

NFPA 72-2010 National Fire Alarm and Signaling Code

What follows are the changes that I found, as compared to the 2007 edition.

KEY: ~~Strikethrough text~~ = deleted text

Underlined text = new text

Chapter 1 Administration

Chapter 2 Referenced Publications

Chapter 3 Definitions

Chapter 4 Reserved

Chapter 5 Reserved

Chapter 6 Reserved

Chapter 7 Reserved

Chapter 8 Reserved

Chapter 9 Reserved

Chapter 10 Fundamentals

Chapter 11 Reserved

Chapter 12 Circuits and Pathways

Chapter 13 Reserved

Chapter 14 Inspection, Testing, and Maintenance

Chapter 15 Reserved

Chapter 16 Reserved

Chapter 17 Initiating Devices

Chapter 18 Notification Appliances

Chapter 19 Reserved

Chapter 20 Reserved

Chapter 21 Emergency Control Functions and Interfaces

Chapter 22 Reserved

Chapter 23 Protected Premises Fire Alarm Systems

Chapter 24 Emergency Communications Systems (ECS)

Chapter 25 Reserved

Chapter 26 Supervising Station Alarm Systems

Chapter 27 Public Emergency Alarm Reporting Systems

Chapter 28 Reserved

Chapter 29 Single- and Multiple-Station Alarms and Household Fire Alarm Systems

NFPA 72-2010 National Fire Alarm and Signaling Code

Annex A Explanatory Material

Annex B Engineering Guide for Automatic Fire Detector Spacing

Annex C System Performance and Design Guide

Annex D Speech Intelligibility

Annex E NEMA SB 30, *Fire Service Annunciator and Interface*

Annex F Sample Ordinance Adopting *NFPA 72*

Annex G Wiring Diagrams and Guide for Testing Fire Alarm Circuits

Annex H Informational References

Annex I Cross-Reference Table

Index

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 1 Administration

1.1.1 *NFPA 72* covers the application, installation, location, performance, inspection, testing, and maintenance of fire alarm systems, supervising station alarm systems, public emergency alarm reporting systems, fire warning equipment and emergency ~~warning equipment~~ communications systems (ECS), and their components.

1.2.1 The purpose of this Code is to define the means of signal initiation, transmission, notification, and annunciation; the levels of performance; and the reliability of the various types of fire alarm systems, supervising station alarm systems, public emergency alarm reporting systems, fire warning equipment, emergency communications systems, and their components.

1.2.4* This Code shall not be interpreted to require a level of fire protection that is greater than that which would otherwise be required by the applicable building or fire code.

1.3.1 Alarm systems shall be classified as follows:

- (1) Fire alarm systems
 - (a) Household fire alarm systems
 - (b) Protected premises (local) fire alarm systems
- (2) Supervising station alarm systems
 - (a) Central station (service) fire alarm systems
 - (b) Remote supervising station fire-alarm systems
 - (c) Proprietary supervising station fire-alarm systems
- (3) Public fire emergency alarm reporting systems
 - (a) Auxiliary fire-alarm systems — local energy type
 - (b) Auxiliary fire alarm systems — shunt type

1.3.2 Emergency communications systems shall be classified as follows:

- (1) One-way emergency communications systems
 - (a) Distributed recipient mass notification systems
 - (b) In-building fire emergency voice/alarm communications systems
 - (c) In-building mass notification systems
 - (d) Wide area mass notification systems
- (2) Two-way emergency communications systems
 - (a) In-building emergency communications systems

1.6.1 The units of measure in this Code are presented in the International System (SI) of units. ~~Where presented, U.S. customary units (inch-pound units) follow the SI units in parentheses.~~

1.6.2 ~~Where both systems of units are presented, either system shall be acceptable for satisfying the requirements in this Code the International System (SI) of units follow the inch-pound units in parentheses.~~

A.1.6.5 ~~Where extracted text contains values dimensions are expressed in only one system of units inches, the values in the extracted text have been retained without conversion to preserve the values established by the responsible technical committee in the source document it is intended that the precision of the measurement be 1 in., thus~~

NFPA 72-2010 National Fire Alarm and Signaling Code

plus or minus 1/2 in. The conversion and presentation of dimensions in millimeters would then have a precision of 25 mm, thus plus or minus 13 mm.

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 2 Referenced Publications

ANSI/UL 864, Standard for Control Units and Accessories for Fire Alarm Systems, 2003, revised 2006.

ISO 7240-19, Fire Detection and Alarm Systems — Part 19: Design, Installation, Commissioning and Service of Sound Systems for Emergency Purposes, 8/15/07.

ISO 7731, Danger signals for work places — Auditory danger signals.

2.3.5 Telcordia Publications. One Telcordia Drive, Piscataway, NJ 08854.

GR-506-CORE, LATA Switching Systems Generic Requirements: Signaling for Analog Interface, 2006.

GR-909-CORE, Fiber in the Loop Systems Generic Requirements, 2004.

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 3 Definitions

3.3.2* 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. (SIG-NAS)

A.3.3.2 Acoustically Distinguishable Space (ADS). All parts of a building or area intended to have occupant notification are subdivided into ADSs as defined. Some ADSs might be designated to have voice communication capability and require that those communications be intelligible. Other spaces might not require voice intelligibility or might not be capable of reliable voice intelligibility. An ADS might have acoustical design features that are conducive for voice intelligibility, or it might be a space where voice intelligibility could be difficult or impossible to achieve. Each is still referred to as an ADS.

In smaller areas, such as those under 400 ft² (40 m²), walls alone will define the ADS. In larger areas, other factors might have to be considered. In spaces that might be subdivided by temporary or movable partitions, such as ballrooms and meeting rooms, each individual configuration should be considered a separate ADS. Physical characteristics, such as a change in ceiling height of more than 20 percent, or a change in acoustical finish, such as carpet in one area and tile in another, would require those areas to be treated as separate ADSs. In larger areas, there might be noise sources that require a section to be treated as a separate ADS. Any significant change in ambient noise level or frequency might necessitate an area be considered a separate ADS.

In areas of 85 dBA or greater ambient sound pressure level, meeting the pass/fail criteria for intelligibility might not be possible, and other means of communication might be necessary.

So, for example, the space immediately surrounding a printing press or other high-noise machine might be designated as a separate ADS, and the design might call for some form of effective notification but not necessarily require the ability to have intelligible voice communication. The aisles or operator's control stations might be separate ADSs where intelligible voice communication might be desired.

Significant differences in furnishings, for example, an area with tables, desks, or low dividers, adjacent to an area with high shelving, would require separate consideration. The entire desk area could be a single acoustic zone, whereas each area between shelving could be a unique zone. Essentially, any noteworthy change in the acoustical environment within an area will mandate consideration of that portion of the area to be treated as an acoustic zone. Hallways and stairwells will typically be considered as individual acoustic zones.

Spaces confined by walls with carpeting and acoustical ceilings can be deemed to be one ADS. An ADS should be an area of consistent size and material. A change of materials from carpet to hard tile, the existence of sound sources, such as decorative waterfalls, large expanses of glass, and changes in ceiling height, are all factors that might separate one ADS from another.

Each ADS might require different components and design features to achieve intelligible voice communication. For example, two ADSs with similar acoustical treatments and noise levels might have different ceiling heights. The ADS with the lower ceiling height

NFPA 72-2010 National Fire Alarm and Signaling Code

might require more ceiling-mounted speakers to ensure that all listeners are in a direct sound field (see Figure A.3.3.2). Other ADSs might benefit from the use of alternate speaker technologies, such as line arrays, to achieve intelligibility.

An ADS that differs from another because of the frequency and level of ambient noise might require the use of speakers and system components that have a wider frequency bandwidth than conventional emergency communications equipment.

However, designers should not use higher bandwidth speakers in all locations, unless needed to overcome certain acoustic and ambient conditions. This is because the higher bandwidth appliance will require more energy to perform properly. This increases amplifier and wire size and power supply requirements.

In some spaces, it might be impractical to achieve intelligibility, and, in such a case, alternatives to voice evacuation might be required within such areas.

There might be some areas of a facility where there are several spaces of the same approximate size and the same acoustic properties. For example, there might be an office space with multiple individual offices, each with one speaker.

If one or two are satisfactorily tested, there is no need to test all of them for speech intelligibility.

3.3.8.1 Auxiliary Box. An alarm box that can only be operated from one or more remote initiating devices or an auxiliary fire alarm system used to send an alarm to the ~~public fire service~~ communications center. (SIG-PRS)

3.3.8.3 Manual Fire Alarm Box. A manually operated device used to initiate a ~~fire~~ alarm signal. (SIG-IDS)

3.3.8.4 Master Box. A publicly accessible fire alarm box that can also be operated by one or more remote initiating devices or an auxiliary fire alarm system used to send an alarm to the ~~public fire service~~ communications center. (SIG-PRS)

3.3.8.5 Publicly Accessible Fire Alarm Box. An enclosure, accessible to the public, housing a manually operated transmitter used to send an alarm to the ~~public fire service~~ communications center. (SIG-PRS)

3.3.15 Ancillary Functions. Ancillary functions are those nonemergency activations of the fire alarm or mass notification audible, visual, and textual output circuits allowed. Ancillary functions can include general paging, background music, or other non-emergency signals. (SIG-ECS)

3.3.28 Building Fire Safety Plan. Documentation that provides information on the use of alarms, transmission of alarms, response to alarms, evacuation of immediate area, evacuation of smoke compartment, preparation of floors and building for evacuation and extinguishment of fire. [SIG-ECS]

3.3.29* Certification of Personnel. ~~A formal program of related instruction and testing as provided by a recognized organization or the authority having jurisdiction.~~ (SIG-FUN)

3.3.33.4 Solid Joist Construction. Ceilings that have solid structural or solid nonstructural members projecting down from the ceiling surface for a distance of more than 4 in. (100 mm) and spaced at intervals of 36 in (910 mm) or less, center to center. (SIG-IDS)

NFPA 72-2010 National Fire Alarm and Signaling Code

3.3.37 Compatibility Listed. A specific listing process that applies only to two-wire devices, such as smoke detectors, that are designed to operate with certain control equipment. (SIG-FUN)

3.3.43* Coded. An audible or visible signal that conveys several discrete bits or units of information. Notification signal examples are numbered strokes of an impact-type appliance and numbered flashes of a visible appliance. (SIG-NAS)

A.3.3.43 Coded. Notification signal examples are numbered strokes of an impact-type appliance and numbered flashes of a visible appliance.

3.3.49* Public Fire Service Communications Center. The building or portion of the a building that is specifically configured for the purpose of providing emergency communications services or public safety answering point (PSAP) services to one or more public safety agencies under the authority of authorities having jurisdiction used to house the central operating part of the fire alarm system; usually the place where the necessary testing, switching, receiving, transmitting, and power supply devices are located. [1221, 2007] (SIG-PRS)

A.3.3.49 Communications Center. Examples of functions of a communications center are as follows:

- (1) Communications between the public and the communications center
- (2) Communications between the communications centers, the emergency response agency (ERA), and emergency response facilities (ERFs)
- (3) Communications within the ERA and between different ERAs
- (4) Communications with the public emergency alarm reporting system

The central operating part of the public emergency alarm reporting system is usually located at the communications center.

3.3.51 Communications Circuit. Any signaling path of an emergency communications system that carries voice, audio, data or other signals. [SIG-ECS]

3.3.53.1* Autonomous Control Unit (ACU). The primary control unit for an in-building mass notification system. (SIG-ECS)

A.3.3.53.1 Autonomous Control Unit (ACU). Although an ACU might incorporate provisions for messages or signals from external sources, the ACU is fully capable of building controls without the need for sources outside the building. An ACU is allowed to be located within a primary building and supply circuits to immediately adjacent support buildings such as detached storage buildings. Larger buildings will generally have their own ACUs to allow individual control within each building.

3.3.53.2 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. (SIG-ECS)

3.3.68 Donor Antenna. The outside antenna on the building where a public safety radio enhancement system operates. (SIG-ECS)

NFPA 72-2010 National Fire Alarm and Signaling Code

3.3.69 Donor Site. The repeater or base station site with which the public safety radio enhancement system communicates. (SIG-ECS)

3.3.70 Fire Rating. The classification indicating in time (hours) the ability of a structure or component to withstand a standardized fire test. This classification does not necessarily reflect performance of rated components in an actual fire. (SIG-FUN)

3.3.72 Downlink. The radio signal from the base station transmitter to the portable public safety subscriber receiver. (SIG-ECS)

3.3.74 Dwelling Unit. One or more rooms arranged for the use of one or more individuals living together, providing complete, independent living facilities, including permanent provisions for living, sleeping, eating, cooking, and sanitation complete, independent housekeeping purposes with space for eating, living, and sleeping; facilities for cooking; and provisions for sanitation. [5000, 2009] (SIG-HOU)

3.3.79 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. (SIG-ECS)

3.3.79.1 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 thereof. (SIG-ECS)

3.3.79.1.1 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. (SIG-ECS)

3.3.79.1.2 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. (SIG-ECS)

3.3.79.1.3 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. (SIG-ECS)

3.3.79.1.4 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. (SIG-ECS)

3.3.79.2 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

NFPA 72-2010 National Fire Alarm and Signaling Code

messages, condition of local environment, and condition of persons, and to give assurance that help is on the way. (SIG-ECS)

3.3.80 Emergency Communications System — Central Control Station. A mass notification system facility(s) with communications and control equipment serving one or more buildings where responsible authorities receive information from premises sources or systems or from (higher level) regional or national sources or systems and then disseminate appropriate information to a building, multiple buildings, outside campus areas, or a combination of these in accordance with the emergency response plan established for the premises. (SIG-ECS)

3.3.81 Emergency Communications Systems — Combination. Various emergency communication systems such as fire alarm, mass notification, fire fighter communications, area of refuge communications, elevator communications, or others and which may be served through a single control system or through an interconnection of several control systems. (SIG-ECS)

3.3.82 Fire Safety Function Control Emergency Control Function Device. The fire alarm or signaling system component that directly interfaces with the control system that controls the fire safety emergency function. (SIG-PRO)

3.3.83 Fire Safety Emergency Control Functions. Building, and 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. (SIG-PRO)

3.3.84 Emergency Response Plan. A documented set of actions to address response to natural, technological, and manmade disasters and other emergencies prepared by the stakeholders from information obtained during the risk analysis. (SIG-ECS)

3.3.92.2.1* 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, such as sprinkler alarm and supervisory control unit or an elevator recall control and supervisory control unit. (SIG-PRO)

A.3.3.92.2.1 Dedicated Function Fire Alarm Control Unit. Examples of a dedicated function fire alarm control unit include an automatic sprinkler alarm and supervisory control unit or an elevator recall control and supervisory control unit.

3.3.95.3 Municipal Fire Alarm System. A public fire alarm reporting system. (SIG-PRS)

3.3.95.4* Protected Premises (Local) Fire Alarm System. A fire alarm system located at the protected premises. (SIG-PRO)

A.3.3.95.4 Protected Premises (Local) Fire Alarm System. A protected premises fire alarm system is any fire alarm system located at the protected premises. It can include any of the functions identified in Section 23.3. Where signals are transmitted to a communication center or supervising station, the protected premises fire alarm system also falls under the definition of one of the following systems: central station service alarm system, remote supervising station alarm system, proprietary supervising station alarm system, or auxiliary alarm system. The requirements that pertain to these systems apply in addition to the requirements for the protected premises fire alarm systems.

NFPA 72-2010 National Fire Alarm and Signaling Code

3.3.97 Fire Extinguisher Electronic Monitoring Device. A device connected to a control unit that monitors the fire extinguisher in accordance with the requirements of NFPA10, *Standard for Portable Fire Extinguishers*. (SIG-IDS)

3.3.106 Frequency. Minimum and maximum time between events (SIG-TMS).

3.3.106.1 Weekly Frequency. Fifty-two times per year, once per calendar week.

3.3.106.2 Monthly Frequency. Twelve times per year, once per calendar month.

3.3.106.3 Quarterly Frequency. Four times per year with a minimum of 2 months, maximum of 4 months.

3.3.106.4 Semiannual Frequency. Twice per year with a minimum of 4 months, maximum of 8 months.

3.3.106.5 Annual Frequency. Once per year with a minimum of 9 months, maximum 15 months.

3.3.113* Hearing Loss. A full or partial decrease in the ability to detect or comprehend sounds. (SIG-NAS)

A.3.3.113 Hearing Loss. The severity of hearing loss is measured by the degree of loudness, as measured in decibels, a sound must attain before being detected by an individual. Hearing loss can be ranked as mild, moderate, severe, or profound. It is quite common for someone to have more than one degree of hearing loss (e.g., mild sloping to severe). The following list shows the rankings and their corresponding decibel ranges:

(1) Mild:

(a) For adults: between 25 and 40 dB

(b) For children: between 15 and 40 dB

(2) Moderate: between 41 and 55 dB

(3) Moderately severe: between 56 and 70 dB

(4) Severe: between 71 and 90 dB

(5) Profound: 90 dB or greater

NIOSH defines material hearing impairment as an average of the hearing threshold levels for both ears that exceeds 25 dB at 1000, 2000, 3000, and 4000 Hz.

The American Medical Association indicates that a person has suffered material impairment when testing reveals a 25 dB average hearing loss from audiometric zero at 500, 1000, 2000, and 3000 Hz. OSHA has recognized that this is the lowest level of hearing loss that constitutes any material hearing impairment.

3.3.113.1 Profound Hearing Loss. A hearing threshold of greater than 90 dB.

3.3.116 High Power Speaker Array (HPSA). High power speaker arrays provide capability for voice and tone communications to large outdoor areas. (SIG-ECS)

3.3.120* Identified (as Applied to Equipment). Recognizable as suitable for the specific purpose, function, use, environment, application, and so forth, where described in a particular *Code* requirement. (SIG-PRS) [70, 2008]

NFPA 72-2010 National Fire Alarm and Signaling Code

A.3.3.120 Identified (as Applied to Equipment). Some examples of ways to determine suitability of equipment for a specific purpose, environment, or application include investigations by a qualified testing laboratory (listing and labeling), an inspection agency, or other organizations concerned with product evaluation. [70:100, FPN]

3.3.122 Operating System Software. The basic operating system software that can be altered only by the equipment manufacturer or its authorized representative. Operating system software is sometimes referred to as firmware, BIOS, or executive program. (SIG-FUN)

3.3.125 Intelligibility. The quality or condition of being intelligible. (SIG-NAS)

3.3.126* Intelligible. Capable of being understood; comprehensible; clear. (SIG-NAS)

A.3.3.126 Intelligible. The term *intelligible* is intended to address only the communications channel and the acoustic environment as shown in Figure A.3.3.126. Intelligibility assumes that the talker or recorded voice message is in a language and using words known to the listener. It also assumes that the listener has normal hearing.

3.3.127.2* Fire Alarm Control Interface. The fire alarm control interface coordinates signals to and from the fire alarm system and other systems. (SIG-ECS)

A.3.3.127.2 Fire Alarm Control Interface. Some mass notification systems' autonomous control units (ACUs) might not be listed to UL 864 for fire alarm service. Any component that is connected to the fire alarm system must be connected through a listed interface that will protect the functions of other systems should one system experience a failure. This can be through isolation modules, control relays, or other approved means that are listed for the intended use. As an example, failure of a stand-alone ACU should not affect any function of the FACU.

3.3.136* Local Operating Console (LOC). A station used by authorized personnel and emergency responders to activate and operate an in-building mass notification system. (SIG-ECS)

A.3.3.136 Local Operating Console (LOC). An LOC allows users within a building to activate prerecorded messages, deliver live voice messages, observe current status of the main autonomous control unit (ACU), or have similar such ACU operator functions at various locations within the building. An LOC serves a similar function as a remote fire alarm annunciator. However, there can be multiple LOC locations within a building, such as on each floor, at each main entry point, at the switchboard or receptionist's console, or as determined by a risk analysis.

3.3.141* Managed Facilities-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. (SIG-SSS)

Subsection 3.3.141 was revised by a tentative interim amendment (TIA). See page 1.

A.3.3.141 Managed Facilities-Based Voice Network (MFVN).

Managed facilities-based voice network service is functionally equivalent to traditional PSTN-based services provided by authorized common carriers (public utility telephone

NFPA 72-2010 National Fire Alarm and Signaling Code

companies) with respect to dialing, dial plan, call completion, carriage of signals and protocols, and loop voltage treatment and provides all of the following features:

- (1) A loop start telephone circuit service interface.
- (2) Pathway reliability that is assured by proactive management, operation, and maintenance by the MFVN provider.
- (3) 8 hours of standby power supply capacity for MFVN communications equipment either located at the protected premises or field deployed. Industry standards followed by the authorized common carriers (public utility telephone companies), and the other communications service providers that operate MFVNs, specifically engineer the selection of the size of the batteries, or other permanently located standby power source, in order to provide 8 hours of standby power with a reasonable degree of accuracy. Of course, over time, abnormal ambient conditions and battery aging can always have a potentially adverse effect on battery capacity. The MFVN field-deployed equipment typically monitors the condition of the standby battery and signals potential battery failure to permit the communications service provider to take appropriate action.
- (4) 24 hours of standby power supply capacity for MFVN communications equipment located at the communication service provider's central office.
- (5) Installation of network equipment at the protected premises with safeguards to prevent unauthorized access to the equipment and its connections.

When providing telephone service to a new customer,

MFVN providers give notice to the telephone service subscriber of the need to have any connected alarm system tested by authorized fire alarm service personnel in accordance with Chapter 14 to make certain that all signal transmission features have remained operational. These features include the proper functioning of line seizure and the successful transmission of signals to the supervising station. In this way, the MFVN providers assist their new customers in complying with a testing procedure similar to that outlined in 26.2.3 for changes to providers of supervising station service.

The evolution of the deployment of telephone service has moved beyond the sole use of metallic conductors connecting a telephone subscriber's premises with the nearest telephone service provider's control and routing point (wire center). In the last 25 years, telephone service providers have introduced a variety of technologies to transport multiple, simultaneous telephone calls over shared communication's pathways. In order to facilitate the further development of the modernization of the telephone network, the authorized common carriers (public utility telephone companies) have transitioned their equipment into a managed facilities-based voice network (MFVN) capable of providing a variety of communications services in addition to the provision of traditional telephone service.

Similarly, the evolution of digital communications technology has permitted entities other than the authorized common carriers (public utility telephone companies) to deploy robust communications networks and offer a variety of communications services, including telephone service.

These alternate service providers fall into two broad categories.

The first category includes those entities that have emulated the MFVN provided by the authorized common carriers.

NFPA 72-2010 National Fire Alarm and Signaling Code

The second category includes those entities that offer telephone service using means that do not offer the rigorous quality assurance, operational stability, and consistent features provided by an MFVN.

The Code intends to only recognize the use of the telephone network transmission of alarm, supervisory, trouble, and other emergency signals by means of MFVNs.

For example, the Code intends to permit an MFVN to provide facilities-based telephone (voice) service that interfaces with the premises fire alarm or emergency signal control unit through a digital alarm communicator transmitter (DACT) using a loop start telephone circuit and signaling protocols fully compatible with and equivalent to those used in public switched telephone networks. The loop start telephone circuit and associated signaling can be provided through traditional copper wire telephone service (POTS—"plain old telephone service") or by means of equipment that emulates the loop start telephone circuit and associated signaling and then transmits the signals over a pathway using packet switched (IP) networks or other communications methods that are part of an MFVN.

Providers of MFVNs have disaster recovery plans to address both individual customer outages and widespread events such as tornados, ice storms, or other natural disasters, which include specific network power restoration procedures equivalent to those of traditional landline telephone services.

Subsection A.3.3.141 was added by a tentative interim amendment (TIA). See page 1.

3.3.143* Mass Notification Priority Mode. The mode of operation whereby all fire alarm occupant notification is superseded by emergency mass notification action. (SIG-ECS)

A.3.3.143 Mass Notification Priority Mode. Non-emergency mass notification activations are not intended to initiate this mode of operation.

3.3.153 Municipal Fire Alarm Box (Street Box). A publicly accessible fire alarm box. See 3.3.8, Fire Alarm Box.

3.3.155 Net-Centric Alerting System (NCAS). A net-centric alerting system incorporates web-based management and alert activation application through which all operators and administrators could gain access to the system's capabilities based on the users' permissions and the defined access policy. (SIG-ECS)

3.3.156 Network Architecture. The physical and logical design of a network, and the inherent ability of the design to carry data from one point to another. [SIG-ECS]

3.3.160.1.2* Textual Audible Notification Appliance. A notification appliance that conveys a stream of audible information. ~~An example of a textual audible notification appliance is a speaker that reproduces a voice message. (SIG-NAS)~~

A.3.3.160.1.2 Textual Audible Notification Appliance. An example of a textual audible notification appliance is a speaker that reproduces a voice message.

3.3.163* Octave Band. The bandwidth of a filter that comprises a frequency range of a factor of 2. (That is, $f_2 = 2f_1$ as defined in IEC 61260. For example, for an octave band centered on 500 Hz, the lower frequency is 353 Hz, and the upper frequency is 707 Hz). (SIG-NAS)

NFPA 72-2010 National Fire Alarm and Signaling Code

A.3.3.163 Octave Band. Frequencies are generally reported based on a standard, preferred center frequency, f_c . The bandwidth of a particular octave band has a lower frequency, f_n , and an upper frequency, f_{n+1} . The relationships are as follows:

$$f_{n+1}/f_n = 2^k$$

where:

$k = 1$ for octave bands

$k = 1/3$ for one-third octave bands

and

$$f_c = f_n^{2^{1/2}}$$

For example, the 500 Hz octave band (center frequency) has a lower limit of 354 and an upper limit of 707 Hz. The octave band with a center frequency of 1000 Hz has a lower frequency of 707 Hz and an upper frequency of 1414 Hz.

3.3.163.1 One-Third Octave Band. The bandwidth of a filter that comprises a frequency range of a factor of $2^{1/3}$. (That is, $f_2 = 2^{1/3} f_1$ as defined in IEC 61260.) The octave filter can be subdivided into three octave-bands. (SIG-NAS)

3.3.174 Path (Pathways). Any circuit, conductor, optic fiber, radio carrier, or other means for transmitting fire alarm system information between connecting two or more locations. (SIG-PROFUN)

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

3.3.177 Personnel.

3.3.177.1 Inspection Personnel. Individuals who conduct a visual examination of a system or portion thereof to verify that it appears to be in operating condition, in proper location, and is free of physical damage or conditions that impair operation. (SIG-TMS)

3.3.177.2 Service Personnel. Individuals who perform those procedures, adjustments, replacement of components, system programming, and maintenance as described in the manufacturer's service instructions that can affect any aspect of the performance of the system. (SIG-TMS)

3.3.177.3 Testing Personnel. Individuals who perform procedures used to determine the status of a system as intended by conducting acceptance, reacceptance, or periodic physical checks on systems. (SIG-TMS)

3.3.190 Story. The portion of a building located between the upper surface of a floor and the upper surface of the floor or roof next above. [101, 2006] (SIG-FUN)

3.3.198 Public Address System. An electronic amplification system with a mixer, amplifier, and loudspeakers, used to reinforce a given sound and distributing the "sound" to the general public around a building. [SIG-ECS]

3.3.199 Public Emergency Fire Alarm Reporting System. A system of alarm-initiating devices, transmitting and receiving equipment, and communication infrastructure (other than a public telephone network) used to transmit alarms to the public fire service

NFPA 72-2010 National Fire Alarm and Signaling Code

communicate with the communications center to provide any combination of manual or auxiliary fire alarm service. (SIG-PRS)

3.3.199.1* Auxiliary Fire Alarm System. A protected premises fire alarm system or other emergency system at the protected premises and the system used to connect a the protected premises fire alarm system to a public fire alarm reporting system for transmitting an alarm to the public fire service communications center. (SIG-PRS)

A.3.3.199.1 Auxiliary Fire Alarm System. Fire alarms from an auxiliary fire alarm system are received at the ~~public fire service~~ communications center on the same equipment and by the same methods as alarms transmitted from public fire alarm boxes. (SIG-PRS)

3.3.199.1.1 Local Energy Type Auxiliary Fire Alarm System. An auxiliary system that employs a locally complete arrangement of parts, initiating devices, relays, power supply, and associated components to automatically activate a master box or auxiliary box over circuits that are electrically isolated from the public fire emergency alarm reporting system circuits. (SIG-PRS)

3.3.199.1.2 Shunt-Type Auxiliary Fire Alarm System. An auxiliary system electrically connected to the public fire emergency alarm reporting system extending a public fire emergency alarm reporting circuit to interconnect initiating devices within a protected premises, which, when operated, opens the public fire emergency alarm reporting circuit shunted around the trip coil of the master box or auxiliary box. The master box or auxiliary box is thereupon energized to start transmission without any assistance from a local source of power. (SIG-PRS)

3.3.199.2 Type A Public Fire Alarm Emergency Alarm Reporting System. A system in which an alarm from an fire alarm box is received and is retransmitted to fire stations either manually or automatically. (SIG-PRS)

3.3.199.3 Type B Public Fire Alarm Emergency Alarm Reporting System. A system in which an alarm from an fire alarm box is automatically transmitted to fire stations and, if used, is transmitted to supplementary alerting devices. (SIG-PRS)

3.3.201 Public Safety Agency. A fire, emergency medical services, or law enforcement agency. (SIG-ECS)

3.3.202 Public Safety Radio Enhancement System. A system installed to assure the effective operation of radio communication systems used by fire, emergency medical services, or law enforcement agencies. (SIG-ECS)

3.3.203 Public Safety Radio System. A radio communication system used by fire, emergency medical services, or law enforcement agencies. (SIG-ECS)

3.3.206* Qualified. A competent and capable person or company that has met the requirements and training for a given field acceptable to the authority having jurisdiction. [96, 2008] (SIG-TMS)

A.3.3.206 Qualified. Qualified might also mean that the person has knowledge of the installation, construction, or operation of apparatus and the hazards involved.

3.3.217 Regional Operations Center (ROC). A network control center that covers multiple geographically separated facilities and installations. (SIG-ECS)

NFPA 72-2010 National Fire Alarm and Signaling Code

3.3.229 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. [SIG-ECS]

3.3.238 Shop Drawings. Documents that provide information pertaining to the system, such as property location, scaled floor plans, equipment wiring details, typical equipment installation details, riser details, conduit/conductor size and routing information, and other information necessary for the installer to complete the fire alarm installation. (SIG-FUN)

3.3.255 Software. Programs, instruments, procedures, data, and the like that are executed by a central processing unit of a product and that influences the functional performance of that product. For the purpose of this Code, software is one of two types: executive software and site-specific software. (SIG-TMS)

3.3.255.1 Executive Software. Control and supervisory program which manages the execution of all other programs and directly or indirectly causes the required functions of the product to be performed. Executive software is sometimes referred to as firmware, BIOS, or executive program. (SIG-TMS)

3.3.255.2 Site-Specific Software. Program that is separate from, but controlled by, the executive software which allows inputs, outputs, and system configuration to be selectively defined to meet the needs of a specific installation. Typically it defines the type and quantity of hardware, customized labels and the specific operating features of a system. (SIG-TMS)

3.3.262 Stakeholder. Any individual, group, or organization that might affect, be

3.3.273 Switched Telephone Network.

3.3.273.1 Loop Start Telephone Circuit. A loop start telephone circuit is an analog telephone circuit that supports loop start signaling as specified in either Telcordia GR-506- CORE, LATA Switching Systems Generic Requirements: Signaling for Analog Interface, or Telcordia GR-909-CORE, Fiber in the Loop Systems Generic Requirements.(SIG-SSS)

3.3.273.2 Public Switched Telephone Network. An assembly of communications facilities and central office equipment and telephone service providers that utilize managed facilities-based voice networks (MFVN) to operated jointly by authorized common-carriers that provides the general public with the ability to establish communications channels via discrete dialing codes. (SIG-SSS)

Subsection 3.3.273 was revised by a tentative interim amendment (TIA). See page 1.

3.3.274 System Operator. An individual trained to operate and or initiate a mass notification system. (SIG-ECS)

3.3.277 Talk Mode. A means of communications within a building normally dedicated to emergency functions. Commonly referred to as fire fighters' phones, but can also be used for communications with fire fighters and/or fire wardens, including occupants, during an emergency, such as between a fire command center and a designated location, such as a stair, stairwell, or location of emergency equipment. (SIG-ECS)

NFPA 72-2010 National Fire Alarm and Signaling Code

3.3.277.1 Common Talk Mode. The ability to conference multiple telephones in a single conversation. This is similar to what was referred to as a party line. (SIG-ECS)

3.3.277.2 Selective Talk Mode. The ability for personnel at the fire command center to receive indication of incoming calls and choose which call to answer. This includes the ability to transfer between incoming calls and conference multiple phone locations. Selective calling may include the ability to initiate calls to emergency phone locations. (SIG-ECS)

3.3.288 Uplink. The radio signal from the portable public safety subscriber transmitter to the base station receiver. (SIG-ECS)

3.3.211* Voice Intelligibility. ~~Audible voice information that is distinguishable and understandable. (SIG-NAS)~~

~~**A.3.3.211 Voice Intelligibility.** As used in this Code, intelligibility and intelligible are both applied to the description of voice communications systems intended to reproduce human speech. When a human being can clearly distinguish and understand human speech reproduced by such a system, the system is said to be intelligible. Satisfactory intelligibility requires adequate audibility and adequate clarity. Clarity is defined as freedom from distortion of all kinds (IEC 60849, Sound systems for emergency purposes, Section 3.6). The following are three kinds of distortion responsible for the reduction of speech clarity in an electroacoustic system:~~

- ~~(1) Amplitude distortion, due to nonlinearity in electronic equipment and transducers~~
- ~~(2) Frequency distortion, due to nonuniform frequency response of transducers and selective absorption of various frequencies in acoustic transmission~~
- ~~(3) Time domain distortion, due to reflections and reverberation in the acoustic domain~~

~~Of these three kinds of distortion, frequency distortion is partially, and time domain distortion is totally, a function of the environment in which the system is installed (size, shape, and surface characteristics of walls, floors, and ceilings) and the character and placement of the loudspeakers (transducers).~~

3.3.292 Voice Message Priority. A scheme for prioritizing mass notification messages. (SIG-ECS)

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 10 Fundamentals

10.1.1 The basic functions of a complete fire alarm or signaling system shall comply with the requirements of this chapter.

10.1.2 The requirements of this chapter shall apply to ~~fire alarm~~ systems, equipment, and components addressed in Chapters ~~5 through Chapter 10~~ 12, 14, 17, 18, 21, 23, 24, 26 and 27.

10.2 Purpose. The purpose of fire alarm and signaling systems shall be primarily to provide notification of ~~fire~~ alarm, supervisory, and trouble conditions; to alert the occupants; to summon aid; and to control ~~fire safety~~ emergency control functions.

10.3 Equipment and Personnel.

10.3.1 Equipment. Equipment constructed and installed in conformity with this Code shall be listed for the purpose for which it is used. ~~Fire alarm system components shall be installed, tested, and maintained in accordance with the manufacturer's published instructions and this Code.~~

10.3.2 System components shall be installed, tested, and maintained in accordance with the manufacturer's published instructions and this Code.

10.3.3* 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.

A.10.3.3 This requirement does not apply to notification appliance circuits.

10.4 Personnel Qualifications.

10.4.1 System Designer.

10.4.1.1 Fire alarm system and emergency communications system plans and specifications shall be developed in accordance with this Code by persons who are experienced in the proper design, application, installation, and testing of ~~fire alarm~~ the systems.

10.4.1.2 State or local licensure regulations shall be followed to determine qualified personnel. Depending on state or local licensure regulations, qualified personnel shall include, but not be limited to, one or more of the following:

- (1) Personnel who are registered, licensed, or certified by a state or local authority
- (2) Personnel who are certified by a nationally recognized ~~fire alarm~~ certification organization acceptable to the authority having jurisdiction
- (3) Personnel who are factory trained and certified for fire alarm system design and emergency communications system design of the specific type and brand of system ~~being designed~~ and who are acceptable to the authority having jurisdiction.

10.4.1.3 The system designer shall ~~be identified on the system design documents.~~ Acceptable provide evidence of their qualifications and/or certifications when requested by the authority having jurisdiction.

10.4.2 System Installer.

NFPA 72-2010 National Fire Alarm and Signaling Code

10.4.2.1 Fire alarm systems and emergency communications systems installation personnel shall be qualified or shall be supervised by persons who are qualified in the installation, inspection, and testing of fire alarm ~~the~~ systems.

10.4.2.2 State or local licensure regulations shall be followed to determine qualified personnel. Depending on state or local licensure regulations, qualified personnel shall include, but not be limited to, one or more of the following:

- (1) Personnel who are registered, licensed, or certified by a state or local authority
- (2) Personnel who are certified by a nationally recognized ~~fire alarm~~ certification organization acceptable to the authority having jurisdiction
- (3) Personnel who are factory trained and certified for fire alarm system installation and emergency communications system installation of the specific type and brand of system ~~being installed~~ and who are acceptable to the authority having jurisdiction.

10.4.3 ~~Service Personnel Qualifications and Experience.~~ Inspection, Testing, and Maintenance Personnel.

10.4.3.1* Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of ~~fire alarm systems addressed within the scope of this Code.~~ Qualified personnel shall include, but not be limited to, one or more of the following:

A.10.4.3.1 It is not the intent to require personnel performing simple inspections or operational tests of initiating devices to require factory training or special certification provided such personnel can demonstrate knowledge in these areas.

- (1) *Personnel who are factory trained and certified for ~~fire alarm system service of the specific type and brand of system~~ being serviced
- (2) *Personnel who are certified by a nationally recognized ~~fire alarm~~ certification organization acceptable to the authority having jurisdiction
- (3) *Personnel who are registered, licensed, or certified by a state or local authority to perform service on systems addressed within the scope of this Code
- (4) Personnel who are employed and qualified by an organization listed by a nationally recognized testing laboratory for the servicing of ~~fire alarm~~ systems within the scope of this Code

10.4.4 Supervising Station Operators.

10.4.4.1 All operators in the supervising station shall demonstrate competence in all tasks required of them in Chapter 26 by one or more of the following:

- (1) Certified by the manufacturer of the receiving system or equipment or the alarm-monitoring automation system
- (2) *Certified by an organization acceptable to the authority having jurisdiction

A.10.4.4.1(2) An example of an organization providing alarm monitoring operator training is the Central Station Alarm Association (CSAA). Note that this reference is for information purposes only, information concerning the product or service has been provided by the manufacturer or other outside sources, and the information concerning the product or service has not been independently verified nor has the product or service been endorsed or certified by the NFPA or any of its technical committees.

NFPA 72-2010 National Fire Alarm and Signaling Code

(3) Licensed or certified by a state or local authority

(4) Other training or certification approved by the authority having jurisdiction

10.4.4.2 Evidence of qualifications and/or certification shall be provided when requested by the authority having jurisdiction. A license or qualification listing shall be current in accordance with the requirements of the issuing authority or organization.

10.4.4.3 Operator trainees shall be under the direct supervision of a qualified operator until qualified as required by 10.4.4.1.

10.5 Power Supplies.

10.5.1 Scope. The provisions of this section shall apply to power supplies used for both protected premises fire alarm systems, ~~described in Chapter 6 and to supervising station facilities~~ alarm systems, public emergency alarm reporting systems, and emergency communications systems and equipment ~~described in Chapter 8.~~

10.5.3.1 Power shall be supplied in compliance with either 10.5.3.2 or 10.5.4.

10.5.3.2 Unless configured in compliance with 10.5.4, at least two independent and reliable power supplies shall be provided, one primary and one secondary, each of which shall be of adequate capacity for the application.

10.5.3.3 Each power supply shall be of adequate capacity for the application.

10.5.4 Uninterruptible Power Supplies (UPS).

10.5.4.1 The UPS device shall be configured in compliance with NFPA111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, for a Type 0, Class 24, Level 1 system.

10.5.4.2 The UPS device shall be supplied by a dedicated branch circuit as described in 10.5.5.1.

10.5.4.3 Failure of the UPS shall result in the initiation of a trouble signal in accordance with Section 10.12.

10.5.5.2 Circuit Identification and Accessibility.

10.5.5.2.1 The location of the dedicated branch circuit disconnecting means shall be permanently identified at the ~~fire alarm~~ control unit.

10.5.5.2.2 For fire alarm systems the circuit disconnecting means shall have a red marking, shall be accessible only to authorized personnel, and shall be identified as "FIRE ALARM CIRCUIT."

10.5.5.2.3 For fire alarm systems the circuit disconnecting means shall have a red marking.

10.5.5.2.4 The circuit disconnecting means shall be accessible only to authorized personnel.

10.5.5.3 Mechanical Protection. The dedicated branch circuit(s) and connections shall be ~~mechanically~~ protected against physical damage.

10.5.6.1* Secondary Power Supply for Protected Premises Fire Alarm Systems and Emergency Communications Systems.

NFPA 72-2010 National Fire Alarm and Signaling Code

10.5.6.1.1 The secondary power supply shall consist of one of the following:

- (1) A storage battery dedicated to the ~~fire alarm~~ system arranged in accordance with 10.5.9
- (2) An automatic-starting, engine-driven generator serving the dedicated branch circuit specified in 10.5.5.1 and arranged in accordance with 10.5.10.3.1, and storage batteries dedicated to the ~~fire alarm~~ system with 4 hours of capacity arranged in accordance with 10.5.9

10.5.6.1.2 Secondary circuits that provide power to the control unit and are not integral to the unit shall be protected against physical damage.

10.5.6.3.1 ~~Unless otherwise permitted or required by 4.4.1.5.3.1(A) or 4.4.1.5.3.1(B),~~ The secondary power supply shall have sufficient capacity to operate the ~~fire alarm~~ system under quiescent load (system operating in a nonalarm condition) for a minimum of 24 hours and, at the end of that period, shall be capable of operating all alarm notification appliances used for evacuation or to direct aid to the location of an emergency for 5 minutes, unless otherwise permitted or required by the following:

- (1) Battery calculations shall include a 20 percent safety margin to the calculated amp-hour rating.
- (2) The secondary power supply for in-building fire emergency voice/alarm communications service shall be capable of operating the system under quiescent load for a minimum of 24 hours and then shall be capable of operating the system during a fire or other emergency condition for a period of 15 minutes at maximum connected load.
- (3) The secondary power supply capacity for supervising station facilities and equipment shall be capable of supporting operations for a minimum of 24 hours.
- (4) The secondary power supply for high-power speaker arrays used for wide-area mass notification systems shall be in accordance with 24.4.3.4.2.2.
- (5) The secondary power supply for textual visible appliances shall be in accordance with 24.4.3.4.7.1.
- (6) The secondary power supply capacity for central control stations of a wide-area mass notification systems shall be capable of supporting operations for a minimum of 24 hours.
- (7) The secondary power supply for in-building mass notification systems shall be capable of operating the system under quiescent load for a minimum of 24 hours and then shall be capable of operating the system during emergency condition for a period of 15 minutes at maximum connected load.

10.5.6.4 Secondary Power Operation.

10.5.6.4.1 Operation on secondary power shall not affect the required performance of a ~~fire alarm~~ system or supervising station facility. ~~The system shall produce the same, including alarm, supervisory, and trouble signals and indications, excluding the alternating current (ac) power indicator, when operating from the secondary power source as are produced when the unit is operating from the primary source.~~

Exception: Audio amplifier monitoring shall comply with 4.4.7.2.1.

10.5.6.4.2 Systems operating on secondary power shall comply with Section 10.17.

NFPA 72-2010 National Fire Alarm and Signaling Code

10.5.6.4.3 While operating on secondary power, audio amplifier monitoring shall comply with 10.17.2.1.2.

10.5.7.1 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.

10.5.7.3.1 Storage batteries dedicated to the fire alarm system or UPS arranged in accordance with the provisions of NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, shall be permitted to supplement the secondary power supply to ensure required operation during the transfer period.

10.5.8.4 The location of any remotely located power supply shall be identified at the master control unit as well as on the record drawings.

10.5.9.1.1 Batteries shall be marked with the month and year of manufacture using the month/year format.

~~A.4.4.1.8.1~~ Markings for month and year can be applied by the manufacturer or in the field on the basis of the manufacturer's date code.

10.5.9.1.2 Where the battery is not marked with the month/year by the manufacturer, the installer shall obtain the date code and mark the battery with the month/year of battery manufacture.

10.5.9.2 Location. Storage batteries shall be located so that the fire alarm equipment, including overcurrent devices, are not adversely affected by battery gases and shall conform to the requirements of *NFPA 70, National Electrical Code*, Article 480.

10.5.10.3.1.1 Engine-driven generators used to provide secondary power for a protected premises fire alarm system or an emergency communications system shall comply with NFPA 110, *Standard for Emergency and Standby Power Systems*, Chapter 4, requirements for a Type 10, Class 24, Level 1 system.

10.5.10.6.1 For public emergency alarm reporting systems, the requirements of Chapter 27 shall apply.

~~4.4.2 Compatibility.~~ All detection devices 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. (Moved to 10.3.3)

10.6 Signal Priority. The priority of signals shall be in accordance with Section 10.6.

10.6.1 ECS priority signals when evaluated by stakeholders through a risk analysis in accordance with 14.4.2.2 shall be permitted to take precedence over all other signals.

10.6.2 Fire alarm signals shall take precedence over all other signals, except as permitted by 10.6.1 or 10.6.3.

10.6.3* Emergency mass notification signals and messages shall be permitted to have priority over fire alarm notification signals in accordance with the requirements of Chapter 24.

NFPA 72-2010 National Fire Alarm and Signaling Code

A.10.6.3 Mass notification signals might, at times, be more important to the building or area occupants than the fire alarm signal. Stakeholders should perform a risk analysis in accordance with 24.4.2.2 to determine which, if any, messages should receive priority.

10.6.4 Emergency mass notification signals and messages shall have priority over supervisory and trouble signals in accordance with the requirements of Chapter 24.

10.6.5 Supervisory signals shall take precedence over trouble signals.

10.6.6 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.

10.6.7* Where separate systems are installed, they shall be permitted to achieve the priority of signals in accordance with Section 10.6.

A.10.6.7 In addition, the override of circuits should be indicated at the control panel of each system to ensure signals are restored to normal.

10.7 Distinctive Signals.

10.7.1 Priority alarms, fire alarms, supervisory signals, and trouble signals shall be distinctively and descriptively annunciated.

10.7.2 Audible alarm notification appliances for a fire alarm system shall produce signals that are distinctive from other similar appliances used for other purposes in the same area that are not part of the fire alarm or emergency communications system.

~~10.7.3* A supervisory signal sound~~ Audible signals on a control unit, or on multiple control units that are interconnected to form a system, or at a remote location, shall be permitted to be used to indicate a trouble condition have the same audible characteristics for all alerting functions including, but not limited to, alarm, trouble, and supervisory, provided if the same sound is used for both supervisory signals and trouble signals that the distinction between signals shall be by other appropriate means, such as visible annunciation.

A.10.7.3 Control unit signals can be audible, visible, or both for any particular function. Some older systems used only audible indicators that had to be coded in order for users to know what the signal meant. Where a control unit uses both audible and visible indicators, the purpose of the audible signal is to get someone's attention. In large system configurations, there might be multiple control units with audible signals.

Also, there might be several different functions requiring an audible alert as a part of the whole signal. Thus, there could be several different audible signals. It is not the intent of the code to have separate and distinct audible signals where there is clear visual distinction that provides the user with the needed information. Visible signals, whether a lamp with a text label, an LCD screen, or a computer monitor, are a better form of human interface.

10.7.4* Supervisory signals shall be distinctive in sound from other signals, and their sound shall not be used for any other purpose except as permitted in 10.7.3.

A.10.7.4 A valve supervisory, a low-pressure switch, or another device intended to cause a supervisory signal when actuated should not be connected in series with the

NFPA 72-2010 National Fire Alarm and Signaling Code

end-of-line supervisory device of initiating device circuits, unless a distinctive signal, different from a trouble signal, is indicated.

10.7.5 Trouble signals required to indicate at the protected premises shall be indicated by distinctive audible signals, which shall be distinctive from alarm signals except as permitted in 10.7.3.

10.7.6 Fire alarm evacuation signals shall be distinctive in sound from other signals, shall comply with the requirements of 18.4.2.1, and their sound shall not be used for any other purpose.

10.8* ECS Priority Signals. Visible indication of priority signals shall be automatically indicated within 10 seconds at the fire alarm control unit or other designated location.

A.10.8 Other locations could include the following:

- (1) Building fire command center for in-building fire emergency voice/alarm communications systems
- (2) Fire alarm control unit for network fire alarm systems
- (3) Supervising station locations for systems installed in compliance with Chapter 26

10.9 Fire Alarm Signals.

10.9.1 Fire alarm signals shall be distinctive in sound from other signals, shall comply with the requirements of 18.4.2.1, and their sound shall not be used for any other purpose.

10.9.2 Actuation of alarm notification appliances or emergency voice communications, ~~fire-safety~~ emergency control functions, and annunciation at the protected premises shall occur within 10 seconds after the activation of an initiating device.

10.9.4 Each round of a coded alarm signal shall consist of not less than three impulses.

10.10* Fire Alarm Signal Deactivation.

10.10.3 ~~A~~ The means for turning off activated alarm notification appliances(s) shall be key-operated or located within a locked cabinet, or arranged to provide equivalent protection against unauthorized use.

10.10.5 Subsequent actuation of initiating devices on other initiating device circuits or subsequent actuation of addressable initiating devices on signaling line circuits shall cause the notification appliances to reactivate.

Exception: ~~If permitted by the authority having jurisdiction, Subsequent actuation of another addressable initiating device of the same type in the same room or space shall not be required to cause the notification appliance(s) to reactivate.~~

10.10.7* Resetting of alarm signals shall comply with the requirements of 23.8.2.2.

A.10.10.7 Resetting of alarm signals should not require the simultaneous operation of multiple reset switches or the disconnection of any wiring or equipment to reset the alarm condition.

10.11 Supervisory Signals.

10.11.1.1 A coded supervisory signal shall be permitted to consist of two rounds of the number transmitted to indicate a supervisory off-normal condition.

NFPA 72-2010 National Fire Alarm and Signaling Code

10.11.1.2 A coded supervisory signal shall be permitted to consist of one round of the number transmitted to indicate the restoration of the supervisory condition to normal.

10.11.3 Self-Restoring Supervisory Signal Indication. Visible and audible indication of self-restoring supervisory signals and visible indication of their restoration to normal shall be automatically indicated within 90 seconds at the following locations:

- (1) Fire alarm control unit for local fire alarm systems
- (2) Building fire command center for in-building fire emergency voice/alarm communications systems
- (3) Supervising station location for systems installed in compliance with Chapter 26

10.11.4.1 Visible and audible indication of latching supervisory signals shall be indicated within 90 seconds at the locations specified in 10.11.3.

10.11.4.2 Restoration of latching supervisory signals shall be indicated within 90 seconds at the ~~same~~ locations specified in 10.11.3 ~~after manual reset of the control unit, when the initiating device is normal.~~

10.11.5.2 The means shall be key-operated or located within a locked cabinet, or arranged to provide equivalent protection against unauthorized use.

10.11.5.4 A means that is left in the “silence” position where there is no supervisory off-normal signal shall operate a visible signal silence indicator.

10.11.5.5 A means that is left in the “silence” position shall cause the trouble signal to sound until the silencing means is restored to normal position.

10.12.1 Trouble signals and their restoration to normal shall be indicated within 200 seconds at the locations identified in 10.12.6 or 10.12.7.

10.12.2 Indication of primary power failure trouble signals transmitted to a supervising station shall be delayed in accordance with 10.17.3.3.

10.12.4 ~~An~~ single audible trouble signal shall be permitted to ~~be common to several supervised circuits~~ annunciate multiple fault conditions.

10.12.6 Visible and audible trouble signals and visible indication of their restoration to normal shall be indicated at the following locations:

- (1) Fire alarm control unit for protected premises alarm systems
- (2) Building fire command center for in-building fire emergency voice/alarm communications systems
- (3) Central station or remote station location for systems installed in compliance with Chapter 26

10.12.8.1 A means for silencing the trouble notification appliance(s) shall be permitted only if it complies with ~~4.4.3.5.8.1(A) through 4.4.3.5.8.1(D)~~ the following:

- (1) The means shall be key-operated or located within a locked ~~enclosure~~ cabinet, or arranged to provide equivalent protection against unauthorized use.
- (2) The means shall transfer the trouble indication to a suitably identified lamp or other acceptable visible indicator.

NFPA 72-2010 National Fire Alarm and Signaling Code

- (3) The visible indication specified in 10.12.8.1(2) shall persist until the trouble condition has been corrected.
- (4) The audible trouble signal shall sound when the silencing means is in its silence position and no trouble exists.

10.13 Emergency Control Function Status Indicators.

10.13.1 All controls provided specifically for the purpose of manually overriding any automatic ~~fire safety~~ emergency control function shall provide visible indication of the status of the associated control circuits.

10.13.2* Where status indicators are provided for emergency equipment or ~~fire safety control~~ functions, they shall be arranged to reflect the actual status of the associated equipment or function.

10.14.2.4 Equipment shall be installed in locations where conditions do not exceed the voltage, temperature, and humidity limits specified in 4.4.4.1 the manufacturer's published instructions ~~shall be permitted~~.

Exception: Equipment specifically listed for use in locations where conditions can exceed the upper and lower limits specified in 4.4.4.1 shall be permitted.

10.14.3.2 Manual fire alarm boxes of the ~~manually operated type~~ shall comply with Section 17.14 and 23.8.5.2.1.

10.15* Protection of Fire Alarm System. In areas that are not continuously occupied, automatic smoke detection shall be provided at the location of each fire alarm control unit(s), notification appliance circuit power extenders, and supervising station transmitting equipment to provide notification of fire at that location.

Exception: Where ambient conditions prohibit installation of automatic smoke detection, automatic heat detection shall be permitted.

~~Exception No. 2: Fully sprinklered buildings shall not require protection in accordance with 4.4.5.~~

10.16 Annunciation and Annunciation Zoning.

10.16.1 Alarm Annunciation.

10.16.1.1 Where required by other governing laws, codes, or standards, the location of an operated initiating device shall be annunciated by visible means.

10.16.1.1.1 Visible annunciation of the location of an operated initiating device shall be by an indicator lamp, alphanumeric display, printout, or other approved means.

10.16.1.1.2 The visible annunciation of the location of operated initiating devices shall not be canceled by the means used to deactivate alarm notification appliances.

10.16.2 Supervisory and Trouble Annunciation.

10.16.2.1 Where required by other governing laws, codes, or standards, supervisory and/or trouble ~~annunciation~~ conditions shall be annunciated by visible means.

10.16.2.1.1 Visible annunciation shall be by an indicator lamp, an alphanumeric display, a printout, or other means.

NFPA 72-2010 National Fire Alarm and Signaling Code

10.16.2.1.2 The visible annunciation of supervisory and/or trouble conditions shall not be canceled by the means used to deactivate supervisory or trouble notification appliances.

10.16.3.1 All required annunciation means shall be readily accessible to responding personnel.

10.16.3.2 All required annunciation means shall be located as required by the authority having jurisdiction to facilitate an efficient response to the fire situation.

10.16.4 Alarm Annunciation Display. Visible Annunciators shall be capable of displaying all zones in alarm.

10.16.4.1 If all zones in alarm are not displayed simultaneously, the zone of origin shall be displayed.

10.16.4.2 If all zones in alarm are not displayed simultaneously, there shall be an indication that other zones are in alarm.

10.16.6.1 For the purpose of alarm annunciation, each floor of the building shall be considered as a separate zone.

10.16.6.2 For the purposes of alarm annunciation, if a floor of the building is subdivided into multiple zones by fire or smoke barriers and the fire plan for the protected premises allows relocation of occupants from the zone of origin to another zone on the same floor, each zone on the floor shall be annunciated separately ~~for the purpose of alarm location.~~

10.17.1.1 Unless otherwise permitted or required by 10.17.1.3 through 10.17.1.14, all means of interconnecting equipment, devices, and appliances and wiring connections shall be monitored for the integrity of the interconnecting conductors or equivalent path so that the occurrence of a single open or a single ground-fault condition in the installation conductors or other signaling channels ~~and their restoration to normal shall be~~ is automatically indicated within 200 seconds.

10.17.1.2 Unless otherwise permitted or required by 10.17.1.3 through 10.17.1.14, all means of interconnecting equipment, devices, and appliances and wiring connections shall be monitored for the integrity of the interconnecting conductors or equivalent path so that their the restoration to normal of a single open or a single ground-fault condition in the installation conductors or other signaling channels shall be is automatically indicated within 200 seconds.

~~**4.4.7.1.1** Monitoring for integrity shall not be required for styles of initiating device circuits, signaling line circuits, and notification appliance circuits tabulated in Table 6.5, Table 6.6.1, and Table 6.7 that do not have an "X" under "Trouble" for the abnormal condition indicated.~~

10.17.1.9 Monitoring for integrity shall not be required for the ~~connections~~ interconnection to and between supplementary system components enclosures containing control equipment located within 20 ft (6 m) of each other where the conductors are installed in conduit or equivalently protected against mechanical injury.

NFPA 72-2010 National Fire Alarm and Signaling Code

10.17.1.17.1* Notification alarm circuits that do not have notification appliances tied directly to the circuit shall be considered control circuits.

A.10.17.1.17.1 Initially this requirement was meant to apply to notification appliance circuits (NACs) emanating from a single fire alarm control unit and did not contemplate the use of NAC extender panels. Acknowledging the control circuit concept allows NAC extender panels and relays to be connected to a control circuit.

10.17.1.17.2 Control circuits shall not be required to comply with 10.17.1.17, provided that the circuit is monitored for integrity in accordance with 10.17.1 and a fault in the installation conductors shall result in a trouble signal in accordance with Section 10.12.

10.17.1.19 Where two or more systems are interconnected, the interconnecting circuit conductors shall be monitored for integrity so that open, short, or ground-fault conditions that affect the required normal operation of either system are indicated as a trouble condition.

10.17.2 Monitoring Integrity of In-Building Fire Emergency Voice/Alarm Communications Systems.

10.17.2.2.1 ~~Where a~~ Two-way telephone communications circuit installation conductors shall be monitored for open ~~and short~~ circuit fault conditions that would cause the telephone communications circuit to become fully or partially inoperative. ~~Two-way telephone communications circuit fault conditions shall result in a trouble signal in accordance with 4.4.3.5.~~

10.17.2.2.2 Two-way telephone communications circuit installation conductors shall be monitored for short circuit fault conditions that would cause the telephone communications circuit to become fully or partially inoperative

10.17.3.1 Unless otherwise permitted or required by 10.17.3.1.3 through and 10.17.3.1.6, all primary and secondary power supplies shall be monitored for the presence of voltage at the point of connection to the system.

10.17.3.1.1 Failure of either supply shall result in a trouble signal in accordance with Section 10.12.

10.17.3.1.2 Where the digital alarm communicator transmitter (DACT) is powered from a protected premises fire alarm system control unit, power failure indication shall be in accordance with ~~this paragraph~~ 10.17.3.1.

10.17.3.3* Unless prohibited by the authority having jurisdiction, supervising station fire alarm systems shall be arranged to delay transmission of primary power failure signals for a period ranging from 60 minutes to 180 minutes.

10.18.1.1 The authority having jurisdiction shall be notified prior to installation or alteration of equipment or wiring.

10.18.1.2* At the authority having jurisdiction's request, complete information regarding the system or system alterations, including specifications, type of system or service, shop drawings, input/output matrix, battery calculations, and notification appliance circuit voltage drop calculations, shall be submitted for approval.

A.10.18.1.2 Shop Drawings.

NFPA 72-2010 National Fire Alarm and Signaling Code

General. Shop drawings for fire alarm systems ~~are intended to~~ should provide basic information consistent with the objective of installing a fully operational, code-compliant fire alarm system and to should provide the basis for the record drawings required elsewhere in this Code.

~~Approval of shop drawings is not intended to imply waiver or modification of any requirements of this Code or any other applicable criteria.~~

Content. Shop drawings should include, to an extent commensurate with the extent of the work being performed, floor plan drawings, riser diagrams (~~except for systems in single-story buildings~~), control unit panel wiring diagrams, point-to-point wiring diagrams, ~~conduit, conductor routing, and typical wiring diagrams, and other information as described herein.~~

All shop drawings should be drawn on sheets of uniform size and should include the following information:

- (1) Name of protected premises, owner, and occupant (where applicable)
- (2) Name of installer or contractor
- (3) Location, including street address of protected premises
- (4) Device legend in accordance with NFPA 170, Standard for Fire Safety and Emergency Symbols
- (5) Date of issue and any revisions
- ~~(5) Input/output programming matrix~~

Floor plan drawings should be drawn to an indicated scale and should include the following information:

- (1) Floor identification
- (2) Point of compass (indication of north)
- (3) Graphic scale
- (4) All walls and doors
- (5) All partitions extending to within ~~±~~ 10 percent of the ceiling height (where applicable)
- (6) Room descriptions
- (7) Fire alarm device/component locations
- (8) Locations of fire alarm primary power connection(s)
- (9) Locations of monitor/control interfaces to other systems
- (10) Riser locations
- ~~(11) Routing for Class A compliance, where applicable~~
- (12) Type and number of fire alarm system components/devices on each circuit, on each floor or level
- ~~(12) Methods for compliance with 6.9.10.4 for survivability (emergency voice systems) as shown in Section 6.9, where applicable~~
- (12) Type and quantity of conductors and conduit (if used) used for each circuit
- ~~(13) Ceiling height and ceiling construction details~~
- (13) Location of all supply and return air diffusers (where automatic detection is used)

Fire alarm system riser diagrams should include the following information:

- (1) General arrangement of the system in building cross-section
- (2) Number of risers

NFPA 72-2010 National Fire Alarm and Signaling Code

- (3) Type and number of circuits in each riser
- (4) Type and number of fire alarm system components/devices on each circuit, on each floor or level
- (5) Type and quantity of conductors and conduit (if used) for each circuit

Control unit wiring diagrams should be provided for all control equipment (i.e., equipment listed as either a control unit or control unit accessory), power supplies, battery chargers, and Annunciators and should include the following information:

- (1) Identification of the control equipment depicted
- (2) Location(s)
- (3) All field wiring terminals and terminal identifications
- (4) All circuits connected to field wiring terminals and circuit identifications
- (5) All indicators and manual controls, including the full text of all labels
- (6) All field connections to supervising station signaling equipment, releasing equipment, and fire safety control interfaces Typical wiring diagrams should be provided for all initiating devices, notification appliances, remote alarm light emitting diodes (LEDs) indicators, ~~annunciators~~, remote test stations, and end-of-line and power supervisory devices.

10.18.2 Completion Documents.

10.18.2.1 Preparation.

10.18.2.1.1* The preparation of a record of completion, Figure 10.18.2.1.1, shall be the responsibility of the qualified and experienced person described in 10.4.2 ~~and shall be in accordance with 4.5.2.1.1 through 4.5.2.1.3.~~

10.18.2.1.2 The preparation of a record of completion, Figure 10.18.2.1.1 shall be in accordance with 10.18.2.1.2.1 through 10.18.2.1.2.8.

10.18.2.1.2.1 Parts 1 through ~~11~~ 14 of the record of completion shall be completed after the system is installed and the installation wiring has been checked.

10.18.2.1.2.2 Parts ~~12~~ 15 and ~~13~~ 16 of the record of completion shall be completed after the operational acceptance tests have been completed.

10.18.2.1.2.3 A preliminary copy of the record of completion shall be given to the system owner and, if requested, to other authorities having jurisdiction after completion of the installation wiring tests.

10.18.2.1.2.4 A final copy of the record of completion shall be provided after completion of the operational acceptance tests.

10.18.2.1.2.5 One copy of the record of completion, ~~updated to reflect all system additions or modifications and maintained in a current condition at all times~~, shall be stored at the fire alarm control unit or other ~~approved~~ location ~~approved by the authority having jurisdiction~~.

10.18.2.1.2.6 This copy shall be updated to reflect all system additions or modifications and maintained in a current condition at all times.

10.18.2.1.2.7 Where not stored at the main fire alarm control unit, the location of these documents shall be identified at the main fire alarm control unit.

NFPA 72-2010 National Fire Alarm and Signaling Code

10.18.2.1.2.8 If the documents are located in a separate enclosure or cabinet, the separate enclosure or cabinet shall be prominently labeled FIRE ALARM DOCUMENTS.

10.18.2.2 Revision. All fire alarm systems ~~that are modified~~ modifications made after the initial installation shall ~~have the original record of completion revised to show all changes from~~ be recorded on a revised version of the original record of completion and shall include ~~a revision date.~~

10.18.2.2.1 All changes from the original information shall be shown.

10.18.2.2.2 The revised record of completion shall include a revision date.

10.18.2.3 Documentation Required. Every system shall include the following documentation, which shall be delivered to the owner or the owner's representative upon final acceptance of the system:

- (1) *An owner's manual and manufacturer's published instructions covering all system equipment
- (4) Record drawings
- (5) For software-based systems, record copy of the site-specific software
- (6) A written sequence of operation

10.18.2.4.1 ~~At a minimum,~~ Verification shall ensure that the installed system includes all ~~required~~ components and functions, that those components and functions are installed and operate as required, that the system has been 100 percent acceptance tested in accordance with Chapter 14, and that all required documentation has been provided to the system owner. ~~For supervising station systems, the verification shall also ascertain proper arrangement, transmission, and receipt of all signals required to be transmitted off premises.~~

Exception: Where the installation is an extension, modification, or reconfiguration of an existing system, the verification shall be required for the new work only, and reacceptance testing in accordance with Chapter 14 shall be acceptable.

10.18.2.4.2 For supervising station systems, the verification shall also ascertain proper arrangement, transmission, and receipt of all signals required to be transmitted off-premises.

Exception: Where the installation is an extension, modification, or reconfiguration of an existing system, the verification shall be required for the new work only, and reacceptance testing in accordance with Chapter 14 shall be acceptable.

10.18.2.4.3 Verification shall include written confirmation that any required corrective actions have been completed.

10.19.4 The system owner or owner's designated representative shall be notified when an impairment period is completed or discontinued.

~~4.7 Mass Notification Systems. See Annex E.~~

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 12, Circuits and Pathways

Summary. Chapter 12, *Circuits and Pathways*, is a new chapter. It brings together requirements that were formerly found in SIG-FUN, *Fundamentals of Fire Alarm Systems* regarding wiring and SIG-PRO, *Protected Premises Fire Alarm Systems* regarding fault tolerance. The old “Class” and “Style” assignments have been changed to reflect a performance-based description of fault tolerance using “Class” only.

Also, wiring requirements are now echoed from NFPA 70 and the description of survivability has been expanded.

Legend. ~~deleted text~~ new text

12.1 Application.

12.1.1 Pathways (interconnections) shall be designated based on the performance characteristics defined in this chapter.

12.1.2 The requirements of Chapter 14 shall apply.

12.2 General.

12.2.1* Performance and survivability characteristics of signaling pathways (interconnections) shall comply with the defined designations of this chapter.

A.12.2.1 In the 2007 edition of NFPA 72, initiating device circuit, signaling line circuit, and notification appliance circuit performance class/style tables were rooted in “copper” wiring methods. Fire alarm control units use new communication technologies, such as Ethernet, fiber optics, and wireless, which do not fit in the “copper” wiring methods.

12.2.2 A pathway (interconnection) class designation shall be dependent on the pathway (interconnection) capability to continue to operate during abnormal conditions.

12.2.3 The designation of the pathways shall be permitted to also include the performance of the pathway (interconnection) to survivability from attack by fire.

12.2.4* Wiring. The installation of all pathway wiring, cable, and equipment shall be in accordance with NFPA 70, *National Electrical Code*, and specifically with Articles 760, 770, and 800 where applicable. Optical fiber cables shall be protected against mechanical injury in accordance with Article 760 the applicable requirements of 12.2.4.1 through 12.2.4.5.

A.12.2.4 The installation of all fire alarm system wiring should take into account the fire alarm system manufacturer’s published installation instructions, and the limitations of the applicable product listings or approvals, and communications circuit protection as required by 12.2.4.2.

12.2.4.1 Optical fiber cables installed as part of the fire alarm system shall meet the requirements of NFPA 70, *National Electrical Code*, Article 770, and be protected against mechanical injury physical damage in accordance with NFPA70, *National Electrical Code*, Article 760.

12.2.4.2* Where fire alarm circuits enter or exit buildings, the circuits and equipment shall be installed in accordance with the requirements of Article 760 of NFPA 70, *National Electrical Code*.

NFPA 72-2010 National Fire Alarm and Signaling Code

Subsection 12.2.4.2 was revised by a tentative interim amendment (TIA). See page 1.

A.12.2.4.2 Interbuilding circuits are considered to have a lightning exposure unless one or more of the following conditions exist:

- (1) Circuits in large metropolitan areas where buildings are close together and sufficiently high to intercept lightning.
- (2) Interbuilding cable runs of 140 ft (42 m) or less, directly buried or in underground conduit, where a continuous metallic cable shield or a continuous metallic conduit containing the cable is connected to each building grounding electrode system.
- (3) Areas having an average of five or fewer thunderstorm days per year and earth resistivity of less than 100 ohm-meters.

Such areas are found along the Pacific coast. [70:800.90(A), FPN No. 2]

It is important to protect the fire alarm system from lightning.

One of the key requirements related to transient protection is NFPA 70, *National Electrical Code*, Section 760.32, which covers installation requirements. Part of those installation requirements are the grounding and bonding rules contained in Part IV of Article 800. Connections to the building grounding electrode system should be made where the circuits enter and exit a building. To minimize potential damage from induced transients, the circuits entering and exiting a building should connect to the grounding electrode system and transient protection equipment nearest the point of entry, before being intermingled with other circuits.

NEC Section 760.32 provides references for fire alarm circuits extending beyond one building. The requirements for the installation of power-limited circuits and communications circuits are covered by Parts II, III, and IV of Article 800, Communications Circuits. The methods and equipment used for providing transient protection of circuits addressed by Article 800 are not necessarily suitable for voltages expected on all fire alarm circuits.

The requirements for the installation of non–power-limited underground outdoor circuits are found in Part I of Article 300 and the applicable sections in Part I of Article 225, Underground Branch Circuits and Feeders. It should be noted that Article 225 does not specifically require transient protection of circuits, but consideration should be given to protecting underground circuits.

In both power-limited and non–power-limited circuits, surge protective devices may be installed to protect against electrical surges. When installing surge protective devices, the requirements of NEC Article 285 should be followed.

Subsections A.12.2.4 and A.12.2.4.2 were revised by a tentative interim amendment (TIA). See page 1.

12.2.4.3* Fire alarm system wiring and equipment, including all circuits controlled and powered by the fire alarm system, shall be installed in accordance with the requirements of this Code and of NFPA 70, *National Electrical Code*.

A.12.2.4.3 Fire alarm systems include fire detection and alarm notification, guard's tour, sprinkler waterflow, and sprinkler supervisory systems. Circuits controlled and powered by the fire alarm system include circuits for the control of building systems safety functions, elevator capture, elevator shutdown, door release, smoke doors and damper control, fire doors and damper control, and fan shutdown, but only where these circuits are powered by and controlled by the fire alarm system. [70:760.1 FPN No.1]

NFPA 72-2010 National Fire Alarm and Signaling Code

Class 1, 2, and 3 circuits are defined in Article 725 (of NFPA 70, National Electrical Code). [70:760.1 FPN No. 2]

12.2.4.4 Grounding. All fire alarm systems shall test free of grounds.

Exception: 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.

12.2.4.5* Wiring methods permitted by other sections of this Code to resist attack by fire shall be installed in accordance with manufacturer's published instructions and the requirements of NFPA 70, Article 760.

A.12.2.4.5 It is important for the intended functionality of circuit integrity cable or electrical circuit protective systems to follow manufacturer's installation instructions. An electrical circuit protective system has detailed installation requirements, and additional requirements can be found in the manufacturer's installation instructions, NFPA 70, National Electrical Code, or the listing organizations' guide information.

12.3* Pathway Class Designations. Pathways shall be designated as Class A, Class B, Class C, Class D, Class E, or Class X, depending on their performance.

A.12.3 The intent of the circuit designations is not to create a hierarchal ranking; rather it is to provide guidance on the levels of performance.

The initiating device circuit, signal line circuit, and notification appliance circuit performance class/style tables from previous editions of the Code have been included as Table A.12.3(a), Table A.12.3(b), and Table A.12.3(c) but have been modified to include the enhanced class references. These tables reflect the classifications as applied to fire alarm systems. Some of the operations are a combination of the requirements of Chapter 12 in conjunction with the requirements of Chapters 10 and 23. Singular ground-fault conditions that do not affect operation of the pathway are not specifically covered in Chapter 12, but are covered by the requirements of other chapters. Users of the Chapter 12 designations should review whether there are other abnormal conditions not specified in Chapter 12 that the pathways need to annunciate and operate through for their application.

12.3.1* Class A. A pathway shall be designated as Class A when it performs as follows:

- (1) It includes a redundant path.
- (2) Operational capability continues past a single open.
- (3) Conditions that affect the intended operation of the path are annunciated.

A.12.3.1 The Class A references for initiating device circuit and notification appliance circuit performance have been changed to eliminate the need for alarm receipt capability during a single ground or annunciation of a single ground fault. The signal line circuit performance has changed to provide a clear separation between the Class A Style 6 and Class A Style 7 performance. The Class A Style 7 performance is now defined as Class X.

Fiber optic or wireless pathways are examples of Class A circuitry not impaired by earth ground connection, and short-circuits, and therefore do not annunciate those conditions as a fault. Users of the code are advised that fire alarm circuits still require alarm receipt capability during a single ground. See Chapter 23.

12.3.2* Class B. A pathway shall be designated as Class B when it performs as follows:

NFPA 72-2010 National Fire Alarm and Signaling Code

- (1) It does not include a redundant path.
- (2) Operational capability stops at a single open.
- (3) Conditions that affect the intended operation of the path are annunciated.

A.12.3.2 The Class B references for initiating device circuit, signal line circuit, and notification appliance circuit performance have been changed to eliminate the need for alarm receipt capability during a single ground or annunciation of a single ground fault. Users of the code are advised that fire alarm circuits still require alarm receipt capability during a single ground. (See Chapter 23.)

12.3.3* Class C. A pathway shall be designated as Class C when it performs as follows:

- (1) It includes one or more pathways where operational capability is verified via end-to-end communication, but the integrity of individual paths is not monitored.
- (2) A loss of end-to-end communication is annunciated.

A.12.3.3 The Class C reference is new and is intended to describe technologies that supervise the communication pathway by polling or continuous communication “handshaking” such as the following:

- (1) Fire control unit or supervisory station connections to a wired LAN, WAN, or Internet
- (2) Fire control unit or supervisory station connections to a wireless LAN, WAN, and Internet
- (3) Fire control unit or supervisory station connections to a wireless (proprietary communications)
- (4) Fire control unit digital alarm communication transmitter or supervisory station digital alarm communication receiver connections to the public switched telephone network

12.3.4* Class D. A pathway shall be designated as Class D when it has fail-safe operation, where no fault is annunciated, but the intended operation is performed in the event of a pathway failure.

A.12.3.4 The Class D reference is intended to describe pathways that are not supervised but have a fail-safe operation that performs the intended function when the connection is lost.

Examples of such pathways include the following:

- (1) Power to door holders where interruption of the power results in the door closing
- (2) Power to locking hardware that release upon an open circuit or fire alarm operation

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

A.12.3.5 The Class E reference is new and is intended to describe pathways, which do not require supervision as described in 10.17.

12.3.6* Class X. A pathway shall be designated as Class X when it performs as follows:

- (1) It includes a redundant path.
- (2) Operational capability continues past a single open or short-circuit.
- (3) Conditions that affect the intended operation of the path are annunciated.

A.12.3.6 The Class X reference is new and is intended to describe pathways as described as Class A Style 7 of the signal line circuit performance of Table A.12.3(b). (Also see A.12.3.)

NFPA 72-2010 National Fire Alarm and Signaling Code

12.4 Pathway Survivability. All pathways shall comply with NFPA 70, *National Electrical Code*.

12.4.1 Pathway Survivability Level 0. Level 0 pathways shall not be required to have any provisions for pathway survivability.

12.4.2 Pathway Survivability Level 1. Pathway survivability Level 1 shall consist of pathways in buildings that are fully protected by an automatic sprinkler system in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, with any interconnecting conductors, cables, or other physical pathways installed in metal raceways.

12.4.3 Pathway Survivability Level 2. Pathway survivability Level 2 shall consist of one or more of the following:

- (1) 2-hour fire-rated circuit integrity (CI) cable
- (2) 2-hour fire-rated cable system [electrical circuit protective system(s)]
- (3) 2-hour fire-rated enclosure or protected area
- (4) 2-hour performance alternatives approved by the authority having jurisdiction

12.4.4 Pathway Survivability Level 3. Pathway survivability Level 3 shall consist of pathways in buildings that are fully protected by an automatic sprinkler system in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, and one or more of the following:

- (1) 2-hour fire rated circuit integrity (CI) cable
- (2) 2-hour fire rated cable system (electrical circuit protective system(s))
- (3) 2-hour fire rated enclosure or protected area
- (4) 2-hour performance alternatives approved by the authority having jurisdiction

12.5 Nomenclature. To identify the properties of the system(s) interconnections and survivability requirements, the following identification nomenclature shall be used:

- (1) System(s) interconnections
- (2) Survivability levels (not required if Level 0)

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 14, Inspection, Testing, and Maintenance

14.1.1 The inspection, testing, and maintenance of ~~fire alarm~~ systems, their initiating devices, and notification appliances shall comply with the requirements of this chapter.

14.2.1.1 Performance Verification. To ensure operational integrity, the ~~fire alarm~~ system shall have an inspection, testing, and maintenance program.

14.2.1.1.1 Inspection, testing, and maintenance programs shall satisfy the requirements of this Code, ~~shall~~ and conform to the equipment manufacturer's published instructions.

14.2.1.1.2 Inspection, testing, and maintenance programs shall verify correct operation of the ~~fire alarm~~ system.

14.2.2 Responsibilities.

14.2.2.1* The property or building ~~owner~~ or the system owner or the owner's designated representative shall be responsible for inspection, testing, and maintenance of the system and for alterations or additions to this system.

14.2.2.3 Inspection, testing, or maintenance shall be permitted to be done by the building or system owner or a person or organization other than the building or system owner if conducted under a written contract.

14.2.2.5* Service Personnel Qualifications and Experience.

Service personnel shall be qualified and experienced in accordance with the requirements of 10.4.3.

14.2.3* Notification.

A.14.2.3 Prior to any scheduled inspection or testing, the service company should consult with the building or system owner or the owner's designated representative. Issues of advance notification in certain occupancies, including advance notification time, building posting, systems interruption and restoration, evacuation procedures, accommodation for evacuees, and other related issues, should be agreed upon by all parties prior to any inspection or testing.

14.2.4 System Documentation. Prior to system maintenance or testing, the ~~system~~ certificate record of completion and the any information required by Section 10.18 regarding the system and system alterations, including specifications, wiring diagrams, and floor plans, shall be provided by the owner or a designated representative to the service personnel upon request.

14.2.4.1 The provided documentation shall include the current revisions of all fire alarm software and the revisions of software of any systems with which the fire alarm software interfaces.

14.2.4.2 The revisions of fire alarm software, and the revisions of the software in the systems with which the fire alarm software interfaces, shall be verified for compatibility in accordance with the requirements of 23.2.2.1.1.

14.2.5.5 Testing shall include verification that the releasing circuits and components energized or actuated by the fire alarm system are electrically supervised monitored for integrity and operate as intended on alarm.

NFPA 72-2010 National Fire Alarm and Signaling Code

14.2.6.1* Testing personnel shall be qualified and experienced in the arrangement and operation of interface equipment and fire safety emergency control functions.

A.14.2.6.1 As an example, testing of the elevator fire service and shutdown functions will usually require a coordinated multi-discipline effort with presence of qualified service personnel for the fire alarm system, the elevator system, and other building systems. The presence of inspection authorities might also be needed in some jurisdictions. The development of a test plan should be considered to ensure that the testing of these features is accomplished in a coordinated and timely manner. This plan should also ensure that all appropriate parties and personnel are present when needed, and that the testing requirements for both the fire alarm system and the elevator system are fulfilled. See Section 21.3 and Section 21.4 for specific elevator fire safety emergency control functions.

14.2.7 Automated Testing.

14.2.7.1 ~~If automatic~~ Automated testing is performed at least weekly by a remotely monitored fire alarm control unit specifically listed for the application arrangements that provide equivalent means of testing devices to those specified in Table 14.4.2.2 at a frequency at least equivalent to those specified in Table 14.4.5 shall be permitted to be ~~extended to annually~~ used to comply with the requirements of this chapter.

14.2.7.2 Failure of a device on an automated test shall result in an audible and visual trouble signal.

14.2.8* Performance-Based Inspection and Testing. As an alternate means of compliance, subject to the authority having jurisdiction, components and systems shall be permitted to be inspected and tested under a performance-based program.

A.14.2.8 This section provides the option to adopt a performance-based inspection and testing method as an alternate means of compliance for Sections 14.3 and 14.4. The prescriptive test and requirements contained in this Code are essentially qualitative. Equivalent or superior levels of performance can be demonstrated through quantitative performance-based analyses. This section provides a basis for implementing and monitoring a performance-based program acceptable under this option (provided that approval is obtained by the authority having jurisdiction). The concept of a performance-based inspection and testing program is to establish the requirements and frequencies at which inspection and testing must be performed to demonstrate an acceptable level of operational reliability. The goal is to balance the inspection and testing frequency with proven reliability of the system or component. The goal of a performance-based inspection program is also to adjust inspection and testing frequencies commensurate with historical documented equipment performance and desired reliability. Frequencies of inspection and testing under a performance-based program may be extended or reduced from the prescriptive inspection and testing requirements contained in this Code when continued inspection and testing has been documented indicating a higher or lower degree of reliability as compared to the authority having jurisdiction's expectations of performance. Additional program attributes should be considered when adjusting inspection and testing.

A fundamental requirement of a performance-based program is the continual monitoring of fire system/component failure rates and determining if they exceed the maximum allowable failure rates as agreed upon with the authority having jurisdiction. The process used to complete this review should be documented and be repeatable. Coupled with

NFPA 72-2010 National Fire Alarm and Signaling Code

this ongoing review is a requirement for a formalized method of increasing or decreasing the frequency of inspection and testing when systems exhibit either a higher than expected failure rate or an increase in reliability as a result of a decrease in failures. A formal process for reviewing the failure rates and increasing or decreasing the frequency of inspection and testing must be well documented. Concurrence from the authority having jurisdiction on the process used to determine test frequencies should be obtained in advance of any alterations to the inspection and testing program. The frequency required for future inspections and tests may be reduced to the next inspection frequency and maintained there for a period equaling the initial data review or until the ongoing review indicates that the failure rate is no longer being exceeded—for example, going from an annual to a semiannual testing when the failure rate exceeds the authority having jurisdiction's expectations, or from annual to every 18 months when the failure trend indicates an increase in reliability.

See also NFPA 551, *Guide for the Evaluation of Fire Risk Assessments*, for additional guidance.

14.3 Inspection.

14.3.1* Unless otherwise permitted by 14.3.2 visual inspections shall be performed in accordance with the schedules in Table 14.3.1 or more often if required by the authority having jurisdiction.

14.3.2 ~~Exception~~ Devices or equipment that is inaccessible for safety considerations (e.g., continuous process operations, energized electrical equipment, radiation, and excessive height) shall be permitted to be inspected during scheduled shutdowns if approved by the authority having jurisdiction. Extended intervals shall not exceed 18 months.

14.3.3 Extended intervals shall not exceed 18 months.

14.4.1.1.1 Initial acceptance testing shall be performed as required in 14.4.1.1.1.1 through 14.4.1.1.1.2.

14.4.1.1.1.1 All new systems shall be inspected and tested in accordance with the requirements of Chapter 14.

14.4.1.1.1.2 The authority having jurisdiction shall be notified prior to the initial acceptance test.

14.4.1.2* Reacceptance Testing.

A.14.4.1.2 Reacceptance testing is performed to verify the proper operation of added or replaced devices, appliances, ~~fire safety~~ emergency control function devices, control equipment, and so forth. It is not the intent of the committee to unduly burden the system owner with increased costs for repeated testing of devices not directly affected by the replacement of devices with like devices.

For example, if a 2 amp fuse is replaced with another 2 amp fuse in the fire alarm control unit, verification of the circuit(s) served by the fused supply is required, but it would not be necessary to test 10 percent of initiating devices not directly affected by replacing the fuse. Likewise, it is not necessary to test all these initiating devices whenever a smoke detector is replaced with a like smoke detector.

NFPA 72-2010 National Fire Alarm and Signaling Code

When wiring changes are made to correct improperly supervised circuits, a test of the affected device or appliance is required, but not a test of 10 percent of initiating devices not directly affected.

Table 14.3.1 Visual Inspection Frequencies

7. In-building fire emergency voice/alarm communications equipment
9. Initiating devices
 - (e) Manual fire alarm boxes
11. Combination systems
 - (a) Fire extinguisher electronic monitoring device/systems
15. Supervising station ~~fire~~ alarm systems — transmitters
17. Supervising station ~~fire~~ alarm systems — receivers*
18. Public ~~fire~~ emergency alarm reporting system transmission equipment
19. Mass notification system, supervised
 - (a) Control equipment
 - (1) Fuses (initially and annually)
 - (2) Interfaces (initially and annually)
 - (3) Lamps/LED (initially and annually)
 - (4) Primary (main) power supply (initially and annually)
 - (b) Secondary power batteries
 - (1) Lead-acid (initially and annually)
 - (2) Nickel-cadmium (initially and annually)
 - (3) Primary (dry-cell) (initially and annually)
 - (4) Sealed lead-acid (initially and annually)
 - (c) Initiating devices (initially and annually)
 - (d) Notification appliances (initially and annually)
20. Mass notification system, non-supervised systems installed prior to adoption of this edition
 - (a) Control equipment
 - (1) Fuses (initially and quarterly)
 - (2) Interfaces (initially and annually)
 - (3) Lamps/LED (initially and annually)
 - (4) Primary (main) power supply (initially and annually)
 - (b) Secondary power batteries
 - (1) Lead-acid (initially and annually)

NFPA 72-2010 National Fire Alarm and Signaling Code

(2) Nickel-cadmium (initially and annually)

(3) Primary (dry cell) (initially and annually)

(4) Sealed lead-acid (initially and annually)

(c) Initiating devices (initially and annually)

(d) Notification appliances (initially and annually)

21. Mass notification system Antenna (initially and annually)

22. Mass notification system Transceivers (initially and annually)

14.4.2* Test Methods.

A.14.4.2 Fire alarm system testing can be conducted using silent testing and the bypassing of emergency control functions.

All input signals should be verified according to the system matrix of operation to ensure they create the appropriate outputs. Tests of audible notification appliances and emergency control functions should be conducted at the conclusion of satisfactory tests of all inputs.

The intent is to reduce the amount of time spent causing audible and visible occupant notification during tests in an occupied building. This reduction will help reduce the negative (cry wolf) impact on occupants caused by excessive operation of notification appliances. System printouts or history logs are an effective way of verifying the correct receipt of signals. However, many outputs such as occupant notification and emergency control functions are tested for correct operation, because logs do not necessarily verify operation of the system output. Operation of audible and visible notification appliances could be accomplished in a lump sum fashion after all inputs are proven correct by silent testing. All inputs tested in this manner must be proved to cause the appropriate signal by verifying alarm receipt at the controls as each device is actuated.

Manufacturer-specific protocols such as “walk test” or “alarm bypass” are an acceptable means of testing under this section. Other methods of mitigating the negative impact include off-hours tests when the building is not occupied

14.4.2.2* ~~Fire alarm Systems and other systems and associated equipment that are associated with fire alarm system and accessory equipment shall be tested according to Table 14.4.2.2.~~

A.14.4.2.2 Table 14.4.2.2, Item 3. Refer to Annex C Table 14.4.2.2, Item 18(a) for wiring diagrams and guidance on the testing various styles of fire alarm circuits transmission equipment.

Table 14.4.2.2, Item 18(a). Some transmission equipment (such as but not limited to cable modems, fiber optic interface nodes, and VoIP interfaces) are typically powered by the building electrical system using a standby power supply that does not meet the requirements of this Code. This is intended to ensure that the testing authority verifies full standby power as required by Chapter 10. Additionally, refer to Table 14.4.2.2, Items 3 through 6 for secondary power supply testing.

Table 14.4.2.2, Item 23. Initiating devices configured to operate an emergency control function are required to be tested per the test methods listed in Table 14.4.2.2, Item 14 and the test frequencies listed in Table 14.4.5, Item 15. Whenever an emergency control function is observed to not operate properly during a test of an emergency control

NFPA 72-2010 National Fire Alarm and Signaling Code

function initiating device, the problem should be reported to the building owner or designated representative. The failure of the emergency control function should be reported as a possible failure of the fire safety feature and not necessarily of the fire alarm system

Table 14.4.2.2 Test Methods

2. Engine-driven generator

If an engine-driven generator dedicated to the fire alarm system is used as a required power source, operation of the generator shall be verified in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems*, by the building owner.

3. Secondary (standby) power supply^a

All primary (main) power supplies shall be disconnected, and the occurrence of required trouble indication for loss of primary power shall be verified.

The system's standby and alarm current demand shall be measured or verified, and, using manufacturer's data, the ability of batteries to meet standby and alarm requirements shall be verified. General alarm systems shall be operated for a minimum of 5 minutes, and emergency voice communications systems for a minimum of 15 minutes. Primary (main) power supply shall be reconnected at end of test.

^aSee A.14.4.2.2.

7. Public fire emergency alarm reporting system power supply

(a) Lead-acid type

Perform the battery tests in accordance with item 6(b)

8. Public fire emergency alarm reporting system transmission equipment

(a) Publicly accessible fire alarm box

Publicly accessible initiating device(s) shall be actuated. Receipt of not less than three complete rounds of signal impulses shall be verified. This test shall be performed under normal circuit conditions. If the device is equipped for open circuit operation (ground return), it shall be tested in this condition as one of the semiannual tests.

(b) Auxiliary box

Each initiating circuit of the auxiliary box shall be tested by actuation of a protected premises initiating device connected to that circuit. Receipt of not less than three complete rounds of signal impulses shall be verified

13. Conductors — nonmetallic

Each initiating device, notification appliance, and signaling line circuit shall be tested for correct indication at the control unit. All circuits shall perform as indicated in ~~Table 6.5, Table 6.6.1, or Table 6.7~~ 23.5.2, 23.5.3, 23.6.2 through 23.6.5, 23.7.2 and 23.7.3.

14. Initiating devices

(d) Heat detectors

NFPA 72-2010 National Fire Alarm and Signaling Code

(1) Fixed-temperature, rate-of-rise, rate of compensation, restorable line, spot type (excluding pneumatic tube type)

Heat test shall be performed with a heat source per the manufacturer's published ~~inspections~~ instructions for response within 1 minute. A test method shall be used that is specified in the ~~published~~ manufacturer's ~~manufacturer's~~ published instructions for the installed equipment, or other method shall be used that will not damage the nonrestorable fixed-temperature element of a combination rate-of-rise/fixed-temperature element detector.

(e) Manual fire alarm boxes

Manual fire alarm boxes shall be operated per the manufacturer's published instructions. Key-operated presignal and general alarm manual fire alarm boxes shall both be tested.

(g) Smoke detectors

(1) In other than one- and two-family dwellings, system detectors and single- or multiple-station smoke alarms

^e ~~The~~ Smoke detectors/smoke alarms shall be tested in place to ensure smoke entry into the sensing chamber and an alarm response. Testing with smoke or listed aerosol, ~~approved~~ acceptable by to the manufacturer of the aerosol or the manufacturer of the smoke detector/smoke alarm and identified in their published instructions, shall be permitted as acceptable test methods.

Other methods listed in the manufacturer's published instructions that ensure smoke entry from the protected area, through the vents, into the sensing chamber shall be permitted.

(2) Smoke/carbon monoxide alarms in other than one- and two-family dwellings.

The smoke alarms shall be tested in place to ensure smoke entry into the sensing chamber and an alarm response. Testing with real smoke or listed simulated aerosol or listed smoke particulate approved by the manufacturer shall be permitted as acceptable test methods. Other methods listed in the manufacturer's published instructions that ensure smoke entry from the protected area, through the vents, into the sensing chamber shall be permitted. Any of the following tests shall be performed to ensure that each smoke alarm is within its listed and marked sensitivity range:

(1) Calibrated test method

(2) Manufacturer's calibrated sensitivity test instrument

(3) Other calibrated sensitivity test method approved by the authority having jurisdiction

The carbon monoxide alarm shall be tested in accordance with NFPA 720.

^e Note, it is customary for the manufacturer of the smoke detector/smoke alarm to test a particular product from an aerosol provider to determine acceptability for use in smoke entry testing of their smoke detector/smoke alarm.

NFPA 72-2010 National Fire Alarm and Signaling Code

(3) Single-and multiple-station smoke alarms connected to protected premises systems

A functional test shall be performed on all single-and-multiple station smoke alarms connected to a protected premises fire alarm system by putting the smoke alarm into an alarm condition and verifying that the protected premises system receives a supervisory signal and does not cause a fire alarm signal.

(4) Single- and multiple-station smoke alarms and system smoke detectors used in one- and two-family dwellings

Functional tests shall be conducted according to manufacturer's published instructions.

(6) Duct type

In addition to the testing required in Table 14.4.2.2(g)(1), ~~air duct smoke detectors utilizing sampling tubes~~ shall be tested ~~or inspected~~ by verifying the correct pressure differential (within the manufacturer's published ranges) between the inlet and exhaust tubes using a method acceptable to the manufacturer to ensure that the device will properly sample the airstream. These ~~The~~ tests shall be made in accordance with the manufacturer's published instructions for the device installed.

(h) Carbon monoxide detectors/carbon monoxide alarms for the purposes of fire detection

The devices shall be tested in place to ensure CO entry to the sensing chamber by introduction of CO gas from the protected area, through the vents, to the sensing chamber.

15. Alarm notification appliances

(a) Audible

(1) Initial and reacceptance testing shall comply with the following:

Sound pressure levels for signals shall be measured with a sound level meter meeting ANSI S1.4a, *Specifications for Sound Level Meters, Type 2* requirements. Sound pressure levels throughout the protected area shall be measured and recorded to confirm that they are in compliance with Chapter 18. The sound level meter shall be set in accordance with ANSI S3.41, *American National Standard Audible Evacuation Signal*, using the time-weighted characteristic F (FAST). ~~Record the maximum output when the audible emergency evacuation signal is on.~~

(2) Periodic testing shall comply with the following: Sound pressure levels for signals shall be measured with a sound level meter meeting ANSI S1.4a, *Specifications for Sound Level Meters, Type 2* requirements. Sound pressure levels shall be measured for conformity to Chapter 18 where building, system, or occupancy changes have occurred. The sound level meter shall be set in accordance with ANSI S3.41, *American National Standard Audible Evacuation Signal*, using the time-weighted characteristic F (FAST).

NFPA 72-2010 National Fire Alarm and Signaling Code

(b) Audible textual notification appliances (speakers and other appliances to convey voice messages)

(1) Initial and reacceptance testing shall comply with the following:

Sound pressure levels for signals shall be measured with a sound level meter meeting ANSI S1.4a, *Specifications for Sound Level Meters, Type 2* requirements. Sound pressure levels throughout the protected area shall be measured and recorded to confirm that they are in compliance with Chapter 18. The sound level meter shall be set in accordance with ANSI S3.41, *American National Standard Audible Evacuation Signal*, using the time-weighted characteristic F (FAST). ~~The maximum output shall be recorded when the audible emergency evacuation signal is on.~~

Audible information shall be verified to be distinguishable and understandable and shall comply with 14.4.13.

(2) Periodic testing shall comply with the following:

Sound pressure levels for signals shall be measured with a sound level meter meeting ANSI S1.4a, *Specifications for Sound Level Meters, Type 2* requirements. Sound pressure levels shall be measured for conformity to Chapter 18 where building, system, or occupancy changes have occurred. The sound level meter shall be set in accordance with ANSI S3.41, *American National Standard Audible Evacuation Signal*, using the time-weighted characteristic F (FAST).

Audible information shall be verified to be distinguishable and understandable and shall comply with 14.4.13 where building, system, or occupancy changes have occurred.

~~In locations where voice intelligibility is required, it shall be verified by one of the following methods:~~

~~(1) Use of subject-based test methods as described in ANSI S3.2, Method for Measuring the Intelligibility of Speech Over Communications Systems~~

~~(2) Use of methods and instruments that measure certain physical parameters and provide a common intelligibility scale score as described in IEC 60849, Sound systems for emergency purposes~~

~~(3) Use of other methods acceptable to the authority having jurisdiction~~

~~The use of test methods that provide a common intelligibility scale score shall be permitted for use in existing systems but shall not require revisions to systems that were designed prior to the 2002 edition of this Code.~~

18. Supervising station fire alarm systems—transmission equipment⁹

19. Supervising station fire alarm systems—receiving equipment

21. Combination systems

(a) Fire extinguisher electronic monitoring device/system

NFPA 72-2010 National Fire Alarm and Signaling Code

Communication between the device connecting the fire extinguisher electronic monitoring device/system and the fire alarm control unit shall be tested to ensure proper signals are received at the FAGU fire alarm control unit and remote annunciator(s) if applicable.

23. Fire Safety Emergency control functions^h

Fire safety Emergency control functions (i.e., fan control, smoke damper operation, elevator recall, elevator power shutdown, door holder release, shutter release, door unlocking, etc.) shall be tested by operating or simulating alarm signals. Testing frequency for fire safety emergency control functions shall be the same as the frequency required for the initiating device that activates the fire safety emergency control function.

27. Mass notification systems

(a) Functions

At a minimum, control equipment shall be tested to verify correct receipt of alarm, supervisory, and trouble signals (inputs); operation of evacuation signals and auxiliary functions (outputs); circuit supervision, including detection of open circuits and ground faults; and power supply supervision for detection of loss of ac power and disconnection of secondary batteries.

(b) Fuses

The rating and supervision shall be verified.

(c) Interfaced equipment

Integrity of single or multiple circuits providing interface between two or more control units shall be verified. Interfaced equipment connections shall be tested by operating or simulating operation of the equipment being supervised. Signals required to be transmitted shall be verified at the control unit.

(d) Lamps and LEDs

Lamps and LEDs shall be illuminated.

(e) Primary (main) power supply

All secondary (standby) power shall be disconnected and tested under maximum load, including all alarm appliances requiring simultaneous operation. All secondary (standby) power shall be reconnected at end of test. For redundant power supplies, each shall be tested separately.

(f) Audible textual notification appliances (speakers and other appliances to convey voice messages)

Sound pressure level shall be measured with a sound level meter meeting ANSI S1.2a, *Specifications for Sound Level Meters, Type 2* requirements.

Levels throughout protected area shall be measured and recorded. The sound level meter shall be set in accordance with ANSI S3.41, *American National Standard Audible Evacuation Signal*, using the time-weighted characteristic F (FAST). The

NFPA 72-2010 National Fire Alarm and Signaling Code

maximum output shall be recorded when the audible emergency evacuation signal is on.

Audible information shall be verified to be distinguishable and understandable.

(g) Visible

Test shall be performed in accordance with manufacturer's published instructions. Appliance locations shall be verified to be per approved layout, and it shall be confirmed that no floor plan changes affect the approved layout. It shall be verified that the candela rating marking agrees with the approved drawing. It shall be confirmed that each appliance flashes.

(h) Control unit functions and no diagnostic failures are indicated

Review event log file, verify that the correct events were logged. Review system diagnostic log file; correct deficiencies noted in file. Delete unneeded log files. Delete unneeded error files. Verify that sufficient free disk space is available. Verify unobstructed flow of cooling air is available. Change/ clean filters, cooling fans, and intake vents.

(i) Control unit reset

Power down the central control unit computer and restart it.

(j) Control unit security

If remote control software is loaded onto the system, verify that it is disabled to prevent unauthorized system access.

(k) Audible/visible functional test

Send out an alert to a diverse set of predesignated receiving devices and confirm receipt. Include at least one of each type of receiving device.

(l) Software backup

Make full system software backup. Rotate backups based on accepted practice at site.

(m) Secondary power test

Disconnect ac power. Verify the ac power failure alarm status on central control equipment. With ac power disconnected, verify battery voltage under load.

(n) Wireless signals

Check forward/reflected radio power is within specifications.

(o) Antenna

Check forward/reflected radio power is within specifications. Verify solid electrical connections with no observable corrosion.

(p) Transceivers

Verify proper operation and mounting is not compromised.

NFPA 72-2010 National Fire Alarm and Signaling Code

14.4.4 Gas Detectors. Gas detectors shall be inspected, tested, and maintained in accordance with the manufacturers' published instructions.

14.4.5* Testing Frequency. Unless otherwise permitted by other sections of this Code, testing shall be performed in accordance with the schedules in Table 14.4.5, or more often if required by the authority having jurisdiction.

Table 14.4.5 Testing Frequencies

12. In-building fire emergency voice/alarm communications equipment

15. Initiating Devices* 14

Table 14.4.5, Item 15. Initiating devices such as smoke detectors used for elevator recall, closing dampers, or releasing doors held in the open position that are permitted by the Code (see NFPA 101, 9.6.3) to initiate supervisory signals at the fire alarm control unit (FACU) should be tested at the same frequency (annual) as those devices when they are generating an alarm signal. They are not "supervisory devices," but they initiate a supervisory signal at the FACU.

(f) Manual fire alarm boxes (initially and annually)

(l) Supervisory signal devices (except valve tamper switches) (initially and quarterly)

(1) Valve supervisory switches (initially and semiannually)

(2) Pressure supervisory indicating devices (initially and quarterly)

(3) Water level supervisory indicating devices (initially and quarterly)

(4) Water temperature supervisory indicating devices (initially and quarterly)

(5) Room temperature supervisory indicating devices (initially and quarterly)

(6) Other suppression system supervisory initiating devices (initially and quarterly)

(7) Other supervisory initiating devices (initially and annually)

(m) Waterflow devices X (initially and semiannually)

17. Combination systems

(a) Fire extinguisher electronic monitoring device/systems

18. Interface equipment and Fire Safety emergency control functions

22. Supervising station fire alarm systems — transmitters

24. Supervising station fire alarm systems — receivers

25. Public fire emergency alarm reporting system transmission equipment

26. Mass notification system — protected premise, supervised

(a) Control unit functions and no diagnostic failures are indicated

(b) Audible/visible functional test

(c) Secondary Power

(d) Verify content of prerecorded messages

NFPA 72-2010 National Fire Alarm and Signaling Code

- (e) Verify activation of correct prerecorded messages
- (f) Verify activation of correct prerecorded message based on a targeted area
- (g) Verify control unit security mechanism is functional

27. Mass notification system — protected premise, nonsupervised systems installed prior to adoption of this Code

- (a) Control unit functions and no diagnostic failures are indicated
- (b) Audible/visible functional test
- (c) Secondary power
- (d) Verify content of prerecorded messages
- (e) Verify activation of correct prerecorded message based on a selected event
- (f) Verify activation of correct prerecorded message based on a targeted area
- (g) Verify control unit security mechanism is functional

28. Mass notification system — wide-area (UFC 4-021-01)

- (a) Control unit functions and no diagnostic failures are indicated
- (b) Control unit reset
- (c) Control unit security
- (d) Audible/visible functional test
- (e) Software backup
- (f) Secondary power test
- (g) Antenna
- (h) Transceivers
- (i) Verify content of prerecorded messages
- (j) Verify activation of correct prerecorded message based on a selected event
- (k) Verify activation of correct prerecorded message base on a targeted area
- (l) Verify control unit security mechanism is functional

14.4.5.1 ~~Exception~~ Devices or equipment that are inaccessible for safety considerations (e.g., continuous process operations, energized electrical equipment, radiation, and excessive height) shall be permitted to be tested during scheduled shutdowns if approved by the authority having jurisdiction. Extended intervals shall not exceed 18 months.

14.4.5.3.5 Unless otherwise permitted by 14.4.5.3.6, smoke detectors or smoke alarms found to have a sensitivity outside the listed and marked sensitivity range shall be cleaned and recalibrated or be replaced.

NFPA 72-2010 National Fire Alarm and Signaling Code

14.4.5.3.6 ~~Exception: Devices~~ Smoke detectors or smoke alarms listed as field adjustable shall be permitted to be either be adjusted within the listed and marked sensitivity range and be cleaned, and recalibrated, or they shall be replaced.

14.4.5.6* Circuit and pathway testing of each monitored circuit or pathway shall be conducted with initial acceptance or re-acceptance testing to verify signals are indicated at the control unit for each of the abnormal conditions specified in 23.5.2, 23.5.3, 23.6.2 through 23.6.5, 23.7.2 and 23.7.3.

A.14.4.5.6 It is not intended to require testing the pathways at every device or circuit junctions.

14.4.7.1 Testing. Household fire alarm systems shall be tested by a qualified service technician at least ~~every 3 years~~ annually according to the methods of Table 14.4.2.2.

14.4.8.2 Combination smoke/carbon monoxide alarms shall be replaced when the end-of-life signal activates or 10 years from the date of manufacture, whichever comes first.

14.4.11.1 Emergency power sources other than batteries shall be ~~operated to supply the system for a continuous period of 1 hour~~ tested at least weekly in accordance with 14.4.11.1.1 and 14.4.11.1.2. This test shall require simulated failure of the normal power source.

14.4.11.1.1 ~~This test~~ Testing shall require include operation of the power source to supply the system for a continuous period of 1 hour at least weekly.

14.4.11.1.2 ~~This test~~ Testing shall require simulated failure of the normal power source.

14.4.11.2 Unless otherwise permitted by 14.4.11.3, testing facilities shall be installed at the communications center and each subsidiary communications center, if used.

14.4.11.3 ~~Exception: If satisfactory to the authority having jurisdiction, those~~ Testing facilities for systems leased from a nonmunicipal organization that might be located elsewhere shall be permitted to be installed at locations other than the communications center if approved by the authority having jurisdiction.

14.4.12* In-Building Emergency Radio Communication Systems.

~~In-building emergency radio communication systems shall be inspected and operationally tested in accordance with the manufacturer's published requirements by the local fire department, building owner, or a designated representative.~~

A.14.4.12 In-building emergency radio communication systems where the ac power source is monitored for integrity should be tested annually. Systems where the ac power source is not monitored for integrity should be tested quarterly.

14.4.12.1 Testing.

14.4.12.1.1 Signal Level Testing. Signal level testing shall be conducted to verify the signal strengths as required in 24.5.2.3 at the following times:

- (1) Initial assessment of radio coverage in accordance with 24.5.2.2.1 and 24.5.2.2.2 for new or existing buildings
- (2) After installation or modification of public safety radio enhancement system needed to ensure compliance with 24.5.2.2.3

NFPA 72-2010 National Fire Alarm and Signaling Code

- (3) On an annual basis or other interval as specified by the authority having jurisdiction

14.4.12.1.2 System Commissioning Testing. System commissioning tests shall comply with the following:

- (1) The building owner shall be responsible for ensuring that a commissioning test of the public safety radio enhancement system occurs prior to final acceptance testing with the authority having jurisdiction.
- (2) The commissioning test shall ensure that two-way coverage on each floor of the building meets the minimum coverage requirements of 24.5.2.2.1 and 24.5.2.2.2.
- (3) Tests shall be made using the frequencies assigned to the jurisdiction.
- (4) Testing shall be coordinated with the authority having jurisdiction to ensure no undue interference to any public safety operations.
- (5) All testing shall be done on frequencies authorized by the FCC.

14.4.12.1.3* Test Procedures. The test plan shall ensure testing throughout the building. Test procedures shall be as directed by the authority having jurisdiction.

A.14.4.12.1.3 Testing procedures typically are done on a grid system. A grid is overlaid onto a floor area to provide 20 grid cells. Grid cells are provided with definite minimum and maximum dimensions. For most buildings, using a minimum grid dimension of 20 ft (6.1 m) and a maximum grid dimension of 80 ft (24.4 m) will suffice to encompass the entire floor area. Where a floor exceeds 128,000 ft² (11,890 m²), which is the floor area that can be covered by the maximum grid dimension of 80 ft (24.4 m), it is recommended that the floor be subdivided into sectors, each having an area of less than or equal to 128,000 ft² (11,890 m²), and that each sector be tested individually with 20 grid cells in each sector. Signal strength measurements should be taken at the center of each grid and should be performed using standardized parameters as specified in A.14.4.12.1.4. Signal strength typically is recorded on the delivered audio quality (DAQ) scale. This scale is a universal standard often cited in system designs and specifications, using the following measures:

- (1) DAQ 1: Unusable speech present but unreadable.
- (2) DAQ 2: Understandable with considerable effort. Frequent repetition due to noise/distortion.
- (3) DAQ 3: Speech understandable with slight effort. Occasional repetition required due to noise/distortion.
- (4) DAQ 3.5: Speech understandable with repetition only rarely required. Some noise/distortion.
- (5) DAQ 4: Speech easily understood. Occasional noise/distortion.
- (6) DAQ 4.5: Speech easily understood. Infrequent noise/distortion.
- (7) DAQ 5: Speech easily understood.

The minimum allowable DAQ for each grid cell typically is DAQ 3. Not more than two nonadjacent grid cells should be allowed to fail the test. In the event that three of the areas fail the test, or if two adjacent areas fail the test, in order to be more statistically accurate, the testing grid resolution should be doubled. This would require decreasing the size to one-half the dimension used in the failed test to a minimum of 10 ft (3.0 m) and a maximum of 40 ft (12.2 m). Further, to cover the same floor area, the number of grids is quadrupled to 80. Not more than eight nonadjacent or five adjacent grid cells should then be allowed to fail the test. In the event that nine or more nonadjacent and/or six or more adjacent grid cells fail the test, consideration should be given to redesigning and reinstalling the public safety radio enhancement system to meet the minimum system design requirements. Failures should not

NFPA 72-2010 National Fire Alarm and Signaling Code

be allowed in critical areas. Measurements should be made with the antenna held in a vertical position at (3 ft to 4 ft) [0.91 m to 1.22 m] above the floor. The DAQ readings should be recorded on small-scale drawings that are used for testing with the authority having jurisdiction. In addition, the gain values of all amplifiers should be measured, and the test measurement results should be kept on file with the building owner so that the measurements can be verified each year during annual tests.

14.4.12.1.4* Measurement Parameters. Signal levels shall be measured to ensure the system meets the criteria of 24.5.2.3 according to parameters as directed by the authority having jurisdiction.

A.14.4.12.1.4 Downlink measurements should be made with the following standardized parameters:

- (1) A calibrated spectrum analyzer, or a calibrated automatic signal level measurement recording system
- (2) Receiving antennas of equal gain to the agency's standard portable radio antenna, oriented vertically, with a centerline between 3 ft and 4 ft above floor
- (4) A resolution bandwidth nearest the bandwidth of the channel under test
- (5) Levels recorded while walking an "X" pattern, with the center of the pattern located approximately in the center of each grid area
- (6) The linear distance of each side of the "X" equal to at least 10 percent of the length of the grid's side, and a minimum length of 10 ft (3.0 m)
- (7) Measurement sampled in averaging mode to include a minimum of one sample per each 5 ft (1.52 m) traveled, recorded with not less than five samples per measurement recorded per side of the "X"

14.4.12.1.5* Acceptance Test. An acceptance test of the public safety radio enhancement system shall be scheduled with the authority having jurisdiction. Acceptance test procedures and requirements shall be as directed by the authority having jurisdiction.

A.14.4.12.1.5 Typically, acceptance tests are required by the authority having jurisdiction prior to building occupancy. As-built drawings should be provided along with other information required from the signal level and commissioning tests, including a full report with grid locations, DAQ measurements, and amplifier gain values should be provided at the acceptance test. The acceptance test typically entails a random test by the authority having jurisdiction of radio communication in various portions of the building, especially including the critical areas. The authority having jurisdiction can review any test documentation and ensure that the findings of the commissioning test with respect to DAQ levels and gain values are supported by the acceptance test.

If amplification systems are utilized in the public safety radio enhancement system, a spectrum analyzer should be utilized to ensure spurious oscillations are not being generated or unauthorized carriers are being repeated in violation of FCC regulations. This testing should be conducted at time of installation and during subsequent inspections. Downlink and uplink spectrum should be recorded with a maximum-hold screen capture at the active system air interfaces, with the system under normal load and at least one uplink carrier active on the indoor portion of the system. Measurements should be analyzed for correct gains on both uplink and downlink paths, noise floor elevation from active components, intermodulation, and other parameters determined necessary by the authority having jurisdiction.

NFPA 72-2010 National Fire Alarm and Signaling Code

Gain values of all amplifiers should be measured and the results kept on file with the building owner and the authority having jurisdiction. In the event that the measurement results become lost, the building owner will need to repeat the acceptance test to reestablish the gain values.

14.4.12.1.6* Annual Tests. Where a public safety radio enhancement system is required, it shall be the building owner's responsibility to have all live components of the system, such as signal boosters, newer supplies, and backup batteries tested at a minimum of once every 12 months. The authority having jurisdiction shall be notified in advance and shall direct annual test procedures and requirements.

A.14.4.12.1.6 Typically, annual tests require several items to be checked. Annual tests should include all procedures encompassed in 14.4.12.1.1 through 14.4.12.1.4. Signal boosters should be tested to ensure that the gain is the same as it was upon initial installation and acceptance. Backup batteries and power supplies should be tested under load for a period of 1 hour to verify that they will properly operate during an actual power outage. Other active components are typically checked to determine that they are operating within the manufacturer's specifications for the intended purpose.

14.4.13* Voice Intelligibility. Voice communication using prerecorded messages and manual voice announcements shall be verified as being intelligible in accordance with the requirements of 18.4.10.

A.14.4.13 See Annex D, Speech Intelligibility.

14.5.1 ~~Fire alarm~~ System equipment shall be maintained in accordance with the manufacturer's published instructions.

14.5.2 The frequency of maintenance of ~~fire alarm~~ system equipment shall depend on the type of equipment and the local ambient conditions.

14.5.3 The frequency of cleaning of ~~fire alarm~~ system equipment shall depend on the type of equipment and the local ambient conditions.

14.5.4 All apparatus requiring rewinding or resetting to maintain normal operation shall be rewound or reset as promptly as possible after each test and alarm. ~~All test signals received shall be recorded to indicate date, time, and type.~~

14.5.5 Unless otherwise permitted by 14.5.6, the retransmission means as defined in Section 26.3 shall be tested at intervals of not more than 12 hours.

~~Exception: If the retransmission means is the public switched telephone network, it shall be permitted to be tested weekly to confirm its operation to each public fire service communications center.~~

14.5.6 When the retransmission means is the public switched telephone network, testing shall be permitted at weekly intervals to confirm its operation to each communications center.

14.6.1.2* Site-Specific Software.

14.6.1.2.1 For software-based systems, a copy of the site-specific software shall be provided to the system owner or owner's designated representative. ~~A copy of the software shall be stored in non-volatile non-erasable, non-rewritable memory and shall be stored on-site.~~

NFPA 72-2010 National Fire Alarm and Signaling Code

14.6.1.2.2 A copy of the site-specific software shall be stored on-site in non-volatile, non-erasable, non-rewritable memory.

14.6.1.3 The system owner shall be responsible for maintaining these records for the life of the system for examination by any authority having jurisdiction. Paper or electronic media shall be permitted.

14.6.2.2 For systems with restorable fixed-temperature, spot-type heat detectors tested over multiple years, records shall be retained for the 5 years of testing and for 1 year thereafter.

14.6.2.4* A record of all inspections, testing, and maintenance shall be provided that includes the following information regarding tests and all the applicable information requested in Figure 14.6.2.4:

- (1) Date
- (2) Test frequency
- (3) Name of property
- (4) Address
- (5) Name of person performing inspection, maintenance, tests, or combination thereof, and affiliation, business address, and telephone number
- (6) Name, address, and representative of approving agency(ies)
- (7) Designation of the detector(s) tested, for example, "Tests performed in accordance with Section _____."
- (8) Functional test of detectors
- (9) *Functional test of required sequence of operations
- (10) Check of all smoke detectors
- (11) Loop resistance for all fixed-temperature, line-type heat detectors
- (12) Functional test of mass notification system control units
- (13) Functional test of signal transmission to mass notification systems
- (14) Functional test of ability of mass notification system to silence fire alarm notification appliances
- (15) Tests of intelligibility of mass notification system speakers
- (16) Other tests as required by the equipment manufacturer's published instructions
- (17) Other tests as required by the authority having jurisdiction
- (18) Signatures of tester and approved authority representative
- (19) Disposition of problems identified during test (e.g., system owner notified, problem corrected/successfully retested, device abandoned in place)

14.6.3 Supervising Station Records. For supervising station fire alarm systems, records pertaining to signals received at the supervising station that result from maintenance, inspection, and testing shall be maintained for not less than 12 months. ~~Upon request, a hard copy record shall be provided to the authority having jurisdiction. Paper or electronic media shall be permitted.~~

14.6.3.1 Records shall be permitted to be maintained on either paper or electronic media.

14.6.3.2 Upon request, a hard copy record shall be provided to the authority having jurisdiction.

NFPA 72-2010 National Fire Alarm and Signaling Code

14.6.4 Simulated Operation Note. If the operation of a device, circuit, fire alarm control unit function, or special hazard system interface is simulated, it shall be noted on the ~~certificate~~ inspection/test form that the operation was simulated ~~and the certificate shall indicate by whom it was simulated.~~

~~10.7 Mass Notification Systems:~~

~~See Annex E.~~

FIGURE 14.6.2.4 Example of an Inspection and Testing Form. (now 11 pages)

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 17, Initiating Devices

17.1.2 The requirements of Chapters ~~4 and Chapter 6~~ 10, 12, 21, 23, and 24 shall also apply unless they are in conflict with this chapter.

17.4.6 Initiating devices shall be installed in all areas, compartments, or locations where required by other NFPA codes and standards or as required by ~~the authority having jurisdiction~~ other governing laws, codes, or standards.

17.4.8 Where ~~in-duct~~ smoke detectors are installed in concealed locations more than 10 ft (3.0 m) above the finished floor or in arrangements where the detector's alarm or supervisory indicator is not visible to responding personnel, the detectors shall be provided with remote alarm or supervisory indication in a location acceptable to the authority having jurisdiction.

17.4.9 Where required by 17.4.8 and unless the specific detector alarm or supervisory signal is indicated at the control unit, remote alarm or supervisory indicators shall be installed in an accessible location and shall be clearly labeled to indicate both their function and the air-handling unit(s) associated with each detector. Subsection 17.4.9 was added by a tentative interim amendment (TIA). See page 1.

17.5.3.1 Total (Complete) Coverage. ~~If~~ Where required by laws, codes, or standards, and unless otherwise modified by 17.5.3.1.1 through 17.5.3.1.5, total coverage shall include all rooms, halls, storage areas, basements, attics, lofts, spaces above suspended ceilings, and other subdivisions and accessible spaces, as well as the inside of all closets, elevator shafts, enclosed stairways, dumbwaiter shafts, and chutes.

17.5.3.1.1 Where inaccessible areas are constructed of or contain combustible material, unless otherwise specified in 17.5.3.1.2, they shall be made accessible and shall be protected by a detector(s).

17.5.3.2* Partial or Selective Coverage. Where codes, standards, or laws, ~~or authorities having jurisdiction~~ require the protection of selected areas only, the specified areas shall be protected in accordance with this Code.

17.5.3.3.1 Detection installed for reasons of achieving specific fire safety objectives, but not required by any laws, codes, or standards, shall meet all of the requirements of this Code, with the exception of the prescriptive spacing criteria of 5.6.5 and 5.7.3.2.3 Chapter 17.

17.6.1.4* Spot-type heat detectors shall include in their installation instructions, technical data, and listing documentation the operating temperature and RTI (~~response time index~~) response time index (RTI) as determined by the organization listing the device. ~~The requirement for RTI documentation shall have an effective date of July 1, 2008.~~

A.17.6.1.4 In order to predict the response of a heat detector using current fire modeling programs and currently published equations describing plume dynamics, two parameters must be known: operating temperature and response time index (RTI). The RTI is the quantification of the rate of heat transfer from the ceiling jet to the detector sensing element per unit of time, expressed as a function of ceiling jet temperature, ceiling jet velocity, and time. Spot-type heat detectors manufactured prior to July 1, 2008, were not required to be marked with an RTI.

NFPA 72-2010 National Fire Alarm and Signaling Code

17.6.2 Temperature.

17.6.2.1 Classification. Heat-sensing fire detectors of the fixed-temperature or rate-compensated, spot type shall be classified as to the temperature of operation ~~and marked with a color code~~ in accordance with Table 17.6.2.1.

17.6.2.2 Marking.

17.6.2.2.1 Color Coding.

17.6.2.2.1.1 Heat-sensing fire detectors of the fixed temperature or rate-compensated, spot type shall be marked with a color code in accordance with Table 17.6.2.1.

17.6.2.2.2 Operating Temperature.

17.6.2.2.2.1 Heat-sensing fire detectors shall be marked with their listed operating temperature. ~~Spot-type heat detectors shall also be marked with their RTI (response time index). The RTI marking requirements shall have an effective date of July 1, 2008.~~

17.6.2.2.2.2 Heat-sensing fire detectors where the alarm threshold is field adjustable shall be marked with the temperature range.

17.6.2.2.2.3 Spot-type heat detectors shall also be marked with their RTI.

17.6.2.3* Ambient Ceiling Temperature. Detectors having fixed-temperature or rate-compensated elements shall be selected in accordance with Table 17.6.2.1 for the maximum expected ambient ceiling temperature. The temperature rating of the detector shall be at least 20°F (11 °C) above the maximum expected temperature at the ceiling.

Table 17.6.2.1 Temperature Classification and Color Code for Heat-Sensing Fire Detectors

17.6.3 Location and Spacing.

17.6.3.1 Smooth Ceiling.

17.6.3.1.1* Spacing. One of the following requirements shall apply:

- (1) The distance between detectors shall not exceed their listed spacing, and there shall be detectors within a distance of one-half the listed spacing, measured at right angles from all walls or partitions extending upward to within the top 15 percent of the ceiling height.
- (2) All points on the ceiling shall have a detector within a distance equal to or less than 0.7 times the listed spacing (0.7S).

17.6.3.1.2 Irregular Areas. For irregularly shaped areas, the spacing between detectors shall be permitted to be greater than the listed spacing, provided that the maximum spacing from a detector to the farthest point of a sidewall or corner within its zone of protection is not greater than 0.7 times the listed spacing.

17.6.3.2* Solid Joist Construction.

17.6.3.2.1 Spacing. The spacing of heat detectors, where measured at right angles to the solid joists, shall not exceed 50 percent of the ~~smooth ceiling~~ listed spacing ~~permitted under 5.6.5.1.1 and 5.6.5.1.2.~~

NFPA 72-2010 National Fire Alarm and Signaling Code

17.6.3.2.2 Location. ~~In the case of solid joist construction, Detectors shall be mounted at the bottom of the joists.~~

17.6.3.3.2 Location. ~~In the case of beam construction Where beams are less than 12 in. (300mm) in depth and less than 96 in. (2.44 m) on center, detectors shall be permitted to be installed on the bottom of beams.~~

17.6.3.4* Sloping Ceilings (Peaked and Shed).

17.6.3.4.1 Spacing.

17.6.3.4.1.1 Roof Ceiling Slope Less Than 30 Degrees. ~~For a roof ceiling slope of less than 30 degrees, all detectors shall be spaced using the height at the peak. For a roof slope of greater than 30 degrees, the average slope height shall be used for all detectors other than those located in the peak.~~

17.6.3.4.1.2 Ceiling Slopes of 30 Degrees or Greater. All detectors, other than those located in the peak, shall be spaced using the average slope height or the height of the peak.

17.6.3.4.1.3 Spacing shall be measured along a horizontal projection of the ceiling in accordance with the type of ceiling construction.

17.6.3.5 High Ceilings.

17.6.3.5.1* On ceilings 10 ft to 30 ft (3.0m to 9.1 m) high, heat detector ~~linear~~ spacing shall be reduced in accordance with Table 17.6.3.5.1 prior to any additional reductions for beams, joists, or slope, where applicable.

17.6.3.5.2* Spacing Minimum. The minimum spacing of heat detectors shall not be required to be less than 0.4 times the height of the ceiling.

17.6.3.7 Other Applications. Where a detector is used in an application other than open area protection, the manufacturer's published instructions shall be followed.

17.7.1.6 Smoke detectors shall be installed in all areas where required by ~~applicable~~ other governing laws, codes, or standards or by other parts of this Code.

17.7.1.11* Protection During Construction.

A.17.7.1.11 Construction debris, dust (especially gypsum dust and the fines resulting from the sanding of drywall joint compounds), and aerosols can affect the sensitivity of smoke detectors and, in some instances, cause deleterious effects to the detector, thereby significantly reducing the expected life of the detector.

17.7.1.11.1 Where detectors are installed for signal initiation during construction, they shall be cleaned and verified to be operating in accordance with the listed sensitivity, or they shall be replaced prior to the final commissioning of the system.

17.7.1.11.2 Where detectors are installed but not operational during construction, they shall be protected from construction debris, dust, dirt, and damage in accordance with the manufacturer's recommendations and verified to be operating in accordance with the listed sensitivity, or they shall be replaced prior to the final commissioning of the system.

NFPA 72-2010 National Fire Alarm and Signaling Code

17.7.1.11.3 ~~Where detection is not required during construction, detectors shall not be installed until after all other construction cleanup of all trades is have completed cleanup.~~

Exception:

~~Where required by the authority having jurisdiction for protection during construction. Detectors that have been installed during construction and found to have a sensitivity outside the listed and marked sensitivity range shall be cleaned or replaced in accordance with Chapter 10 at completion of construction.~~

17.7.3.1.4* ~~If the intent is to protect against a specific hazard, initiate action when smoke/fire threatens a specific object or space, the detector(s) shall be permitted to be installed closer in close proximity to the hazard that object or space in a position where the detector can intercept the smoke.~~

A.17.7.3.1.4 There are some applications that do not require full area protection, but do require detection, to initiate action when specific objects or spaces are threatened by smoke or fire, such as at elevator landings that have ceilings in excess of 15 ft (4.6 m) and for protection of fire alarm control units. In high-ceiling areas, to achieve the desired initiation, such as for elevator recall and protection of fire alarm control units (FACUs), detection should be placed on the wall above and within 60 in. (1.52 m) from the top of the elevator door(s) or FACU.

17.7.3.2* Spot-Type Smoke Detectors.

17.7.3.2.1* ~~Spot-type smoke detectors shall be located on the ceiling or not less than 100 mm (4 in.) from a sidewall to the near edge or, if on a sidewall, between 100 mm and 300 mm (4 in. and 12 in.) the ceiling and 12 in. (300 mm) down from the ceiling to the top of the detector.~~

A.17.7.3.2.1 Refer to Figure A.17.7.3.2.1 for an example of proper mounting for detectors. Sidewall detectors mounted closer to the ceiling will respond faster.

17.7.3.2.3.1* ~~In the absence of specific performance-based design criteria, smooth ceiling smoke detectors shall be permitted to be located using spacing shall be a nominal 30 ft (9.1 m) spacing.~~

A.17.7.3.2.3.1 The 30 ft (9.1 m) spacing is a guide for prescriptive designs. The use of such a spacing is based upon customary practice in the fire alarm community.

Where there are explicit performance objectives for the response of the smoke detection system, the performance based design methods outlined in Annex B should be used. For the purposes of this section, “nominal 30 ft (9.1 m)” should be determined to be 30 ft (9.1 m) +/-5 percent [+/-18 in. (460 mm)].

FIGURE A.17.7.3.2.1 Example of Proper Mounting of Smoke Detectors.

17.7.3.2.4.2 For level ceilings, the following shall apply:

- (1) For ceilings with beam depths of less than 10 percent of the ceiling height ($0.1 H$), smooth ceiling spacing shall be permitted. Spot-type smoke detectors shall be permitted to be located on ceilings or on the bottom of beams.
- (2) For ceilings with beam depths equal to or greater than 10 percent of the ceiling height ($0.1 H$), and beam spacing equal to or greater than 40 percent of the

NFPA 72-2010 National Fire Alarm and Signaling Code

~~ceiling height (0.4 H), spot-type detectors shall be located on the ceiling in each beam pocket~~ the following shall apply:

- (a) Where beam spacing is equal to or greater than 40 percent of the ceiling height (0.4 H), spot-type detectors shall be located on the ceiling in each beam pocket.
 - (b) Where beam spacing is less than 40 percent of the ceiling height (0.4 H), the following shall be permitted for spot detectors:
 - i. Smooth ceiling spacing in the direction parallel to the beams and at one-half smooth ceiling spacing in the direction perpendicular to the beams
 - ii. Location of detectors either on the ceiling or on the bottom of the beams
- (3) *~~For beam pockets formed by intersecting beams, including waffle or pan-type ceilings, For waffle or pan-type ceilings with beams or solid joists no greater than 600 mm (24 in.) deep and no greater than 3.66 m (12 ft) center to center spacing, the following shall be permitted:~~ the following shall apply:

A.17.7.3.2.4.2(3) The geometry and reservoir effect is a significant factor that contributes to the development of velocity, temperature, and smoke obscuration conditions at smoke detectors located on the ceiling in beam pocket areas or at the bottom of beams as smoke collected in the reservoir volume spills into adjacent pockets. The waffle- or pan-type ceiling created by beams or solid joists, although retarding the initial flow of smoke, results in increased optical density, temperature rise, and gas velocities comparable to unconfined smooth ceilings.

For waffle- or pan-type ceilings with beams or solid joists, an alternative smoke detector grid arrangement (such as a shifted grid), with detectors located to take advantage of the channeling effect due to the reservoirs created by the beam pockets, will improve detector response and might allow greater spacing. See Figure A.17.7.3.2.4.2(3)(a) and Figure A.17.7.3.2.4.2(3)(b) for an example of shifted grids. The alternative smoke detector grid arrangement and spacing should be justified by an engineering analysis comparing the alternative smoke detector grid arrangement with the performance of smoke detectors on a level ceiling of equal height using 30 ft (9.1 m) smoke detector spacing.

Figure A.17.7.3.2.4.2(3)(a) illustrates the reservoir and channeling effect that results from the deep beam configuration.

The strongest gas flows occur in a direction perpendicular to the beam opposite the fire location. The weaker flow occurs in a directional 45 degrees off the beam grid; however, the reservoir effect accounts for higher concentrations of smoke eventually flowing from the strong area reservoirs into the weak area reservoirs.

Figure A.17.7.3.2.4.2(3)(b) is a generic example illustrating how a smoke detection grid using 30 ft (9.1 m) spacing can be shifted to take advantage of the channeling and reservoir effect to optimize detection response. In the circle, the fire is split into four beam bays that must fill with smoke before appreciable flows occur into the next adjoining eight beam bays.

NFPA 72-2010 National Fire Alarm and Signaling Code

This represents the worst case scenario for smoke to reach the detectors on the circle. The three other fire locations shown require the fire to initially fill only one or two bays before spilling to adjacent bays.

FIGURE A.17.7.3.2.4.2(3)(a) Reservoir and Channeling Effect of Deep Beams.

FIGURE A.17.7.3.2.4.2(3)(b) Shifted Smoke Detection Grid to Optimize Detection for Deep Beam Effects.

- (a) For beam depths less than 10 percent of the ceiling height ($0.1 H$), spacing shall be in accordance with 17.7.3.2.4.2(1).
- (b) For beam depths greater than or equal to 10 percent of the ceiling height ($0.1 H$), spacing shall be in accordance with 17.7.3.2.4.2(2).
- (4) *For corridors 15 ft (4.6 m) in width or less having ceiling beams or solid joists perpendicular to the corridor length, the following shall ~~be permitted~~ apply:
 - (a) ~~Smooth ceiling spacing shall be permitted including those provisions permitted for irregular areas in 5.6.5.1.2, substituting "selected spacing" for "listed spacing".~~
 - (b) Location of spot-type smoke detectors on ceilings, sidewalls, or the bottom of beams or solid joists
- (5) For rooms of 900 ft² (84 m²) or less, ~~only one smoke detector shall be required~~ the following shall be permitted:
 - (a) Use of smooth ceiling spacing
 - (b) Location of spot-type smoke detectors on ceilings or on the bottom of beams

17.7.3.2.4.3* For sloped sloping ceilings with beams running parallel to up the slope, ~~spacing shall comply with the following~~ shall apply:

A.17.7.3.2.4.3 ~~The spacing guidelines in 5.7.3.2.4.3 are based on a detection design fire of 100 kW. For detection at a larger 1 MW fire, the following spacings should be used:~~

- ~~(1) For beamed ceilings with beams running parallel to (up) the slope, with slopes 10 degrees or less, spacing for flat beamed ceilings should be used. For ceilings with slopes greater than 10 degrees, twice the smooth ceiling spacing should be used in the direction parallel to (up) the slopes, and one-half the spacing should be used in the direction perpendicular to (across) the slope. For slopes greater than 10 degrees, the detectors located at a distance of one-half the spacing from the low end are not required. Spacing should be measured along the horizontal projection of the ceiling.~~
- ~~(2) For beamed ceilings with beams running perpendicular to (across) the slope, for any slope, smooth ceiling spacing should be used in the direction parallel to the beams (across the slope), and one-half the smooth ceiling spacing should be used in the direction perpendicular to the beams (up the slope).~~

A smoke detector should be placed within each beam channel. Computer modeling has shown that parallel beams (upslope) are very effective at channeling smoke, and smoke spillover is rarely detectable in adjacent parallel pockets.

- ~~(1) The spacing for level beamed ceilings shall be used. Spot-type detector(s) shall be located on the ceiling within beam pocket(s).~~
- ~~(2) The ceiling height shall be taken as the average height over slope.~~

NFPA 72-2010 National Fire Alarm and Signaling Code

- ~~(3) For slopes greater than 10 degrees, the detectors located at one-half the spacing from the low end shall not be required.~~
- (3) Spacing shall be measured along a horizontal projection of the ceilings.
- (4) Smooth ceiling spacing shall be permitted within beam pocket(s) parallel to the beams.
- (5) For beam depths less than or equal to 10 percent of the ceiling height (0.1 H), spot-type detectors shall be located with smooth ceiling spacing perpendicular to the beams.
- (6) For beam depths greater than 10 percent of the ceiling height (0.1 H), the following shall apply for spacing perpendicular to the beams:
 - (a) For beam spacing greater than or equal to 40 percent of the ceiling height (0.4 H), spot-type detectors shall be located in each beam pocket.
 - (b) For beam spacing less than 40 percent of the ceiling height (0.4 H), spot-type detectors shall not be required in every beam pocket but shall be spaced not greater than 50 percent of smooth ceiling spacing.

17.7.3.2.4.4* For sloped sloping ceilings with beams running perpendicular to across the slope, ~~spacing shall comply with the following shall apply:~~

A.17.7.3.2.4.4 Irregular area spacing guidance for level beam ceilings can be used. Computer modeling has shown that spot type detectors should be located on the bottom of perpendicular beams.

- ~~(1) The spacing for level beamed ceilings shall be used. Spot-type detector(s) shall be located at the bottom of the beams.~~
- ~~(2) The ceiling height shall be taken as the average height over slope.~~
- ~~(3) Spacing shall be measured along a horizontal projection of the ceiling.~~
- ~~(4) Smooth ceiling spacing shall be permitted within beam pocket(s).~~
- ~~(5) For beam depths less than or equal to 10 percent of the ceiling height (0.1 H), spot-type detectors shall be located with smooth ceiling spacing.~~
- ~~(6) For beam depths greater than 10 percent of the ceiling height (0.1 H), spot-type detectors shall not be required to be located closer than (0.4 H) and shall not exceed 50 percent of smooth ceiling spacing.~~

17.7.3.2.4.5* For sloped ceilings with beam pockets formed by intersecting beams, the following shall apply:

A.17.7.3.2.4.5 Computer modeling has shown that spot-type detectors should be located on the bottom of perpendicular beams and should be aligned with the center of pocket, as shown, in Figure A.17.7.3.2.4.5.

FIGURE A.17.7.3.2.4.5 Spot-Type Detector Spacing for Sloping Ceilings with Beam Pockets.

17.7.6.3.3.2 Air-sampling or projected beam smoke detectors shall be installed in accordance with the manufacturer's published instructions.

17.7.7.4* All component controls and software shall be protected from unauthorized changes. All changes to the software or component settings shall be tested in accordance with Chapter 14.

NFPA 72-2010 National Fire Alarm and Signaling Code

A.17.7.7.4 Video image smoke detection control and software should be protected from tampering by passwords, software keys, or other means of limiting access to authorized/qualified personnel. Component settings include any control or programming that might affect the operation or coverage of the detection. This includes, but is not limited to, camera focus, field of view, motion sensitivity settings, and change of camera position. Any changes in component settings or ambient conditions that affect the design performance of the detector should initiate a trouble signal.

17.8.5.4* All component controls and software shall be protected from unauthorized changes. All changes to the software or component settings shall be tested in accordance with Chapter 14.

A.17.8.5.4 Video image flame detection control and software should be protected from tampering by passwords, software keys, or other means of limiting access to authorized/qualified personnel. Component settings include any control or programming that might affect the operation or coverage of the detection. This includes, but is not limited to, camera focus, field of view, motion sensitivity settings, and change of camera position. Any changes in component settings or ambient conditions that affect the design performance of the detector should initiate a trouble signal.

17.10 Gas Detection.

17.10.1 General. The purpose and scope of Section 17.10 shall be to provide requirements for the selection, installation, and operation of gas detectors.

17.10.2 Gas Characteristics and Detector Selection.

17.10.2.1 Gas detection equipment shall be listed for detection of the specific gas or vapor to be encountered.

17.10.2.2 Any gas detection systems installed on a fire alarm system shall comply with all the applicable requirements of Chapters 1, 10, 14, 17, and 23 of this Code.

17.10.2.3 The requirements of this Code shall not apply to gas detection systems used solely for process control.

17.10.2.4* The selection and placement of the gas detectors shall be based on an engineering evaluation.

A.17.10.2.4 The engineering evaluation should include, but is not limited to, the following:

- (1) Structural features, size, and shape of the rooms and bays
- (2) Occupancy and uses of areas
- (3) Ceiling heights
- (4) Ceiling shape, surface, and obstructions
- (5) Ventilation
- (6) Ambient environment
- (7) Gas characteristics of the gases present
- (8) Configuration of the contents in the area to be protected
- (9) Response time(s)

17.11 Other Fire Detectors.

17.11.1 Detectors that operate on principles different from those covered by Sections 17.6 through 17.8 shall be classified as “other fire detectors.”

NFPA 72-2010 National Fire Alarm and Signaling Code

17.11.2* “Other fire detectors” shall operate where subjected to the abnormal concentration of combustion effects that occur during a fire ~~such as water vapor, ionized molecules, or other phenomena for which they are designed.~~

A.17.11.2 Examples of such combustion effects are water vapor, ionized molecules, or other phenomena for which they are designed. The performance characteristics of the detector and the area into which it is to be installed should be evaluated to minimize nuisance alarms or conditions that would interfere with operation.

17.11.5.2 Detectors shall not be spaced beyond their listed or approved maximums.

17.11.5.3 The location and sensitivity of the detectors shall be ~~the result of~~ based on an a documented engineering evaluation that includes the manufacturer’s installation instructions and the following:

- (1) Structural features, size, and shape of the rooms and bays
- (2) Occupancy and uses of the area
- (3) Ceiling height
- (4) Ceiling shape, surface, and obstructions
- (5) Ventilation
- (6) Ambient environment
- (7) Burning characteristics of the combustible materials present
- (8) Configuration of the contents in the area to be protected

17.14.1.1* Unless installed in an environment that precludes the use of red paint or red plastic, manual fire alarm boxes shall be red in color.

A.17.14.1.1 In environments where red paint or red plastic is not suitable, an alternative material, such as stainless steel, could be used as long as the box meets the requirements of 17.14.5.

17.14.1.2 Manual pull stations for initiating other than fire alarm shall be permitted if the devices are differentiated from the manual fire alarm boxes by a color other than red and labeling.

~~A.5.13.5 Manual fire alarm boxes should be of contrasting color to the background on which they are mounted.~~

17.14.1.3 Manual fire alarm boxes shall be mounted on a background of contrasting color.

17.14.4 The operable part of each manual fire alarm box shall be not less than ~~1.1 m (3½ ft)~~ 42 in. (1.07 m) and not more than ~~1.37 m (4½ ft)~~ 48 in. (1.22 m) above floor level.

17.15 Fire Extinguisher Electronic Monitoring Device. A fire extinguisher electronic monitoring device shall indicate those conditions for a specific fire extinguisher required by NFPA 10, *Standard for Portable Fire Extinguishers*, to a fire alarm control unit or other control unit.

5.17 Mass Notification Systems.

See Annex E.

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 18, Notification Appliances for Fire Alarm Systems

18.1.1 The requirements of this chapter shall apply where required by the authority having jurisdiction enforcing authority; or other governing laws, codes, or standards; or other parts of this Code.

18.1.5* The requirements of this chapter shall apply to the areas, spaces, or system functions where required by other parts of this code, the authority having jurisdiction, the enforcing authority; governing laws, codes, or standards; or other parts of this Codes and standards requiring compliance with this chapter.

18.4.2 Distinctive Evacuation Signal.

18.4.2.1* To meet the requirements of Section 10.7, the alarm audible signal pattern used to notify building occupants of the need to evacuate (leave the building) shall be the standard alarm evacuation signal consisting of a three-pulse temporal pattern.

The pattern shall be in accordance with Figure 18.4.2.1 and shall consist of the following in this order:

- (1) "On" phase lasting 0.5 second ± 10 percent
- (2) "Off" phase lasting 0.5 second ± 10 percent for three successive "on" periods
- (3) "Off" phase lasting 1.5 seconds ± 10 percent

Exception: Where approved by the authority having jurisdiction, continued use of the existing consistent evacuation signaling scheme shall be permitted.

A.18.4.2.1 Paragraph 10.7 requires that alarm signals be distinctive in sound from other signals and that this sound not be used for any other purpose. The use of the distinctive three pulse temporal pattern fire alarm evacuation signal required by 18.4.2.1 became effective July 1, 1996, for new systems installed after that date. It is not the intent to prohibit continued use of an existing consistent evacuation signaling scheme, subject to approval by the authority having jurisdiction. It is also not the intent that the distinct pattern be applied to visible appliances.

The temporal pattern can be produced by any audible notification appliance, as illustrated in Figure A.18.4.2.1(a) and Figure A.18.4.2.1(b).

18.4.2.2 A single-stroke bell or chime sounded at "on" intervals lasting 1 second ± 10 percent, with a 2-second ± 10 percent "off" interval after each third "on" stroke, shall be permitted.

FIGURE 18.4.2.1 Temporal Pattern Parameters.

18.4.2.3 The signal shall be repeated for a period appropriate for the purposes of evacuation of the building, but for not less than 180 seconds. The minimum repetition time shall be permitted to be manually interrupted.

18.4.2.4 The use of the standard evacuation signal shall be restricted to situations where it is desired that all occupants hearing the signal evacuate the building immediately. It shall not be used where, with the approval of the authority having jurisdiction, the planned action during an emergency is not evacuation, but rather is the relocation of occupants or their protection in place, as directed by the building emergency response plan or as directed by emergency personnel.

NFPA 72-2010 National Fire Alarm and Signaling Code

18.4.2.5* The standard evacuation signal shall be synchronized within a notification zone.

18.4.4.3.1 If approved by the authority having jurisdiction, A system arranged to stop or reduce ambient noise shall be permitted to produce a sound level at least 10 dB above the reduced average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds after reduction of the ambient noise level, whichever is greater, measured 5 ft (1.5 m) above the floor, using the A-weighted scale (dBA).

18.4.5.3* Effective January 1, 2014, where audible appliances are provided to produce signals for sleeping areas, they shall produce a low frequency alarm signal that complies with the following:

- (1) The alarm signal shall be a square wave or provide equivalent awakening ability.
- (2) The wave shall have a fundamental frequency of 520 Hz ± 10 percent.

A.18.4.5.3 It is not the intent of this section to preclude devices that have been demonstrated through peer reviewed research to awaken occupants with hearing loss as effectively as those using the frequency and amplitude specified in this section.

Fundamental frequency: 520 Hz ± 10 percent. Odd harmonic frequency components 3, 5, 7 and 9 times the fundamental frequency should be present in appropriate magnitude defined by the Fourier transform of a square wave (see below) ± 20 percent.

On a linear scale where X is the peak magnitude of the fundamental frequency component, the harmonic frequencies should have the following peak magnitudes with the tolerance defined above:

- (1) 520 Hz X
- (2) 1560 Hz 1/3 X
- (3) 2600 Hz 1/5 X
- (4) 3640 Hz 1/7 X
- (5) 4680 Hz 1/9 X

A square wave contains only the odd integer harmonics. In general, a square wave can be expressed using the Fourier series. As presented by Wolfram MathWorld, the general mathematical expression for the function of an ideal square wave as an infinite series is

$$X_{square}(t) = X_{square} \left(t \right) = \frac{4}{\pi} \sum_{n=1,3,5,\dots}^{\infty} \frac{1}{n} \sin(2n\pi ft)$$

Where $X_{square}(t)$ is the square wave as a function of time, t , $\sin()$ is the sine wave function, f is the frequency, π is pi, the relationship between the circumference and the diameter of a circle, and n is the odd harmonics. An expanded expression for the 1st, 3rd, 5th, 7th, and 9th harmonics is

$$X_{square}(t) = \frac{4}{\pi} \left(\frac{1}{1} \sin(2\pi t) + \frac{1}{3} \sin(6\pi t) + \frac{1}{5} \sin(10\pi t) + \frac{1}{7} \sin(14\pi t) + \frac{1}{9} \sin(18\pi t) \right)$$

An example of a 520 Hz square wave audio signal is presented as a spectrograph in Figure A.18.4.5.3. Note the dBA scale and weighting.

NFPA 72-2010 National Fire Alarm and Signaling Code

Additional harmonics for the square wave beyond the 9th harmonic can be present in the signal, but should not contribute more than 10 percent of the integrated-averaged sound level.

18.4.7.2* In addition to 18.4.7.1, as a minimum, to ensure that exit marking audible notification appliance signals are clearly heard and produce the desired directional effects for 50 ft (15.24 m) within an unobstructed egress path, they shall meet the audibility requirements of 18.4.6 in at least one one-third octave band or one octave band within the effective frequency ranges of the interaural time difference (ITD), interaural level or intensity difference (ILD or IID), and anatomical transfer function or head-related transfer function (ATF or HRTF) localization cues. The signal shall penetrate both the ambient noise and the fire alarm signal.

A.18.4.7.2 ITD: A difference in arrival times of waveform features (such as peaks and positive-going zero crossings) at the two ears is known as the interaural time difference, or ITD. The binaural physiology is capable of using phase information from ITD cues only at low frequencies below about 1500 Hz. However, the binaural system can successfully register an ITD that occurs at a high frequency such as 4000 Hz if the signal is modulated. The modulation, in turn, must have a rate that is less than about 1000 Hz.

ILD: Comparison between intensities in the left and right ears is known as the interaural level difference, or ILD. ILD cues exist physically only for frequencies above about 500 Hz. They become large and reliable for frequencies above 3000 Hz, making ILD cues most effective at high frequencies.

ATF: The anatomical transfer function (ATF), also known as the head-related transfer function (HRTF), is used by listeners to resolve front-back confusion and to determine elevation. Waves that come from behind tend to be boosted in the 1000 Hz frequency region, whereas waves that come from the forward direction are boosted near 3000 Hz. The most dramatic effects occur above 4000 Hz.

These localization cues can be implemented simultaneously when the source signal is a broadband sound containing a range of low to high frequencies. For example, octave bands of 1 kHz (707–1414 Hz) for ITD, 4 kHz (2828–5856) Hz for ILD, and 8 kHz (5657–11314 Hz) for ATF would fall within the effective frequency ranges required in 18.4.6.

Additional information on sound localization and auditory localization cues is contained in the following article: <http://www.aip.org/pt/nov99/locsound.html>, H.1.2.14.2.

The ability to pinpoint the location of a sound source is based on the physics of sound and the physiology of the human hearing mechanism. The brain processes a large amount of neural signals, some of which provide cues to the sound source's location. People are able to hear sound ranging from about 20 Hz to 20,000 Hz. Unfortunately, pure tones in this frequency range provide only limited localization information. The primary localization cues are provided by interaural time differences (ITDs) (lower frequencies), interaural intensity differences (IIDs) (mid to higher frequencies), and the head-related transfer function (HRTF) (higher frequencies). In enclosed spaces that can be somewhat reverberant, the precedence effect (PE) also provides directional information.

The interaural time difference (ITD) and interaural intensity difference (IID) are termed binaural cues because they depend on both ears separated by the width of the head. At lower frequencies (longer wavelength), the time delay between arriving sound signals is

NFPA 72-2010 National Fire Alarm and Signaling Code

detectable. ITD is most evident in frequencies below about 500 Hz with clicks or short bursts of sound. At higher frequencies (shorter wavelength), the loudness/intensity differences between the ears is more noticeable because of partial shielding of the more distant ear by the head. IID is most evident for frequencies above 3000 Hz.

The head-related transfer function (HRTF) relies on the effect of the external ear on perceived sound. The HRTF describes the transforming effect of the head, torso, and external ear on sound as it travels from the sound source to the ear canals. The HRTF changes depending on sound source location, providing an additional localization cue. HRTF operates over a range of frequencies but seems to be most effective in the 5000 Hz to 10,000 Hz range. Combined with the listener's head motion, HRTF provides an independent localization method to complement ITD and IID capabilities.

The precedence effect (PE) is important for discriminating between the direct sound signal and reflected sound, a common situation within buildings. The ear is capable of discerning and fixating on the first sound received (line-of-sight direct signal) and disregarding later signals (reflected sound). The acoustical signal arriving first at the ears suppresses the ability to hear other signals (including reverberation) that arrive up to about 40 milliseconds after the initial signal.

All of the preceding cues are utilized simultaneously when the source signal is broadband sound containing a range of low and high frequencies, and when the sound arrives in bursts rather than as steady state sound. The combination of different cues provides reinforcement and redundancy of information to enhance the ability to locate the sound source. Broadband sound tends to eliminate potential ambiguities that occur for pure tone or narrowband sound sources.

Other types of sound patterns can be used as directional sounders that can be used for audible exit marking. Some scientific research has been performed to develop a directional sounder that utilizes a tonal sound different from the example above. As with the directional sound example presented above, the development of this alternative signal is similarly rooted in the vast research data that exists for sound localization and directional auditory cues.

An example of an alternative directional sound signal can be a sequence of two harmonic two-tone complexes. This sequence starts with a complex of low fundamental frequencies of 262 and 330 Hz having duration of 200 ms. This sound is then followed by a 200-ms silence. Next the sequence continues with a second sound that is a complex of low fundamental frequencies of 330 and 392 Hz having a duration of 200 ms.

After another 200-ms silence, this whole pattern is repeated. Localizability was ensured by the dense harmonic structure of the signal, with closely spaced harmonics up to 20 kHz. In addition sharp signal onsets were included to aid the detection of interaural time differences, thus increasing localizability.

18.4.7.3 Where required by the enforcing authority; governing laws, codes, or standards; or other parts of this Code, exit marking audible notification appliances shall be installed in accordance with the manufacturer's instructions.

18.4.7.4* Where required by the enforcing authority; governing laws, codes, or standards; or other parts of this Code, exit marking audible notification shall be located at the entrance to all building exits and areas of refuge as defined by the applicable building or fire code.

NFPA 72-2010 National Fire Alarm and Signaling Code

18.4.8.5 Mounting heights other than required by 18.4.8.1 and 18.4.8.2 shall be permitted, by the authority having jurisdiction provided that the sound pressure level requirements of 7.4.2 and 7.4.3 18.4.3 for public mode or 18.4.4 for private mode, or 18.4.5 for sleeping areas, based on the application, are met.

18.4.10* Voice Intelligibility. Within the acoustically distinguishable spaces (ADS) where voice intelligibility is required, voice communications systems shall be capable of the reproduction of reproduce prerecorded, synthesized, or live (e.g., microphone, telephone handset, and radio) messages with voice intelligibility.

A.18.4.10 See Annex D, Speech Intelligibility.

~~A.7.4.1.4~~ Voice intelligibility should be measured in accordance with the guidelines in Annex A of IEC 60849, Sound Systems for Emergency Purposes. When tested in accordance with Annex B, Clause B1, of IEC 60849, the system should exceed the equivalent of a common intelligibility scale (CIS) score of 0.70. Intelligibility is achieved when the quantity \bar{I} , as specified in B3 of IEC 60849, exceeds this value. \bar{I} is the arithmetical average of the measured intelligibility values on the CIS, and σ is the standard deviation of the results.

~~Objective means of determining intelligibility are found in Part 16 of IEC 60268, The Objective Rating of Speech Intelligibility by Speech Transmission Index. Subject-based techniques for measuring intelligibility are defined by ANSI S3.2, Method for Measuring the Intelligibility of Speech Over Communications Systems. ANSI S3.2 should be considered an acceptable alternative to ISO TR 4870, where referenced in IEC 60268, Part 16.~~

~~The designer of an intelligible voice/alarm system should possess skills sufficient to properly design a voice/alarm system for the occupancy to be protected. System designs for many smaller occupancies can be accomplished satisfactorily, if not optimally, on the basis of experience with the performance of other systems in similar spaces. For existing construction, relatively simple acoustic measurements combined with knowledge of the chosen loudspeaker's performance characteristics can frequently result in satisfactory performance using mathematical formulas developed for the purpose.~~

~~For occupancies that do not yet exist, the designer should have an understanding of the acoustic characteristics of the architectural design, as well as the acoustic performance properties of available loudspeakers. Architecturally, this includes the physical size and shape of the space, as well as the acoustic properties of the walls, floors, ceilings, and interior furnishings. A proper design analysis can sometimes reveal that an intelligible system is not achievable unless some features of the architectural design are changed. The designer should be prepared to defend such conclusions and, if necessary, refuse to certify the installation of such a system. While "hand calculations" and experience work well for simpler installations, more complex designs are frequently better and more cost-effectively analyzed using one of a number of readily available computer-based design programs.~~

~~The designer and the authority having jurisdiction should both be aware that the acoustic performance parameters of the chosen loudspeakers, as well as their placement in the structure, play a major role in determining how many devices are necessary for adequate intelligibility. The numerical count of devices for a given design and protected space cannot, by itself, be used to determine the adequacy of the design. Sometimes, the acoustic problems of certain placement constraints can be satisfactorily overcome~~

NFPA 72-2010 National Fire Alarm and Signaling Code

through the careful selection of loudspeakers with the requisite performance characteristics, rather than by increasing their number.

There might be applications where not all spaces will require intelligible voice signaling. For example, in a residential occupancy such as an apartment, the authority having jurisdiction and the designer might agree to a system that achieves the required audibility throughout but does not result in intelligible voice signaling in the bedrooms. The system would be sufficient to awaken and alert. However, intelligibility might not be achieved in the bedrooms with the doors closed and the sounder in the adjacent hallway or room. In some cases this can require that messages repeat a sufficient number of times to ensure that occupants can reach a location where the system is sufficiently intelligible to be understood. Systems that use tone signaling in some areas and voice signaling in other areas would not require voice intelligibility in those areas only covered by the tone.

18.4.10.1* ADSs shall be determined by the system designer during the planning and design of all emergency communications systems.

A.18.4.10.1 See the definition of acoustically distinguishable space in 3.3.2.

18.4.10.2 Each ADS shall be identified as requiring or not requiring voice intelligibility.

18.4.10.3* Where required by the authority having jurisdiction, ADS assignments shall be submitted for review and approval.

A.18.4.10.3 ADS assignments should be a part of the original design process. See the discussion in A.3.3.2. The design drawings should be used to plan and show the limits of each ADS where there is more than one.

All areas that are intended to have audible occupant notification, whether by tone only or by voice should be designated as one or more ADSs. Drawings or a table listing all ADSs should be used to indicate which ADSs will require intelligible voice communications and those that will not. The same drawings or table could be used to list audibility requirements where tones are used and to list any forms of visual or other notification or communications methods being employed in the ADS.

18.5.4.3.6* If ceiling heights exceed 30 ft (9.14 m), ceiling mounted visible notification appliances shall be suspended at or below 30 ft (9.14 m) or at the mounting height determined using the performance-based alternative of 18.5.4.5, or wall mounted visible notification appliances shall be installed in accordance with Table 18.5.4.3.1(a).

18.11* **Standard Emergency Service Interface.** Where required by the authority having jurisdiction enforcing authority; governing laws, codes, or standards; or other parts of this Code, annunciators, information display systems, and controls for portions of a system provided for use by emergency service personnel shall be designed, arranged, and located in accordance with the requirements of the organizations intended to use the equipment.

A.18.11 *Standard Emergency Service Interface.* Annunciators, information display systems, and controls for portions of a system provided for use by the fire service emergency service personnel should be designed, arranged, and located in accordance with the needs of the organizations intended to use the equipment.

NFPA 72-2010 National Fire Alarm and Signaling Code

Where annunciators, information display systems, and controls for portions of the fire alarm system are provided for use by ~~the fire service~~ emergency service personnel, these should have a common design and operation to avoid confusion of users.

See Annex ~~F~~ E, NEMA Standards Publication SB 30-2005, *Fire Service Annunciator and Interface*.

7.12 Mass Notification Systems.

~~See Annex E.~~

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 21 Protected Premises Fire Safety Emergency Control Functions and Interfaces

21.1 Application. The provisions of ~~Section 6.16~~ Chapter 21 shall cover the minimum requirements for the interconnection of ~~protected premises fire safety emergency control functions (e.g., fan control, door control)~~ to the fire alarm system and emergency communications systems in accordance with and (sic) 21.2.1 through 21.2.3 and 23.8.1.1.

21.1.1 The requirements of Chapters 10, 17, 18, 23, 24 and 26 shall also apply, unless they are in conflict with this chapter.

21.1.2 The requirements of Chapter 14 shall apply.

21.1.3 The requirements of this chapter shall not apply to Chapter 29 unless otherwise noted.

21.2 General.

21.2.1* ~~Fire safety~~ Emergency control functions shall be permitted to be performed automatically.

A.21.2.1 The performance of automatic emergency control functions refers to their normal operation. For instance, it is all right to shut down elevator mainline power when the system has been designed to do so.

21.2.2 The performance of automatic emergency control functions shall not interfere with power for lighting or for operating elevators.

21.2.3 The performance of automatic emergency control functions shall not preclude the combination of fire alarm services with other services requiring monitoring of operations.

21.2.4* A listed relay or other listed appliance connected to the fire alarm system used to initiate control of protected premises emergency control functions shall be located within 3 ft (1 m) of the controlled circuit or appliance.

21.2.6 The installation wiring between the fire alarm control unit and the relay or other appliance shall be ~~monitored for integrity~~ Class A, Class B, Class D, or Class X in accordance with Chapter 12.

Exception: Relays or appliances that operate on loss of power shall be considered self-monitoring for integrity.

21.2.7 ~~Fire safety~~ Emergency control functions shall not interfere with other operations of the fire alarm system.

21.2.12 The operation of all fire safety emergency control functions shall be verified by an operational test at the time of system acceptance.

21.3* Elevator Recall for Fire Fighters' Service.

A.21.3 The terms *machinery space, control space, machine room, and control room* are defined in *NFPA 70, National Electrical Code, and ANSI/ASME A17.1a/CSA B44.*

21.3.1 ~~System type smoke detectors, or other automatic fire detection as permitted by 6.16.3.7, located in elevator lobbies, elevator hoistways, and elevator machine rooms~~

NFPA 72-2010 National Fire Alarm and Signaling Code

~~including machine space, control room, and control space~~ All initiating devices used to initiate fire fighters' service recall shall be connected to the building fire alarm system.

21.3.2* ~~In facilities without a building fire alarm system, these smoke detectors or other automatic fire detection as permitted by 6.16.3.7~~ initiating devices used to initiate fire fighters' service recall shall be connected to a dedicated function fire alarm control unit that shall be designated as "elevator recall control and supervisory control unit," permanently identified on the dedicated function fire alarm control unit and on the record drawings.

21.3.3 Unless otherwise required by the authority having jurisdiction, only the elevator lobby, elevator hoistway, and elevator machine room smoke detectors, or other automatic fire detection as permitted by 21.3.7, and initiating devices used to initiate shutdown of elevator power in accordance with Section 21.4 shall be used to recall elevators for fire fighters' service.

21.3.4 ~~Each elevator lobby, elevator hoistway, and elevator machine room smoke detector, or other automatic fire detection as permitted by 6.16.3.7,~~ initiating device used to initiate fire fighters' service recall shall be capable of initiating elevator recall when all other devices on the same initiating device circuit have been manually or automatically placed in the alarm condition.

21.3.9 Actuation from the elevator hoistway, elevator machine room, elevator machinery space, elevator control space, or elevator control room smoke detectors, or other automatic fire detection as permitted by 21.3.7, shall cause separate and distinct visible annunciation at the building fire alarm control unit, or the fire alarm control unit described in 21.3.2, and at required Annunciators to alert fire fighters and other emergency personnel that the elevators are no longer safe to use.

21.3.12.1 Designated Level Recall. For each elevator or group of elevators, an output shall be provided to signal elevator recall to the designated level in response to the following:

- (1) Activation of smoke detectors, or other automatic fire detection as permitted by 21.3.7, located at any elevator lobby served by the elevator(s) other than the lobby at the designated level
- (2) Activation of smoke detectors, or other automatic fire detection as permitted by 21.3.7, located at any elevator machine room, elevator machinery space, elevator control space, or elevator control room serving the elevator(s), except where ~~the machine room~~ such rooms or spaces is are located at the designated level
- (3) Activation of smoke detectors, or other automatic fire detection as permitted by 21.3.7, located in the elevator hoistway serving the elevator where sprinklers are located in the hoistway, unless otherwise specified in 21.3.12.2(3)

21.3.12.2 Alternate Level Recall. For each elevator or group of elevators, an output shall be provided to signal elevator recall to the alternate level in response to the following:

- (1) Activation of smoke detectors, or automatic fire detection as permitted by 21.3.7, located at the designated level lobby served by the elevator(s)

NFPA 72-2010 National Fire Alarm and Signaling Code

- (2) Activation of smoke detectors, or other automatic fire detection as permitted by 21.3.7, located in the elevator machine room, elevator machinery space, elevator control space, or elevator control room serving the elevator(s) if ~~the machine room~~ such rooms or spaces ~~is~~ are located at the designated level
- (3) *Activation of the initiating devices identified in 21.3.12.1(3) if they are installed at or below the lowest level of recall in the elevator hoistway and the alternate level is located above the designated level

21.3.12.3* Visual Warning. For each elevator or group of elevators, an output(s) shall be provided for the elevator visual warning signal in response to the following:

- (1) Activation of the elevator machine room, elevator machinery space, elevator control space, or elevator control room initiating devices identified in 21.3.12.1(2) or 21.3.12.2(2)
- (2) Activation of the elevator hoistway initiating devices identified in 21.3.12.1(3) or 21.3.12.2(3)

21.4.2* If heat detectors are used to shut down elevator power prior to sprinkler operation, they shall be placed within 24 in. (610 mm) of each sprinkler head and be installed in accordance with the requirements of Chapter 17. Alternatively, engineering methods, such as those specified in Annex B, shall be permitted to be used to select and place heat detectors to ensure response prior to any sprinkler head operation under a variety of fire growth rate scenarios.

A.21.4.2 Upon activation of the heat detector used for elevator power shutdown, there should be a delay in the activation of the power shunt trip. This delay should be the time that it takes the elevator cab to travel from the top of the hoistway to the lowest recall level.

21.4.4* Control circuits to shut down elevator power shall be monitored for the presence of operating voltage. Loss of voltage to the control circuit for the disconnecting means shall cause a supervisory signal to be indicated at the control unit and required remote annunciators.

A.21.4.4 ~~Upon activation of the heat detector used for elevator power shutdown, there should be a delay in the activation of the power shunt trip. This delay should be the time that it takes the elevator cab to travel from the top of the hoistway to the lowest recall level.~~ Figure A.21.4.4 illustrates one method of monitoring elevator shunt trip control power for integrity.

21.5 First Responders Use Elevators. Where one or more elevators are specifically designated and marked for use by first responders during fires, the conditions specified in 21.5.1 for the elevators, associated lobbies, and machine rooms shall be continuously monitored and displayed during any such use.

21.5.1 The conditions monitored and displayed shall include, but are not limited to, the following:

- (1) Availability of main and emergency power to operate the elevator(s), elevator controller(s), and machine room (if provided) ventilation
- (2) Status of the elevator(s), including location within the hoistway, direction of travel, position of landing doors, and whether they are occupied

NFPA 72-2010 National Fire Alarm and Signaling Code

(3) Temperature and presence of smoke in associated lobbies and machine room (if provided)

21.5.2 The conditions shall be displayed on a standard emergency services interface complying with Section 18.11.

21.6 Elevators for Occupant-Controlled Evacuation.

21.6.1 Where one or more elevators are specifically designated and marked for use by occupants for evacuation during fires, they shall comply with all of the provisions of Section 21.5.

21.6.2 The lobbies of elevators required by other governing codes or standards for use by occupants for evacuation in fires shall be provided with a status indicator complying with Chapter 18.

21.6.2.1 The required status indicator shall display an illuminated green light and the message “Elevators available for occupant evacuation” while the elevators are operating under normal service and the fire alarm system is in an alarm condition, but before Phase I Emergency Recall Operation in accordance with ANSI/ASME A.17.1a/CSA B44a, *Safety Code for Elevators and Escalators*, has been initiated.

21.6.2.2 The required status indicator shall display an illuminated red light and the message “Elevators out of service, use exit stairs” once the elevators are under Phase I or Phase II operation in accordance with ANSI/ASME A17.1a/CSA B44a, *Safety Code for Elevators and Escalators*.

21.7.3* Connections between fire alarm systems and the HVAC system for the purpose of monitoring and control shall operate and be monitored in accordance with applicable NFPA standards.

A.21.7.3 This standard does not specifically require detection devices used to cause the operation of HVAC system smoke dampers, fire dampers, fan control, smoke doors, and fire doors to be connected to the fire alarm system. ~~Connection to the fire alarm system would be determined by the requirements established by the authority having jurisdiction. See A.1.2.4.~~

21.9 Electrically Locked Doors.

21.9.1 Any device or system intended to actuate the locking or unlocking of exits electrically lock a required means of egress door in the direction of egress shall be connected to the fire alarm system serving the protected premises.

21.9.2* All exits connected in accordance with 6.16.7.1 ~~Electrically locked doors in a required means of egress shall unlock upon receipt of any fire alarm signal by means of the fire alarm system serving the protected premises in the direction of egress as prescribed by other laws, codes, and governing standards.~~

Exception: Where otherwise required or permitted by the authority having jurisdiction or other codes.

A.21.9.2 Doors are commonly locked for various security reasons. Though doors are permitted to be locked to prevent ingress, doors are generally not permitted to be locked to restrict egress unless specifically permitted by governing laws, codes, and standards. Examples of special locking arrangements include delayed-egress locking and access

NFPA 72-2010 National Fire Alarm and Signaling Code

control locking. Approved locking requirements by governing laws, codes, and standards can vary extensively. For example, some might require all fire alarm initiating devices to immediately unlock electrically locked egress doors, while others might permit such doors to remain locked when a single manual fire alarm box is activated. Some codes might also permit electrically locked doors to remain locked when a single smoke detector has activated. These allowances are typically permitted only in sprinklered buildings and are generally used as additional safeguards to counter efforts to breach security, without compromising occupant safety.

21.9.3* For all exits means of egress doors connected in accordance with 21.9.1, and where batteries are used in accordance with 10.5.6.1.1(1) as the secondary power supply, the batteries shall not be utilized to maintain these doors in the locked condition, unless the fire alarm control unit is arranged with circuitry and sufficient secondary power to ensure the exits will unlock within 10 minutes of loss of primary power.

21.9.5 If exit means of egress doors are unlocked by the fire alarm system, the unlocking function shall occur prior to, or concurrent with, activation of any public-mode notification appliances in the area(s) served by the normally locked exits means of egress doors.

21.10* Exit Marking Audible Notification Systems.

21.10.1 Where required by other governing laws, codes, standards, or the authority having jurisdiction, exit marking audible notification appliances shall be activated by the building fire alarm system.

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 23, Protected Premises Fire alarm Systems

23.1.5 The requirements of 24.4.1 shall apply where in-building fire emergency voice/alarm communications systems are used.

23.2.2.1.1* Software and firmware within the fire alarm control system that interfaces to other required software or firmware shall be functionally compatible.

A.23.2.2.1.1 Compatibility between software systems is necessary to ensure that the systems can communicate correctly and that the overall system can function as intended. Unfortunately, software that is compatible can become incompatible when the software is updated. Newer revisions of software might not maintain compatibility with older revisions. This paragraph requires that the fire alarm software or firmware that interfaces with software or firmware in another system is compatible. An example might be a smoke control system that gets information from the fire alarm system. The term “required” indicates that this compatibility requirement is intended for required functions (e.g., smoke control) and not for supplemental functions that are not part of the required operation of the fire alarm system. An example of a supplemental function might be an RS-232 port that connects to a terminal emulator program used for maintenance purposes. The term “functionally” is intended to ensure that the intended functionality is maintained by the software. It is trying to avoid a situation where a change in software revision might still be compatible but changes the available functionality so that the two systems no longer perform the intended functions, even though the software communicates correctly.

23.2.2.1.2* The compatible software or firmware versions shall be documented at the initial acceptance test and at any reacceptance tests.

A.23.2.2.1.2 Compatibility between systems will be documented in one or the other (or both) of the manufacturer’s installation documents for the compatible products and controlled by the listings agencies. This documentation will be referenced in the marking on the product. The documentation might be paper copy or electronic media (disk, web site, etc.). When a software revision changes, the documentation can be consulted to ensure that it is still compatible with the software or firmware on the other side of the interface.

23.3.3 Required Features.

23.3.3.1 Building Fire Alarm Systems. Protected premises fire alarm systems that serve the general fire alarm needs of a building or buildings shall include one or more of the following systems or functions:

- (1) Manual fire alarm signal initiation
- (2) Automatic fire alarm and supervisory 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 fire alarm notification appliances
- (7) In-building fire emergency voice/alarm communications
- (8) Guard’s tour supervisory service
- (9) Process monitoring supervisory systems
- (10) Activation of off-premises signals
- (11) Combination systems

NFPA 72-2010 National Fire Alarm and Signaling Code

(12) Integrated systems

23.4.2 Circuit Designations. Initiating device circuits, notification appliance circuits, and signaling line circuits shall be designated by class ~~or style, or both~~, depending on the circuit's capability to continue to operate during specified fault conditions as indicated in Sections 23.5 through 23.7.

~~**A.6.4.2** Class A circuits are considered to be more reliable than Class B circuits because they remain fully operational during the occurrence of a single open or a single ground fault, while Class B circuits remain operational only up to the location of an open fault. However, neither Class A nor Class B circuits remain operational during a wire-to-wire short.~~

~~For both Class A and Class B initiating device circuits, a wire-to-wire short is permitted to cause an alarm on the system based on the rationale that a wire-to-wire short is the result of a double fault (e.g., both circuit conductors have become grounded), while the Code only considers the consequences of single faults.~~

~~Limitation to Class A and Class B circuits only poses a more serious problem for signaling line circuits. Though a Class A signaling line circuit remains fully operational during the occurrence of a single open or single ground fault, a wire-to-wire short disables the entire circuit. The risk of such a catastrophic failure is unacceptable to many system designers, users, and authorities having jurisdiction. Using the style designation makes it possible to specify either full system operation during a wire-to-wire short (Style 7), or system degradation during a wire-to-wire short (Style 6), or a level of performance in between that of a Style 7 and a minimum function Class A circuit (Style 2).~~

6.4.2.1 Class.

~~**6.4.2.1.1** Initiating device circuits, notification appliance circuits, and signaling line circuits shall be permitted to be designated as either Class A or Class B, depending on their performance during nonsimultaneous single circuit fault conditions as specified by the following:~~

- ~~(1) Initiating device circuits and signaling line circuits that transmit an alarm or supervisory signal, or notification appliance circuits that allow all connected devices to operate during a single open or a nonsimultaneous single ground fault on any circuit conductor, shall be designated as Class A.~~
- ~~(2) Initiating device circuits and signaling line circuits that do not transmit an alarm or supervisory signal, or notification appliance circuits that do not allow connected devices to operate beyond the location of a single open on any circuit conductor, shall be designated as Class B.~~

~~**23.4.2.1** An open or ground condition Specified fault conditions shall result in the annunciation of a trouble signal at the protected premises within 200 seconds as required in Section 10.17.~~

~~**23.4.2.2*** All styles of Class A circuits and Class X circuits using physical conductors (e.g., metallic, optical fiber) shall be installed such that the outgoing and return conductors, exiting from and returning to the control unit, respectively, are routed separately. The outgoing and return (redundant) circuit conductors shall not be run be~~

NFPA 72-2010 National Fire Alarm and Signaling Code

permitted in the same cable assembly (i.e., multi-conductor cable), enclosure, or raceway only under the following conditions:

- (1) For a distance not to exceed 10 ft (3.0 m) where the outgoing and return conductors enter or exit the initiating device, notification appliance, or control unit enclosures
- (2) For single conduit/raceway drops to individual devices or appliances
- (3) For single conduit/raceway drops to multiple devices or appliances installed within a single room not exceeding 1000 ft² (93 m²) in area

Exception:

~~The outgoing and return (redundant) circuit conductors shall be permitted to be run in the same cable assembly, enclosure, or raceway under any of the following conditions:~~

- ~~(1) For a distance not to exceed 3 m (10 ft) where the outgoing and return conductors enter or exit the initiating device, notification appliance, or control unit enclosures~~
- ~~(2) Single conduit/raceway drops to individual devices or appliances~~
- ~~(3) Single conduit/raceway drops to multiple devices or appliances installed within a single room not exceeding 92.9 m² (1000 ft²) in area~~

23.4.2.3* 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 23.4.3 and approved by the authority having jurisdiction.

A.23.4.2.3 The intent of this paragraph is to prevent situations where the signaling line circuit to a device is required to be one class of operation, while the power circuits, running in the same raceways and subject to the same threats, are wired to a lower class of operation. This means that it is possible to have power wiring connected to a device that is of a different class than the signaling line or initiating device circuits. One example of where meeting the same minimum performance requirements would still allow different classes of wiring is where the performance requirements are based on distance or the number of devices attached to the wires. For example, if the signaling line circuit supplies 200 devices and the performance requirement is that not more than 10 devices be lost to a wiring fault, then the class of wiring on the signaling line circuit will be Class A, with isolators to protect against shorts. Where the power wires never supply more than 10 devices, the power wires could be wired as Class B.

23.4.3.2 When determining the integrity and reliability of the interconnecting signaling paths (circuits) installed within the protected premises, the following influences shall be considered:

- (1) Transmission media used
- (2) Length of the circuit conductors
- (3) Total building area covered by, and the quantity of initiating devices and notification appliances connected to, a single circuit
- (4) Effect of a fault in the fire alarm system on the that would hinder the performance objectives stated in Section 6.2 of the system that protects the occupants, mission, and property of the protected premises

NFPA 72-2010 National Fire Alarm and Signaling Code

- (5) Nature of hazards present within the protected premises
- (6) Functional requirements of the system necessary to provide the level of protection required for the system
- (7) Size and nature of the population of the protected premises

23.5 Performance of Initiating Device Circuits (IDCs).

~~A.6.5 Table 6.5 and Table 6.6.1 should be used as follows:~~

- ~~(1) It should be determined whether the initiating devices are directly connected as follows:
 - ~~(a) To the initiating device circuit~~
 - ~~(b) To a signaling line circuit interface on a signaling line circuit~~
 - ~~(c) To an initiating device circuit, which in turn is connected to a signaling line circuit interface on a signaling line circuit~~~~
- ~~(2) The prime purpose of the tables is to enable identification of minimum performance for styles of signaling line circuits. It is not the intention that the styles be construed as grades. That is, a Style 6 system is not superior to a Style 4 system, or vice versa. In fact, a particular style might better provide adequate and reliable signaling for an installation than a more complex style.~~
- ~~(3) Table 6.5 and Table 6.6.1 allow users, designers, manufacturers, and the authority having jurisdiction to identify minimum performance of systems by determining the trouble and alarm signals received at the control unit for the specified abnormal conditions.~~
- ~~(4) The number of automatic fire detectors connected to an initiating device circuit is limited by good engineering practice and the listing of the detectors. If a large number of detectors are connected to an initiating device circuit, locating the detector in alarm or locating a faulty detector becomes difficult and time consuming.~~

~~On certain types of detectors, a trouble signal results from faults in the detector. When this occurs where there are large numbers of detectors on an initiating device circuit, locating the faulty detector also becomes difficult and time consuming.~~

23.5.1 The assignment of class designations to initiating device circuits shall be based on their performance capabilities under abnormal (fault) conditions in accordance with the requirements of Table 6.5 for Class A or Class B pathways specified in Chapter 12, as well as the requirements specified in 23.5.2 and 23.5.3.

~~A.6.5 Table 6.5 and Table 6.6.1 should be used as follows:~~

- ~~(1) It should be determined whether the initiating devices are directly connected as follows:
 - ~~(a) To the initiating device circuit~~
 - ~~(b) To a signaling line circuit interface on a signaling line circuit~~
 - ~~(c) To an initiating device circuit, which in turn is connected to a signaling line circuit interface on a signaling line circuit~~~~
- ~~(2) The prime purpose of the tables is to enable identification of minimum performance for styles of signaling line circuits. It is not the intention that the styles be construed as grades. That is, a Style 6 system is not superior to a Style 4 system, or vice versa. In fact, a particular style might better provide adequate and reliable signaling for an installation than a more complex style.~~
- ~~(3) Table 6.5 and Table 6.6.1 allow users, designers, manufacturers, and the authority having jurisdiction to identify minimum performance of systems by determining the~~

NFPA 72-2010 National Fire Alarm and Signaling Code

~~trouble and alarm signals received at the control unit for the specified abnormal conditions.~~

- ~~(4) The number of automatic fire detectors connected to an initiating device circuit is limited by good engineering practice and the listing of the detectors. If a large number of detectors are connected to an initiating device circuit, locating the detector in alarm or locating a faulty detector becomes difficult and time consuming.~~

~~On certain types of detectors, a trouble signal results from faults in the detector. When this occurs where there are large numbers of detectors on an initiating device circuit, locating the faulty detector also becomes difficult and time consuming.~~

23.5.2 An open or ground condition shall result in the annunciation of a trouble signal.

23.5.3 The circuit shall maintain alarm receipt capability during the application of a single ground fault.

23.6* Performance of Signaling Line Circuits (SLCs).

23.6.1 The assignment of class designations or style designations, or both to signaling line circuits shall be based on their performance capabilities under abnormal (fault) conditions in accordance with the requirements of Table 6.6.1 for Class A, Class B, or Class X pathways specified in Chapter 12 and the requirements of 23.6.2 through 23.6.5.

23.6.2 An open, short circuit, or ground fault shall result in the annunciation of a trouble signal.

23.6.3 Class B pathways shall maintain alarm capability during the application of a single ground fault.

23.6.4 Class A and Class X 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.

23.7 Performance of Notification Appliance Circuits (NACs).

23.7.1 The assignment of class designations to notification appliance circuits shall be based on their performance capabilities under abnormal (fault) conditions in accordance with the requirements of Table 6.7 for Class A or Class B pathways specified in Chapter 12, as well as the requirements specified in 23.7.2 and 23.7.3.

23.7.2 An open or ground condition shall result in the annunciation of a trouble signal.

23.7.3 The circuit shall maintain alarm capability during the application of a single ground fault.

23.8.1.2.1 Systems that have a presignal feature complying with 23.8.1.2 shall be permitted if approved by the authority having jurisdiction.

23.8.1.2* Presignal Feature.

23.8.1.2.2 If permitted by the authority having jurisdiction systems shall be permitted to have a presignal feature that allows initial fire alarm signals to sound only in department offices, control rooms, fire brigade stations, or other constantly attended locations and for which human action is subsequently required to activate a general alarm, or a feature that allows the control equipment to delay the general alarm by more than 1

NFPA 72-2010 National Fire Alarm and Signaling Code

~~minute after the start of alarm processing. shall meet the following conditions: If there is a connection to a remote location, the transmission of the alarm signal to the supervising station shall activate upon the initial alarm signal.~~

- (1) The initial fire alarm signals sound only in department offices, control rooms, fire brigade stations, or other constantly attended central locations.
- (2) Where there is a connection to a remote location, the transmission of the fire alarm signal to the supervising station activates upon the initial alarm signal.
- (3) Subsequent system operation is by either of the following means:
 - (a) Human action that activates the general fire alarm
 - (b) A feature that allows the control equipment to delay the general alarm by more than 1 minute after the start of the alarm processing

23.8.1.3 Positive Alarm Sequence.

~~23.8.1.3.1 Systems that have positive alarm features complying with 6.8.1.3 shall be permitted if approved by the authority having jurisdiction. The positive alarm sequence operation shall comply with the following:~~

- (1) To initiate the positive alarm sequence operation, the signal from an automatic fire detection device selected for positive alarm sequence operation shall be acknowledged at the fire alarm control unit by trained personnel within 15 seconds of annunciation ~~in order to initiate the alarm investigation phase.~~
- (2) If the signal is not acknowledged within 15 seconds, notification signals in accordance with the building evacuation or relocation plan and remote signals shall be automatically and immediately activated.
- (3) If the positive alarm sequence operation is initiated in accordance with 23.8.1.3.1.1(1), trained personnel shall have up to 180 seconds during the alarm investigation phase of up to 180 seconds to evaluate the fire condition and reset the system.
- (4) If the system is not reset during the alarm investigation phase, notification signals in accordance with the building evacuation or relocation plan and remote signals shall be automatically and immediately activated.
- (5) If a second automatic fire detector selected for positive alarm sequence is actuated during the alarm investigation phase, notification signals in accordance with the building evacuation or relocation plan and remote signals shall be automatically and immediately activated.
- (6) *If any other fire alarm initiating device is actuated, notification signals in accordance with the building evacuation or relocation plan and remote signals shall be automatically and immediately activated.

A.23.8.1.3.1.1(6) "Immediately activated" means there are no delays imposed by the system other than the processing of the signal in accordance with 23.8.1.1.

23.8.2.1 Fire alarm systems shall be permitted to ~~be either integrated systems combining~~ all detection, notification, and auxiliary functions in a single system or be a combination of component subsystems.

23.8.2.2 Except as permitted in 23.8.2.3, the fire alarm systems components shall be permitted to share control equipment or shall be able to operate as stand-alone subsystems, but, in any case, they shall be arranged to function as a single system.

NFPA 72-2010 National Fire Alarm and Signaling Code

23.8.2.3 Exception: Where the building is not served by a building fire alarm system, independent dedicated function fire alarm systems and/or releasing fire alarm systems shall not be required to be interconnected to function as a single system.

23.8.4.3 Non-Fire Alarm Equipment.

23.8.4.3.1* For non-fire alarm equipment listed to the performance requirements specified in 10.14.1, the requirements of 23.8.4.3.1.1 through 23.8.4.3.1.3 shall apply.

~~**A.6.8.4.1** The provisions of 6.8.4.1 apply to types of equipment used in common for fire alarm systems, such as fire alarm, sprinkler supervisory, or guard's tour service, and for other systems, such as burglar alarm or coded paging systems, and to methods of circuit wiring common to both types of systems. The intent of connecting non-fire systems with the fire alarm system is often to cause the non-fire systems to react appropriately when signaled by the fire alarm system.~~

A.23.8.4.3.1 For systems such as carbon monoxide detection, fire extinguisher electronic monitoring device, emergency communication (mass notification), or intrusion, much of the benefit of a combination system comes from being able to use common wiring. If the equipment in the combination system is of equivalent quality to fire alarm equipment, and the system monitors the wiring and equipment in the same way as fire alarm equipment, then sharing of wiring is permitted. If the equipment is not of equivalent quality, isolation between the systems would be required.

23.8.4.3.1.1 The equipment shall be permitted to be attached to a fire alarm circuit, either among the fire alarm devices or as a branch or extension of the fire alarm pathways, when the following requirements are met:

- (1) All the equipment and pathways shall meet the monitoring for integrity requirements of Section 10.17.
- (2) All the equipment and pathways shall be maintained by a single service organization.
- (3) All the equipment and pathways shall be installed in accordance with the requirements of this Code.
- (4) All the equipment shall be listed as compatible with the fire alarm equipment or shall have a contact closure interface listed for the connected load.

23.8.4.3.1.2 If the equipment is attached to the fire alarm system via separate pathways, then short circuits, or open circuits, or grounds in this equipment, or between this equipment and the fire alarm system wiring pathways, shall not interfere with impede or impair the monitoring for integrity of the fire alarm system or prevent alarm, supervisory, or fire safety control signal transmissions.

~~**A.6.8.4.3** When a non-fire system is combined with the fire alarm system using a data transmission method such as EIA232 serial data, isolation of the interconnect circuitry is essential to proper operation. Methods for isolating the non-fire alarm system may include isolation wiring methods or a barrier to prevent failure of the fire alarm system functions due to transfer of wiring faults between the systems. It is also important to consider the adverse impact on the fire alarm system caused by excessive traffic on the communications link.~~

NFPA 72-2010 National Fire Alarm and Signaling Code

23.8.4.3.1.3 Grounds in this equipment, or between this equipment and the fire alarm system pathways, shall be reported, annunciated, and corrected in the same manner as grounds in the rest of the fire alarm system.

~~23.8.4.3.2~~ All ~~For~~ non-fire alarm components of a combination system shall be listed for fire alarm use unless removal, replacement, failure, or maintenance procedure on any non-fire alarm hardware, software, or circuits does not impair the required operation for the fire alarm system equipment not listed to the performance requirements specified in 10.14.1, the requirements of 23.8.4.3.2.1 through 23.8.4.3.2.3 shall apply.

~~23.8.4.3.2.2~~ Short circuits, open circuits, or Grounds in this equipment, or between this equipment and the fire alarm system wiring pathways, shall not interfere with the monitoring for integrity of the fire alarm system or prevent alarm, supervisory, or fire safety control signal transmissions be reported, annunciated, and corrected in the same manner as grounds in the rest of the fire alarm system.

~~A.6.8.4.3~~ When a non-fire system is combined with the fire alarm system using a data transmission method such as EIA232 serial data, isolation of the interconnect circuitry is essential to proper operation. Methods for isolating the non-fire alarm system may include isolation wiring methods or a barrier to prevent failure of the fire alarm system functions due to transfer of wiring faults between the systems. It is also important to consider the adverse impact on the fire alarm system caused by excessive traffic on the communications link.

23.8.4.3.2.3 Removal, replacement, failure, maintenance procedures, or ground on this hardware, software, or circuits shall not impair the required operation of the fire alarm system.

~~6.8.4.4~~ All non-fire alarm components of a combination system shall be listed for fire alarm use unless removal, replacement, failure, or maintenance procedure on any non-fire alarm hardware, software, or circuits does not impair the required operation of the fire alarm system.

23.8.4.4 Speakers used as alarm notification appliances on fire alarm systems shall also be permitted to be used for ~~mass notification~~ emergency communications systems when installed in accordance with Chapter 24.

~~A.6.8.4.5~~ If the building paging system can be controlled by personnel at the fire command center, and if permitted by the authority having jurisdiction, the building paging system can be used as a supplementary notification system to provide selective and all-call fire alarm evacuation voice messages and messages for occupants to relocate to safe areas in a building.

~~Dedicated fire alarm/voice evacuation alarm systems are not required to monitor the integrity of the speaker circuits while active for emergency purposes.~~

~~These circuits must be monitored for integrity while active for nonemergency purposes. The building operator, system designer, and authority having jurisdiction should be aware that in some situations such a system could be subject to deliberate tampering. Tampering is usually attempted to reduce the output of a sound system that is in constant use as a music or paging system and is a source of annoyance to employees. The likelihood of tampering can be reduced through proper consideration of loudspeaker accessibility and system operation. Access can be reduced through the use of hidden or~~

NFPA 72-2010 National Fire Alarm and Signaling Code

~~nonadjustable transformer taps (which can reduce playback levels), use of vandal-resistant listed loudspeakers, and placement in areas that are difficult to access, such as high ceilings (any ceiling higher than could be reached by standing on a desk or chair). Nonemergency operation of the system should always consider that an audio system that annoys an employee potentially reduces employee productivity and can also annoy the public in a commercial environment. Most motivations for tampering can be eliminated through appropriate use of the system and employee discipline. Access to amplification equipment and controls should be limited to those in authority to make adjustments to such equipment. It is common practice to install such equipment in a manner that allows adjustment of nonemergency audio signal levels while defaulting to a fixed, preset level of playback when operating in emergency mode. Under extreme circumstances, certain zones of a protected area might require a dedicated emergency voice/alarm communications zone.~~

23.8.4.5* In combination systems, fire alarm signals shall be distinctive, clearly recognizable, and ~~with the exception of mass notification inputs, take precedence over any other signal even when a non-fire alarm signal is initiated first shall be indicated as follows in descending order of priority, unless~~ except where otherwise permitted required by other governing laws, codes or standards, or by other parts of this Code:

- (1) Signals associated with life safety
- (2) Signals associated with property protection
- (3) Trouble signals associated with life and/or property protection
- (4) All other signals

6.8.4.9* ~~Live voice instructions originating from the protected premises fire or mass notification systems shall override all previously initiated signals and shall have priority over both of the following:~~

- (1) ~~Any subsequent automatically initiated signals on that channel~~
- (2) ~~Remotely generated mass notification messages~~

~~**A.6.8.4.9** When interfacing fire alarm and mass notification functions, the system designer should evaluate the proximity of the individual operating locations (controls/microphone). This requirement applies where mass notification systems are installed in buildings that do not have emergency voice alarm systems (in accordance with 6.9.1); otherwise, the provisions of 6.9.6.7 apply.~~

23.8.4.8* Fire Extinguisher Electronic Monitoring Devices and Systems. Signals from a fire extinguisher electronic monitoring device or fire extinguisher monitoring system transmitted to a fire alarm system shall be permitted to be supervisory signals.

23.8.5.1.2* ~~For~~ Where connected to a supervising station, fire alarm systems employing automatic fire detectors or waterflow detection devices at least one shall include a manual fire alarm box shall be provided to initiate a fire alarm signal. to initiate a fire alarm signal to the supervising station. ~~This fire alarm box shall be located where required by the authority having jurisdiction.~~

Exception: Fire alarm systems dedicated to elevator recall control and supervisory service as permitted in Section 21.3.

A.23.8.5.1.2 The manual fire alarm box means required by 23.8.5.1.2 is intended to provide a backup means to manually activate the fire alarm system when the automatic

NFPA 72-2010 National Fire Alarm and Signaling Code

fire detection system or waterflow devices are out of service due to maintenance or testing, or where human discovery of the fire precedes automatic sprinkler system or automatic detection system activation. ~~Where The fire alarm system is connected to a monitoring facility the manual fire alarm box required by 23.8.5.1.2 should be connected to a separate circuit that is not placed "on test" when the detection or sprinkler system is placed "on test." The manual fire alarm box means is only intended for use by the system technician or the building owner and should be located in an area that is accessible to occupants of the building and should not be locked by the sprinkler riser or fire alarm control unit.~~

23.8.5.2 Fire Alarm Signal Initiation — Manual. Manual fire alarm signal initiation shall comply with the requirements of Section 17.14.

23.8.5.2.1 If signals from manual fire alarm boxes and other fire alarm initiating devices within a building are transmitted over the same signaling line circuit, there shall be no interference with manual fire alarm box signals when both types of initiating devices are operated at the same time.

23.8.5.5* Fire Alarm Signal Initiation — Sprinkler Systems.

23.8.5.5.1 Where required by other governing laws, codes, or standards to be electronically monitored, waterflow alarm initiating devices shall be connected to a dedicated function fire alarm control unit designated as "sprinkler waterflow and supervisory system" and permanently identified on the control unit and record drawings.

Exception:

Where waterflow alarm-initiating devices are connected to a building fire alarm system, a dedicated function fire alarm control unit shall not be required.

23.8.5.6* Supervisory Signal Initiation — Sprinkler Systems.

23.8.5.6.1 Where required by other governing laws, codes, or standards to be electronically monitored, supervisory signal-initiating devices shall be connected to a dedicated function fire alarm control unit designated as "sprinkler waterflow and supervisory system" and permanently identified on the control unit and record drawings.

Exception:

Where supervisory signal-initiating devices are connected to a building fire alarm system, a dedicated function fire alarm control unit shall not be required.

23.8.6.2* Notification Appliances in Exit Stair Enclosures, Exit Passageways, and Elevator Cars. Notification appliances shall not be required in exit stair enclosures, exit passageways, and elevator cars in accordance with 23.8.6.2.1 through 23.8.6.2.4.

A.23.8.6.2 The general purpose of the fire alarm audible and visual notification appliances is to alert occupants that there is a fire condition and for occupants to exit from the building. Once the occupants are in the exit enclosures, high noise levels and light intensity from notification appliances ~~may~~ could cause confusion and impede egress. There could be conditions that warrant the installation of notification appliances in exit ~~enclosures~~ passageways, but careful analysis is necessary to avoid impeding exiting from the building.

NFPA 72-2010 National Fire Alarm and Signaling Code

23.8.5.7 Alarm Signal Initiation — Fire Suppression Systems Other Than Sprinklers.

23.8.5.7.1 Where required by other governing laws, codes, or standards to be monitored and a building fire alarm system is installed, the actuation of a fire suppression system shall annunciate an alarm or supervisory condition at the building fire alarm control unit.

23.8.5.10 Fire Alarm and Supervisory Signal Initiation — Releasing Service Control Units Fire Alarm Systems.

23.8.5.10.3 Where required by other governing laws, codes, or standards, actuation of any suppression system connected to a releasing service fire alarm control unit shall be annunciated at the protected premises fire alarm control unit, even where the system actuation is by manual means or otherwise accomplished without actuation of the releasing service fire alarm control unit.

23.8.5.10.5 In facilities that are not required to install a protected premises fire alarm system, the alarm and supervisory devices shall be connected to the releasing service fire alarm control unit, and their actuation shall be annunciated at the releasing service control unit.

23.8.6 Fire Alarm and Mass Notification System Notification Outputs.

23.8.6.1 Occupant Notification. Fire alarm and mass notification systems provided for evacuation or relocation of occupants shall have one or more notification appliances listed for the purpose on each floor of the building and be so located that they have the characteristics described in Chapter 18 for public mode or private mode, as required.

23.8.6.4.2 ~~In protected premises with more than one notification zone~~ Where there are addressable notification appliances on a signaling line circuit that serves with more than one different notification zones, a single open, short-circuit, or ground on the system installation conductors that signaling line circuit shall not affect operation of more than one notification zone.

6.8.6.5 Distinctive Evacuation Signal.

6.8.6.5.1* ~~To meet the requirements of 4.4.3.6, the fire alarm audible signal pattern used to notify building occupants of the need to evacuate (leave the building) shall be in accordance with ANSI S3.41, American National Standard Audible Emergency Evacuation Signal.~~

Exception:

Where approved by the authority having jurisdiction, use of the existing consistent evacuation signaling scheme shall be permitted.

A.6.8.6.5.1 Paragraph 4.4.3.6 requires that fire alarm signals be distinctive in sound from other signals and that this sound not be used for any other purpose. The use of the distinctive three-pulse temporal pattern fire alarm evacuation signal required by 6.8.6.5.1 became effective July 1, 1996, for new systems installed after that date. It is not the intent that the ANSI S3.41 requirements for sound pressure levels or the distinct pattern for visible appliances be applied in NFPA 72. It had been previously recommended for this purpose by this Code since 1979. It has since been adopted as both an American

NFPA 72-2010 National Fire Alarm and Signaling Code

National Standard (ANSI S3.41, American National Standard Audible Emergency Evacuation Signal) and an International Standard (ISO 8201, Audible Emergency Evacuation Signal).

Copies of both of these standards are available from either of the following:

- (1) The web at asa.aip.org/map_standards.html
- (2) Standards Publication Fulfillment, P.O. Box 1020, Sewickly, PA 15143-9998, Tel. 412-741-1979

For information about the Acoustical Society of America, or for how and why the three-pulse temporal pattern signal was chosen as the international standard evacuation signal, contact Standards Secretariat, Acoustical Society of America, 120 Wall Street, New York, NY 10005-3993. Tel. 212-248-0373.

The standard fire alarm evacuation signal is a three-pulse temporal pattern using any appropriate sound. The pattern consists of the following in this order:

- (3) An on phase lasting 0.5 seconds ± 10 percent.
- (4) An off phase lasting 0.5 seconds ± 10 percent, for three successive on periods.
- (5) An off phase lasting 1.5 seconds ± 10 percent [see Figure A.6.8.6.5.1(a) and Figure A.6.8.6.5.1(b)]. The signal should be repeated for a period that is appropriate for the purposes of evacuation of the building, but for not less than 180 seconds. A single-stroke bell or chime sounded at "on" intervals lasting 1 second ± 10 percent, with a 2-second ± 10 percent "off" interval after each third "on" stroke, is permitted [see Figure A.6.8.6.5.1(c)].

The minimum repetition time is permitted to be manually interrupted.

FIGURE A.6.8.6.5.1(a) Temporal Pattern Parameters.

FIGURE A.6.8.6.5.1(b) Temporal Pattern Imposed on Audible Notification Appliances That Otherwise Emit a Continuous Signal While Energized.

FIGURE A.6.8.6.5.1(c) Temporal Pattern Imposed on a Single-Stroke Bell or Chime.

6.8.6.5.2 The use of the American National Standard evacuation signal shall be restricted to situations where it is desired that all occupants hearing the signal evacuate the building immediately. It shall not be used where, with the approval of the authority having jurisdiction, the planned action during a fire emergency is not evacuation, but rather is the relocation of occupants or their protection in place as directed by the building fire protection plan or as directed by fire-fighting personnel.

6.8.6.5.3* The American National Standard evacuation signal shall be synchronized within a notification zone.

A.6.8.6.5.3 Coordination or synchronization of the audible signal within a notification zone is needed to preserve the temporal pattern. It is unlikely that the audible signal in one evacuation/notification zone will be heard in another at a level that will destroy the temporal pattern. Thus, it would not normally be necessary to provide coordination/synchronization for an entire system. Caution should be used in spaces such as atriums where the sounds produced in one notification zone can be sufficient to cause confusion regarding the temporal pattern.

23.9 In-Building Fire Emergency Voice/Alarm Communications.

NFPA 72-2010 National Fire Alarm and Signaling Code

~~23.9.1 Section 6.9 shall be used in the design and application of In-building fire emergency voice/alarm communications shall meet the requirements of Chapter 24.~~

~~**6.9.2 Automatic Response.** The emergency voice/alarm communications system shall be used to provide an automatic response to the receipt of a signal indicative of a fire alarm or other emergency.~~

~~**6.9.2.1** If the monitoring location is constantly attended by trained operators, and operator acknowledgment of receipt of a fire alarm or other emergency signal is received within 30 seconds, automatic response shall not be required.~~

~~**6.9.2.2** If acceptable to the authority having jurisdiction, the system shall permit the application of an automatic evacuation signal to one or more evacuation signaling zones and, at the same time, shall permit manual voice paging to the other evacuation signaling zones selectively or in any combination.~~

~~**23.9.2** All live voice communications systems shall meet the requirements of Chapter 24.~~

~~**6.9.3 Voice Evacuation Messages.**~~

~~**6.9.3.1** In response to an initiating signal indicative of a fire emergency, the system shall be permitted to transmit a voice message.~~

~~**6.9.3.2** Evacuation messages shall be preceded and followed by a minimum of two cycles of the emergency evacuation signal specified in 6.8.6.5.~~

~~**6.9.4 Positive Alarm Sequence.** Emergency voice/alarm communications systems shall be permitted to use positive alarm sequence complying with 6.8.1.3 if approved by the authority having jurisdiction.~~

~~**6.9.5 Tones.** 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.~~

~~**6.9.6 Controls.**~~

~~**6.9.6.1*** Controls for the emergency voice/alarm communication system shall be at a location approved by the authority having jurisdiction.~~

~~**A.6.9.6.1** The choice of the location(s) for the emergency voice/alarm communications control equipment should also take into consideration the ability of the fire alarm system to operate and function during any probable single event. Although NFPA 72 does not regulate either building construction or contents, system designers should consider the potential for fire in proximity to fire alarm control equipment, including remotely located control devices, to disable the system or a portion thereof. Where practical, it is prudent to minimize unnecessary fire exposures of fire alarm control equipment through the use of fire-rated construction or enclosures, limiting adjacent combustibles and ignition sources or other appropriate means.~~

~~**6.9.6.2** Controls shall be located or secured to allow access by only trained and authorized personnel.~~

~~**6.9.6.3** Operating controls shall be clearly identified.~~

~~**6.9.6.4** If there are multiple emergency voice/alarm communications control locations, only one shall be in control at any given time.~~

NFPA 72-2010 National Fire Alarm and Signaling Code

~~6.9.6.5~~ The location having control of the system shall be identified by a visible indication at that location.

~~6.9.6.6~~ Manual controls shall be arranged to provide visible indication of the on-off status for their associated evacuation signaling zone.

~~6.9.6.7~~ If live voice instructions are provided, they shall override previously initiated signals to the selected notification zone(s) and shall have priority over any subsequent automatically initiated signals to the selected zone(s).

~~6.9.7* Speakers.~~ Speakers and their enclosures shall be installed in accordance with Chapter 7.

~~A.6.9.7~~ Speakers located in the vicinity of the emergency voice/alarm communications control equipment should be arranged so they do not cause audio feedback when the system microphone is used. Speakers installed in the area of two-way telephone stations should be arranged so that the sound pressure level emitted does not preclude the effective use of the two-way telephone system. Circuits for speakers and telephones should be separated, shielded, or otherwise arranged to prevent audio cross-talk between circuits.

~~6.9.8 Monitoring Integrity.~~ Speaker amplifiers and tone-generating equipment shall be monitored for integrity in accordance with 4.4.7.2.

~~6.9.9 Secondary Power.~~ The secondary (standby) power supply shall be provided in accordance with 4.4.1.5, 4.4.1.6.1, and 4.4.1.6.2.

~~6.9.10* Relocation and Partial Evacuation.~~ The requirements of 6.9.10 shall apply only to systems used for relocation or partial evacuation.

~~A.6.9.10~~ When a fire or other emergency occurs in a building, the usual goal is to evacuate the occupants or relocate them so that they are not exposed to hazardous conditions. The exception occurs in occupancies using SIP/DIP [1] (Stay In Place, Defend In Place) strategies. It may also be necessary to alert and provide information to trained staff responsible for assisting evacuation or relocation. Figure A.6.9.10 shows several key steps in a person's reaction and decision-making process [2].

~~FIGURE A.6.9.10~~ Key Steps in a Person's Reaction.

~~Occupants rarely panic in fire situations [3,4]. The behavior that they adopt is based on the information they have, the perceived threat and the decisions they make. The entire decision path is full of thought and decisions on the part of the occupant. All of which take time before leading to the development of adaptive behavior. In hindsight, the actions of many occupants in real fires are sometimes less than optimal. However, their decisions may have been the best choices given the information they had.~~

~~Fire alarm systems that only use audible tones and/or flashing strobe lights impart only one bit of information: Fire Alarm. It has long been recognized that environments having complex egress situations or high hazard potentials require occupant notification systems that provide more than one bit of information [5]. To reduce the response time of the occupants and to effect the desired behavior, the message should contain several key elements [3,6]. These include:~~

- ~~• Tell them what has happened and where.~~
- ~~• Tell them what they should do.~~

NFPA 72-2010 National Fire Alarm and Signaling Code

- Tell them why they should do it.

There does not seem to be any research that has tested actual message content to determine the best way to inform occupants. The problem is that each building and each fire is unique. Messaging is further complicated by the need to give different information to different people depending on their location relative to the fire, their training, and their physical/mental capabilities.

Messages should use positive language and avoid negative instructions that could be misinterpreted due to unintelligible communications. For example, if you want people to leave an area, say so: “A fire has been reported in the area. For your safety, use the stairs to evacuate the area immediately.” A bad example is: “The signal tone you have just heard indicated a report of an emergency. If your floor evacuation signal sounds after this message, do not use the elevator, walk to the nearest stairway and leave the floor. While the report is being verified, occupants on other floors should await further instructions.” This message is too long, ambiguous, and subject to misunderstanding if not heard clearly. The word “not” may not be heard clearly, or it may be heard to apply to all of the remaining sentence. Similarly, care should be used in selecting and clearly enunciating words such as fifth and sixth, which can sound the same if the system and environment lead to low intelligibility. Content of the message should be predicated on the building fire safety plan, the nature of the building and its occupants, the design of the fire alarm system, and testing of the occupant reaction to the message. Caution is advised that the fire alarm system operation and message actuation might be initiated by a manual pull station or detector remote from the fire.

[1] Schifilliti, R.P., “To Leave or Not to Leave — That is the Question!”, National Fire Protection Association, World Fire Safety Congress & Exposition, May 16, 2000, Denver, CO.

[2] Ramachandran, G., “Informative Fire Warning Systems,” Fire Technology, Volume 47, Number 1, February 1991, National Fire Protection Association, 66-81.

[3] J. Bryan, “Psychological Variables That May Affect Fire Alarm Design,” Fire Protection Engineering, Society of Fire Protection Engineers, Issue No. 11, Fall 2001.

[4] Proulx, G., “Cool Under Fire,” Fire Protection Engineering, Society of Fire Protection Engineers, Issue No. 16, Fall 2002.

[5] General Services Administration, Proceedings of the Reconvened International Conference on Fire Safety in High Rise Buildings, Washington, D.C., October 1971.

[6] Proulx, G., “Strategies for Ensuring Appropriate Occupant Response to Fire Alarm Signals,” National Research Council of Canada, Ottawa, Ontario, Construction Technology Update, No. 43, 1-6, December 2000.

6.9.10.1 Systems shall be provided with manual voice transmission capabilities selectively to one or more zones or on an all-call basis.

6.9.10.2 Where the system is used to transmit relocation instructions or other non-evacuation messages, a continuous alert tone of 3-second to 10-second duration followed by a message (or messages where multi-channel capability is provided) shall be automatic, and the sequence shall be repeated at least three times to direct occupants in the evacuation signaling zone where the alarm initiation originated and other evacuation signaling zones in accordance with the building’s fire evacuation plan.

NFPA 72-2010 National Fire Alarm and Signaling Code

~~6.9.10.3~~ Where provided, speakers in each enclosed stairway shall be connected to a separate notification zone for manual paging only.

~~6.9.10.4~~ The requirements of 6.9.10.4 shall apply to both audible (tone and voice) and visible notification appliance circuits.

23.10 Prerecorded (Digital) Voice and Tone Fire Alarm Systems.

~~23.10.1~~ The requirements of Section 23.10 shall apply to both audible (tone and prerecorded voice) and visible notification appliance circuits.

~~23.10.3~~ Speakers that transmit prerecorded voice and/or tone signals shall be permitted to be used as fire alarm notification appliances.

~~23.11 Two-Way Communication Service.~~ Two-way communication service shall meet the requirements of Chapter 24.

~~6.10 Two-Way Communication Service.~~

~~6.10.1 Two-Way Telephone Communication Service.~~

~~6.10.1.1~~ Two-way telephone communications equipment shall be listed for two-way telephone communications service and installed in accordance with Section 6.10.1.

~~6.10.1.2~~ Two-way telephone communications service, if provided, shall be for use by the fire service and collocated with the emergency voice alarm communications equipment.

~~6.10.1.3~~ Monitoring of the integrity of two-way telephone communications circuits shall be in accordance with 4.4.7.2.

~~6.10.1.4~~ Additional uses, if specifically permitted by the authority having jurisdiction, shall be permitted to include signaling and communications for a building fire warden organization, signaling and communications for reporting a fire and other emergencies (e.g., voice call box service, signaling, and communications for guard's tour service), and other uses.

~~6.10.1.5~~ Variation of equipment and system operation provided to facilitate additional use of the two-way telephone communications service shall not adversely affect performance when used by the fire service.

~~6.10.1.6*~~ Two-way telephone communications service shall be capable of permitting the simultaneous operation of any five telephone stations in a common talk mode.

~~A.6.10.1.6~~ Consideration should be given to the type of telephone handset that fire fighters use in areas where high ambient noise levels exist or areas where high noise levels could exist during a fire condition. Push-to-talk handsets, handsets that contain directional microphones, or handsets that contain other suitable noise-canceling features can be used.

~~6.10.1.7~~ 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.

NFPA 72-2010 National Fire Alarm and Signaling Code

~~6.10.1.8 A means for silencing the audible call-in signal sounding appliance shall be permitted, provided it is key-operated, 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.~~

~~6.10.1.9 If a selective talk system is used, such a switch shall be permitted, provided subsequent telephone circuits going off-hook operate the distinctive off-hook audible signal sounding appliance.~~

~~6.10.1.10 As a minimum (for fire service use only), two-way telephone systems shall be common talk (i.e., a conference or party line circuit), providing at least one telephone station or jack per floor and at least one telephone station or jack per exit stairway.~~

~~6.10.1.11 In buildings equipped with a fire pump(s), a telephone station or jack shall be provided in each fire pump room.~~

~~6.10.1.12 If the two-way telephone system is intended to be used by fire wardens in addition to the fire service, the minimum requirement shall be a selective talk system (where phones are selected from the control location).~~

~~6.10.1.13 Systems intended for fire warden use shall provide telephone stations or jacks as required for fire service use, and additional telephone stations or jacks as necessary to provide at least one telephone station or jack in each notification zone. Telephone circuits shall be selectable from the control location either individually or, if approved by the authority having jurisdiction, by floor or stairwell.~~

~~6.10.1.14 If the control equipment provided does not indicate the location of the caller (common talk systems), each telephone station or telephone jack shall be clearly and permanently labeled to allow the caller to identify his or her location to the control center by voice.~~

~~6.10.1.15 If telephone jacks are provided, two or more portable handsets, as determined by the authority having jurisdiction, shall be stored at each control center for use by emergency responders.~~

~~6.10.1.16* All circuits necessary for the operation of two-way telephone communication systems shall be installed using one of the following methods:~~

~~**A.6.10.1.16** One or more of the following means might be considered acceptable to provide a level of survivability consistent with the intent of this requirement:~~

- ~~(1) Routing two-way telephone circuits separately~~
- ~~(2) Using short-circuit fault tolerant circuits~~
- ~~(1) A 2-hour fire rated circuit integrity (CI) cable~~
- ~~(2) A 2-hour fire rated cable system (electrical circuit protective system)~~
- ~~(3) A 2-hour fire rated enclosure~~
- ~~(4) Performance alternatives approved by the authority having jurisdiction~~
- ~~(5) Buildings fully protected by an automatic sprinkler system installed in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems, with the wiring or cables installed in metal raceways and in accordance with Article 760 of NFPA 70~~

NFPA 72-2010 National Fire Alarm and Signaling Code

~~6.10.2* Two-Way In-Building Radio Communications Enhancement Systems.~~

~~A.6.10.2 Monitoring of the in-building two-way communications system by the fire control system is permissible. The following should be considered as part of the system design and monitoring criteria:~~

~~Monitoring (if provided):~~

- ~~(1) Primary operating power~~
- ~~(2) Secondary operating power~~
- ~~(3) Antenna connections~~
- ~~(4) Antenna integrity~~
- ~~(5) Signal strength~~
- ~~(6) Multi-pathing~~
- ~~(7) Interference~~
- ~~(8) Channel integrity~~
- ~~(9) Interconnecting wiring~~

~~Design:~~

- ~~(1) Survivability~~
- ~~(2) FCC licensing~~
- ~~(3) Interior and external building reception~~
- ~~(4) Testing and maintenance by licensing group~~
- ~~(5) Environmental conditions~~
- ~~(6) Future systems expansion~~

~~6.10.2.1 Installation of two-way in-building radio communications enhancement systems shall be permitted.~~

~~6.10.2.2 Two-way in-building radio communications enhancement systems shall be permitted to be monitored by the building fire alarm system.~~

23.13 Suppression System Actuation.

23.13.1 Releasing service fire alarm control units used for automatic or manual activation of a fire suppression system shall be listed for releasing service.

23.13.5 Releasing service fire alarm systems used for fire suppression-releasing service shall be provided with a disconnect switch to allow the system to be tested without actuating the fire suppression systems.

23.13.5.1 Operation of a disconnect switch or a disable function shall cause a supervisory signal at the releasing service fire alarm control unit.

23.13.8 Suppression systems or groups of systems shall be controlled by a single releasing service fire alarm control unit that monitors the associated initiating device(s), actuates the associated releasing device(s), and controls the associated agent release notification appliances.

23.13.9 ~~Exception:~~ If the configuration of multiple control units is listed for releasing device service, and if a trouble condition or manual disconnect on either control unit causes a trouble or supervisory signal, the initiating device on one control unit shall be permitted to actuate releasing devices on another control unit in lieu of 23.13.8.

NFPA 72-2010 National Fire Alarm and Signaling Code

23.13.10 If the releasing service fire alarm control unit is located in a protected premises having a separate fire alarm system, it shall be monitored for alarm, supervisory, and trouble signals, but shall not be dependent on or affected by the operation or failure of the protected premises fire alarm system.

23.13.11 Releasing fire alarm systems performing suppression system releasing functions shall be installed in such a manner that they are effectively protected from damage caused by activation of the suppression system(s) they control.

23.14.4* It shall be permitted to provide supplementary transmission of real-time data from the fire system to off-premises equipment.

A.23.14.4 Off-site logging of fire alarm data can be useful to preserve information in the face of fire or building failure to facilitate accurate reconstruction of the event. It can also be beneficial to send data off-premises to incident command personnel to enhance situational awareness and response decisions and to maintain safe and efficient operations.

23.14.4.1 Transmission of real-time data off-premises shall not affect the operation or response of the fire alarm control unit.

23.14.4.2 Any data transmitted shall be consistent with the data generated by the system.

23.17.1 Emergency Elevator Operations. Emergency elevator operations shall meet the requirements of Sections 21.3, 21.4, 21.5, and 21.6.

6.16.3 Elevator Recall for Fire Fighters' Service.

6.16.3.1 ~~System type smoke detectors, or other automatic fire detection as permitted by 6.16.3.7, located in elevator lobbies, elevator hoistways, and elevator machine rooms including machine space, control room, and control space used to initiate fire fighters' service recall, shall be connected to the building fire alarm system.~~

6.16.3.2* ~~In facilities without a building fire alarm system, these smoke detectors, or other automatic fire detection as permitted by 6.16.3.7, shall be connected to a dedicated function fire alarm control unit that shall be designated as "elevator recall control and supervisory control unit," permanently identified on the dedicated function fire alarm control unit and on the record drawings.~~

~~**A.6.16.3.2** In facilities without a building alarm system, dedicated function fire alarm control units are required by 6.16.3.2 for elevator recall in order that the elevator recall systems be monitored for integrity and have primary and secondary power meeting the requirements of this Code.~~

~~The fire alarm control unit used for this purpose should be located in an area that is normally occupied and should have audible and visible indicators to annunciate supervisory (elevator recall) and trouble conditions; however, no form of general occupant notification or evacuation signal is required or intended by 6.16.3.2.~~

~~**6.16.3.3** Unless otherwise required by the authority having jurisdiction, only the elevator lobby, elevator hoistway, and the elevator machine room smoke detectors, or other automatic fire detection as permitted by 6.16.3.7, shall be used to recall elevators for fire fighters' service.~~

NFPA 72-2010 National Fire Alarm and Signaling Code

~~6.16.3.4 Each elevator lobby, elevator hoistway, and elevator machine room smoke detector, or other automatic fire detection as permitted by 6.16.3.7, shall be capable of initiating elevator recall when all other devices on the same initiating device circuit have been manually or automatically placed in the alarm condition.~~

~~6.16.3.5* A lobby smoke detector shall be located on the ceiling within 6.4 m (21 ft) of the centerline of each elevator door within the elevator bank under control of the detector.~~

~~*Exception: For lobby ceiling configurations exceeding 4.6 m (15 ft) in height or that are other than flat and smooth, detector locations shall be determined in accordance with Chapter 5.*~~

~~**A.6.16.3.5** Smoke detectors should not be installed in outdoor locations or locations that are open to the weather (such as unenclosed elevator lobbies in open parking structures), because such environments can exceed the parameters of the detector listing and can result in unwanted alarms. See 6.16.3.7.~~

~~6.16.3.6 Smoke detectors shall not be installed in unsprinklered elevator hoistways unless they are installed to activate the elevator hoistway smoke relief equipment.~~

~~6.16.3.7* If ambient conditions prohibit installation of automatic smoke detection, other automatic fire detection shall be permitted.~~

~~**A.6.16.3.7** The objective of Phase I Emergency Recall Operation is to have the elevator automatically return to the recall level before fire can effect the safe operation of the elevator. This includes both the safe mechanical operation of the elevator as well as the delivery of passengers to a safe lobby location. Where ASME A17.1, Safety Code for Elevators and Escalators, specifies the use of smoke detectors, these devices are expected to provide the earliest response to situations that would require Phase I Emergency Recall Operations. The use of other automatic fire detection is only intended where smoke detection would not be appropriate due to the environment. Where ambient conditions prohibit the installation of smoke detectors, the selection and location of other automatic fire detection should be evaluated to ensure the best response is achieved. When heat detectors are used, consideration should be given to both detector temperature and time lag characteristics. The consideration of a low temperature rating alone might not provide the earliest response.~~

~~6.16.3.8 When actuated, any detector that has initiated firefighters' recall shall also be annunciated at the building fire alarm control unit, or other fire alarm control unit as described in 6.16.3.2, and required remote annunciators.~~

~~6.16.3.9 Actuation from elevator hoistway and elevator machine room smoke detectors or other automatic fire detection as permitted by 6.16.3.7 shall cause separate and distinct visible annunciation at the building fire alarm control unit or the fire alarm control unit described in 6.16.3.2 and required annunciators to alert fire fighters and other emergency personnel that the elevators are no longer safe to use.~~

~~6.16.3.10 Where approved by the authority having jurisdiction, the detectors used to initiate elevator recall shall be permitted to initiate a supervisory signal in lieu of an alarm signal.~~

~~6.16.3.11 Where lobby detectors are used for other than initiating elevator recall, the signal initiated by the detector shall also initiate an alarm signal.~~

NFPA 72-2010 National Fire Alarm and Signaling Code

~~6.16.3.12*~~ Separate outputs from the fire alarm systems to the elevator controller(s) shall be provided to implement elevator Phase I Emergency Recall Operation in accordance with Section 2.27 of ASME A17.1, *Safety Code for Elevators and Escalators*, as required in ~~6.16.3.12.1 through 6.16.3.12.3.~~

~~A.6.16.3.12~~ It is recommended that the installation be in accordance with Figure A.6.16.3.12(a) and Figure A.6.16.3.12(b). Figure A.6.16.3.12(a) should be used where the elevator is installed at the same time as the building fire alarm system. Figure A.6.16.3.12(b) should be used where the elevator is installed after the building fire alarm system.

~~FIGURE A.6.16.3.12(a) Elevator Zone — Elevator and Fire Alarm System Installed at Same Time.~~

~~FIGURE A.6.16.3.12(b) Elevator Zone — Elevator Installed After Fire Alarm System.~~

~~6.16.3.12.1 Designated Level Recall.~~ For each elevator or group of elevators, an output shall be provided to signal elevator recall to the designated level in response to the following:

- ~~(1) Activation of smoke detectors, or other automatic fire detection as permitted by 6.16.3.7, located at any elevator lobby served by the elevator(s) other than the lobby at the designated level~~
- ~~(2) Activation of smoke detectors, or other automatic fire detection as permitted by 6.16.3.7, located at any elevator machine room serving the elevator(s) except where the machine room is located at the designated level~~
- ~~(3) Activation of smoke detectors, or other automatic fire detection as permitted by 6.16.3.7, located in the elevator hoistway serving the elevator when sprinklers are located in the hoistway unless otherwise specified in 6.16.3.12.2(3)~~

~~6.16.3.12.2 Alternate Level Recall.~~ For each elevator or group of elevators, an output shall be provided to signal elevator recall to the alternate level in response to the following:

- ~~(1) Activation of smoke detectors, or the automatic fire detection as permitted by 6.16.3.7, located at the designated level lobby served by the elevator(s)~~
- ~~(2) Activation of smoke detectors, or other automatic fire detection as permitted by 6.16.3.7, located in the elevator machine room serving the elevator(s) if the machine room is located at the designated level~~
- ~~(3) *Activation of the initiating devices identified in 6.16.3.12.1(3) if they are installed at or below the lowest level of recall in the elevator hoistway and the alternate level is located above the designated level~~

~~A.6.16.3.12.2(3)~~ Where initiating devices are located in the elevator hoistway at or below the lowest level of recall, ASME A17.1, *Safety Code for Elevators and Escalators*, requires that the elevator be sent to the upper recall level. Note that the lowest level of recall could be the “designated level” or “alternate level” as determined by the local authority for the particular installation. Also note that the elevator hoistway, as defined in ASME A.17.1, includes the elevator pit.

Where heat detectors are installed in elevator pits to recall elevators, they should be, whenever practicable, installed in accordance with Chapter 5. In situations that preclude

NFPA 72-2010 National Fire Alarm and Signaling Code

installation of heat detectors in accordance with Chapter 5, detectors should be installed using best judgment so that the detector will stand the best chance of earliest detection of fire and also be readily available for testing and servicing.

6.16.3.12.3* Visual Warning. For each elevator or group of elevators, an output(s) shall be provided for the elevator visual warning signal in response to the following:

- (1) Activation of the elevator machine room initiating devices identified in 6.16.3.12.1(2) or 6.16.3.12.2(2)
- (2) Activation of the elevator hoistway initiating devices identified in 6.16.3.12.1(3) or 6.16.3.12.2(3)

A.6.16.3.12.3 ASME A17.1, *Safety Code for Elevators and Escalators*, requires differentiation between separate hoistways that share a common elevator machine room. For instance, in a situation where there is more than one single hoistway sharing the same elevator machine room, a separate signal must be derived from each hoistway

6.16.4 Elevator Shutdown.

6.16.4.1* Where heat detectors are used to shut down elevator power prior to sprinkler operation, the detector shall have both a lower temperature rating and a higher sensitivity as compared to the sprinkler.

A.6.16.4.1 When determining desired performance, consideration should be given to the temperature and time lag characteristics of both the sprinkler head and the heat detector to ensure as much as possible that the heat detector will operate prior to the sprinkler head, because a lower temperature rating alone might not provide earlier response. The listed spacing rating of the heat detector should be 7.6 m (25 ft) or greater.

6.16.4.2 If heat detectors are used to shut down elevator power prior to sprinkler operation, they shall be placed within 610 mm (2 ft) of each sprinkler head and be installed in accordance with the requirements of Chapter 5. Alternatively, engineering methods, such as specified in Annex B, shall be permitted to be used to select and place heat detectors to ensure response prior to any sprinkler head operation under a variety of fire growth rate scenarios.

6.16.4.3* If pressure or waterflow switches are used to shut down elevator power immediately upon or prior to the discharge of water from sprinklers, the use of devices with time-delay switches or time-delay capability shall not be permitted.

A.6.16.4.3 Care should be taken to ensure that elevator power cannot be interrupted due to water pressure surges in the sprinkler system. The intent of the Code is to ensure that the switch and the system as a whole do not have the capability of introducing a time delay into the sequence. The use of a switch with a time delay mechanism set to zero does not meet the intent of the Code, because it is possible to introduce a time delay after the system has been accepted. This might occur in response to unwanted alarms caused by surges or water movement, rather than addressing the underlying cause of the surges or water movement (often due to air in the piping). Permanently disabling the delay in accordance with the manufacturer's printed instructions should be considered acceptable. Systems that have software that can introduce a delay in the sequence should be programmed to require a security password to make such a change.

NFPA 72-2010 National Fire Alarm and Signaling Code

~~6.16.4.4*~~ Control circuits to shut down elevator power shall be monitored for presence of operating voltage. Loss of voltage to the control circuit for the disconnecting means shall cause a supervisory signal to be indicated at the control unit and required remote annunciators.

~~A.6.16.4.4~~ Upon activation of the heat detector used for elevator power shutdown, there should be a delay in the activation of the power shunt trip. This delay should be the time that it takes the elevator cab to travel from the top of the hoistway to the lowest recall level. Figure A.6.16.4.4 illustrates one method of monitoring elevator shunt trip control power for integrity.

~~FIGURE A.6.16.4.4 Typical Method of Providing Elevator Power Shunt Trip Supervisory Signal.~~

~~6.16.4.5~~ The initiating devices described in 6.16.4.2 and 6.16.4.3 shall be monitored for integrity by the fire alarm control unit required in 6.16.3.1 and 6.16.3.2.

23.17.2 HVAC Systems. HVAC systems shall meet the requirements of Section 21.7.

~~6.16.5 HVAC Systems.~~

~~6.16.5.1~~ The provisions of 6.16.5 shall apply to the basic method by which a fire alarm system interfaces with the HVAC systems.

~~6.16.5.2*~~ If connected to the fire alarm system serving the protected premises, all detection devices used to cause the operation of HVAC systems smoke dampers, fire dampers, fan control, smoke doors, and fire doors shall be monitored for integrity in accordance with 4.4.7.

~~A.6.16.5.2~~ See A.6.16.5.3.

~~6.16.5.3*~~ Connections between fire alarm systems and the HVAC system for the purpose of monitoring and control shall operate and be monitored in accordance with applicable NFPA standards. Smoke detectors mounted in the air ducts of HVAC systems shall initiate either an alarm signal at the protected premises or a supervisory signal at a constantly attended location or supervising station.

~~A.6.16.5.3~~ This standard does not specifically require detection devices used to cause the operation of HVAC system smoke dampers, fire dampers, fan control, smoke doors, and fire doors to be connected to the fire alarm system. Connection to the fire alarm system would be determined by the requirements established by the authority having jurisdiction. See A.1.2.4.

~~6.16.5.4~~ If the fire alarm control unit actuates the HVAC system for the purpose of smoke control, the automatic alarm-initiating zones shall be coordinated with the smoke control zones they actuate.

~~6.16.5.5~~ Where interconnected as a combination system, a Firefighter's Smoke Control Station (FSCS) shall be provided to perform manual control over the automatic operation of the system's smoke control strategy.

~~6.16.5.6~~ Where interconnected as a combination system, the smoke control system programming shall be designed such that normal HVAC operation or changes do not prevent the intended performance of the smoke control strategy.

NFPA 72-2010 National Fire Alarm and Signaling Code

23.17.3 Door Release Service. Door release service shall meet the requirements of Section 21.8.

6.16.6 Door Release Service.

~~6.16.6.1~~ The provisions of 6.16.6 shall apply to the methods of connection of door hold-open release devices and to integral door hold-open release, closer, and smoke detection devices.

~~6.16.6.2~~ All detection devices used for door hold-open release service shall be monitored for integrity in accordance with 4.4.7.

Exception: Smoke detectors used only for door release and not for open area protection.

~~6.16.6.3~~ All door hold-open release and integral door release and closure devices used for release service shall be monitored for integrity in accordance with 6.16.2.

~~6.16.6.4~~ Magnetic door holders that allow doors to close upon loss of operating power shall not be required to have a secondary power source.

23.17.4 Electrically Locked Doors. Door-unlocking devices shall meet the requirements of Section 21.9.

6.16.7 Door Unlocking Devices.

~~6.16.7.1~~ Any device or system intended to actuate the locking or unlocking of exits shall be connected to the fire alarm system serving the protected premises.

~~6.16.7.2~~ All exits connected in accordance with 6.16.7.1 shall unlock upon receipt of any fire alarm signal by means of the fire alarm system serving the protected premises.

Exception: Where otherwise required or permitted by the authority having jurisdiction or other codes.

~~6.16.7.3*~~ For all exits connected in accordance with 6.16.7.1 and where batteries are used in accordance with 4.4.1.5.1(1) as the secondary power supply, the batteries shall not be utilized to maintain these doors in the locked condition unless the fire alarm control unit is arranged with circuitry and sufficient secondary power to ensure the exits will unlock within 10 minutes of loss of primary power.

~~A.6.16.7.3~~ A problem could exist when batteries are used as a secondary power source if a fire alarm control unit having 24 hours of standby operating power were to lose primary power and be operated for more than 24 hours from the secondary power source (batteries). It is possible that sufficient voltage would be available to keep the doors locked but not enough voltage would be available to operate the fire alarm control unit to release the locks.

~~6.16.7.4~~ Locks powered by independent power supplies dedicated to lock power and access control functions and which unlock upon loss of power shall not be required to comply with 6.16.7.3.

~~6.16.7.5~~ If exit doors are unlocked by the fire alarm system, the unlocking function shall occur prior to or concurrent with activation of any public-mode notification appliances in the area(s) served by the normally locked exits.

NFPA 72-2010 National Fire Alarm and Signaling Code

~~6.16.7.6~~ All doors that are required to be unlocked by the fire alarm system in accordance with 6.16.7.1 through 6.16.7.5 shall remain unlocked until the fire alarm condition is manually reset.

23.17.5 Exit Marking Audible Notification Systems. ~~Where required~~ Exit marking audible notification systems shall ~~be activated by the building fire alarm system~~ meet the requirements of Section 21.10.

A.6.16.8 When a fire alarm evacuation signal activates, the exit marking system will be activated. In some cases, the activation may be sequenced to meet the fire safety plan of the property.

~~6.16.8.2~~ Exit marking systems shall meet the requirements of Chapter 7.

23.18.4.2 The occurrence of any single fault that disables transmission between any low-power radio transmitter and the receiver/fire alarm control unit shall cause a latching trouble signal within 200 seconds.

Exception: ~~Where Federal Communications Commission (FCC) regulations prevent meeting the 200-second requirement~~ Until the expiration date for this exception of June 30, 2013, the time period for a low-power radio transmitter with only a single, connected alarm-initiating device shall be permitted to be increased to four times the minimum time interval permitted for a 1-second transmission up to the following:

- (1) 4 hours maximum for a transmitter serving a single initiating device
- (2) 4 hours maximum for a retransmission device (repeater), where disabling of the repeater or its transmission does not prevent the receipt of signals at the receiver/fire alarm control unit from any initiating device transmitter.

23.18.4.5 Removal of a low-power radio transmitter from its installed location shall cause immediate transmission of a distinctive supervisory signal that indicates its removal and individually identifies the affected device.

Exception: ~~This requirement shall not apply to dwelling unit fire warning systems.~~

23.18.5 Output Signals from Receiver/Control. When the receiver/control is used to actuate remote appliances, such as notification appliances and relays, by wireless means, the remote appliances shall meet the following requirements:

- (1) Power supplies shall comply with Chapter 10 or the requirements of 23.18.2.
- (2) All ~~supervision~~ monitoring for integrity requirements of Chapter 10, Chapter 23, or 23.18.4 shall apply.
- (3) The maximum allowable response delay from activation of an initiating device to activation of required alarm functions shall be 10 seconds.
- (4) Each receiver/control shall automatically repeat alarm transmission at intervals not exceeding 60 seconds or until confirmation that the output appliance has received the alarm signal.
- (5) The appliances shall continue to operate (latch-in) until manually reset at the receiver/control.

~~6.18 Mass Notification Systems.~~

See Annex E.

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 24, Emergency Communication Systems (ECS)

24.1 Application.

24.1.1 ~~E.1.1~~ Scope. ~~Annex E covers~~ The application, installation, location and performance and maintenance of mass-notification emergency communications systems (MNSs) and their components shall comply with the requirements of this chapter.

24.1.2* The requirements of this chapter shall apply to emergency communications systems within buildings and outdoor areas.

A.24.1.2 An emergency communications system could target the general building, area, space, campus, or region.

24.1.3 The requirements of Chapters 10, 12, 17, 18, 21, 23, 26 and 27 shall also apply, unless they are in conflict with this chapter.

24.1.4 The requirements of Chapter 14 shall apply.

24.1.5 The requirements of this chapter shall not apply to Chapter 29 unless specifically indicated.

24.2 Purpose.

24.2.1 ~~E.1.2~~ Purpose. ~~The systems covered under Annex E Chapter 24 are for the protection of life by indicating the existence of an emergency situation and instructing the occupants of the necessary and~~ communicating information necessary to facilitate an appropriate response and action.

24.2.2 This chapter establishes minimum required levels of performance, reliability, and quality of installation for emergency communications systems but does not establish the only methods by which these requirements are to be achieved.

24.2.3 An emergency communications system is intended to communicate information about emergencies including, but not limited to, fire, human-caused events (accidental and intentional), other dangerous situations, accidents, and natural disasters.

24.3 General.

24.3.1* Intelligible Voice Messages. ~~Where required, voice~~ Emergency communications systems shall be capable of the reproduction of prerecorded, synthesized, or live (e.g., microphone, telephone handset, and radio) messages with voice intelligibility in accordance with Chapter 18.

A.24.3.1 In certain situations, it is important to provide a distributed sound level with minimal sound intensity variations to achieve an intelligible voice message. This differs from past fire alarm design practice that used fewer notification appliances, but with each having greater sound pressure output levels. Non-emergency system design practice is to use more speakers and less sound intensity from each speaker.

Besides improving intelligibility of the message, this approach minimizes annoyance to building occupants from the system and lessens the likelihood of tampering with the system by occupants because of speakers being too loud. In other applications, such as outdoor signaling where reverberation is not a problem, intelligibility can be achieved by using fewer appliances or clusters of appliances covering larger areas.

NFPA 72-2010 National Fire Alarm and Signaling Code

Intelligibility is a complex function of the source audio, the acoustic response of the architectural features and materials of the immediate vicinity, and the dynamics created by the room's occupants. Refer to Annex D for more information on speech intelligibility and how it is predicted. Spacing speakers closely can be an intelligibility-enhancing technique but can occasionally lead to opposite results when improperly designed.

There are several techniques using directionality features that do not use closely spaced speakers but rather use the room/space acoustic response in their favor.

When actuated, recorded or live mass notification voice messages should take priority over fire alarm messages and signals. If the fire alarm system is in the alarm mode when recorded voice message or audible signals are sounding, and the mass notification system is actuated, it should temporarily cause deactivation of all fire alarm-initiated audible and visible notification appliances during the time period required to transmit the mass notification emergency message.

~~A.7.4.1.4 Voice intelligibility should be measured in accordance with the guidelines in Annex A of IEC 60849, Sound Systems for Emergency Purposes. When tested in accordance with Annex B, Clause B1, of IEC 60849, the system should exceed the equivalent of a common intelligibility scale (CIS) score of 0.70. Intelligibility is achieved when the quantity \bar{I}_{av} , as specified in B3 of IEC 60849, exceeds this value. \bar{I}_{av} is the arithmetical average of the measured intelligibility values on the CIS, and σ is the standard deviation of the results.~~

~~Objective means of determining intelligibility are found in Part 16 of IEC 60268, The Objective Rating of Speech Intelligibility by Speech Transmission Index. Subject-based techniques for measuring intelligibility are defined by ANSI S3.2, Method for Measuring the Intelligibility of Speech Over Communications Systems. ANSI S3.2 should be considered an acceptable alternative to ISO TR 4870, where referenced in IEC 60268, Part 16.~~

~~The designer of an intelligible voice/alarm system should possess skills sufficient to properly design a voice/alarm system for the occupancy to be protected. System designs for many smaller occupancies can be accomplished satisfactorily, if not optimally, on the basis of experience with the performance of other systems in similar spaces. For existing construction, relatively simple acoustic measurements combined with knowledge of the chosen loudspeaker's performance characteristics can frequently result in satisfactory performance using mathematical formulas developed for the purpose.~~

~~For occupancies that do not yet exist, the designer should have an understanding of the acoustic characteristics of the architectural design, as well as the acoustic performance properties of available loudspeakers. Architecturally, this includes the physical size and shape of the space, as well as the acoustic properties of the walls, floors, ceilings, and interior furnishings. A proper design analysis can sometimes reveal that an intelligible system is not achievable unless some features of the architectural design are changed. The designer should be prepared to defend such conclusions and, if necessary, refuse to certify the installation of such a system. While "hand calculations" and experience work well for simpler installations, more complex designs are frequently better and more cost-effectively analyzed using one of a number of readily available computer-based design programs.~~

~~The designer and the authority having jurisdiction should both be aware that the acoustic performance parameters of the chosen loudspeakers, as well as their placement in the structure, play a major role in determining how many devices are necessary for~~

NFPA 72-2010 National Fire Alarm and Signaling Code

adequate intelligibility. The numerical count of devices for a given design and protected space cannot, by itself, be used to determine the adequacy of the design. Sometimes, the acoustic problems of certain placement constraints can be satisfactorily overcome through the careful selection of loudspeakers with the requisite performance characteristics, rather than by increasing their number.

There might be applications where not all spaces will require intelligible voice signaling. For example, in a residential occupancy such as an apartment, the authority having jurisdiction and the designer might agree to a system that achieves the required audibility throughout but does not result in intelligible voice signaling in the bedrooms. The system would be sufficient to awaken and alert. However, intelligibility might not be achieved in the bedrooms with the doors closed and the sounder in the adjacent hallway or room. In some cases this can require that messages repeat a sufficient number of times to ensure that occupants can reach a location where the system is sufficiently intelligible to be understood. Systems that use tone signaling in some areas and voice signaling in other areas would not require voice intelligibility in those areas only covered by the tone.

24.3.2* Required Emergency Communications Systems. An emergency communications system shall be installed in occupancies where required by the authority having jurisdiction or by other applicable governing laws, codes, or standards.

A.24.3.2 The requirements found in *NFPA 70, National Electrical Code, Article 708*, should be considered for emergency communications systems that are installed in vital infrastructure facilities classified as a designated critical operations area (DCOA). This includes facilities that, if destroyed or incapacitated, would disrupt national security, the economy, public health or safety and where enhanced electrical infrastructure for continuity of operation has been deemed necessary by governmental authority.

24.3.3* Nonrequired (Voluntary) Emergency Communications Systems.

A.24.3.3 The features for a nonrequired system should be established by the system designer on the basis of the goals and objectives intended by the system owner.

24.3.3.1 Nonrequired emergency communications systems and components shall meet the requirements of this chapter.

24.3.3.2 Nonrequired emergency communications systems and components shall be identified on the record drawings required in 10.18.2.3(2).

24.3.4 Ancillary Functions.

24.3.4.1 E.3.2 Supplementary Ancillary functions, including the use of the MNS a fire alarm system or mass notification system for general paging, background music, or other non-emergency functions are permitted and must shall not interfere with the performance requirements of the fire alarm systems or the mass notification system.

24.3.4.2* Fire alarm system speakers used as alarm notification appliances on fire alarm systems shall also be permitted to be used for non-emergency purposes provided that condition (1) or (2) is met providing ancillary functions shall meet the conditions of either 24.3.4.2(1) or (2):

- (1) The fire command center is shall be constantly attended by trained personnel, and selective paging is permitted by the authority having jurisdiction.
- (2) All of the following conditions are shall be met:

NFPA 72-2010 National Fire Alarm and Signaling Code

- (a) The speakers and associated audio equipment are installed or located with safeguards to resist tampering or misadjustment of those components essential for intended emergency notification.
- (b) The monitoring integrity requirements of Section 10.17 shall continue to be met while the system is used for non-emergency purposes.
- (c) It is permitted by the local authority having jurisdiction.

~~A.24.3.4.2 A.6.8.4.5 If the building paging system can be controlled by personnel at the fire command center, and if permitted by the authority having jurisdiction, the building paging system can be used as a supplementary notification system to provide selective and all-call fire alarm evacuation voice messages and messages for occupants to relocate to safe areas in a building.~~

Dedicated in-building fire alarm emergency alarm/voice voice/alarm evacuation alarm communications systems are not required to monitor the integrity of the speaker notification appliance circuits while active for emergency purposes. However, these circuits have to be monitored for integrity while active for non-emergency purposes.

The building operator, system designer, and authority having jurisdiction should be aware that, in some situations, such a system could be subject to deliberate tampering. Tampering is usually attempted to reduce the output of a sound system that is in constant use, such as background music or a paging system, and that could be a source of annoyance to employees.

The likelihood of tampering can be reduced through proper consideration of loudspeaker accessibility and system operation.

~~These circuits must be monitored for integrity while active for nonemergency purposes. The building operator, system designer, and authority having jurisdiction should be aware that in some situations such a system could be subject to deliberate tampering. Tampering is usually attempted to reduce the output of a sound system that is in constant use as a music or paging system and is a source of annoyance to employees. The likelihood of tampering can be reduced through proper consideration of loudspeaker accessibility and system operation.~~

Access can be reduced through the use of hidden or nonadjustable transformer taps (which can reduce playback levels), use of vandal-resistant listed loudspeakers, and placement in areas that are difficult to access, such as high ceilings (any ceiling higher than could be reached by standing on a desk or chair). Non-emergency operation of the system should always consider that an audio system that annoys an employee potentially reduces employee productivity and can also annoy the public in a commercial environment. Most motivations for tampering can be eliminated through appropriate use of the system and employee discipline. Access to amplification equipment and controls should be limited to those authorized to make adjustments to such equipment. It is common practice to install such equipment in a manner that allows adjustment of non-emergency audio signal levels while defaulting to a fixed, preset level of playback when operating in emergency mode. Under extreme circumstances, certain zones of a protected area might require a dedicated in-building fire emergency voice/alarm communications zone.

24.3.4.3 Where ancillary functions are not monitored for integrity, they shall be inspected periodically in accordance with the frequency identified in Chapter 14.

24.3.5 Pathway Survivability.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.3.5.1 Pathway survivability levels shall be as described in Section 12.4.

24.3.5.2 Other component survivability shall comply with the provisions of 24.4.1.8.4.6.

24.3.5.3* The pathway survivability requirements in 24.3.5.4 through 24.3.5.12 shall apply to notification and communications circuits and other circuits necessary to ensure the continued operation of the emergency communications system.

A.24.3.5.3 This section is not meant to preclude a performance based pathway survivability approach. As with most performance based approaches, documentation should be provided by the designer and maintained with system documentation for the life of the system. Written documentation of the approval from the authority having jurisdiction should also be maintained.

A performance-based approach to pathway survivability could be equivalent to, less stringent than, or more stringent than the prescriptive approach in 24.3.5. Often a performance based approach will result from a risk analysis.

This section is also not meant to preclude less stringent pathway survivability requirements supported by a risk analysis for those unique occupancies that employ voice alarm/emergency communication systems for relocation or partial evacuation as part of their fire safety plan where relocation or partial evacuation could be readily superseded by total evacuation and where buildings are of a type other than Type I or Type II (222) construction where the pathway survivability performance requirement does not need to be for two hours. Examples include low rise education and day care occupancies, nursing homes, ambulatory health care occupancies, hotel and dormitory occupancies, and residential board and care occupancies.

24.3.5.4 In-building fire emergency voice/alarm communications systems shall comply with 24.3.5.4.1 or 24.3.5.4.2.

24.3.5.4.1 For systems employing relocation or partial evacuation, a Level 2 or Level 3 pathway survivability shall be required.

24.3.5.4.2 For systems that do not employ relocation or partial evacuation, a Level 0, Level 1, Level 2, or Level 3 pathway survivability shall be required.

24.3.5.4.3 Refer to Annex G for previous nomenclature and cross reference.

24.3.5.5 In-building mass notification systems shall be permitted to have a Level 0 pathway survivability or greater if determined by a risk analysis.

24.3.5.6 All circuits for wide-area mass notification systems shall be permitted to have a pathway survivability of Level 0 or greater if determined by a risk analysis.

24.3.5.7 Two-way in-building wired emergency communications systems shall have a pathway survivability of Level 2 or Level 3.

24.3.5.8 Two-way radio communications enhancement systems shall comply with 24.3.5.8.1 and 24.3.5.8.2.

24.3.5.8.1 Where a two-way radio communications enhancement system, exclusive of the antennae, is used in lieu of a two-way in-building wired emergency communications system, it shall have a pathway survivability of Level 2 or Level 3.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.3.5.8.2 Where a two-way radio communications enhancement system is used in lieu of a two-way in-building wired emergency communications system, the design of the system shall be approved by the authority having jurisdiction.

24.3.5.9* Area of refuge (area of rescue assistance) emergency communications systems shall comply with 24.3.5.9.1 and 24.3.5.9.2.

A.24.3.5.9 Although in some instances areas of refuge (areas of rescue assistance) might be installed in buildings that use general evacuation and not relocation/partial evacuation, it is still crucial that people awaiting assistance can communicate with emergency responders to facilitate their evacuation.

Thus, their evacuation time might be prolonged, and therefore the emergency communications systems should be capable of operating reliably during a fire incident.

24.3.5.9.1 Area of refuge emergency communications systems shall have a pathway survivability of Level 2 or Level 3.

24.3.5.9.2 Circuits intended to transmit off-premises shall have a pathway survivability of Level 0, Level 1, Level 2, or Level 3.

24.3.5.10 Elevator emergency communications systems shall have a pathway survivability of Level 0, Level 1, Level 2, or Level 3.

24.3.5.11 Central command station emergency communications systems shall have pathway survivability as determined by the risk analysis.

24.3.5.12 All other emergency communications system circuits shall have pathway survivability as determined by the risk analysis.

24.3.6* System Classification. Emergency communications systems (ECS) shall consist of two classifications of systems, one-way and two-way.

A.24.3.6 One-way emergency communications systems are intended to broadcast information, in an emergency, to personnel in one or more specified indoor or outdoor areas. It is intended that emergency messages be conveyed either by audible or visible textual means or both. This section does not apply to bells, horns, or other sounders and lights, except where used in conjunction with the desired operation of emergency messages and signaling.

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 both to 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 its way.

NFPA 72 contains requirements that can impact the application of emergency communications systems. For instance, coordination of the functions of an emergency communications system with other systems that communicate audibly and/or visibly [such as fire alarm systems, security systems, and public address (PA) systems] is essential in order to provide effective communication in an emergency situation. Conflicting or competing signals or messages from different systems could be very confusing to occupants and have a negative impact on the intended occupant response.

NFPA 72-2010 National Fire Alarm and Signaling Code

Where independent systems using audible and/or visible notification are present, the emergency communications system needs to interface with those systems to effect related control actions such as deactivating both audible and visible notification appliances.

The use of a single integrated combination system might offer both economic and technical advantages. In any case, coordination between system functions is essential. The coordination of emergency communications systems with other systems should be considered part of the risk analysis for the emergency communications system. (See Figure A.24.3.6.) Additional documents such as NEMA Standard SB 40, Communications Systems for Life Safety in Schools, can also be used as supplemental resources to provide help with risk assessment and application considerations.

FIGURE A.24.3.6 Emergency Communications Systems.

24.4 One-Way Emergency Communications Systems.

24.4.1* In-Building Fire Emergency Voice/Alarm Communications Systems (EVACS). Subsection 24.4.1 shall be used in the design and application of in-building fire emergency voice/alarm communications for fire alarm systems.

A.24.4.1 Where used, recorded voice messages for fire emergency alarm systems (~~where used~~) should be prepared in accordance with this Code by persons who are experienced with the operation of building fire emergency alarm systems and are knowledgeable of the building's construction, layout, and fire protection plan, including evacuation procedures. The proposed voice messages should be approved by the authority having jurisdiction prior to being implemented. Persons who record the messages for fire emergency alarm systems should be able to read and speak the language used for the message clearly, concisely, and without an accent that would have an adverse affect on intelligibility.

It is not the intention that in-building fire emergency voice/ alarm communications service be limited to English-speaking populations. Emergency messages should be provided in the language of the predominant building population. If there is a possibility of isolated groups that do not speak the predominant language, multilingual messages should be provided. It is expected that small groups of transients unfamiliar with the predominant language will be picked up in the traffic flow in the event of an emergency and are not likely to be in an isolated situation.

24.4.1.1 Automatic Response. The in-building fire emergency voice/alarm communications system shall be used to provide an automatic response to the receipt of a signal indicative of a fire alarm or other emergency.

24.4.1.1.1 When ~~When~~ If the monitoring location is constantly attended by trained operators, and operator acknowledgment of receipt of a fire alarm or other emergency signal is received within 30 seconds, automatic response shall not be required.

24.4.1.2 Voice Evacuation Messages.

24.4.1.2.2 Voice messages shall comply with the requirements of 24.3.1.

24.4.1.2.2.1 The following requirements shall be met for layout and design:

- (1) The speaker layout of the system shall be designed to ensure intelligibility and audibility.

NFPA 72-2010 National Fire Alarm and Signaling Code

- (2) Intelligibility shall first be determined by ensuring that all areas in the building have the required level of audibility.
- (3) The design shall incorporate speaker placement to provide intelligibility.

24.4.1.2.2* System design shall incorporate designation of acoustically distinguishable spaces (ADS) within the occupied areas as required in Chapter 18.

A.24.4.1.2.2.2 Generally speaking, in a standard building configuration with normal ceiling height [8 ft to 12 ft (2.4 m to 3.7 m)], normal ceiling construction (e.g., drop acoustical ceiling tiles), standard wall configurations, and finishes and carpeted floors, ceiling-mounted speakers should be installed in all normally occupiable spaces and in corridors spaced at a maximum of twice the ceiling height or as determined by a commercially available computer acoustical/speaker modeling program. Where wall-mounted speakers are used, manufacturer recommendations should be reviewed and/or computer modeling should be employed. One of the goals of speaker placement is to provide the shortest practical distance from the source (speaker) to the recipient (person hearing the signal). In many applications, a combination of wall- and ceiling-mounted speakers might be required. The audibility and intelligibility of the speakers can be impacted by the tap/setting at which the speaker is connected and should meet the audibility requirements of the Code while still having the message intelligible. Connecting to a high setting to meet the audibility requirements of the code could distort the intelligibility of the signal.

In an ADS that is a non-acoustically challenging area, designing for audibility will typically result in an intelligible system provided minimum speaker guidelines are followed. Areas typically considered to be non-acoustically challenging include traditional office environments, hotel guest rooms, dwelling units, and spaces with carpeting and furnishings.

Special attention must be given to acoustically challenging ADSs. Such areas might incorporate appreciable hard surfaces (e.g., glass, marble, tile, metal, etc) or appreciably high ceilings (e.g., atriums, multiple ceiling heights). These conditions will require more stringent design guidelines to ensure intelligibility (e.g., a closer than normal speaker spacing with lower taps). This can help reduce the effect of excessive reverberation and result in better intelligibility. In extreme cases there could be areas where intelligibility is not attainable, but this can be acceptable if there is an ADS within 30 ft (9.1 m) where the intelligibility of the system is deemed adequate.

In an ADS where the ambient noise level exceeds 85 dB it is acknowledged that intelligibility might not be attainable and an alternate means of notification is required.

Design guidance is provided in the NEMA Standards Publication SB 50-2008, *Emergency Communications Audio Intelligibility Applications Guide*.

24.4.1.2.2.3 Audibility shall be required in all areas in accordance with Chapter 18.

24.4.1.2.2.4 Unless specifically required by the authority having jurisdiction, intelligibility shall not be required in the following locations:

- (1) Private bathrooms, shower rooms, saunas and similar rooms/areas
- (2) Mechanical/electrical/elevator equipment rooms
- (3) Elevator cars
- (4) Individual offices
- (5) Kitchens

NFPA 72-2010 National Fire Alarm and Signaling Code

- (6) Storage rooms
- (7) Closets
- (8) Rooms/areas where intelligibility cannot reasonably be predicted

24.4.1.3 Positive Alarm Sequence. In-building fire emergency voice/alarm communications systems shall be permitted to use positive alarm sequence complying with 23.8.1.3 if approved by the authority having jurisdiction.

24.4.1.4.1 In occupancies where sleeping accommodations are provided, the pre-alert tone shall 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.

24.4.1.5 Controls.

24.4.1.5.1* Controls for the in-building fire emergency voice/alarm communications system shall be at a location approved by the authority having jurisdiction.

A.24.4.1.5.1 The choice of the location(s) for the in-building fire emergency voice/alarm communications control equipment should also take into consideration the ability of the fire alarm system to operate and function during any probable single event.

Although NFPA 72 does not regulate either building construction or contents, system designers should consider the potential for ~~fire in proximity to fire alarm control equipment~~ an event that could damage the equipment, including remotely located control devices, to disable the system or a portion thereof. Where practical, it is prudent to minimize unnecessary fire exposures of fire alarm control equipment through the use of fire-rated construction or enclosures, by limiting adjacent combustibles and ignition sources, or other appropriate means.

24.4.1.5.4 If there are multiple in-building fire emergency voice/alarm communications control locations, only one shall be in control at any given time.

24.4.1.5.7 If live voice instructions are provided, they shall perform as follows:

- (1) Override previously initiated signals to the selected notification zone(s).
- (2) Have priority over any subsequent automatically initiated signals to the selected zone(s).

24.4.1.6 Speakers.

24.4.1.6.1* Speakers and their enclosures shall be installed in accordance with Chapter 18.

A.24.4.1.6.1 Speakers located in the vicinity of the in-building fire emergency voice/alarm communications control equipment should be arranged so they do not cause audio feedback when the system microphone is used. Speakers installed in the area of two-way telephone stations should be arranged so that the sound pressure level emitted does not preclude the effective use of the two-way telephone system. Circuits for speakers and telephones should be separated, shielded, or otherwise arranged to prevent audio cross-talk between circuits.

24.4.1.6.2 Speakers used as alarm notification appliances on fire alarm systems shall also be permitted to be used for mass notification.

24.4.1.7 Priority.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.1.7.1* Notification appliances required to provide special suppression pre-discharge notification shall not be overridden by other systems.

A.24.4.1.7.1 Special suppression systems that are delivered through a total flooding or localized application include, but are not limited to, carbon dioxide, clean agents, halons, and other extinguishing agents. Special suppression systems require audible and visible warning alarms to provide personnel the opportunity to evacuate or to alert personnel not to enter the area of discharge that could be hazardous to life. A special suppression system discharge can be a life-threatening hazard for personnel who are not notified and, therefore, fail to react to the pre-discharge alarm. In such cases, pre-discharge and discharge alarms should be independent of the fire alarm speakers that are used as part of the mass notification system. A special suppression system discharge could pose a greater threat to personnel that are located in the protected area, or that could enter the protected area, if the local signals were to be overridden and they did not receive the appropriate warning.

24.4.1.7.2 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.

24.4.1.7.3 It shall not be required to transmit this condition to a supervising station.

24.4.1.7.4 The fire alarm system shall not automatically override emergency mass notification messages. Priority of mass notification messages over fire alarm evacuation shall be permitted when evaluated by the stakeholders through a risk analysis in accordance with 24.4.2.2.

24.4.1.8* Relocation and Partial Evacuation. The requirements of 24.4.1.8 shall apply only to systems used for relocation or partial evacuation during a fire condition.

A.24.4.1.8 When a fire or other emergency occurs in a building, the usual goal is to evacuate the occupants or relocate them so that they are not exposed to hazardous conditions. The exception occurs in occupancies using stay-in-place/defend-in-place (SIP/DIP) [1] strategies. It might also be necessary to alert and provide information to trained staff responsible for assisting evacuation or relocation. Figure A.24.4.1.8 shows several key steps in a person's reaction and decision-making process [2].

Occupants rarely panic in fire situations [3, 4]. The behavior that they adopt is based on the information they have, the perceived threat, and the decisions they make. The entire decision path is full of thought and decisions on the part of the occupant, all of which take time before leading to the development of adaptive behavior. In hindsight, the actions of many occupants in real fires are sometimes less than optimal. However, their decisions might have been the best choices given the information they had.

Fire alarm systems that only use audible tones and/or flashing strobe lights impart only one bit of information: fire alarm. It has long been recognized that environments having complex egress situations or high hazard potentials require occupant notification systems that provide more than one bit of information [5]. To reduce the response time of the occupants and to affect the desired behavior, the message should contain several key elements [3, 6]. ~~These include~~ The key elements include the following:

- (1) Tell ~~them~~ occupants what has happened and where.
- (2) Tell ~~them~~ occupants what they should do.
- (3) Tell ~~them~~ occupants why they should do it.

NFPA 72-2010 National Fire Alarm and Signaling Code

There does not seem to be any research that has tested actual message content to determine the best way to inform occupants. The problem is that each building and each fire is unique. Messaging is further complicated by the need to give different information to different people, depending on their location relative to the fire, their training, and their physical/mental capabilities.

Messages should use positive language and avoid negative instructions that could be misinterpreted due to unintelligible communications. For example, if you want people to leave an area, say so: "A fire has been reported in the area. For your safety, use the stairs to evacuate the area immediately." A bad example is: "The signal tone you have just heard indicated a report of an emergency. If your floor evacuation signal sounds after this message, do not use the elevator, walk to the nearest stairway and leave the floor. While the report is being verified, occupants on other floors should await further instructions." This message is too long, ambiguous, and subject to misunderstanding if not heard clearly. The word "not" ~~may~~ might not be heard clearly, or it might be heard to apply to ~~all~~ of the entire remaining sentence. Similarly, care should be used in selecting and clearly enunciating words such as "fifth" and "sixth," which can sound the same if the system and environment lead to low intelligibility. See A.24.4.2.17 for more information on methodology for improved message content, structure, and intelligibility. Refer to Annex D for more information on speech intelligibility and how it is predicted. Content of the message should be predicated on the building fire safety plan, the nature of the building and its occupants, the design of the fire alarm system, and testing of the occupant reaction to the message. Caution is advised that the fire alarm system operation and message actuation might be initiated by a manual pull station or detector remote from the fire.

[1] Schifiliti, R. P., "To Leave or Not to Leave—That is the Question!", National Fire Protection Association, World Fire Safety Congress & Exposition, May 16, 2000, Denver, CO.

[2] Ramachandran, G., "Informative Fire Warning Systems," *Fire Technology*, vol. 47, no. 1, February 1991, National Fire Protection Association, 66–81.

[3] J., Bryan, "Psychological Variables That May Affect Fire Alarm Design," *Fire Protection Engineering*, Society of Fire Protection Engineers, Issue No. 11, Fall 2001.

[4] Proulx, G., "Cool Under Fire," *Fire Protection Engineering*, Society of Fire Protection Engineers, Issue No. 16, Fall 2002.

[5] General Services Administration, Proceedings of the Reconvened International Conference on Fire Safety in High Rise Buildings, Washington, D.C., October 1971.

[6] Proulx, G., "Strategies for Ensuring Appropriate Occupant Response to Fire Alarm Signals," National Research Council of Canada, Ottawa, Ontario, *Construction Technology Update*, No. 43, 1–6, December 2000.

24.4.1.8.2 Under a fire condition, where the system is used to transmit relocation instructions or other fire emergency nonevacuation messages, a ~~continuous alert tone of 3-second to 10-second duration~~ 1-second to 3-second alert tone followed by a message (or messages where multi-channel capability is ~~provided~~ used) shall be ~~automatic, and the sequence shall be repeated at least three times to direct occupants in the evacuation signaling zone where the alarm initiation originated and other evacuation signaling zones in accordance with the building's fire evacuation plan provided.~~

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.1.8.2.1 The sequence [the alert tone followed by the message(s)] shall be repeated at least three times to inform and direct occupants in the evacuation signaling zone where the alarm initiation originated, as well as and other evacuation signaling zones in accordance with the building's fire safety evacuation plan.

24.4.1.8.2.2 Approved alternative fire alarm notification schemes shall be permitted so long as the occupants are effectively notified and are provided instructions in a timely and safe manner in accordance with the building fire safety plan.

24.4.1.8.4.1* Fire alarm systems used for partial evacuation and relocation shall be designed and installed such that attack by fire within an evacuation signaling zone ~~shall~~ does not impair control and operation of the notification appliances outside the evacuation signaling zone.

A.24.4.1.8.4.1 Along with the pathway survivability requirements, one or more of the following means ~~might~~ could be considered acceptable to provide a level of survivability consistent with the intent of this requirement:

- ~~1. Installing a fire alarm system in a fully sprinklered building in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems~~
1. Routing notification appliance circuits separately
2. Using short-circuit, fault-tolerant signaling line circuits for controlling evacuation signals

The requirement for notification appliances to operate in those evacuation signaling zones that are not attacked by fire will also require that circuits and equipment that are common to more than one evacuation signaling zone be designed and installed such that the fire will not disable them. For instance, a signaling line circuit used to control notification appliances in multiple evacuation signaling zones should be properly designed and installed so that one fire would not impair the signaling line circuit, rendering the notification appliances serving more than one evacuation signaling zone inoperative. ~~Power supply requirements of Chapter 4 apply to these systems. The secondary power supply requirements of that chapter meet the intent of these survivability requirements.~~

24.4.1.8.4.2 Performance features provided to ensure survivability operational reliability under adverse conditions shall be described and technical justification provided in the documentation submitted to the authority having jurisdiction with the evaluation analysis required in 23.4.3.1.

24.4.1.8.4.3* All circuits necessary for the operation of the notification appliances shall be protected until they enter the evacuation signaling zone that they serve by the protection provided by the pathway survivability level required in 24.3.5.4.1 or by performance alternatives approved by the authority having jurisdiction. Any of the following methods shall be considered acceptable as meeting the requirements of this subsection:

A.24.4.1.8.4.3 Paragraph 24.4.1.8.4.3 requires the protection of circuits as they pass through fire areas other than the one served. The purpose of this is to delay possible damage to the circuits from fires in areas other than those served by the circuits and to increase the likelihood that circuits serving areas remote from the original fire will have the opportunity to be actuated and serve their purpose. Note that the protection requirement would also apply to a signaling line circuit that extends from a master fire

NFPA 72-2010 National Fire Alarm and Signaling Code

alarm control unit to another remote fire alarm control unit where notification appliance circuits might originate.

- (1) A 2-hour fire rated circuit integrity (CI) cable
- (2) A 2-hour fire rated cable system (electrical circuit protective system)
- (3) A 2-hour fire rated enclosure
- (4) *Performance alternatives approved by the authority having jurisdiction

A.6.9.10.4.2(4) Paragraph 6.9.10.4.2 requires the protection of circuits as they pass through fire areas other than the one served. The purpose of this is to delay possible damage to the circuits from fires in areas other than those served by the circuits and to increase the likelihood that circuits serving areas remote from the original fire will have the opportunity to be actuated and serve their purpose. Note that the protection requirement would also apply to a signaling line circuit that extends from a master fire alarm control unit to another remote fire alarm control unit where notification appliance circuits might originate.

- (5) Buildings fully protected by an automatic sprinkler system installed in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems, and with the interconnecting wiring or cables used for the operation of notification appliances installed in metal raceways and in accordance with Article 760 of NFPA 70

24.4.1.8.4.4 Where the separation of in-building fire emergency voice/alarm control equipment locations results in the portions of the system controlled by one location being dependent upon the control equipment in other locations, the circuits between the dependent controls shall be protected against attack by fire by the protection provided by the pathway survivability level required in 24.3.5.4.1 or by performance alternatives approved by the authority having jurisdiction. Using one of the following methods:

- (1) A 2-hour fire rated circuit integrity (CI) cable
- (2) A 2-hour fire rated cable system (electrical circuit protective system)
- (3) Routing the cable through a 2-hour rated enclosure
- (4) Performance alternatives approved by the authority having jurisdiction
- (5) Buildings fully protected by an automatic sprinkler system installed in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems, and with the interconnecting wiring or cables between the emergency voice/alarm communication control equipment locations installed in metal raceways and in accordance with Article 760 of NFPA 70

24.4.1.8.4.6 Where the separation of the in-building fire emergency voice/alarm control equipment occurs as in 24.4.1.8.4.4, and where the circuits are run through junction boxes, terminal cabinets or control equipment, such as system control units, power supplies and amplifiers, and where cable integrity is not maintained, these components shall, in addition to the pathway survivability required by 24.3.5.4.1, be protected by using one of the following methods:

- (1) A 2-hour fire rated enclosure
- (2) A 2-hour fire rated room
- (3) Other equivalent means to provide a 2-hour fire resistance rating approved by the authority having jurisdiction

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.1.8.4.7 Paragraphs 24.4.1.8 through 24.4.1.8.4.6 shall not automatically apply when relocation or partial evacuation is of a non-fire emergency unless identified and required by a risk analysis.

24.4.1.9 Evacuation Signal Zoning.

24.4.1.9.2 If multiple notification appliance circuits are provided within a single evacuation signaling zone, all of the notification appliances within the zone shall be arranged to activate or deactivate simultaneously, either automatically or by actuation of a common manual control.

~~Exception: Where the different notification appliance circuits within an evacuation signaling zone perform separate functions (for example, presignal and general alarm signals, and pre-discharge and discharge signals).~~

24.4.1.9.3 Exception: Where there are different notification appliance circuits within an evacuation signaling zone that perform separate functions, (for example such as presignal and general alarm signals, and pre-discharge and discharge signals), they shall not be required to activate or deactivate simultaneously.

24.4.2* In-Building Mass Notification Systems. The requirements of 24.4.2 shall apply to mass notification systems installed in buildings or structures for the purpose of notifying and instructing occupants in an emergency.

A.24.4.2 E.1.1 Scope. ~~Annex E~~ This section covers the application, installation, location, performance, and maintenance of mass notification systems (MNSs) ~~used for emergency purposes.~~

~~NOTE: For the purposes of this annex, a~~ An in-building mass notification system is considered to be a system used to provide information and instructions to people in a building(s), area, site, or other space using intelligible voice communications and including visible signals, text, graphics, tactile, or other communication methods.

Mass notification systems can consist of fully independent systems with minimal or no interface with the building fire alarm system, systems that report trouble and supervisory signals through the fire alarm system, systems that share audible and visible notification circuits and appliances with the fire alarm system, or combination mass notification and fire alarm systems.

24.4.2.1* General Performance. The performance, selection, installation, operation, and use of a mass notification system shall comply with the requirements of 24.4.2.

A.24.4.2.1 Although some minimum criteria are outlined for a particular feature, the feature might not be applicable for every project.

The information and instructions delivered by a mass notification system could be initiated manually by an operator or automatically by sensors or other systems and might be delivered to the target audience using prerecorded messages or live messages, or both, tailored to the situation and the audience.

Each mass notification system could be different, depending on the anticipated threat and the level of protection intended.

As an example, a particular project might not require secure radio transmissions. As such, criteria for such would not apply. However, if the authority having jurisdiction or design professional has specified secure radio transmissions, the minimum applicable

NFPA 72-2010 National Fire Alarm and Signaling Code

criteria within this document would be required. Deviation from these minimum criteria would require approval of the stakeholders.

Mass notification systems can consist of fully independent systems with minimal or no interface with the building fire alarm system, systems that report trouble and supervisory signals through the fire alarm system, systems that share audible and visible notification circuits and appliances with the fire alarm system, or combination mass notification and fire alarm systems.

24.4.2.1.1 Interconnection of protected premises emergency control functions with the mass notification systems shall comply with Chapter 21.

24.4.2.1.2 An in-building mass notification system shall include one or more of the following components:

- (1) Autonomous control unit (ACU)
- (2) Local operating console (LOC)
- (3) Fire alarm control interface
- (4) Notification appliance network
- (5) Initiating devices
- (6) *Interface to other systems and alerting sources

A.24.4.2.1.2(6) Other systems could include wide-area mass notification, distributed recipient mass notification, and regional and national alerting.

24.4.2.1.3 Control units installed as part of a mass notification system shall be in compliance with this Code and applicable standards such as ANSI/UL 864, *Standard for Control Units and Accessories for Fire Alarm Systems*, or UL 2017, *Standard for General-Purpose Signaling Devices and Systems*.

24.4.2.1.4 Mass notification system components shall be installed, tested, and maintained in accordance with the manufacturer's published instructions and this Code.

24.4.2.1.5 In-building emergency mass notification operation shall be permitted to be initiated by manual or automatic means.

24.4.2.1.6 Mass notification system activation shall initiate recorded messages or live voice and visible notification.

24.4.2.1.7 The priority level of recorded messages shall be determined by the emergency response plan.

24.4.2.1.8 Only recorded messages determined by the emergency response plan to be of higher priority than fire alarm activation shall be permitted to override the fire alarm notification and initiate the mass notification priority indicator.

24.4.2.1.9 Activation of any other recorded message shall not interfere with the operation of fire alarm notification.

24.4.2.1.10 Initiation of live voice announcements from microphones on the fire alarm system at an ACU, and at an LOC, shall not automatically place the fire alarm system in a mass notification priority mode.

24.4.2.1.11 Combination of mass notification with fire alarm systems shall be permitted and shall meet the requirements of 23.8.4.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.2.2 Risk Analysis for Mass Notification Systems.

24.4.2.2.1* Each application of a mass notification system shall be specific to the nature and anticipated risks of each facility for which it is designed.

A.24.4.2.2.1 Although this chapter outlines some specific criteria and/or limitations, each application should be based on recognized performance-based design practices and the emergency response plan developed for the specific facility. Refer also to the risk analysis information found in 24.7.7.

Here are the general categories of questions that might be presented to the senior manager responsible for mass notification decisions. The actual questions for each project must be tailored to the area, the building, the campus, and the culture of the user organization. Following is a brief description of potential content within the mass notification event questions:

(1) What is the type of emergency event—that is, is it fire, security, safety, health, environmental, geological, meteorological, utility service disruption, or another type of event?

(2) What is the urgency of the emergency event — that is, does it represent immediate danger, has it already occurred, is it expected to occur soon, is it expected to occur in the future, or is its occurrence unknown?

(3) What is the anticipated or expected severity of the emergency event that is, how will it impact our facility and its functions, is it expected to be extreme, severe, etc.?

(4) What is the certainty of the emergency event that is, is it happening now, is it very likely to occur, is it likely to occur, is it possible that it will occur in the future, is it unlikely to occur, or is its occurrence unknown?

(5) What is the location of the event, or from what direction is the emergency event approaching,—that is, has it or will it be approaching from the north, south, east, or west?

(6) What zone or areas should receive the emergency message(s),—that is, is it a floor of a building, multiple floors of a building, the entire building, multiple buildings, a campus of buildings, an entire town or city, an entire state, an entire region of states, or an entire country?

(7) What is the validity of the emergency event,—that is, has the emergency event been investigated and/or confirmed?

(8) What instructions should we send to our personnel — that is, should they evacuate the facility, should they shelter-in-place, should they shelter-in-place at a special location, should they proceed to a safe haven area, and other action oriented items?

(9) Are there any special instructions, procedures, or special tasks that we need to remind personnel about or to accomplish — that is, close your office door, open your office door, stay away from windows, do not use elevators, and other information relating to personnel actions?

The questions suggested in items (1) through (9) are offered for consideration, and not all of them might be appropriate for every mass notification system installation. It is important to remember that when an emergency event occurs, the response must be immediate and deliberate. Therefore, there is no time for indecision. So the questions selected to reside in the emergency messaging decision tree illustrated in items (1)

NFPA 72-2010 National Fire Alarm and Signaling Code

through (9) must be straightforward and as simple as possible. They must also be tailored to the specific organization, culture, site, and unique requirements of each local environment.

24.4.2.2.2 The designer shall consider both fire and non-fire emergencies when determining risk tolerances for survivability for the mass notification system.

24.4.2.2.3 Performance-based design and the risk analysis shall be applied in accordance with Section 24.7.

24.4.2.2.4 The risk analysis shall be used as the basis for development of the emergency response plan.

24.4.2.3* Emergency Response Plan Elements. A well-defined emergency response plan shall be developed in accordance with *NFPA 1600, Standard on Disaster/Emergency Management and Business Continuity Programs*, and *NFPA 1620, Recommended Practice for Pre-Incident Planning*, as part of the design and implementation of a mass notification system.

A.24.4.2.3 The emergency response plan should include, but not be limited to, the following elements:

- (1) Emergency response team structure
- (2) Emergency response procedures, as follows:
 - (a) Building system related emergencies
 - (b) Human-related emergencies
 - (c) Terrorism-related emergencies
 - (d) Weather-related emergencies
- (3) Emergency response equipment and operations
- (4) Emergency response notification, as follows:
 - (a) Emergency message content
 - (b) Emergency notification approval process
 - (c) Emergency notification initiation process
- (5) Emergency response training and drills, as follows:
 - (a) Classroom training
 - (b) Table-top training
 - (c) Live drills

24.4.2.4 System Operation.

24.4.2.4.1* Authorized personnel shall be permitted to control message initiation over the mass notification system.

A.24.4.2.4.1 Authorized personnel could include building occupants who can readily access and originate messages in emergency situations. Depending on the individual facility, use of the mass notification system to originate non-emergency messages could also be permitted. The selection of authorized personnel should be based on a risk assessment and the building emergency response plan.

24.4.2.4.2* Where identified by the risk analysis, the mass notification system shall provide the capability for authorized personnel to remotely activate live and prerecorded emergency messages.

A.24.4.2.4.2 Authorized personnel could effect message initiation over the mass notification system from either a central control station or a secondary (backup) control

NFPA 72-2010 National Fire Alarm and Signaling Code

station(s). In cases where clusters of facilities within the same geographical region exist, one or more regional control stations could effect message initiation. The mass notification system could permit activation of messages originated by mobile sentries and roving patrols using wireless activation devices. Since it is common practice to allow mass notification systems to be utilized for "nonemergency" messages, the central control station should incorporate a clearly marked and easy to operate means to distinguish between emergency and non-emergency use. Comprehensive training and a fail-safe default to the emergency mode of operation should be employed to ensure that no actual emergency message gets transmitted as a nonemergency broadcast.

24.4.2.4.3* Operating controls shall be clearly identified.

A.24.4.2.4.3 As a general practice, the number of message selection switches included as part of the operating controls should be limited, so that authorized personnel can utilize the system with only minimal familiarity. This, of course, could be a different matter on an industrial or college campus where trained individuals are likely to be very familiar with the operation and use of the system. In that case, more selection switches could be beneficial.

24.4.2.4.4 If there are multiple ~~emergency voice/alarm communications~~ control locations, only one shall be in control at any given time.

24.4.2.4.5 ~~The location having control of the system shall be identified by a visible indication at that location.~~ If there are multiple control locations, a visible indication shall be provided at all other control locations indicating that another control location is in use.

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

24.4.2.4.7 If live voice instructions are provided, they shall ~~override previously initiated signals to the selected notification zone(s) and shall have priority over any subsequent automatically initiated signals to the selected zone(s)~~ perform as follows:

- (1) Override previously initiated signals to the selected notification zone(s).
- (2) Have priority over any subsequent automatically initiated signals to the selected zone(s).

24.4.2.4.8 A manual means shall be provided at each mass notification system control location to permit the mass notification system to relinquish control of the fire alarm system.

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

A.24.4.2.4.9 During emergencies, building occupants should periodically receive an audible clue that the emergency notification given by the mass notification system is still in effect. This also can help building occupants and emergency response personnel recognize that the mass notification system is overriding fire alarm notification appliances. The audible signal could consist of a simple signal such as a chirp of sufficient duration to be recognized by the usual building occupants and, typically, by occupants who are not hearing disabled.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.2.5 Coverage.

24.4.2.5.1* The mass notification system shall provide for live voice and prerecorded localized messaging within a protected individual building, areas surrounding the building, and other outdoor designated areas.

A.24.4.2.5.1 The mass notification system could permit activation of messages originated by mobile sentries and roving patrols using wireless activation devices.

24.4.2.5.2 Notification zones shall be established on the basis of a risk analysis.

24.4.2.5.3* If the mass notification system serves more than one building, it shall be capable of providing separate messages to one individual building or to multiple buildings at any given time.

A.24.4.2.5.3 Generally, each separate building should be provided with a separate in-building mass notification system; however, some facilities (such as a campus-type high school with multiple separate buildings) might be more effectively served by a single in-building mass notification system. Alternately, a risk analysis could determine that a wide-area mass notification system provides the optimal capability for mass notification.

24.4.2.6 Speaker Circuits.

24.4.2.6.1* Speaker circuits used for mass notification that are not fire alarm circuits shall be exempt from the monitoring requirements of this Code, provided that alternate methods of achieving comparable reliability are accepted by the authority having jurisdiction.

A.24.4.2.6.1 Alternate methods that achieve the desired statistical availability could be deemed acceptable in lieu of monitoring the integrity of circuits, signaling channels, or communication pathways where consistent with the risk analysis and emergency response plan.

24.4.2.6.2 Survivability for speaker circuits used for mass notification shall be determined by the risk analysis for the building.

24.4.2.7 Documentation.

24.4.2.7.1 Security. Security for mass notification systems documentation shall be determined by the stakeholders.

24.4.2.7.2 Record of Completion.

24.4.2.7.2.1 A record of completion form, as shown in Figure 10.18.2.1.1, shall be required for documentation of the mass notification system.

24.4.2.7.2.2 All systems that are modified after the initial installation shall have the original record of completion revised to show all changes from the original information and shall be identified with a revision date.

24.4.2.7.3 Required Documentation. Every system shall include the following documentation, which shall be delivered to the owner or the owner's representative upon final acceptance of the system:

NFPA 72-2010 National Fire Alarm and Signaling Code

- (1) An owner's manual including a complete set of operations and maintenance manuals, manufacturer's published instructions, and product data sheets covering all system equipment
- (2) Record and as-built drawings
- (3) One current copy of the record of completion form, updated to reflect all system additions or modifications
- (4) For software-based systems, a record copy of the system specific software
- (5) Emergency response plan, with operational management procedures defined for management and activation of the system

24.4.2.7.4 Document Accessibility.

24.4.2.7.4.1 An as-built plans cabinet ~~should~~ shall be provided ~~and should include the following~~ to house the documentation required in 24.4.2.7.3.

- (1) Shop drawings (as-built)
- (2) Complete set of operations and maintenance manuals for all components
- (3) Product cut sheets for each component
- (4) Copies of all inspection and commissioning reports

24.4.2.7.4.2 The cabinet ~~should~~ shall be sized so that it can neatly contain all necessary documentation, including future inspection and service reports.

24.4.2.7.4.3 The contents of the cabinet ~~should~~ shall be ~~maintained~~ accessible to by authorized personnel only.

E.2.4.6 Records. Records should comply with 4.5.3 and Section 10.6. [SIG-FUN]

E.2.5 Impairments. Impairments should comply with Section 4.6. [SIG-FUN]

24.4.2.7.4.4 ~~Records should comply with 4.5.3 and Section 10.6~~ Mass notification system and fire alarm system as-built plans and other related documentation shall be permitted to be maintained together, including the appearance of both systems on the same drawings.

24.4.2.7.4.5 The requirements of 10.18.3 and Section 14.6 shall be applicable for mass notification system records and record keeping.

24.4.2.8 Impairments. ~~Impairments should comply with Section 4.6~~ The requirements of Section 10.19 shall be applicable when a mass notification system is impaired.

24.4.2.9 Inspection, Testing, Permanent Records and Maintenance Requirements.

~~MNSs~~ Mass notification systems shall be inspected, tested, and maintained in accordance with the manufacturer's requirements and the inspection, testing, and maintenance requirements of Chapter 14.

24.4.2.10* System Priorities. Priority levels shall be established on the basis of the risk analysis.

A.24.4.2.10 The risk analysis should identify what emergency situations will take priority over the fire alarm evacuation signal. Should a tornado warning for the area take priority over an active fire in the building? Should a breach of security at the campus entry gate

NFPA 72-2010 National Fire Alarm and Signaling Code

take priority over an active fire in the building? If a manual fire alarm pull box has been activated, it might be a terrorist action to have people leave the building and walk into an exterior threat. In such a case, mass notification input is intended to override the fire alarm evacuation signals to redirect the occupants based on the conditions.

24.4.2.11 Initiation Indication. The source of system activation shall be visibly and audibly indicated at the central control station and at the building control unit, unless otherwise determined by the risk analysis.

24.4.2.12 Initiating Devices.

24.4.2.12.1 Devices connected to a mass notification system for the purpose of initiating an automatic response to an emergency shall be evaluated based on the risk analysis.

24.4.2.12.2* All mass notification initiating devices shall be listed for their intended purpose.

A.24.4.2.12.2 Devices such as gas or chemical sensors and detectors, weather alert signals, or other such signals can be desirable to connect to the mass notification system to provide a faster response to emergency conditions.

24.4.2.12.3 Where no listed device exists for the detection required by the emergency response plan, nonlisted devices shall be permitted to be used if their failure will not impair the operation of the mass notification system.

24.4.2.12.4 Non-fire emergency manual actuating stations (boxes) ~~should~~ shall be listed to with an applicable standard, such as ANSI/UL 2017, *Standard for General Purpose Signaling Devices and Systems*.

24.4.2.12.5 ~~Dedicated~~ Non-fire emergency manual actuating boxes shall have tactile markings, be of a contrasting color to manual fire alarm boxes on the protected premises, and not be red.

24.4.2.12.6 Non-fire emergency manual actuating boxes ~~should~~ shall be installed similarly to manual fire alarm boxes in accordance with the requirements of 17.14.3 through 17.14.5.

24.4.2.13* Secure Access of Fire Alarm/Mass Notification System Interface. Access to, and physical protection of, the fire alarm/mass notification system interface shall be determined by the risk analysis and as defined in the emergency response plan.

A.24.4.2.13 Refer to 24.4.2.4 for requirements related to operation of the system by authorized personnel. It is recognized that, based on the risk analysis, control equipment and circuits could need different levels of protection for different facilities. Access to the fire alarm/mass notification interface should be consistent with the action outlined in the emergency response plan. It could have been prior practice in some jurisdictions to locate the fire alarm control unit in the main lobby of a facility. However, it might not be appropriate to locate the mass notification system autonomous control unit within the lobby if the general public would have access to deactivate mass notification system components.

Based on the risk analysis, it could be appropriate to locate the autonomous control unit within a secured room while providing local operating consoles for use by other authorized personnel.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.2.14 Autonomous Control Unit (ACU).

24.4.2.14.1 Where provided, the building ACU shall monitor and control the notification appliance network.

24.4.2.14.2 Building occupants meeting the requirements of 24.4.2.4.1 shall be permitted to initiate communications from the ACU.

24.4.2.14.3 Unless otherwise identified through the risk analysis, actions taken at the building ACU shall take precedence over actions taken at any remote location, including the local operating console, or inputs from a wide-area mass notification system.

24.4.2.14.4 When there are multiple ACUs controlling the same notification appliance network, only one shall be in control at any given time.

24.4.2.14.5 When the ACU is integrated with the building fire alarm control unit to form one combined system that performs both functions, the system shall meet the standby power requirements of this chapter.

24.4.2.14.6 When a combined system is installed with an ACU and fire alarm control unit and placed in separate equipment enclosures, the ACU and fire alarm control unit shall be interfaced as required by this chapter.

24.4.2.14.7 When the ACU is part of a stand-alone mass notification system and no fire alarm system exists, the ACU shall meet the requirements of this chapter.

24.4.2.15 Local Operating Console (LOC).

24.4.2.15.1* Building occupants meeting the authorized personnel requirement of 24.4.2.4.1 shall be permitted to initiate communications from the LOC.

A.24.4.2.15.1 Mass notification systems can include a system local operating console(s) for authorized occupants to readily access and originate messages in emergency and nonemergency situations. The quantity and location(s) of an LOC(s) should be determined by the risk analysis and the facilities emergency response plan.

24.4.2.15.2 The use of lock wire seals or break-glass-type enclosures to house the operating consoles for the system, or equivalent protection against unauthorized use, shall be permitted.

24.4.2.15.3 Operating controls shall be clearly identified.

24.4.2.15.4 If there are multiple control locations, only one shall be in control at any given time.

24.4.2.15.5 The location having control of the system shall be identified by a visible indication at that location.

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

24.4.2.15.7 If live voice instructions are provided, they shall override previously initiated signals to the selected notification zone(s) and shall have priority over any subsequent automatically initiated signals to the selected zone(s).

24.4.2.16 Voice Message Priority.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.2.16.1* The priority of mass notification messages shall be established using risk analysis methods.

A.24.4.2.16.1 The following is an example scheme for message prioritization, from highest (1) to lowest (5), for consideration during the risk analysis:

- (1) Live voice messages from personnel in the building should be the highest priority. If systems provide control locations that are usable by non-authorized personnel, these controls should be disabled or overridden during emergency operations.
- (2) Automatic fire alarm messages/other high priority messages as determined by risk analysis criteria.
- (3) External messages originated by a wide-area mass notification system.
- (4) Message priority for emergency conditions such as severe weather warnings, gas leaks, chemical spills, and other hazardous conditions should be determined by risk analysis criteria and defined in the emergency response plan.
- (5) Non-emergency messages, such as general announcements and time function signaling (work breaks, class change, etc.), should have the lowest priority.

24.4.2.16.2 The local building mass notification system shall have the ability to override the fire alarm system with live voice or manual activation of a high priority message, but only where that message and operation are approved under the risk analysis criteria.

24.4.2.16.3 All other messages shall also be prioritized by using the risk analysis method.

24.4.2.16.4 When identified by the risk analysis and emergency response plan, messages from the mass notification system shall take priority over fire alarm messages and signals.

24.4.2.16.5 If the fire alarm system is in the alarm mode and a recorded voice message or the audible signals are sounding, and the mass notification system is actuated, it shall cause deactivation of all fire alarm-initiated audible and visible notification appliances, unless they have also been designated for mass notification use.

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

- (1) Without an active fire alarm signal, the fire alarm system shall automatically restore to normal operation.
- (2) *With an active fire alarm signal, the fire alarm system shall operate based on the emergency response plan.

A.24.4.2.16.6(2) Unless the risk analysis determines otherwise, the fire alarm system should always be automatically returned to normal functionality. Specific instructions should be in place explaining how the fire alarm system notification appliances should be reactivated. This could vary and should be documented in the building emergency response plan.

24.4.2.16.7 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.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.2.16.8 The fire alarm signal deactivation function shall be permitted to occur only when both the fire alarm system is in an alarm condition and a voice message is initiated by the mass notification system.

24.4.2.16.9 When the fire alarm notification is overridden as permitted in 24.4.2.16.8, all other features of the fire alarm system shall remain unaffected.

24.4.2.17* Message Content.

A.24.4.2.17 The fundamental structure of the prerecorded or live messages is critical for providing information and instructions that are intelligible. Prerecorded messages created in a controlled environment are considerably more intelligible than live messages and should be developed and provided to handle as many of the probable emergencies that a particular facility will encounter.

The voice instructions (live or prerecorded) should be preceded by a tone to get attention and prepare the target audience for voice instructions. This tone should be differentiated for specific emergencies, based on the standards for that facility.

The actual voice message (live or pre-recorded) should be delivered in a well-enunciated, clear, calm, and deliberate manner, using respectful language. Focus the message on the action to be taken and minimize wasting words on the cause.

For the voice itself, best results will vary, depending on the specific location — for example, in outdoor applications, it has been shown that a male voice will provide better intelligibility, as the naturally lower frequency of the male voice travels better. Inversely, in an interior application, where the background ambient noise is typically in the same lower frequencies, a female voice tends to penetrate better, as it is more distinct from the ambient. Messages should be constructed using 2-second to 3-second bursts of information and brief periods of quiet between the bursts of information. This methodology facilitates better processing of information by the brain and minimizes the negative effects of reverberation and echo.

Generally, the emergency message should consist of an alert tone of 1 second to 3 seconds, followed by a voice message that is repeated at least three times. The alert tone can be used in between repeats of the voice message.

For live instructions, it is critical that the message be delivered in a clear and calm manner. When possible, the following procedure is recommended:

(1) Think about what information must be delivered in the live announcement, keep it brief, and write down the message.

(2) Read the message out loud for a practice round in a clear and projecting voice.

(3) When you are ready to announce, key the microphone and read the message two to three times.

(4) When possible, use an alert tone, such as a Code 3, 1000 Hz signal preceding the message, and then announce over the live microphone.

(5) Repeat the message a few times more as the emergency warrants.

24.4.2.17.1 For an evacuation message, a tone in accordance with 18.4.2 shall be used with a minimum of two cycles preceding and following the voice message.

24.4.2.17.2 A test message that clearly states “this is a test” shall be provided.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.2.18 Volume Control.

24.4.2.18.1 Local controls shall be permitted to adjust volume levels of non-emergency signals such as, but not limited to, background music and building paging.

24.4.2.18.2 Upon activation of an emergency signal, the system shall override any local volume setting to deliver at a preset volume setting that has been established through testing and acceptance of sound level and speech intelligibility as required by this Code.

24.4.2.19 Visible Notification.

24.4.2.19.1 Where audible notification is provided, mass notification systems shall also provide visible notification information to serve the hearing impaired and for high-noise areas.

24.4.2.19.2 The visible notification required by 24.4.2.19.1 shall be accomplished using strobes.

24.4.2.19.3 In addition to the strobes required by 24.4.2.19.1, textual, graphic, or video displays shall be permitted.

24.4.2.19.4 Transmission of visible notification and messages shall be simultaneous to audible notification and messages.

24.4.2.20 Visible Appliances.

24.4.2.20.1 Where strobes are used as visible appliances, they shall meet the requirements of Sections 18.5 or 18.6, as appropriate.

24.4.2.20.2 Visible notification appliances shall be of a sufficient quantity and intensity and located so as to meet the intent of the design and be in compliance with Section 18.5.

24.4.2.20.3 The word "ALERT" shall be stamped or imprinted on the appliance and be visible to the public.

24.4.2.20.4 Strobes used in combination systems where the same strobe is used for both mass notification and fire notification shall comply with the following:

- (1)** Be clear or nominal white, meeting the listing requirements of ANSI/UL 1971, *Standard for Signaling Devices for the Hearing Impaired*
- (2)** Have no marking or be marked with the word "ALERT" stamped or imprinted on the appliance
- (3)** Be visible to the public

24.4.2.20.5 In situations where existing notification appliances previously used exclusively for fire alarm applications, and are marked with the word "FIRE," and are to be used for other emergency notification purposes, field modification to the marking shall be permitted, provided that it is accomplished by one of the following methods:

- (1)** Replacement of the manufacturer's approved escutcheon or trim plate
- (2)** Covering of, or removal of, the word "FIRE" using a manufacturer's approved method

NFPA 72-2010 National Fire Alarm and Signaling Code

- (3) Installation of a permanent sign directly adjacent or below the notification appliance indicating that it is multipurpose and will operate for fire and other emergency conditions

24.4.2.20.6 Strobes used in combination systems where the same strobe is used for both mass notification and fire notification shall be clear or nominal white, meeting the listing requirements of ANSI/UL 1971, *Standard for Signaling Devices for the Hearing Impaired*.

24.4.2.20.7 Strobes with colored lenses shall be marked with the listed effective intensity using the lens color installed.

24.4.2.20.8 The intensity of strobes shall meet the requirements of Chapter 18.

24.4.2.20.9 Strobes used for mass notification shall be listed to an applicable standard such as ANSI/UL 1971, *Standard for Signaling Devices for the Hearing Impaired*.

24.4.2.20.10 Strobes used for mass notification shall meet the synchronization requirements of Section 18.5.

24.4.2.21* Textual Visible Notification.

A.24.4.2.21 Care in location and placement is critical to the survivability of the textual visible appliance and maximizing its effectiveness. Locate the textual visible appliance away from direct sunlight or direct local area lighting. Avoid locating the textual visible appliance near heating and air-conditioning ducts.

24.4.2.21.1 Where textual visible appliances are provided, they shall meet the requirements of Section 18.9 and 24.4.2.21.

24.4.2.21.2 The intensity and readability of text, graphic, and video displays shall meet the requirements of 24.4.2.21.

24.4.2.21.3 Textual visible appliances shall be listed for the purpose for which they are used.

24.4.2.21.4 Textual visible appliances shall be installed in accordance with the manufacturer's installation instructions.

24.4.2.21.5 Textual visible notification appliances shall be permitted to be used for primary or supplemental notification.

24.4.2.21.6 Textual visible notification shall be considered to be primary notification where it is the only method used to convey emergency mass notification information to the general public or to specific individuals.

24.4.2.21.7 Textual visible appliances within buildings shall meet the power supply requirements specific to protected premises fire alarm systems in 10.17.3.

24.4.2.21.8 If a textual visible appliance, other than the main control unit, is not on a dedicated branch circuit, it shall have a primary source of power and a secondary source of power and be monitored for power integrity in accordance with Section 10.5.

24.4.2.21.9 All mass notification system notification appliances that receive their power from a signaling line circuit of a mass notification system control unit shall be listed for use with the control unit.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.2.21.10 Textual visible appliance messages shall be permitted to be static, flashing, or scrolling, depending on the message being delivered.

24.4.2.21.11 The message text shall be permitted to be any color, as long as it is clearly legible in the environment in which it is located.

24.4.2.21.12 Emergency textual messages shall override nonemergency textual messages.

24.4.2.21.13 Textual visible appliances that are not monitored for integrity or loss of communication by a control unit shall be provided with visual status indicators, including loss of communication or loss of power, that are clearly visible on the appliance.

24.4.2.21.14* Character Size and Viewing Distance.

A.24.4.2.21.14 The information in this section is based on the *NFPA Emergency Evacuation Planning Guide for People with Disabilities*.

24.4.2.21.14.1* Characters shall contrast with their background using either light characters on a dark background or dark characters on a light background.

A.24.4.2.21.14.1 Signs are more legible for persons with low vision when characters contrast as much as possible with their background. Additional factors affecting the ease with which the text can be distinguished from its background include shadows cast by lighting sources, surface glare, and the uniformity of the text and its background colors and textures.

24.4.2.21.14.2 Characters shall be permitted to be uppercase or lowercase, or a combination of both.

24.4.2.21.14.3 Characters shall be conventional in form and not italic, oblique, script, highly decorative, or of other unusual form.

24.4.2.21.14.4 Characters shall be selected from fonts where the width of the uppercase letter “O” is minimum 55 percent and maximum 110 percent of the height of the uppercase letter “I”.

24.4.2.21.14.5 Character height shall meet the following criteria:

- (1) Minimum character height shall comply with Table 24.4.2.21.14.5.
- (2) Viewing distance shall be measured as the horizontal distance between the character and an obstruction preventing further approach towards the sign.
- (3) Character height shall be based on the uppercase letter “I”.

24.4.2.21.14.6 Visual character height shall be greater than 70 in. (1780 mm) from finished floor in accordance with Table 24.4.2.21.14.5.

24.4.2.21.14.7 Stroke thickness of the uppercase letter “I” shall be minimum 10 percent and maximum 30 percent of the height of the character.

24.4.2.21.14.8 Character spacing shall be measured between the two closest points of adjacent characters, excluding word spaces. Spacing between individual characters shall be minimum 10 percent and maximum 35 percent of character height.

24.4.2.22 Tactile Notification Appliances. Where tactile notification appliances are provided for emergency notification, they shall meet the requirements of Section 18.10.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.2.23* Video Alerting. Video display systems that provide alerts and messages to video appliances shall be permitted to be used to supplement mass notification.

A.24.4.2.23 The video display can be a video appliance used to facilitate mass notification. Information displayed could be video, graphic, text, or audio. Information can be transmitted over a video distribution network, MATV, or CATV system.

These messages can be standardized or customized for specific applications or situations. Dynamic text elements can be derived from secure data or updated in real time, either locally or remotely. Messages can be controlled by authorities to update and alter content with manual overrides from authorized security, police, and so forth to ensure up-to-date and real-time information. The same can be accomplished with remote control from a central control station. Examples of interfaces used for real-time control include USB, Ethernet, RS-232, and GPI.

24.4.2.24 Supplemental Notification. Supplemental notification shall be permitted to provide additional information or more detailed instructions than those transmitted by the primary notification means.

24.4.2.25 Interfaces. Any system fault condition that would prevent reliable emergency operation of any interfaced system shall be annunciated both audibly and visibly at the affected control location.

24.4.2.25.1 Fire Alarm Control Interface (FACI).

24.4.2.25.1.1 Where a fire alarm system is installed covering all or part of the same building or other area as the mass notification system, an interface shall be provided between the systems for operational coordination purposes.

24.4.2.25.1.2 A listed barrier gateway in accordance with 10.3.1, integral with, or attached to, each control unit or group of control units, as appropriate, shall be provided to prevent the other systems from interfering with or controlling the fire alarm system.

24.4.2.25.1.3* The fire alarm control interface shall coordinate signals to and from each system to accomplish the following:

A.24.4.2.25.1.3 Where automatic transmission is required to a supervisory station, it should be performed in accordance with the emergency response plan. The purpose for disabling or overriding the fire alarm system notification appliances during simultaneous fire and mass notification events is so that occupants will not receive conflicting messages and fail to respond correctly.

Fire alarm notification that should be overridden during a mass notification system activation could include audible notification appliances, visible notification appliances, textual notification appliances, and video notification appliances.

- (1) Indicate the failure at the system control unit that will be impaired
- (2) Provide indication to the fire alarm system that the mass notification system is active
- (3) Cause the fire alarm system to deactivate all audible and visible notification appliances whose operation could interfere with the intelligibility of the mass notification message or that will deliver conflicting information to occupants

NFPA 72-2010 National Fire Alarm and Signaling Code

- (4) Not permit the fire alarm system to turn off audible and visible notification appliances for special suppression pre-discharge notification required by 24.4.1.7.1
- (5) Where required, provide for a signal to a supervising station in accordance with Chapter 26 that is indicative of the mass notification system overriding the fire alarm system notification appliances during simultaneous fire and mass notification events

Table 24.4.2.21.14.5 Visual Character Height

Height to Finished Floor or Ground from Baseline of Character

Horizontal Viewing Distance Minimum Character Height

>70 in. (1780 mm)–≤10 ft (3050 mm)

<15 ft (4570 mm) 2 in. (51 mm)

>70 in. (1780 mm)–≤10 ft (3050 mm)

≥15 ft (4570 mm) 2 in. (51 mm), + 1/8 in. (3.2 mm)/

12 in. (305 mm) of viewing distance above 15 ft (4570 mm)

>10 ft (3050 mm) <21 ft (6400 mm) 3 in. (77 mm)

>10 ft (3050 mm) ≥21 ft (6400 mm) 3 in. (77 mm), + 1/8 in. (3.2 mm)/12 in. (305 mm) of viewing distance above 21 ft (6400 mm)

24.4.2.25.1.4 If the fire alarm control interface is used to broadcast non-emergency messages, music, or other signals over the fire alarm notification appliance circuits, the operation shall meet the requirements of 24.4.2.18.

24.4.2.25.2 Interfaces to Building Controls. The mass notification system shall be permitted to provide air-handling control, door control, elevator controls, and control of other building systems as determined by the risk analysis, and as permitted by the authority having jurisdiction.

24.4.2.25.3 Interfaces with Wide-Area Mass Notification Systems.

24.4.2.25.3.1* Individual building mass notification systems shall be permitted to interface with wide-area mass notification systems.

A.24.4.2.25.3.1 As part of the risk analysis and emergency response plan, consideration should be given to future interfacing in-building mass notification systems with a wide-area mass notification system if it does not presently exist. In-building mass notification systems should be designed to allow future interface with a wide-area mass notification system.

24.4.2.25.3.2 The in-building mass notification system shall not be activated or controlled by a wide-area mass notification system, unless the wide-area mass notification system also meets the design and performance requirements of this chapter or has been deemed to be acceptable by the risk analysis and the authority having jurisdiction.

24.4.2.26 Combination Emergency Communications Systems.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.2.26.1* When the mass notification system is integrated with the building fire alarm control unit to form one combined system that performs both functions, the system shall comply with this chapter.

A.24.4.2.26.1 A combined system can include an autonomous control unit and fire alarm control unit supplied from different manufacturers or placed in separate equipment enclosures; however, the autonomous control unit and fire alarm control unit should be integrated in their controls and performance to meet the requirements of this Code.

24.4.2.26.2 All components that affect the operation of the fire alarm system shall be listed for fire alarm use and shall be in compliance with applicable standards such as ANSI/UL 864, *Standard for Control Units and Accessories for Fire Alarm Systems*.

24.4.2.27 Public Address (PA) Systems Used for Emergency Communications.

24.4.2.27.1 The voice communications or public address system that is to be used for mass notification shall be evaluated by the emergency communications system designer, as defined in Chapter 10, to determine applicability and compliance.

24.4.2.27.2 A document signed by the emergency communications system designer attesting to the fact that the public address system has been evaluated and meets the requirements determined by Chapter 24 and the risk analysis, and is therefore deemed reliable and acceptable to provide emergency communications for the particular facility, shall be maintained with the fire alarm record drawings.

24.4.2.28 Public Address (PA) System Interface with Facility Fire Alarm System.

24.4.2.28.1 When a public address system is used to deliver mass notification messages, the public address system shall provide (either internally as a design feature or with an approved or listed external controller) for a signal to control the facility's fire alarm system for the purpose of deactivating the fire alarm audible and visible notification appliances in accordance with 24.4.2.25.1.

24.4.2.28.2 All of the following features shall be provided in, or added to, the public address system:

- (1) Emergency messages must have priority over nonemergency messages.**
- (2) All individual or zone speaker volume controls must default to the emergency sound level when used for an emergency mass notification message.**
- (3) When monitoring of circuit integrity is provided by the public address system, monitoring must continue, even if local speaker volume controls are placed in the "off" position.**
- (4) The required visible notification appliance network (i.e., strobes and textual signs) must be provided where required.**

24.4.3* Wide-Area Mass Notification Systems.

A.24.4.3 Wide-area mass notification systems are generally installed to provide real-time information to outdoor areas.

These systems are normally provided with, and operated from, two or more central control stations. Communications between central control stations and in-building mass notification systems is provided. Communications between the central control stations and regional or national command systems could also be provided. Wide-area mass

NFPA 72-2010 National Fire Alarm and Signaling Code

notification systems are often those such as campus giant voice systems, military base public address systems, civil defense warning systems, large outdoor visible displays, and so forth.

24.4.3.1 Voice Messages.

24.4.3.1.1 Voice messages shall comply with the requirements of 24.3.1.

24.4.3.1.2 Where identified by the risk analysis, multiple languages shall be permitted to be used.

24.4.3.1.3 Where required by the emergency response plan, specific warning tones shall be provided.

24.4.3.2* Wide-area mass notification systems shall have multiple levels of password protection access control, including levels for system operators, maintainers, supervisors, and executives, or other means to limit access to system controls shall be provided based on a risk analysis.

A.24.4.3.2 A commonly used method of protecting against unauthorized changes using multiple levels of password protection can be described as follows (in ascending levels of access):

- (1) Access Level 1. Access by persons who have a general responsibility for safety supervision, and who might be expected to investigate and initially respond to an alarm or trouble signal.
- (2) Access Level 2. Access by persons who have a specific responsibility for safety, and who are trained to operate the control unit.
- (3) Access Level 3. Access by persons who are trained and authorized to take control over a given area of a site to allow local paging, which might be different from that of another area. Note: This might require a higher form of access to the local control.

24.4.3.3* Wide-area mass notification systems shall be permitted to connect to regional mass notification systems, public emergency alarm reporting systems, as defined in this Code, and public reporting systems as defined in NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*.

A.24.4.3.3 A wide-area mass notification system could have the capability to communicate with other notification systems on the site, such as the telephone alerting system, paging system, cell phone, pager, PDA activation, e-Blast, message scrolling, reverse 911, fax transmission, and highway advisory radio and sign control system (used for dynamic control of radio information and traffic signs for emergency information and traffic management).

24.4.3.4 Wide-Area Mass Notification System Components.

24.4.3.4.1 Central Control Station. Refer to Section 24.6 for requirements of a central control station.

24.4.3.4.2* High Power Speaker Array (HPSA). When required by the risk analysis, high power speaker arrays (HPSAs) shall be provided, installed, and maintained.

A.24.4.3.4.2 High power speaker arrays should be designed with directional characteristics that will minimize the distortion of voice signals by interface from other zones and will minimize the transmission of voice or tone signals into environmentally sensitive areas or off the site.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.3.4.2.1 The HPSA shall be arranged in such a manner to provide intelligible voice and audible tone communications.

- (A) When multiple HPSAs are used, they shall be arranged in physical or virtual notification zones so that each notification zone can be individually controlled by the central control station.
- (B) *HPSAs shall be designed to maintain the intelligibility of voice signals within the notification zone in accordance with the requirements of Chapter 18.

A.24.4.3.4.2.1(B) Refer to Annex D for more information on speech intelligibility and how it is predicted.

Normal weather conditions should be specified as appropriate for the geographic location. Intelligibility meters with internal compensation should be used to adjust STI measurements for other than normal weather conditions.

In outdoor areas, such as in industrial areas with many multi-story buildings, the maximum distance of personnel from an outdoor speaker often has to be significantly reduced to retain acceptable intelligibility of the voice message. Speakers that provide directional capability should be used. These can be mounted on building exteriors if the speakers do not radiate unacceptable levels of sound into the building on which they are mounted.

At some sites, it could be necessary to control the amount of sound that propagates in undesirable directions, such as into civilian communities adjacent to the site boundaries or into wildlife areas with protected or endangered animal species.

Additionally, in some areas, it might be necessary to mount wide-area mass notification speakers on the side of a building while simultaneously preventing an unacceptable increase in that building's interior noise levels.

24.4.3.4.2.2 Secondary power for HPSAs used for wide-area mass notification systems 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.

24.4.3.4.2.3 An HPSA shall have the capability to provide voice and tone communications as determined by the emergency response plan.

24.4.3.4.2.4* An HPSA shall operate in the environment in which it is located, considering such factors as temperature, humidity, wind, dust, vibration, and other environmental factors.

A.24.4.3.4.2.4 At a minimum, the high power speaker array controller should be located above known high water level during historic floods. In northern states, the high power speaker array should be located above known snow levels.

When selecting high power speaker arrays, care should be taken to ensure the equipment is rated to operate between the high and low temperature range and other anticipated environmental conditions for the geographical location of installation.

The system designer should inquire about this information as part of the risk analysis.

24.4.3.4.3 High Power Speaker Array Enclosures.

24.4.3.4.3.1 Enclosures for HPSAs shall be of the NEMA 4 or 4X type.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.4.3.4.3.2 HPSA enclosures shall have intrusion detection that signals the central control station.

- (A) The signal shall be initiated whenever the door of the enclosure is in the open position.
- (B) The transmitted signal shall be a latching supervisory signal.

24.4.3.4.4 High Power Speaker Array Mounting.

24.4.3.4.4.1 HPSAs shall be mounted at a minimum mounting height that is based on the rated output of the array.

24.4.3.4.4.2* HPSAs shall be installed at a height and orientation to prevent hearing damage to anyone in the immediate vicinity of the speakers.

A.24.4.3.4.4.2 High power speaker arrays should be mounted not to exceed the OSHA occupational noise exposure limits to anyone in the immediate vicinity of the speakers.

24.4.3.4.4.3 All external conductors (conductors passing outside of the HPSA equipment cabinet) shall be provided with surge suppression to minimize potential equipment damage from lightning strikes.

24.4.3.4.5 High Power Speaker Array Noise Consideration.

HPSA notification zones shall not be used to provide mass notification inside any structures.

24.4.3.4.6* High Power Speaker Array Structural Loads, Wind, and Seismic Design. HPSAs and their supporting structures shall meet the structural, wind, and seismic loads as identified in the risk analysis.

A.24.4.3.4.6 High power speaker arrays and their supporting structures should have a minimum design wind speed of 100 miles/hr [161 km/hr (86.8 kn)]. The supporting structure should be sized to accommodate the static and dynamic loads produced by the sound systems and all attachments. Seismic loads are generally site specific.

24.4.3.4.7 Textual Visible Appliances. Textual visible appliances shall meet the requirements of Section 18.9 and 24.4.2.21.

24.4.3.4.7.1 After loss of primary power, textual visible appliances shall have sufficient secondary power to operate for a minimum of 2 hours of continuous display time during an emergency event.

24.4.3.4.7.2 Scrolling message boards shall be provided with means to control the scrolling rate.

24.4.3.4.8 In-Building Mass Notification Systems. The in-building mass notification system shall meet the requirements of 24.4.2.

24.4.3.4.9 Interfaces with Wide-Area Mass Notification Systems.

Interfaces between wide-area mass notification systems and in-building mass notification systems, other alert and notification systems, regional mass notification systems, and offsite interfaces shall have a standard interface method (such as an

NFPA 72-2010 National Fire Alarm and Signaling Code

audio line-level output and multiple relay contacts) or supply the necessary communications protocols to provide interoperability and a secure communications link.

24.4.3.4.9.1 The interface shall be such that the primary function of both systems shall not be compromised.

24.4.3.4.9.2 The interface shall be monitored for integrity in accordance with Section 10.17, so that a fault that could prevent reliable system operation is audibly and visibly annunciated at both systems' control units.

24.4.3.4.10 Control Hierarchy. There shall be a predefined control hierarchy between the wide-area mass notification system, the in-building mass notification system, and the regional mass notification system for information flow from the remote control center, as well as information from specific locations.

24.4.3.4.11 Communications Links.

24.4.3.4.11.1 The wide-area mass notification system, including communications links, shall minimize the potential for interference from jamming, spoofing, hacking, eavesdropping, or other malicious acts.

24.4.3.4.11.2 The wide-area mass notification system shall have a primary and redundant communications link with minimal functional and spatial interconnection with each other.

24.4.3.4.11.3 Wide-area and in-building mass notification systems equipment and interface methods connecting to, or utilizing, public emergency alarm reporting systems and associated communications infrastructure shall be electrically and operationally compatible so as not to interfere with the public emergency alarm reporting systems.

24.4.4* Distributed Recipient Mass Notification Systems (DRMNSs).

A.24.4.4 Distributed recipient mass notification systems are enterprise-class systems for the management of, and mass distribution of, emergency notification messages within buildings, throughout installations, across entire geographical regions, or throughout a worldwide military command. Using distributed recipient mass notification systems, designated system operators would be able to rapidly and reliably inform appropriate personnel of homeland security levels (including chemical, biological, radiological, and nuclear threats; hazardous weather conditions; and many other critical events), possibly with near real-time response capability.

A distributed recipient mass notification system is meant to communicate to a wide range of targeted individuals and groups.

These systems might use mass dialing systems, including reverse 911, email, SMS, or other directed communications methods to broadcast information. They might also use wired or wireless networks for one- or two-way communications and/or control between a building or area and an emergency services organization (information, command, and control).

Distributed recipient mass notification systems could be capable of centrally tracking, in real time, all alerting activities for each individual recipient, including sending, receiving, and responding to alerts, and be able to generate reports based on tracked information.

NFPA 72-2010 National Fire Alarm and Signaling Code

Distributed recipient mass notification systems could incorporate a predefined library of signals and messaging appropriate for, but not limited to, the following:

- (1) Presidential alert message
- (2) Homeland security levels
- (3) Terrorism threats, watches, or warnings
- (4) Evacuation routes
- (5) Emergency directives
- (6) Personnel recall requirements
- (7) Federal, DOD, police, fire, or locally /installation-specific warning and notification requirements
- (8) Amber alerts

The distributed recipient mass notification system could be capable of monitoring emergency notifications from multiple data sources [Commercial Mobile Alert System (CMAS), National Weather Service, Emergency Managers Weather Information Network (EMWIN), Naval Meteorology and Oceanography (METOC), and others as determined locally] and automatically sending out notifications to designated facilities and personnel based on predefined rules.

A mass notification system could also be capable of reaching out to all online personnel by leveraging a highly secure, redundant, Web-based IP network architecture to manage the entire mass notification process. Agencies and organizations can create role-based uses such as operators, administrators, and recipients, based on their access rights across multiple facilities, campuses, and installations. System rules could be established to determine operator permissions and actions such as creating and activating scenarios, as well as the extent and geography of alerts and delivery systems and devices that should be used. Such a Web-based mass notification system would employ an open, standards-based architecture. The system could be integrated with existing user directories to support organizational hierarchy and emergency response groups. It could be structured to allow emergency criteria-based targeting of emergency alerts.

Additionally, this annex material provides information on ongoing development of system requirements for net-centric alerting systems (NCAS) that will be based on IP technologies.

This annex is not mandatory, but is provided to stimulate development of suitable requirements and standards. Consequently, user suggestions and feedback on this annex are highly encouraged and requested. Methods to ensure reliability and robustness in off-normal or emergency conditions are of particular concern. The required amount of and method for isolating alerting functions from normal, non-alerting system functions needs development.

NCAS leverage the IP network infrastructure to instantly reach those personnel who have access to nearly any IP-connected devices [such as pop-up alerts on personal computers (PC), text messages to personal data assistants (PDA) and cellular telephones, electronic mail to IP-capable cellular telephones, and recorded voice messages to voiceover-IP (VoIP) telephones and PCs]. Additionally, NCAS could be used to activate, through a single interface, non-IP alerting systems, such as wide-area alerting systems and traditional dial-up telephone alerting systems.

NCAS can be installed independently or at a central location. In a centrally managed NCAS configuration, personnel and facilities in the regional operations center's particular area of coverage could be alerted instantly by events, either from any individual

NFPA 72-2010 National Fire Alarm and Signaling Code

installation, or centrally from the regional operations center. Using management tools, designated operators from each installation in the region could log in via a web browser and have complete access to their own portion of the NCAS. The regional operations center would retain the ability to centrally monitor and manage all portions of the system.

The NCAS would incorporate a Web-based management and alert activation application through which all operators and administrators could gain access to the system's capabilities, based on the users' permissions and the defined access policy. Such a management application would incorporate management of the alert activation flow through all delivery methods, as well as end-user management, operators' permission and access, tracking and reporting, and all administrative aspects of the system.

Distributed recipient mass notification systems could interface and interoperate with other types of mass notification capabilities, including wide-area and in-building mass notification systems. During emergencies, systems operators should not need to send notifications using multiple alerting systems.

The distributed recipient mass notification system, particularly NCAS, might be able to provide the capability to integrate user interfaces and consolidate access to multiple mass notification and alerting systems.

24.4.4.1* Overview. Distributed recipient mass notification system (DRMNS) alerting shall not be used in lieu of required audible and visible alerting mass notification systems but shall be integrated with mass notification systems whenever possible.

A.24.4.4.1 Distributed recipient mass notification systems could enable the management of the notification flow, including users' management, groups targeting, operators' permissions, access policies, predefined emergency scenarios, and response tracking and reporting.

24.4.4.2* Targeted Recipients. The DRMNS shall be capable of sending alert messages to target recipients.

A.24.4.4.2 Distributed recipient mass notification systems could be capable of sending alert messages in a prioritized method to target recipients according to the following:

- (1) Hierarchical organizational structure (as would be imported from an active directory)
- (2) Organizational roles
- (3) Specific distribution lists [e.g., hazardous materials (HAZMAT) response teams]
- (4) Specific distribution (e.g., hearing impaired or others with impairments that warrant prioritized notification)
- (5) Dynamic groups created through on-the-fly queries of the user directory
- (6) Geographical locations (e.g., entire bases, zones within bases)
- (7) IP addresses (required for targeting devices in specific physical locations)

24.4.4.3* Network Security Compliance. DRMNSs shall be installed behind the appropriate internet system firewalls to protect the integrity of the network.

A.24.4.4.3 Distributed recipient mass notification systems could use a Web-based user interface, support locally designated standard network ports and protocols, and provide open interfaces to support interoperability, such as eXtensible markup language (XML) and common access protocol (CAP) based emergency messages.

24.4.4.4 Network Architecture. The network shall be provided with net-centric architecture that fully supports local designated standards and security requirements.

NFPA 72-2010 National Fire Alarm and Signaling Code

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

A.24.4.4.5 Distributed recipient mass notification systems would be capable of sending alert messages to end-users (recipients) via multiple delivery methods, including the following:

- (1) Audio-visual network alerts to desktops and laptops via desktop pop-up
- (2) Text alerts to mobile phones and pagers
- (3) Text alerts to electronic mail (e-mail) clients
- (4) Audio alerts to phones
- (5) Audio alerts to existing wide-area or building voice and or mass notification systems
- (6) Network alerts to any other IP-connected devices via standard XML and CAP protocols

The system could be extendable to support additional delivery methods in the future as this technology develops.

24.4.4.6* Backup Distributed Recipient Mass Notification Systems.

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

A.24.4.4.6 A distributed recipient mass notification system could support multiple server configurations to achieve a “hot standby” failover configuration (i.e., no down time in case of failure in a single server), as well as to support higher load scenarios (e.g., more users). This could be accomplished with premises-based systems or hosted configurations.

24.5 Two-Way, In-Building Emergency Communications Service Systems.

24.5.1* Two-Way, Telephone In-Building Wired Emergency Services Communications Systems.

A.24.5.1 Two-way, in-building emergency services communications systems are used by fire fighters, police, and other emergency services personnel. This does not preclude equipment outside of the protected premises.

24.5.1.2 Two-way telephone communications service, if provided, shall be for use by the fire service and collocated with the in-building fire emergency voice/alarm communications equipment.

24.5.1.4 Additional uses ~~if specifically permitted by the authority having jurisdiction~~ shall be permitted to include signaling and communications for a building fire warden organization, and signaling and communications for reporting a fire and other emergencies (e.g., voice call box service, signaling, and communications for guard's tour service).

24.5.1.8 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.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.5.1.9 If a selective talk system is used, means as specified in 24.5.1.8 shall be permitted, provided that subsequent telephone circuits going off-hook operate the distinctive off-hook signal sounding appliance.

24.5.1.10 ~~As a minimum (for fire service use),~~ Two-way telephone systems shall be common talk (i.e., a conference or party line circuit) ~~providing at least one telephone station or jack per floor and at least one telephone station or jack per exit stairway.~~

24.5.1.11 In buildings provided with a two-way telephone communications system, at least one telephone station or jack shall be provided at the following locations:

- (1) Each floor level
- (2) Each notification zone
- (3) Each elevator cab
- (4) Elevator lobbies
- (5) Elevator machine room(s)
- (6) Emergency and standby power room(s)
- (7) Fire pump room(s)
- (8) Area(s) of refuge
- (9) Each floor level inside an enclosed exit stair(s)
- (10) Other room(s) or area(s) as required by the authority having jurisdiction

24.5.1.12 If the two-way telephone system is intended to be used by fire wardens in addition to the fire service, the minimum requirement shall be a selective talk system, (where phones are selected from the control location).

24.5.1.13 ~~Systems intended for fire warden use shall provide telephone stations or jacks as required for fire service use, and additional telephone stations or jacks as necessary to provide at least one telephone station or jack in each notification zone.~~ Telephone circuits shall be selectable from the control location either individually or, if approved by the authority having jurisdiction, by floor or stairwell.

24.5.1.16* All circuits necessary for the operation of two-way telephone communications systems shall be installed using one of the following methods in accordance with the pathway survivability requirements in 24.3.5.7.

A.24.5.1.16 Two-way, in-building wired emergency services communications systems are intended to provide emergency service personnel and designated building occupants with a supervised, reliable communication system that is completely independent of other in-building communication systems.

The survivability of two-way, in-building wired emergency services communications systems is paramount as they are intended for use during and throughout the duration of a fire or other emergency event. This kind of functionality requires that measures are taken to ensure that the system is designed, installed, and maintained in such a manner that they can survive and function under extreme conditions.

~~A.6.10.1.16~~ One or more of the following means might be considered acceptable to provide a level of survivability consistent with the intent of this requirement:

- ~~(1) Routing two-way telephone circuits separately~~
- ~~(2) Using short-circuit fault tolerant circuits~~

24.5.2* Two-Way In-Building Radio Communications Enhancement Systems.

NFPA 72-2010 National Fire Alarm and Signaling Code

A.24.5.2 The use of radio communication enhancement systems has become prevalent throughout the country.

Safety features and flexibilities of radio systems include:

- (1) Allowing full building coverage to facilitate communications from any point within the building, in case access to the telephone jack is compromised.
- (2) Allowing communications to be conducted between emergency responders in the field to allow quicker dissemination of safety and emergency information.
- (3) Each emergency responder typically will carry an individual radio, allowing for each individual to provide information or request assistance individually, which can be important if members of crews separate from each other during an incident.
- (4) Radio systems allow for "fire fighter down" emergency calls in case of injury, where, by pushing a single button, a call is placed to a central location to initiate a roll call in order to determine the emergency responder who has been injured and requires assistance.
- (5) Radio systems can employ an emergency call where, by pushing a single button, an emergency responder call jump to the next radio given system access to allow wide-range communication of a superseding emergency, such as building structure failure, failure of a fire pump or standpipe system, or other emergency that could cause a change in operational strategies.

~~A.6.10.2 Monitoring of the in-building two-way communications system by the fire control system is permissible. The following should be considered as part of the system design and monitoring criteria:~~

~~Monitoring (if provided):~~

- ~~(1) Primary operating power~~
- ~~(2) Secondary operating power~~
- ~~(3) Antenna connections~~
- ~~(4) Antenna integrity~~
- ~~(5) Signal strength~~
- ~~(6) Multi-pathing~~
- ~~(7) Interference~~
- ~~(8) Channel integrity~~
- ~~(9) Interconnecting wiring~~

~~Design:~~

- ~~(1) Survivability~~
- ~~(2) FCC licensing~~
- ~~(3) Interior and external building reception~~
- ~~(4) Testing and maintenance by licensing group~~
- ~~(5) Environmental conditions~~
- ~~(6) Future systems expansion~~

24.5.2.1 General.

24.5.2.1.1 Non-Interference. No amplification system capable of operating on frequencies or causing interference on frequencies assigned to the jurisdiction by the FCC shall be installed without prior coordination and approval of the authority having jurisdiction. The building manager/owner shall suspend and correct other equipment installations that degrade the performance of the public safety radio system or public safety radio enhancement system.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.5.2.1.2 Approval and Permit. Plans shall be submitted for approval prior to installation. At the conclusion of successful acceptance testing, a renewable permit shall be issued for the public safety radio enhancement system where required by the authority having jurisdiction.

24.5.2.2 Radio Coverage. Radio coverage shall be provided throughout the building as a percentage of floor area as specified in 24.5.2.2.1 through 24.5.2.2.3.

24.5.2.2.1 Critical Areas. Critical areas, such as the emergency command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the authority having jurisdiction, shall be provided with 99 percent floor area radio coverage.

24.5.2.2.2 General Building Areas. General building areas shall be provided with 90 percent floor area radio coverage.

24.5.2.2.3 Amplification Components. Buildings and structures that cannot support the required level of radio coverage shall be equipped with a radiating cable system or a distributed antenna system (DAS) with FCC-certified signal boosters, or both, or with a system that is otherwise approved, in order to achieve the required adequate radio coverage.

24.5.2.3 Signal Strength.

24.5.2.3.1 Inbound. A minimum inbound signal strength of -95 dBm, or other signal strength as required by the authority having jurisdiction, shall be provided throughout the coverage area.

24.5.2.3.2 Outbound. A minimum outbound signal strength of -95 dBm at the donor site, or other signal strength as required by the authority having jurisdiction, shall be provided from the coverage area.

24.5.2.3.3 Isolation. If a donor antenna exists, isolation shall be maintained between the donor antenna and all inside antennas and shall be a minimum of 15 dB above the signal booster gain under all operating conditions.

24.5.2.4* System Radio Frequencies. 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.

A.24.5.2.4 Modulation technologies include analog and digital modulation.

It is important that interoperability be developed and maintained when implementing analog and digital two-way radio systems. The simplest means to gaining a measure of interoperability with analog two-way radio systems is programming into a radio existing, operational channels from agencies that are adjacent to each other geographically and that operate in the same public safety frequency band. To gain interoperability with digital two-way radio systems, systems and devices that are (APCO) Project 25 (P25) compatible can be used. Project 25 is a standard for the manufacturing of interpretable digital two-way wireless communications systems and devices. A P25 radio system provides interoperability, because it incorporates a common air interface and a multi-band excitation vocoder that converts speech into a digital bit stream.

NFPA 72-2010 National Fire Alarm and Signaling Code

P25 defines standard modes of radio operation to enable multi-vendor interoperability such as trunking, encryption, over-the-air rekeying, and so forth. Formally, P25 specifications are defined in the ANSI/TIA/EIA 102 suite of standards.

All homeland security funding promotes interoperable communications and recommends adherence to open architecture technologies and P25 standards.

24.5.2.4.1 List of Assigned Frequencies. The authority having jurisdiction shall maintain a list of all inbound/outbound frequency pairs for distribution to system designers.

24.5.2.4.2* Frequency Changes. 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.

A.24.5.2.4.2 There is currently an ongoing national effort to eliminate current interference issues between cellular carriers and public safety bands in the 800 MHz band. This effort could revise the actual frequencies for public agencies within this band. The public safety radio enhancement system design should be capable of being changed to accommodate updated frequencies in order to allow maintenance of the minimum system design criteria.

24.5.2.5 System Components.

24.5.2.5.1 Component Approval. 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 approved and shall be compatible with the public safety radio system.

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

24.5.2.5.3 External Filters. Permanent external filters and attachments shall not be permitted.

24.5.2.5.4 Signal Booster Components. If used, signal boosters shall meet the following requirements, as well as any other requirements determined by the authority having jurisdiction:

- (1) *Signal boosters shall have FCC certification prior to installation.

A.24.5.2.5.4(1) All repeaters, transmitters, receivers, and signal boosters should be installed and operated in a manner consistent with Title 47, CFR. Within these regulations is a mandatory requirement that repeaters, transmitters, and signal boosters have Federal Communications Commission (FCC) "certification." Receivers do not normally have a FCC certification requirement but must comply with other applicable FCC regulations. FCC certification is a formal procedure that verifies the equipment meets certain minimum FCC technical specifications. Each brand and model type is issued a distinct FCC certification number. Use of repeaters, transmitters, or signal boosters that do not have an existing FCC-issued certification is a violation of federal law, and users are subject to fine and/or imprisonment. A label displaying the exact FCC certification number must be placed in a visible place on the equipment itself.

FCC certification verification can be obtained from any FCC office or online (<https://fjallfoss.fcc.gov/oetcf/eas/reports/genericsearch.cfm>).

NFPA 72-2010 National Fire Alarm and Signaling Code

- (2) All signal boosters shall be compatible with both analog and digital communications simultaneously at the time of installation. The authority having jurisdiction shall provide the maximum acceptable propagation delay standard.

24.5.2.6 System Monitoring.

24.5.2.6.1 Fire Alarm System. 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 integrity of the circuit monitoring signal booster(s) and power supply(ies) shall comply with 10.17.1.
- (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

24.5.2.6.2* Dedicated Panel. A dedicated monitoring panel shall be provided within the emergency command center 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

A.24.5.2.6.2 Due to the longer backup battery requirement for the public safety radio communications enhancement system, it is recognized that the fire alarm system might not be available to provide monitoring of radio system signals, including low-battery signals. Therefore, redundant status annunciation is required to provide local signals to the incident commander or his/her designee at the emergency command center.

24.5.2.7 Technical Criteria. The authority having jurisdiction shall maintain a document of technical information specific to its requirements. This document shall contain, as a minimum, the following:

- (1) Frequencies required
- (2) Location and effective radiated power (ERP) of radio sites used by the public safety radio enhancement system
- (3) Maximum propagation delay (in microseconds)
- (4) List of specifically approved system components
- (5) Other supporting technical information necessary to direct system design

24.5.2.8 Inspection and Testing. Inspection and testing shall be performed in accordance with testing frequencies and methods in Chapter 14.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.5.3* Area of Refuge (Area of Rescue Assistance) Emergency Communications Systems.

A.24.5.3 “Areas of refuge” or “areas of rescue assistance” are areas that have direct access to an exit, where people who are unable to use stairs can remain temporarily in safety to await further instructions or assistance during emergency evacuation or other emergency situation. It is, therefore, important that a method to communicate between that location and a central control point where appropriate action for assistance be initiated.

24.5.3.1* Where required by the building code in force, an area of rescue assistance two-way emergency communications system shall be installed in accordance with 24.5.3.

A.24.5.3.1 Generally, the building code or engineer specification will provide the specifics on the required locations of the remote area of refuge (area of rescue assistance) stations, as well as the central control point.

24.5.3.2 The area of refuge (rescue assistance) emergency communications system shall be comprised of remotely located area of refuge stations and a central control point.

24.5.3.3 The remote area of refuge stations and the central control point shall communicate with each other.

24.5.3.4* If the central control point is not constantly attended, it shall have a timed automatic communications capability to connect with a constantly attended monitoring location acceptable to the authority having jurisdiction where responsible personnel can initiate the appropriate response.

A.24.5.3.4 In order to ensure a timely response to a call for assistance, the call is to be forwarded to a constantly attended approved location, such as a supervising station, 911 communications center, or other monitoring location where responsible personnel can initiate the appropriate response.

24.5.3.5 The physical location of the central control point shall be as designated by the building code in force or the authority having jurisdiction.

24.5.3.6 The area of refuge station shall provide for handsfree, two-way communication provide an audible and visible signal to indicate communication has occurred and indicate to the receiver the location sending the signal.

24.5.3.7 Instructions for the use of the two-way communications system instructions for summoning assistance via the two-way communications system and written identification, including in braille, of the location shall be posted adjacent to the two-way communications system.

24.5.4 Elevator Emergency Communications Systems. Elevator two-way emergency communications systems shall be installed in accordance with the requirements of ANSI/ASME A17.1a/CSA B44a, Safety Code for Elevators and Escalators.

24.6* Information, Command, and Control. The requirements of Section 24.6 shall apply to the communications methods and equipment used to receive and transmit

NFPA 72-2010 National Fire Alarm and Signaling Code

information between premises sources or premises systems and the central control station(s).

A.24.6 An emergency communications system information, command, and control is intended to include wired or wireless networks for one- or two-way communications and/or control between a building or area and a central control station and could include an emergency services organization or public alarm reporting system. In a very basic configuration, a system and the receiving facility could be a supervising station system. However, there can be more complex systems that allow control of building systems and communication to building occupants from a remote location, including a municipal or other public alarm reporting command center or possibly even from a mobile command vehicle using secure communications.

24.6.1* Central Control Station for Emergency Communications Systems.

A.24.6.1 For the purposes of this chapter, a central control station is considered to be a mass notification system facility(s), with communications and control equipment serving more than one building, where responsible authorities receive information from premises sources or systems, or from (higher level) regional or national sources or systems, and then disseminate appropriate information to a building, multiple buildings, outside campus areas, municipalities, or a combination of these in accordance with the emergency response plan established for the premises. A mass notification system could include at least one central control station with optional secondary/alternate central control stations.

24.6.1.1* The location of the central control station shall be defined in the emergency response plan and as approved by the authority having jurisdiction.

A.24.6.1.1 The location of the central control station should be coordinated with the first responders. The primary central control station should be located at the command post, emergency operations center, or some such similar location. A redundant central control station, if required, should be located at a physically separate location, such as a police station, fire station, or similar facility.

Generally, the primary central control station should be housed in a building or portion of a building separated from the rest of the facility and having a 2-hour fire-resistive-rated separation.

The mass notification system might require activation of messages originated by mobile sentries and roving patrols using wireless activation devices. In cases where clusters of facilities within the same geographical region exist, one or more regional control stations might also exercise control.

24.6.1.2 The level of security at the central control station shall be defined in the emergency response plan.

24.6.1.3* Staffing.

A.24.6.1.3 The central control station should be staffed by qualified personnel who would monitor the system and take action appropriate to the emergency response plan established for the specific premises.

24.6.1.3.1 Central control station personnel requirements shall be defined in the documentation in the emergency response plan.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.6.1.3.2* Individuals expected to operate an emergency communications system shall be properly trained in the purpose, functions, procedures, and anticipated actions of such systems.

A.24.6.1.3.2 It is imperative that individuals expected to initiate or deliver emergency messages be properly trained in the expected operations. Individuals must be familiar with the equipment, its location, and functions if they will be expected to react properly in an emergency. In an emergency situation, people only react according to instinct or habit. If the individual has not had proper and repeated training over the emergency expectations, they could lack the proper instinct or habit.

Reading an employee manual is generally not an effective means of training for an emergency. To be effective, training must be reinforced with multiple means such as text, audio, visual, and, most importantly, hands-on experience. Regular drills allowing for delivery of live messages indicating an emergency condition is important. Many people have a very difficult time communicating clearly and effectively in an emergency situation when they are excited or fearful. If live messages are to be effective, they must be short, to the point, and in a calm tone conveying exactly what is expected.

Screaming into the microphone, for instance, would not be appropriate. Actual message content will depend on the emergency response plan in place for the respective business and the response to an unfolding event. Situations such as an intruder in a building have become more common today and, as such, should be considered and planned for.

24.6.1.4 The central control station shall be capable of receiving voice messages by telephone or radio and transmitting via equipment at the central control station.

24.6.1.5 The central control station operator shall have the ability to monitor inputs/sensors and control output devices automatically, manually, or automatically with operator override.

24.6.2 Emergency Communications Control Unit (ECCU).

24.6.2.1 An emergency communications control unit (ECCU), where identified by the risk analysis, and defined in the emergency response plan, shall be provided at each central control station.

24.6.2.2 The system operator shall be able to send live voice signals or activate prerecorded voice messages, tones, and other signals.

24.6.2.3 The signals shall be selectable 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, in accordance with the emergency response plan established for the premises.

24.6.2.4 The central control emergency communications control unit shall automatically or manually assign priorities to all transmitted signals.

24.6.2.5 Multiple Emergency Communications Control Units.

24.6.2.5.1 In wide-area mass notification systems, the central control station shall have a primary emergency communications control unit.

24.6.2.5.2 Multiple emergency communications control units shall be permitted.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.6.3* Signals. Where identified by the risk analysis and defined in the emergency response plan, the emergency communications control unit shall be permitted to automatically or manually send different messages or signals to different locations.

A.24.6.3 Different messages or signals could be prerecorded

or live voice, tones, and so forth.

24.6.4 Power Supply.

24.6.4.1 At the central control station, the emergency communications control unit shall meet the requirements of Section 10.5.

24.6.4.2 The power supply for the central control station shall include an uninterrupted power source with capacity sufficient to support the emergency response plan established for the specific premises.

24.6.5 Transmission. Signals shall be capable of being automatically or manually transmitted to a regional or national emergency response center or to other nearby facilities that have a need to be alerted of the emergency.

24.6.6* Other Systems. The central control station shall be capable of interfacing with and controlling other notification systems, such as telephone dialers, tone alert systems, computer network alerting systems, pagers, facsimile machines, textual devices, and other visual control signs, as determined by the emergency response plan.

A.24.6.6 Text notification via wireless devices and desktop computer notification could be an effective means for delivering mass notification messages to multiple recipient groups. Supplementary wireless text messaging could be effective in reaching remote personnel. Desktop notification is particularly effective when more complex information must be conveyed, and it can be a cost-effective interim solution prior to, but not in lieu of, installing an in-building mass notification system.

24.6.7 Inspection, Testing, and Maintenance. Inspection, testing, and maintenance shall be performed on a periodic basis, as described in Chapter 14, to verify and ensure proper system operation and readiness.

24.7* Performance-Based Design of Mass Notification Systems.

The requirements of Section 24.7 shall apply to mass notification systems designed to recognize performance-based practices.

A.24.7 Ensuring accurate information dissemination to the right people, at the right place, and at the right time is essential to the mitigation of threat actions and consequences.

Trained personnel are charged with making such decisions in real time. Quite often, the instructions provided to personnel in affected areas pertain to acting in specific defensive ways so as not to expose them to danger. A typical example is the case of a chemical or biological agent attack wherein the right response is to relocate to secure areas within the building while sealing doors and windows and shutting down air intakes, rather than to leave the building and be exposed to the attacking agent.

In cases of bomb threats, where specific information is available, directions for evacuation are to be given; these directions require more specificity than simply the instruction "Evacuate the building." In most cases, the evacuation route might depend on

NFPA 72-2010 National Fire Alarm and Signaling Code

threat intelligence and is likely to be different from that specified in an emergency response plan. Most people can tell where the fire comes from but do not always know where the bomb is. Automatic evacuation of a building, a common procedure in cases of a fire, is to be avoided, since it might expose personnel to even greater danger.

One of the reasons for implementing a mass notification system is the threat of terrorism. Terrorism attacks tend to be well organized and are often planned with details to inflict the widest degree of damage that is possible. The mass notification system must be designed to withstand various attack scenarios and survive even if some damage has already occurred.

Each design of a mass notification system should be specific to the nature and anticipated risks of each facility for which it is designed. Although this chapter outlines some specific criteria and/or limitations, each design should be based on recognized performance-based design practices.

The mass notification system should be evaluated (risk analysis) and take into account various considerations, such as those indicated in this chapter. The particular design might or might not incorporate these provisions.

Considerations for developing a mass notification system are as follows:

- (1) Specific design for the facility
- (2) Account for anticipated risks
- (3) Use of live and/or prerecorded messaging
- (4) Interfacing with other building emergency communications systems
- (5) Interfacing with wide-area notification systems
- (6) Ability to control the HVAC and access control systems
- (7) Access to system components
- (8) Survivability of the system
- (9) Communication link redundancy and security
- (10) Redundancy and security of the central control stations
- (11) Ability to customize and add to prerecorded message library
- (12) Messages should be tailored to the situation and audience
- (13) Scripted messages for live voice messages
- (14) Proper training of individuals that operate the system

24.7.1 Goals and Objectives. The performance-based design shall meet the following goals and objectives:

- (1) The risk analysis, design criteria, design brief, system performance, and testing criteria are developed in the spirit of this chapter.
- (2) The system disseminates information to the target audience in an accurate and timely manner.
- (3) The design and performance criteria are specific to the nature and anticipated risks of each location.
- (4) The system is capable of withstanding various scenarios and survives even if some damage has already occurred.
- (5) Message initiation can be effected by all responding entities responsible for the safety and security of occupants.

24.7.2* Qualifications. The performance-based design and risk analysis shall be prepared by a design professional certified or approved by the authority having jurisdiction.

NFPA 72-2010 National Fire Alarm and Signaling Code

A.24.7.2 The design professional(s) as part of the design team should be experienced in multiple areas considered essential for conducting the risk analysis and performance design based on the scope and size of the project. Areas of experience can include, but are not limited to:

- (1) Applying recognized performance-based design concepts,
- (2) Conducting hazard and operability studies
- (3) Technical aspects of fire alarm system design
- (4) Technical aspects of emergency communication systems
- (5) Security risks and/or terrorist threats
- (6) Building code requirements and limitations with respect to egress
- (7) Human response to emergency conditions
- (8) Development of emergency response plans
- (9) Other qualifications relative to the needs of the user/risk

The design professional(s) will often be a part of the engineering design team preparing project documents and specifications.

However, the design professional can work for or be obtained by a qualified installation company. The design professional should be bound by professional licensing guidelines to ensure that the risk analysis is conducted in an objective manner based on user needs and not based on product or employment.

24.7.3 Independent Review. The authority having jurisdiction shall be permitted to require an approved, independent third party to review the proposed design brief and provide an evaluation of the design to the authority having jurisdiction.

24.7.4 Final Determination. The authority having jurisdiction shall make the final determination as to whether the performance objectives have been met.

24.7.5 Maintenance of Design Features. The design features required for the system to continue to meet the performance goals and objectives of this Code shall be maintained for the life of the building.

24.7.6 Performance Criteria.

24.7.6.1 General. All designs shall meet the goals and objectives specified in 24.7.1 and shall be considered equivalent, provided that the performance criterion in 24.7.6.2 is met, the design team concurs with the design, and the risk analysis considers the following factors:

- (1) Number of persons to be notified
- (2) Occupancy characteristics
- (3) Anticipated threat
- (4) Staff capabilities
- (5) Coordination with the emergency response plan

24.7.6.2 Performance Criterion. The performance criterion shall include timely and accurate notification of all persons within the boundaries of the mass notification system in a medium to which they can respond when given directions by responding entities.

24.7.6.3* Design Team. The design team shall be comprised of the design professional, the owner or owner's representative, representatives of the authority having jurisdiction, and representatives of the responding entities.

NFPA 72-2010 National Fire Alarm and Signaling Code

24.7.7* Risk Analysis.

24.7.7.1 General.

24.7.7.1.1 The design of the mass notification system shall be specific to the nature and anticipated risks of each facility for which it is designed.

24.7.7.1.2 The design of the mass notification system shall include the preparation of a design brief that is prepared utilizing recognized performance-based design practices.

24.7.7.1.3 The risk analysis shall consider the number of persons, type of occupancy, and perceived peril to occupants.

24.7.7.2 Number of Persons. The analysis shall be based on the maximum number of people that every occupied room, building, area, space, campus, or region is expected to contain.

24.7.7.3 Occupancy Characteristics.

24.7.7.3.1 The risk analysis shall consider characteristics of the buildings, areas, spaces, campuses or regions, equipment, and operations that are not inherent in the design specifications.

24.7.7.3.2 Those elements that are not inherent in the design specifications, but that affect occupant behavior or the rate of hazard development, shall be explicitly identified and included in the risk analysis.

24.7.7.4 Anticipated Threat. The risk analysis shall consider hazards from natural disasters, accidental hazards, and human caused events (accidental and intentional).

24.7.7.5 Extent of Notification. The risk analysis shall include a review of the extent to which occupants and personnel are notified, based on the incident (potential hazard).

24.7.7.6 Operational Status and System Effectiveness. The performance of the system shall reflect the documented performance and reliability of the components of those systems or features, unless design specifications are incorporated to modify the expected performance.

24.7.7.6.1 Staff Assistance. The inclusion of trained employees as part of the mass notification system shall be identified and documented.

24.7.7.6.2 Emergency Response Personnel. The design shall consider the characteristics or other conditions related to the availability, speed of response, effectiveness, roles, and other characteristics of emergency response personnel.

24.7.8* Design Brief.

24.7.8.1 Clear Statement. Design specifications and briefs used in the performance-based design shall be clearly stated and shown to be realistic and sustainable.

24.7.8.2 Testing. Specific testing requirements that are necessary to maintain reliable performance shall be stated in the design brief.

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 26, Supervising Station Fire Alarm Systems

26.2.1 Alarm Signal Disposition. Except as permitted by 29.7.8.2, all fire alarm signals received by a supervising station shall be immediately retransmitted to the ~~public fire service~~ communications center.

26.2.4 Qualification of Supervising Station Operators. Supervising station operators shall be qualified in accordance with the requirements of 10.4.4.

26.3 Fire Alarm Systems for Central Station Service. Fire Alarm systems used to provide central station service shall comply with the general requirements and the use requirements of Section 26.3.

26.3.1 System Scope. Fire Alarm systems for central station service shall include the central station physical plant, exterior communications channels, subsidiary stations, and alarm and signaling equipment located at the protected premises.

26.3.3 Contract Requirements. The central station service elements shall be provided under contract to a subscriber by one of the following:

- (1) A listed central station that provides all of the elements of central station service with its own facilities and personnel.
- (2) A listed central station that provides, as a minimum, the signal monitoring, retransmission, and associated record keeping and reporting with its own facilities and personnel and shall be permitted to subcontract all or any part of the installation, testing, and maintenance and runner service.
- (3) A listed ~~fire alarm service~~–local company that provides the installation, testing, and maintenance with its own facilities and personnel and that subcontracts the monitoring, retransmission, and associated record keeping and reporting to a listed central station. The required runner service shall be provided by the listed alarm service–local company with its own personnel or the listed central station with its own personnel.
- (4) A listed central station that provides the installation, testing, and maintenance with its own facilities and personnel and that subcontracts the monitoring, retransmission, and associated record keeping and reporting to another listed central station. The required runner service shall be provided by either central station.

26.3.4* Indication of Central Station Service. The prime contractor shall conspicuously indicate that the ~~fire~~ alarm system providing service at a protected premises complies with all the requirements of this Code through the use of a systematic follow-up program under the control of the organization that has listed the prime contractor.

26.3.4.1 Documentation indicating Code compliance of the ~~fire~~ alarm system shall be issued by the organization that has listed the prime contractor.

26.3.4.2 The documentation shall include, at a minimum, the following information:

- (1) Name of the prime contractor involved with the ongoing Code compliance of the central station service
- (2) *Full description of the ~~fire~~ alarm system as installed

NFPA 72-2010 National Fire Alarm and Signaling Code

- (3) Issue and expiration dates of the documentation
- (4) Name, address, and contact information of the organization issuing the document
- (5) Identification of the authority(ies) having jurisdiction for the central station service installation

26.3.4.3 The documentation shall be physically posted within 3 ft (1 m) of the ~~fire alarm~~ control unit, and copies of the documentation shall be made available to the authority(ies) having jurisdiction upon request.

26.3.4.5* ~~Fire~~ Alarm system service that does not comply with all the requirements of Section 26.3 shall not be designated as central station service.

26.3.6.1.6* Two independent means shall be provided to retransmit an ~~fire~~ alarm signal to the designated ~~public fire service~~ communications center.

26.3.6.1.6.2 If the principal means of retransmission is not equipped to allow the communications center to acknowledge receipt of each ~~fire~~ alarm report, both means shall be used to retransmit.

26.3.6.2 Personnel.

26.3.6.2.1 The central station shall have not less than two ~~persons~~ qualified operators on duty at the central station at all times to ensure disposition of signals in accordance with the requirements of 26.3.7.

26.4 Proprietary Supervising Station Systems.

26.4.1 Application. Supervising facilities of proprietary ~~fire~~ alarm systems shall comply with the operating procedures of Section 26.4. The facilities, equipment, personnel, operation, testing, and maintenance of the proprietary supervising station shall also comply with Section 26.4.

26.4.2.3 If a protected premises ~~fire alarm~~ control unit is integral to or co-located with the supervising station equipment, the requirements of Section 26.6 shall not apply.

26.4.3 Facilities.

26.4.3.1* The proprietary supervising station shall be located in ~~a fire-resistive, detached building or in a cutoff room and shall not be exposed to the hazardous parts of the premises that are protected~~ either of the following:

A.26.4.3.1 Consideration should be given to providing the following features for a proprietary supervising station location:

- (1) Fire resistive construction meeting the requirements of adopted building codes
- (2) Air handling systems isolated from common building systems
- (1) Fire-resistive, detached building
- (2) A fire-resistive room protected from the hazardous parts of the building

26.4.4.2.2.3 One recording instrument shall be used for recording all incoming signals, while the other shall be used for required ~~fire alarm~~, supervisory, and trouble signals only.

- (A) Failure to acknowledge a signal shall not prevent subsequent signals from recording.

NFPA 72-2010 National Fire Alarm and Signaling Code

(B) Restoration of the signal to its prior condition shall be recorded.

26.4.4.3.2 Fire Alarm signals shall be segregated on a separate visual display in this configuration.

Exception: Fire Alarm signals shall not be required to be segregated on a separate display if given priority status on the common visual display.

26.4.4.4 Display Rate. To facilitate the prompt receipt of fire alarm signals from systems handling other types of signals that are able to produce multiple simultaneous status changes, the requirements of either of the following shall be met:

- (1) The system shall record simultaneous status changes at a rate not slower than either a quantity of 50 or 10 percent of the total number of initiating device circuits connected, within 90 seconds, whichever number is smaller, without loss of any signal.
- (2) The system shall either display or record fire alarm signals at a rate not slower than one every 10 seconds, regardless of the rate or number of status changes occurring, without loss of any signals.

Exception: If fire alarm, waterflow alarm, and sprinkler supervisory signals and their associated trouble signals are the only signals processed by the system, the rate of recording shall not be slower than one signal every 30 seconds.

26.4.4.6 Personnel.

26.4.4.6.1 The proprietary supervising station shall have at least two qualified operators on duty at all times. One of the two operators shall be permitted to be a runner.

Exception: If the means for transmitting alarms to the fire department is automatic, at least one operator shall be on duty at all times.

26.4.5 Operations.

26.4.5.1 Communications and Transmission Channels.

26.4.5.1.1 All communications and transmission channels between the proprietary supervising station and the protected premises ~~fire alarm~~ control unit shall be operated manually or automatically once every 24 hours to verify operation.

26.4.5.3 Retransmission. Indication of a fire shall be promptly retransmitted to the ~~public fire service~~ communications center or other locations accepted by the authority having jurisdiction, indicating the building or group of buildings from which the alarm has been received.

26.4.5.6 Dispositions of Signals.

26.4.5.6.1 Alarms. Upon receipt of an fire alarm signal, the proprietary supervising station operator shall initiate action to perform the following:

- (1) Immediately notify the fire department, the ~~plant fire brigade~~ emergency response team, and such other parties as the authority having jurisdiction requires
- (2) Dispatch a runner or technician to the alarm location to arrive within 2 hours after receipt of a signal

NFPA 72-2010 National Fire Alarm and Signaling Code

- (3) Restore the system as soon as possible after disposition of the cause of the alarm signal

26.4.5.6.4 Trouble Signals. Upon receipt of trouble signals or other signals pertaining solely to matters of equipment maintenance of the fire alarm system, the proprietary supervising station operator shall initiate action to perform the following, if required:

- (1) Communicate immediately with the designated person(s) to ascertain reason for the signal
- (2) Dispatch personnel to arrive within 4 hours to initiate maintenance, if necessary
- (3) Notify the fire department if required by the authority having jurisdiction
- (4) Notify the authority having jurisdiction when interruption of service exists for 4 hours or more
- (5) When equipment has been out of service for 8 hours or more, provide written notice to the authority having jurisdiction as to the nature of the signal, time of occurrence, and restoration of service

26.4.7 Testing and Maintenance. Testing and maintenance of proprietary fire alarm systems shall be performed in accordance with Chapter 14.

26.5.1.2 The installation, maintenance, testing, and use of a remote supervising station fire alarm system that serves properties under various ownership from a remote supervising station shall comply with the requirements of Section 26.5.

26.5.1.4 Remote supervising station fire alarm systems shall provide an automatic audible and visible indication of alarm, supervisory, and trouble conditions at a location remote from the protected premises.

26.5.1.5 Section 26.5 shall not require the use of audible or visible notification appliances other than those required at the remote supervising station. If it is desired to provide fire alarm evacuation signals in the protected premises, the alarm signals, circuits, and controls shall comply with the provisions of Chapters 18 and 23 in addition to the provisions of Section 26.5.

26.5.2 Indication of Remote Station Service. Owners utilizing remote station alarm systems shall provide annual documentation to the authority having jurisdiction identifying the party responsible for the inspection, testing, and maintenance requirements of Chapter 14. This documentation shall take one of the following forms:

- (1) *An affidavit attesting to the responsibilities and qualifications of the parties performing the inspection, testing, and maintenance and accepting responsibility of compliance with Chapter 14. This document shall be signed by a representative of the service provider.

A.26.5.2(1) Chapter 14 permits the building owner or his designated representative to perform these services if they are qualified. In this situation, the documentation could be a declaration of qualification signed by the building owner. Multiple service providers are permitted.

- (2) Documentation indicating code compliance of the remote station alarm system issued by the organization that listed the service provider.
- (3) Other documentation acceptable to the authority having jurisdiction.

NFPA 72-2010 National Fire Alarm and Signaling Code

26.5.3* Facilities.

26.5.3.1 Fire Alarm systems utilizing remote supervising station connections shall transmit alarm and supervisory signals to a facility meeting the requirements of either 26.5.3.1.1, 26.5.3.1.2 or 26.5.3.1.3.

26.5.3.1.1 Fire Alarm, supervisory, and trouble signals shall be permitted to be received at a ~~public fire service communications center, at the fire station, or at the governmental agency that has the public responsibility for taking prescribed action to ensure response upon receipt of a fire alarm signal~~ that complies with the requirements of NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems.*

26.5.3.1.2 Alarm, supervisory, and trouble signals shall be permitted to be received at the fire station or at the governmental agency that has public responsibility for taking prescribed action to ensure response upon receipt of a alarm signal.

26.5.3.1.3* Where permitted by the authority having jurisdiction, fire alarm, supervisory, and trouble signals shall be permitted to be received at an alternate location approved by the authority having jurisdiction.

A.26.5.3.1.3 A listed central station might be considered an acceptable alternate location for receipt of fire alarm, ~~and supervisory, and trouble~~ signals.

26.5.3.2* Trouble signals shall be permitted to be received at an ~~constantly attended approved~~ location that has personnel on duty who are trained to recognize the type of signal received and to take prescribed action. The location shall be permitted to be other than that at which alarm and supervisory signals are received.

A.26.5.3.2 A listed central station might be considered an acceptable alternate location for receipt of trouble signals.

26.5.3.3 If locations other than the ~~public fire service~~ communications center are used for the receipt of signals, access to receiving equipment shall be restricted in accordance with the requirements of the authority having jurisdiction.

26.5.4.4 Retransmission of an alarm signal, if required, shall be by one of the following methods, which appear in descending order of preference as follows:

- (1) A dedicated circuit that is independent of any switched telephone network. This circuit shall be permitted to be used for voice or data communications.
- (2) A one-way (outgoing only) telephone at the remote supervising station that utilizes the public switched telephone network. This telephone shall be used primarily for voice transmission of alarms to a telephone at the ~~public fire service~~ communications center that cannot be used for outgoing calls.
- (3) A private radio system using the fire department frequency, where permitted by the fire department.
- (4) Other methods accepted by the authority having jurisdiction.

26.5.4.5.1 ~~Personnel staffing and duties shall comply with 8.5.3.5.1 and 8.5.3.5.2.~~ The remote supervising station shall have not less than two qualified operators on duty at the remote supervising station at all times to ensure disposition of signals in accordance with the requirements of 26.5.5.

NFPA 72-2010 National Fire Alarm and Signaling Code

26.5.5 Operations.

26.5.5.1 If the remote supervising station is at a location other than the ~~public fire service~~ communications center, alarm signals shall be immediately retransmitted to the ~~public fire service~~ communications center.

26.5.5.2 Upon receipt of an alarm, a supervisory, or a trouble signal by the remote supervising station other than the ~~public fire service~~ communications center, the operator on duty shall be responsible for notifying the owner or the owner's designated representative immediately.

26.6 Communications Methods for Supervising Station Fire Alarm Systems.

26.6.2.4 Equipment.

26.6.2.4.1 Fire Alarm system equipment and installations shall comply with Federal Communications Commission (FCC) rules and regulations, as applicable, concerning the following:

- (1) Electromagnetic radiation
- (2) Use of radio frequencies
- (3) Connection to the public switched telephone network of telephone equipment, systems, and protection apparatus

26.6.2.5.3 For active and two-way RF multiplex systems that are part of a central station fire alarm system, restoration of service to the affected portions of the system shall be automatically recorded. When service is restored, the first status change of any initiating device circuit, any initiating device directly connected to a signaling line circuit, or any combination thereof that occurred at any of the affected premises during the service interruption also shall be recorded.

~~26.6.3 Other Transmission Technologies Communication Methods~~

~~8.6.3.1 Active Multiplex Transmission Systems.~~

~~**8.6.3.1.1** The multiplex transmission channel shall terminate in a transmitter at the protected premises and in a system unit at the supervising station.~~

~~**8.6.3.1.1.1** The derived channel shall terminate in a transmitter at the protected premises and in derived channel equipment at a subsidiary station location or a telephone company wire center.~~

~~**8.6.3.1.1.2** The derived channel equipment at the subsidiary station location or a telephone company wire center shall select or establish the communications with the supervising station.~~

~~**8.6.3.1.2*** Operation of the transmission channel shall conform to the requirements of this Code whether channels are private facilities, such as microwave, or leased facilities furnished by a communications utility company. If private signal transmission facilities are used, the equipment necessary to transmit signals shall also comply with the requirements for duplicate equipment or replacement of critical components, as described in 8.6.5.2.~~

NFPA 72-2010 National Fire Alarm and Signaling Code

~~A.8.6.3.1.2~~ Where derived channels are used, normal operating conditions of the telephone equipment are not to inhibit or impair the successful transmission of signals. These normal conditions include, but are not limited to, the following:

- ~~(1) Intraoffice calls with a transponder on the originating end~~
- ~~(2) Intraoffice calls with a transponder on the terminating end~~
- ~~(4) Intraoffice calls with transponders on both ends~~
- ~~(5) Receipt and origination of long-distance calls~~
- ~~(6) Calls to announcement circuits~~
- ~~(7) Permanent signal receiver off-hook tone~~
- ~~(8) Ringing with no answer, with transponder on either the originating or the receiving end~~
- ~~(9) Calls to tone circuits (i.e., service tone, test tone, busy, or reorder)~~
- ~~(10) Simultaneous signal with voice source~~
- ~~(11) Simultaneous signal with data source~~
- ~~(12) Tip and ring reversal~~
- ~~(13) Cable identification equipment~~

~~8.6.3.1.2.1~~ The trunk transmission channels shall be dedicated facilities for the main channel.

Exception: Derived channel scanners with no more than 32 legs shall be permitted to use the public switched telephone network for the main channel.

~~8.6.3.1.2.2~~ For Type 1 multiplex systems, the public switched telephone network facilities shall be permitted to be used for the alternate channel.

~~8.6.3.1.3~~ Derived channel signals shall be permitted to be transmitted over the leg facility, which shall be permitted to be shared by the telephone equipment under all on-hook and off-hook operating conditions.

~~8.6.3.1.4~~ If derived channel equipment uses the public switched telephone network to communicate with a supervising station, such equipment shall meet the requirements of 8.6.3.2.

~~8.6.3.1.5~~ The maximum end-to-end operating time parameters allowed for an active multiplex system shall be as follows:

- ~~(1) The maximum allowable time lapse from the initiation of a single fire alarm signal until it is recorded at the supervising station shall not exceed 90 seconds. When any number of subsequent fire alarm signals occur at any rate, they shall be recorded at a rate no slower than one every 10 additional seconds.~~
 - ~~(2) *The maximum allowable time lapse from the occurrence of an adverse condition in any transmission channel until recording of the adverse condition is started shall not exceed 90 seconds for Type 1 and Type 2 systems and 200 seconds for Type 3 systems. The requirements of 8.6.3.1.6 shall apply.~~
- ~~A.8.6.3.1.5(2)~~ Derived channel systems comprise Type 1 and Type 2 systems only.
- ~~(3) In addition to the maximum operating time allowed for fire alarm signals, the requirements of one of the following shall be met:
 - ~~(a) A system unit that has more than 500 initiating device circuits shall be able to record not less than 50 simultaneous status changes within 90 seconds.~~~~

NFPA 72-2010 National Fire Alarm and Signaling Code

- (b) A system unit having fewer than 500 initiating device circuits shall be able to record not less than 10 percent of the total number of simultaneous status changes within 90 seconds.

Exception: Proprietary supervising station systems that have operating time requirements specified in 8.4.4.4 through 8.4.4.6.

~~8.6.3.1.6~~ The classifications for active multiplex systems shall be divided into three categories on the basis of their ability to perform under adverse conditions of their transmission channels. The system classifications shall be as described in 8.6.3.1.6.1 through 8.6.3.1.6.3.

~~8.6.3.1.6.1~~ A Type 1 system shall have dual control as described in 8.6.2.6.

- (A) An adverse condition on a trunk or leg facility shall not prevent the transmission of signals from any other trunk or leg facility, except those signals dependent on the portion of the transmission channel in which the adverse condition has occurred.
- (B) An adverse condition limited to a leg facility shall not interrupt service on any trunk or other leg facility.
- (C) The requirements of 8.6.2.1 through 8.6.2.5 shall be met by Type 1 systems.

~~8.6.3.1.6.2~~ A Type 2 system shall have the same requirements as a Type 1 system.

Exception: Dual control of the primary trunk facility shall not be required.

~~8.6.3.1.6.3~~ A Type 3 system shall automatically indicate and record at the supervising station the occurrence of an adverse condition on the transmission channel between a protected premises and the supervising station. The requirements of 8.6.2 shall be met.

Exception: The requirements of 8.6.2.6 shall not apply.

~~8.6.3.1.7*~~ Allowable system loading capacities of active multiplex systems shall be in accordance with Table 8.6.3.1.7 unless otherwise permitted by 8.6.3.1.8.

~~A.8.6.3.1.7~~ The capacities of active multiplex systems are based on the overall reliability of the signal receiving, processing, display, and recording equipment at the supervising and subsidiary stations, and the capability to transmit signals during adverse conditions of the signal transmission facilities.

~~Table 8.6.3.1.7 Loading Capacities for Active Multiplex Systems~~

~~8.6.3.1.8~~ If the signal receiving, processing, display, and recording equipment are duplicated at the supervising station and a switchover is able to be accomplished in not more than 30 seconds with no loss of signals during this period, the capacity of a system unit shall be unlimited.

~~26.6.3.1* General.~~

A.26.6.3.1 Certain legacy technologies (active multiplex, McCulloh, directly connected non-coded and private microwave) have been removed from the text of the document. Existing systems utilizing these technologies are acceptable, because all these technologies also comply with the general provisions of 26.6.3.1.

NFPA 72-2010 National Fire Alarm and Signaling Code

26.6.3.1.1 Conformance. ~~Other transmission technologies shall include those transmission technologies that operate on principles different from specific transmission technologies covered by this chapter and Communications methods operating on principles different from specific methods covered by this chapter shall be permitted to be installed if they conform to the performance requirements of this subsection and to all other applicable requirements of this Code.~~

26.6.3.1.2 Federal Communications Commission. Fire Alarm system equipment and installations shall comply with the Federal Communications Commission (FCC) rules and regulations, as applicable, concerning electromagnetic radiation, use of radio frequencies, and connections to the public switched telephone network of telephone equipment, systems, and protection apparatus.

26.6.3.1.4 Communications Integrity. Provision shall be made to monitor the integrity of the transmission technology and its communications path. ~~The following requirements shall apply:~~

- ~~(1) Any failure shall be annunciated at the supervising station within 5 minutes of the failure.~~
- ~~(2) If communications cannot be established with the supervising station, an indication of this failure to communicate shall be annunciated at the protected premises.~~
- ~~(3) If a portion of the communications path cannot be monitored for integrity, a redundant communications path shall be provided.~~
- ~~(4) Provision shall be made to monitor the integrity of the redundant communications path.~~
- ~~(5) Failure of both the primary and redundant communications paths shall be annunciated at the supervising station within not more than 24 hours of the failure.~~
- ~~(6) System units at the supervising station shall be restored to service within 30 minutes of a failure.~~
- ~~(7) The transmission technology shall be designed so that upon failure of a transmission channel serving a system unit at the supervising station, the loss of the ability to monitor shall not affect more than 3000 transmitters.~~

26.6.3.1.4.1 Single Communications Technology. Where only one communications technology is used, any failure of the communications path shall be annunciated at the supervising station within 5 minutes of the failure.

26.6.3.1.4.2 Multiple Communications Technologies. Where two or more different technologies are used, the following requirements shall be met:

- (1) Provision shall be made to monitor the integrity of each communications path.
- (2) Failure of any communications path shall be annunciated at the supervising station and at the protected premises within not more than 24 hours of the failure.

Exception: Where technologies used are described elsewhere in this Code, monitoring for integrity shall be permitted to comply with those requirements.

26.6.3.1.5 Spare System Unit Equipment. An inventory of spare equipment shall be maintained at the supervising station such that any failed piece of equipment can be

NFPA 72-2010 National Fire Alarm and Signaling Code

replaced and the systems unit restored to full operation within the time limitations specified in this Code 30 minutes of failure.

26.6.3.1.6.2 If duplicate spare system units are maintained at the supervising station and switchover can be achieved in 30 seconds, then the system capacity shall be permitted to be unlimited.

26.6.3.1.10.1 Communication of alarm, supervisory, and trouble signals shall be in a ~~highly reliable manner~~ accordance with this section to prevent degradation of the signal in transit, which in turn would result in either of the following:

- (1) Failure of the signal to be displayed and recorded at the supervising station
- (2) An incorrect corrupted signal displayed and recorded at the supervising station

26.6.3.1.10 Signal Error Detection and Correction.

~~**8.6.4.11* Signal Priority.** If the communications methodology is shared with any other usage, all fire alarm, supervisory, and trouble signals shall take precedence, in that respective order of priority, over all other signals unless otherwise permitted by the authority having jurisdiction.~~

~~*Exception: If an order of signal priority cannot be assured, then the maximum duration between the initiation of an alarm signal at the protected premises, transmission of the signal, and subsequent display and recording of the alarm signal at the supervising station shall not exceed 90 seconds.*~~

~~**A.8.6.4.11** Signals from hold-up alarms or other signals indicating life-threatening situations are permitted to take precedence over supervisory and trouble signals if acceptable to the authority having jurisdiction.~~

26.6.3.1.11* Sharing Communications Equipment On-Premises.

If the fire alarm transmitter is sharing on-premises communications equipment, the shared equipment shall be listed for the purpose. ~~If on-premises communications equipment is not listed for the purpose, the fire alarm transmitter shall be installed ahead of the unlisted communications equipment.~~

~~**A.26.6.3.1.11** Most communications equipment is not specifically listed for fire alarm applications, but is listed in accordance with applicable product standard for general communications equipment.~~

26.6.3.1.12* Secondary Power. Secondary power capacity in accordance with 10.5.6 shall be provided for all equipment necessary for the transmission and reception of alarm, supervisory, trouble, and other signals located at the protected premises and at the supervising station.

~~**A.26.6.3.1.12** This requirement is to ensure that communications equipment will operate for the same period of time on secondary power as the alarm control unit.~~

~~**8.6.4.13 Service Provider Diversity.** When a redundant path is required, both paths shall be private or the alternate path shall be provided by a public communications service provider different from the primary path, if available.~~

26.6.3.1.13 Unique Flaws Not Covered by This Code. If a communications technology has a unique flaw that could result in the failure to communicate a signal, the

NFPA 72-2010 National Fire Alarm and Signaling Code

implementation of that technology for fire alarm signaling shall compensate for that flaw so as to eliminate the risk of missing an fire alarm signal.

~~**8.6.4.14 Throughput Probability.** When the supervising station does not regularly communicate with the transmitter at least once every 200 seconds, then the throughput probability of the alarm transmission shall be at least 90 percent in 90 seconds, 99 percent in 180 seconds, or 99.999 percent in 450 seconds.~~

26.6.3.2 Digital Alarm Communicator Systems.

26.6.3.2.1 Digital Alarm Communicator Transmitter (DACT).

26.6.3.2.1.1* Public Switched Network. A DACT shall be connected to the public switched telephone network upstream of any private telephone system at the protected premises.

- (A) The connections to the public switched telephone network shall be under the control of the subscriber for whom service is being provided by the supervising station fire alarm system.
- (B) Special attention shall be required to ensure that this connection is made only to a loop start telephone circuit and not to a ground start telephone circuit.

Exception: If public cellular telephone service is used as a secondary means of transmission, the requirements of 26.6.3.2.1.1 shall not apply to the cellular telephone service.

26.6.3.2.1.4 Transmission Channels.

- (A) *A system employing a DACT shall employ one telephone line (number). In addition, one of the following transmission means shall be employed:
 - (1) A second telephone line (number)
 - (2) A cellular telephone connection
 - (3) A one-way radio system
 - (4) A one-way private radio alarm system
 - (5) A private microwave radio system
 - (6) A two-way RF multiplex system
 - (7) A transmission means complying with 26.6.3.1

Exception: One telephone line (number) equipped with a derived local channel or a single integrated services digital network (ISDN) telephone line using a terminal adapter specifically listed for supervising station alarm service, where the path between the transmitter and the switched telephone network serving central office is monitored for integrity so that the occurrence of an adverse condition in the path shall be annunciated at the supervising station within 200 seconds.

- (B) The following requirements shall apply to all combinations listed in 26.6.3.2.1.4(A):
 - (1) Both channels shall be supervised in a manner approved for the means of transmission employed.
 - (2) Both channels shall be tested at intervals not exceeding 24 hours.

Exception No. 1: For public cellular telephone service, a verification (test) signal shall be transmitted at least monthly.

NFPA 72-2010 National Fire Alarm and Signaling Code

Exception No. 2: Where two telephone lines (numbers) are used, it shall be permitted to test each telephone line (number) at alternating 24-hour intervals.

- (3) The failure of either channel shall send a trouble signal on the other channel within 4 minutes.
- (4) When one transmission channel has failed, all status change signals shall be sent over the other channel.

Exception: Where used in combination with a DACT, a derived local channel shall not be required to send status change signals other than those indicating that adverse conditions exist on the telephone line (number).

- (5) The primary channel shall be capable of delivering an indication to the DACT that the message has been received by the supervising station.
- (6) *The first attempt to send a status change signal shall use the primary channel.

A.26.6.3.2.1.4(B)(6) Where two telephone lines (numbers) are used, care should be taken to assign the primary DACT telephone line (number) to a nonessential telephone line (number) at the protected premises so that the primary line used in the premises is not unnecessarily interrupted.

Exception: Where the primary channel is known to have failed.

- (7) Simultaneous transmission over both channels shall be permitted.
- (8) Failure of telephone lines (numbers) or cellular service shall be annunciated locally.

26.6.3.2.1.5 DACT Transmission Means. The following requirements shall apply to all digital alarm communications transmitters:

- (1) A DACT shall be connected to two separate means of transmission at the protected premises.
- (2) The DACT shall be capable of selecting the operable means of transmission in the event of failure of the other means.
- (3) The primary means of transmission shall be a telephone line (number) connected to the public switched network.
- (4) *The first transmission attempt shall utilize the primary means of transmission.

A.26.6.3.2.1.5(4) Where two telephone lines (numbers) are used, care should be taken to assign the primary DACT telephone line (number) to a nonessential telephone line (number) at the protected premises so that the primary line used in the premises is not unnecessarily interrupted.

- (5) Each DACT shall be programmed to call a second DACR line (number) when the signal transmission sequence to the first called line (number) is unsuccessful.
- (6) Each DACT shall automatically initiate and complete a test signal transmission sequence to its associated DACR at least once every 24 hours. A successful signal transmission sequence of any other type, within the same 24-hour period, shall fulfill the requirement to verify the integrity of the reporting system, provided that signal processing is automated so that 24-hour delinquencies are individually acknowledged by supervising station personnel.

NFPA 72-2010 National Fire Alarm and Signaling Code

- (7) *If a DACT is programmed to call a telephone line (number) that is call forwarded to the line (number) of the DACR, a means shall be implemented to verify the integrity of the call forwarding feature every 4 hours.

26.6.3.2.3.3 Digital Alarm Radio Receiver (DARR) Equipment.

- (A) A spare DARR shall be provided in the supervising station and shall be able to be switched into the place of a failed unit within 30 seconds after detection of failure.
- (B) Facilities shall be provided at the supervising station for supervisory and control functions of subsidiary and repeater station radio-receiving equipment. This shall be accomplished via a supervised circuit where the radio equipment is remotely located from the supervising or subsidiary station. The following conditions shall be supervised at the supervising station:
- (1) Failure of ac power supplying the radio equipment
 - (2) Malfunction of receiver
 - (3) Malfunction of antenna and interconnecting cable
 - (4) Indication of automatic switchover of the DARR
 - (5) Malfunction of data transmission line between the DARR and the supervising or subsidiary station

~~8.6.3.3 McCulloh Systems.~~

~~8.6.3.3.1 Transmitters.~~

~~8.6.3.3.1.1 A coded alarm signal from a transmitter shall consist of not less than three complete rounds of the number or code transmitted.~~

~~8.6.3.3.1.2* A coded fire alarm box shall produce not less than three signal impulses for each revolution of the coded signal wheel or another approved device.~~

~~8.6.3.3.1.3 Circuit adjusting means for emergency operating shall be permitted to be either automatic or be provided through manual operation upon receipt of a trouble signal.~~

~~8.6.3.3.1.4* Equipment shall be provided at the supervising or subsidiary station on all circuits extending from the supervising or subsidiary station that is utilized for McCulloh systems for performing the following:~~

~~A.8.6.3.3.1.4 The current readings, in accordance with 8.6.3.3.1.4(1), should be compared with the normal readings to determine whether a change in the circuit condition has occurred. A zero current reading in accordance with 8.6.3.3.1.4(2) indicates that the circuit is clear of a foreign ground.~~

- ~~(1) Tests on current on each circuit under nontransmitting conditions~~
- ~~(2) Tests on current on each side of the circuit with the receiving equipment conditioned for an open circuit~~

~~8.6.3.3.2 Transmission Channels.~~

~~8.6.3.3.2.1 Circuits between the protected premises and the supervising or subsidiary station that are essential to the actuation or operation of devices that initiate a signal~~

NFPA 72-2010 National Fire Alarm and Signaling Code

indicative of fire shall be arranged so that the occurrence of a single break or single ground fault does not prevent transmission of an alarm.

~~8.6.3.3.2.2~~ Circuits wholly within the supervising or subsidiary station shall not be required to be arranged in accordance with 8.6.3.3.2.1.

~~8.6.3.3.2.3~~ The carrier system portion of circuits shall not be required to be arranged in accordance with 8.6.3.3.2.1.

~~8.6.3.3.2.4~~ The occurrence of a single break or a single ground fault on any circuit shall not of itself cause a false signal that is able to be interpreted as an alarm of fire. If such a single fault prevents the functioning of any circuit, its occurrence shall be indicated automatically at the supervising station by a trouble signal that compels attention and that is distinguishable from signals other than those indicative of an abnormal condition of supervised parts of a fire suppression system(s).

~~8.6.3.3.2.5~~ The circuits and devices shall be arranged to receive and record a signal identifiable as to location of origin, and provisions shall be made for identifying transmission to the public fire service communications center.

~~8.6.3.3.2.6~~ Multipoint transmission channels between the protected premises and the supervising or subsidiary station and within the protected premises, consisting of one or more coded transmitters and an associated system unit(s), shall meet the requirements of either 8.6.3.3.2.7 or 8.6.3.3.2.8.

~~8.6.3.3.2.7~~ If end-to-end metallic continuity is present, signals shall be received from other points under any one of the following transmission channel fault conditions at one point on the line:

- (1) Open
- (2) Ground
- (3) *Wire-to-wire short

~~A.8.6.3.3.2.7(3)~~ Though rare, it is understood that the occurrence of a wire-to-wire short on the primary trunk facility near the supervising station could disable the transmission system without immediate detection.

- (4) Open and ground

~~8.6.3.3.2.8~~ If end-to-end metallic continuity is not present, the nonmetallic portion of transmission channels shall meet all of the following requirements:

- (1) Two nonmetallic channels or one channel plus a means for immediate transfer to a standby channel shall be provided for each transmission channel, with a maximum of eight transmission channels being associated with each standby channel, or shall be furnished over one channel, provided that service is limited to one plant.
- (2) The two nonmetallic channels (or one channel with standby arrangement) for each transmission channel shall be provided by one of the following means, shown in descending order of preference:
 - (a) Over separate facilities and separate routes
 - (b) Over separate facilities in the same route
 - (c) Over the same facilities in the same route

NFPA 72-2010 National Fire Alarm and Signaling Code

- (3) Failure of a nonmetallic channel or any portion thereof shall be indicated immediately and automatically in the supervising station.
- (4) Signals shall be received from other points under any one of the following fault conditions at one point on the metallic portion of the transmission channel:
 - (a) Open
 - (b) Ground
 - (c) *Wire-to-wire short

A.8.6.3.3.2.8(4)(c) Though rare, it is understood that the occurrence of a wire-to-wire short on the primary trunk facility near the supervising station could disable the transmission system without immediate detection.

8.6.3.3.3 Loading Capacity of McCulloh Circuits.

8.6.3.3.3.1 The number of transmitters connected to any transmission channel shall be limited to eliminate interference.

8.6.3.3.3.2 The total number of code wheels or other approved devices connected to a single transmission channel shall not exceed 250.

8.6.3.3.3.3 Alarm signal transmission channels shall be reserved exclusively for fire alarm signal transmitting service unless the transmission channels meet the requirements of 8.6.3.3.3.6.

8.6.3.3.3.4 The number of waterflow switches permitted to be connected to actuate a single transmitter shall not exceed five switches.

8.6.3.3.3.5 The number of supervisory switches permitted to be connected to actuate a single transmitter shall not exceed 20 switches.

8.6.3.3.3.6 Combined alarm and supervisory transmission channels shall comply with the following:

- (1) If both sprinkler supervisory signals and fire or waterflow alarm signals are transmitted over the same transmission channel, provision shall be made to obtain either alarm signal precedence or continuous repetition of the alarm signal to prevent the loss of any alarm signal.
- (2) Other signal transmitters (e.g., burglar, industrial processes) on an alarm transmission channel shall not exceed five.

8.6.3.3.3.7* If signals from manual fire alarm boxes and waterflow alarm transmitters within a building are transmitted over the same transmission channel and are operating at the same time, there shall be no interference with the fire box signals. Provision of the shunt noninterfering method of operation shall be permitted for this performance.

A.8.6.3.3.3.7 At the time of system acceptance, verification should be made that manual fire alarm box signals are free of transmission channel interference.

8.6.3.3.3.8 One alarm transmission channel shall serve not more than 25 plants.

- (A) A plant shall be permitted to consist of one or more buildings under the same ownership, and the circuit arrangement shall be such that an alarm signal cannot be received from more than one transmitter at a time within a plant.
- (B) If such noninterference is not provided, each building shall be a plant.

NFPA 72-2010 National Fire Alarm and Signaling Code

~~8.6.3.3.3.9~~ One sprinkler supervisory transmission channel circuit shall serve not more than 25 plants. A plant shall be permitted to consist of one or more buildings under the same ownership.

~~8.6.3.3.3.10~~ Connections to a guard supervisory transmission channel or to a combination manual fire alarm and guard transmission channel shall be limited so that not more than 60 scheduled guard report signals are transmitted in any 1-hour period. Patrol scheduling shall be such as to eliminate interference between guard report signals.

~~8.6.3.3.4*~~ Unless accepted by the authority having jurisdiction, McCulloh systems shall not be permitted to be installed after June 30, 2003.

~~A.8.6.3.3.4~~ It is anticipated that McCulloh transmission technology will cease to be a viable option due to many factors, including unavailability of parts, unavailability of telephone facilities, and lack of technical support availability. This does not preclude the use, maintenance, or expansion of existing McCulloh systems.

26.6.3.3 Radio Systems.

26.6.3.3.1 Two-Way Radio Frequency (RF) Multiplex Systems.

26.6.3.3.1.1 Maximum Operating Time. The maximum end-to-end operating time parameters allowed for a two-way RF multiplex system shall be as follows:

- (1) The maximum allowable time lapse from the initiation of a single fire alarm signal until it is recorded at the supervising station shall not exceed 90 seconds. When any number of subsequent fire alarm signals occur at any rate, they shall be recorded at a rate no slower than one every additional 10 seconds.
- (2) The maximum allowable time lapse from the occurrence of an adverse condition in any transmission channel until recording of the adverse condition is started shall not exceed 200 seconds for Type 4 and Type 5 systems. The requirements of 26.6.3.3.1.4 shall apply.
- (3) In addition to the maximum operating time allowed for fire alarm signals, the requirements of one of the following shall be met:
 - (a) A system unit that has more than 500 initiating device circuits shall be able to record not less than 50 simultaneous status changes within 90 seconds.
 - (b) A system unit that has fewer than 500 initiating device circuits shall be able to record not less than 10 percent of the total number of simultaneous status changes within 90 seconds.

26.6.3.3.2 One-Way Private Radio Alarm Systems.

26.6.3.3.2.1 Independent Receivers.

- (A) The requirements of 26.6.3.3.2 for a radio alarm repeater station receiver (RARSR) shall be satisfied if the signals from each radio alarm transmitter (RAT) are received and supervised, in accordance with Chapter 26, by at least two independently powered, independently operating, and separately located RARSRs or radio alarm supervising station receivers (RASSRs), or by one of each.

NFPA 72-2010 National Fire Alarm and Signaling Code

- (B) At least two separate paths shall be provided from a RAT to the ultimate RASSR.
- (C) Only one path to the RASSR shall be required to be utilized in the event alarms can be transmitted from a RAT to the RASSR and the RAT has the ability to receive a positive acknowledgment that the RASSR has received the signal.

26.6.3.3.2.2* Maximum Operating Time. The end-to-end operating time parameters allowed for a one-way radio alarm system shall be as follows:

- (1) There shall be a 90 percent probability that the time between the initiation of a single alarm signal until it is recorded at the supervising station will not exceed 90 seconds.
- (2) There shall be a 99 percent probability that the time between the initiation of a single fire alarm signal until it is recorded at the supervising station will not exceed 180 seconds.
- (3) There shall be a 99.999 percent probability that the time between the initiation of a single fire alarm signal until it is recorded at the supervising station will not exceed 7.5 minutes (450 seconds), at which time the RAT shall cease transmitting. When any number of subsequent fire alarm signals occurs at any rate, they shall be recorded at an average rate no slower than one every additional 10 seconds.
- (4) In addition to the maximum operating time allowed for alarm signals, the system shall be able to record not less than 12 simultaneous status changes within 90 seconds at the supervising station.

26.6.3.3.2.3 Supervision. Equipment shall be provided at the supervising station for the supervisory and control functions of the supervising or subsidiary station and for the repeater station radio transmitting and receiving equipment. This shall be accomplished via a supervised circuit where the radio equipment is remotely located from the system unit and the conditions of 26.6.3.3.2.3(A) through 26.6.3.3.2.3(D) are met.

26.6.3.3.2.4 Transmission Channels. Transmission channels shall comply with 26.6.3.3.2.4(A) through 26.6.3.3.2.4(F).

26.6.3.3.2.6 Loading Capacities. The loading capacities of one-way radio alarm systems shall be based on the overall reliability of the signal-receiving, processing, display, and recording equipment at the supervising or subsidiary station and the capability to transmit signals during adverse conditions of the transmission channels. Loading capacities shall comply with 26.6.3.3.2.6(A) and 26.6.3.3.2.6(B).

- (A) Allowable loading capacities shall be in accordance with Table 26.6.3.3.2.6(A), except as modified by the following:
 - (1) Each guard's tour transmitter shall reduce the allowable RATs by 15.
 - (2) Each two-way protected premises radio transmitter shall reduce the allowable RATs by two.
 - (3) Each supervised burglar alarm (open/close) or each suppressed guard's tour transmitter shall reduce the allowable RATs by five.
- (B) If the signal-receiving, processing, display, and recording equipment is duplicated at the supervising station and a switchover is able to be accomplished in not

NFPA 72-2010 National Fire Alarm and Signaling Code

more than 30 seconds, with no loss of signals during this period, the capacity of a system unit shall be permitted to be unlimited.

8.6.3.6 Directly Connected Noncoded Systems.

8.6.3.6.1 Circuits. ~~Circuits for transmission of alarm signals between the fire alarm control unit or the transmitter in the protected premises and the supervising station shall be arranged to comply with either (1) or (2):~~

- ~~(1) These circuits shall be arranged so that the occurrence of a single break or single ground fault does not prevent the transmission of an alarm signal. Circuits complying with this paragraph shall be automatically self-adjusting in the event of either a single break or a single ground fault and shall be automatically self-restoring in the event that the break or fault is corrected.~~
- ~~(2) These circuits shall be arranged so that they are isolated from ground (except for reference ground detection) and so that a single ground fault does not prevent the transmission of an alarm signal. Circuits complying with this paragraph shall be provided with a ground reference circuit so as to detect and indicate automatically the existence of a single ground fault.~~

8.6.3.6.1.1 Additional Requirements. ~~In addition, these circuits shall comply with all of the following requirements:~~

- ~~(1) A multiple ground fault condition that would prevent alarm operation shall be indicated by an alarm or by a trouble signal.~~
- ~~(2) Circuits for transmission of supervisory signals shall be separate from alarm circuits.~~
- ~~(3) The occurrence of a single break or a single ground fault on any circuit shall not of itself cause a false signal that is able to be interpreted as an alarm of fire.~~

8.6.3.6.1.2 Exclusions. ~~The requirements of this section shall not apply to the following circuits:~~

- ~~(1) Circuits wholly within the supervising station~~
- ~~(2) Circuits wholly within the protected premises extending from one or more automatic fire detectors or other noncoded initiating devices other than waterflow devices to a transmitter or fire alarm control unit~~
- ~~(3) Power supply leads wholly within the building or buildings protected~~

8.6.3.6.2 Loading Capacity of Circuits.

8.6.3.6.2.1 ~~The number of initiating devices connected to any signaling circuit and the number of plants that shall be permitted to be served by a signal circuit shall be determined by the authority having jurisdiction and shall not exceed the limitations specified in this subsection.~~

8.6.3.6.2.2 ~~A plant shall be permitted to consist of one or more buildings under the same ownership.~~

8.6.3.6.2.3* ~~A single circuit shall not serve more than one plant.~~

A.8.6.3.6.2.3 ~~If a single plant involves more than one gate entrance or involves a number of buildings, separate circuits might be required so that the alarm to the~~

NFPA 72-2010 National Fire Alarm and Signaling Code

supervising station indicates the area to which the fire department is to be dispatched.

8.6.3.7 Private Microwave Radio Systems.

8.6.3.7.1* If a private microwave radio is used as the transmission channel and communications channel, supervised transmitting and receiving equipment shall be provided at supervising, subsidiary, and repeater stations.

A.8.6.3.7.1 A private microwave radio can be used either as a transmission channel, to connect a transmitter to a supervising station or subsidiary station, or as a communications channel to connect a subsidiary station(s) to a supervising station(s). This can be done independently or in conjunction with wireline facilities.

8.6.3.7.2 If more than five protected buildings or premises or 50 initiating devices or initiating device circuits are being serviced by a private radio carrier, the supervising, subsidiary, and repeater station radio facilities shall meet all of the following criteria:

- (1) Dual supervised transmitters, arranged for automatic switching from one to the other in case of trouble, shall be installed.
- (2) If the transmitters are located where someone is always on duty, switchboard facilities shall be permitted to be manually operated, provided the switching is able to be carried out within 30 seconds.
- (3) If the transmitters are located where no one is continuously on duty, the circuit extending between the supervising station and the transmitters shall be a supervised circuit.
- (4) *Transmitters shall be operated on a time ratio of 2:1 within each 24 hours.
A.8.6.3.7.2(4) Transmitters should be operated alternately, 16 hours on and 16 hours off.
- (5) Dual receivers shall be installed with a means for selecting a usable output from one of the two receivers.
- (6) The failure of one receiver shall in no way interfere with the operation of the other receiver, and failure of either receiver shall be annunciated.

8.6.3.7.3 Means shall be provided at the supervising station for the supervision and control of supervising, subsidiary, and repeater station radio transmitting and receiving equipment. If the radio equipment is remote from the supervising station, this shall be accomplished via a supervised circuit.

8.6.3.7.3.1 The following conditions shall be supervised at the supervising station:

- (1) Transmitter in use (radiating)
- (2) Failure of ac power supplying the radio equipment
- (3) Receiver malfunction
- (4) Indication of automatic switchover

8.6.3.7.3.2 It shall be possible to independently deactivate either transmitter from the supervising station.

8.6.4 Other Transmission Technologies.

NFPA 72-2010 National Fire Alarm and Signaling Code

8.6.4.1 Conformance. ~~Other transmission technologies shall include those transmission technologies that operate on principles different from specific transmission technologies covered by this chapter and shall be permitted to be installed if they conform to the requirements of this subsection and to all other applicable requirements of this Code.~~

8.6.4.2 Federal Communications Commission. ~~Fire alarm system equipment and installations shall comply with the Federal Communications Commission (FCC) rules and regulations, as applicable, concerning electromagnetic radiation, use of radio frequencies, and connections to the public switched telephone network of telephone equipment, systems, and protection apparatus.~~

8.6.4.3 National Electrical Code. ~~Equipment shall be installed in compliance with NFPA 70, *National Electrical Code*.~~

8.6.4.4 Communications Integrity. ~~Provision shall be made to monitor the integrity of the transmission technology and its communications path. The following requirements shall apply:~~

- ~~(1) Any failure shall be annunciated at the supervising station within 5 minutes of the failure.~~
- ~~(2) If communications cannot be established with the supervising station, an indication of this failure to communicate shall be annunciated at the protected premises.~~
- ~~(3) If a portion of the communications path cannot be monitored for integrity, a redundant communications path shall be provided.~~
- ~~(4) Provision shall be made to monitor the integrity of the redundant communications path.~~
- ~~(5) Failure of both the primary and redundant communications paths shall be annunciated at the supervising station within not more than 24 hours of the failure.~~
- ~~(6) System units at the supervising station shall be restored to service within 30 minutes of a failure.~~
- ~~(7) The transmission technology shall be designed so that upon failure of a transmission channel serving a system unit at the supervising station, the loss of the ability to monitor shall not affect more than 3000 transmitters.~~

8.6.4.5 Spare System Unit Equipment. ~~An inventory of spare equipment shall be maintained at the supervising station such that any failed piece of equipment can be replaced and the systems unit restored to full operation within the time limitations specified in this Code.~~

8.6.4.6 Loading Capacity of a System Unit.

8.6.4.6.1 ~~The maximum number of independent fire alarm systems connected to a single system unit shall be limited to 512.~~

8.6.4.6.2 ~~If duplicate spare system units are maintained at the supervising station and switchover can be achieved in 30 seconds, then the system capacity shall be unlimited.~~

8.6.4.7 End-to-End Communication Time for an Alarm. ~~The maximum duration between the initiation of an alarm signal at the protected premises, transmission of the~~

NFPA 72-2010 National Fire Alarm and Signaling Code

signal, and subsequent display and recording of the alarm signal at the supervising station shall not exceed 90 seconds.

8.6.4.8 Unique Identifier. If a transmitter shares a transmission or communications channel with other transmitters, it shall have a unique transmitter identifier.

8.6.4.9 Recording and Display Rate of Subsequent Alarms. Recording and display of alarms at the supervising station shall be at a rate no slower than one complete signal every 10 seconds.

8.6.4.10 Signal Error Detection and Correction.

8.6.4.10.1 Communication of alarm, supervisory, and trouble signals shall be in a highly reliable manner to prevent degradation of the signal in transit, which in turn would result in either of the following:

- (1) Failure of the signal to be displayed and recorded at the supervising station
- (2) An incorrect corrupted signal displayed and recorded at the supervising station

8.6.4.10.2 Reliability of the signal shall be achieved by any of the following:

- (1) Signal repetition — multiple transmissions repeating the same signal
- (2) Parity check — a mathematical check sum algorithm of a digital message that verifies correlation between transmitted and received message
- (3) An equivalent means to 8.6.4.10.2(1) or 8.6.4.10.2(2) that provides a certainty of 99.99 percent that the received message is identical to the transmitted message

8.6.4.11* Signal Priority. If the communications methodology is shared with any other usage, all fire alarm, supervisory, and trouble signals shall take precedence, in that respective order of priority, over all other signals unless otherwise permitted by the authority having jurisdiction.

Exception: If an order of signal priority cannot be assured, then the maximum duration between the initiation of an alarm signal at the protected premises, transmission of the signal, and subsequent display and recording of the alarm signal at the supervising station shall not exceed 90 seconds.

A.8.6.4.11 Signals from hold-up alarms or other signals indicating life-threatening situations are permitted to take precedence over supervisory and trouble signals if acceptable to the authority having jurisdiction.

8.6.4.12 Sharing Communications Equipment On-Premises. If the fire alarm transmitter is sharing on-premises communications equipment, the shared equipment shall be listed for the purpose. If on-premises communications equipment is not listed for the purpose, the fire alarm transmitter shall be installed ahead of the unlisted communications equipment.

8.6.4.13 Service Provider Diversity. When a redundant path is required, both paths shall be private or the alternate path shall be provided by a public communications service provider different from the primary path, if available.

8.6.4.14 Throughput Probability. When the supervising station does not regularly communicate with the transmitter at least once every 200 seconds, then the throughput

NFPA 72-2010 National Fire Alarm and Signaling Code

probability of the alarm transmission shall be at least 90 percent in 90 seconds, 99 percent in 180 seconds, or 99.999 percent in 450 seconds.

~~8.6.4.15 Unique Flaws Not Covered by This Code.~~ If a communications technology has a unique flaw that could result in the failure to communicate a signal, the implementation of that technology for fire alarm signaling shall compensate for that flaw so as to eliminate the risk of missing a fire alarm signal.

26.6.4 Display and Recording Requirements for All Transmission Technologies.

26.6.4.1* Any status changes, including the initiation or restoration to normal of a trouble condition, that occur in an initiating device or in any interconnecting circuits or equipment, including the local protected premises controls from the location of the initiating device(s) to the supervising station, shall be presented in a form to expedite prompt operator interpretation. Status change signals shall provide the following information:

A.26.6.4.1 The signal information can be permitted to be provided in coded form. Records can be permitted to be used to interpret these codes.

- (1) Identification of the type of signal to show whether it is an alarm, supervisory, delinquency, or trouble signal
- (2) Identification of the signal to differentiate between an initiation of an alarm, a supervisory, a delinquency, or a trouble signal and a clearing from one or more of these conditions
- (3) Identification of the site of origin of each status change signal
- (4) *Identification of specific types of signals that dictate a different Response

A.26.6.4.1(4) Any signal that would dictate a different response, such as carbon monoxide alarms or mass notification alarms, should be individually identifiable so the appropriate response to the event can be initiated. There are more types of alarms and other signals that are being received at supervising stations and that require different responses by supervising station operators. These signals could be other than fire, but still life safety in nature, and must be uniquely identified because their signal is indicative of a different response.

26.6.4.2* If duplicate equipment for signal receiving, processing, display, and recording is not provided, the installed equipment shall be designed so that any critical assembly is able to be replaced from on-premises spares and the system is able to be restored to service within 30 minutes. A critical assembly shall be an assembly in which a malfunction prevents the receipt and interpretation of signals by the supervising station operator.

Exception: Proprietary ~~and remote~~ station systems.

8.7 Mass Notification Systems. See Annex E.

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 27, Public Fire Emergency Alarm Reporting Systems

27.1 Application.

27.1.1 The provisions of this chapter apply to the proper configuration, performance, installation, and operation of public emergency alarm reporting systems and auxiliary alarm systems.

Public emergency alarm reporting systems shall consist of alarm boxes and alarm processing equipment that communicate on a wired or wireless network(s), one-way or two-way, meeting the requirements of this chapter. This shall include systems that use a communications infrastructure that is publicly owned, operated, and controlled.

27.1.2 The installation and use of public fire emergency alarm reporting systems and auxiliary fire alarm systems shall comply with the requirements of this chapter.

27.1.3 The requirements of this chapter shall apply to systems and equipment for the transmission and reception of fire alarm and other emergency signals, including those from auxiliary fire alarm systems, connected to the public fire emergency alarm reporting system.

27.1.6 The application of public fire emergency alarm reporting systems and auxiliary fire alarm systems to provide defined reporting functions from or within private premises shall be permitted where approved by the authority having jurisdiction.

27.1.7* Where a protected premises fire alarm system or other emergency system at the protected premises has its signals sent to a communications center via public emergency alarm reporting system, the protected premises system shall become an auxiliary alarm system.

A.27.1.7 Auxiliary alarm systems include the equipment at the protected premises as well as the equipment connecting it to the public emergency alarm reporting system. While the operational requirements relating to the signals sent off premises fall under the scope of Chapter 27, the requirements of Chapter 23 also apply.

27.2 General Fundamentals.

27.2.1* Public fire emergency alarm reporting systems shall be designed, installed, operated, and maintained in accordance with this chapter to provide reliable transmission and receipt of fire alarms in a manner acceptable to the authority having jurisdiction.

A.27.2.1 When choosing from available options to implement a public fire emergency alarm reporting system, the operating agency should consider which of the choices would facilitate the maximum reliability of the system, where such a choice is not cost prohibitive.

27.2.2 A public fire emergency alarm reporting system, as described herein, shall be permitted to be used for the transmission of other signals or calls of a public emergency nature, provided that such transmission does not interfere with the transmission and receipt of fire alarms.

27.2.3* All devices shall be designed to function satisfactorily under the climatic and environmental conditions to which they ~~may~~ could be exposed.

NFPA 72-2010 National Fire Alarm and Signaling Code

A.27.2.3 Consideration should be given to the fact that devices could be installed in areas that are exposed to higher or lower temperatures, moisture, or other environmental conditions that could be more severe than ambient conditions found in a typical building. As an example, equipment could be installed inside a building in a boiler room, basement, attic, and so forth, where temperatures actually exceed ambient conditions outside the building. It is recommended that the authority having jurisdiction consider all possible installation locations and environmental conditions and that the equipment selected be designed to operate within the most extreme conditions to which it could be exposed.

27.2.3.1 All devices shall be identified as suitable for the location and conditions for which they are installed.

27.3.3 Where maintenance is provided by an organization or person(s) other than the jurisdiction or its employees, complete written records of the installation, maintenance, test, and extension of the system shall be forwarded to the designated employee as soon as possible in a time period and manner approved by the authority having jurisdiction.

27.3.4 All equipment shall be installed in locations accessible to the authority having jurisdiction for the purpose of maintenance and inspection.

27.3.5 Records of wired public fire emergency alarm reporting system circuits shall include the following:

- (1) Outline plans showing terminals and box sequence
- (2) Diagrams of applicable office wiring
- (3) List of materials used, including trade name, manufacturer, and year of purchase or installation

27.3.6 Public fire emergency alarm reporting systems as defined in this chapter shall, in their entirety, be subject to a complete operational acceptance test upon completion of system installation.

27.3.6.1 ~~This~~ The test(s) required by 27.3.6 shall be made in accordance with the requirements of the authority having jurisdiction; however, in no case shall the operational functions tested be less than those stipulated in Chapter 14.

27.3.6.2 Operational acceptance tests shall ~~also~~ be performed on any alarm-reporting devices, as ~~identified~~ covered in this chapter that are ~~added~~ installed or modified subsequent to the ~~installation of the initial system~~ test required by 27.3.6.

27.3.7 Personnel Qualification.

27.3.7.1 System Designer.

27.3.7.1.1 Public fire emergency alarm reporting system plans and specifications shall be developed in accordance with this Code by persons who are qualified in the proper design, application, installation, and testing of public fire emergency alarm reporting systems.

27.3.7.1.2 The system ~~designer~~ design documents shall ~~be identified on system design documents~~ include the name and contact information of the system designer.

NFPA 72-2010 National Fire Alarm and Signaling Code

27.3.7.2 System Installer. Installation personnel shall be qualified in the installation, inspection, and testing of public fire emergency alarm reporting systems.

27.3.7.3 Service Personnel. Service personnel shall be qualified in the service, inspection, maintenance, and testing of public fire emergency alarm reporting systems.

27.3.7.4 Qualification.

27.3.7.4.1 Personnel shall demonstrate qualification by being trained and certified in public fire emergency alarm reporting system design, installation, or service (as appropriate) by one or more of the following:

- (1) Certified by the manufacturer of the system or equipment
- (2) *Certified by an organization acceptable to the authority having jurisdiction

A.27.3.7.4.1(2) An example of an organization providing public fire emergency alarm reporting system certification is the International Municipal Signal Association. Note that this reference is for information purposes only. Information concerning the product or service has been provided by the manufacturer or other outside sources, and the information concerning the product or service has not been independently verified, nor has the product or service been endorsed or certified by NFPA or any of its technical committees.

- (3) Licensed or certified by a state or local authority

27.4 Communications Methods.

27.4.1 Application.

27.4.1.1 A public emergency alarm reporting system shall include wired or wireless network(s), for one-way signaling or two-way command and control communications between alarm boxes, alarm processing equipment, and the communications center.

27.4.1.2 A public emergency alarm reporting system shall be permitted to be used with emergency communications systems covered under Chapter 24.

27.4.2 Wired Network(s). The terms *wired network* and *public cable plant* shall be considered the same and interchangeable throughout this chapter.

27.4.2.1 All wired networks or public cable plants shall meet the requirements of Section 27.7.

27.4.2.2 Alarm processing equipment at the communications center shall meet the requirements of 27.5.2 and 27.5.4.

27.4.2.3 Alarm processing equipment at a remote communications center shall meet the requirements of 27.4.2.2 and 27.5.3.

27.4.2.4 Alarm boxes shall meet the following requirements:

- (1) Publicly accessible boxes shall meet the requirements of 27.6.1 through 27.6.2 and 27.6.5.
- (2) Auxiliary boxes shall meet the requirements of 27.6.1, 27.6.3, and 27.6.5.
- (3) Master boxes shall meet the requirements of 27.6.1 through 27.6.3 and 27.6.5.

27.4.3 Wireless Network(s). The terms *wireless network* and *radio system* shall be considered the same and interchangeable throughout this chapter.

NFPA 72-2010 National Fire Alarm and Signaling Code

27.4.3.1 All wireless networks shall meet the requirements of 27.4.3.2 through 27.4.3.3.

27.4.3.2 In addition to the requirements of this Code, ~~coded radio boxes~~ all wireless equipment shall be designed and operated in compliance with all applicable rules and regulations of the Federal Communications Commission (FCC) or, where required, the National Telecommunications and Information Administration (NTIA).

27.4.3.3 Radio Box Channel (Frequency). The number of alarm boxes permitted on a single frequency shall be governed by the following:

- (1) For systems that use one-way transmission in which the individual alarm box automatically initiates the required message (*see 27.5.5.3.3*) using circuitry integral to the alarm boxes, not more than 500 boxes shall be permitted on a single frequency.
- (2) For systems that use a two-way concept in which interrogation signals (*see 27.5.5.3.3*) are transmitted to the individual alarm boxes from the ~~public fire service~~ communications center on the same frequency used for receipt of alarms, not more than 250 alarm boxes shall be permitted on a single frequency. Where interrogation signals are transmitted on a frequency that differs from that used for receipt of alarms, not more than 500 alarm boxes shall be permitted on a single frequency.
- (3) A specific frequency shall be designated for both fire and other fire-related or public safety alarm signals and for monitoring for integrity signals.

27.4.3.4 Alarm processing equipment at the communications center shall meet the requirements of 27.5.2 and 27.5.5.

27.4.3.5 Alarm processing equipment at a remote communications center shall meet the requirements of 27.4.3.4 and 27.5.3.

27.4.3.6 Alarm boxes shall meet the following requirements:

- (1) Publicly accessible boxes shall meet the requirements of 27.6.1 through 27.6.2 and 27.6.6.
- (2) Auxiliary boxes shall meet the requirements of 27.6.1, 27.6.3, and 27.6.6.
- (3) Master boxes shall meet the requirements of 27.6.1 through 27.6.3 and 27.6.6.

27.5 Alarm Processing Equipment. The alarm processing equipment required to receive and control the public emergency alarm reporting system shall be installed in the communications center or remote communications center used by emergency response agencies as defined in NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems.*

27.5.1 General. The requirements of 27.5.2 shall apply to all processing equipment, wired or wireless, for a public emergency alarm reporting network.

27.5.2 Alarm Receiving Processing Equipment at Public Fire Service a Communications Center.

27.5.2.2 Visual Recording Devices.

27.5.2.2.1 Alarms from alarm boxes shall be automatically received and recorded at the ~~public fire service~~ communications center.

NFPA 72-2010 National Fire Alarm and Signaling Code

27.5.2.2.2 A device for producing a permanent graphic recording of all alarm, supervisory, trouble, and test signals received or retransmitted, or both, shall be provided at each ~~public fire service~~ communications center for each alarm circuit and tie circuit.

27.5.2.2.4 In a Type B wired system, one such recording device shall be installed in each fire station, and at least one shall be installed in the ~~public fire service~~ communications center.

27.5.2.2.6 The audible signal device shall be permitted to be common to two or more box circuits and arranged so that the fire emergency alarm operator is able to manually silence the signal temporarily by a self-restoring switch.

27.5.2.5 Power Supply. The forms and arrangements for public fire emergency alarm reporting systems power supplies shall comply with 27.5.2.5.1 through 27.5.2.5.8.

27.5.2.5.1 Each box circuit or ~~coded radio~~ wireless receiving system shall be served by the following:

- (1) *Form 4A, which is an inverter, powered from a common rectifier, receiving power by a single source of alternating current with a floating storage battery having a 24-hour standby capacity

A.27.5.2.5.1(1) Figure A.27.5.2.5.1(1) illustrates a Form 4A arrangement.

- (2) *Form 4B, which is an inverter, powered from a common rectifier, receiving power from two sources of alternating current with a floating storage battery having a 4-hour standby capacity

A.27.5.2.5.1(2) Figure A.27.5.2.5.1(2) illustrates a Form 4B arrangement.

- (3) *Form 4C, which is a rectifier, converter, or motor generator receiving power from two sources of alternating current with transfer facilities to apply power from the secondary source to the system within 30 seconds

27.5.2.5.3 The capacity of batteries, motor generators, or rectifiers, or other permitted power supplies shall be able to supply exceed the calculated load of all connected circuits, without exceeding the capacity of any battery or overloading any generator or rectifier, so that circuits developing grounds or crosses with other circuits each shall be able to be supplied by an independent source to the extent required by 27.5.2.5.1.

27.5.2.5.4 Provision shall be made for supplying to connect any circuit ~~from~~ to any battery, generator, or rectifier, or other permitted power supply.

27.5.2.5.5 ~~Enclosed fuses shall be provided at points where supplies for individual circuits are taken from common leads~~ Individual circuits supplied from common leads shall be protected by the installation of enclosed fuses located at the point where the circuit conductors receive their supply.

27.5.2.5.6 Local circuits at ~~public fire service~~ communications centers shall be supplied in accordance with 27.5.2.5.6.1 and 27.5.2.5.6.2.

27.5.2.5.6.2 Local circuits at ~~public fire service~~ communications centers shall be supplied either in common permitted to be connected to the same power source with as

NFPA 72-2010 National Fire Alarm and Signaling Code

box circuits, or ~~coded radio~~ wireless receiving system circuits, or by a separate power source.

27.5.2.6.1 Rectifiers shall be supplied ~~through~~ from the secondary of an isolating transformer ~~that takes energy from a circuit not to exceed 250 volts.~~

27.5.2.6.1.1 The primary of the isolating transformer shall be connected to a circuit not to exceed exceeding 250 volts.

27.5.2.6.4 Leads from rectifiers or motor generators, with ~~a storage~~ float-charged battery ~~floating~~, shall ~~have~~ be protected by fuses rated at ~~not less than~~ a minimum of 1 ampere and ~~not more than~~ a maximum of 200 percent of ~~maximum~~ connected load at nominal circuit voltage. Where not provided with ~~battery floating~~ a float-charged battery, the fuses shall be ~~not less than~~ rated at a minimum of 3 amperes.

27.5.2.8 Float-Charged Batteries.

27.5.2.8.1 Float-charged batteries shall be of the storage type. Primary batteries (dry cells) shall not be used. Lead-acid batteries shall be in jars of glass or other identified or approved transparent materials; other types of batteries shall be in containers identified or approved for the purpose.

27.5.2.8.2 Float-charged batteries shall be above ~~ground~~ building grade level.

27.5.2.8.3 Float-charged batteries shall be located on the same floor of the building as the operating equipment.

27.5.2.8.4 Float-charged batteries shall be ~~available~~ accessible for maintenance and inspection.

27.5.2.8.5 Float-charged batteries shall be ~~ventilated to prevent accumulation of explosive gas mixtures; special ventilation shall be required only for unsealed cells installed in accordance with Article 480 of NFPA 70, National Electrical Code.~~

27.5.2.8.6 Batteries shall be mounted to provide effective insulation from the ground or working platform and from other batteries. Battery Mounting equipment shall be ~~protected against deterioration and shall provide stability, especially in geographic areas subject to seismic disturbance listed and identified for the location. It shall be permissible for the authority having jurisdiction to waive this requirement to allow the use of alternative mounting equipment where it is assured that equivalent objectives can be achieved.~~

27.5.3 Remote Receiving Equipment Alarm Facilities for Receipt of Box Alarms Processing Equipment at a Remote Communications Center. Where the alarm-receiving equipment is located at a location other than where the box circuit protection, controls, and power supplies are located, the requirements of 27.5.3.1 through 27.5.3.8, in addition to all of the requirements of Section 27.5, shall apply.

27.5.3.3 Monitoring for integrity of all power supplies shall be provided with visual and audible means to indicate a loss of primary or standby power supplies at both the ~~public fire service~~ communications center and remote communications center.

27.5.3.4 A minimum of two separate means of interconnection shall be provided between the ~~public fire service~~ communications center and remote communications

NFPA 72-2010 National Fire Alarm and Signaling Code

center receiving equipment. This interconnection shall be dedicated and shall not be used for any other purpose.

27.5.3.8.1 A separate tie circuit shall be provided from the ~~public fire service~~ communications center to each subsidiary communications center.

27.5.3.8.2 The tie circuit between the ~~public fire service~~ communications center and the subsidiary ~~public fire service~~ communications center shall not be used for any other purpose.

27.5.4 Coded Wired Reporting Network Systems.

27.5.4.1.2 ~~The disablement of any A~~ metallic box open circuit condition shall cause a warning signal in all other circuits, and, thereafter, the ~~circuit or circuit(s) not otherwise broken in the open circuit condition~~ shall be automatically restored to operative condition.

27.5.4.1.6.1 A common sounding device for more than one circuit shall be permitted to be used in a Type A system and shall be installed at the ~~public fire service~~ communications center.

27.5.4.1.6.2 In a Type B system, a sounding device shall be installed in each fire station at the same location as the recording device for that circuit, unless installed at the ~~public fire service~~ communications center, where a common sounding device shall be permitted.

27.5.4.3.1 Where common-current source systems are grounded, the resistance of the ground shall not exceed 10 percent of resistance of any connected circuit and shall be located at one side of the battery.

27.5.4.3.2 Visual and audible indicating devices shall be provided for each box and dispatch circuit to give immediate warning of ground leakage ~~endangering operability~~ current that will have a detrimental effect on circuit operation.

27.5.4.4.1.1 A permanent visual recording device installed in the communications center shall be provided to record all incoming box signals.

27.5.5 Coded Radio Wireless Reporting Systems Network.

27.5.5.1.1.2 Both receiving networks shall be installed at the ~~public fire service~~ communications center.

27.5.5.1.1.3 The failure of either one receiving network shall not affect the receipt of interfere with the other receiving network's ability to receive messages from boxes.

27.5.5.1.2.1 For each frequency used, a single, complete receiving network shall be permitted in each fire station, provided that the ~~public fire service~~ communications center conforms to 27.5.5.1.1.1 through 27.5.5.1.1.3. Where the jurisdiction maintains two or more alarm reception points in operation, one receiving network shall be permitted to be at each alarm reception point.

27.5.5.1.2.2 Where alarm signals are transmitted to a fire station from the ~~public fire service~~ communications center using the ~~coded radio~~ wireless-type receiving equipment in the fire station to receive and record the alarm message, a second receiving network

NFPA 72-2010 National Fire Alarm and Signaling Code

conforming to 27.5.5.1.2.1 shall be provided at each fire station, and that receiving network shall employ a frequency other than that used for the receipt of box messages.

27.5.5.1.3 A device for producing a permanent graphic recording of all alarm, supervisory, trouble, and test signals received or retransmitted, or both, shall be provided at the ~~public fire service~~ communications center.

27.5.5.1.4 Where box message signals to the ~~public fire service~~ communications center or acknowledgment of message receipt signals from the ~~public fire service~~ communications center to the box are repeated, associated repeating facilities shall conform to the requirements indicated in 7.1.1.4(d) of NFPA1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*.

27.5.5.3 Monitoring for Integrity.

27.5.5.3.1 All ~~coded radio~~ wireless box systems shall provide constant monitoring of the frequency in use. Both an audible and a visual indication of any sustained carrier signal, where in excess of a 15-second duration, shall be provided for each receiving system at the ~~public fire service~~ communications center.

27.5.5.3.3* Each ~~coded radio~~ wireless box shall automatically transmit a test message at least once in each 24-hour period.

27.5.5.3.4 Receiving equipment associated with ~~coded radio~~ wireless-type systems, including any related repeater(s), shall be tested at least hourly. The receipt of test messages that do not exceed 60-minute intervals shall meet this requirement.

27.6 Alarm ~~Transmission Equipment Boxes (Publicly Accessible Fire Alarm Boxes, Auxiliary Boxes, and Master Boxes)~~.

27.6.1* General. The requirements of 27.6.1.1 through 27.6.1.6 shall apply to all alarm ~~transmission equipment~~ boxes.

A.27.6.1 There are three types of alarm boxes covered under Chapter 27. They are the publicly accessible box, auxiliary box, and master box.

- (1) The publicly accessible box has a manual control that can be operated by the public. This type of alarm box is typically located outside on a pole or building and was previously called a street box. The box type was renamed because it is not necessarily located on or near a street.
- (2) An auxiliary box is part of an auxiliary alarm system and can be automatically activated either by initiating devices in limited applications or by a protected premises alarm system (Chapter 23). An auxiliary box can be located inside or outside a building.
- (3) The master box is a combination box that can be manually operated (publicly accessible) and automatically activated by the auxiliary alarm system (auxiliary box). The master box is typically located outside on a pole or building.

27.6.1.2 Boxes and associated equipment, when in an abnormal condition, shall ~~leave the circuit usable~~ not disable the public emergency alarm reporting system circuit.

27.6.1.4* Boxes, when actuated, shall give a visible or audible indication to the user that the box is operating or that the signal has been transmitted to the ~~public fire service~~ communications center.

NFPA 72-2010 National Fire Alarm and Signaling Code

27.6.1.5 Box cases and parts that are accessible to the public shall be permitted to be of nonconductive material.

27.6.1.6 Box cases and parts that are accessible to the public and that are constructed of conductive materials of insulating materials or permanently and effectively grounded. ~~All ground connections to boxes shall comply~~ shall comply be installed in accordance with the requirements of *NFPA 70, National Electrical Code, Articles 250 and 760.*

27.6.2* Publicly Accessible Fire Alarm Boxes.

A.27.6.2 Publicly accessible fire alarm boxes were commonly referred to as “street boxes” in previous editions of the Code. Applications of these boxes are no longer limited to street locations.

27.6.2.1 Fundamental Requirements. The requirements of 27.6.2.1.1 through 27.6.2.1.11 shall apply to all publicly accessible fire alarm boxes.

27.6.2.1.1 Means for actuation of alarms by the public shall be located where they are ~~conspicuous~~ visible, unobstructed, and readily accessible for operation.

27.6.2.1.2 The box housing shall protect the internal components ~~from the weather~~ and shall be identified for the location installed.

27.6.3.1.4 Where the auxiliary box is a wired box, the requirements of Section 27.7 shall apply.

27.6.3.1.5 Where the auxiliary box is a wireless box, the requirements of 27.6.6 shall apply.

27.6.3.2 Auxiliary Fire Alarm Systems.

27.6.3.2.1 Application. The equipment and circuits necessary to connect a protected premises to a public fire emergency alarm reporting system shall comply with the requirements of 27.6.3.2.

27.6.3.2.1.1 The requirements of Chapter 10, in addition to those of Chapters 14 and ~~Chapter~~ 17, shall apply to auxiliary fire alarm systems unless they conflict with the requirements of 27.6.3.2.

27.6.3.2.1.3 The requirements of Section 27.7 shall also apply to ~~coded~~ wired auxiliary fire alarm systems.

27.6.3.2.2 Types of Systems.

27.6.3.2.2.1 Auxiliary fire alarm systems shall be of the following two types:

(1) *Local energy type

A.27.6.3.2.2.1(1) The local energy-type system [*see Figure A.27.6.3.2.2.1(1)(a) and Figure A.27.6.3.2.2.1(1)(b)*] is electrically isolated from the public fire emergency alarm reporting system and has its own power supply. The tripping of the transmitting device does not depend on the current in the system. In a wired circuit, receipt of the alarm by the communications center when the circuit is accidentally opened depends on the design of the transmitting device and the associated communications center equipment (~~in other words i.e.~~, whether or not the system is designed to receive alarms through manual or automatic ground operational facilities). In a radio box-type

NFPA 72-2010 National Fire Alarm and Signaling Code

system, receipt of the alarm by the communications center depends on the proper operation of the radio transmitting and receiving equipment.

- (a) Local energy systems shall be permitted to be of the coded or noncoded type.
 - (b) Power supply sources for local energy systems shall conform to Chapter 10.
 - (c) Transmitter trouble signals shall be ~~announced~~ indicated at the control unit and the building fire command center in accordance with 10.12.6.
- (2) *Shunt type

A.27.6.3.2.2.1(2) The shunt-type system [see Figure A.27.6.3.2.2.1(2)(a) and Figure A.27.6.3.2.2.1(2)(b)] is electrically connected to, and is an integral part of, the public fire emergency alarm reporting system. A ground fault on the auxiliary circuit is a fault on the public fire emergency alarm reporting system circuit, and an accidental opening of the auxiliary circuit sends a needless (or false) alarm to the communications center. An open circuit in the transmitting device trip coil is not indicated either at the protected property or at the communications center. Also, if an initiating device is operated, an alarm is not transmitted, but an open circuit indication is given at the communications center. If a public fire emergency alarm reporting system circuit is open when a connected shunt-type system is operated, the transmitting device does not trip until the public fire emergency alarm reporting system circuit returns to normal, at which time the alarm is transmitted, unless the auxiliary circuit is first returned to a normal condition.

Additional design restrictions for shunt-type systems are found in laws or ordinances.

- (a) Shunt systems shall be noncoded with respect to any remote electrical tripping or actuating devices.
- (b) All conductors of the shunt circuit shall be installed in accordance with *NFPA 70, National Electrical Code*, Article 344, for rigid metal conduit, or Article 358, for electrical metallic tubing.
- (c) Both sides of the shunt circuit shall be in the same conduit.
- (d) Where a shunt loop is used, it shall not exceed a length of 750 ft (230 m) and shall be in conduit.
- (e) Conductors of the shunt circuits shall not be smaller than 14 AWG and shall be insulated as prescribed in *NFPA 70, National Electrical Code*, Article 310.
- (f) The power for shunt-type systems shall be provided by the public fire emergency alarm reporting system.
- (g) *A local system made to an auxiliary alarm system by the addition of a relay whose coil is energized by a local power supply and whose normally closed contacts trip a shunt-type master box shall not be permitted.

A.27.6.3.2.2.1(2)(g) See Figure A.27.6.3.2.2.1(2)(b).

27.6.3.2.2.2 The interface of the two types of auxiliary fire alarm systems with the three types of public emergency alarm reporting systems shall be in accordance with Table 27.6.3.2.2.2.

Table 27.6.3.2.2.2 Application of Public Fire Emergency Alarm Reporting Systems with Auxiliary Fire Alarm Systems

Table 27.6.3.2.2.3 Application of Initiating Devices with Auxiliary Fire Alarm Systems

NFPA 72-2010 National Fire Alarm and Signaling Code

27.6.3.2.3.3 The same box shall be permitted to be used as a public fire emergency alarm reporting system box and as a transmitting device for an auxiliary alarm system where permitted by the authority having jurisdiction, provided that the box is located at the outside of the entrance to the protected property.

27.6.3.2.3.6 The system shall be designed and arranged so that a single fault on the auxiliary alarm system shall not jeopardize operation of the public fire emergency alarm reporting system and shall not, in case of a single fault on either the auxiliary or public fire emergency alarm reporting system, transmit a false alarm on either system.

Exception: Shunt systems complying with 27.6.3.2.2.1(2).

27.6.3.2.3.7 A means that is available only to the agency responsible for maintaining the public fire emergency alarm reporting system shall be provided for disconnecting the auxiliary loop to the connected property.

27.6.3.2.3.9 An auxiliary fire alarm system shall be used only in connection with a public fire emergency alarm reporting system that is approved for the service. A system approved by the authority having jurisdiction shall meet this requirement.

27.6.3.2.3.10 Permission for the connection of an auxiliary fire alarm system to a public fire emergency alarm reporting system, and acceptance of the type of auxiliary transmitter and its actuating mechanism, circuits, and components connected thereto shall be obtained from the authority having jurisdiction.

27.6.3.2.3.11 Paragraph 27.6.3.2 shall not require the use of audible alarm signals other than those necessary to operate the auxiliary fire alarm system. Where it is desired to provide fire alarm evacuation signals in the protected property, the alarms, circuits, and controls shall comply with the provisions of Chapter 23 in addition to the provisions of 27.6.3.2.

27.6.3.2.3.12 ~~Multizone auxiliary fire alarm systems shall provide a means for transmitting an alarm to the public reporting system upon the subsequent actuation of initiating devices on other initiating device circuits or subsequent actuation of addressable initiating devices.~~ Where an auxiliary alarm system is in an alarm condition that has been acknowledged, deactivated, or bypassed, subsequent actuation of initiating devices on other initiating device circuits or subsequent actuation of addressable initiating devices on signaling line circuits shall cause an alarm signal to be transmitted to the communications center.

27.6.3.2.3.14 Where data communications between a microprocessor-based fire alarm control unit and an auxiliary fire alarm system are utilized, they shall comply with the requirements of 27.6.3.2.3.14(A) through 27.6.3.2.3.14(C).

- (A)** The monitoring for integrity shall include communications test messages transmitted between the fire alarm control unit and the auxiliary alarm system.
- (B)** The communications test message shall be initiated by either the fire alarm control unit or the auxiliary fire alarm system and shall require a response from the corresponding unit, and the following shall apply:
 - (1)** An invalid response or no response from the fire alarm control unit or the auxiliary fire alarm system shall be recognized as a communications failure.

NFPA 72-2010 National Fire Alarm and Signaling Code

- (2) A communications failure shall initiate a specific communications failure trouble message, which shall be transmitted from the auxiliary fire alarm system and shall be automatically indicated within 200 seconds at the ~~public fire service~~ communications center.
- (3) A trouble condition in 27.6.3.2.3.14(B)(2) shall activate an audible and distinctive visual signal at the auxiliary box indicating a communications failure.
- (4) A trouble condition shall ~~activate a trouble signal~~ be indicated at the ~~fire alarm control unit or~~ and the building fire command center in accordance with 10.12.6.

(C) Where a separate device is required to interface the ~~fire alarm control unit~~ to the auxiliary fire alarm system, all communication paths shall be monitored for integrity and shall comply with 27.6.3.2.3.14.

27.6.5 Wired Network Boxes. The requirements of Section 27.7 shall apply to wired network boxes.

27.6.5.1 Telephone Boxes. The requirements of Section 27.7 shall also apply to telephone boxes.

27.6.5.1.2 Telephone boxes shall be designed to allow the ~~public fire service~~ communications center operator to determine whether or not the telephone box has been restored to normal condition after use.

27.6.6 Coded Radio Wireless Network Boxes.

27.6.6.1 In addition to the requirements of this Code, ~~coded radio~~ wireless boxes shall be designed and operated in compliance with all applicable rules and regulations of the Federal Communications Commission (FCC) or, where required by other governing laws, the National Telecommunications and Information Administration (NTIA).

27.6.6.3 ~~Coded radio~~ Wireless boxes shall provide no less than three specific and individually identifiable functions to the ~~public fire service~~ communications center, in addition to the box number, as follows:

- (1) Test
- (2) Tamper
- (3) Fire

27.6.6.4 ~~Coded radio~~ Wireless boxes shall transmit to the ~~public fire service~~ communications center as follows:

- (1) No less than one repetition for “test”
- (2) No less than one repetition for “tamper”
- (3) No less than two repetitions for “fire”

27.6.6.5 Where multifunction- ~~coded radio~~ wireless boxes are used to transmit signals in addition to those in 27.6.6.3, each such additional signal shall be individually identifiable.

27.6.6.6 Multifunction- ~~coded radio~~ wireless boxes shall be designed so as to prevent the loss of supplemental or concurrently actuated messages.

NFPA 72-2010 National Fire Alarm and Signaling Code

27.6.6.8 The primary power source for ~~coded radio~~ wireless boxes shall be permitted to be from one or more of the following, as approved by the authority having jurisdiction:

- (1) A utility distribution system
- (2) A solar photovoltaic power system
- (3) User power
- (4) Self-powered, using either an integral battery or other stored energy source

27.6.6.9.5 When the primary power has failed, boxes shall transmit a power failure message to the ~~public fire service~~ communications center as part of subsequent test messages until primary power is restored.

27.6.6.9.6 A low-battery message shall be transmitted to the ~~public fire service~~ communications center where the remaining battery standby time is less than 54 hours.

27.6.6.10 Boxes powered by a solar photovoltaic system shall comply with 27.6.6.10.1 through 27.6.6.10.5.

27.6.6.10.1 Solar photovoltaic power systems shall provide box operation for not less than 6 months.

27.6.6.10.2 Solar photovoltaic power systems shall be monitored for integrity.

27.6.6.10.4 The box shall transmit a trouble message to the ~~public fire service~~ communications center when the charger has failed for more than 24 hours. This message shall be part of all subsequent transmissions.

27.6.6.10.5 Where the remaining battery standby duration is less than 10 days, a low-battery message shall be transmitted to the ~~public fire service~~ communications center.

27.6.6.12.2 Self-powered boxes shall transmit a low-power warning message to the ~~public fire service~~ communications center for at least 15 days prior to the time the power source will fail to operate the box. This message shall be part of all subsequent transmissions.

27.7.1.1.2 Where a public box is installed inside a building, the circuit from the point of entrance to the public box shall be installed in rigid metal conduit, intermediate metal conduit, or electrical metallic tubing in accordance with *NFPA 70, National Electrical Code*.

Exception: This requirement shall not apply to ~~coded radio~~ wireless box systems.

27.7.1.2.5.1 Signaling wires supplied by a power source having a voltage and/or current rating sufficient to introduce a hazard shall be installed in accordance with *NFPA 70, National Electrical Code, Article 760, Part II*.

27.7.1.3 Underground Cables.

27.7.1.3.1 Underground metallic and fiber-optic cables in duct or direct burial shall be permitted to be brought aboveground only at ~~points where liability of mechanical injury or of disablement from heat incidental to fires in adjacent buildings is minimized~~ locations approved by the authority having jurisdiction.

27.7.1.3.1.1 Protection from physical damage or heat incidental to fires in adjacent buildings shall be provided.

NFPA 72-2010 National Fire Alarm and Signaling Code

27.7.1.3.2 Metallic and fiber-optic cables shall be permitted to be located in duct systems and manholes containing ~~low-tension~~ power limited fire alarm system conductors only, except ~~low-tension~~ power limited secondary power cables shall be permitted.

27.7.1.3.3 Where located in duct systems or manholes that contain power circuit conductors ~~in excess of~~ over 250 volts to ground, metallic and fiber-optic ~~fire~~ emergency alarm cables shall be located as far as possible from such power cables and shall be separated from them by a noncombustible barrier or ~~by such other means as is practicable~~ approved by the authority having jurisdiction to protect the ~~fire~~ emergency alarm cables from ~~injury~~ physical damage.

27.7.1.3.5 ~~All conduits~~ Raceways or ducts entering buildings from underground duct systems shall be effectively sealed ~~against~~ with an identified sealing compound or other means acceptable to the authority having jurisdiction to prevent the entrance of moisture or gases ~~entering the building from the underground duct system~~.

27.7.1.3.7.2 Such cables shall be buried at least 18 in. (500mm) deep and, where crossing streets or other areas likely to be opened for other underground construction, shall be in duct or conduit ~~or be covered by creosoted planking of at least 50 mm × 100 mm (2 in. × 4 in.) with half-round grooves, spiked or banded together after the cable is installed~~.

27.7.1.4 Aerial Construction.

27.7.1.4.1 Fire alarm wires and cables shall be ~~run~~ located under all other wires except communications wires.

27.7.1.4.1.1 Precautions shall be provided where passing through trees, under bridges, over railroads, and at other places where ~~injury or deterioration is possible~~ subject to physical damage.

27.7.1.4.1.2 ~~All wires and cables shall not be attached to a crossarm that carries electric light and power wires, except circuits carrying up to 220 volts for public communications use, and then only where the 220 volt circuits are tagged or otherwise identified~~ Conductors and cables for public emergency alarm reporting system use shall not be attached to a crossarm that carries electric light and power conductors.

Exception: Power conductors for public emergency alarm reporting system use, operating at 250 volts or less, shall be permitted to share the crossarm with the conductors and cables and shall be tagged.

27.7.1.4.2 Aerial cable shall be supported by messenger wire of approved tensile strength or shall conform to one of the following:

- (1) IMSA specifications as a self-supporting cable assembly or an approved equivalent
- (2) Fiber-optic cable with integral supporting means or all dielectric self-supporting (ADSS) type

~~Exception No. 1: Two-conductor cable that has conductors of 20 AWG or larger size and has mechanical strength equal to 10 AWG hard-drawn copper.~~

NFPA 72-2010 National Fire Alarm and Signaling Code

Exception No. 2: Fiber optic cable with integral supporting means or all dielectric self-supporting (ADSS) type.

27.7.1.5 Leads Down Poles.

27.7.1.5.1 Leads down poles shall be protected ~~against from~~ mechanical injury physical damage. Any metallic covering shall form a continuous conducting path to ground. Installation, in all cases, shall prevent water from entering the conduit or box.

27.7.1.5.2 Leads to boxes shall have 600-volt insulation listed or approved for wet locations, as defined in *NFPA 70, National Electrical Code*.

27.7.1.6 Wiring Inside Buildings.

27.7.1.6.1 At the ~~public fire service~~ communications center, all conductors, cables, and ~~metallic and~~ fiber-optic cables shall extend as directly as possible to the ~~operating room~~ operations center in conduits, ducts, shafts, raceways, or overhead racks and troughs of a ~~type of construction~~ listed or identified as suitable to affording provide protection against ~~fire and mechanical injury physical damage~~.

27.7.1.6.2* Where installed in buildings, conductors and fiber optic cables shall be installed in any of the following wiring methods:

A.27.7.1.6.2 There ~~may~~ could be environmental conditions that necessitate the use of rigid nonmetallic conduit.

- (1) Electrical metallic tubing
- (2) Intermediate metal conduit
- (3) Rigid metal conduit

Exception: Rigid nonmetallic conduit shall be permitted where approved by the authority having jurisdiction.

27.7.2.2.1 A means ~~provided~~ accessible only to the authority having jurisdiction or the agency responsible for maintaining the public fire ~~emergency~~ alarm reporting systems shall be provided ~~for~~ to disconnecting the all circuit conductors inside ~~the a~~ a building or other structure.

27.7.3.2 Surge arresters designed and approved for the purpose shall be ~~provided~~ installed at a location accessible to qualified persons and shall be marked with the name of the manufacturer and model designation.

27.7.3.4 All fuses, fuseholders, and adapters shall be plainly marked with their ampere ~~capacity~~ rating. All fuses rated over 2 amperes shall be of the enclosed type.

27.7.3.5 Circuit protection required at the ~~public fire service~~ communications center shall be provided in every building that houses ~~public fire service~~ communications center equipment.

27.7.3.7 All metallic conductors entering the ~~public fire service~~ communications center shall be protected by the following devices, in the order named, starting from the exterior circuit:

- (1) A fuse rated at 3 amperes minimum to 7 amperes maximum and not less than 2000 volts

NFPA 72-2010 National Fire Alarm and Signaling Code

- (2) A surge arrester(s)
- (3) A fuse or circuit breaker rated at ½ ampere

9.8 Mass Notification System.

See Annex E.

27.7.3.8 In regard to 27.7.3.7, the ½-ampere protection on the tie circuits shall be omitted at subsidiary ~~public fire service~~ communications centers.

27.8.1* ECS shall be permitted to be connected to public emergency alarm reporting systems.

A.27.8.1 The public emergency alarm reporting system infrastructure could be used to facilitate the operation of wide area signaling, as is currently being done for emergency notification to the public in some communities and as has been done in the past for civil defense notification.

27.8.2 ECS equipment and interface methods connecting to or utilizing public emergency alarm reporting systems shall be electrically and operationally compatible so as not to interfere with the public emergency alarm reporting systems.

NFPA 72-2010 National Fire Alarm and Signaling Code

Chapter 29, Single- and Multiple-Station Alarms and Household Fire Alarm Systems

29.1 Application.

29.1.1* The performance, selection, installation, operation, and use of single- and multiple-station alarms and household fire alarm systems shall comply with the requirements of this chapter.

A.29.1.1 Chapter 29 does not attempt to cover all equipment, methods, and requirements that might be necessary or advantageous for the protection of lives and property from fire.

Currently Available Smoke Alarm Technology. The technologies used in currently available smoke alarms include ionization smoke detection and photoelectric detection. These detection types are defined in 3.3.252.2 and 3.3.252.4 and are further explained in A.3.3.252.2 and A.3.3.252.4. Ionization smoke detection is more responsive to invisible particles produced by most flaming fires. Photoelectric smoke detection is more responsive to the visible particles produced by most smoldering fire. Residential smoke alarms and commercial smoke detectors are currently available with either ionization technology or photoelectric technology or a combination of both technologies. The use of both technologies generally offers the advantage of providing a faster response to both flaming and smoldering fires, and is recommended for those who desire a higher level of protection than the minimum requirements of this Code.

Fatal home fires involving smoldering fires and flaming fires occur at night and during the day. It is not possible to reliably predict what type of fire will occur or at what hour of the day it will occur. Therefore, the preference of one technology over the other on the basis of the expectation of a particular type of fire (predominately smoldering or flaming) is not a sound basis for selection. While the current consensus of experts suggests that neither technology offers an advantage when the fire type is not known, there is a consensus that there would be a benefit to having both technologies since the type of fire cannot be predicted.

Based on recent analysis of the full scale fire tests documented by the National Institute of Standards and Technology in Report TN 1455-1 2-2008, the minimum provisions of the Code using either technology are considered to provide an adequate level of protection for most individuals who are not intimate with the fire and are capable of self rescue. This would include occupants in the room of fire origin for both flaming and smoldering fires who escape through the normal path of egress. Protection beyond the minimum provisions of the Code using both technologies should be considered for situations involving individuals who are not capable of self rescue or who might need additional time for escape. These situations might include families where extra time is needed to awaken or assist others.

While it is true that ionization detection technology is more susceptible to nuisance alarms due to cooking, the use of this technology should not be dismissed, particularly where the additional protection of both technologies is suggested. In addition, there is no substantial evidence that suggests that either technology is more susceptible to nuisance alarms from bathroom steam. Provisions and guidance have been added to 29.8.3.4 to help minimize nuisance alarms from both sources. This is important since smoke alarms that are disabled due to frequent nuisance alarms offer no protection whatsoever. A higher level of protection would be afforded by using both technologies in all locations required by this Code with additional locations in other rooms of the

NFPA 72-2010 National Fire Alarm and Signaling Code

dwelling. In considering this, pending the availability of smoke alarms specifically designed for nuisance alarm immunity, additional locations within 20 ft of a cooking appliance should be minimized, especially for smoke alarms using ionization technology.

While these considerations reflect the consensus of experts based on currently available test data that allows analysis of tenability along with alarm response, full scale fire testing and nuisance alarm testing of current technologies has continued and analysis of this data will also continue. In addition, new technologies are being considered with the prospect of enhanced detection response along with a higher immunity to nuisance activations. The work of the industry and the NFPA technical committee responsible for smoke alarm provisions will be ongoing.

29.1.2* Smoke and heat alarms shall be installed in all occupancies where required by applicable other governing laws, codes, or standards.

29.1.4* The requirements of this chapter shall not apply to installations in manufactured homes.

A.29.1.4 Installations in manufactured homes are under the jurisdiction of The Department of Housing and Urban Development (HUD). The rules for installation are addressed in the Federal Manufactured Housing Construction Safety Standards (available at <http://www.hud.gov/offices/hsg/sfh/mhs/mhshome.cfm>).

29.2* Purpose. Fire-warning equipment for residential occupancies shall provide a reliable means to notify the occupants of the presence of a threatening fire and the need to escape to a place of safety before such escape might be impeded by untenable conditions in the normal path of egress.

A.29.2 Fire Danger in the Home. In ~~1998~~ 2005, fire was the third leading cause of unintentional injury deaths in the home, and the ~~fifth~~ sixth leading cause of unintentional injury deaths overall (*Injury Facts*, ~~1999~~ 2007 edition, by National Safety Council).

Eighty ~~two~~ four (~~81.8~~) (84.4) percent of the fire fatalities in ~~1999~~ 2007 resulted from residential fires— ~~66.5~~ 68.5 percent resulted from fires in one- and two-family dwellings, including manufactured homes, ~~14.6~~ 15.0 percent were caused by apartment fires, and ~~0.7~~ 0.9 percent resulted from fires in other residential occupancies (“Fire Loss in the United States during ~~1999~~ 2007,” by Michael J. Karter, NFPA Fire Analysis and Research Division).

Approximately half (53 percent) of the home (dwellings and apartments) fire fatalities resulted from fires that started reported between 10:00 11:00 p.m. and 8:00 7:00 a.m., the common sleeping hours (“The U.S. Fire Problem Overview Report Home Structure Fires,” by Marty Ahrens, NFPA Fire Analysis and Research Division, February 2007).

Over three-quarters (76.9 percent) of all reported fire injuries occurred in the home, with more than one-half (54.6 percent) in one- and two-family dwellings (including manufactured housing), and more than one-fifth (22.3 percent) in apartments (“Fire Loss in the United States during ~~1999~~ 2007,” by Michael J. Karter, NFPA Fire Analysis and Research Division).

It is estimated that each household will experience three (usually unreported) fires per decade and two fires serious enough to report to a fire department per lifetime (“A Few Fire Facts at the Household Level,” NFPA Fire Analysis Division, *Fire Journal*, May 1986).

NFPA 72-2010 National Fire Alarm and Signaling Code

Fire Safety in the Home. NFPA 72 is intended to provide reasonable fire safety for persons in family living units. Reasonable fire safety can be produced through the following three-point program:

- (1) Minimizing fire hazards
- (2) Providing a fire-warning equipment
- (3) Having and practicing an escape plan

Minimizing Fire Hazards. This Code cannot protect all persons at all times. For instance, the application of this Code might not provide protection against the following three traditional fatal fire scenarios:

- (1) Smoking in bed
- (2) Leaving children home alone
- (3) Cleaning with flammable liquids, such as gasoline

However, Chapter 29 can lead to reasonable safety from fire when the three-point program is observed.

Fire-Warning Equipment. There are two types of fire to which household fire-warning equipment needs to respond. One is a rapidly developing, high-heat fire. The other is a slow, smoldering fire. Either can produce smoke and toxic gases.

Fire-Warning Equipment. There are two types of fire to which household fire-warning equipment needs to respond. One is a rapidly developing, high-heat fire. The other is a slow, smoldering fire. Either can produce smoke and toxic gases.

Family Escape Plan. There often is very little time between the detection of a fire and the time it becomes deadly. This interval can be as little as 1 or 2 minutes. Thus, this Code requires detection means to give a family some advance warning of the development of conditions that become dangerous to life within a short period of time. Such warning, however, could be wasted unless the family has planned in advance for rapid exit from their residence. Therefore, in addition to the fire-warning equipment, this Code assumes that the residents have developed and practiced an exit plan.

Planning and practicing for fire conditions with a focus on rapid exit from the residence are important. Drills should be held so that all family members know the action to be taken.

Each person should plan for the possibility that exit out of a bedroom window could be necessary. An exit out of the residence without the need to open a bedroom door is essential.

Household fires are especially dangerous at night when the occupants are asleep. Fires produce smoke and deadly gases that can overcome occupants while they are asleep. Furthermore, dense smoke reduces visibility. Most fire casualties are victims of smoke and gas inhalation rather than burns. To warn against a fire, Chapter 29 provides ~~for~~ smoke detectors (alarms) requirements in accordance with 29.5.1, and the associated annex recommends heat or smoke ~~alarms~~ or smoke detectors (alarms) in all other major areas.

29.3.3* The installation of smoke alarms or fire alarm systems, or combinations of these, shall comply with the requirements of this chapter and shall satisfy the minimum requirements for number and location of smoke alarms or smoke detectors by one of the following arrangements:

NFPA 72-2010 National Fire Alarm and Signaling Code

A.29.3.3 This Code establishes minimum standards for the use of fire-warning equipment. The use of additional alarms or detectors over and above the minimum standard is encouraged.

The use of additional devices can result in a combination of equipment (e.g., a combination of single- and multiple-station alarms or a combination of smoke alarms or smoke detectors that are part of a security/fire system and existing multiple-station alarms). Though a combination is allowed, one type of equipment must independently meet the requirements of the Code. Compliance with the requirements of the Code cannot rely on the combination of the following fire-warning equipment:

- (1) Single-station alarms
- (2) Multiple-station alarms
- (3) Household fire alarm system (includes a security/fire system with smoke alarms or smoke detectors)

It is encouraged that the highest level of protection be used where possible. For example, if multiple-station alarms are added to an occupancy with compliant single-station alarms, the multiple-station alarms should be installed to replace all of the single-station alarms. Similarly, if a monitored household fire alarm system is added to a house that has compliant multiple-station alarms, monitored smoke alarms or smoke detectors should be installed to replace the multiple-station alarms or be installed to provide the same required coverage.

The responsiveness of ionization- and photoelectric-type smoke alarms depends on a number of factors, including the type of fire (smoldering, flaming), the chemistry of materials involved in the fire, and the properties of the resulting smoke. Several fire safety organizations recommend that a consumer utilize both ionization and photoelectric technologies in their home smoke alarm systems to permit the longest potential escape times for nonspecific fire situations. This will not preclude the development of new technology with equivalent performance.

- (1) The required minimum number and location of smoke detection devices shall be satisfied (independently) through the installation of smoke alarms. The installation of additional smoke alarms shall be permitted. The installation of additional system-based smoke detectors, including partial or complete duplication of the smoke alarms satisfying the required minimum, shall be permitted.
- (2) The required minimum number and location of smoke detection devices shall be satisfied (independently) through the installation of system smoke detectors. The installation of additional smoke detectors shall be permitted. The installation of additional smoke alarms, including partial or complete duplication of the smoke detectors satisfying the required minimum, shall be permitted.

29.3.5* Fire-warning equipment to be installed in residential occupancies shall produce the audible emergency evacuation signal described in ANSI S3.41, *American National Standard Emergency Evacuation Signal*, whenever the intended response is to evacuate the building.

A.29.3.5 The use of the distinctive three-pulse temporal pattern fire alarm evacuation signal has been recommended by this Code since 1979. It has since been adopted as both an American National Standard (ANSI S3.41, *American National Standard Audible Emergency Evacuation Signal*) and an International Standard (ISO 8201, *Audible Emergency Evacuation Signal*).

NFPA 72-2010 National Fire Alarm and Signaling Code

Copies of both of these standards are available from either of the following:

- (1) The web at asa.aip.org/map_standards.html asastore.aip.org
- (2) Standards Publication Fulfillment, P.O., Box 1020, Sewickly, PA 15143-9998, Tel. 412-741-1979

For information about the Acoustical Society of America, or for how and why the three-pulse temporal pattern signal was chosen as the international standard evacuation signal, contact Standards Secretariat, Acoustical Society of America, 120 Wall Street, New York, NY 10005-3993, Tel. 212-248-0373 35 Pinelawn Road, Suite 114E, Melville, NY 11747, Tel. 531-490-0215, Email: asastds@aip.org.

The standard fire alarm evacuation signal is a three-pulse temporal pattern using any appropriate sound. The pattern consists of the following in this order:

- (1) An “on” phase lasting 0.5 second ± 10 percent.
- (2) An “off” phase lasting 0.5 second ± 10 percent for three successive “on” periods.
- (3) An “off” phase lasting 1.5 seconds ± 10 percent [see Figure A.29.3.5(a) and Figure A.29.3.5(b)]. The signal should be repeated for a period appropriate for the purposes of evacuation of the building, but for not less than 180 seconds.

A single-stroke bell or chime sounded at “on” intervals lasting 1 second ± 10 percent, with a 2-second ± 10 percent “off” interval after each third “on” stroke, is permitted [see Figure A.29.3.5(c)].

The minimum repetition time is permitted to be manually interrupted.

29.3.7 When visible appliances are provided, they shall meet the requirements of Section 18.5. Since hearing deficits are often not apparent, the responsibility for advising the appropriate person(s) of the existence of this deficit shall be that of the hearing impaired party with hearing loss.

29.3.8 Notification appliances provided in sleeping rooms and guest rooms for those with hearing loss shall comply with 29.3.8.1 and 29.3.8.2, as applicable.

29.3.8.1 Mild to Severe Hearing Loss. Notification appliances provided for those with mild to severe hearing loss shall comply with the following:

- (1) An audible notification appliance producing a low frequency alarm signal shall be installed in the following situations:

- (a) *Where required by governing laws, codes or standards for people with hearing loss

A.29.3.8.1(1)(a) As an example, governing laws, codes, or standards might require a certain number of accommodations be equipped for those with hearing loss or other disability.

- (b) Where provided voluntarily for those with hearing loss

- (2) *The low frequency alarm signal output shall comply with the following:

A.29.3.8.1(2) It is not the intent of this section to preclude devices that have been demonstrated through peer reviewed research to awaken occupants with hearing loss as effectively as those using the frequency and amplitude specified in this section.

- (a) The alarm signal shall be a square wave or provide equivalent awakening ability.

NFPA 72-2010 National Fire Alarm and Signaling Code

(b) *The wave shall have a fundamental frequency of 520 Hz ± 10 percent.

A.29.3.8.1(2)(b) Fundamental frequency: 520 Hz ± 10 percent. Odd harmonic frequency components 3, 5, 7, and 9 times the fundamental frequency should be present in appropriate magnitude defined by the Fourier transform of a square wave (see below) ± 20 percent. On a linear scale where X is the peak magnitude of the fundamental frequency component, the harmonic frequencies should have the following peak magnitudes with the tolerance defined above:

(1) 520 Hz X

(2) 1560 Hz 1/3 X

(3) 2600 Hz 1/5 X

(4) 3640 Hz 1/7 X

(5) 4680 Hz 1/9 X

A square wave contains only the odd integer harmonics. In general, a square wave can be expressed using the Fourier series. As presented by Wolfram MathWorld, the general mathematical expression for the function of an ideal square wave as an infinite series is

$$x_{square}(t) = \frac{4}{\pi} \sum_{n=1,3,5,\dots}^{\infty} \frac{1}{n} \sin(2n\pi ft)$$

where $x_{square}(t)$ is the square wave as a function of time, t , $\sin(\)$ is the sine wave function, f is the frequency, π is pi, the relationship between the circumference and the diameter of a circle, and n is the odd harmonics. An expanded expression for the 1st, 3rd, 5th, 7th, and 9th harmonics is

$$x_{square}(t) = \frac{4}{\pi} \left(\frac{1}{1} \sin(2\pi ft) + \frac{1}{3} \sin(6\pi ft) + \frac{1}{5} \sin(10\pi ft) + \frac{1}{7} \sin(14\pi ft) + \frac{1}{9} \sin(18\pi ft) \right)$$

An example of a 520 Hz square wave audio signal is presented as a spectrograph in Figure A.29.3.8.1(2)(b). Note the dBA scale and weighting.

Additional harmonics for the square wave can be present in the signal, but should not contribute more than 10 percent of the integrated-averaged sound level.

(c) The minimum sound level at the pillow shall be 75 dBA, or 15 dB above the average ambient sound level, or 5 dB above the maximum sound level having duration of at least 60 seconds, whichever is greater.

29.3.8.2* Profound Hearing Loss. Visible notification appliances in accordance with the requirements of 18.5.4.6 and tactile notification appliances in accordance with the requirements of 18.10 shall be required for those with profound hearing loss in the following situations:

A.29.3.8.2 Tactile notification appliances such as bed shakers have been shown to be effective in waking those with profound hearing loss [Ashley et al., 2005, UL 1971, 1991].

Tactile signaling has been studied and found to be an effective way to alert and notify sleeping persons. However, there are many variables that have not been tested that

NFPA 72-2010 National Fire Alarm and Signaling Code

might affect the reliability of their performance. Some of the appliance variables include the mass of the appliance, frequency of vibration and the throw or displacement of the vibrating mass. Occupant variables that might affect the reporting of test results and the effectiveness of the appliance include the person's age, how long a person has lived with their hearing loss, and what sleep stage the person is experiencing when the appliance operates. The type of mattress might also have an effect of the performance of certain tactile appliances. Mattress variables can include thickness, firmness, memory foam, pillow tops, water beds, air beds, and motion isolation mattresses. Users of tactile appliances should be cautioned to test how well they might sense the effect of the appliance.

The Code requires both strobes and tactile appliances. Strobes can awaken sleeping persons, provide verification that there is a fire alarm condition, and serve to alert persons when they are not in contact with a tactile appliance.

- (1) *Where required by governing laws, codes, or standards for people with hearing loss

A.29.3.8.2(1) As an example, governing laws, codes, or standards might require a certain number of accommodations be equipped for those with hearing loss or other disability.

- (2) Where provided voluntarily for those with hearing loss

29.4* Assumptions.

~~**A.11.4** Fire-warning equipment for residential occupancies are capable of protecting about half of the occupants in potentially fatal fires. Victims are often intimate with the fire, too old or too young, or physically or mentally impaired such that they cannot escape even when warned early enough that escape should be possible. For these people, other strategies such as protection in place or assisted escape or rescue would be necessary.~~

~~*Family Escape Plan.* There often is very little time between the detection of a fire and the time it becomes deadly. This interval can be as little as 1 or 2 minutes. Thus, this Code requires detection means to give a family some advance warning of the development of conditions that become dangerous to life within a short period of time. Such warning, however, could be wasted unless the family has planned in advance for rapid exit from their residence. Therefore, in addition to the fire-warning equipment, this Code requires exit plan information to be furnished.~~

~~Planning and practicing for fire conditions with a focus on rapid exit from the residence are important. Drills should be held so that all family members know the action to be taken. Each person should plan for the possibility that exit out of a bedroom window could be necessary. An exit out of the residence without the need to open a bedroom door is essential.~~

~~*Special Provisions for the Disabled.* For special circumstances where the life safety of an occupant(s) depends on prompt rescue by others, the fire-warning equipment should include means of prompt automatic notification to those who are to be depended on for rescue.~~

29.4.1* Occupants. The requirements of this chapter shall assume that occupants are not intimate with the ignition and are capable of self-rescue.

NFPA 72-2010 National Fire Alarm and Signaling Code

A.29.4.1 Working smoke alarms cut the risk of dying in reported home structure fires in half. Victims who are intimate with the fire or are incapable of taking action to escape might not benefit from the early warning. For these people, other strategies such as protection in-place or assisted escape or rescue would be necessary.

29.4.2* Escape Route.

A.29.4.2 Family Escape Plan. There often is very little time between the detection of a fire and the time it becomes deadly.

This interval can be as little as 1 or 2 minutes. Thus, this Code requires detection means to give a family some advance warning of the development of conditions that become dangerous to life within a short period of time. Such warning, however, could be wasted unless the family has planned in advance for rapid exit from their residence. Therefore, in addition to the fire-warning equipment, this Code requires exit plan information to be furnished.

Planning and practicing for fire conditions with a focus on rapid exit from the residence are important. Drills should be held so that all family members know the action to be taken.

Each person should plan for the possibility that exit out of a bedroom window could be necessary. An exit out of the residence without the need to open a bedroom door is essential.

Special Provisions for the Disabled. For special circumstances where the life safety of an occupant(s) depends on prompt rescue by others, the fire-warning equipment should include means of prompt automatic notification to those who are to be depended on for rescue.

29.4.2.3* The escape route shall be along the normal path of egress for the occupancy.

A.29.4.2.3 The normal path of egress does not include windows or other means of escape.

29.5.1* Required Detection.

A.29.5.1 All hostile fires in dwelling units generate smoke and heat. However, the results of full-scale experiments conducted over the last several decades in the United States, using typical fires in dwelling units, indicate that detectable quantities of smoke precede detectable levels of heat in nearly all cases (NBS GCR 75-51, *Detector Sensitivity and Siting Requirements for Dwellings*, 1975; NBS GCR 77-82, *Detector Sensitivity and Siting Requirements for Dwellings Phase 2*, 1977; and NIST Technical Note 1455-1, *Performance of Home Smoke Detectors Analysis of the Response of Several Available Technologies in a Residential Setting*, 2007). In addition, slowly developing, smoldering fires can produce smoke and toxic gases without a significant increase in the room's temperature. Again, the results of experiments indicate that detectable quantities of smoke precede the development of hazardous thermal atmospheres in nearly all cases.

For the preceding reasons, the required protection in this Code utilizes smoke alarms as the primary life safety equipment for providing a reasonable level of protection against fire.

The installation of additional alarms of either the smoke or heat type should result in a higher degree of protection. Adding alarms to rooms that are normally closed off from the required alarms increases the escape time because the fire does not need to build to the higher level necessary to force smoke out of the closed room to the required alarms.

NFPA 72-2010 National Fire Alarm and Signaling Code

As a consequence, it is recommended that the householder consider the installation of additional fire protection devices.

However, it should be understood that Chapter 29 does not require additional smoke alarms over and above those called for in 29.5.1. Refer to Figure A.29.5.1(a) through Figure A.29.5.1(d) where required smoke alarms are shown.

Where to Locate the Required Smoke Alarms. Fifty-three percent of home fire deaths were reported between 11:00 p.m. and 7:00 a.m. Persons in sleeping areas can be threatened by fires in the remainder of the unit; therefore, smoke alarms are best located in each bedroom and between the bedroom areas and the rest of the unit as shown in Figure A.29.5.1(b). In dwelling units with more than one bedroom area or with bedrooms on more than one floor, more than one smoke alarm is required, as shown in Figure A.29.5.1(c).

In addition to smoke alarms outside of the sleeping areas and in each bedroom, Chapter 29 requires the installation of a smoke alarm on each additional level of the dwelling unit, including the basement. These installations are shown in Figure A.29.5.1(d). The living area smoke alarm should be installed in the living room or near the stairway to the upper level, or in both locations. The basement smoke alarm should be installed in close proximity to the stairway leading to the floor above. Where installed on an open-joisted ceiling, the smoke alarm should be placed on the bottom of the joists. The smoke alarm should be positioned relative to the stairway so as to intercept smoke coming from a fire in the basement before the smoke enters the stairway.

Are More Smoke Alarms Desirable? The required number of smoke alarms might not provide reliable early warning protection for those areas separated by a door from the areas protected by the required smoke alarms. For this reason, the use of additional smoke alarms for those areas for increased protection is recommended. The additional areas include dining room, furnace room, utility room, and hallways not protected by the required smoke alarms. The installation of smoke alarms in kitchens, attics (finished or unfinished), or garages is not normally recommended, because these locations occasionally experience conditions that can result in improper operation.

29.5.1.1* Where required by applicable other governing laws, codes, or standards for a specific type of occupancy, approved single- and multiple-station smoke alarms shall be installed as follows:

~~**A.11.5.1** Experience has shown that all hostile fires in dwelling units generate smoke to some degree. This is also true with respect to heat buildup from fires. However, the results of full-scale experiments conducted over the past several years in the United States, using typical fires in dwelling units, indicate that detectable quantities of smoke precede detectable levels of heat in nearly all cases. In addition, slowly developing, smoldering fires can produce smoke and toxic gases without a significant increase in the room's temperature. Again, the results of experiments indicate that detectable quantities of smoke precede the development of hazardous thermal atmospheres in nearly all cases.~~

~~For the preceding reasons, the required protection in this Code utilizes smoke alarms as the primary life safety equipment for providing a reasonable level of protection against fire.~~

~~The installation of additional alarms of either the smoke or heat type should result in a higher degree of protection. Adding alarms to rooms that are normally closed off from the required alarms increases the escape time because the fire does not need to build to~~

NFPA 72-2010 National Fire Alarm and Signaling Code

the higher level necessary to force smoke out of the closed room to the required alarms. As a consequence, it is recommended that the householder consider the installation of additional fire protection devices. However, it should be understood that Chapter 11 does not require additional smoke alarms over and above those called for in 11.5.1. Refer to Figure A.11.5.1(a) through Figure A.11.5.1(d) where required smoke alarms are shown.

Where to Locate the Required Smoke Alarms. The major threat from fire in a dwelling unit occurs at night when everyone is asleep. Persons in sleeping areas can be threatened by fires in the remainder of the unit; therefore, smoke alarms are best located in each bedroom and between the bedroom areas and the rest of the unit as shown in Figure A.11.5.1(b). In dwelling units with more than one bedroom area or with bedrooms on more than one floor, more than one smoke alarm is required, as shown in Figure A.11.5.1(c).

In addition to smoke alarms outside of the sleeping areas and in each bedroom, Chapter 11 requires the installation of a smoke alarm on each additional level of the dwelling unit, including the basement. These installations are shown in Figure A.11.5.1(d). The living area smoke alarm should be installed in the living room or near the stairway to the upper level, or in both locations. The basement smoke alarm should be installed in close proximity to the stairway leading to the floor above. Where installed on an open-joisted ceiling, the smoke alarm should be placed on the bottom of the joists. The smoke alarm should be positioned relative to the stairway so as to intercept smoke coming from a fire in the basement before the smoke enters the stairway.

Are More Smoke Alarms Desirable? The required number of smoke alarms might not provide reliable early warning protection for those areas separated by a door from the areas protected by the required smoke alarms. For this reason, the use of additional smoke alarms for those areas for increased protection is recommended. The additional areas include the basement, bedrooms, dining room, furnace room, utility room, and hallways not protected by the required smoke alarms. The installation of smoke alarms in kitchens, attics (finished or unfinished), or garages is not normally recommended, because these locations occasionally experience conditions that can result in improper operation.

FIGURE A.11.5.1(a) Split Level Arrangement.

FIGURE A.11.5.1(b) A Smoke Alarm Should Be Located Between the Sleeping Area and the Rest of the Dwelling Unit as Well as in Each Bedroom.

FIGURE A.11.5.1(c) In Dwelling Units with More Than One Sleeping Area, a Smoke Alarm Should Be Provided to Protect Each Sleeping Area in Addition to Smoke Alarms Required in Bedrooms.

FIGURE A.11.5.1(d) A Smoke Alarm Should Be Located on Each Level in Addition to Each Bedroom.

A.29.5.1.1 Occupancies where smoke alarms are typically required include residential, residential board and care, or daycare home. The term *residential occupancy* is defined in 3.3.227 and includes one- and two-family dwellings; lodging or rooming houses; hotels, motels, and dormitories; and apartment buildings. The term *residential board and care occupancy* is defined in 3.3.226 and includes both small and large facilities.

NFPA 101, Life Safety Code, specifies a small facility to be one with sleeping accommodations for not more than 16 residents.

NFPA 72-2010 National Fire Alarm and Signaling Code

The term *day-care home*, defined in 3.3.54, is a specific category of day-care occupancy. It should be noted that applicable laws, codes, or standards might include conditions that could impact the applicability of these requirements. The local authority should be consulted for specific details.

- (1) *In all sleeping rooms and guest rooms
- (2) *Outside of each separate dwelling unit sleeping area, within 21 ft (6.4 m) of any door to a sleeping room, with the distance measured along a path of travel
- (3) On every level of a dwelling unit, including basements
- (4) On every level of a residential board and care occupancy (small facility), including basements and excluding crawl spaces and unfinished attics
- (5) *In the living area(s) of a guest suite
- (6) In the living area(s) of a residential board and care occupancy (small facility)

29.7.2* Smoke Alarms, System Smoke Detectors, and Other Non-Heat Fire Detectors. Each device shall detect abnormal quantities of smoke or applicable fire signature, shall operate in the normal environmental conditions, and shall be in compliance with applicable standards such as ANSI/UL 268, *Standard for Safety Smoke Detectors for Fire Alarm Signaling Systems*, or ANSI/UL 217, *Standard for Safety Single and Multiple Station Smoke Alarms*.

29.7.4 Operability. Single- and multiple-station alarms, including heat alarms, shall be provided with a convenient means for testing its operability by the occupant, system owner, or other responsible parties.

29.7.5.7 System control equipment shall be in compliance with applicable standards such as ANSI/UL 985, *Standard for Safety Household Fire Warning System Units*; ~~or~~ ANSI/UL 1730, *Standard for Safety for Smoke Detector Monitors and Accessories for Individual Living Units of Multifamily Residences and Hotel/Motel Rooms*; or ANSI/UL 864, *Standard for Control Units and Accessories for Fire Alarm Systems*.

29.7.6.7* Installations that include the connection of single- or multiple-station alarms with other input or output devices ~~such as but not limited to relay modules, remote signaling devices, phone dialers, security control units, heat detectors, and manual pull stations~~ shall be permitted providing that an open or short circuit of the wiring leading to these input or output devices does not prevent normal operation of the single- or multiple-station alarm. An open, ground fault or short circuit of the wiring connecting input or output devices to the single- or multiple-station alarms shall not prevent operation of each individual alarm.

A.29.7.6.7 Such input and output devices include, but are not limited to, relay modules, notification appliances, phone dialers, security control units, heat detectors, and manual fire alarm boxes.

29.7.7 Wireless Devices.

29.7.7.1 Low-Power Wireless Systems. Household fire alarm systems utilizing low-power wireless transmission of signals within the protected dwelling unit shall comply with the requirements of Section 23.18.

29.7.7.2 Nonsupervised Wireless Interconnected Alarms.

NFPA 72-2010 National Fire Alarm and Signaling Code

29.7.7.2.1* To ensure adequate transmission and reception capability, nonsupervised, low-power wireless alarms shall be capable of reliably communicating at a distance of 100 ft (30.5 m) indoors as tested to an equivalent open area test distance, D_{EOAT} between two devices in accordance with the following equations:

$$\underline{D_{EOAT}} = 30.5 \times \left(10^{\frac{L_b}{40}} \right)$$

where L_b is the building attenuation factor, a value dependent on the frequency of the wireless transmission. The building attenuation factor, L_b , represents the maximum attenuation value of typical floors and walls within a majority of structures the factor. L_b shall assume four walls and two floors and be calculated as follows:

$$\underline{x_{square}(t)} = \frac{4}{\pi} \left(\frac{1}{1} \sin(2\pi ft) + \frac{1}{3} \sin(6\pi ft) + \frac{1}{5} \sin(10\pi ft) + \frac{1}{7} \sin(14\pi ft) + \frac{1}{9} \sin(18\pi ft) \right)$$

where:

L_w = attenuation value of a wall

$$\underline{\quad} = 2 \times L_1 + L_2$$

L_f = attenuation value of a floor

$$\underline{\quad} = L_1 + L_2 + L_3 + L_4$$

L_1 = frequency-dependent attenuation value for ½ in. (13 mm) drywall

L_2 = frequency-dependent attenuation value for 1½ in. (38 mm) structural lumber

L_3 = frequency-dependent attenuation value for ¾ in. (19 mm) plywood

L_4 = frequency-dependent attenuation value for ½ in. (13 mm) glass/tile floor

A.29.7.7.2.1 For RF waves traveling along the earth surface, the signal power loss (in dB), L_p , can be calculated using the following plane-earth propagation loss model:

$$\underline{L_p} = 10 \log \left[\frac{D_p^4}{h_{TX}^2 h_{RX}^2} \right] \quad \text{(A.29.7.7.2.1a)}$$

where D_p represents the distance between the transmitter and receiver and h_{TX} and h_{RX} are the heights of the transmitter and receiver, respectively, above the earth.

NFPA 72-2010 National Fire Alarm and Signaling Code

The plane earth propagation model is a practical simplification and requires that $\frac{h_{TX}}{h_{RX}} \ll D_p$. It reflects the average expected attenuation due to distance of the RF carrier for a stationary set of radios with an essentially clear line of sight. It predicts maximum communications range only in the UHF band (300 MHz to 3 GHz) and is not dependent on frequency.

Inside a building, the model can be expanded to determine the total path loss, L_T , which includes the plane earth loss, L_p (equation A.29.7.7.2.1a), and the loss due to the building materials in the propagation path, L_b , as follows:

$$L_T = 10 \log \left[\frac{D_p^4}{h_{TX} h_{RX}} \right] + L_b \quad \text{(A.29.7.7.2.1b)}$$

If an equivalent open area test distance D_{EOAT} is defined as follows:

$$L_T = 10 \log \left[\frac{D_p^4}{h_{TX} h_{RX}} \right] + L_b \quad \text{(A.29.7.7.2.1c)}$$

then D_{EOAT} can be shown to be:

$$D_{EOAT} = 10^{\frac{-L_T}{40}} \sqrt{h_{TX}} \sqrt{h_{RX}} = D_p \cdot 10^{\frac{L_b}{40}} \quad \text{(A.29.7.7.2.1d)}$$

The D_{EOAT} function is used to calculate a test distance required to verify the functional range of wireless alarm products.

As noted above in the right side of equation A.29.7.7.2.1d, the function represents two factors—one that describes the attenuation of a radio frequency signal due to plane earth propagation path loss (D_p), and one that describes the dwelling material losses

(L_b) in the signal's propagation path. It is the combination of dwelling loss and propagation path loss that is used in the calculation of the test distance D_{EOAT} . The losses are expressed in dB, and the unit for distances is meter.

In reviewing average home sizes, a reliable (indoor) communication of 100 ft (30.5 m) is adequate for a majority of dwellings, based on an average house size of 2200 ft² (204 m²) [National Association of Home Builders]. Construction materials of a home (walls and floors) can attenuate an RF signal, with the RF signal being attenuated more at higher frequencies [Stone, 1997]. Communication specifications for devices of this type are typically specified as open field (no obstructions) test distances, and not in terms of attenuation. Therefore, the standard specifies a minimum open area test distance, D_{EOAT} , that the RF products must communicate. This distance is equal to 100 ft (30.5 m) (the longest straight line distance within a majority of homes) plus an additional distance that is equivalent to the attenuation of four walls and two floors (the most straight line obstructions in a majority of homes). The additional distance varies depending on the

NFPA 72-2010 National Fire Alarm and Signaling Code

operating frequency of the product. Formulas for calculating D_{EOAT} are included below, along with examples for a number of different frequencies. These criteria are expected to yield reliable indoor communications at 100 ft (30.5 m) when used inside a majority of dwellings.

The building attenuation factor, L_b , represents the maximum attenuation value of typical floors and walls within a majority of structures. L_b is calculated using attenuation values of different materials. The following method is used to calculate L_b . The building materials attenuation coefficients specified in this application are taken from Stone, 1977. Other sources of appropriate building material attenuation coefficients may be used; however, testing organizations should apply values consistently for all products tested.

L_1 = Frequency dependent attenuation value for ½ in. (13 mm) drywall

L_2 = Frequency dependent attenuation value for 1½ in. (38 mm) structural lumber

L_3 = Frequency dependent attenuation value for ¾ in. (19 mm) plywood

L_4 = Frequency dependent attenuation value for ½ in. (13 mm) glass/tile floor

L_w = Attenuation value of a wall = $2 \times L_1 + L_2$

L_f = Attenuation value of a floor = $L_1 + L_2 + L_3 + L_4$

Assuming four walls and two floors,

$$\underline{L_b = 4 \times L_w + 2 \times L_f}$$

The source for the equation in 29.7.7.2.1 is Stone, W. "Electromagnetic Attenuation in Construction Materials," National Institute of Standards and Technology, NISTIR 6055, 1997.

29.7.7.2.2 Fire alarm signals shall have priority over all other signals.

29.7.7.2.3 The maximum allowable response delay from activation of an initiating device to receipt and alarm/display by the receiver/control unit shall be 20 seconds.

29.7.7.2.4* Wireless interconnected smoke alarms (in receive mode) shall remain in alarm as long as the originating unit (transmitter) remains in alarm.

A.29.7.7.2.4 Receiving units that stay in alarm for 30 seconds or 1 minute longer than the transmitting alarm would provide additional protection if the first alarm is damaged due to a very fast growing fire. The persisting alarm signal would provide additional notification to occupants. This option needs to be considered in light of the potential for the longer alarm signals on receiving smoke alarms being a potential nuisance to occupants during test and other nuisance alarm events.

29.7.7.2.5 The occurrence of any single fault that disables a transceiver shall not prevent other transceivers in the system from operating.

NFPA 72-2010 National Fire Alarm and Signaling Code

29.7.8.1.1 Where a digital alarm communicator transmitter (DACT) is used, the DACT serving the protected premises shall only require a single telephone line and shall only require a call to a single digital alarm communicator transmitter (DACR) number.

29.7.8.1.2 Where a DACT is used, the DACT test signals shall be transmitted at least monthly.

29.7.8.1.3 Such Supervising station systems shall not be required to be certified or placarded comply with requirements for indication of central station service in 26.3.4.

29.7.8.1.4 A dedicated cellular telephone connection shall be permitted to be used as a single means to transmit alarms to a constantly attended remote monitoring location.

Subsection 29.7.8.1.5 was deleted by a tentative interim amendment (TIA). See page 1.

29.7.8.3 Household fire alarm systems shall be programmed by the manufacturer to generate at least a monthly test of the communication or transmission means.

29.8.1.4 The supplier or installing contractor shall provide the system owner or other responsible parties with the following:

- (1) An instruction booklet illustrating typical installation layouts
- (2) Instruction charts describing the operation, method, and frequency of testing and maintenance of fire-warning equipment
- (3) Printed information for establishing an emergency evacuation plan
- (4) Printed information to inform system owners where they can obtain repair or replacement service, and where and how parts requiring regular replacement, such as batteries or bulbs, can be obtained within 2 weeks
- (5) Information noting both of the following:
 - (a) Unless otherwise recommended by the manufacturer's published instructions, smoke alarms shall be replaced when they fail to respond to tests.
 - (b) Smoke alarms installed in one- and two-family dwellings shall not remain in service longer than 10 years from the date of manufacture.

29.8.2.2* The interconnection of smoke or heat alarms shall comply with the following:

- (1) Smoke or heat alarms shall not be interconnected in numbers that exceed the manufacturer's published instructions.
- (2) In no case shall more than 18 initiating devices be interconnected (of which 12 can be smoke alarms) where the interconnecting means is not supervised.
- (3) In no case shall more than 64 initiating devices be interconnected (of which 42 can be smoke alarms) where the interconnecting means is supervised.
- (4) Smoke or heat alarms shall not be interconnected with alarms from other manufacturers unless listed as being compatible with the specific model.
- (5) When alarms of different types are interconnected, all interconnected alarms shall produce the appropriate audible response for the phenomena being detected or remain silent.

29.8.3* Smoke Alarms and Smoke Detectors. Smoke alarms, smoke detectors, devices, combination of devices, and equipment shall be installed in accordance with the manufacturer's listing and published instructions, and, unless specifically listed for the application, shall comply with requirements in 29.8.3.1 through 29.8.3.4.

NFPA 72-2010 National Fire Alarm and Signaling Code

A.29.8.3 One of the most critical factors of any fire alarm system is the location of the fire detecting devices. This annex is not a technical study. It is an attempt to provide some fundamentals on fire-warning equipment location. For simplicity, only those types of alarms or detectors recognized by Chapter 29 (e.g., smoke and heat alarms or smoke and heat detectors) are discussed. In addition, special problems requiring engineering judgment, such as locations in attics and in rooms with high ceilings, are not covered. Specific mounting locations of fire-warning equipment in unoccupied or architecturally unique areas (e.g., as in attics or in rooms with high ceilings) should be evaluated by a qualified professional.

~~Smoke Alarm or Smoke Detector Mounting — Dead Air Space. The smoke from a fire generally rises to the ceiling, spreads out across the ceiling surface, and begins to bank down from the ceiling. The corner where the ceiling and wall meet is an air space into which the smoke could have difficulty penetrating. In most fires, this dead air space measures about 0.1 m (4 in.) along the ceiling from the corner and about 0.1 m (4 in.) down the wall, as shown in Figure A.11.8.3. Detectors should not be placed in this dead air space. The conclusions of the Kemano Study and FPRF Smoke Detector Spacing Requirements Report (2008) have determined revisions to smoke alarm and smoke detector mounting within 4 in. (100 mm) of a flat ceiling/wall corner are now acceptable. The studies have shown that acceptable detection performance does not depend on the 4 in. (100 mm) separation.~~

Figure A.29.8.3 Example of Proper Mounting for Detectors illustrates acceptable smoke alarm and smoke detector mounting locations.

~~**11.8.3.1 Flat Ceilings.** Smoke alarms or smoke detectors mounted on a flat ceiling shall be located no closer than 102 mm (4 in.) from the adjoining wall surface.~~

29.8.3.1* Peaked Ceilings. Smoke alarms or smoke detectors mounted on a peaked ceiling shall be located within 36 in. (910 mm) horizontally of the peak, but not closer than 4 in. (100 mm) vertically to the peak.

~~**A.29.8.3.1** See Figure A.11.8.3.2 for further information on a smoke alarm or smoke detector mounting layout for a peaked ceiling. Figure A.29.8.3.1 illustrates acceptable smoke alarm or smoke detector mounting locations for a peaked ceiling.~~

29.8.3.2* Sloped Ceilings. Smoke alarms or smoke detectors mounted on a sloped ceiling having a rise greater than 1 ft in 8 ft (1 m in 8 m) horizontally shall be located within 36 in. (910 mm) of the high side of the ceiling, but not closer than 4 in. (100 mm) from the adjoining wall surface.

~~**A.29.8.3.2** See Figure A.11.8.3.3 for further information on a smoke alarm or smoke detector mounting layout for a sloped ceiling. Figure A.29.8.3.2 illustrates acceptable smoke alarm or smoke detector mounting locations for a sloped ceiling.~~

29.8.3.3* Wall Mounting. Smoke alarms or smoke detectors mounted on walls shall be located not closer than 102 mm (4 in.) from the adjoining ceiling surface and not farther than 12 in. (300 mm) from the adjoining ceiling surface.

~~**A.29.8.3.3** See Figure A.11.8.3 for an example of proper mounting for smoke alarms. Figure A.29.8.3 illustrates acceptable smoke alarm or smoke detector mounting locations. In those dwelling units employing radiant heating in the ceiling, the wall location is the recommended location. Radiant heating in the ceiling can create a hot air~~

NFPA 72-2010 National Fire Alarm and Signaling Code

boundary layer along the ceiling surface, which can seriously restrict the movement of smoke and heat to a ceiling-mounted detector.

29.8.3.4 Specific Location Requirements. The installation of smoke alarms and smoke detectors shall comply with the following requirements:

- (1) Smoke alarms and smoke detectors shall not be located where ambient conditions, including humidity and temperature, are outside the limits specified by the manufacturer's published instructions.
- (2) Smoke alarms and smoke detectors shall not be located within unfinished attics or garages or in other spaces where temperatures can fall below 40°F (4°C) or exceed 100°F (38°C).
- (3) *Where the mounting surface could become considerably warmer or cooler than the room, such as a poorly insulated ceiling below an unfinished attic or an exterior wall, smoke alarms and smoke detectors shall be mounted on an inside wall.

A.29.8.3.4(3) Smoke detectors and smoke alarms should be installed in those locations recommended by the manufacturer's published instructions, except in those cases where the space above the ceiling is open to the outside and little or no insulation is present over the ceiling. Such cases result in the ceiling being excessively cold in the winter or excessively hot in the summer. Where the ceiling is significantly different in temperature from the air space below, smoke and heat have difficulty reaching the ceiling and a detector that is located on that ceiling.

- (4) *Smoke alarms and smoke detectors shall not be installed between within an area of exclusion determined by a 10 ft (3.0 m) radial distance along a horizontal flow path from a stationary or fixed cooking appliance, shall be equipped with an alarm-silencing means or use photoelectric detection unless listed for installation in close proximity to cooking appliances.

Smoke alarms and smoke detectors installed between 10 ft (3.0 m) and 20 ft (6.1 m) along a horizontal flow path from a stationary or fixed cooking appliance shall be equipped with an alarm-silencing means or use photoelectric detection.

A.29.8.3.4(4) As per annex material located in A.29.5.1, it is not normally recommended that smoke alarms or smoke detectors be placed in kitchen spaces. This section of the code provides guidelines for safe installation if a need exists to install a smoke alarm or smoke detector in a residential kitchen space or cooking area.

Within this Code section, a fixed cooking appliance is any appliance that is intended to be permanently connected electrically to the wiring system or the fuel source. A stationary cooking appliance is any appliance that is intended to be fastened in place or located in a dedicated space, and is connected to the supply circuit or fuel source.

Exception: Smoke alarms or smoke detectors that use photoelectric detection shall be permitted for installation at a radial distance greater than 6 ft (1.8 m) from any stationary or fixed cooking appliance when the following conditions are met:

- (a) *The kitchen or cooking area and adjacent spaces have no clear interior partitions or headers and*

NFPA 72-2010 National Fire Alarm and Signaling Code

(b) The 10 ft (3.0 m) area of exclusion would prohibit the placement of a smoke alarm or smoke detector required by other sections of this code.

- (5) *Smoke alarms and smoke detectors shall not be installed within a 36 in. (910 mm) horizontal path from a door to a bathroom containing a shower or tub.

A.29.8.3.4(5) Studies indicate that smoke alarms and smoke detectors that use ionization detection, photoelectric detection, or a combination of ionization and photoelectric detection, are susceptible to nuisance alarms caused by steam. Little research has been done on the comparative response of these types of detection to steam. Steam particles, in general, are visible, reflect light easily, and are typically produced in a size range that would be more likely to activate a photoelectric sensor. Thus, it is required that smoke alarms and smoke detectors be installed greater than 36 in. (910 mm) from the bathroom door where possible. Increasing the distance between the smoke alarm or smoke detector and the bathroom door can reduce the frequency of nuisance alarms from bathroom steam. Frequent nuisance alarms can result in the occupant disabling the smoke alarm. Each incremental increase in separation, up to 10 ft (3.0 m), between the bathroom door and the smoke alarm or smoke detector is expected to reduce the frequency of nuisance alarms.

- (6) Smoke alarms and smoke detectors shall not be installed within a 36 in. (910 mm) horizontal path from the supply registers of a forced air heating or cooling system and shall be installed outside of the direct airflow from those registers.
- (7) Smoke alarms and smoke detectors shall not be installed within a 36 in. (910 mm) horizontal path from the tip of the blade of a ceiling-suspended (paddle) fan.
- (8) Where stairs lead to other occupied levels, a smoke alarm or smoke detector shall be located so that smoke rising in the stairway cannot be prevented from reaching the smoke alarm or smoke detector by an intervening door or obstruction.
- (9) For stairways leading up from a basement, smoke alarms or smoke detectors shall be located on the basement ceiling near the entry to the stairs.
- (10) *For tray-shaped ceilings (coffered ceilings), smoke alarms and smoke detectors shall be installed on the highest portion of the ceiling or on the sloped portion of the ceiling within 12 in. (300 mm) vertically down from the highest point.

A.29.8.3.4(10) Figure A.29.8.3.4(10) illustrates acceptable smoke alarm or smoke detector mounting locations for tray shaped ceilings.

- (11) Smoke alarms and detectors installed in rooms with joists or beams shall comply with the requirements of 17.7.3.2.4.
- (12) Heat alarms and detectors installed in rooms with joists or beams shall comply with the requirements of 17.6.3.

29.8.4* Heat Detectors and Heat Alarms.

A.29.8.4 While Chapter 29 does not require heat alarms or heat detectors as part of the basic protection scheme, it is recommended that the householder consider the use and placement of additional heat detectors for the same reasons presented under A.29.8.3. The ~~For example~~, additional areas lending themselves to protection with heat alarms or heat detectors are could be considered, but not limited to, the following areas: the kitchen, dining room, attic (finished or unfinished), furnace room, utility room, basement,

NFPA 72-2010 National Fire Alarm and Signaling Code

and integral or attached garage. For bedrooms, the installation of a smoke alarm or smoke detector is recommended over the installation of a heat detector for protection of the occupants from fires in their bedrooms.

~~Heat Detector Mounting — Dead Air Space. Heat from a fire rises to the ceiling, spreads out across the ceiling surface, and begins to bank down from the ceiling. The corner where the ceiling and the wall meet is an air space into which heat has difficulty penetrating. In most fires, this dead air space measures about 100 mm (4 in.) along the ceiling from the corner and 100 mm (4 in.) down the wall as shown in Figure A.11.8.3. Heat detectors should not be placed in this dead air space.~~

The placement of the heat alarm or heat detector is critical where maximum speed of fire detection is desired. Thus, a logical location for a heat alarm or heat detector is the center of the ceiling. At this location, the heat alarm or heat detector is closest to all areas of the room.

~~The next logical location for mounting detectors is on the sidewall. Any detector mounted on the sidewall should be located as near as possible to the ceiling. A detector mounted on the sidewall should have the top of the detector between 100 mm and 300 mm (4 in. and 12 in.) from the ceiling.~~

~~The Spacing of Detectors. Where a room is too large for protection by a single detector, several detectors should be used. It is important that they be properly located so all parts of the room are covered. (For further information on the spacing of detectors, see Chapter 5.)~~

~~Where the Distance Between Detectors Should Be Further Reduced. The distance between detectors is based on data obtained from the spread of heat across a smooth ceiling. Where the ceiling is not smooth, the placement of the detector should be tailored to the situation.~~

~~For instance, with open wood joists, heat travels freely down the joist channels so that the maximum distance between detectors [15 m (50 ft)] can be used. However, heat has trouble spreading across the joists, so the distance in this direction should be one-half the distance allowed between detectors, as shown in Figure A.11.8.4, and the distance to the wall is reduced to 3.8 m (12.5 ft). Since one-half of 15 m (50 ft) is 7.6 m (25 ft), the distance between detectors across open wood joists should not exceed 7.6 m (25 ft), as shown in Figure A.11.8.4, and the distance to the wall is reduced [one-half of 7.6 m (25 ft)] to 3.8 m (12.5 ft). Paragraph 11.8.4.4 requires that detectors be mounted on the bottom of the joists and not up in joist channels.~~

~~Walls, partitions, doorways, ceiling beams, and open joists interrupt the normal flow of heat, thus creating new areas to be protected.~~

~~FIGURE A.11.8.4—Open Joists, Attics, and Extra-High Ceilings are Some of the Areas that Require Special Knowledge for Installation.~~

~~In addition to the special requirements for heat detectors installed on ceilings with exposed joists, reduced spacing also might be required due to other structural characteristics of the protected area, possible drafts, or other conditions that could affect detector operation.~~

29.8.4.1* On smooth ceilings, heat detectors and heat alarms shall be installed within the strict limitations of their listed spacing.

NFPA 72-2010 National Fire Alarm and Signaling Code

A.29.8.4.1 *Heat Alarm or Heat Detector Mounting — Dead Air Space.* Heat from a fire rises to the ceiling, spreads out across the ceiling surface, and begins to bank down from the ceiling.

The corner where the ceiling and the wall meet is an air space into which heat has difficulty penetrating. In most fires, this dead air space measures about 4 in. (100 mm) along the ceiling from the corner and about 4 in. (100 mm) down the wall as shown in Figure A.17.6.3.1.3.1. Heat alarm or heat detectors should not be placed in this dead air space.

29.8.4.2* For sloped ceilings having a rise greater than 1 ft in 8 ft (1 m in 8 m) horizontally, the detector or alarm shall be located within 36 in. (910 mm) of the peak. The spacing of additional detectors or alarms, if any, shall be based on a horizontal distance measurement, not on a measurement along the slope of the ceiling.

A.29.8.4.2 Figure A.29.8.3.2 illustrates acceptable heat alarm or heat detector mounting locations for sloped ceilings.

29.8.4.3* Heat detectors or alarms shall be mounted on the ceiling at least 4 in. (100 mm) from a wall or on a wall with the top of the detector or alarm not less than 4 in. (100 mm), nor more than 12 in. (300 mm), below the ceiling.

A.29.8.4.3 *Spacing of Detectors.* Where a room is too large for protection by a single heat alarm or heat detector, multiple alarms or detectors should be used. It is important that they be properly located so all parts of the room are covered. (For further information on the spacing of detectors, see Chapter 17.)

Where the Distance Between Detectors Should Be Further Reduced. The distance between detectors is based on data obtained from the spread of heat across a smooth ceiling. Where the ceiling is not smooth, the placement of the heat alarm or heat detector should be tailored to the situation.

Figure A.17.6.3.1.3.1 illustrates acceptable heat alarms or heat detector mounting locations for smooth ceilings and sidewalls.

Exception: Where the mounting surface could become considerably warmer or cooler than the room, such as a poorly insulated ceiling below an unfinished attic or an exterior wall, the detectors or alarms shall be mounted on an inside wall.

29.8.4.5* Detectors or alarms installed on an open-joisted ceiling shall have their smooth ceiling spacing reduced where this spacing is measured at right angles to solid joists; in the case of heat detectors or heat alarms, this spacing shall not exceed one-half of the listed spacing.

A.29.8.4.5 Refer to Figure A.29.8.4.5, where the distance between heat alarms or heat detectors should be further reduced.

For instance, with open wood joists, heat travels freely down the joist channels so that the maximum distance between the heat alarm or heat detectors [(50 ft) 15.2 m] can be used. However, heat has trouble spreading across the joists, so the distance in this direction should be one-half the distance allowed between detectors, as shown in Figure A.29.8.4.5, and the distance to the wall is reduced to 12.5 ft (3.8 m). Since one-half of 50 ft (15.2 m) is 25 ft (7.6 m), the distance between heat alarms or detectors

across open wood joists should not exceed 25 ft (7.6 m), as shown in Figure A.29.8.4.5, and the distance to the wall is reduced [one half of 25 ft (7.6 m)] to 12.5 ft (3.8 m).

NFPA 72-2010 National Fire Alarm and Signaling Code

Paragraph 29.8.4.4 requires that a heat alarm or heat detectors be mounted on the bottom of the joists and not up in joist channels.

Walls, partitions, doorways, ceiling beams, and open joists interrupt the normal flow of heat, thus creating new areas to be protected.

In addition to the special requirements for heat detectors installed on ceilings with exposed joists, reduced spacing also might be required due to other structural characteristics of the protected area, possible drafts, or other conditions that could affect heat alarm or detector operation.

29.11 Markings and Instructions.

29.11.1 Alarms. All alarms shall be plainly marked with the following information on the unit:

- (1) Manufacturer's or listee's name, address, and model number
- (2) A mark or certification that the unit has been approved or listed by a testing laboratory
- (3) Electrical rating (where applicable)
- (4) Manufacturer's published operating and maintenance instructions
- (5) Test instructions
- (6) Replacement and service instructions
- (7) Identification of lights, switches, meters, and similar devices regarding their function, unless their function is obvious
- (8) Distinction between alarm and trouble signals on units employing both
- (9) The sensitivity setting for an alarm having a fixed setting (For an alarm that is intended to be adjusted in the field, the range of sensitivity shall be indicated. The marked sensitivity shall be indicated as a percent per foot obscuration level. The marking shall include a nominal value plus tolerance.)
- (10) Reference to an installation diagram and system owner's manual
- (11) Date of manufacture in the format YEAR (in 4 four digits), MONTH (in letters), and DAY (in 2 two digits) located on the outside of the alarm

Exception: Where space limitations prohibit inclusion of 29.11.1(4) and (6), it is not prohibited for this information to be in the installation instructions instead.

~~11.12 Mass Notification Systems.~~

See Annex E.