FM Approvals

CLASS NUMBER 3010

Examination Standard for Fire Alarm Signaling Systems

September 2021

Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

TABLE OF CONTENTS

1 INTRODUCTION

1.1 PURPOSE

This standard states testing and certification requirements for fire alarm signaling systems and is largely based on NFPA 72® National Fire Alarm and Signaling Code 2013 Edition and other applicable certification standards.

1.1.1 Reference[s] to the appropriate [NFPA] paragraph[s] describing the specific requirement pertaining to a fire alarm signaling system is for additional information on a specific requirement.

1.1.2 This standard provides a guideline for typical tests that are required by the certification agency. The certification agency reserves the right to modify any test program as required to suit the specific tests needs of a given piece of equipment.

1.1.3 Testing and certification criteria may include, but are not limited to, performance requirements, critical documentation including marking requirements, examination of manufacturing facility (ies), audit of quality assurance procedures, and a surveillance program.

1.2 SCOPE

1.2.1 This standard applies to design, construction, operation, maintenance, and testing of permanently connected and permanently installed fire alarm signaling systems and associated components intended for indoor use in ordinary electrical locations. The functionality of a complete fire alarm or signaling system shall comply with the requirements of this standard.

1.2.2 The equipment covered by this standard [inter]connects to other peripheral equipment (initiating, notification and off-premises) to provide indicating and control functions associated with a commercial fire alarm system in accordance with NFPA 72.

1.2.3 Components comprising a certified fire alarm system and intended to provide a particular capability or feature, e.g. auxiliary power supplies, digital alarm communicator transmitters, will be examined including for compatibility with the particular systems with which they are to be used.

1.2.4 This standard provides the operating basis for alarm signaling and does not cover initiating devices and notification appliances as well as the use in damp, wet or hazardous (classified) locations (other standards apply).

1.2.5 Equipment covered by this standard may be combined with additional standards for use in other areas.

1.2.6 The requirements of this standard shall apply to systems, equipment, and components addressed in this standard and NFPA 72 [Chapters 7, 10, 12, 14, 17, 18, 21, 23, 24, 26 and 27].

1.2.7 The fire alarm and signaling system[s] purpose is [are] to provide: notification and location of alarm, supervisory, and trouble conditions; to alert the occupants; to summon aid; and to control emergency control functions such as releasing function.

1.3 BASIS FOR REQUIREMENTS

1.3.1 The requirements in this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.

1.3.2 The requirements in this standard reflect tests and practices used to examine characteristics of fire alarm signaling systems for the purpose of obtaining certification. Equipment having characteristics not anticipated by this standard may be certified if performance equal, or superior, to that required by this standard is demonstrated.

1.4 BASIS FOR CERTIFICATION

Certification is based on satisfactory evaluation of the product and the manufacturer in the following major areas:

1.4.1 Examination and tests on production samples shall be performed to evaluate

- the suitability of the product;
- the performance of the product as specified by the manufacturer and required for certification; and
- as far as practical, the durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be made to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.5 BASIS FOR CONTINUED CERTIFICATION

The basis for continual certification may include, but is not limited to, the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified.
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agency's product surveillance program.

1.6 EFFECTIVE DATE

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

1.7 SYSTEM OF UNITS

Units of measurement used in this standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI-10.

Two units (liter and bar), outside of but recognized by SI, are commonly used in international fire protection and are used in this standard.

1.8 NORMATIVE REFERENCES

The following referenced documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies.

FM 3810 Electrical Equipment for Measurement, Control and Laboratory Use

ANSI/NFPA 101 Life Safety Code

ANSI/NFPA 92 Standard for Smoke Control Systems

ANSI/NFPA 72: 2013 National Fire Alarm and Signaling Code

ANSI/NFPA 70 National Electrical Code

NEMA 250 Enclosures for Electrical Equipment

ANSI/IEC 60529 Degrees of Protection provided by Enclosures (IP Code)

ANSI/IEEE/ASTM SI 10 American National Standard for Metric Practice

1.9 APPLICABILITY OF OTHER STANDARDS

Except where modified by the requirements of the standards listed in 1.8, electrical equipment shall also comply with the applicable American National Standards Institute (ANSI) requirements for ordinary locations. In the event that no ANSI Standard exists for the category of equipment, then FM Approvals Examination Standard FM 3810 *Electrical Equipment for Measurement, Control and Laboratory Use* shall be used as the source document for basic safety requirements.

1.10 TERMS AND DEFINITIONS

For purposes of this standard, the following terms apply:

Acknowledge - To confirm that a message or signal has been received, such as by the pressing of a button or the selection of a software command [NFPA 72, Chapter 3.3.5].

Acoustically Distinguishable Space (ADS) - An emergency communications system notification zone, or subdivision thereof, that might be an enclosed or otherwise physically defined space, or that might be distinguished from other spaces because of different acoustical, environmental, or use characteristics, such as reverberation time and ambient sound pressure level [NFPA 72, Chapter 3.3.6].

Active Multiplex System - A multiplexing system in which signaling devices such as transponders are employed to transmit status signals of each initiating device or initiating device circuit within a prescribed time interval so that the lack of receipt of such a signal can be interpreted as a trouble signal [NFPA 72, Chapter 3.3.7].

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 [NFPA 72, Chapter 3.3.~~4~~8].

Alarm Signal - A signal indicating an emergency condition or an alert that requires action [NFPA 72, Chapter 3.3.132.2].

Alarm Verification Feature - 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 within a given time period after being reset, in order to be accepted as a valid alarm initiation signal [NFPA 72, Chapter 3.3.1~~2~~6].

Analog Initiating Device (Sensor) - An initiating device that transmits a signal indicating varying degrees of condition as contrasted with a conventional initiating device, which can only indicate an on–off condition [NFPA 72, Chapter 3.3.122.1].

Annunciator - A unit 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 [NFPA 72, Chapter 3.3.20].

Authority Having Jurisdiction [AHJ] - An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure [NFPA 72, Chapter 3.2.2].

Communications Circuit - Any signaling path of an emergency communications system that carries voice, audio, data or other signals [NFPA 72, Chapter 3.3.55].

Compatibility - A process where the equipment (controls & peripherals) are verified as suitably rated to operate and/or communicate properly as a system and as intended. Equipment can specifically be tested for compatibility and often applies to initiating devices, two-wire and digital communication type to designate operation with certain control equipment. The compatibility of four-wire type devices is often determined through electrical rating comparisons.

All devices and appliances that receive their power from the initiating device circuit or signaling line circuit of a control unit shall be listed for use with the control unit [NFPA 72, Chapter 10.3.3.]

Control Unit - A system component that monitors inputs and controls outputs through various types of circuits [NFPA 72, Chapter 3.3.59].

- ***Autonomous Control Unit (ACU)*** - The primary control unit for an in-building mass notification system [NFPA 72, Chapter 3.3.59.1].
- ***Emergency Communications Control Unit (ECCU)*** - A system capable of sending mass notification messages to individual buildings, zones of buildings, individual outdoor speaker arrays, zones of outdoor speaker arrays or; a building, multiple buildings, outside areas, or a combination of these [NFPA 72, Chapter 3.3.59.2].
- ***Fire Alarm Control Unit (FACU)*** - See Fire Alarm System definition.
- ***Wireless Control Unit*** - A component that transmits/receives and processes wireless signals [NFPA 72, Chapter 3.3.59.4].

Cross-Zone - A detection application where the operation of two detectors within a single zone or area of protection is needed to complete an operation or output. In cross zone applications, the activation of the first device causes a normal alarm notification. This application can also be accomplished via virtual or counting group or zones on addressable/intelligent systems.

Digital Alarm Communicator System (DACS) - A system in which signals are transmitted from a digital alarm communicator transmitter (DACT) located at the protected premises through the public switched telephone network to a digital alarm communicator receiver (DACR) [NFPA 72, Chapter 3.3.68].

- ***Digital Alarm Communicator Transmitter (DACT)*** - A system component at the protected premises to which initiating devices or groups of devices are connected. The DACT seizes the connected telephone line, dials a preselected number to connect to a DACR, and transmits signals indicating a status change of the initiating device [NFPA 72, Chapter 3.3.69].
- ***Digital Alarm Radio Receiver (DARR)*** - A system component composed of two subcomponents: one that receives and decodes radio signals, the other that annunciates the decoded data. These two subcomponents can be coresident at the central station or separated by means of a data transmission channel [NFPA 72, Chapter 3.3.70].
- ***Digital Alarm Radio System (DARS)*** - A system in which signals are transmitted from a digital alarm radio transmitter (DART) located at a protected premises through a radio channel to a digital alarm radio receiver (DARR) [NFPA 72, Chapter 3.3.71].
- ***Digital Alarm Radio Transmitter (DART)*** - A system component that is connected to or an integral part of a digital alarm communicator transmitter (DACT) that is used to provide an alternate radio transmission channel [NFPA 72, Chapter 3.3.72].

Emergency Communications System – A system for the protection of life by indicating the existence of an emergency situation and communicating information necessary to facilitate an appropriate response and action. [NFPA 72, Chapter 3.3.87].

- ***One-Way Emergency Communications System***. – One way emergency communications systems are intended to broadcast information, in an emergency, to people in one or more specified indoor or outdoor areas. It is intended that emergency messages be conveyed either by audible, visible, or textual means, or any combination. [NFPA 72, Chapter 3.3.87.1]
- ***Distributed Recipient Mass Notification System (DRMNS)*** - A distributed recipient mass notification system is a system meant to communicate directly to targeted individuals and groups that might not be in a contiguous area [NFPA 72, Chapter 3.3.87.1.1].
- ***In-Building Fire Emergency Voice/Alarm Communications System*** - Dedicated manual or automatic equipment for originating and distributing voice instructions, as well as alert and evacuation signals pertaining to a fire emergency, to the occupants of a building [NFPA 72, Chapter 3.3.87.1.2].
    - ***In-Building Mass Notification System -*** A system used to provide information and instructions to people in a building(s) or other space using intelligible voice communications and including visible signals, text, graphics, tactile, or other communication methods [NFPA 72, Chapter 3.3.87.1.3].
    - ***Wide-Area Mass Notification System*** - Wide-area mass notification systems are generally installed to provide real-time information to outdoor areas and could have the capability to communicate with other notification systems provided for a campus, military base, municipality, or similar single or multiple contiguous areas [NFPA 72, Chapter 3.3.87.1.4].
    - ***Two-Way Emergency Communications System*** – Two-way emergency communications systems are divided into two categories, those systems that are anticipated to be used by building occupants and those systems that are to be used by fire fighters, police, and other emergency services personnel. Two-way emergency communications systems are used to both exchange information and to communicate information such as, but not limited to, instructions, acknowledgement of receipt of messages, condition of local environment, and condition of persons, and to give assurance that help is on the way [NFPA 72, Chapter 3.3.87.2].

Emergency Communication Control Unit [ECCU] –See Control Unit [NFPA 72, Chapter 3.3.86].

Emergency Control Functions - Building, fire, and emergency control functions that are intended to increase the level of life safety for occupants or to control the spread of the harmful effects of fire [NFPA 72, Chapter 3.3.91].

Fire Alarm Control Interface - The fire alarm control interface coordinates signals to and from the fire alarm system and other systems. [NFPA 72, Chapter 3.3.137.2]

Fire Alarm Control Unit (FACU) - A component of the fire alarm system, provided with primary and secondary power sources, which receives signals from initiating devices or other fire alarm control units, and processes these signals to determine part or all of the required fire alarm system output function(s). [NFPA 72, Chapter 3.3.102]

Fire Alarm System - A system or portion of a combination system that consists of components and circuits arranged to monitor and annunciate the status of fire alarm or supervisory signal-initiating devices and to initiate the appropriate response to those signals [NFPA 72, Chapter 3.3.105].

- ***Auxiliary Alarm System*** - A protected premises fire alarm system or other emergency system at the protected premises and the system used to connect the protected premises system to a public emergency alarm reporting system for transmitting an alarm to the communications center [NFPA 72, Chapter 3.3.199.1].
- ***Central Station (Fire Alarm System)*** - See NFPA 72 Chapter 3.3.267.1, Central Station Service Alarm System. [NFPA 72, Chapter 3.3.38].
- ***Combination System*** - A fire alarm system in which components are used, in whole or in part, in common with a non-fire signaling system [NFPA 72, Chapter 3.3.105.1].
- ***Dedicated Function Fire Alarm System*** – See NFPA 72, Chapter 3.3.105.4.2.

Initiating Device - A system component that originates transmission of a change-of-state condition, such as in a smoke detector, manual fire alarm box, or supervisory switch. [NFPA 72, Chapter 3.3.132]

Initiating Device Circuit (IDC) - A circuit to which automatic or manual initiating devices are connected where the signal received does not identify the individual device operated. [NFPA 72, Chapter 3.3.133]

Master Fire Alarm Control Unit – A fire alarm control unit that serves the protected premises or portion of the protected premises as a local fire alarm control unit and accepts inputs from other fire alarm control units. [NFPA 72, Chapter 3.3.102.1]

- ***Protected Premises (Local) Control Unit*** - A fire alarm control unit that serves the protected premises or a portion of the protected premises. [NFPA 72, Chapter 3.3.102.2]
- ***Dedicated Function Fire Alarm Control Unit*** - A protected premises fire alarm control unit which is intended to provide operation of a specifically identified fire safety function. [NFPA 72, Chapter 3.3.102.2.1]
- ***Releasing Service Fire Alarm Control Unit*** - A protected premises fire alarm control unit specifically listed for releasing service that is part of a fire suppression system and which provides control outputs to release a fire suppression agent based on either automatic or manual input. [NFPA 72, Chapter 3.3.102.2.2]

Municipal (Fire Alarm System) – A public emergency alarm reporting system.. [NFPA 72, Chapter 3.3.105.3]

Managed Facility-Based Voice Network (MFVN) - A physical facilities-based network capable of transmitting real time signals with formats unchanged that is managed, operated, and maintained by the service provider to ensure service quality and reliability from the subscriber location to public switched telephone network (PSTN) interconnection points or other MFVN peer networks. [NFPA 72, Chapter 3.3.152]

Multiplexing - A signaling method characterized by transmission and reception of multiple signals on a signaling line circuit, a transmission channel, or a communications channel, including the means to positively identifying each signal. [NFPA 72, Chapter 3.3.163]

Notification Appliance - A fire alarm system component such as a bell, horn, speaker, light, or text display that provides audible, tactile, or visible outputs, or any combination thereof. [NFPA 72, Chapter 3.3.173]

Notification Appliance Circuit (NAC) - A circuit or path directly connected to a notification appliance(s). [NFPA 72, Chapter 3.3.174]

NRTL – OSHA (Occupational Safety and Health Administration) accredited Nationally Recognized Testing Laboratory.

Pathway (Pathways) -Any circuit, conductor, optic fiber, radio carrier, or other means connecting two or more locations. [3.3.190]

Pathway Survivability - The ability of any conductor, optic fiber, radio carrier, or other means for transmitting system information to remain operational during fire conditions. [NFPA 72, Chapter 3.3.191]

Positive Alarm Sequence - An automatic sequence that results in an alarm signal, even when manually delayed for investigation, unless the system is reset. [NFPA 72, Chapter 3.3.198]

Pre-Signal - An application where the operation of an input device actuates only a selective or partial notification for the purpose of notifying key personnel who then have the option of manually initiating a general alarm.

Proprietary Supervising Station (Fire Alarm System) - See Supervising Station Alarm System. [NFPA 72, Chapter 3.3.209]

Protected Premises (Local) Fire Alarm System – Afire alarm system located at the protected premises. [NFPA 72, Chapter 3.3.213, .105]

Public Emergency Alarm Reporting System - A system of alarm-initiating devices, transmitting and receiving equipment, and communication infrastructure (other than a public telephone network) used to communicate with the communications center to provide any combination of manual or auxiliary alarm service. [NFPA 72, Chapter 3.3.215]

Public Switched Telephone Network - An assembly of communications equipment and telephone service providers that utilize managed facilities-based voice networks (MFVN) to provide the general public with the ability to establish communications channels via discrete dialing codes. [NFPA 72, Chapter 3.3.220, 290]

Releasing Fire Alarm System - A protected premises fire alarm system that is part of a fire suppression system and/or which provides control inputs to a f ire suppression system related to the fire suppression system's sequence of operations and outputs for other signaling and notification. [NFPA 72, Chapter 3.3.234, .105]

Remote Supervising Station - A supervising station to which alarm, supervisory, or trouble signals or any combination of those signals emanating from protected premises fire alarm systems are received and where personnel are in attendance at all times to respond. [NFPA 72, Chapter 3.3.237, .283]

Reset - A control function that attempts to return a system or device to its normal, non-alarm state. [NFPA 72, Chapter 3.3.241]

Response Time - The time lapse from the occurrence of an input status change, (alarm, trouble or supervisory) to the activation of a system output.

Risk Analysis - A process to characterize the likelihood, vulnerability, and magnitude of incidents associated with natural, technological, and manmade disasters and other emergencies that address scenarios of concern, their probability, and their potential consequences. [NFPA 72, Chapter 3.3.246]

Signal - A status indication communicated by electrical or other means [NFPA 72, Chapter 3.3.257]:

- ***Fire Alarm Signal*** - A signal initiated by a fire alarm-initiating device such as a manual fire alarm box, automatic fire detector, water-flow switch, or other device in which activation is indicative of the presence of a fire or fire signature. [NFPA 72, Chapter 3.3.257.5]
- ***Alert Tone - An attention-getting signal to alert occupants of the pending transmission of a voice message. [NFPA 72, Chapter 3.3.17]***
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- ***Evacuation Signal - A distinctive signal intended to be recognized by the occupants as requiring evacuation of the building. [NFPA 72, Chapter 3.3.257.4]***
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- ***Supervisory Signal - A signal indicating the need for action in connection with the supervision of fire suppression systems or equipment, or the maintenance features of related systems. [NFPA 72, Chapter 3.3.287]***
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- ***Guard's Tour Supervisory Signal - A supervisory signal monitoring the performance of guard patrols. [NFPA 72, Chapter 3.3.257.6]***
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- ***Trouble Signal - A signal initiated by the fire alarm system or device indicative of a fault in a monitored circuit or component. [NFPA 72, Chapter 3.3.257.10]***

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. [NFPA 72, Chapter 3.3.259]

Supervisory Service -The service required to monitor performance of guard tours and the operative condition of fixed suppression systems or other systems for the protection of life and property [NFPA 72, Chapter 3.3.286].

Supervisory Signal Initiating Device - An initiating device such as a valve supervisory switch, water level indicator, or low air pressure switch on a dry-pipe sprinkler system in which the change of state signals an off-normal condition and its restoration to normal of a fire protection or life safety system; or a need for action in connection with guard tours, fire suppression systems or equipment, or maintenance features of related systems. [NFPA 72, Chapter 3.3.132.5]

Supplementary - As used in this Code, supplementary refers to equipment or operations not required by this Code and designated as such by the authority having jurisdiction. [NFPA 72, Chapter 3.3.289]

Two way Emergency Communication Systems – [NFPA 72, Chapter 3.3.302, .87.2] See Emergency Communications System [NFPA 72, Chapter 3.3.87].

Voice Intelligibility - Voice communication using prerecorded messages and manual voice announcements verified as being intelligible in accordance with the requirements of NFPA 72, 18.4.10. [NFPA 72, Chapter 3.3.302, .87.2, 3.3.135, 3.3.136, 14.4.11]

Wireless Protection System - A system or a part of a system that can transmit and receive signals without the aid of interconnection wiring. It can consist of either a wireless control unit or a wireless repeater. [NFPA 72, Chapter 3.3.318]

Zone - A defined area within the protected premises from which a signal can be received, an area to which a signal can be sent, or an area in which a form of control can be executed. [NFPA 72, Chapter 3.3.300]

2 GENERAL INFORMATION

2.1 FIRE ALARM AND SIGNALING PRODUCT CATEGORIZATION

Fire alarm control equipment is comprised of electronic components that when combined in accordance with the manufacturer's instructions make up a fire alarm signaling system. They may be fabricated and shipped as complete assemblies or sub-assemblies. Fire alarm control equipment is usually categorized based on the intended application or use as follows:

Protected Premises Fire Alarm Systems

- In-Building Fire Emergency Voice/Alarm Communications
- Two-Way Communication Service
- Guard's Tour Supervisory Service
- Protected Premises Fire Safety Functions
- Special Requirements for Low-Power Radio (Wireless) Systems
- Suppression System Actuation
  - Automatic Extinguishing or
  - Pre-Action & Deluge Release

Emergency Communications Systems [ECS]

- One-Way Emergency Communications System.
- Distributed Recipient Mass Notification System (DRMNS)
- In-Building Fire Emergency Voice/Alarm Communications System
- In-Building Mass Notification System
- Wide-Area Mass Notification System -
- Two-Way Emergency Communications System
- Information, Command, and Control

Supervising Station Alarm Systems

- Proprietary Supervising Station Systems
- Alarm Systems for Central Station Service
- Remote Supervising Station Alarm Systems
- Communications Methods

Public (Municipal) Emergency Reporting Systems

- Communications Methods
- Alarm Processing Equipment Alarm Boxes
- Emergency Communications Systems (ECS)

2.2 APPROVAL APPLICATION REQUIREMENTS

The manufacturer shall provide the following preliminary information with any request for Approval consideration:

- A complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration;
- General assembly drawings, complete set of manufacturing drawings, materials list, anticipated marking format, piping and electrical schematics, nameplate format, brochures, sales literature, spec. sheets, installation, operation and maintenance procedures; and
- the number and location of manufacturing facilities.
- All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

2.3 REQUIREMENTS FOR EXAMINATION

2.3.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing based on the following:

- Sample requirements to be determined by the certification agency.

2.3.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.

2.3.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency.

2.3.4 It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the maximum rated load capabilities, maximum system configurations and the devices necessary for the determination of peripheral compatibility with the fire alarm signaling equipment.

2.3.5 Review of Documentation - During the initial investigation and prior to physical testing, the manufacturer's specifications and details shall be reviewed to assess the practicality of installation and use. The certification examination results shall define the limits of the final certification.

3 GENERAL SYSTEM REQUIREMENTS

3.1 FIRE ALARM SYSTEM PHYSICAL OR STRUCTURAL FEATURES

The fire alarm equipment and enclosure shall include the required features and be suitable for the intended environmental exposures as determined by testing in accordance with this standard and acceptable national, regional, or international codes and standards (see 2.3.5).

3.1.1 Means shall be provided to mount the fire alarm equipment securely and independently of the wiring.

3.1.2 The fire alarm equipment shall be capable of withstanding normal handling and installation.

3.1.3 Fire alarm control equipment intended for use in hazardous (classified) locations shall comply with certification requirements for hazardous (classified) location electrical equipment in addition to this standard.

3.1.4 The fire alarm control equipment shall accommodate secure and compliant wiring methods in accordance with NFPA 70 including Articles 760, 770 and 800, National Electrical Code and NFPA 72, National Fire Alarm and Signaling Code.

3.1.5 The fire alarm control equipment shall be compatible with a certified fire alarm control system that will produce distinctive alarm, supervisory (if equipped) and trouble signals.

3.1.6 The fire alarm equipment shall have response times in accordance with NFPA 72, National Fire Alarm and Signaling Code and within those defined in the manufacturer's specifications and installation and operational manual. The maximum response values as found in NFPA 72 are as follows [for other system timing requirements see the applicable sections]:

- Alarm - 10 seconds
- Supervisory – 90 seconds
- Trouble – 200 seconds

3.1.7 The controls on a product intended for use in unsecured (public) areas for the purpose of signal acknowledge, reset, optional program initiation, manual override of any control sequence, or altering of system parameters, shall be of restricted access. Access shall be via a key-lock, or located within a locked cabinet, or limited by a software security code or other equivalent protection against unauthorized use.

Note: If the manual controls are accessed via the opening of the key-locked enclosure, the equipment shall be arranged so that access does not result in the exposure of live electrical parts.

3.1.8 As a minimum, all control equipment and their displays shall use the following basic indicators:

- GREEN (Normal). This green indicator shall illuminate when all power is applied to the system and no off-normal situations exist.
- RED (Fire Alarm). This red indicator shall illuminate when any fire condition exists in the building, flashing until acknowledged, steady state following acknowledgement.
- YELLOW (Supervisory signal). This yellow indicator shall illuminate when any supervisory condition exists in the building, flashing until acknowledged, steady state following acknowledgement.
- YELLOW, (Trouble signal). This yellow indicator shall illuminate when any trouble condition exists in the building, flashing until acknowledged, steady state following acknowledgement.
- For alarm, supervisory and trouble conditions, the annunciation shall be audible and visible.

While adherence to the Standard Fire Service Interface (NFPA 72, E.4, E.5) is not required, it is suggested.

3.2 EQUIPMENT CONSTRUCTION

3.2.1 Requirement

3.2.1.1 The fire alarm system construction shall not adversely affect the functionality, present the risk of fire, electric shock, and/or injury to persons that may operate the product, when tested under all conditions as defined in this standard.

3.2.1.2 As tested within the definitions of this standard, the system shall:

- Not sustain damage that may compromise functionality, except were permitted, and/or safety,
- Restrict entry of foreign objects so functionality, except were permitted, and/or safety are not compromised;
- Protection against electrical shock from enclosed live parts,
- Protect the equipment from external combustible materials,
- Have no sharp edges that may cause injury,
- Be constructed of material[s] to prevent the emission or propagation of flame, molten metal, flaming or flowing particles, or flaming drops originating from the equipment.

3.2.2 Tests/Verification

The fire alarm system construction shall be examined before and during all of the tests defined in this standard including section 5 [Operations Requirements] for compliance with the above requirements.

3.3 ESSENTIAL SAFETY AND FUNCTIONAL COMPONENT RELIABILITY

3.3.1 Requirement

The fire alarm system components shall operate satisfactorily and within their specified parameters under all conditions of testing as defined in this standard.

3.3.2 Tests/Verification

3.3.2.1 Reliability can be demonstrated with NRTL certification, testing, or equivalent means. The fit, form and function of essential system components including printed circuit boards, terminal blocks, insulated wiring, transformers, relays, circuit protectors, etc. shall be examined in accordance with the manufacturer's published specifications and this standard.

3.3.2.2 Component certifications may be incomplete in some respects. Component certification limitations shall be considered for their intended application.

3.3.2.3 Compliance documentation[s] must be provided with a declaration listing:

3.3.2.3.1 Quality management system was an integral part of the full system design,

3.3.2.3.2 System Components were chosen for the designated purpose,

3.3.2.3.3 System components will operate within the specified tolerance under all testing conditions.

3.3.2.4 The manufacturer shall demonstrate that the equipment/component reliability and suitability is acceptable for the application. Third party equipment/component reliability can be achieved with sufficient equipment field experience (e.g. ≥ 1 year). The interconnection with [in] the system must be clearly defined, and related documentation must be made available for compliance review.

3.3.2.5 Alternative method of compliance may be submitted with a rationale for equivalency.

3.4 MARKINGS

3.4.1 Requirement

3.4.1.1 The equipment shall be plainly and permanently marked so it is visible after installation and identifiable. Any information not directly affixed to the equipment must be referenced on a label affixed to the equipment. This includes references to Wiring Diagrams and Installation Instructions if not affixed to the installed system and shall include the following information:

- name and address of the manufacturer or marking traceable to the manufacturer;
- •date of manufacture or code traceable to date of manufacture or lot identification;
- •model number, size, rating, capacity, etc., as appropriate.
- •System(s) interconnections, inter-equipment wiring diagrams
- •Batteries shall be permanently marked with the [format] month/year of manufacture.

- •When hazard warnings are needed, the markings should be universally recognizable.
- Grounding markings shall be in accordance with NFPA 70 requirements.

3.4.1.2 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity. .

3.4.1.3 The certification agency's mark of conformity shall be displayed visibly and permanently on the product and/or packaging as appropriate and in accordance with the requirements of the certification agency. The manufacturer shall exercise control of this mark as specified by the certification agency and the certification scheme.

3.4.2 Test/Verification

3.4.2.1 All markings shall be legible; the size of the letters shall be suitable for the purpose.

3.4.2.2 In no case shall the type be smaller than 1.6mm (4.5 point type)

3.4.2.3 Safety warnings "Caution", "Warning", "Shock Hazard" or equivalent shall be 2.8mm, (8 point type) all other words in the safety notice to comply with the preceding requirement.

3.4.2.4 The markings shall contrast with the background (i.e. color, depth raised or lowered)

3.4.2.5 All markings shall be durable.

3.4.2.6 The markings shall be rubbed by hand, without undue pressure, for 15 seconds with a cloth soaked with the manufacturer's specified cleaning agent, or if none specified, with water. Contrasting color shall not be removed, (remain legible) and the label material shall remain attached.

3.4.2.7 The markings shall be rubbed by hand, without undue pressure, for 15 seconds with a cloth soaked with isopropyl alcohol. Contrasting color shall not be removed, (remain legible) and the label material shall remain permanently attached at the end of the 3010 test program.

3.4.2.8 Modular System Marking - The modular system manual shall list the components that comprise a certified system.

3.5 MANUFACTURER'S INSTALLATION AND OPERATION INSTRUCTIONS

3.5.1 The installation instructions or manual shall be marked with a document name, number, revision, date, along with a statement or equivalent "installation shall comply with NFPA 72, 70, and local authority having jurisdiction".

3.5.2 The following information is required with each system:

- Name (or Trademark) and Model designation.
- Environmental suitability (Operating temperature, humidity)
- All switches and indicators must be clearly marked as to the function of each
- Electrical ratings
- Enclosure ratings beyond normal suitability
- Intended use, Commercial Fire Alarm, or other as necessary
- Applicable NFPA references.
- Instructions for the installation, maintenance, and operation of the system;
- Facilities for repair of the system and supply replacement parts; and
- Services to ensure proper installation, inspection, or maintenance for systems of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection, or maintenance
- All terminals and field serviceable components shall be identified

3.5.3 The IOM [Installation, Operation, Maintenance] instructions should include at a minimum the following items:

- Instructions for the installation, testing, maintenance, and operation of the system;
- Basic operational requirements to NFPA 72 (Chapter 10, 12, 17, 18, 21, 23, 24, 26 and 27).
- Facilities for repair of the system and supply replacement parts, and
- Services to ensure proper installation, inspection, or maintenance for systems of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection, or maintenance.
- Battery calculations shall include a 20% safety margin to the calculated amp-hour rating. [NFPA 72, Chapter 10.6.7.2.1(1)]
- Installation and Operation manual shall specify "must be installed in accordance with applicable NFPA, or applicable national and local requirements".
- Installation and Operation manual shall specify "connect only certified releasing devices to certified F.A.C.P, if applicable.
- Identification of power limited and non-power limited circuits/wiring with separation requirements.
- Where circuit survivability is required in this standard, equal protection shall be provided for power supply circuits NFPA 72, Chapter 10.6.11.3.1.3]
- Class A and Class X circuit outgoing and return conductors shall be routed separately except when:
  - distance does not exceed 10 ft (3.0 m) where the outgoing and return conductors enter or exit the initiating device, notification appliance, or control unit enclosures
  - single raceway drops to individual devices or appliances
  - single raceway drops to multiple devices or appliances installed within a single room not exceeding 1000 ft^2 (93 m^2).
- Systems with releasing circuits that support Automatic Extinguishing and Pre-Action/Deluge shall include a statement in the instructions such as: system will not initiate an alarm signal due to movement of waste water, surges, or variable pressure. [NFPA 72, Chapter 17.12.3].
- Systems with voice communication using prerecorded messages and manual voice announcements shall include a statement in the instructions confirming that system voice intelligibility is in accordance with the requirements of NFPA 72, 18.4.10. [NFPA 72, Chapter 3.3.302, .87.2, 3.3.135, 3.3.136, 14.4.11]

3.6 CALIBRATION

3.6.1 Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified as traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.

3.6.2 When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of this equipment.

4 PERFORMANCE REQUIREMENTS

4.1 NORMAL OPERATIONS

4.1.1 Requirement

4.1.1.1 Representative samples of the equipment (system or modules) will be powered according to the manufacturer's instructions and programmed (if applicable) for proper operation and application. Re-wiring, re-configuring or programming to satisfy different types of applications is often required. Demonstrations or simulations at maximum rated loads of power supplies, IDC, SLC and NAC will be required.

4.1.1.2 Basic operational capabilities of a protected premises fire alarm system shall include one or more of the following features: [NFPA 72, Chapter 23.3.3.1]

1) Manual alarm signal initiation
2) Automatic alarm signal initiation
3) Monitoring of abnormal conditions in fire suppression systems
4) Activation of fire suppression systems
5) Activation of fire safety functions
6) Activation of alarm notification appliances
7) In building Emergency voice/alarm communications
8) Guard's tour supervisory service
9) Process monitoring supervisory systems
10) Activation of off-premises signals
11) Combination systems
12) Integrated systems

4.1.1.3 Alarm Signals, Supervisory Signals and Trouble Signals, their annunciation and de-activation shall be demonstrated and documented and verified to all below applicable types of systems:

- Protected Premises Fire Alarm Signaling System
- Guards Tour Supervisory Service
- Releasing Service
  - Automatic Extinguishing or
  - Pre-Action & Deluge Release
- Emergency Voice/Alarm Communication System
- Emergency Communication System[s]
- Supervising Station Fire Alarm Systems
  - Proprietary Signaling Systems
  - Fire Alarm Systems for Central Station Service
  - Remote Supervising Station Fire Alarm Systems
- Public (Municipal) Fire Alarm reporting Systems
- Auxiliary Signaling

4.1.1.4 Priority of signals shall comply with NFPA 72, Chapter 10.7.

- Fire alarm signals shall take precedence over all other signals, except as permitted for ECS priority signals or emergency mass notification signals and messages.
- Emergency mass notification signals and messages shall be permitted to have priority over fire alarm notification signals including supervisory and trouble signals in accordance with the requirements of NFPA 72, Chapter 24.
- Supervisory signals shall take precedence over trouble signals.
- Hold-up alarms or other life-threatening signals shall be permitted to take precedence over supervisory and trouble signals where acceptable to the authority having jurisdiction Hold-up alarms or other life-threatening signals shall comply with NFPA 72, Chapter 10.7.8.

4.1.1.5 Fire Alarm signal deactivation shall meet the requirements of NFPA 72, Chapter 12.6, 10.13, 10.14.7.

4.1.1.6 Distinctive Signals shall comply with NFPA 72, Chapter 10.10, 18.4.2, 23.8.4.6, 23.8.4.8, 23.13.4, 23.16.2(3), 23.16.4.5, 24.4.2.7.3, 24.4.3.14.7, 24.4.3.22.1.3(2), 24.5.1.7, 24.5.1.9, 27.6.3.2.3.14(B)(3)].

4.1.1.7 Fire Alarm Signals shall comply with NFPA 72, Chapter 10.7.2 and 10.12.

4.1.1.8 Supervisory and Trouble Annunciation shall comply with NFPA 72, Chapter 10.7.7, 10.8.2.2, 10.9.3, 10.10.5, 10.14, 10.15, 10.18.2.

4.1.1.9 Emergency control functions shall comply with: NFPA 72, Chapter 21.

4.1.1.10 Combination Systems shall comply with: NFPA 72, Chapter 23.8.4, 21.2.11, 21.7.7, 21.7.8

4.1.1.11 Interconnected Fire Alarm Systems shall comply with NFPA 72, Chapter 10.10.4, 12.6.17, 21.2.11, 21.7.7, 21.7.8, 23.3.3.2.2, 23.8.2.3, 23.8.2.7, 23.8.2.8, 24.4.3.2.5.

4.1.1.12 Fire Alarm System Inputs shall comply with NFPA 72, Chapter 23.8.5.

4.1.1.13 Fire Alarm System Notification Outputs shall comply with NFPA 72, Chapter 23.8.6.

4.1.1.14 In-Building Fire Emergency Voice/Alarm Communications shall comply with NFPA 72, Chapter 23.9, 24

4.1.1.15 Prerecorded (Digital) Voice and Tone Fire Alarm Systems shall comply with NFPA 72, Chapter 23.10.

4.1.1.16 Two-Way Communication Service shall comply with NFPA 72, Chapter 24

4.1.1.17 Suppression System Actuation shall comply with NFPA 72, Chapter 23.3.3.1, 23.8.5.4.4, 23.8.5.7, 23.8.5.8, 23.8.5.11, 23.11, 24.2.7.1, 24.4.3.22.1.3, 26.3.8.1.1, 26.3.8.3, 17.13.

4.1.1.18 Off-Premises Signals shall comply with NFPA 72, Chapter 23.14.

4.1.1.19 Guard's Tour Supervisory Service shall comply with NFPA 72, Chapter 23.15.

4.1.1.20 Suppressed (Exception Reporting) Signal System shall comply with NFPA 72, Chapter 23.1.

4.1.1.21 Special Requirements for Low-Power Radio (Wireless) Systems shall comply with NFPA 72, Chapter 23.16.

4.1.1.22 Protected Premises Fire Safety Functions shall comply with NFPA 72, Chapter 23.15.

4.1.1.23 Manual Controls shall comply with NFPA 72, Chapter 24.4, 10.16.1.

4.1.1.24 Supervisory Signal–Initiating Devices shall comply with NFPA 72, Chapter 17.16.

4.1.1.25 Sprinkler Waterflow Alarm-Initiating Devices shall comply with NFPA 72, Chapter 17.12.

4.1.1.26 Detection of the Operation of Other Automatic Extinguishing Systems shall comply with NFPA 72, Chapter 17.13.

4.1.1.27 Manually Actuated Alarm-Initiating Devices shall comply with NFPA 72, Chapter 17.14.

4.1.1.28 Fire Extinguisher Electronic Monitoring Device shall comply with NFPA 72, Chapter 17.15.

4.1.1.29 Fire Alarm Control Interface (FACI) shall comply with NFPA 72, Chapter 24.4. 3.22.1.

4.1.1.30 Fire Alarm System with capability to control Electrically Locked Doors shall comply with NFPA 72, Chapter 21.9.

4.1.1.31 Smoke Control System shall comply with NFPA 72, Chapter 17.7.5, 17.7.6.3, 21.7.2, 21.7.5, 21.7.6, 21.7.7, 21.7.8, 21.8, 24.6.1.2, NFPA 92, NFPA 101.

4.1.1.32 Public Emergency Alarm Reporting Systems shall comply with NFPA 72, Chapter 27

4.1.1.33 Fire Alarm System display and recording methods [for all transmission technologies] shall comply with NFPA 72, Chapter 26.6.4.

4.1.2 Tests/Verification

Basic operation to NFPA 72 will be verified and documented as specified in the owner's or instruction manual.

4.2 POWER SUPPLY/ELECTRICAL SUPERVISION

4.2.1 Requirement

4.2.1.1 At least two independent, reliable and supervised power sources are required for any fire alarm signaling system. While a primary dedicated branch electrical circuit and a dedicated storage battery system are the most common, other options exist and must be specified in the installation manual and may fall under the discretion of local on-site verification and AHJ acceptance (NFPA 72, Chapter 10.6).

4.2.1.2 AC "Brown-out", where the system transfers to secondary power such as batteries, shall occur at or less than 85% of rated voltage. An audible and visual trouble signal during brown out is required. Change over back to primary power shall occur at less than 90% of rated voltage.

4.2.1.3 Both primary and secondary source are to be monitored at the point of connection to the fire alarm equipment [NFPA 72, Chapter 10].

4.2.1.4 The secondary power supply shall automatically provide power to the protected premises fire alarm system within 10 seconds, whenever the primary power supply fails to provide the minimum voltage required for proper operation [NFPA 72, Chapter 10].

4.2.2 Tests/Verification

4.2.2.1 Failure of either one of the power supplies shall result in proper annunciation, be seamless and not result in any loss of data, signal transmission or annunciation that differs from normal primary power (except the loss of an AC power indication) [NFPA 72, Chapter 10.6.6].

4.2.2.2 Any secondary power supply shall have sufficient capacity to power the system for a minimum of 24 hours of standby operation followed by 5 or 15 minutes at the maximum alarm load [NFPA 72, Chapter 10.6.7.2].

4.2.2.3 The secondary power supply for an EVAC type system shall have in addition to the 24 hours standby operation followed by sufficient capacity to power the system for a 15 minute maximum alarm load [NFPA 72, Chapter 10.6.7.2].

4.2.2.4 The secondary power supply for a Pre-Action/Deluge Release panel shall have sufficient capacity to power the system for a minimum of 90 hours of standby operation followed by 5 minutes at the maximum alarm load.

4.2.2.5 Monitoring integrity of installation conductors and other Signaling Channels shall comply with NFPA 72, Chapter 12.6.

4.3 CHARACTERISTICS OF CIRCUITS AND PATHWAYS [NFPA 72, CHAPTER 12, 23.4]

4.3.1 Requirement

4.3.1.1 Proper performance of all Circuits and pathways under various adverse conditions and by their ability to survive attack from fire, [survivability] shall be verified in accordance with NFPA 72 classifications.

4.3.1.2 All devices and appliances that receive their power from the initiating device circuit, signaling line circuit, NAC circuit, or any other power output circuit of a control unit shall be certified for use with the control unit.

4.3.2 Tests/Verification

Each circuit and pathway shall be tested as defined below:

Table 1

Pathway Designation	**Performance Requirement**
Class A	Redundant path Operates past a single open Path faults are annunciated Pathways shall maintain alarm capability during the application of a single ground fault, and also during the combination of a single open and a single ground fault. An open or ground condition shall result in annunciation of a trouble signal
Class B	Does not operate past single open Does operate past single ground Path faults are annunciated
Class C	Single or multi pathways with end-to-end operational communication capability, Integrity of individual paths is not monitored. Loss of end-to-end communication is annunciated
Class D	Fail-safe operation Faults are not annunciated Operation continues in the event of a pathway failure
Class E	Not monitored for integrity
Class X	Includes a redundant path Pathways shall maintain alarm capability during the application of a single ground fault, and also during the combination of a single open and a single ground fault. An open or ground condition shall result in annunciation of a trouble signal. Operation continues past a single open or short-circuit Operation degradation, path faults are annunciated

Where the power to a device is supplied over a separate circuit from the signaling line circuit or initiating device circuit, the operation of the power circuit shall meet the performance requirements of the initiating device circuit or signaling line circuit, unless different performance requirements are established in accordance with the evaluation in NFPA 72, Chapter 23.4.3 and approved by the authority having jurisdiction.

Parts of circuits or equipment that are intentionally and permanently grounded to provide ground-fault detection, noise suppression, emergency ground signaling, and circuit protection grounding shall be permitted.

4.4 CIRCUIT SUPERVISION (IDC)

4.4.1 Requirement

4.4.1.1 IDC circuit[s] Class A, and Class B designation are defined by performance capabilities specified in the circuit pathway Table 1 in Section 4.3, in NFPA 72, Chapter 12 and the requirements of NFPA 72, Chapter 23.5.

4.4.1.2 Proper operation of Initiating Device Circuits shall be verified as defined in the installation instructions or on a label affixed to the control panel itself and NFPA 72, Chapter 12 requirements.

4.4.2 Tests/Verification

Each IDC circuit shall be subjected to fault and alarm conditions as prescribed in the above Table 1 to determine the classification of each circuit.

4.5 SMOKE DETECTOR COMPATIBILITY

4.5.1 Requirement

Smoke detector compatibility shall be verified with respective control equipment and or zone interface circuits and defined in the installation instructions or on a label affixed to the control panel itself.

4.5.2 Tests/Verification

4.5.2.1 Four wire detectors that interface via separate power and initiation shall have compatibility determined by suitable (compatible) voltage and current ratings only.

4.5.2.2 Two wire detectors that interface via the same wires for power and alarm initiation shall demonstrate compatibility as specified in the manufacturer's installation instructions and the completion of the "Smoke Detector Compatibility Data Sheet" verified either by testing or as completed and provided by another NRTL.

4.5.2.3 Analog/addressable detectors that interface via proprietary digital communication methods shall demonstrate compatibility as specified in the manufacturer's installation instructions.

4.6 CIRCUIT SUPERVISION (NAC)

4.6.1 Requirement

4.6.1.1 Proper operation of all Notification Appliance Circuits shall be verified as defined in the installation instructions or on a label affixed to the control panel itself and NFPA 72, Chapter 12 requirements.

4.6.2 Tests/Verification

4.6.2.1 Each NAC circuit shall be subjected to fault and alarm conditions as prescribed in NFPA 72, Chapter 12. NAC class designation is defined by Class A or Class B pathways performance capabilities specified in the circuit pathway, Table 1 in section 4.3.3, in NFPA 72, Chapter 12 and the requirements of NFPA 72, Chapter 23.7.

4.6.2.2 An open, ground, or short-circuit fault on the installation conductors of one alarm notification appliance circuit shall not affect the operation of any other alarm notification circuit.

4.7 NAC COMPATIBILITY

4.7.1 Requirement

Notification appliance compatibility shall be verified with respective control equipment and or notification circuits and defined in the installation instructions or on a label affixed to the control panel itself. [See also synchronization performance testing].

4.7.2 Tests/Verification

Notification appliance circuits shall have compatibility determined by suitable (compatible) voltage and current ratings.

4.8 CIRCUIT SUPERVISION (SLC)

4.8.1 Requirement

4.8.1.1 Proper operation of all Signaling Line Circuits shall be verified in accordance with NFPA 72, Chapter 12 Signaling line circuit[s]. Class A, Class B, or Class X designation is defined by performance capabilities specified in the circuit pathway, Table 1 in Section 4.3.2, in NFPA 72, Chapter 12 and the requirements of NFPA 72, Chapter 23.6.

4.8.1.2 For digital communications, a trouble signal is required when digital signals are not transmitted over a signaling line circuit.

4.8.2 Tests/Verification

Each SLC circuit shall be subjected to fault and alarm conditions as prescribed in NFPA 72, Chapter 12.

4.9 SLC COMPATIBILITY

4.9.1 Requirement

Signaling line compatibility shall be verified with respective control equipment and or SLC interface and defined in the installation instructions or on a label affixed to the control panel itself.

4.9.2 Tests/Verification

Equipment connected via signaling lines to the control equipment shall be verified as compatible via operational testing with the connected device[s].

4.10 DETECTION OF THE OPERATION OF OTHER AUTOMATIC EXTINGUISHING SYSTEMS [NFPA 72, CHAPTER 17.13]

4.10.1 Requirement

Detection of the Operation of Other Automatic Extinguishing Systems shall comply with NFPA 72, Chapter 17.13.

4.10.2 Tests/Verification

The operation of fire extinguishing systems or suppression systems shall initiate an alarm signal by alarm initiating devices installed in accordance with their individual certification requirements.

4.11 VOLTAGE VARIATIONS

4.11.1 Requirement

It shall be verified that the fire alarm system maintains the normal operational capability and functionality throughout typical voltage extremes of both the primary and secondary power supplies they are powered from. This includes auxiliary power output circuit[s], if regulated.

4.11.2 Tests/Verification

4.11.2.1 As a minimum, the normal operation of the equipment shall be verified at 85% to 110% of the rated primary (AC) and secondary (DC) power sources [NFPA 72, Chapter 10]. If the manufacturer specifies a voltage range beyond these extremes, the equipment will be tested using those values specified by the manufacturer.

4.11.2.2 Typical Voltage Ranges are defined as shown in the table below:

Nominal	**+10%**	**-15%**
120 Vac	132 Vac	102 Vac
240 Vac	264 Vac	204 Vac
12 Vdc	13.2 Vdc	10.2 Vdc
24 Vdc	26.4 Vdc	20.4 Vdc

4.12 ENVIRONMENTAL CONDITIONING

4.12.1 Requirement

It shall be verified that the fire alarm system is designed so that it is capable of performing its intended normal operational capability and functionality throughout temperature extremes and high humidity conditions that are typical of equipment intended for indoor applications. If the manufacturer specifies a temperature range beyond those typical for indoor/dry locations, the equipment will be tested using the values specified by the manufacturer.

4.12.2 Tests/Verification

As a minimum, be subjected to the following environmental extremes [NFPA 72, Chapter 10]. If rated for extremes beyond these values, the equipment will be tested using those values specified by the manufacturer.

- For a period of 4 hours at 0°C (32°F) and 49°C (120°F).
- For a period of 24 hours at a relative humidity of 90% and ambient temperature of 37.8°C (100°F).

The equipment shall:

- Operate as intended, including [if applicable] 15 min. synchronization, and show no signs of instability or false alarms during these exposures.

4.13 BATTERY CHARGE/DISCHARGE [NFPA 72, CHAPTER 10.6.10]

4.13.1 Requirement

Equipment shall be capable of recharging the secondary batteries fully within 48 hours following a single discharge cycle as specified below [NFPA 72, Chapter 10.6.10.3].

4.13.2 Tests/Verification

The equipment is allowed to be powered in a normal condition for a minimum of 48 hours to ensure that the batteries are fully charged and the charge voltage and current levels recorded. With the equipment configured to simulate the worst case standby load or condition and the primary power is disconnected (turned OFF) and the equipment is powered solely from the secondary power source for a period of 24 hrs (or 90).

Following this standby (discharge) time, the equipment is then placed into an alarm condition (with outputs at the maximum rated load) for a period of 5 minutes (or 15 minutes) and the secondary battery voltage and current reading recorded.

Following the appropriate alarm (discharge) time of 5 min. or 15 min., the primary power is restored (turned ON), the equipment is returned to a normal standby condition and allowed to charge the secondary batteries for a maximum period of 48 hours. At the end of the recharge time, the voltage and current readings are made at the battery and compared to those obtained at the start of the test. The readings are required to be similar to those initial reading for the results to be acceptable.

4.14 ENCLOSURE

4.14.1 Requirement

4.14.1.1 The system enclosures[s] constructed for indoor use must provide a degree of protection to personnel against incidental contact and to provide a degree of protection against falling objects. Additional claims made by the manufacturer shall be verified in accordance with the appropriate enclosure claims.

4.14.1.2 The enclosure must meet the ingress protection requirement for a NEMA 250, Type 1 or ANSI/IEC 60529, IP30 enclosure ratings as a minimum for indoor applications. It is not necessary to mark the product for Type 1 / IP30 enclosures. Additional claims made by the manufacturer will be verified according to specified enclosure classifications

4.14.1.3 Polymeric Materials used as an enclosure (or the sole support of current carrying parts) of a FACP shall not warp to an extent that it impairs the intended operation or exposes high voltage components.

4.14.2 Test/Verification

4.14.2.1 The enclosure will be examined to the requirements of this standard, and acceptable national, regional or international electrical codes.

4.14.2.2 Polymeric Materials, an enclosure sample shall be mounted as intended and placed in a circulating air-oven shall be aged at 194°F (90°C) for seven days or at 158°F (70°C) for twenty eight days.

4.14.2.3 Following the aging tests Polymeric Materials used as an enclosure (or the sole support of current carrying parts) of a FACP shall not warp to an extent that it impairs the intended operation or exposes high voltage components, and the unit shall operate normally following this test.

4.14.2.4 Equipment rated at or above 30 V ac and 42.4 V dc requires a proper ground terminal to be provided. The

earthing adequacy is determined by testing in accordance with appropriate acceptable national, regional, or international codes and standards.

4.14.2.5 Internal and field wiring shall comply with: this standard; NFPA 72, NFPA 70 requirements including - NEC 110 - Requirements for Electrical Installations, NEC 300 - Wiring Methods, NEC 725 - Fire Alarm Signaling Systems, and NEC 760 - Fire Alarm Signaling Systems.

4.15 VIBRATION

4.15.1 Requirement

The [AC] line connected power supply equipment (enclosure and assemblies) shall be tested to verify its mechanical strength and ability to withstand the vibration as defined in this section. As a result of this testing, there shall be no loosening of parts or visible signs of permanent deformation.

4.15.2 Tests/Verification

With the equipment powered and installed in accordance with the manufacturer's instructions, the equipment shall be subjected to a vertical movement as described below.

Duration	4 hours
Displacement	0.022 in. (0.55 mm)
Sweep Frequency Range	10 Hz-30 Hz-10 Hz
Sweep Rate	2 cycles/min.

Following the 4 hour vibration exposure, the equipment shall:

- not have loose parts
- or visible signs of permanent deformation that would compromise the electrical safety of the equipment
- operate as intended.

4.16 JARRING

4.16.1 Requirement

The system assembly shall withstand the jarring resulting from an impact as might be expected during normal installation.

4.16.2 Test/Verification

The equipment, in standby, shall be subjected to a 3 foot-pound (4.08 joules) impact. The equipment shall produce no false indication of alarm signal or non-resettable trouble signal. There shall be no loosening of parts or permanent deformation as a result of this test.

4.17 ENDURANCE

4.17.1 Requirement

The fire alarm system, in alarm, shall be tested for 6,000 on and off cycles at rated voltage and frequency with specified devices connected to the output circuits, max. device wiring load factor.

4.17.2 Tests/Verification

The fire alarm system and its components shall operate as intended and shall not exhibit any safety risks when subjected to the required endurance test.

4.18 DIELECTRIC

4.18.1 Requirement

The equipment shall withstand for 1 minute the application of AC voltage, or a DC voltage applied between live parts and the enclosure and dead metal parts that may come in contact with, and live parts of circuits operating at different voltages. The test voltages are described below.

Circuit Ratings	Dielectric Test Voltage
≤ 30 Vac (42.4 Vdc)	500 Vac (707 Vdc)
≥ 30 Vac (42.4 Vdc)	1,000 Vac + 2 x rated voltage (for Vdc multiply this value by 1.414)

4.18.2 Tests/Verification

There shall be:

- No indication of a dielectric breakdown or leakage current greater than 0.5mA during the 1 minute test exposure.

4.19 SYSTEM LOAD RATING AND OVERLOAD

4.19.1 Requirement

The standby or alarm current necessary to power the system shall not exceed 110% of the rated value over the entire voltage range that the equipment is rated or intended for, and the system/components shall continue to operate satisfactorily with no malfunctioning or failures.

4.19.2 Tests/Verification

4.19.2.1 With the equipment configured for its maximum rated current draw (outputs at full rated load). The input voltage is varied over the extremes as determined in 4.12 of this document. At no time shall the measured current value exceed 110% of the rating on the nameplate or the manufacturer's installation instructions.

4.19.2.2 The system is to be subjected to overload of 50 cycles in and out of the alarm state at a maximum of 15 cycles per minute, with alarm signal loads and 115% input voltage

4.20 DC CIRCUIT REVERSE POLARIZATION

4.20.1 Requirement

All DC supply circuits including the battery circuit shall be tested with a reverse polarity condition if such installation is possible without mechanically altering, modifying or damaging the equipment or battery.

4.20.2 Tests/Verification

The DC power leads are reversed while the primary power is OFF, and ON, if possible. Then the secondary [DC] power is turned ON. Normal operation is not required following this test, but the equipment shall fail in a safe mode (no indication of continued heating, visible fire or molten material) and indicate a trouble condition if no longer operational. Protective fuse rupture is permitted.

4.21 PROTECTIVE GROUNDING/BONDING

4.21.1 Requirement

Any equipment that contains or connects to a high voltage circuit shall provide a positive grounding system for all exposed dead metal parts to reduce the risk of electrical shock, as required by NFPA 70, Article 525.

4.21.2 Tests/Verification

4.21.2.1 The bonding resistance shall be measured at ≤ 0.1 ohm.

4.21.2.2 All bonding conductors shall be 14 AWG minimum.

Exception: 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 or those which are positively separated from wiring and un-insulated live parts.

4.22 POWER SUPPLY FAILURE

4.22.1 Requirement

The equipment shall provide the required degree of protection from fault as demonstrated by the simulation of a worst case condition failure, shorting the secondary's of line voltage connected equipment for linear power supplies, or [worst case] overload for switching power supplies.

4.22.2 Tests/Verification

With the equipment connected to an appropriately rated, time delayed, fused branch circuit in accordance with the manufacturer's instructions and all field serviceable fuses on the equipment under test are replaced with those of maximum current ratings:

The unit shall be powered and produce or result in -

- no emission of flame, escape of molten metal, or infringement of the protection against electrical shock.
- no dielectric breakdown within 1 minute of test completion.
- operation of the branch circuit fuse
- operation of any of the field serviceable fuses (when replaced with those of the maximum rated value)
- operation of any non-replaceable protection components or
- temperature stabilization where there is no further change due to the fault.

4.23 COMPONENT TEMPERATURE

4.23.1 Requirement

4.23.1.1 One powered and fully loaded system shall meet the component temperature criteria.

4.23.1.2 Using a suitable thermal measurement method, the electronic components shall be monitored for max. temperatures.

4.23.2 Tests/Verification

The equipment shall:

- Employ components that do not exceed the max. temperature values specified for the component in all worst case operational system modes including, battery charging circuit[s], power limiting circuit[s], etc.
- If applicable, not have emission of flame, escape of molten metal, or infringement of the protection against electrical shock in all operational system modes.

Exceptions:

1. component with a temperature rise greater than the Maximum specified value, may be acceptable if provided reliability data is reviewed and found to meet the intent of the component temperature requirements.

2. component temp. may be waived for the following: resistors dissipating power is [less or equal] 0.5 of rated power, or aluminum electrolytic capacitors with less than or equal to 80% working voltage derating, or all other capacitors with less than or equal to 60% working voltage de rating

4.24 POWER LIMITED AND NON POWER CIRCUITS

4.24.1 Requirement

Circuits shall comply with NFPA 72, 70 [Article 760, 800] requirements

4.24.2 Test/Verification

The equipment circuits, as well as the Installation, Operating, and Maintenance instructions shall be reviewed, tested, or equivalently demonstrated that the circuits comply with the chapter and section described above.

4.25 EXTRANEOUS TRANSIENTS (RFI IMMUNITY)

4.25.1 Requirement

The system shall be protected against extraneous transients from sources which are described below.

4.25.2 Test/Verification

One powered sample of the control equipment will be subjected to extraneous transients described below with Field strength of 40 V/m to the DUT.

Radio frequency transmissions with equivalent power levels.

Frequency:	**Watts**	***12 in. distance**
27 MHz	5	√
150-174 MHZ	5	√
450-467 MHZ	5	√
850-870 MHz	3	√
900-920 MHz	4	√

*The distance from radiating antennas to the product under test.

The system shall produce:

- No false signals (alarm or trouble)
- No reset in alarm
- No false actuation of outputs including releasing device(s)

Exception: self restoring or manually resettable trouble signal is acceptable.

4.26 FIELD WIRING TRANSIENTS (LOW VOLTAGE CIRCUITS)

4.26.1 Requirement

Protection against line surge transients will be a requirement for any low voltage circuit (power, input, outputs, releasing, IDC, SLC or NAC).

4.26.2 Test/Verification

4.26.2.1 This test applies to all system field wiring terminals that have a possibility of being subjected to line-induced voltage (i.e., initiating device circuits, releasing circuits, power circuits, and remote/auxiliary connections).

4.26.2.2 A powered sample's circuits shall be subjected to transient waveforms beginning with 100 Vdc and ending with 2,400 Vdc having peak levels of:

- 100 V dc [2]
- 500 V dc [2]
- 1,000 V dc [2]
- 2,400 V dc [4]

4.26.2.3 Transient pulses shall be applied with one polarity and opposite polarity: between any two circuit leads or terminals, and between each circuit / terminal and system safety ground.

4.26.2.4 The system shall produce:

- No false signals (alarm or trouble)

- No reset in alarm
- No false actuation of outputs including releasing device(s)
- No evidence of instability during or at the end of this test, including memory [ex. retention event history], and
- Normal system operation following this test.

Exceptions: Any circuit specified to remain in the same room or 20 ft (6 m) or less in length and in conduit. Self restoring or manually resettable trouble signal is acceptable, only if trouble condition does not impair alarm indication.

4.27 SURGE LINE TRANSIENTS

4.27.1 Requirement

The Fire Alarm System's AC voltage supplied circuits shall be protected against AC line surge transients.

4.27.2 Test/Verification

One powered sample shall be subjected to 6 kV oscillatory (100 kHz) transient pulses. Each transient pulse shall have a rise time of less than 0.5 microseconds and a total duration of 20 microseconds. The pulse decay shall result in each peak being no more than 60% of the amplitude of the preceding pulse. Each pulse shall be applied at the peak of the AC power waveform.

500 transient pulses are to be applied at a rate of 6 transients per minute. [250 positive pulses with reference to earth ground, and 250 negative pulses with reference to earth ground. Each set of pulses is to consist of 225 pulses in supervisory condition and 25 pulses in the alarm condition.]

The system shall produce:

- No false signals (alarm or trouble)
- No reset in alarm
- No false actuation of outputs including releasing device(s)
- No evidence of instability during or at the end of this test, including memory [ex. retention event history], and
- The system shall operate normally following this test.

4.28 INTERNALLY INDUCED TRANSIENTS

4.28.1 Requirement

The Fire Alarm System's AC voltage supplied circuits shall be protected against internally induced transients.

4.28.2 Test/Verification

One powered sample of the system, in standby condition and at rated AC voltage, shall be subjected to 500 on / off cycles of the AC power source. The Off cycle portion is to be about 1 second with a maximum of six cycles per minute.

The system shall produce:

- No false signals (alarm or trouble)
- No reset in alarm
- No false actuation of outputs including releasing device(s)
- No evidence of instability during or at the end of this test, including memory [ex. retention event history], and
- The system shall operate normally following this test.

If the system includes more than one AC input, the system shall be tested with all AC inputs simultaneously.

4.29 STATIC DISCHARGE

4.29.1 Requirement

The Fire Alarm System shall be protected against electrostatic discharges.

4.29.2 Test/Verification

The enclosure is to be connected to earth ground.

Time between discharges is to be at least 1 sec.

Products intended to interconnect to releasing devices shall be tested with each releasing device connected as specified in the installation wiring diagram/instructions.

Twenty 10,000 V discharges, with at least 3 discharges for each operation feature, are to be applied to the accessible points of the product.

Ten discharges shall be applied with positive polarity on the product and ten discharges with the polarity reversed.

The system shall produce:

- No false signals (alarm or trouble)
- No reset in alarm
- No false actuation of outputs including releasing device(s)
- No evidence of instability during or at the end of this test, including memory [ex. retention event history], and
- The system shall operate normally following this test.

4.30 NOTIFICATION APPLIANCE SYNCHRONIZATION AND COMPATIBILITY

4.30.1 Requirement

4.30.1.1 A Notification Appliance Circuit (NAC) intended to provide synchronization of alarm notification appliances shall meet the requirements of this section.

4.30.1.2 The synchronized pulse repetition rate shall be between 1 and 2 pulses per second.

4.30.1.3 When connected to a circuit intended to provide synchronization, the aggregate light output from all the visual notification appliances shall conform to the following:

- If the nominal flash duration of a single device is less than 10 ms, all flashes shall occur within a single 10 ms window.
- If the nominal flash duration of a single device is greater than 10 ms, the aggregate flash duration shall be not greater than the nominal single flash duration plus 10 ms.
- A maximum pulse duration shall be 0.2 second with a maximum duty cycle of 40 percent.

4.30.1.4 The pulse duration shall be defined as the time interval between initial and final points of 10 percent of maximum signal.

4.30.1.5 For Notification Appliance Circuits that are intended to provide synchronization between other such circuits within a fire alarm system, the requirements of 4.30.1.3 shall apply to all devices connected to all such circuits.

4.30.2 Test/Verification

Synchronization and compatibility shall be performed on a worst case fully loaded system [one NAC circuit fully loaded with appliances].

The synchronization testing shall be performed for 30 minutes at each of the following conditions:

- 85% rated primary voltage (with maximum simulated wiring resistance)*
- 110% rated primary voltage (with minimum simulated wiring resistance)
- 85% rated secondary (with maximum simulated wiring resistance)
- 110% rated secondary voltage (with minimum simulated wiring resistance)

*Verify battery is not contributing power.

(If there is less than 5% variation in the Notification Appliance Circuit output voltage with the above variations in primary voltage, the synchronization testing at the extremes of primary voltage may be omitted).

The synchronization testing shall be performed for 15 minutes at each exposure of the Environmental Conditioning test. It is permissible to load each NAC with a minimum of three visual notification appliances, in conjunction with a simulated

load to bring the load to the rated capacity of the circuit.

4.31 SOFTWARE REQUIREMENTS

4.31.1 Requirement

Equipment dependent on software program(s) to achieve proper operation shall meet all of the items described below (see NFPA 72, Chapter 23.2.2).

4.31.2 Tests/Verification

- Any changes to the software /firmware shall result in a revision to the release level.
- The operating software and firmware shall not be accessible for any changes or modification beyond what it has been Approved (listed) for.
- All software and firmware shall be protected from unauthorized changes.
- Any software failure that renders the system inoperable shall result in a trouble condition at the fire alarm control (e.g. watchdog timer).
- Software and firmware version[s] shall be identified on the fire alarm control unit.
- Software and firmware within the fire alarm control system that interfaces to other required software or firmware shall be functionally compatible.

4.32 RELEASING CIRCUITS (NFPA 72, CHAPTER 14.2.6, 14.2.6.5, 23.8.5.10, 23.11)

4.32.1 Requirement

The proper monitoring, supervision and operation of release circuits shall be verified (NFPA 72, Chapter 12) and listed for the following specific release categories: Automatic Extinguishing and Pre-Action/Deluge.

4.32.2 Tests/Verification

4.32.2.1 Release circuits shall:

4.32.2.1.1 Be supervised for open and ground conditions

4.32.2.1.2 Supervise the integrity and presence of the releasing device (NFPA 72, Chapter 12)

4.32.2.1.3 Demonstrate proper operation (no false trips/alarms) when subjected to 500 on/off interruptions of the primary power cycles.

4.32.2.2 For Automatic Extinguishing Release Application [all electrical measurements shall be at the end of the circuit wiring]:

4.32.2.2.1 Each circuit must remain within 20.4 to 26.4 Vdc under all conditions.

4.32.2.3 For Pre-Action and Deluge Applications:

4.32.2.3.1 Each circuit must remain within 20.4 to 26.4 Vdc under all conditions [all electrical measurements shall be at the end of the circuit wiring]

4.32.2.3.2 Must be tested for compatibility with certified releasing devices,

4.32.2.3.3 Must have specific Release Application Instructions with the following certification requirements included:

4.32.2.3.4 Class A initiating circuits only

4.32.2.3.5 90 hours stand-by operation (secondary power duration)

4.32.2.3.6 Compatible solenoids and maximum wiring distances & losses to maintain the required 20.4 Vdc at the solenoid.

4.33 CROSS ZONING

4.33.1 Requirement

Systems may have the capability of requiring the operation of two automatic detectors (cross-zoning, counting zones) to indicate an alarm as long as the following conditions are satisfied:

- Activation of the first device causes a normal alarm notification.
- Verification is defeated and cannot be used.
- At least two automatic detectors are in each zone, area or space of protection.

4.33.2 Tests/Verification

4.33.2.1 Verify occurrence of correct sequence with cross zoning operation [NFPA 72 Table 14.4.3.2].

4.33.2.2 The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed.

4.34 CONFIRMATION/ALARM VERIFICATION

4.34.1 Requirement

Systems may have the capability of automatic detection verification to indicate an alarm as long as the following conditions are satisfied: [refer to NFPA 72, Chapter 23]

- It shall not be part of any “default” configuration, and must be manually installed.
- Shall not delay the alarm actuation by more than 60 seconds
- Actuation of another detector or input device overrides the verification cycle and causes alarm operation without any additional delays.
- Enabling the alarm verification feature shall be protected by password or other limited access.

4.34.2 Tests/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature successfully demonstrated in accordance with the chapter and section described above.

4.35 PRE-SIGNAL

4.35.1 Requirement

A system may employ a Pre-Signal annunciation where the initial alarm signal is distributed to a limited or selective area only and manual activation is required for a general alarm as long as the following conditions are satisfied: [refer to NFPA 72, Chapter 23]

- It shall not be part of any “default” configuration, and must be manually installed.
- Actuation of another detector or input device overrides the Pre-Signal cycle and causes alarm operation without any additional delays.
- Any off-premises signaling (if employed) shall activate on the initial alarm

4.35.2 Tests/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature successfully demonstrated in accordance with the chapter and section described above.

4.36 POSITIVE ALARM SEQUENCE

4.36.1 Requirement

Systems may have the capability of a delaying an alarm signal (via Positive Alarm Sequence) as long as the following conditions are satisfied: [refer to NFPA 72, Chapter 23.8.1.3]

- The initial alarm signal acknowledgement must occur within 15 seconds of alarm receipt.
- Alarm activation can then be delayed up to 180 seconds (and reset during that period) but if not manually reset, shall activate the normal alarm signaling process.

4.36.2 Tests/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature successfully demonstrated in accordance with the above requirements.

4.37 DRIFT COMPENSATION

4.37.1 Requirement

Systems may employ a drift compensation capability that adjusts the sensitivity of fire detection devices as long as the following conditions are satisfied: [refer to NFPA 72, Chapter 23.8.5.4.2]:

- The fire detector remains within its prescribed sensitivity limits over the range of compensation.
- The fire detector indicates a fault condition once it has reached the limit of its adjustment.
- The control unit annunciates that the device has exceeded its compensation limits

4.37.2 Tests/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature successfully demonstrated in accordance with the appropriate NFPA chapter and section.

4.38 EMERGENCY [VOICE ALARM] COMMUNICATIONS SYSTEMS (ECS) (NFPA 72, CHAPTER 24)

4.38.1 The fire alarm system voice alarm communication feature[s] will be tested for compliance with all applicable requirements for the appropriate feature[s].

- One-Way Systems (NFPA 72, Chapter 24.4)
  - In-Building Fire Emergency Voice/Alarm Communications Systems – EVAC (NFPA 72, Chapter 24.4.2)
  - In-Building Mass Notification Systems (NFPA 72, Chapter 24.4.3)
  - Wide Area Mass Notification Systems (NFPA 72, Chapter 24.4.4)
  - Distributed Recipient Mass Notification Sys (NFPA 72, Chapter 24.4.~~4~~5)
- Two-Way Systems (NFPA 72, Chapter 24.5)
  - In-Building Wired Emergency Services Communications Systems [two-way telephone] (NFPA 72, Chapter 24.5.1)
  - Radio Communications Enhancement Systems (NFPA 72, Chapter 24.5.2)
  - Area of Refuge Emergency Communications Systems (NFPA 72, Chapter 24.5.3)
  - Elevator Emergency Communications Systems (NFPA 72, Chapter 24.5.4)

The detailed requirements are conveyed in the following paragraphs.

4.39 IN-BUILDING FIRE EMERGENCY VOICE / ALARM COMMUNICATION SYSTEMS (EVACS)

4.39.1 Requirement

4.39.1.1 The system shall allow the application of an evacuation signal to one or more zones and, at the same time allow voice paging to the other zones selectively or in any combination.

4.39.1.2 When primary power is available, failure of any audio amplifier shall result in a trouble signal. [NFPA 72, Chapter 10.19.1.1]

4.39.1.3 When an alarm is present and primary power is not available, failure of any audio amplifier shall result in a trouble signal [NFPA 72, Chapter 10.6.7.1].

4.39.1.4 Failure of any tone-generating equipment shall result in a trouble signal, unless the tone-generating and amplifying equipment are enclosed as integral parts and serve only a single, listed loudspeaker. [NFPA 72, Chapter 10.19.1.3]

4.39.1.5 Ancillary functions, such as use of a fire alarm system or mass notification system for general paging, background music, or other non-emergency functions are permitted but shall not interfere with the

performance requirements of the fire alarm system or the mass notification system.

4.39.1.6 In-Building Fire Emergency Voice/Alarm Communications Systems, Speaker amplifier and tone generating equipment, Two-Way Telephone Communications Circuit shall be monitored and supervised for presence and operation during primary power conditions [NFPA 72, Chapter 10.19.2]

4.39.1.7 Evacuation voice messages shall be preceded and followed by a minimum of two cycles of the audible emergency evacuation signal.

4.39.1.8 The use of a Positive Alarm Sequence is permitted.

4.39.1.9 The tone preceding any message shall be permitted to be a part of the voice message or to be transmitted automatically from a separate tone generator.

4.39.1.10 A pre-alert tone shall be 1 to 3 sec. duration and include a low frequency component of 520 Hz square wave range to accommodate the need of the hearing impaired for fire voice messages and emergency communication messages in occupancies where sleeping accommodations are provided.

4.39.1.11 Operating controls shall be clearly identified.

4.39.1.12 Where the system is designed to be installed in multiple locations within the same building, the following provisions shall exist:

- Only one system shall be in control at a given time
- The location of the system in control shall be visibility indicated at that location

4.39.1.13 Manual controls shall be arranged to provide visible indication of the on/off status for their associated notification zone.

4.39.1.14 Notification appliances required to provide special suppression pre-discharge notification shall not be overridden by other systems. [NFPA 72, Chapter 24 4.3.22.1.3]

4.39.1.15 When the fire alarm system has been activated, and mass notification has been given priority over the fire alarm system, a distinctive audible and visible indication shall be provided at the building fire alarm control unit. [24.2.7.2]. It shall not be required to transmit this condition to a supervising station. [NFPA 72, Chapter 24. 2.7.3]

4.39.1.16 The fire alarm system shall not automatically override emergency mass notification messages. It shall be possible to configure priority of mass notification messages over fire alarm evacuation if required by the installation [NFPA 72, Chapter 24.2.7.5, 24. 3.14.2].

4.39.1.17 Under a fire condition, where the system is used to transmit relocation instructions or other fire emergency non-evacuation messages, the system shall be capable of producing a 1-second to 3-second alert tone followed by a message (or messages where multi-channel capability is used). It shall be capable of repeating the sequence [the alert tone followed by the message(s)] at least three times.

4.39.1.18 The fire alarm system emergency voice alarm communication shall comply with: NFPA 72; ANSI/UL 1711 Amplifiers for Fire Protective Signaling Systems [Sections 31, 32, 33, 35, 41, 42, 45, 49].

4.39.2 Test/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature[s] successfully demonstrated in accordance with the chapter and section described above.

4.40 IN-BUILDING MASS NOTIFICATION SYSTEMS (MNS) (ONE WAY)

4.40.1 Requirement

4.40.1.1 MNS activation shall initiate recorded messages or live voice and visible notification. The system shall be capable of prioritizing recorded messages.

4.40.1.2 The MNS system shall be capable of configuring recorded messages to be of higher priority than fire alarm activation and to override the fire alarm notification and initiate the mass notification priority indicator. However, activation of any other recorded message shall not interfere with the operation of fire alarm notification.

4.40.1.3 Initiation of live voice announcements from microphones on the fire alarm system shall not automatically place the fire alarm system in a MNS priority mode.

4.40.1.4 The MNS shall provide the capability for authorized personnel to remotely activate live and prerecorded emergency messages.

4.40.1.5 Operating controls shall be clearly identified.

4.40.1.6 Where the system is designed to be installed in multiple locations within the same building, the following provisions shall exist:

- Only one system shall be in control at a given time
- The location of the system in control shall be visibility indicated at that location

4.40.1.7 Manual controls shall be arranged to provide visible indication of the on/off status for their associated notification zone.

4.40.1.8 Where an interface to a fire alarm system exists, or if the MNS is in combination with the fire alarm system, a manual means shall be provided to permit the MNS to relinquish control of the fire alarm system.

4.40.1.9 During the period after the MNS has seized control of the audible notification appliances, but before the MNS relinquishes control, an audible and visible signal shall be actuated by the notification appliances at least once every 30 seconds.

4.40.1.10 If the MNS system is intended to be installed in an area that is also covered by a fire alarm system, or if the MNS is integrated with the fire alarm control unit to form one combined system performing both functions, the respective systems and the interface shall be capable of:

- Deactivating all fire-alarm initiated audible and visual notification appliances if the MNS system is activated when (and only when) the fire alarm system is in the alarm mode, unless the notification devices have also been designated for MNS use.
- Deactivation of fire alarm audible and visible notification signals shall cause an individually identified supervisory signal to be initiated at the building fire alarm control unit for each affected fire alarm control unit. Under these conditions, all other features of the fire alarm system shall remain unaffected.
- Not permit the fire alarm system to turn off audible and visible notification appliances for special suppression pre-discharge notification.
- Be capable of providing a signal to a supervising station that is indicative of the MNS overriding the fire alarm system notification appliances during simultaneous fire and MNS events.

4.40.1.11 After the mass notification system relinquishes control, the following shall occur:

- Without an active fire alarm signal, the fire alarm system shall automatically restore to normal operation.
- With an active fire alarm signal, the fire alarm system shall restore to the alarm condition, unless configured to behave differently (based on the emergency response plan).

4.40.1.12 For an evacuation message, the MNS shall be capable of delivering the audible emergency evacuation signal

with a minimum of two cycles preceding and following the voice message.

4.40.1.13 The MNS shall be capable of generating a test message that clearly states “this is a test”.

4.40.1.14 If the MNS resources are used for non-emergency signals, upon activation of an emergency signal, the system shall override any local volume setting to deliver emergency signals at a preset volume setting.

4.40.1.15 Where audible notification is provided, MNS shall also provide the capability for visible notification information (strobes) to serve the hearing impaired and for high-noise areas.

4.40.1.16 Strobes used in MNS shall meet the synchronization requirements of this standard [NFPA 72 Chapter 24.4.3.17.10].

4.40.1.17 In addition to visible notification information to serve the hearing impaired and for high-noise areas, textural, graphic or visual displays are permitted. These shall meet the requirements of NFPA 72 Chapter 24.4.3.18. Any system fault condition that would prevent reliable emergency operation of any interfaced display system shall be annunciated both audibly and visibly at the affected MNS control location.

4.40.2 Test/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature[s] successfully demonstrated in accordance with the chapter and section described above.

4.41 WIDE AREA MASS NOTIFICATION SYSTEMS (ONE WAY)

4.41.1 Requirement

4.41.1.1 The requirements of voice messages for Wide Area MNS are the same as those for In Building MNS [see 4.39].

4.41.1.2 If the Wide Area MNS is designed to operate High Power Speaker Arrays (HPSA), secondary power for HPSAs shall have sufficient capacity to operate the unit for a minimum of 7 days in standby, followed by 60 minutes of operation at full load.

4.41.1.3 High Power Speaker Arrays (HPSA) shall meet the requirements of NFPA 72 Chapter 24. 4.4.4.

4.41.1.4 The interface between a Wide Area MNS and an In-Building MNS shall meet the following requirements:

- It shall be monitored for integrity, so that a fault that could prevent reliable system operation is audibly and visibly annunciated at both systems' control units.
- There shall be a primary and redundant communications link with minimal functional and spatial interconnection with each other.

4.41.2 Test/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature[s] successfully demonstrated in accordance with the chapter and section described above.

4.42 DISTRIBUTED RECIPIENT MASS NOTIFICATION (DRMN) (ONE WAY)

4.42.1 Requirement

4.42.1.1 Distributed recipient mass notification system (DRMN) alerting shall not be used in lieu of required audible and visible alerting MNS.

4.42.1.2 The DRMNS shall be capable of sending alert messages to end-users (recipients) via multiple delivery methods.

4.42.1.3 A stand-alone DRMNS used to send emergency messages shall be provided with a backup configuration to facilitate distribution of messages.

4.42.2 Test/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature[s] successfully demonstrated in accordance with the chapter and section described above.

4.43 IN-BUILDING WIRED EMERGENCY SERVICES COMMUNICATIONS SYSTEMS [TWO-WAY]

4.43.1 Requirement

4.43.1.1 Two-way telephone communications circuits shall be monitored for open and short circuit conditions that would cause the telephone communications circuit to become fully or partially inoperative. Either fault shall result in a Trouble signal.

4.43.1.2 Two-way telephone communications service shall be capable of permitting the simultaneous operation of any five telephone stations in a common talk mode.

4.43.1.3 A notification signal at the control equipment, distinctive from any other alarm, supervisory, or trouble signal, shall indicate the off-hook condition of a calling telephone circuit. If a selective talk telephone communications service is supplied, a distinctive visible indicator shall be furnished for each selectable circuit, so that all circuits with telephones off-hook are continuously and visibly indicated.

4.43.1.4 A means for silencing the audible call-in signal sounding appliance shall be permitted, provided that it is key-operated or located in a locked cabinet, or provided with protection to prevent use by unauthorized persons. The means shall operate a visible indicator and sound a trouble signal whenever the means is in the silence position and no telephone circuits are in an off-hook condition.

4.43.1.5 If a selective talk system is used, means for silencing the audible call-in signal sounding appliance as specified above shall be permitted, provided that subsequent telephone circuits going off-hook operate the distinctive off-hook signal.

4.43.1.6 Two-way telephone systems shall be common talk (i.e., a conference or party line circuit).

4.43.2 Test/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature[s] successfully demonstrated in accordance with the chapter and section described above.

4.44 RADIO COMMUNICATIONS ENHANCEMENT SYSTEMS [TWO-WAY]

4.44.1 Requirement

4.44.1.1 Two-way telephone communications circuit installation conductors shall be monitored for open and short circuit fault conditions. [NFPA 72, Chapter 10.19.2.1, 10.19.2.2]

4.44.1.2 The public safety radio enhancement system shall be capable of transmitting all public safety radio frequencies assigned to the jurisdiction and be capable of using any modulation technology.

4.44.1.3 Systems shall be capable of upgrade, to allow for instances where the jurisdiction changes or adds system frequencies, in order to maintain radio system coverage as originally designed.

4.44.1.4 Components utilized in the installation of the public safety radio enhancement system, such as repeaters, transmitters, receivers, signal boosters, cabling, and fiber-distributed antenna systems, shall be tested for compatibility with the public safety radio system.

4.44.1.5 All repeater, transmitter, receiver, and signal booster components shall be contained in a NEMA 4- or 4X- type enclosure(s).

4.44.1.6 Permanent external filters and attachments shall not be permitted.

4.44.1.7 All signal boosters shall be compatible with both analog and digital communications simultaneously.

4.44.1.8 The public safety radio communications enhancement system shall include automatic supervisory and trouble signals for malfunctions of the signal booster(s) and power supply(ies) that are annunciated by the fire alarm system and comply with the following:

1) The signal booster(s) and power supply(ies) shall be supervised.
2) System and signal booster supervisory signals shall include the following:
   a) Antenna malfunction
   b) Signal booster failure
3) Power supply supervisory signals shall include the following for each signal booster:
   a) Loss of normal ac power
   b) Failure of battery charger
   c) Low-battery capacity, alarming at 70 percent of battery capacity

4.44.1.9 A dedicated monitoring panel shall be provided to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:

1) Normal ac power
2) Signal booster trouble
3) Loss of normal ac power
4) Failure of battery charger
5) Low-battery capacity

4.44.2 Test/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature[s] successfully demonstrated in accordance with the chapter and section described above.

4.45 COMBINATION SYSTEMS

4.45.1 Requirement

Fire alarm systems shall be permitted to share components, equipment, circuitry, and installation wiring with non–fire alarm systems. Operation of a non–fire system function(s) originating within a connected non–fire system shall not interfere with the required operation of the fire alarm system, unless otherwise permitted by NFPA 72.

4.45.2 Tests/Verification

Requirement shall be verified to NFPA 72, Chapter 23.8.4 during the system examination.

4.46 GUARD'S TOUR SUPERVISORY SERVICE

4.46.1 Requirement

Systems may have the capability of a guard's tour operation as long as the following conditions and those described in NFPA 72, 23.13, 26.3.8.2, 26.4.6.6.2 are satisfied:

- It reports as a supervisory signal only

4.46.2 Tests/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature successfully demonstrated in accordance with the chapter[s] and section[s] described above.

4.47 AUXILIARY SYSTEMS

4.47.1 Requirement

Auxiliary Systems shall have the capability of signaling off-premises to a municipal or public fire service communication center using methods similar and via the same equipment as manually operated municipally connected street boxes. Auxiliary Service from protected premises shall meet the following conditions and those described in NFPA 72 Chapter 27:

- Auxiliary trip devise shall be supervised

- Shall not transmit an alarm on the occasion of any single fault to either system
- Shall have a means to disconnect from the Auxiliary System
- Shall indicate when the Auxiliary System is not in-service.

4.47.2 Tests/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature successfully demonstrated in accordance with NFPA 72, Chapter 27.6.

4.48 CENTRAL STATION SERVICE - SUPERVISING STATION ALARM SYSTEMS

4.48.1 Requirement

Equipment for Central Station Service shall have the capability of signaling (Protected Premises) or receiving (Supervising Station) using methods described in NFPA 72, Chapter 26, 10.5.4, 10.5.6, 23.12, 29.7.9 and may communicate via the following transmission techniques:

- Active Multiplex Transmission Systems.
- Digital Alarm Communicator Systems.
- Digital Alarm Radio System.
- McCulloh Systems.
- Two-Way Radio Frequency (RF) Multiplex Systems.
- One-Way Private Radio Alarm Systems.
- Private Microwave Radio Systems.
- Transmission Means complying with NFPA 72, Chapter 26.6.

4.48.2 Tests/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature successfully demonstrated in accordance with NFPA 72, Chapter 26.

4.49 DIGITAL ALARM COMMUNICATORS [DACS]

4.49.1 Requirement

Fire Alarm System DACs shall comply with the requirements in this standard and NFPA 72, Chapter 26.6.3.2

4.49.2 Tests/Verification

The Fire Alarm System [DACs] Installation, Operating, and Maintenance instructions shall be reviewed. Compliance with this standard and NFPA 72, Chapter 26.6.3.2 will be verified. DACTs are to be listed with compatible protocols [not receivers]; DACRs are to be listed with compatible protocols [not FACPs].

4.50 REMOTE STATION SERVICE - SUPERVISING STATION ALARM SYSTEMS

4.50.1 Requirement

Equipment for Remote Station Service shall have the capability of signaling (Protected Premises) or receiving (Supervising Station) using methods described in NFPA 72, Chapter 26 and may communicate via the following transmission techniques:

- Active Multiplex Transmission Systems.
- Digital Alarm Communicator Systems.
- Digital Alarm Radio System.
- McCulloh Systems.
- Two-Way Radio Frequency (RF) Multiplex Systems.
- One-Way Private Radio Alarm Systems.
- Private Microwave Radio Systems.
- Transmission Means complying with NFPA 72, Chapter 26.6

4.50.2 Tests/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature

successfully demonstrated in accordance with the chapter and section described above.

4.51 PROPRIETARY SUPERVISORY STATION SYSTEMS - SUPERVISING STATION ALARM SYSTEMS

4.51.1 Requirement

Equipment for Proprietary Supervising Station Service shall have the capability of signaling (Protected Premises) or receiving (Supervising Station) using methods described in NFPA 72, Chapter 26 and may communicate via the following transmission techniques:

- Active Multiplex Transmission Systems.
- Digital Alarm Communicator Systems.
- Digital Alarm Radio System.
- McCulloh Systems.
- Two-Way Radio Frequency (RF) Multiplex Systems.
- One-Way Private Radio Alarm Systems.
- Private Microwave Radio Systems.
- Transmission Means complying with NFPA 72, Chapter 26.6.

4.51.2 Tests/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the feature successfully demonstrated in accordance with NFPA 72, Chapter 26.

4.52 PUBLIC (MUNICIPAL) FIRE ALARM REPORTING SYSTEMS

4.52.1 Requirement

The alarm-receiving equipment at a Public Fire Service Communication Center shall comply with NFPA 72, Chapter 27, 14.4.9 requirements and have the capability of receiving signals via the following transmission techniques:

- Coded (McCulloh) Wired
- Coded Radio)
- Telephone Series
- Wireless Network Boxes.

4.52.2 Tests/Verification

The equipment, as well as the Installation, Operating, and Maintenance instructions shall be reviewed and the features successfully demonstrated in accordance with the chapter and NFPA 72, Chapter 27.

4.53 ADDITIONAL (OPTIONAL) TESTS

Additional tests may be required, at the discretion of the certification agency, depending on design features and results of any foregoing tests.

4.54 TEST FAILURE DISPOSITION

Any test following a failure shall be acceptable only at the discretion of the certification agency and with a technical justification of the conditions or reasons for failure.

5 OPERATIONS REQUIREMENTS

5.1 DEMONSTRATED QUALITY CONTROL PROGRAM

5.1.1 A quality assurance program is required to assure that subsequent equipment produced by the manufacturer shall present the same quality and reliability as the specific equipment examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests, and is documented in the certification report.
- Continued conformance to this standard is verified by the certifier's surveillance program.
- Quality of performance is determined by field performance and by periodic re-examination and testing.

5.1.2 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines;
- product design quality assurance guidelines;
- incoming quality assurance, including testing;
- in process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and
- handling and disposition of non-conforming materials.

5.1.3 Manual

There should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

5.1.4 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.5 Drawing and Change Control

- The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the certification report, must be reported to, and authorized by, the certification agency prior to implementation for production.
- Records of all revisions to all certified products shall be maintained.

5.2 SURVEILLANCE AUDIT

5.2.1 An audit of the manufacturing facility may be part of the certification agency's surveillance requirements to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to ensure a uniform product consistent with that which was tested and certified.

5.2.2 Certified products or services shall be produced or provided at, or provided from, location(s) disclosed as part of the certification examination. Manufacture of products bearing the certification mark is not permitted at any other location prior to disclosure to the certification agency.

5.3 INSTALLATION INSPECTIONS

Field inspections may be conducted to review an installation. The inspections are conducted to assess ease of application, and conformance to written specifications. When more than one application technique is used, one or all may be inspected at the discretion of the certification agency.

5.4 MANUFACTURER'S RESPONSIBILITIES

The manufacturer shall notify the certification agency of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation.

5.5 MANUFACTURING AND PRODUCTION TESTS

5.5.1 Dielectric Voltage-Withstand Test

Equipment rated at 30 V rms or 60 V dc and above shall be dielectric tested on 100% of production. The power leads and/or relay terminal leads and associated circuitry shall withstand for one minute with no insulation breakdown, the application of 1,000 V ac, 60 hz, or 1,400 V dc with respect to protective ground lead. Alternatively, test potential 20% higher may be applied for at least one second.

WARNING

The dielectric test required may present a hazard of injury

to personnel and/or property and should be performed only

by persons knowledgeable of the potential hazards of such

testing to minimize the likelihood of shock and/or fire.

5.5.2 Ground Continuity Test

The manufacturer shall verify the electrical continuity of any high-voltage cord-connected equipment to the grounding blade of the attached plug.

6 BIBLIOGRAPHY

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FM 3011 *Central Station Service for Fire Alarm Systems & Protective Equipment Supervision*

FM 3150 *Audible Notification for Automatic Fire Alarm Signaling*

FM 3210 *Heat Detectors for Automatic Fire Alarm Signaling*

FM 3230 *Smoke Actuated Detectors for Automatic Fire Alarm Signaling*

FM 3232 *Video Image Smoke Detection for Automatic Fire Alarm Signaling*

FM 3260 *Radiant Energy Sensing Fire Detectors for Automatic Fire Alarm Signaling*

NEMA SB-50 *Emergency Communications Audio Intelligibility Applications Guide*

ANSI/UL50[E] *Enclosures for Electrical Equipment [Environmental Considerations]*

ANSI/UL94 *Tests for Flammability of Plastic Materials for Parts in Devices and Appliances*

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ANSI/UL 864 *Control Units and Accessories for Fire Alarm Systems*

ISO/IEC 17025: 2017 *General Requirements for the Competence of Testing and Calibration Laboratories*.