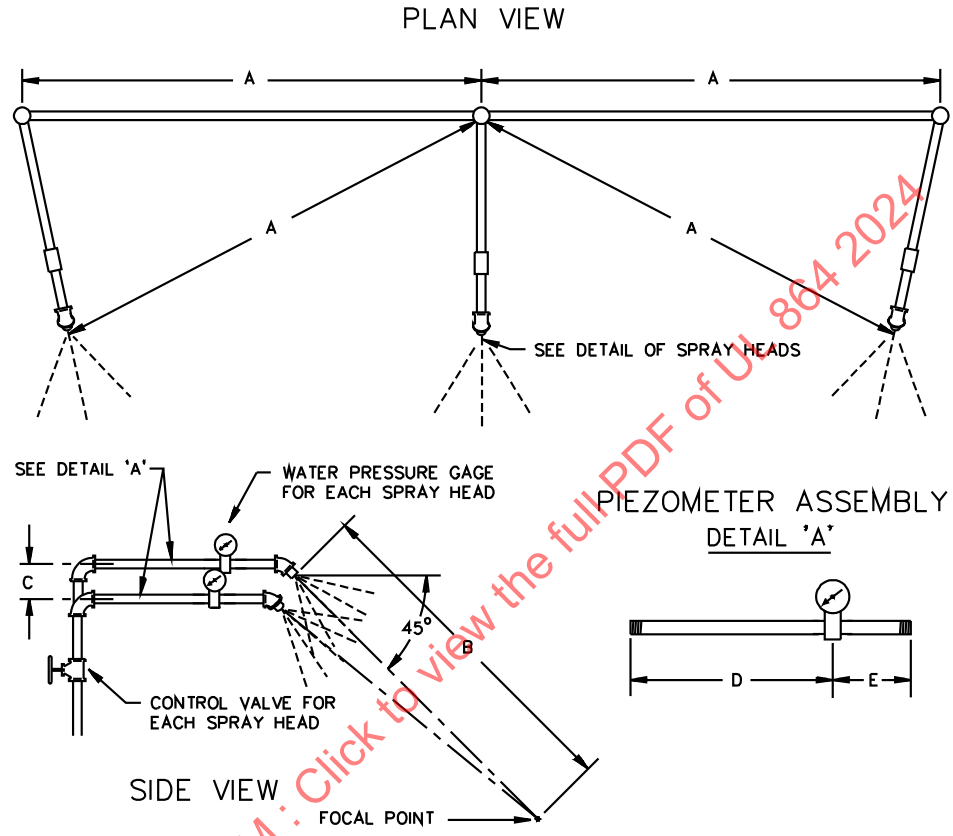
82.4.6 After each exposure, the complete product shall comply with the requirements of Section 79, Dielectric Voltage-Withstand Test. In addition, the product shall operate as intended.

82.4.7 The rain test apparatus is to consist of three spray heads mounted in a water supply rack as shown in Figure 82.1. Spray heads are to be constructed in accordance with Figure 82.2. The water pressure for all tests is to be maintained at 34.5 kPa at each spray head. The unit is to be brought into the focal area of the three spray heads in such position and under such conditions that the greatest quantity of

water will enter the product. The spray is to be directed at an angle of 45° to the vertical toward the louvers or other openings closest to live parts.

Figure 82.1

Spray Head Piping



Item	inch	mm
A	28	710
B	55	1400
C	2–1/4	55
D	9	230
E	3	75

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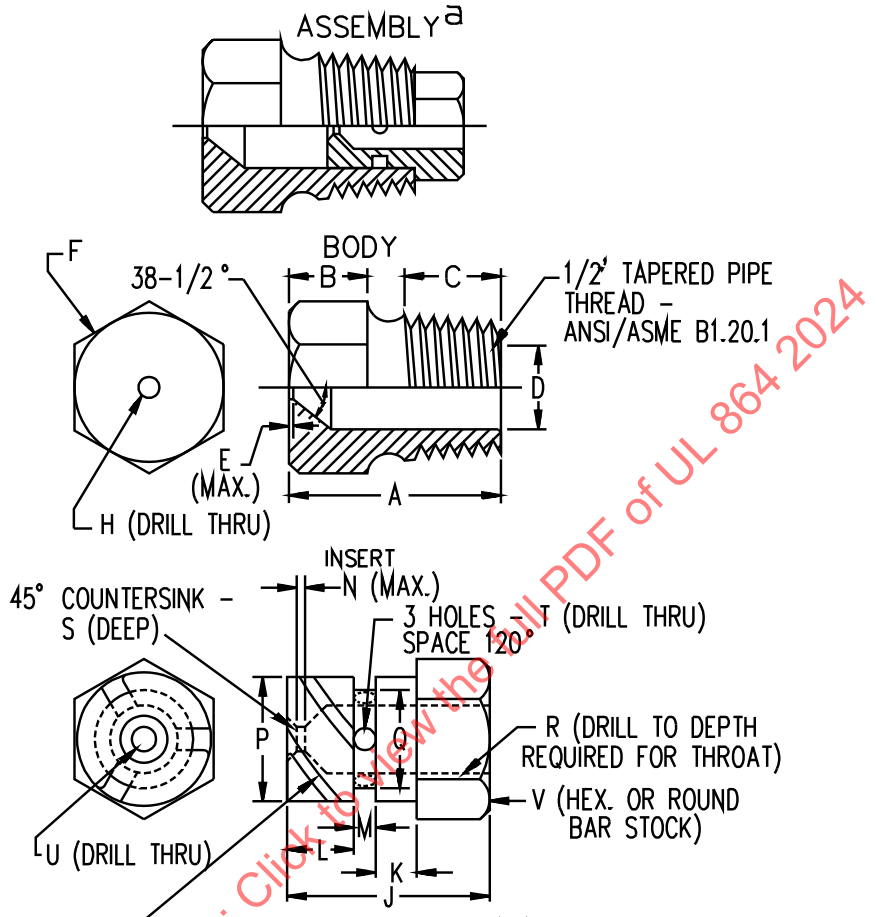
Figure 82.2

Spray Head



Item	inch	mm	Item	inch	mm
A	1-7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0		.576	14.63
D	.578	14.68	Q	.453	11.51
	.580	14.73		.454	11.53
E	1/64	0.40	R	1/4	6.35
F	c	c	S	1/32	0.80
G	.06	1.52	T	(No. 35)[b]	2.80
H	(No.9)[b]	5.0	U	(No. 40)[b]	2.50
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

[a] Nylon Rain–Test Spray Heads are available from Underwriters Laboratories

[b] ANSI B94.11M Drill Size

[c] Optional – To serve as a wrench grip.

RT100E

82.5 Gasket testing

82.5.1 General

82.5.1.1 A gasket shall be of a material able to withstand the temperature and use to which it will be subjected. The gasket material shall be resistant to aging. A gasket that will be disturbed during routine servicing, such as during battery replacement, shall be formed of resilient material such as neoprene or silicone rubber.

82.5.1.2 A gasket of neoprene, rubber, neoprene composition, or rubber composition used in a product shall be subjected to the test in 82.5.2.1 and, when intended for outdoor use, the test in 82.5.3.1 and 82.5.3.2.

82.5.1.3 A gasket material other than those specified in 82.5.1.2 meets the intent of the requirement when determined to have equivalent characteristics, including resistance to aging. Such material is determined resistant to aging when there is no visible evidence of deterioration (such as cracking, after flexing, softening, or hardening) after these characteristics are investigated.

82.5.2 Gasket accelerated aging test

82.5.2.1 A gasket of elastomeric materials such as neoprene, rubber, neoprene composition, rubber composition or flexible cellular material used to prevent the entry of water into a product shall be subjected to an accelerated aging test as specified in Table 82.1. Results are identified as satisfying the requirements in 82.5.1.1 – 82.5.1.3 when, following the test, there is no visible evidence of deterioration such as cracking after flexing, shrinkage, distortion, softening, hardening, or similar deterioration to an extent that affects the integrity of the seal intended to be provided by the material, when compared to unaged samples.

Table 82.1
Accelerated Aging Conditions

Measured temperature rise[a]				Test program[b]
More than		Not more than		
°C	(°F)	°C	(°F)	
0	(32)	35	(95)	Air-circulating oven aging for 70 h at 100 °C (212 °F)
35	(95)	50	(122)	Air-circulating oven aging for 168 h at 100 °C (212 °F)
50	(122)	55	(131)	Air-circulating oven aging for 168 h at 113 °C (235 °F)
55	(131)	65	(149)	Air-circulating oven aging for 240 h at 121 °C (250 °F)
65	(149)	80	(176)	Air-circulating oven aging for 168 h at 136 °C (277 °F)
80	(176)	120	(240)	Air-circulating oven aging for 1440 h at 150 °C (212 °F)
120	(240)	125	(257)	Air-circulating oven aging for 1440 h at 158 °C (302 °F)
125	(257)	130	(266)	Air-circulating oven aging for 1440 h at 164 °C (327 °F)
130	(266)	140	(291)	Air-circulating oven aging for 1440 h at 174 °C (345 °F)
140	(291)	150	(302)	Air-circulating oven aging for 1440 h at 184 °C (363 °F)
150	(302)	160	(320)	Air-circulating oven aging for 1440 h at 194 °C (381 °F)
160	(320)	170	(338)	Air-circulating oven aging for 1440 h at 204 °C (399 °F)
170	(338)	175	(347)	Air-circulating oven aging for 1440 h at 210 °C (410 °F)

Table 82.1 Continued on Next Page

Table 82.1 Continued

Measured temperature rise[a]				Test program[b]
More than		Not more than		
°C	(°F)	°C	(°F)	
175	(347)	185	(365)	Air-circulating oven aging for 1440 h at 220 °C (428 °F)
185	(365)	195	(383)	Air-circulating oven aging for 1440 h at 230 °C (446 °F)
195	(383)	205	(401)	Air-circulating oven aging for 1440 h at 240 °C (464 °F)
205	(401)	215	(419)	Air-circulating oven aging for 1440 h at 250 °C (482 °F)
215	(419)	225	(437)	Air-circulating oven aging for 1440 h at 260 °C (500 °F)

[a] Maximum temperature rise measured on the material during the temperature test.

[b] Air-circulating oven temperatures specified have a tolerance of ±2 °C.

82.5.3 Gasket low temperature test – outdoor use

82.5.3.1 The low temperature test is to be conducted on solid elastomer material, and both open and closed flexible cellular material utilized in products intended for outdoor use.

82.5.3.2 Three specimens of the gasket are to be subjected to 24 ±0.5 h at minus 40 ±2 °C. While at the test temperature, each specimen is to be bent within 5 s around the 6.4-mm mandrel to form a U-shaped bend. To minimize heat transfer to the specimen or "O" ring segment, gloves are to be worn. Each specimen is to be examined for evidence of cracking. Following the test, there shall be no visible evidence of deterioration such as cracking after flexing, shrinkage, distortion, softening, hardening, or similar deterioration to an extent that affects the integrity of the seal intended to be provided by the material, when compared to unconditioned samples.

82.6 Polymeric materials tests

82.6.1 A polymeric material used for (or as part of) the enclosure of a shall meet the requirements of the following tests:

a) In Canada only: CSA-C22.2 No. 0.17,

1) Ultraviolet Light Exposure Test;

2) Water Exposure and Immersion Test; and

3) The Resistance to Impact Test, which is to be conducted as specified in CSA C22.2 No. 0.17, at a low temperature of – 40 ±2 °C.

b) In the United States only: UL 746C

1) Ultraviolet Light Exposure Test;

2) Water Exposure and Immersion Test; and,

3) Resistance to Impact Test, which is to be conducted as specified in UL 746C, at a low temperature of – 40 ±2 °C

Exception: With regard to 82.6.1 (a) and (c), the examination of the property-retention parameters for a polymeric material not used as an enclosure, but attached to or exposed on the outside of the product such as a viewing window, need only include dimensional change with regard to affecting the water seal, and translucence such that viewing of required information is prohibited.

83 Jarring Test

83.1 A product shall withstand jarring resulting from impact and vibration without:

a) Resulting in a risk of shock or fire hazard;

b) Causing false signaling operation of any part; and

c) Impairing the subsequent intended operation.

83.2 Product utilizing freestanding, desktop, or other non-wall- or ceiling-type mounting shall comply with the requirements in 83.1 when subjected to the jarring described in 83.4.

83.3 Products, including batteries where applicable, weighing less than 13.6 kg and utilizing wall or ceiling mount configurations shall comply with the requirements in 83.1 when subjected to the jarring described in 83.5. Products, including batteries where applicable, weighing 13.6 kg or more and utilizing wall or ceiling mount configurations shall comply with the requirements in 83.1 when subjected to the jarring described in 83.4 or 83.5. The direct impact shall be applied to the centre of the side of the product intended to be adjacent to the mounting surface during intended mounting.

83.4 An impact of 4.10 ±0.025 J (3 ±0.03 ft/lb) is to be applied directly to any non-display area of the product by means of a minimum 540 ±5 g (1.19 ±0.01 lb), 51 ±1 mm (2 ±0.04 in) diameter steel sphere swung through a pendulum arc from a height (h) of 775 ±5 mm (30.5 ±0.2 in). The at-rest suspension point of the steel sphere is to be 25.4 ±2 mm (1 ±0.08 in) in front of the plane of the product to be impacted.

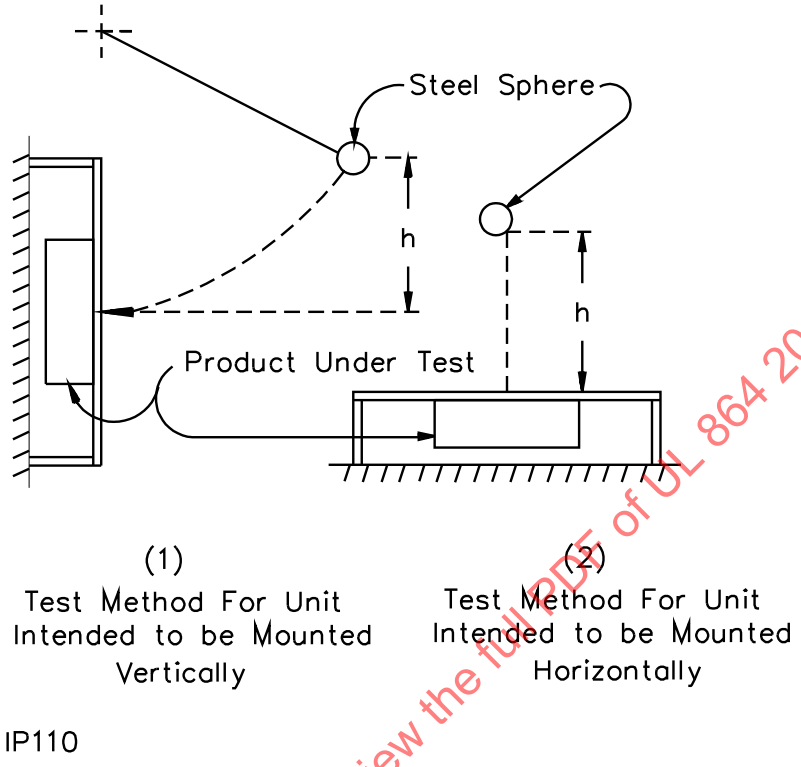
83.5 The product is to be mounted as intended to the centre of a 1.8 by 1.2 m nominal 19.1 mm thick plywood board secured in place at four corners. A 100 by 100 mm steel plate, 3.2 mm thick, shall be rigidly secured to the centre of the reverse side of the board. A 4.10 ±0.025 J (3 ±0.03 ft/lb) impact is to be applied to the centre of the steel plate by means of a 540 ±5 g (1.19 ±0.01 lb), 51 ±1 mm (2 ±0.04 in) diameter steel sphere either (Refer to Figure 83.1):

a) Swung through a pendulum arc from a height of 775 ±5 mm (30.5 ±0.2 in); or

b) Dropped from a height of 775 ±5 mm (30.5 ±0.2 in) depending upon the mounting of the equipment.

Figure 83.1

Jarring Test



83.6 During this test, the product shall be connected to a rated source of supply voltage and tested while in the normal supervisory condition.

84 Endurance Test

84.1 General

84.1.1 The product shall be tested with supply circuit at rated voltage and frequency and with rated devices or equivalent loads connected to the output circuits.

84.1.2 The number of cycles shall be based upon the frequency of expected use, with each circuit of the product tested for the number of cycles and at the rate indicated in Table 84.1:

a) The product shall not show a manifestation of a fire or risk of electrical shock and shall be capable of operating in the intended manner after being subjected to repetitive signal operation; and

b) There shall be no electrical or mechanical failure or evidence of approaching failure of the product components.

Exception No. 1: When circuits are not capable of the rate indicated in Table 84.1 the test cycle rate shall be the maximum rate permitted by the design of the product.

Exception No. 2: Voice amplifiers meeting the requirements of 84.7, Voice Amplifiers.

In the United States only:

Exception No. 3: Digital alarm communicators utilized for off-premise signaling shall be subjected to 6000 cycles of signal operation.

Table 84.1
Endurance Test Cycles

Frequency of use	Type operation	Total number of operations	Operations per min
Daily use	Coded[a]	1,000,000	60
	Noncoded[b]	30,000	15
Occasional use	Coded[a]	250,000	60
	Noncoded[b]	6,000	15

[a] "Coded" refers to a repetitive group of on-off signals.

[b] "Noncoded" refers to a continuous signal.

84.1.3 The loads or equivalent loads specified in 84.1.1 shall conform to the power factor loading indicated in 85.1.4.

84.2 Integral operating devices

84.2.1 An operating device supplied as a part of a product [such as a switch, relay, or coding mechanism (except a time-limit cutout)], shall perform as intended when operated for the number of cycles and at the rate indicated in Table 84.1. When an electrical load is involved, the contacts of the device are to make and break the normal current at the rated voltage. The load is to represent that which the device is intended to control or an equivalent load consistent with 85.2.3. The endurance tests of these devices may be conducted in conjunction with the endurance test on a product.

Exception: This requirement does not apply when the circuit controlled has a power factor less than 75 %, is not a coded or daily use type operation, and the integral operating device employs the following ratings:

a) A horsepower rating (evaluated on the basis of the ampere equivalent); or

b) A current rating of not less than 200 % of the maximum load current.

84.3 Power supplies

84.3.1 A product employing either power-supply circuitry or circuitry for the power-supply battery charger shall operate as intended following 6000 cycles operation as described in 84.3.2.

Exception: For a control unit employing only a battery charger, the product shall operate as intended after 500 cycles as specified in 84.4.1.

84.3.2 With the input of the product connected to a voltage source in accordance with Section 68, General, a resistive load or loads drawing maximum rated output power shall be connected to the power supply output and then alternately applied and removed or reduced to the manufacturer's specified minimum value at a rate consistent with 84.1.1. Each cycle is to consist of the load application followed by the load removal (or reduction) for an equal time.

84.4 Battery charger

84.4.1 For a product employing battery charger circuitry, the input circuit is to be connected to a source having a rated voltage defined by Section 68, General. A load drawing maximum charging current to a discharged battery, as defined in the Section 75, Battery Test, is to be applied to the charger circuitry for 5 s intervals for a total of 500 cycles.

84.5 Printers

84.5.1 A printer, whether separate or integral with a product, shall operate as intended after being subjected to 500 000 cycles of operation. A cycle shall consist of one full line of print or a status change recording, whichever is greater. Replacement of ink, ribbons, or other renewable components is acceptable during the conduct of the test.

84.6 Audible signal device

84.6.1 An audible signal device integral with a product shall operate as intended when the product is operated for 8 h of alternate 5 min periods of energization and de-energization, followed by 72 h of continuous energization. For this test, the product is to be connected to a source of rated voltage and frequency. For a battery-operated product, a filtered DC supply is to be used that has an output voltage equivalent to the fresh battery voltage.

84.7 Voice amplifiers

84.7.1 An amplifier shall operate as intended when operated continuously at full rated speech power for 250 h.

84.7.2 The amplifier is to be mounted as intended and operated with a sine wave input whose rms value is adjusted to deliver rated output voltage. The input frequency is to be varied from 400 to 4000 Hz at a uniform rate, then returned to 400 Hz, so that the amplifier is subjected to 400 to 4000 Hz frequency sweeps 12 times per min. The output of the amplifier is to be a resistive load equal to the combined maximum system load intended for use with the amplifier. Gain controls, if provided, are to be adjusted to the maximum gain setting.

84.7.3 Following 250 h of operation, there shall not be evidence of flame or smoke, or distortion greater than the limits specified in 94.1.2.1 and 94.1.2.2.

85 Overload Test

85.1 Products supplied from AC power

85.1.1 A product that obtains power from AC power shall not show manifestation of a fire or risk of electrical shock and shall be capable of operating as intended after being subjected to 50 cycles of alarm signal operation at a rate of not more than 15 cycles/min with the supply circuit at 115 % of rated voltage, and at rated frequency. During the cycling output circuits that receive energy from the product's power supply shall be connected as described in 85.1.2 – 85.1.5. Each cycle shall consist of starting with the product energized in the normal supervisory condition, actuating for alarm, and returning to the normal supervisory condition. There shall be no electrical or mechanical failure of any of the components of the product.

Exception: Voice amplifiers meeting the requirements of 85.4.

85.1.2 Rated loads are to be connected to those output circuits of the product that are energized from the product power supply. The loads shall be those devices normally intended for connection or other loads that have been determined to be equivalent. Where an equivalent load is used for a device consisting of an inductive load, the applicable power factor indicated in 85.1.4 is to be used.

The rated loads are established initially with the product connected to rated supply voltage and frequency, following which the input supply voltage is raised to 115 % of rating.

85.1.3 For direct current loads, an inductive load that has been determined to be equivalent is to have the required direct current resistance for the test current and the inductance (calibrated) to obtain the applicable power factor indicated in 85.1.4 when connected to a 60 Hz 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 AC current measured with the load connected to an alternating current circuit will be equal to the rated DC current multiplied by the applicable power factor indicated in 85.1.4.

85.1.4 For output circuits intended for connection to notification appliances, the power factor is to be 0.60. The power factor of a motor load is to be 0.40 to simulate locked rotor conditions. When a circuit is specified for use in pilot duty applications, the power factor is to be 0.35. A power factor of 1.0 is to be used for all other applications.

85.1.5 Unless the device controlling a motor circuit has a horsepower rating, it is to be tested with the motor stalled.

85.1.6 A product for use with a grounded supply circuit is to be tested with the enclosure and all other normally grounded parts connected through a 15 A fuse to the grounding conductor of the supply circuit.

85.2 Separately energized circuits

85.2.1 A product shall be capable of operating in the intended manner after being subjected to 50 cycles of signal operation at a rate of not more than 15 cycles/min with the product connected to a source of rated voltage and frequency and 150 % rated loads applied to output circuits which do not receive energy from the product. There shall be no electrical or mechanical failure of any of the components of the product.

Exception: This requirement does not apply when the circuit controlled has a power factor less than 75 % and the integral operating device employs the following ratings:

a) A horsepower rating (evaluated on the basis of the ampere equivalent); or

b) A current rating of not less than 200 % of the maximum load current.

85.2.2 The test loads shall be set at 150 % of rated current while connected to a separate power source of rated voltage and frequency at the applicable power factor indicated in 85.2.3.

85.2.3 For circuits intended for use with notification appliances, the power factor is to be 0.60 inductive. The power factor of a motor load is to be 0.40, inductive, to simulate locked rotor conditions. When a circuit is specified for use in pilot duty applications, the power factor is to be 0.35, inductive. Circuits rated for use with resistive loads shall use a power factor of 1.0. When no particular load application is specified, the power factor is to be 0.35, inductive.

85.3 Battery charger transfer mechanism

85.3.1 A product using a transfer mechanism in conjunction with a power-supply battery charger or a battery charger shall be capable of operating in the intended manner after the transfer mechanism is

subjected to 50 cycles, at a rate of not more than 15 cycles/min, of the greater of the two following currents;

a) 150 % of the maximum rated load (normal standby or alarm) current; or

b) One that is equivalent to the maximum inrush current entering a discharged battery connected to the charging circuitry (a discharged battery is defined in the Section 75, Battery Test).

85.4 Voice amplifiers

85.4.1 An amplifier shall operate as intended after operating at 115 % of rated supply voltage while delivering rated output current (sine wave) for at least 1 h at the frequency that results in the greatest output voltage (greatest amplifier gain). The output is to be connected to a resistive load equal to the combined maximum system load intended for use with the amplifier.

85.4.2 Following the 1 h of operation, the amplifier shall not show evidence of smoke, flame, or non-operation, or distortion greater than the limits specified in 94.1.2.1 and 94.1.2.2.

86 Transient Test

86.1 General

86.1.1 When subjected to the tests described in 86.2, Externally-Induced Supply-Line Transients; 86.3, Internally-Induced Transients; and 86.4, Input/Output Field-Wiring Transients, and while energized from a source of supply in accordance with 68.4, a product shall:

a) Not falsely annunciate alarms or troubles;

b) Not falsely actuate outputs or releasing device(s);

c) Not reset during an alarm condition;

d) Experience no electrical or mechanical failure of any components of the product;

e) Operate as intended following the test; and

f) As appropriate, retain required stored memory (such as date, type, and location of a signal transmission) within the unit.

Exception No. 1: Annunciation of a trouble signal that, either automatically restores or is manually resettable through the operator interface, is acceptable during the internally induced and input/output field-wiring transient tests.

Exception No. 2: Supplemental information stored within the product is not required to be retained during any of the transient tests.

86.1.2 Products intended to interconnect to releasing devices shall be tested with each releasing device connected as specified in the installation wiring diagram/instructions.

86.2 Externally-induced supply-line transients

86.2.1 A product intended to be powered from AC power shall be subjected to supply line transients induced directly between the power supply circuit conductors of the equipment under test.

86.2.2 For this test, the product is to be connected to a transient generator capable of producing the Location Category A3 100 kHz Ring Wave transients as defined in Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits, IEEE C62.41.

86.2.3 The product is to be subjected to 500 transient pulses induced at a rate of 6 transients per min. A total of 250 pulses are to be applied so that the transient is induced during the positive phase with reference to earth ground, and the remaining 250 pulses are to be induced during the negative phase with regard to earth ground. Of the total 250 pulses at each polarity, 225 are to be applied with the product in the normal supervisory condition and 25 are to be applied with the product in the alarm condition.

86.3 Internally-induced transients

86.3.1 The product is to be energized in the intended standby condition from a rated source of supply that is to be interrupted a total of 500 times. Each interruption is to be for approximately 1 s at a rate of not more than six interruptions per min. The test is to be conducted for each different type of secondary power source configuration described in the installation document such as internal battery charging or connection to a separate battery charger. Where the system configuration involves two or more products, each with their own AC input, the test is to be conducted by momentarily interrupting the input to all products simultaneously.

86.4 Input/output field-wiring transients

86.4.1 The product is to be energized in the normal standby condition while connected to a source of supply in accordance with Section 68, General. All field-wiring circuits rated less than or equal to 30 V rms or 42.4 V DC/peak shall be tested as specified in:

a) 86.4.2 and 86.4.3; or

b) 86.4.4 – 86.4.9.

Exception: A circuit or cable, other than that for a release suppression device circuit, that does not exceed 30 m (98.5 ft) is not required to be subjected to this test.

86.4.2 For this test, each output circuit is to be subjected to the transient waveforms specified in the Table 86.1 as delivered into a 200 Ù load. The transient pulses are to be coupled directly onto the output circuit conductors of the equipment under test.

Table 86.1
Transient Waveforms

Peak voltage level V[b]	Minimum energy level, J	Minimum pulse duration, µs	Figure No.
2400	1.0	80	Figure 86.1
1000[a]	0.31	150	Figure 86.2
500[a]	0.10	250	Figure 86.3
100	0.011	1120	Figure 86.4

[a] Other applied transients having peak voltages representative of the entire range of 100 – 2400 V shall be used in lieu of these values when the output circuit is only designed specifically to protect against these predetermined values. The transients shall meet or exceed the specified minimum pulse duration (Figure 86.5) and minimum energy level (Figure 86.6) parameters, and shall have an equal or faster minimum transient pulse rise time than that specified in Figure 86.7.

[b] The calibration of the waveforms is performed by measuring the source through a 200 Ω load in series with 0.1 uF capacitor. The capacitor is removed during the test.

Figure 86.1

Signal Line Transients – 2400V Curve

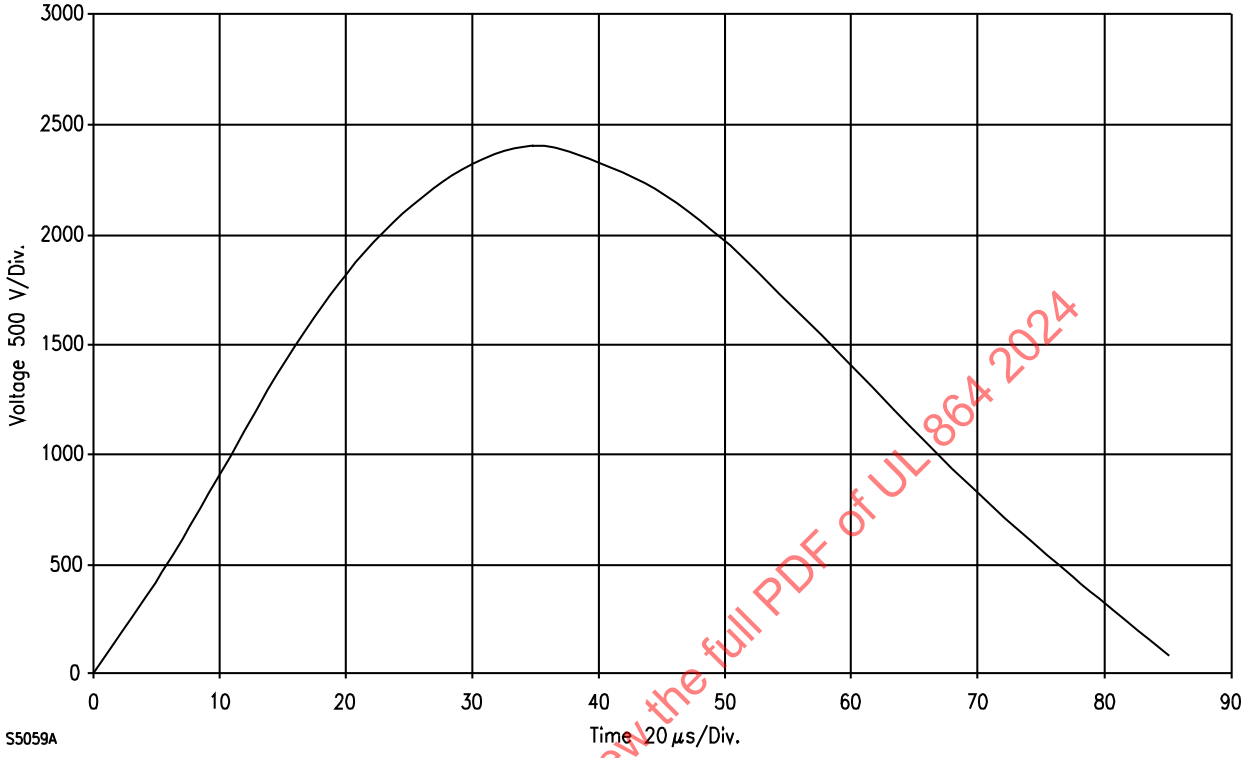


Figure 86.2

Signal Line Transients – 1000V Curve