NFPA® 720

Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment

2015 Edition

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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NFPA® 720

Standard for the

Installation of Carbon Monoxide (CO) Detection and Warning Equipment

2015 Edition

This edition of NFPA 720, *Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment*, was prepared by the Technical Committee on Carbon Monoxide Detection (SIG-CAR), released by the Correlating Committee on Signaling Systems for the Protection of Life and Property (SIG-AAC), and acted on by NFPA at its June Association Technical Meeting held June 9–12, 2014, in Las Vegas, NV. It was issued by the Standards Council on August 14, 2014, with an effective date of September 3, 2014, and supersedes all previous editions.

This edition of NFPA 720 was approved as an American National Standard on September 3, 2014.

Origin and Development of NFPA 720

With the increased concern over carbon monoxide (CO) hazards in residential applications, the National Fire Protection Association was petitioned to develop a document covering the installation of CO detectors and related equipment. In late 1993, the Technical Committee on Household Fire Warning Equipment was tasked to develop a document covering the installation and use of CO detectors. This document was originally prepared by the Technical Committee on Household Fire Warning Equipment but was returned to committee at the 1995 Annual Meeting. The NFPA Standards Council later approved the formation of the Technical Committee on Carbon Monoxide and Fuel Gas Detectors to further develop this document.

The 2003 edition reflected editorial revisions to comply with the *Manual of Style for NFPA Technical Committee Documents*. Those revisions included the addition of three administrative chapters at the beginning of the document: "Administration," "Referenced Publications," and "Definitions." Two technical chapters followed the administrative chapters: "General Provisions" from Chapter 1 (in part) of the 1998 edition and "Household Carbon Monoxide Warning Equipment" from Chapter 2 of the 1998 edition. Editorial revisions also included breaking out paragraphs with multiple requirements into individually numbered paragraphs, minimizing the use of exceptions, and using consistent headings for sections and subsections. Changes also were made in some sections to provide language and terminology that was more consistent and user friendly. The 2003 edition also contained technical revisions, including the recommendation that printed instructions for carbon monoxide alarms and detectors include minimum and recommended distances from fuel-burning appliances.

As communities began to recognize the life safety benefit of carbon monoxide warning equipment, requirements by local jurisdictions for the installation of this equipment became more common, and the need for an installation standard written in enforceable language became evident. The 2005 edition of NFPA 720 reflected that need — it was changed from a recommended practice to a standard. In addition, terms such as *family living unit* and *household* were replaced, where appropriate, with the term *dwelling unit*, to provide language consistent with standard terminology used in NFPA codes and standards.

The 2009 edition was a complete rewrite of the standard and addressed installations of carbon monoxide detection systems in commercial types of applications as well as the installation of carbon monoxide warning equipment in household applications. The 2009 edition was largely extracted from the 2007 edition of *NFPA 72, National Fire Alarm Code*, and was organized in a fashion similar to that of *NFPA 72*. Paragraphs that were extracted from *NFPA 72* were shown with the extract reference in brackets [ ] at the end of the paragraph. In some cases, modifications were made to the extracted text to use terminology appropriate for this standard, such as the term *carbon monoxide* instead of *fire*. In those instances, brackets

encased the modified words. In a similar manner, where terms were deleted, empty brackets were shown, such as where the word *smoke* was removed from the term *smoke alarm*.

Some of the technical changes in the 2009 edition included the introduction of requirements for the placement of carbon monoxide detectors in commercial applications. Those requirements were based on the Fire Protection Research Foundation report *Development of a Technical Basis for Carbon Monoxide Detector Siting Research Project*. In addition, requirements for the siting, power supply, and interconnection of carbon monoxide alarms were updated.

The previous edition of NFPA 720 was largely extracted from the 2007 edition of *NFPA 72*. Extensive changes were made in the organization and content of the 2010 edition of *NFPA 72*. As a result, the extract material from *NFPA 72* was updated in the 2012 edition of NFPA 720 to provide consistency. As in the 2009 edition, paragraphs that were extracted from *NFPA 72* were shown with the extract reference in brackets [] at the end of the paragraph. In some cases, modifications were made to the extracted text to use terminology appropriate for this standard, such as the term *carbon monoxide* instead of *fire*. In those instances, brackets encased the modifying words. In similar manner, where terms were deleted, empty brackets were shown, such as where the word *smoke* was removed from the term *smoke alarm*.

Several noteworthy technical changes were also included in the 2012 edition of NFPA 720. These included an expanded definition of the term "carbon monoxide alarm"; a revision of the secondary power requirement for systems monitored by a supervising station; a revision of the record of completion form and the inspection, testing, and maintenance form; an addition of a provision to permit performance-based designs for the location of system CO detectors; new provisions for low-frequency audible signaling for sleeping areas; removal of requirements for sensitivity testing of system CO detectors; revisions to address the replacement of combination smoke/CO alarms; new provisions to address signaling to the deaf and hard of hearing in applications of CO alarms and household CO detection systems; new provisions for CO alarms that use wireless signals to interconnect alarms within a household; and updated provisions for the transmission of signals from a household CO detection system to a supervising station.

As with the two previous editions, the 2015 edition of NFPA 720 is largely extracted from *NFPA 72*. Numerous extracts have been updated in this edition to maintain consistency with the 2013 edition of *NFPA 72*. The same convention for identifying the extracts, as well as editorial changes to the extracts, has been used as in the previous two editions.

Technical changes have also been included in the 2015 edition of NFPA 720. These include the following: revision of requirements for personnel qualifications in Chapter 4 so they are more specific to CO systems; revision of the requirements for the audible CO alarm signal in Chapters 5 and 9 to allow the use of more than one tone; revision of the inspection and testing tables in Chapter 8 so they are consistent with the format used in *NFPA 72*; revision of the requirements in Chapter 9 for secondary power supply standby capacity from 8 to 24 hours; revision of the requirements in Chapter 9 for distinctive alarm signals to make it clear that CO, fire, and other alarm signals must each use a different audible signal; and the addition of new Annex C, Guidelines for Emergency Responders.

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Committee Scope: This Committee shall have primary responsibility for documents addressing the selection, installation, operation, and maintenance of carbon monoxide warning equipment.

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Standard for the

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A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex D. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex D.

Chapter 1 Administration

1.1* Scope.

1.1.1 This standard is primarily concerned with life safety, not with protection of property.

1.1.2* This standard covers the selection, design, application, installation, location, performance, inspection, testing, and maintenance of carbon monoxide detection and warning equipment in buildings and structures.

1.1.3 This standard contains requirements for the selection, installation, operation, and maintenance of equipment that detects concentrations of carbon monoxide that could pose a life safety risk to most occupants in buildings and structures.

1.2* Purpose.

1.2.1 The purpose of this standard is to provide requirements for carbon monoxide detection and warning equipment intended to warn occupants of the presence of carbon monoxide in sufficient time to allow occupants to either escape or take other appropriate action and where required to summon aid.

1.2.2 The requirements provided by this standard address the means of signal initiation, transmission, notification, and annunciation; the levels of performance; and the reliability of carbon monoxide detection and warning equipment.

1.3 Application.

1.3.1 The requirements of this standard apply to the installation of carbon monoxide detection and warning equipment, including the following:

(1) Single- and multiple-station carbon monoxide alarms
(2) Carbon monoxide detectors and their related systems and components

1.3.2* Carbon monoxide detection and warning equipment shall not be used in lieu of fire detection or warning equipment required by *NFPA 72, National Fire Alarm and Signaling Code*; NFPA *101, Life Safety Code*; or *NFPA 5000, Building Construction and Safety Code*.

1.4 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, devices, or appliances of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.4.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.4.2 The system, method, device, or appliance shall be approved for the intended purpose by the authority having jurisdiction.

1.4.3 All alarms or detectors and related equipment having materials or forms different from those detailed in this standard shall be examined and tested in accordance with applicable standards and, if found equivalent, shall be permitted to be approved.

1.5 Units of Measure.

1.5.1 The units of measure in this standard are presented in U.S. customary units (inch/pound units).

1.5.2 Where presented, International System (SI) units follow the inch/pound units in parentheses.

1.5.3 Where both systems of units are presented, either system shall be acceptable for satisfying the requirements in this standard.

1.5.4 Where both systems of units are presented, users of this standard shall apply one set of units consistently and shall not alternate between units.

1.5.5 The values presented for measurements in this standard are expressed with a degree of precision appropriate for practical application and enforcement. It is not intended that the application or enforcement of these values be more precise than the precision expressed.

1.5.6* Where extracted text contains values expressed in only one system of units, 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.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 70®, National Electrical Code®, 2014 edition.

NFPA 72®, National Fire Alarm and Signaling Code, 2013 edition.

NFPA *101®, Life Safety Code®,* 2015 edition.

NFPA 110, *Standard for Emergency and Standby Power Systems,* 2013 edition.

NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems,* 2013 edition.

NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems,* 2013 edition.

NFPA 5000®, Building Construction and Safety Code®, 2015 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI A-58.1, *Building Code Requirements for Minimum Design Loads in Buildings and Other Structures*, 1982.

ANSI S1.4A, *Specification for Sound Level Meters*, 1985 (R2006).

ANSI S3.41, *Audible Emergency Evacuation Signal,* 1990 (R2001).

ANSI/TIA 568-C.3, *Optical Fiber Cabling Components Standard,* June 2008.

2.3.2 ISO Publications. International Organization for Standardization, 1, rue de Varembé, case postale 56, CH-1211 Geneve 20, Switzerland.

ISO 7731, *Ergonomics — Danger signals for work places — Auditory danger signals*, 2003.

2.3.3 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 1971, *Signaling Devices for Hearing Impaired*, November 2002, revised October 2008.

ANSI/UL 2034, *Single and Multiple Station Carbon Monoxide Alarms*, February 2008, revised February 2009.

ANSI/UL 2075, *Gas and Vapor Detectors and Sensors*, March 2013.

2.3.4 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA 72®, National Fire Alarm and Signaling Code, 2013 edition.

NFPA 211, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel–Burning Appliances,* 2013 edition.

NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems,* 2013 edition.

NFPA 5000®, Building Construction and Safety Code®, 2015 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, informational note, or other means as permitted in the *Manual of Style for NFPA Technical Committee Documents.*

3.3 General Definitions.

3.3.1* 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. [**72,** 2013]

3.3.2 Alarm.

3.3.2.1 ***Carbon Monoxide Alarm.*** A single- or multiple-station carbon monoxide alarm intended for the purpose of detecting carbon monoxide gas and alerting occupants by a distinct audible signal comprising an assembly that incorporates a sensor, control components, and an alarm notification appliance in a single unit operated from a power source either located in the unit or obtained at the point of installation.

3.3.2.2 ***Multiple-Station [Carbon Monoxide] Alarm.*** A single-station [carbon monoxide] alarm capable of being interconnected to one or more additional alarms so that the actuation of one causes the appropriate alarm signal to operate in all interconnected alarms. [**72,** 2013]

3.3.2.3 ***Single-Station [Carbon Monoxide] Alarm.*** A detector comprising an assembly that incorporates a sensor, control components, and an alarm notification appliance in one unit operated from a power source either located in the unit or obtained at the point of installation. [**72,** 2013]

3.3.3* [Carbon Monoxide] Control Function Interface Device. A listed [carbon monoxide detection] system component that directly interfaces with the system that operates the [carbon monoxide] control function. [**72,** 2013]

3.3.4 Carbon Monoxide Control Functions. Carbon monoxide control elements or systems that are initiated by the carbon monoxide detection system and either increase the level of life safety for occupants or control the spread of the harmful effects of carbon monoxide.

3.3.5 [Carbon Monoxide Detection] Control Unit. A component of the [carbon monoxide detection] system, provided with primary and secondary power sources, which receives signals from initiating devices or other [carbon monoxide detection] control units, and processes these signals to determine part or all of the required [carbon monoxide detection] system output function(s). [**72**, 2013]

3.3.6 Carbon Monoxide Detector. A device having a sensor that responds to carbon monoxide gas that is connected to an alarm control unit.

3.3.7 [Carbon Monoxide] Warning Equipment. Any detector, alarm, device, or material related to single- and multiple-station alarms or household [carbon monoxide detection] systems. [**72,** 2013]

3.3.8* Communications Center. A building or portion of a building that is specifically configured for the primary purpose of providing emergency communications services or public safety answering point (PSAP) services to one or more public safety agencies under the authority or authorities having jurisdiction. [**1221,**2013]

3.3.9 Control Unit. A system component that monitors inputs and controls outputs through various types of circuits. [**72**, 2013]

3.3.10 Dwelling Unit. One or more rooms arranged for complete, independent housekeeping purposes, with space for eating, living, and sleeping; facilities for cooking; and provisions for sanitation. [**5000,** 2015]

3.3.11* Emergency Response Agency (ERA). Organizations providing law enforcement, emergency medical, fire, rescue, communications, and related support services. [**1221,** 2013]

3.3.12 Fireplace. A hearth, fire chamber, or similarly prepared area and a chimney. [**211,** 2013]

3.3.13 Frequency. Minimum and maximum time between events. [**72,** 2013]

3.3.13.1 ***Weekly Frequency.*** Fifty-two times per year, once per calendar week. [**72**, 2013]

3.3.13.2 ***Monthly Frequency.*** Twelve times per year, once per calendar month. [**72**, 2013]

3.3.13.3 ***Quarterly Frequency.*** Four times per year with a minimum of 2 months, maximum of 4 months. [**72**, 2013]

3.3.13.4 ***Semiannual Frequency.*** Twice per year with a minimum of 4 months, maximum of 8 months. [**72**, 2013]

3.3.13.5 ***Annual Frequency.*** Once per year with a minimum of 9 months, maximum 15 of months. [**72**, 2013]

3.3.14* Fuel-Burning Appliance. A device that burns solid, liquid, or gaseous fuel or a combination thereof.

3.3.15 Gateway. A device that is used in the transmission of serial data (digital or analog) from the [carbon monoxide detection] control unit to other building system control units, equipment, or networks and/or from other building system control units to the [carbon monoxide detection] control unit. [**72**, 2013]

3.3.16 Multiple-Purpose Alarm. An alarm that incorporates detection capabilities for more than one hazardous condition, such as fire, fuel gas, or carbon monoxide.

3.3.17 Notification Appliance. A [ ] system component such as a bell, horn, speaker, light, or text display that provides audible, tactile, or visible outputs, or any combination thereof. [**72**, 2013]

3.3.18 Occupiable. A room or enclosed space designed for human occupancy. [**72,** 2013]

3.3.19 Occupiable Area. An area of a facility occupied by people on a regular basis. [**72,** 2013]

3.3.20 Protected Premises. The physical location protected by a [ ] system. [**72**, 2013]

3.3.21 Response Plan. The action to be taken in response to a carbon monoxide alarm signal.

3.3.22* Separate Sleeping Area. The area of a dwelling unit where the bedrooms or sleeping rooms are located.

3.3.23 Signal.

3.3.23.1 ***Carbon Monoxide Alarm Signal.*** A signal indicating a concentration of carbon monoxide at or above the alarm threshold that could pose a risk to the life safety of the occupants and that requires immediate action.

3.3.23.2 ***Supervisory Signal.*** A signal indicating the need for action in connection with a pre-alarm condition, or in connection with the supervision of protected premises carbon monoxide safety functions or equipment, or the maintenance features of related systems.

3.3.23.3 ***Trouble Signal.*** A signal initiated by a system or device indicative of a fault in a monitored circuit, system, or component.

3.3.24 Supplementary. As used in this standard, *supplementary* refers to equipment or operations not required by this standard and designated as such by the authority having jurisdiction. [**72**, 2013]

3.3.25 System.

3.3.25.1 ***Carbon Monoxide Detection System.*** A system or portion of a combination system that consists of a control unit, components, and circuits arranged to monitor and annunciate the status of carbon monoxide alarm initiating devices and to initiate the appropriate response to those signals.

3.3.25.2 ***Combination Carbon Monoxide Detection System.*** A carbon monoxide detection system in which components are used, in whole or in part, in common with a non–carbon monoxide signaling system, and in which components are not used as part of a fire alarm system.

3.3.25.3* ***Combination System.*** A fire alarm system in which components are used, in whole or in part, in common with a non-fire signaling system. [**72**, 2013]

3.3.25.4 ***Fire Alarm System.*** A system or portion of a combination system that consists of components and circuits arranged to monitor and annunciate the status of fire alarm or supervisory signal-initiating devices and to initiate the appropriate response to those signals. [**72**, 2013]

3.3.25.5 ***Household Carbon Monoxide Detection System.*** A system of devices that uses a control unit to produce an alarm signal in the household for the purpose of notifying the occupants of the presence of concentrations of carbon monoxide that could pose a life safety risk.

Chapter 4 Fundamentals of Carbon Monoxide Detection Systems

4.1 Application.

4.1.1 The basic functions of a complete carbon monoxide detection system shall comply with the requirements of this chapter.

4.1.2 The requirements of this chapter shall apply to carbon monoxide detection systems, equipment, and components addressed in Chapter 5 through Chapter 8 of this document.

4.2 Purpose. The purpose of carbon monoxide detection systems shall be primarily to provide notification of predetermined exposure levels of carbon monoxide.

4.3 Equipment.

4.3.1 Equipment constructed and installed in conformity with this standard shall be listed for the purpose for which it is used. [**72:**10.3.1]

4.3.2 System components shall be installed, tested, inspected, and maintained in accordance with the manufacturer's published instructions and this standard. [**72:**10.3.2]

4.3.3* 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. [**72:**10.3.3]

4.3.4* Where no carbon monoxide product listing standard exists, products listed for fire alarm service shall be permitted provided all the requirements of this standard are met.

4.4 Personnel Qualifications.

4.4.1 System Designer.

4.4.1.1 Carbon monoxide detection system plans and specifications shall be developed in accordance with this standard by persons who are knowledgeable and experienced in the proper design, application, installation, and testing of the systems.

4.4.1.2 Where available, state or local licensure regulations shall be followed to determine qualified personnel.

4.4.1.2.1 Depending on state or local licensure regulations, qualified personnel shall be permitted to include, but not be limited to, one or more of the following:

(1) Personnel who are factory trained and certified for carbon monoxide detection system design of the specific type and brand of system being designed and who are acceptable to the authority having jurisdiction
(2) Personnel with expertise in the design of carbon monoxide systems that are registered, licensed, or certified by state or local authority

4.4.1.3 The system designer shall provide evidence of qualifications and/or certifications when requested by the authority having jurisdiction.

4.4.1.4 The system designer shall be identified on the system design documents. [**72:**10.5.1.3]

4.4.2 System Installer.

4.4.2.1 [Carbon monoxide detection] system installation personnel shall be qualified or shall be supervised by persons who are qualified in the installation, inspection, and testing of the systems. [**72:**10.5.2.1]

4.4.2.2 Where available, state or local licensure regulations shall be followed to determine qualified personnel.

4.4.2.2.1 Depending on state or local licensure regulations, qualified personnel shall be permitted to include, but not be limited to, one or more of the following:

(1) Personnel with expertise in the installation of carbon monoxide systems that are registered, licensed, or certified by a state or local authority
(2) Personnel who are factory trained and certified for carbon monoxide detection system installation of the specific type and brand of system being designed and who are acceptable to the authority having jurisdiction

4.4.2.3 The system installer shall provide evidence of qualifications and/or certifications when requested by the authority having jurisdiction.

4.4.3 Inspection, Testing, and Maintenance Personnel.

4.4.3.1* Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of systems addressed within the scope of this standard.

4.4.3.1.1 Qualified personnel shall be permitted to include, but not be limited to, one or more of the following:

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

4.4.3.2 Evidence of qualifications shall be provided to the authority having jurisdiction upon request. [**72:**10.5.3]

4.5 Power Supplies.

4.5.1 Scope. The provisions of this section shall apply to power supplies used for carbon monoxide detection systems.

4.5.2 Code Conformance. All power supplies shall be installed in conformity with the requirements of *NFPA 70, National Electrical Code*, for such equipment and with the requirements indicated in this subsection. [**72:**10.6.2]

4.5.3 Power Supply Sources.

4.5.3.1 Power shall be supplied in compliance with either 4.5.3.2 or 4.5.4. [**72:**10.6.3.1]

4.5.3.2 Unless configured in compliance with 4.5.4, at least two independent and reliable power supplies shall be provided, one primary and one secondary. [**72:**10.6.3.2]

4.5.3.3 Each power supply shall be of adequate capacity for the application. [**72:**10.6.3.3]

4.5.3.4 Monitoring the integrity of power supplies shall be in accordance with 4.5.9.6. [**72:**10.6.3.4]

4.5.4 Uninterruptible Power Supplies (UPS).

4.5.4.1 The UPS device shall be configured in compliance with NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, for a Type O, Class 24, Level 1 system. [**72:**10.6.4.1]

4.5.4.2 The UPS device shall comply with the requirements of 4.5.5. [**72:**10.6.4.2]

4.5.4.3 Failure of the UPS shall result in the initiation of a trouble signal in accordance with Section 4.9. [**72:**10.6.4.3]

4.5.5 Primary Power Supply.

4.5.5.1 Branch Circuit. The branch circuit supplying the [carbon monoxide] equipment(s) [] shall supply no other loads and shall be supplied by one of the following:

(1) Commercial light and power
(2) An engine-driven generator or equivalent in accordance with 4.5.10.2, where a person specifically trained in its operation is on duty at all times
(3) An engine-driven generator or equivalent arranged for cogeneration with commercial light and power in accordance with 4.5.10.2, where a person specifically trained in its operation is on duty at all times

[**72:**10.6.5.1]

4.5.5.2 Circuit Identification and Accessibility.

4.5.5.2.1 The location of the branch circuit disconnecting means shall be permanently identified at the control unit. [**72:**10.6.5.2.1]

4.5.5.2.2 The circuit disconnecting means shall be clearly marked and shall be accessible only to authorized personnel.

4.5.5.3 Mechanical Protection. The branch circuit(s) and connections shall be protected against physical damage. [**72:**10.6.5.3]

4.5.5.4 Overcurrent Protection. An overcurrent protective device of suitable current-carrying capacity that is capable of interrupting the maximum short-circuit current to which it can be subject shall be provided in each ungrounded conductor. [**72:**10.6.5.5]

4.5.6 Secondary Power Supply.

4.5.6.1* Secondary Power Supply for Protected Premises [Carbon Monoxide Detection] Systems.

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

(1) A storage battery dedicated to the [carbon monoxide detection] system arranged in accordance with 4.5.9
(2) An automatic-starting, engine-driven generator serving the branch circuit specified in 4.5.5.1 and arranged in accordance with 4.5.10.3.1, and storage batteries dedicated to the [carbon monoxide detection] system with 4 hours of capacity arranged in accordance with 4.5.9

[**72:**10.6.7.3.1]

4.5.6.1.2 Secondary circuits that provide power to the control unit and are not integral to the unit shall be protected against physical damage. [**72:**10.6.7.3.2]

4.5.6.2 Capacity.

4.5.6.2.1* Where a combination (fire) system is used, the secondary power supply capacity requirements shall comply with 4.5.6.2.3 and with those of *NFPA 72, National Fire Alarm and Signaling Code.*

4.5.6.2.2* Where a combination carbon monoxide detection system is used, the secondary power supply capacity requirements shall comply with 4.5.6.2.3 and with the provisions of the applicable NFPA code or standard.

4.5.6.2.3 The secondary power supply shall have sufficient capacity to operate the carbon monoxide detection 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 the carbon monoxide detection system and all notification appliances for 12 hours. Notification appliances shall perform in accordance with 5.8.6.5.

Exception: The 12-hour requirement shall be permitted to be reduced to 5 minutes where the system is monitored by a supervising station and emergency response in accordance with 7.2.2 is provided.

4.5.6.2.4 For systems not addressed by 4.5.6.2.1 through 4.5.6.2.3, the secondary power supply capacity required shall include all power supply loads that are not automatically disconnected upon the transfer to the secondary power supply.

4.5.6.3 Secondary Power Operation. Operation on secondary power shall not affect the required performance of a carbon monoxide detection system.

4.5.7* Continuity of Power Supplies.

4.5.7.1 The secondary power supply shall automatically provide power to the protected premises system within 10 seconds whenever the primary power supply fails to provide the minimum voltage required for proper operation. [**72:**10.6.6.1]

4.5.7.2 Required signals shall not be lost, interrupted, or delayed by more than 10 seconds as a result of the primary power failure. [**72:**10.6.6.3]

4.5.7.2.1 Storage batteries dedicated to the [carbon monoxide detection] system or an uninterruptible power supply (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. [**72:**10.6.6.3.1]

4.5.7.2.2 Where a UPS is employed in 4.5.7.2.1, a positive means for disconnecting the input and output of the UPS system while maintaining continuity of power supply to the load shall be provided. [**72:**10.6.6.3.2]

4.5.8 Power Supply for Remotely Located Control Equipment.

4.5.8.1* Additional power supplies, where provided for control units, circuit interfaces, or other equipment essential to system operation, and located remotely from the main control unit, shall be comprised of a primary and secondary power

supply that shall meet the same requirements as those of 4.5.1 through 4.5.7 and 4.13.2. [**72:**10.6.8.1]

4.5.8.2 The location of any remotely located power supply shall be identified at the master control unit. [**72:**10.6.8.2]

4.5.8.3 The master control unit display shall be permitted to satisfy the requirement of 4.5.8.2. [**72:**10.6.8.3]

4.5.8.4 The location of any remotely located power supply shall be identified on the record drawings. [**72:**10.6.8.4]

4.5.9 Storage Batteries.

4.5.9.1 Marking.

4.5.9.1.1 Batteries shall be marked with the month and year of manufacture using the month/year format. [**72:**10.6.10.1.1]

4.5.9.1.2 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. [**72:**10.6.10.1.2]

4.5.9.2 Location. Storage batteries shall be located so that the [carbon monoxide detection] 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. [**72:**10.6.10.2]

4.5.9.2.1 Cells shall be suitably insulated against ground-faults. [**72:**10.6.10.2.1]

4.5.9.2.2 Cells shall be suitably insulated against crosses. [**72:**10.6.10.2.2]

4.5.9.2.3 Cells shall be mounted in such a manner so as to be protected from physical damage. [**72:**10.6.10.2.3]

4.5.9.2.4 Racks shall be suitably protected against deterioration. [**72:**10.6.10.2.4]

4.5.9.2.5 If not located in or adjacent to the [carbon monoxide detection] control unit, the batteries and their charger location shall be permanently identified at the [carbon monoxide detection] control unit. [**72:**10.6.10.2.5]

4.5.9.3 Battery Charging.

4.5.9.3.1 Adequate facilities shall be provided to automatically maintain the battery fully charged under all conditions of normal operation. [**72:**10.6.10.3.1]

4.5.9.3.2 Adequate facilities shall be provided to recharge batteries within 48 hours after fully charged batteries have been subject to a single discharge cycle as specified in 4.5.6.2. [**72:**10.6.10.3.2]

4.5.9.3.3 Upon attaining a fully charged condition, the charge rate shall not be so excessive as to result in battery damage. [**72:**10.6.10.3.3]

4.5.9.3.4 Supervising stations shall maintain spare parts or units available, which shall be used to restore failed charging capacity prior to the consumption of one-half of the capacity of the batteries for the supervising station equipment. [**72:**10.6.10.3.5]

4.5.9.4 Overcurrent Protection.

4.5.9.4.1 The batteries shall be protected against excessive load current by overcurrent devices. [**72:**10.6.10.4.1]

4.5.9.4.2 The batteries shall be protected from excessive charging current by overcurrent devices or by automatic current-limiting design of the charging source. [**72:**10.6.10.4.2]

4.5.9.5 Metering. The charging equipment shall provide either integral meters or readily accessible terminal facilities for the connection of portable meters by which the battery voltage and charging current can be determined. [**72:**10.6.10.5]

4.5.9.6 Monitoring Integrity of Battery Charger.

4.5.9.6.1 Means for monitoring integrity appropriate for the batteries and charger employed shall be provided to detect a battery charger failure. [**72:**10.6.10.6.1]

4.5.9.6.2 Failure of the battery charger shall result in the initiation of a trouble signal in accordance with Section 4.9. [**72:**10.6.10.6.2]

4.5.10 Engine-Driven Generators.

4.5.10.1 Application and Installation. The application and installation of engine-driven generators shall be as specified in 4.5.10.2 through 4.5.10.7. [**72:**10.6.11.1]

4.5.10.2 Primary Power Supply.

4.5.10.2.1 Engine-driven generators arranged as the primary supply shall be designed in an approved manner. [**72:**10.6.11.2.1]

4.5.10.2.2 Engine-driven generators arranged as the primary supply shall be installed in an approved manner. [**72:**10.6.11.2.2]

4.5.10.3 Secondary Power Supplies.

4.5.10.3.1 Engine-driven generators used to provide secondary power for a [carbon monoxide detection] 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. [**72:**10.6.11.3.1.1]

4.5.10.3.2 Installation of engine-driven generators used to provide secondary power for a [carbon monoxide detection] system shall be in accordance with *NFPA 70, National Electrical Code*, Article 700. [**72:**10.6.11.3.1.2]

4.5.10.4 Performance, Operation, Testing, and Maintenance. The requirements for performance, operation, testing, and maintenance of engine-driven generators shall conform to the applicable provisions of NFPA 110, *Standard for Emergency and Standby Power Systems*. [**72:**10.6.11.4]

4.5.10.5 Capacity. The unit shall be of a capacity that is sufficient to operate the system under the maximum normal load conditions in addition to all other demands placed upon the unit. [**72:**10.6.11.5]

4.5.10.6 Fuel. Unless otherwise required or permitted in 4.5.10.6.1 through 4.5.10.6.2, fuel shall be available in storage sufficient for 6 months of testing plus the capacity specified in 4.5.6. [**72:**10.6.11.6]

4.5.10.6.1 If a reliable source of supply is available at any time on a 2-hour notice, it shall be permitted to have fuel in storage sufficient for 12 hours of operation at full load. [**72:**10.6.11.6.2]

4.5.10.6.2 Fuel systems using natural or manufactured gas supplied through reliable utility mains shall not be required to have fuel storage tanks unless located in seismic risk zone 3 or greater as defined in ANSI A-58.1, *Building Code Requirements for Minimum Design Loads in Buildings and Other Structures*. [**72:**10.6.11.6.3]

4.5.10.7 Battery and Charger. A separate storage battery and separate automatic charger shall be provided for starting the engine-driven generator and shall not be used for any other purpose. [**72:**10.6.11.7]

4.6 Distinctive Signals.

4.6.1 Carbon monoxide alarm signals and carbon monoxide detection system supervisory and trouble signals shall be distinctively and descriptively annunciated.

4.6.2 Audible alarm notification appliances for a [carbon monoxide detection] 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 [carbon monoxide detection] system. [**72:**10.10.2]

4.6.3* An audible notification appliance 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 have the same audible characteristics for all alerting functions including, but not limited to, alarm, trouble, and supervisory, provided that the distinction between signals shall be by other appropriate means, such as visible annunciation. [**72:**10.10.4]

4.6.4* 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 4.6.3. [**72:**10.10.5]

4.6.5 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 4.6.3. [**72:**10.10.6]

4.6.6 When a carbon monoxide detection system is combined with either a fire alarm system and/or an intrusion detection system, trouble signals from each system shall be permitted to use a common audible signal.

4.7 Alarm Signals.

4.7.1 Carbon monoxide alarm signals shall comply with 5.8.6.5.

4.7.2 An alarm signal that has been deactivated at the protected premises shall comply with 4.7.3.1 and 4.7.3.2. [**72:**10.12.6]

4.7.2.1 The audible and visible alarm signal at the control unit only shall automatically reactivate every 24 hours or less until alarm signal conditions are restored to normal. [**72:**10.12.6.1]

4.7.2.2 The audible and visible alarm signal shall operate until it is manually silenced or acknowledged. [**72:**10.12.6.2]

4.7.3 [Carbon Monoxide] Alarm Notification Appliance Deactivation.

4.7.3.1 A means for turning off activated alarm notification appliance(s) shall be permitted only if it complies with 4.7.3.3 through 4.7.3.7.

Exception: An initiating device with integral sounder shall be permitted to comply with 5.8.2.9.

4.7.3.2 When an occupant notification alarm signal deactivation means is actuated, both audible and visible notification appliances shall be simultaneously deactivated. [**72:**10.13.2]

4.7.3.3 The [carbon monoxide] alarm notification deactivation means shall be key-operated or located within a locked cabinet, or arranged to provide equivalent protection against unauthorized use. [**72:**10.13.3]

4.7.3.4 The means shall comply with the requirements of 4.12.1. [**72:**10.13.4]

4.7.3.5 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: 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.

4.7.3.6 A [carbon monoxide] alarm notification deactivation means that remains in deactivation position when there is no alarm condition shall operate an audible trouble notification appliance until the means is restored to normal. [**72:**10.13.6]

4.7.3.7* Resetting of alarm signals shall comply with the requirements of 5.8.2.2. [**72:**10.13.4

4.8 Supervisory Signals.

4.8.1 Supervisory Signal Indication. Visible and audible indication of supervisory signals and visible indication of their restoration to normal shall be indicated within 90 seconds at the following locations:

(1) Control unit for local carbon monoxide detection systems
(2) Building command center for emergency voice/alarm communications systems
(3) Supervising station location for systems installed in compliance with Chapter 7

4.8.2 Self-Restoring Signal. A supervisory signal initiating device shall be permitted to be self-restoring provided the control panel continues to indicate the supervisory condition.

4.8.3 Supervisory Notification Appliance Location. The audible supervisory notification appliances shall be located in an area where they are likely to be heard. [**72:**10.14.5]

4.8.4 Supervisory Signal Reactivated. A supervisory signal that has been deactivated at the protected premises shall comply with 4.8.4.1 and 4.8.4.2. [**72:**10.14.6]

4.8.4.1 The audible and visible supervisory signal at the control unit only shall automatically reactivate every 24 hours or less until supervisory signal conditions are restored to normal. [**72:**10.14.6.1]

4.8.4.2 The audible and visible supervisory signal shall operate until it is manually silenced or acknowledged. [**72:**10.14.6.2]

4.8.5 Supervisory Notification Appliance Deactivation.

4.8.5.1 A means for deactivating a supervisory notification appliance(s) shall be permitted only if it complies with 4.8.5.2 through 4.8.5.5.

4.8.5.2 The means shall be key-operated or located within a locked cabinet, or arranged to provide equivalent protection against unauthorized use. [**72:**10.14.7.2]

4.8.5.3 The means for deactivating supervisory notification appliances shall comply with the requirements of 4.12.2. [**72:**10.14.7.3]

4.8.5.4 Subsequent actuation of supervisory initiating devices in other building zones shall cause supervisory notification appliances to actuate as required by the system input/output matrix. [**72:**10.14.7.4]

4.8.5.5 A means for deactivating supervisory notification appliances that remain in the deactivated position when there is

no supervisory condition shall operate an audible trouble notification appliance until the means is restored to normal. [**72:**10.14.7.5]

4.9 Trouble Signals.

4.9.1 Trouble signals and their restoration to normal shall be indicated within 200 seconds at the locations identified in 4.9.7. [**72:**10.15.1]

4.9.2 Indication of primary power failure trouble signals transmitted to a supervising station shall be in accordance with 4.13.2.3. [**72:**10.15.2]

4.9.3 An audible trouble signal shall be permitted to be intermittent provided it sounds at least once every 10 seconds, with a minimum duration of ½ second. [**72:**10.15.3]

4.9.4 A single audible trouble signal shall be permitted to annunciate multiple fault conditions. [**72:**10.15.4]

4.9.5 The audible trouble notification appliances shall be located in an area where they are likely to be heard. [**72:**10.15.5]

4.9.6 Actuated notification appliances at the protected premises shall continue to operate unless they are manually silenced as permitted 4.9.9.1. [**72:**10.15.6]

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

(1) Control unit for carbon monoxide detection systems
(2) Building command center for emergency voice/alarm communications systems
(3) Supervising stations for systems installed in compliance with Chapter 7

4.9.8* A trouble signal that has been deactivated at the protected premises shall comply with 4.9.8.1 and 4.9.8.2. [**72:**10.15.9]

4.9.8.1 The audible and visible trouble signal shall automatically reactuate at the control unit every 24 hours or less until trouble signal conditions are restored to normal. [**72:**10.15.9.1]

4.9.8.2 The audible and visible trouble signal associated with signaling the depletion or failure of the primary battery of a wireless system as required by 5.12.2(3) and 5.12.2(4) shall automatically resound every 4 hours or less until the depletion signal is restored to normal. [**72:**10.15.9.2]

4.9.9 Trouble Notification Appliances Deactivation.

4.9.9.1 A means for deactivating trouble notification appliance(s) shall be permitted only if it complies with 4.9.9.2 through 4.9.9.7.

4.9.9.2 The means shall be key-operated or located with a lock cabinet, or arranged to provide equivalent protection against unauthorized use. [**72:**10.15.10.2]

4.9.9.3 The means for deactivating trouble notification appliances shall comply with the requirements of 4.12.2. [**72:**10.15.10.3]

4.9.9.4 If an audible trouble notification appliances is also used to indicate a supervisory condition, as permitted by 4.6.3, a trouble notification appliance deactivation means shall not prevent subsequent actuation of supervisory notification appliances. [**72:**10.15.10.4]

4.9.9.5 Subsequent trouble signals shall cause trouble notification appliances to activate as required by the system input/output matrix. [**72:**10.15.10.5]

4.9.9.6 A means for deactivating trouble notification appliances that remains in the deactivated position when there is no trouble condition shall operate an audible trouble notification appliance until the means is restored to normal. [**72:**10.15.10.6]

4.9.9.7 Unless otherwise permitted by the authoring having jurisdiction, trouble notification appliances at the protected premises of a supervising station [ ] alarm system arranged in accordance with Chapter 7, that have been silenced at protected premises shall automatically reactuate every 24 hours or less until the fault conditions are restored to normal. [**72:**10.15.10.7]

4.10 [Carbon Monoxide] Control Function Status Indicators.

4.10.1 All controls provided specifically for the purpose of manually overriding any automatic [carbon monoxide] control function shall provide visible indication of the status of the associated control circuits. [**72:**10.16.1]

4.10.2* Where status indicators are provided for emergency equipment or [carbon monoxide] control functions, they shall be arranged to reflect the actual status of the associated equipment or function. [**72:**10.16.2]

4.11 Performance and Limitations.

4.11.1 Voltage, Temperature, and Humidity Variation. Equipment other than that addressed by 4.11.2.4 and 5.8.5.3.6 shall be designed so that it is capable of performing its intended functions under the following conditions:

(1)*At 85 percent and at 110 percent of the nameplate primary (main) and secondary (standby) input voltage(s)
(2) At ambient temperatures of 32°F (0°C) and 120°F (49°C)
(3) At a relative humidity of 85 percent and an ambient temperature of 86°F (30°C)

4.11.2 Installation and Design.

4.11.2.1* All systems shall be installed in accordance with the manufacturer's published installation instructions and applicable codes and standards.

4.11.2.2 Devices and appliances shall be located and mounted so that accidental operation or failure is not caused by vibration or jarring. [**72:**10.4.2]

4.11.2.3 All apparatus requiring [ ] resetting to maintain normal operation shall be restored to normal as promptly as possible after each abnormal condition and maintained in normal condition for operation. [**72:**10.3.4]

4.11.2.4 Equipment shall be installed in locations where conditions do not exceed the voltage, temperature, and humidity limits specified in the manufacturer's published instructions. [**72:**10.4.3]

4.12 Annunciation and Annunciation Zoning.

4.12.1 Alarm Annunciation.

4.12.1.1 The location of an actuated initiating device shall be annunciated by visible means.

4.12.1.2 Visible annunciation of the location of an operated initiating device shall be by an indicator lamp, alphanumeric display, printout, or other approved means. [**72:**10.18.1.1.1]

4.12.1.3 The visible annunciation of the location of operated initiating devices shall not be canceled by the means used to deactivate alarm notification appliances. [**72:**10.18.1.1.2]

4.12.2 Supervisory and Trouble Annunciation.

4.12.2.1 Supervisory and/or trouble annunciation shall be annunciated by visible means.

4.12.2.2 Visible annunciation shall be by an indicator lamp, an alphanumeric display, a printout, or other means. [**72:**10.18.2.1.1]

4.12.2.3 The visible annunciation of supervisory and/or trouble conditions shall not be canceled by the means used to deactivate supervisory or trouble notification appliances. [**72:**10.18.2.1.2]

4.12.3* Annunciator Access and Location.

4.12.3.1 All required annunciation means shall be readily accessible to responding personnel. [**72:**10.18.3.1]

4.12.3.2 All required annunciation means shall be located as required by the authority having jurisdiction to facilitate an efficient response to the situation. [**72:**10.18.3.2]

4.12.4 Alarm Annunciation Display. Visible annunciators shall be capable of displaying all zones in alarm. [**72:**10.18.4]

4.12.4.1 If all zones in alarm are not displayed simultaneously, the zone of origin shall be displayed. [**72:**10.18.4.1]

4.12.4.2 If all zones in alarm are not displayed simultaneously, there shall be an indication that other zones are in alarm. [**72:**10.18.4.2]

4.12.5 Annunciation Zoning.

4.12.5.1 For the purpose of alarm annunciation, each floor of the building shall be considered as a separate zone. [**72:**10.18.5.1]

4.12.5.2 Where the system serves more than one building, each building shall be annunciated separately. [**72:**10.18.5.3]

4.13 Monitoring Integrity.

4.13.1* Monitoring Integrity and Circuit Performance of Installation Conductors and Other Signaling Channels.

4.13.1.1 Unless otherwise permitted or required by 4.13.1.3 through 4.13.1.10, 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 is automatically indicated within 200 seconds. [**72:**12.6.1]

4.13.1.2 Unless otherwise permitted or required by 4.13.1.3 through 4.13.1.10, 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 restoration to normal of a single open or a single ground-fault condition in the installation conductors or other signaling channels is automatically indicated within 200 seconds. [**72:**12.6.2]

4.13.1.3 Shorts between conductors shall not be required to be monitored for integrity, unless required by 4.13.1.14 or 4.13.1.15. [**72:**12.6.3]

4.13.1.4 Monitoring for integrity shall not be required for connections to and between supplementary system components, provided that single open, ground-fault, or short-circuit conditions of the supplementary equipment or interconnecting means, or both, do not affect the required operation of the [carbon monoxide detection] system. [**72:**12.6.5]

4.13.1.5 Monitoring for integrity shall not be required for the circuit of an alarm notification appliance installed in the same room with the central control equipment, provided that the notification appliance circuit conductors are installed in conduit or are equivalently protected against mechanical injury. [**72:**12.6.6]

4.13.1.6 Monitoring for integrity shall not be required for a trouble notification appliance circuit. [**72:**12.6.7]

4.13.1.7* Monitoring for integrity shall not be required for the interconnection between listed equipment within a common enclosure. [**72:**12.6.8]

4.13.1.8 Monitoring for integrity shall not be required for the interconnection between 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. [**72:**12.6.9]

4.13.1.9 Monitoring for integrity shall not be required for the conductors for ground–fault detection where a single ground does not prevent the required normal operation of the system. [**72:**12.6.10]

4.13.1.10 Monitoring for integrity shall not be required for the interconnecting wiring of a stationary computer and the computer's keyboard, video monitor, mouse-type device, or touch screen, as long as the interconnecting wiring does not exceed 8 ft (2.4 m) in length; is a listed computer/data processing cable as permitted by *NFPA 70*, *National Electrical Code*; and failure of cable does not cause the failure of the required system functions not initiated from the keyboard, mouse, or touch screen. [**72:**12.6.13]

4.13.1.11 Interconnection means shall be arranged so that a single break or single ground–fault does not cause an alarm signal. [**72:**12.6.15]

4.13.1.12 Unacknowledged alarm signals shall not be interrupted if a fault on an initiating device circuit or a signaling line circuit occurs while there is an alarm condition on that circuit unless the faulted circuit is used to interconnect control units. [**72:**10.12.5]

4.13.1.13 An open, ground-fault, or short-circuit fault on the installation conductors of one alarm notification appliance circuit shall not affect the operation of any other alarm notification circuit for more than 200 seconds regardless of whether the short-circuit fault is present during normal or activated circuit state. [**72:**10.17.1]

4.13.1.13.1 Notification alarm circuits that do not have notification appliances connected directly to the circuit shall be considered control circuits. [**72:**10.17.2]

4.13.1.13.2 Control circuits shall not be required to comply with 4.13.1.13, provided that the circuit is monitored for integrity in accordance with 4.13.1 and a fault in the installation conductors shall result in a trouble signal in accordance with Section 4.9. [**72:**10.17.3]

4.13.1.14 A wire-to-wire short-circuit fault on any alarm notification appliance circuit shall result in a trouble signal in accordance with Section 4.9 and 4.9.7, except as permitted by 4.13.1.4 or 4.13.1.5. [**72:**12.6.16]

4.13.1.15 Where two or more systems are interconnected, the systems shall be connected using Class A, B, or X circuits as described in 5.4.3. [**72:**12.6.17]

4.13.2 Monitoring Integrity of Power Supplies.

4.13.2.1 Unless otherwise permitted or required by 4.13.2.1.3 through 4.13.2.1.6, all primary and secondary power supplies shall be monitored for the presence of voltage at the point of connection to the system. [**72:**10.6.9.1]

4.13.2.1.1 Failure of either supply shall result in a trouble signal in accordance with Section 4.9. [**72:**10.6.9.1.1]

4.13.2.1.2 Where the digital alarm communicator transmitter (DACT) is powered from a protected premises [carbon monoxide detection] control unit, power failure indication shall be in accordance with 4.13.2.1. [**72:**10.6.9.1.2]

4.13.2.1.3 Monitoring shall not be required for a power supply for supplementary equipment. [**72:**10.6.9.1.3]

4.13.2.1.4 Monitoring shall not be required for the neutral of a three-, four-, or five-wire alternating current (ac) or direct current (dc) supply source. [**72:**10.6.9.1.4]

4.13.2.1.5 Monitoring shall not be required for the main power supply in a central station, provided the fault condition is otherwise indicated so as to be obvious to the operator on duty. [**72:**10.6.9.1.5]

4.13.2.1.6 Monitoring shall not be required for the output of an engine-driven generator that is part of the secondary power supply, provided that the generator is tested weekly in accordance with Chapter 8. [**72:**10.6.9.1.6]

4.13.2.2* Power supply sources and electrical supervision for digital alarm communications systems shall be in accordance with Sections 4.5 and 4.13. [**72:**10.6.9.2]

4.13.2.3* Unless prohibited by the authority having jurisdiction, where carbon monoxide detection systems are connected to a supervising station, the system shall be arranged to delay transmission of primary power failure signals for a period ranging from 60 to 180 minutes.

4.13.2.4 Power supervisory devices shall be arranged so as not to impair the receipt of [carbon monoxide] alarm or supervisory signals. [**72:**10.6.9.4]

4.14 Documentation.

4.14.1 Approval and Acceptance.

4.14.1.1 The authority having jurisdiction shall be notified prior to installation or alteration of equipment or wiring. [**72:**10.20.2]

4.14.1.2* 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.

4.14.1.3 Before requesting final approval of the installation, if required by the authority having jurisdiction, the installing contractor shall furnish a written statement stating that the system has been installed in accordance with approved plans and tested in accordance with the manufacturer's published instructions and the appropriate NFPA requirements. [**72:**7.5.2]

4.14.1.4* The carbon monoxide detection system record of completion form, Figure 4.14.1.4, shall be permitted to be a part of the written statement required in 4.14.1.3.

4.14.1.4.1 When more than one contractor has been responsible for the installation, each contractor shall complete the portions of the form for which that contractor had responsibility.

4.14.2 Completion Documents.

4.14.2.1 Preparation.

4.14.2.1.1* The preparation of a carbon monoxide detection system record of completion, Figure 4.14.1.4, shall be the responsibility of the qualified and experienced person described in 4.4.2.

4.14.2.1.2 The preparation of a carbon monoxide detection system record of completion, Figure 4.14.1.4, shall be in accordance with 4.14.2.1.2.1 through 4.14.2.1.2.5.

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

4.14.2.1.2.2 Parts 15 and 16 of the record of completion shall be completed after the operational acceptance tests have been completed.

4.14.2.1.2.3 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.

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

4.14.2.1.2.5 One copy of the record of completion shall be stored at the carbon monoxide detection control unit or other approved location.

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

4.14.2.1.2.7 Where not stored at the main carbon monoxide detection control unit, the location of these documents shall be identified at the main fire alarm control unit.

4.14.2.1.2.8 If the documents are located in a separate enclosure or cabinet, the separate enclosure or cabinet shall be prominently labeled CARBON MONOXIDE DETECTION DOCUMENTS.

4.14.2.2 Revision. All [carbon monoxide detection] system modifications made after the initial installation shall be recorded on a revised version of the original [record of completion]. [**72:**7.5.6.6.1]

4.14.2.2.1 All changes from the original information shall be shown.

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

CARBON MONXIDE SYSTEM RECORD OF COMPLETION

To be completed by the system installation contractor at the time of system acceptance and approval.
It shall be permitted to modify this form as needed to provide a more complete and/or clear record.
Insert N/A in all unused lines.
Attach additional sheets, data, or calculations as necessary to provide a complete record.

1. PROPERTY INFORMATION

Name of property: _____

Address: _____

Description of property: _____

Occupancy type: _____

Name of property representative: _____

Address: _____

Phone: _____ Fax: _____ E-mail: _____

Authority having jurisdiction over this property: _____

Phone: _____ Fax: _____ E-mail: _____

2. INSTALLATION, SERVICE, AND TESTING CONTRACTOR INFORMATION

Installation contractor for this equipment: _____

Address: _____

License or certification number: _____

Phone: _____ Fax: _____ E-mail: _____

Service organization for this equipment: _____

Address: _____

License or certification number: _____

Phone: _____ Fax: _____ E-mail: _____

A contract for test and inspection in accordance with NFPA standards is in effect as of: _____

Contracted testing company: _____

Address: _____

Phone: _____ Fax: _____ E-mail: _____

Contract expires: _____ Contract number: _____ Frequency of routine inspections: _____

3. DESCRIPTION OF SYSTEM OR SERVICE

❑ Carbon monoxide system (nonvoice)

❑ Carbon monoxide emergency voice alarm communication system (EVACS)

❑ Combination carbon monoxide detection system, with the following components, describe: _____

_____

_____

NFPA 720 edition: _____ Additional description of system(s): _____

_____

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FIGURE 4.14.1.4 Carbon Monoxide Detection System Record of Completion.

3. DESCRIPTION OF SYSTEM OR SERVICE *(continued)*

3.1 Control Unit

Manufacturer: _____ Model number: _____

3.2 System Documentation

❑ An owner's manual, a copy of the manufacturer's instructions, a written sequence of operation, and a copy of the numbered record drawings are stored on site. Location: _____

3.3 System Software

❑ This system does not have alterable site-specific software.

Operating system (executive) software revision level: _____

Site-specific software revision date: _____ Revision completed by: _____

❑ A copy of the site-specific software is stored on site. Location: _____

3.4 Off-Premises Signal Transmission

❑ This system does not have off-premises transmission.

Name of organization receiving alarm signals with phone numbers:

Alarm: _____ Phone: _____

Supervisory: _____ Phone: _____

Trouble: _____ Phone: _____

Entity to which alarms are retransmitted: _____ Phone: _____

Method of retransmission: _____

Specify the means of transmission from the protected premises to the supervising station or receiving station:

_____

4. CIRCUITS AND PATHWAYS

4.1 Signaling Line Pathways

4.1.1 Pathways Class Designations

Pathways class: _____ Quantity: _____

(See NFPA 720, 5.4.3.)

4.1.2 Pathways Utilizing Two or More Media

Quantity: _____ Description: _____

_____

4.1.3 Device Power Pathways

❑ No separate power pathways from the signaling line pathway

❑ Power pathways are separate but of the same pathway classification as the signaling line pathway

❑ Power pathways are separate and different classification from the signaling line pathway

4.1.4 Isolation Modules

Quantity: _____

FIGURE 4.14.1.4 *Continued*

4. CIRCUITS AND PATHWAYS *(continued)*

4.2 Alarm Initiating Device Pathways

4.2.1 Pathways Class Designations

Pathways class: _____ Quantity: _____

(See NFPA 720, 5.4.3.)

4.2.2 Pathways Utilizing Two or More Media

Quantity: _____ Description: _____

4.2.3 Device Power Pathways

❑ No separate power pathways from the initiating device pathway

❑ Power pathways are separate but of the same pathway classification as the initiating device pathway

❑ Power pathways are separate and different classification from the initiating device pathway

4.3 Non-Voice Audible System Pathways

4.3.1 Pathways Class Designations

Pathways class: _____ Quantity: _____

(See NFPA 720, 5.4.3.)

4.3.2 Pathways Utilizing Two or More Media

Quantity: _____ Description: _____

4.3.3 Device Power Pathways

❑ No separate power pathways from the notification appliance pathway

❑ Power pathways are separate but of the same pathway classification as the notification appliance pathway

❑ Power pathways are separate and different classification from the notification appliance pathway

5. ALARM INITIATING DEVICES

5.1 Automatic Initiating Devices

5.1.1 Carbon Monoxide Detectors

Type and number of devices: Addressable: _____ Conventional: _____

Other (specify): _____

Type of detector sensing technology: ❑ Electrochemical ❑ Biomimetic ❑ Metal oxide semiconductor (MOS)

Other (specify): _____

5.1.2 Addressable Monitoring Modules ❑ This system does not have monitoring modules.

Number of devices: _____

5.1.3 Other Initiating Devices ❑ This system does have other initiating devices.

Describe: _____

6. SUPERVISORY SIGNAL–INITIATING DEVICES

6.1 Supervisory Devices ❑ This system does not have supervisory devices.

Type and number of devices: Addressable: _____ Conventional: _____ Coded: _____ Transmitter: _____

Describe: _____

FIGURE 4.14.1.4 *Continued*

7. ANNUNCIATORS

❑ This system does not have annunciators.

7.1 Location and Description of Annunciators

Location 1: _____

Location 2: _____

Location 3: _____

8. ALARM NOTIFICATION APPLIANCES

8.1 Emergency Voice Alarm Communication System

❑ This system does not have an EVACS.

Number of single voice alarm channels: _____ Number of multiple voice alarm channels: _____

Number of speakers: _____ Number of speaker circuits: _____

Location of amplification and sound-processing equipment: _____

Location of paging microphone stations:

Location 1: _____

Location 2: _____

Location 3: _____

8.2 Nonvoice Notification Appliances

❑ This system does not have nonvoice notification appliances.

Horns: _____ With visible: _____ Bells: _____ With visible: _____

Chimes: _____ With visible: _____

Visible only: _____ Other (describe): _____

8.3 Notification Appliance Power Extender Panels

❑ This system does not have power extender panels.

Quantity: _____

Locations: _____

9. CARBON MONOXIDE SAFETY FUNCTIONS

This system activates the following control functions: _____

_____

Describe: _____

9.1 Addressable Control Modules

❑ This system does not have control modules.

Number of devices: _____

Other (specify): _____

10. SYSTEM POWER

10.1 Control Unit

10.1.1 Primary Power

Input voltage of control panel: _____ Control panel amps: _____

Overcurrent protection: Type: Amps: _____

Location (of primary supply panel board):

Disconnecting means location: _____

FIGURE 4.14.1.4 *Continued*

10. SYSTEM POWER *(continued)*

10.1.2 Engine-Driven Generator ❑ This system does not have a generator.

Location of generator: _____

Location of fuel storage: _____ Type of fuel:

10.1.3 Uninterruptible Power System ❑ This system does not have a UPS.

Equipment powered by a UPS system: _____

Location of UPS system: _____

Calculated capacity of UPS batteries to drive the system components connected to it:

In standby mode (hours): _____ In alarm mode (minutes): _____

10.1.4 Batteries

Location: _____ Type: _____ Nominal voltage: _____ Amp/hour rating: _____

Calculated capacity of batteries to drive the system:

In standby mode (hours): _____ In alarm mode (minutes): _____

❑ Batteries are marked with date of manufacture ❑ Battery calculations are attached

10.2 Emergency Voice Alarm Communication System

❑ This system does not have an EVACS.

10.2.1 Primary Power

Input voltage of EVACS panel: _____ EVACS panel amps: _____

Overcurrent protection: Type: _____ Amps: _____

Location (of primary supply panel board): _____

Disconnecting means location: _____

10.2.2 Engine-Driven Generator ❑ This system does not have a generator.

Location of generator: _____

Location of fuel storage: _____ Type of fuel: _____

10.2.3 Uninterruptible Power System ❑ This system does not have a UPS.

Equipment powered by a UPS system: _____

Location of UPS system: _____

Calculated capacity of UPS batteries to drive the system components connected to it:

In standby mode (hours): _____ In alarm mode (minutes): _____

10.2.4 Batteries

Location: _____ Type: _____ Nominal voltage: _____ Amp/hour rating: _____

Calculated capacity of batteries to drive the system:

In standby mode (hours): _____ In alarm mode (minutes): _____

❑ Batteries are marked with date of manufacture ❑ Battery calculations are attached

10.3 Notification Appliance Power Extender Panels

❑ This system does not have power extender panels

FIGURE 4.14.1.4 *Continued*

10. SYSTEM POWER *(continued)*

10.3.1 Primary Power

Input voltage of power extender panel(s): _____ Power extender panel amps: _____

Overcurrent protection: Type: _____ Amps: _____

Location (of primary supply panel board): _____

Disconnecting means location: _____

10.3.2 Engine-Driven Generator

❑ This system does not have a generator.

Location of generator: _____

Location of fuel storage: _____ Type of fuel: _____

10.3.3 Uninterruptible Power System

❑ This system does not have a UPS.

Equipment powered by a UPS system: _____

Location of UPS system: _____

Calculated capacity of UPS batteries to drive the system components connected to it:

In standby mode (hours): _____ In alarm mode (minutes): _____

10.3.4 Batteries

Location: _____ Type: _____ Nominal voltage: _____ Amp/hour rating: _____

Calculated capacity of batteries to drive the system:

In standby mode (hours): _____ In alarm mode (minutes): _____

❑ Batteries are marked with date of manufacture ❑ Battery calculations are attached

11. RECORD OF SYSTEM INSTALLATION

Fill out after all installation is complete and wiring has been checked for opens, shorts, ground faults, and improper branching, but before conducting operational acceptance tests.

This is a: ❑ New system ❑ Modification to an existing system Permit number: _____

The system has been installed in accordance with the following requirements: (Note any or all that apply.)

❑ NFPA 720, Edition: _____

❑ *NFPA 72,* Edition: _____

❑ *NFPA 70, National Electrical Code,* Article 760*,* Edition: _____

❑ Manufacturer's published instructions

Other (specify): _____

_____

System deviations from referenced NFPA standards: _____

_____

Signed: _____ Printed name: _____ Date: _____

Organization: _____ Title: _____ Phone: _____

FIGURE 4.14.1.4 ***Continued***

12. RECORD OF SYSTEM OPERATONAL ACCEPTANCE TEST

❑ New system

All operational features and functions of this system were tested by, or in the presence of, the signer shown below, on the date shown below, and were found to be operating properly in accordance with the requirements for the following:

❑ Modifications to an existing system

All newly modified operational features and functions of the system were tested by, or in the presence of, the signer shown below, on the date shown below, and were found to be operating properly in accordance with the requirements of the following:

❑ NFPA 720, Edition: _____

❑ *NFPA 72,* Edition: _____

❑ *NFPA 70, National Electrical Code,* Article 760, Edition: _____

❑ Manufacturer's published instructions

Other (specify): _____

_____

❑ Individual device testing documentation [Inspection and Testing Form (Figure 8.6.2.2) is attached]

Signed: _____ Printed name: _____ Date: _____

Organization: _____ Title: _____ Phone: _____

13. CERTIFICATIONS AND APPROVALS

13.1 System Installation Contractor:

This system, as specified herein, has been installed and tested according to all NFPA standards cited herein.

Signed: _____ Printed name: _____ Date: _____

Organization: _____ Title: _____ Phone: _____

13.2 System Service Contractor:

The undersigned has a service contract for this system in effect as of the date shown below.

Signed: _____ Printed name: _____ Date: _____

Organization: _____ Title: _____ Phone: _____

13.3 Supervising Station:

This system, as specified herein, will be monitored according to all NFPA standards cited herein.

Signed: _____ Printed name: _____ Date: _____

Organization: _____ Title: _____ Phone: _____

FIGURE 4.14.1.4 ***Continued***

13. CERTIFICATIONS AND APPROVALS *(continued)*

13.4 Property or Owner Representative:

I accept this system as having been installed and tested to its specifications and all NFPA standards cited herein.

Signed: _____ Printed name: _____ Date: _____

Organization: _____ Title: _____ Phone: _____

13.5 Authority Having Jurisdiction:

I have witnessed a satisfactory acceptance test of this system and find it to be installed and operating properly in accordance with its approved plans and specifications, with its approved sequence of operations, and with all NFPA standards cited herein.

Signed: _____ Printed name: _____ Date: _____

Organization: _____ Title: _____ Phone: _____

FIGURE 4.14.1.4 *Continued*

4.14.2.3 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
(2) Record drawings
(3) For software-based systems, record copy of the site-specific software
(4) A written sequence of operation

Chapter 5 Protected Premises Carbon Monoxide Detection Systems

5.1 Application.

5.1.1 The application, installation, and performance of carbon monoxide detection systems within protected premises, including carbon monoxide alarm, supervisory, and trouble signals, shall comply with the requirements of this chapter.

5.1.2 The requirements of Chapters 4, 6, and 7 shall also apply, unless they are in conflict with this chapter.

5.1.3 The requirements of Chapter 8 shall apply.

5.1.4 The requirements of this chapter shall not apply to carbon monoxide alarms and household carbon monoxide detection systems addressed in Chapter 9 unless otherwise noted.

5.2 General.

5.2.1* Purpose. The systems covered in Chapter 5 shall be for the protection of life by indicating the existence of carbon monoxide impacting the protected premises.

5.2.2 Software and Firmware Control.

5.2.2.1 A record of installed software and firmware version numbers shall be maintained at the location of the [carbon monoxide detection] control unit. [**72:**23.2.2.1]

5.2.2.1.1* Software and firmware within the [carbon monoxide detection] system that interfaces to other required software or firmware shall be functionally compatible. [**72:**23.2.2.1.1]

5.2.2.1.2* The compatible software or firmware versions shall be documented at the initial acceptance test and at any reacceptance tests. [**72:**23.2.2.1.2]

5.2.2.2* All software and firmware shall be protected from unauthorized changes. [**72:**23.2.2.2]

5.2.2.3 All changes shall be tested in accordance with 8.4.2. [**72:**23.2.2.3]

5.2.3 Separate Systems. The requirements of this chapter shall not preclude the use of separate fire, life safety, and carbon monoxide detection systems, provided that the systems do not generate simultaneous conflicting notification to building occupants or conflicting activation of safety functions.

5.3 System Features. The features required for a protected premises [carbon monoxide detection] system shall be documented as a part of the system design and shall be determined in accordance with 5.3.1 through 5.3.3. [**72:**23.3]

5.3.1 Required Systems. Features for required systems shall be based on the requirements of other applicable codes or statutes that have been adopted by the enforcing jurisdiction. [**72:**23.3.1]

5.3.2* Nonrequired (Voluntary) Systems and Components. The features for a nonrequired system shall be established by the system designer on the basis of the goals and objectives intended by the system owner. [**72:**23.3.2]

5.3.2.1 Nonrequired [carbon monoxide detection] systems and components shall meet the requirements of this standard. [**72:**23.3.2.1]

5.3.2.2 Nonrequired [carbon monoxide detection] systems and components shall identified on the record drawings required in 4.14.2.3(2). [**72:**23.3.2.2]

5.3.3 Required Features. Protected premises carbon monoxide detection systems that serve the general carbon monoxide alarm needs of a building or buildings shall include one or more of the following systems or functions:

(1) Automatic alarm signal initiation
(2) Activation of carbon monoxide safety functions
(3) Activation of alarm notification appliances
(4) Emergency voice/alarm communications
(5) Activation of off-premises signals
(6) Combination carbon monoxide detection systems
(7) Integrated systems

5.4 System Performance and Integrity.

5.4.1 General. The performance and integrity of carbon monoxide detection systems shall comply with the applicable requirements of 5.4.2 through Section 5.7.

5.4.2 Circuits and Pathways.

5.4.2.1 Performance [ ] characteristics of signaling pathways (interconnections) shall comply with the defined designations of 5.4.2 and 5.4.3. [**72:**12.2.1]

5.4.2.2 A pathway (interconnection) class designation shall be dependent on the pathway (interconnection) capability to continue to operate during abnormal conditions. [**72:**12.2.2]

5.4.2.3 The installation of all pathway wiring, cable, and equipment shall be in accordance with *NFPA 70, National Electrical Code*, and the applicable requirements of 5.4.2.3.1 through 5.4.2.3.4. [**72:**12.2.4]

5.4.2.3.1 Optical fiber cables installed as part of the [carbon monoxide detection] system shall meet the requirements of *NFPA 70, National Electrical Code*, Article 770, and be protected against physical damage in accordance with *NFPA 70, National Electrical Code*, Article 760. [**72:**12.2.4.1]

5.4.2.3.2 All non-power-limited and power-limited signaling system circuits entering a building shall be provided with transient protection.
[**72:**12.2.4.2]

5.4.2.3.3 [Carbon monoxide detection] system wiring and equipment, including all circuits controlled and powered by the [carbon monoxide detection] system, shall be installed in accordance with the requirements of this standard and of *NFPA 70, National Electrical Code*, Article 760.
[**72:**12.2.4.3]

5.4.2.3.4 Ground Connections.

5.4.2.3.4.1 All [carbon monoxide detection] 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.
*[**72:***12.2.5.1]*

5.4.2.3.4.2* On conductive pathways, operational capability shall be maintained during the application of a signal ground connection. [**72:**12.2.5.2]

5.4.3* 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. [**72:**12.3]

5.4.3.1* 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, and the single open fault shall result in the annunciation of a trouble signal.
(3) Conditions that affect the intended operation of the path are annunciated as a trouble signal.
(4) Operational capability is maintained during the application of a single ground fault.
(5) A single ground condition shall result in the annunciation of a trouble signal.

Exception: Requirements in 5.4.3.1(4) and 5.4.3.1(5) shall not apply to nonconductive pathways (e.g., wireless or fiber).

[**72:**12.3.1]

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

(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 as a trouble signal.
(4) Operational capability is maintained during the application of single ground fault.
(5) A single ground condition shall result in the annunciation of a trouble signal.

Exception: Requirements in 5.4.3.2(4) and 5.4.3.2(5) shall not apply to nonconductive pathways (e.g. wireless or fiber).

[**72:**12.3.2]

5.4.3.3 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.

5.4.3.4* 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. [**72:**12.3.4]

5.4.3.5* Class E. A pathway shall be designated as Class E when it is not monitored for integrity. [**72:**12.3.5]

5.4.3.6* 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, and the single open fault shall result in the annunciation of a trouble signal.
(3) Operational capability continues past a single short-circuit, and the single short-circuit fault shall result in the annunciation of a trouble signal.
(4) Operational capability continues past a combination open fault and ground fault
(5) Conditions that affect the intended operation of the path are annunciated as trouble signal.
(6) Operational capability is maintained during the application of a single ground fault.
(7) A single ground condition shall result in the annunciation of a trouble signal.

Exception: Requirements in 5.4.3.6(3), 5.4.3.6(4), 5.4.3.6(6), and 5.4.3.6(7) shall not apply to nonconductive pathways (e.g. wireless or fiber).

[**72:**12.3.6]

5.4.4 Circuit Designations. Initiating device circuits, notification appliance circuits, and signaling line circuits shall be designated by class, depending on the circuit's capability to continue to operate during specified fault conditions as indicated in Sections 5.5 through 5.7. [**72:**23.4.2]

5.4.4.1 Specified fault conditions shall result in the annunciation of a trouble signal at the protected premises within 200 seconds as required in Section 4.13. [**72:**23.4.2.1]

5.4.4.2* Class A 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 be 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 raceway drops to individual devices or appliances
(3) For single raceway drops to multiple devices or appliances installed within a single room not exceeding 1000 ft^2 (93 m^2) in area

[**72:**12.4.3.7]

5.4.4.3 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 5.4.5 and approved by the authority having jurisdiction. [**72:**23.4.2.2]

5.4.5 Pathway Classification.

5.4.5.1 The class of pathways shall be determined from an evaluation based on the path performance as required by governing laws, codes, standards, and a site-specific engineering analysis. [**72:**23.4.3.1]

5.4.5.2 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 [carbon monoxide detection] system that would hinder the performance objectives of the system that protects the occupants [and mission] of the protected premises
(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

[**72:**23.4.3.2]

5.4.5.3 Results of the evaluation required by 5.4.5.1 shall be included with the documentation required by 4.14.1.2. [**72:**23.4.3.3]

5.5 Performance of Initiating Device Circuits (IDCs). 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 for Class A or Class B pathways specified in 5.4.3. [**72:**23.5]

5.6 Performance of Signaling Line Circuits (SLCs). The assignment of class designations to signaling line circuits shall be based on their performance capabilities under abnormal (fault) conditions in accordance with the requirements for Class A, Class B, or Class X pathways specified in 5.4.3. [**72:**23.6]

5.6.1 A single fault on a pathway connected to addressable devices shall not cause the loss of more than 50 addressable devices. [**72:**23.6.4.1]

5.7 Performance of Notification Appliance Circuits (NACs). 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 for Class A, Class B, or Class X pathways specified in 5.4.3. [**72:**23.7]

5.8 System Requirements.

5.8.1* Actuation Time. Actuation of alarm notification appliances or emergency voice communications, [carbon monoxide] control function interface devices, and annunciation at the protected premises shall occur within 10 seconds after the activation of an initiating device. [**72:**23.8.1.1]

5.8.2* Carbon Monoxide Detection Control Units.

5.8.2.1 [Carbon monoxide detection] systems shall be permitted to combine all detection, notification, and auxiliary functions in a single system or be a combination of component subsystems. [**72:**23.8.2.1]

5.8.2.2 Carbon monoxide detection system 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.

5.8.2.3 All component subsystems shall be capable of simultaneous, full-load operation without degradation of the required overall system performance. [**72:**23.8.2.4]

5.8.2.4 The method of interconnection of [carbon monoxide detection] control units shall meet the monitoring requirements of Section 4.13 and *NFPA 70, National Electrical Code*, Article [725], and shall be achieved by the following recognized means:

(1) Electrical contacts listed for the connected load
(2) Data communications over signaling line circuit(s) dedicated to the [carbon monoxide detection system] or shared with other premises operating systems
(3) Other listed methods

[**72:**23.8.2.5]

5.8.2.5 Where the signaling line circuit is shared by other premises operating systems, operation shall be in accordance with 5.8.4. [**72:**23.8.2.6]

5.8.2.5.1 All signal control and transport equipment (such as routers and servers) located in a critical [carbon monoxide] control function interface device signaling path shall be listed for [carbon monoxide] alarm service, unless the following conditions are met:

(1) The equipment meets the performance requirements of 4.11.1.
(2) The equipment is provided with primary and secondary power and monitored for integrity as required in Section 4.5.
(3) All programming and configuration ensure a [carbon monoxide detection] system actuation time as required in 5.8.1.
(4) System bandwidth is monitored to confirm that all communications between equipment that is critical to the operation of the [carbon monoxide detection] system or [carbon monoxide] control function interface devices take place within 10 seconds; failure shall be indicated within 200 seconds.
(5) Failure of any equipment that is critical to the operation of the [carbon monoxide detection] system or [carbon monoxide] control function interface devices is indicated at the master [carbon monoxide detection] control unit within 200 seconds.

[**72:**23.8.2.6.1]

5.8.2.5.2 A listed barrier gateway, 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 [carbon monoxide detection] system. [**72:**23.8.2.6.2]

5.8.2.6 Each interconnected [carbon monoxide detection] control unit shall be separately monitored for alarm, supervisory, and trouble conditions. [**72:**23.8.2.7]

5.8.2.7 Interconnected [carbon monoxide detection] control unit alarm signals shall be permitted to be monitored by zone or by combined common signals. [**72:**23.8.2.8]

5.8.2.8 Protected premises carbon monoxide detection control units shall be capable of silencing building-wide notification from the alarm control unit at the protected premises unless otherwise permitted by 5.8.2.9.

5.8.2.9 An initiating device with integral sounder shall be permitted to be silenced locally, provided the control panel continues to indicate an alarm function.

5.8.2.9.1 If the carbon monoxide dissipates, the initiating device shall return normal mode.

5.8.3 Protected Premises Carbon Monoxide Detection Systems Interconnected with Household Carbon Monoxide Detection System.

5.8.3.1 A protected premises [carbon monoxide detection] system shall be permitted to be interconnected to a household

[carbon monoxide detection] system(s) for the purpose of activating the notification appliances connected to the household [carbon monoxide detection] system(s). [**72:**23.8.3.1]

5.8.3.2 The status of dwelling unit carbon monoxide detectors shall be permitted to be displayed at the protected premises carbon monoxide detection system control unit and annunciators.

5.8.3.3 If interconnected, an alarm condition at the protected premises carbon monoxide detection system shall cause the alarm notification appliance(s) of the dwelling unit household carbon monoxide detection system to become energized. The notification appliances shall remain energized until the protected premises carbon monoxide detection system is silenced or reset.

5.8.3.4 The interconnection circuit or path from the protected premises carbon monoxide detection system to the dwelling unit household carbon monoxide detection system shall be monitored for integrity by the protected premises carbon monoxide detection system in accordance with Section 4.13.

5.8.3.5 An alarm condition occurring at the dwelling unit household carbon monoxide detection system or the operation of any test switches provided as part of the dwelling unit household carbon monoxide equipment shall not cause an alarm condition at the protected premises carbon monoxide detection system.

5.8.4 Combination Carbon Monoxide Detection Systems.

5.8.4.1* [Carbon monoxide detection] systems shall be permitted to share components, equipment, circuitry, and installation wiring with [non–carbon monoxide detection] systems. [**72:**23.8.4.1]

5.8.4.2 Operation of non–carbon monoxide detection system function(s) originating within a connected non–carbon monoxide detection system shall not interfere with the required operation of the carbon monoxide detection system, unless otherwise required by applicable codes or standards.

5.8.4.3 For non–[carbon monoxide detection system] equipment listed to the performance requirements specified in 4.11.1, the requirements of 5.8.4.3.1 through 5.8.4.3.3 shall apply. [**72:**23.8.4.3]

5.8.4.3.1 The equipment shall be permitted to be attached to a [carbon monoxide detection system] circuit, either among the [carbon monoxide detection system] devices or as a branch or extension of the [carbon monoxide detection system] pathways, when the following requirements are met:

(1) All the equipment and pathways shall meet the monitoring for integrity requirements of Section 4.13.
(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 standard.
(4) All the equipment shall be listed as compatible with the [carbon monoxide detection system] equipment or the equipment shall have an interface listed as compatible with the [carbon monoxide detection system] equipment.

[**72:**23.8.4.3.1]

5.8.4.3.2 If the equipment is attached to the [carbon monoxide detection] system via separate pathways, then short circuits or open circuits in this equipment, or between this equipment and the [carbon monoxide detection] system pathways, shall not impede or impair the monitoring for integrity of the [carbon monoxide detection] system or prevent alarm, supervisory, or [ ] safety control signal transmissions. [**72:**23.8.4.3.2]

5.8.4.3.3 Grounds in this equipment, or between this equipment and the [carbon monoxide detection] system pathways, shall be reported, annunciated, and corrected in the same manner as grounds in the rest of the [carbon monoxide detection] system. [**72:**23.8.4.3.3]

5.8.4.4 For non–[carbon monoxide detection system] equipment not listed to the performance requirements specified in 4.11.1, the requirements of 5.8.4.4.1 through 5.8.4.4.3 shall apply. [**72:**23.8.4.4]

5.8.4.4.1 Short circuits or open circuits in the equipment, or between the equipment and the [carbon monoxide detection] system pathways, shall not impede or impair the monitoring for integrity of the [carbon monoxide detection] system or prevent alarm, supervisory, or [ ] safety control signal transmissions. [**72:**23.8.4.4.1]

5.8.4.4.2 Grounds in this equipment, or between this equipment and the [carbon monoxide detection] system pathways, shall be reported, annunciated, and corrected in the same manner as grounds in the rest of the [carbon monoxide detection] system. [**72:**23.8.4.4.2]

5.8.4.4.3 Removal, replacement, failure, maintenance procedures, or ground on this hardware, software, or circuits shall not impair the required operation of the [carbon monoxide detection] system. [**72:**23.8.4.4.3]

5.8.4.5 Speakers used as mass notification or emergency communications systems installed in accordance with the requirements of *NFPA 72, National Fire Alarm and Signaling Code,* shall also be permitted to be used as alarm notification appliances for carbon monoxide detection systems.

5.8.4.6* In combination carbon monoxide detection systems, carbon monoxide alarm signals shall be distinctive, be clearly recognizable, and take priority over signals associated with property protection.

5.8.4.7 Signals from carbon monoxide detectors and carbon monoxide detection systems transmitted to another alarm system shall be as a distinct carbon monoxide alarm signal unless otherwise required by the authority having jurisdiction.

5.8.5 Carbon Monoxide Detection System Inputs.

5.8.5.1 General. All initiating devices shall be installed in accordance with 5.8.5 and tested in accordance with Chapter 8.

5.8.5.1.1 Where subject to mechanical damage, an initiating device shall be protected.

5.8.5.1.1.1 A mechanical guard used to protect a detector shall be listed for use with the detector.

5.8.5.1.2 Initiating devices shall be supported independently of their attachment to the circuit conductors. [**72:**17.4.3]

5.8.5.1.3 Initiating devices shall be installed in a manner that provides accessibility for periodic inspection, testing, and maintenance. [**72:**17.4.4]

5.8.5.1.4* Duplicate terminals, leads, or connectors that provide for the connection of installation wiring shall be provided on each initiating device for the express purpose of connecting into the [carbon monoxide detection] system to monitor the integrity of the signaling and power wiring.

Exception: Initiating devices connected to a system that provides the required monitoring.
[**72:**17.4.6]

5.8.5.1.5 Initiating devices shall not be located in areas where environmental conditions cause an adverse effect on the initiating devices' ability to detect the targeted hazardous gas.

5.8.5.2 Alarm Signal Initiation — Initiating Devices with Separate Power and Signaling Wiring.

5.8.5.2.1 Automatic [carbon monoxide] alarm signal initiating devices that have integral trouble signal contacts shall be connected to the initiating device circuit so that a trouble condition within a device does not impair alarm transmission from any other initiating device.

Exception: Where the trouble condition is caused by electrical disconnection of the device or by removing the initiating device from its plug-in base.
[**72:**23.8.5.3.1]

5.8.5.2.2* Automatic [carbon monoxide] alarm signal initiating devices that use a nonintegral device to monitor the integrity of the power supply wiring to the individual initiating devices shall have the nonintegral device connected to the initiating device circuit so that a fault on the power supply wiring does not impair alarm transmission from any operational initiating device. [**72:**23.8.5.3.2]

5.8.5.3 Requirements for Carbon Monoxide Detectors.

5.8.5.3.1 Carbon monoxide detectors shall be installed as specified in the manufacturer's published instructions in accordance with 5.8.5.3.1(1) and 5.8.5.3.1(2), or 5.8.5.3.1(3):

(1)*On the ceiling in the same room as permanently installed fuel-burning appliances
(2)*Centrally located on every habitable level and in every HVAC zone of the building
(3) A performance-based design in accordance with 5.8.5.3.2

5.8.5.3.2 Performance-Based Design.

5.8.5.3.2.1 Performance-based designs submitted to the authority having jurisdiction for review and approval shall include documentation, in an approved format, of each performance objective and applicable scenario, together with any calculations, modeling, or other technical substantiation used in establishing the proposed design's [ ] life safety performance. [**72:**17.3.1]

5.8.5.3.2.2 The authority having jurisdiction shall determine whether such identified performance objectives are appropriate and have been met. [**72:**17.3.2]

5.8.5.3.2.3 The authority having jurisdiction shall approve modifications to or variations from the approved design or design basis in advance. [**72:**17.3.3]

5.8.5.3.3 Carbon monoxide detectors shall be marked in accordance with their listing. Detector thresholds shall be set to respond at the levels specified by ANSI/UL 2034, *Standard for Single and Multiple Station Carbon Monoxide Alarms*.

5.8.5.3.4 All carbon monoxide detectors shall be located and mounted so that accidental operation will not be caused by jarring or vibration.

5.8.5.3.5 The location of carbon monoxide detectors shall be based on an evaluation of potential ambient sources and flows of carbon monoxide, moisture, temperature, dust, or fumes and of electrical or mechanical influences to minimize nuisance alarms. [**72:**17.7.1.9]

5.8.5.3.6 The selection and placement of [carbon monoxide] detectors shall take into account both the performance characteristics of the detector and the areas into which the detectors are to be installed to prevent nuisance and unintentional alarms or improper operation after installation. [**72:**17.7.1.7]

5.8.5.3.7 Unless specifically designed and listed for the expected conditions, carbon monoxide detectors shall not be installed where any of the following ambient conditions exist:

(1) Temperature below 32°F (0°C)
(2) Temperature above 100°F (38°C)
(3) Relative humidity outside the range of 10 percent to 95 percent

5.8.5.3.8 Unless tested and listed for recessed mounting, carbon monoxide detectors shall not be recessed into the mounting surface.

5.8.5.3.9 Protection During Construction.

5.8.5.3.9.1 Where detectors are installed for signal initiation during construction, they shall be replaced prior to the final commissioning of the system.

5.8.5.3.9.2 Where detection is not required during construction, detectors shall not be installed until after all other construction trades have completed cleanup. [**72:**17.7.1.11.3]

5.8.5.4 Carbon Monoxide Detectors for Control of Carbon Monoxide Spread.

5.8.5.4.1 System designers shall consider the spread of carbon monoxide through an occupancy through the HVAC system.

5.8.5.4.2 Interaction with smoke control systems, if such is provided, shall be coordinated.

5.8.6 Carbon Monoxide Alarm Notification System Notification Outputs.

5.8.6.1 General. The performance, location, and mounting of notification appliances used to initiate or direct [action], evacuation or relocation of the occupants, or for providing information to occupants or staff, shall comply with Chapter 6. [**72:**18.1.3]

5.8.6.2 Occupant Notification.

5.8.6.2.1 Except as permitted in 5.8.6.2.2, occupant notification shall be throughout the protected premises.

5.8.6.2.2 Where carbon monoxide alarm signals are transmitted to a constantly attended on-site location or off-premises location in accordance with Chapter 7, selective public mode occupant notification shall be permitted to be limited to the notification zone encompassing the area where the carbon monoxide alarm signal was initiated.

5.8.6.3 Notification Zones.

5.8.6.3.1 Notification zones shall be consistent with the emergency response plan for the protected premises.

5.8.6.3.2* The boundaries of notification zones shall be coincident with the area where the alarm initiation originated and other signaling zones in accordance with the building's emergency response plan.

5.8.6.4 Circuits for Addressable Notification Appliances.

5.8.6.4.1 Circuit configuration for addressable notification appliances shall comply with the applicable performance requirements for notification zones. [**72:**23.8.6.4.1]

5.8.6.4.2 Where there are addressable notification appliances on a signaling line circuit that serves different notification zones, a single open, short–circuit, or ground on that signaling line circuit shall not affect operation of more than one notification zone. [**72:**23.8.6.4.2]

5.8.6.5 Distinctive Signal.

5.8.6.5.1* The audible carbon monoxide alarm signal shall be a four-pulse temporal pattern and comply with the following:

(1) Signals shall be a pattern consisting of four cycles of 100 milliseconds ± 10 percent "on" and 100 milliseconds ± 10 percent "off," followed by 5 seconds ± 10 percent "off."
(2) After the initial 4 minutes of alarm, the 5-second "off" time shall be permitted to be changed to 60 seconds ± 10 percent.
(3) The alarm signal shall be repeated in compliance with 5.8.6.5.1(1) and 5.8.6.5.1(2) until the alarm resets or the alarm signal is manually silenced.

5.8.6.5.2* The audible alarm signal shall be synchronized within a notification zone.

5.8.7 Emergency Voice/Alarm Communications. Where an emergency voice/alarm communications system is installed for the purpose of occupant notification related to carbon monoxide detection, it shall comply with the requirements of 24.4.2 of *NFPA 72, National Fire Alarm and Signaling Code*, excluding the requirements in 24.4.2.8.5.

5.9 Signal Annunciation.

5.9.1 Protected premises carbon monoxide detection systems shall be arranged to annunciate carbon monoxide alarm, supervisory, and trouble signals in accordance with Section 4.12.

5.9.2* If a remote alarm indicator is provided for an automatic [carbon monoxide] detector in a concealed location, the location of the detector and the area protected by the detector shall be prominently indicated at the remote alarm indicator by a permanently attached placard or by other approved means. [**72:**17.4.8]

5.10 Off-Premises Signals.

5.10.1 Systems requiring transmission of signals to continuously attended locations providing supervising station service (e.g., central station, proprietary supervising station, remote supervising station) shall also comply with the applicable requirements of Chapter 7. [**72:**23.12.1]

5.10.2 Relays or modules providing transmission of trouble signals to a supervising station shall be arranged to provide fail-safe operation. [**72:**23.12.2]

5.10.3 Means provided to transmit trouble signals to supervising stations shall be arranged so as to transmit a trouble signal to the supervising station for any trouble condition received at the protected premises control unit, including loss of primary or secondary power. [**72:**23.12.3]

5.11 Protected Premises Carbon Monoxide Control Functions. Where provided, the interconnection of control functions shall comply with the requirements of 5.11.1 through 5.11.9.

5.11.1 Carbon monoxide control functions shall be permitted to be performed automatically.

5.11.2* A [carbon monoxide] control function interface device shall be located within 3 ft (1 m) of the component controlling the [carbon monoxide] control function. [**72:**21.2.4]

5.11.3 The [carbon monoxide] control function interface device shall function within the voltage and current limitations of the [carbon monoxide detection] control unit. [**72:**21.2.5]

5.11.4 The installation wiring between the [carbon monoxide detection] control unit and the [carbon monoxide] control function interface device shall be Class A, Class B, Class D, or Class X in accordance with 5.4.3. [**72:**21.2.6]

5.11.5 [Carbon monoxide] control functions shall not interfere with other operations of the [carbon monoxide detection system]. [**72:**21.2.7]

5.11.6 The method(s) of interconnection between the [carbon monoxide detection] system and [carbon monoxide] control function interface device shall be monitored for integrity in accordance with Section 4.13. [**72:**21.2.8]

5.11.7 The method(s) of interconnection between the [carbon monoxide] control function interface device and the component controlling the [carbon monoxide] control function shall comply with the applicable provisions of *NFPA 70, National Electrical Code*. [**72:**21.2.9]

5.11.8 The method(s) of interconnection between the [carbon monoxide] control function interface device and the component controlling the [carbon monoxide] control function shall be achieved by one of the following recognized means:

(1) Electrical contacts listed for the connected load
(2) Data communications over a signaling line circuit(s) dedicated to the [carbon monoxide detection] or shared with other premises operating systems
(3) Other listed methods

[**72:**21.2.10]

5.11.9 If a [carbon monoxide detection] system is a component of a life safety network and it communicates data to other systems providing life safety functions, or it receives data from such systems, the following shall apply:

(1) The path used for communicating data shall be monitored for integrity. This shall include monitoring the physical communication media and the ability to maintain intelligible communications.
(2) Data received from the network shall not affect the operation of the [carbon monoxide detection] system in any way other than to display the status of life safety network components.
(3) Where [non–carbon monoxide detection] systems are interconnected to the [carbon monoxide detection] system using a network or other digital communication technique, a signal (e.g., heartbeat, poll, ping, query) shall be generated between the [carbon monoxide detection] system and the [non–carbon monoxide detection] system. Failure of the [carbon monoxide detection] system to receive confirmation of the transmission shall cause a trouble signal to indicate within 200 seconds.

[**72:**21.2.11]

5.12* Special Requirements for Low-Power Radio (Wireless) Systems.

5.12.1* Listing Requirements. Compliance with Section 5.12 shall require the use of low-power radio equipment specifically listed for the purpose. [**72:**23.16.1]

5.12.2 Power Supplies. A primary battery (dry cell) shall be permitted to be used as the sole power source of a low-power radio transmitter where all of the following conditions are met:

(1) Each transmitter shall serve only one device and shall be individually identified at the receiver/[carbon monoxide detection] control unit.
(2) The battery shall be capable of operating the low-power radio transmitter for not less than 1 year before the battery depletion threshold is reached.
(3) A battery depletion signal shall be transmitted before the battery has been depleted to a level below that required to support [carbon monoxide] alarm transmission after 7 additional days of nonalarm operation. This signal shall be distinctive from [carbon monoxide] alarm, supervisory, tamper, and trouble signals; shall visibly identify the affected low-power radio transmitter; and, when silenced, shall automatically re-sound at least once every 4 hours.
(4) Catastrophic (open or short) battery failure shall cause a trouble signal identifying the affected low-power radio transmitter at its receiver/[carbon monoxide detection] control unit. When silenced, the trouble signal shall automatically re-sound at least once every 4 hours.
(5) Any mode of failure of a primary battery in a low-power radio transmitter shall not affect any other low-power radio transmitter.

[**72:**23.16.2]

5.12.3 Carbon Monoxide Alarm Signals.

5.12.3.1* When actuated, each low-power radio transmitter shall automatically transmit a [carbon monoxide] alarm signal. [**72:**23.16.3.1]

5.12.3.2 Each low-power radio transmitter shall automatically repeat [carbon monoxide] alarm transmission at intervals not exceeding 60 seconds until the initiating device is returned to its nonalarm condition. [**72:**23.16.3.2]

5.12.3.3 [Carbon monoxide] alarm signals shall have priority over all other signals. [**72:**23.16.3.3]

5.12.3.4 The maximum allowable response delay from activation of an initiating device to receipt and display by the receiver/[carbon monoxide detection] control unit shall be 10 seconds. [**72:**23.16.3.4]

5.12.3.5 A [carbon monoxide] alarm signal from a low-power radio transmitter shall latch at its receiver/[carbon monoxide detection] control unit until manually reset and shall identify the particular initiating device in alarm. [**72:**23.16.3.5]

5.12.4 Monitoring for Integrity.

5.12.4.1 The low-power radio transmitter shall be specifically listed as using a transmission method that is highly resistant to misinterpretation of simultaneous transmissions and to interference (e.g., impulse noise and adjacent channel interference). [**72:**23.16.4.1]

5.12.4.2 The occurrence of any single fault that disables transmission between any low-power radio transmitter and the receiver/[carbon monoxide detection] control unit shall cause a latching trouble signal within 200 seconds.

Exception: Until the expiration date for this exception of [June 30, 2015], 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/[carbon monoxide detection] control unit from any initiating device transmitter

[**72:**23.16.4.2]

5.12.4.3 A single fault on the signaling channel shall not cause a [carbon monoxide] alarm signal. [**72:**23.16.4.3]

5.12.4.4 The periodic transmission required to comply with 5.12.4.2 from a low-power radio transmitter shall ensure successful [carbon monoxide] alarm transmission capability. [**72:**23.16.4.4]

5.12.4.5 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. [**72:**23.16.4.5]

5.12.4.6 Reception of any unwanted (interfering) transmission by a retransmission device (repeater) or by the main receiver/control unit, for a continuous period of 20 seconds or more, shall cause an audible and visible trouble indication at the main receiver/control unit. This indication shall identify the specific trouble condition as an interfering signal. [**72:**23.16.4.6]

5.12.5 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 4 or the requirements of 5.12.2.
(2) All supervision requirements of Chapter 4, Chapter 5, or 5.12.4 shall apply.
(3) The maximum allowable response delay from activation of an initiating device to activation of required carbon monoxide detection functions shall be 10 seconds.
(4) Each receiver/control shall automatically repeat carbon monoxide alarm signal transmission at intervals not exceeding 60 seconds or until confirmation that the output appliance has received the carbon monoxide alarm signal.

Chapter 6 Notification Appliances for Carbon Monoxide Detection Systems

6.1* Application.

6.1.1 The requirements of this chapter shall apply where required by the enforcing authority; governing laws, codes, or standards; or other parts of this standard. [**72:**18.1.1]

6.1.2 The requirements of this chapter shall address the reception of a notification signal and not the signal's information content. [**72:**18.1.2]

6.1.3 The performance, location, and mounting of notification appliances used to initiate or direct evacuation or relocation of the occupants, or for providing information to occupants or staff, shall comply with this chapter. [**72:**18.1.3]

6.1.4 The performance, location, and mounting of annunciators, displays, and printers used to display or record information for use by occupants, staff, responding emergency personnel, or supervising station personnel shall comply with this chapter. [**72:**18.1.4]

6.1.5* The requirements of this chapter shall apply to the areas, spaces, or system functions where required by the enforcing authority; governing laws, codes, or standards; or other parts of this standard requiring compliance with this chapter. [**72:**18.1.5]

6.1.6 The requirements of Chapter 4 and Chapter 5 shall apply to the interconnection of notification appliances, the control configurations, the power supplies, and the use of the information provided by notification appliances. [**72:**18.1.7]

6.1.7 Notification appliances shall be permitted to be used within buildings or outdoors and to target the general building, area, or space, or only specific parts of a building, area, or space designated in specific zones and sub-zones. [**72:**18.1.8]

6.2 Purpose. Notification appliances shall provide stimuli for initiating emergency action and provide information to users, emergency response personnel, and occupants. [**72:**18.2]

6.3 General.

6.3.1 Listing. All notification appliances installed in conformity with Chapter 6 shall be listed for the purpose for which they are used. [**72:**18.3.1]

6.3.2 Nameplates.

6.3.2.1 Notification appliances shall include on their nameplates reference to electrical requirements and rated audible or visible performance, or both, as defined by the listing authority. [**72:**18.3.2.1]

6.3.2.2 Audible appliances shall include on their nameplates reference to their parameters or reference to installation documents (supplied with the appliance) that include the parameters in accordance with 6.4.2 or 6.4.3. [**72:**18.3.2.2]

6.3.2.3 Visible appliances shall include on their nameplates reference to their parameters or reference to installation documents (supplied with the appliance) that include the parameters in accordance with 6.5.3.1 or Section 6.6. [**72:**18.3.2.3]

6.3.3 Physical Construction.

6.3.3.1 Appliances intended for use in special environments, such as outdoors versus indoors, high or low temperatures, high humidity, dusty conditions, and hazardous locations, or where subject to tampering, shall be listed for the intended application. [**72:**18.3.3.1]

6.3.3.2* Notification appliances used for [carbon monoxide] signaling [ ] shall not have the word FIRE, or any fire symbol, in any form (i.e., stamped, imprinted, etc.) on the appliance visible to the public. Notification appliances with multiple visible elements shall be permitted to have fire markings only on those visible elements used for fire signaling. [**72:**18.3.3.2]

6.3.4* Mechanical Protection.

6.3.4.1 Appliances subject to mechanical damage shall be suitably protected. [**72:**18.3.4.1]

6.3.4.2 If guards, covers, or lenses are employed, they shall be listed for use with the appliance. [**72:**18.3.4.2]

6.3.4.3 The effect of guards, covers, or lenses on the appliance's field performance shall be in accordance with the listing requirements. [**72:**18.3.4.3]

6.3.5 Mounting.

6.3.5.1 Appliances shall be supported independently of their attachments to the circuit conductors. [**72:**18.3.5.1]

6.3.5.2 Appliances shall be mounted in accordance with the manufacturer's published instructions. [**72:**18.3.5.2]

6.3.6* Connections. Terminals, leads, or addressable communication that provide for monitoring the integrity of the notification appliance connections shall be provided. [**72:**18.3.6]

6.4 Audible Characteristics.

6.4.1 General Requirements.

6.4.1.1 An average ambient sound level greater than 105 dBA shall require the use of a visible notification appliance(s) in accordance with Section 6.5 where the application is public mode or Section 6.6 where the application is private mode. [**72:**18.4.1.1]

6.4.1.2 The total sound pressure level produced by combining the ambient sound pressure level with all audible notification appliances operating shall not exceed 110 dBA at the minimum hearing distance. [**72:**18.4.1.2]

6.4.1.3* Sound from normal or permanent sources, having a duration greater than 60 seconds, shall be included when measuring maximum ambient sound level. Sound from temporary or abnormal sources shall not be required to be included when measuring maximum ambient sound level. [**72:**18.4.1.3]

6.4.1.4 Audible notification appliances for alert and evacuation signal tones shall meet the requirements of 6.4.2 (Public Mode Audible Requirements), 6.4.3 (Private Mode Audible Requirements), 6.4.4 (Sleeping Area Requirements), or 6.4.5 (Narrow Band Tone Signaling for Exceeding Masked Thresholds), as applicable. [**72:**18.4.1.4]

6.4.1.4.1* The designer of the audible notification system shall identify the rooms and spaces that will have audible notification and those where audible notification will not be provided [**72:**18.4.1.4.1]

6.4.1.4.2* Unless otherwise required by other sections of this standard, the coverage area for audible occupant notification shall be as required by other governing laws, codes or standards. Where the other governing laws, codes, or standards require audible occupant notification for all or part of an area or space, coverage shall only be required in occupiable area as defined in 3.3.19. [**72:**18.4.1.4.2]

6.4.1.4.3 The sound pressure levels that must be produced by audible appliances in the coverage areas to meet the requirements of this standard shall be documented by the system designer during the planning and design of the notification system. The greater of the expected average ambient sound pressure level or expected maximum sound pressure level having a duration of at least 60 seconds shall also be documented for the coverage area by the system designer to ensure compliance with 6.4.2, 6.4.3, 6.4.4, or 6.4.5 for the coverage area [**72:**18.4.1.4.3]

6.4.1.4.4 The design sound pressure levels to be produced by the notification appliances for the various coverage areas shall be documented for use during acceptance testing of the system. [**72:**18.4.1.4.4]

6.4.1.4.5 Where required by authority having jurisdiction, documentation of the design sound pressure levels for the various coverage areas shall be submitted for review and approval. [**72:**18.4.1.4.5]

6.4.1.5 Voice messages shall not be required to meet the audibility requirements of 6.4.2 (Public Mode Audible Requirements), 6.4.3 (Private Mode Audible Requirements), 6.4.4 (Sleeping Area Requirements), or 6.4.5 (Narrow Band Tone Signaling for Exceeding Masked Thresholds), but shall meet the intelligibility requirements of 6.4.8 where voice intelligibility is required. [**72:**18.4.1.5]

6.4.2* Public Mode Audible Requirements.

6.4.2.1 To ensure that audible public mode signals are clearly heard, unless otherwise permitted by 6.4.2.2 through 6.4.2.5, they shall have a sound level at least 15 dB above the average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds, whichever is greater, measured 5 ft (1.5 m) above the floor in the area required to be served by the system using the A-weighted scale (dBA). [**72:**18.4.3.1]

6.4.2.2 Where approved by the authority having jurisdiction or other governing codes or standards, the requirements for audible signaling shall be permitted to be reduced or eliminated when visible signaling is provided in accordance with Section 6.5. [**72:**18.4.3.2]

6.4.2.3 Audible alarm notification appliances installed in elevator cars shall be permitted to use the audibility criteria for private mode appliances detailed in 6.4.3.1. [**72:**18.4.3.3]

6.4.2.4 If approved by the authority having jurisdiction, audible alarm notification appliances installed in restrooms shall be permitted to use the audibility criteria for private mode appliances detailed in 6.4.3.1. [**72:**18.4.3.4]

6.4.2.5 A [carbon monoxide detection] system arranged to stop or reduce ambient noise shall comply with 6.4.2.5.1 through 6.4.2.5.3. [**72:**18.4.3.5]

6.4.2.5.1 A [carbon monoxide detection] system arranged to stop or reduce ambient noise shall produce a sound level at least 15 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 in the area required to be served by the system using the A-weighted scale (dBA). [**72:**18.4.3.5.1]

6.4.2.5.2 Visible notification appliances shall be installed in the affected areas in accordance with Sections 6.5 or 6.6. [**72:**18.4.3.5.2]

6.4.2.5.3 Relays, circuits, or interfaces necessary to stop or reduce ambient noise shall meet the requirements of Chapter 4 and Chapter 5. [**72:**18.4.3.5.3]

6.4.3 Private Mode Audible Requirements.

6.4.3.1 To ensure that audible private mode signals are clearly heard, they shall have a sound level at least 10 dB above the average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds, whichever is greater, measured 5 ft (1.5 m) above the floor in the area required to be served by the system using the A-weighted scale (dBA). [**72:**18.4.4.1]

6.4.3.2* Where approved by the authority having jurisdiction or other governing codes or standards, the requirements for audible signaling shall be permitted to be reduced or eliminated when visible signaling is provided in accordance with Section 6.5. [**72:**18.4.4.2]

6.4.3.3 A system arranged to stop or reduce ambient noise shall comply with 6.4.3.3.1 through 6.4.3.3.3. [**72:**18.4.4.3]

6.4.3.3.1 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). [**72:**18.4.4.3.1]

6.4.3.3.2 Visible notification appliances shall be installed in the affected areas in accordance with Sections 6.5 or 6.6. [**72:**18.4.4.3.2]

6.4.3.3.3 Relays, circuits, or interfaces necessary to stop or reduce ambient noise shall meet the requirements of Chapter 4 and Chapter 5. [**72:**18.4.4.3.3]

6.4.4 Sleeping Area Requirements.

6.4.4.1 Where audible appliances are installed to provide signals for sleeping areas, they shall have a sound level of at least 15 dB above the average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds or a sound level of at least 75 dBA, whichever is greater, measured at the pillow level in the area required to be served by the system using the A-weighted scale (dBA). [**72:**18.4.5.1]

6.4.4.2 If any barrier, such as a door, curtain, or retractable partition, is located between the notification appliance and the pillow, the sound pressure level shall be measured with the barrier placed between the appliance and the pillow. [**72:**18.4.5.2]

6.4.4.3* Effective [January 1, 2015], audible appliances provided for the sleeping areas to awaken occupants 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.

[**72:**18.4.5.3]

6.4.5* Narrow Band Tone Signaling for Exceeding Masked Thresholds.

6.4.5.1 Masked Threshold Allowance. Audible tone signaling shall be permitted to comply with the masked threshold requirements in this subsection in lieu of the A-weighted signaling requirements in 6.4.2 and 6.4.3. [**72:**18.4.6.1]

6.4.5.2* Calculation Method. The effective masked threshold shall be calculated in accordance with ISO 7731, *Danger signals for work places — Auditory danger signals.* [**72:**18.4.6.2]

6.4.5.3 Noise Data. Noise data for calculating the effective masked threshold shall be the peak value of noise lasting

60 seconds or more for each octave or one-third octave band. [**72:**18.4.6.3]

6.4.5.4 Documentation. Analysis and design documentation shall be submitted to the authority having jurisdiction and shall contain the following information:

(1) Frequency data for the ambient noise, including the date, time, and location where measurements were taken for existing environments, or projected data for environments not yet constructed
(2) Frequency data of the audible notification appliance
(3) Calculations of the effective masked threshold for each set of noise data
(4) A statement of the sound pressure level that would be required by 6.4.2 or 6.4.3 if masked threshold signaling had not been done

[**72:**18.4.6.4]

6.4.5.5 Sound Pressure Level. For masked threshold signaling, the audible signal tone shall meet the requirements of either 6.4.5.5.1 or 6.4.5.5.2 but not for the reproduction of prerecorded, synthesized, or live messages. [**72:**18.4.6.5]

6.4.5.5.1 The sound pressure level of the audible tone signal shall exceed the masked threshold in one or more octave bands by at least 10 dB in the octave band under consideration. [**72:**18.4.6.5.1]

6.4.5.5.2 The sound pressure level of the audible tone signal shall exceed the masked threshold in one or more one-third octave bands by at least 13 dB in the one-third octave band under consideration. [**72:**18.4.6.5.2]

6.4.6 Location of Audible Notification Appliances for a Building or Structure.

6.4.6.1 If ceiling heights allow, and unless otherwise permitted by 6.4.6.2 through 6.4.6.5, wall-mounted appliances shall have their tops above the finished floors at heights of not less than 90 in. (2.29 m) and below the finished ceilings at distances of not less than 6 in. (150 mm). [**72:**18.4.8.1]

6.4.6.2 Ceiling-mounted or recessed appliances shall be permitted. [**72:**18.4.8.2]

6.4.6.3 If combination audible/visible appliances are installed, the location of the installed appliance shall be determined by the requirements of 6.5.5. [**72:**18.4.8.3]

6.4.6.4 Appliances that are an integral part of a [carbon monoxide] detector, [carbon monoxide] alarm, or other initiating device shall be located in accordance with the requirements for that device. [**72:**18.4.8.4]

6.4.6.5 Mounting heights other than required by 6.4.6.1 and 6.4.6.2 shall be permitted, provided that the sound pressure level requirements of 6.4.2 for public mode or 6.4.3 for private mode, or 6.4.4 for sleeping areas, based on the application, are met. [**72:**18.4.8.5]

6.4.7 Location of Audible Notification Appliances for Wide-Area Signaling. Audible notification appliances for wide-area signaling shall be installed in accordance with the requirements of the authority having jurisdiction, approved design documents, and the manufacturer's installation instruction to achieve the required performance. [**72:**18.4.9]

6.4.8* Voice Intelligibility. Within the acoustically distinguishable spaces (ADS) where voice intelligibility is required, voice communications systems shall reproduce prerecorded, synthesized, or live (e.g., microphone, telephone handset, and radio) messages with voice intelligibility. [**72:**18.4.10]

6.4.8.1* ADSs shall be determined by the system designer during the planning and design of all emergency communications systems. [**72:**18.4.10.1]

6.4.8.2 Each ADS shall be identified as requiring or not requiring voice intelligibility. [**72:**18.4.10.2]

6.4.8.2.1* Unless specifically required by other governing laws, codes or standards, or by other parts of this standard, intelligibility shall not be required in all ADSs. [**72:**18.4.10.2.1]

6.4.8.3* Where required by the enforcing authority; governing laws, codes, or standards; or by other parts of this standard, ADS assignments shall be submitted for review and approval. [**72:**18.4.10.3]

6.4.8.4 Intelligibility shall not be required to be determined through quantitative measurements. [**72:**18.4.10.4]

6.4.8.5 Quantitative measurements as described in D.2.4 of *NFPA 72, National Fire Alarm and Signaling Code*, shall be permitted but are not required. [**72:**18.4.10.5]

6.5* Visible Characteristics — Public Mode.

6.5.1* Visible Signaling.

6.5.1.1 Public mode visible signaling shall meet the requirements of Section 6.5 using visible notification appliances. [**72:**18.5.1.1]

6.5.1.2* The coverage area for visible occupant notification shall be as required by other governing laws, codes, or standards. Where the other governing laws, codes, or standards require visible occupant notification for all or part of an area or space, coverage shall only be required in occupiable areas as defined in 3.3.19. [**72:**18.5.1.2]

6.5.2 Area of Coverage.

6.5.2.1 The designer of the visible notification system shall document the rooms and spaces that will have visible notification and those where visible notification will not be provided. [**72:**18.5.2.1]

6.5.2.2* Unless otherwise specified or required by other sections of this standard, the required coverage area for visible occupant notification shall be as required by other governing laws, codes, or standards. [**72:**18.5.2.2]

6.5.2.3 Where required by the authority having jurisdiction, documentation of the effective intensity (cd) of the visible appliances for the area of coverage shall be submitted for review and approval. [**72:**18.5.2.3]

6.5.3 Light, Color, and Pulse Characteristics.

6.5.3.1 The flash rate shall not exceed two flashes per second (2 Hz) nor be less than one flash every second (1 Hz) throughout the listed voltage range of the appliance. [**72:**18.5.3.1]

6.5.3.2 A maximum pulse duration shall be 0.2 second with a maximum duty cycle of 40 percent. [**72:**18.5.3.2]

6.5.3.3 The pulse duration shall be defined as the time interval between initial and final points of 10 percent of maximum signal. [**72:**18.5.3.3]

6.5.3.4 Lights used for carbon monoxide alarm signaling shall be as required by the emergency plan and the authority

having jurisdiction for the area or building, and shall not exceed 1000 cd (effective intensity).

6.5.3.5 The strobe synchronization requirements of this chapter shall not apply where the visible notification appliances located inside the building are viewed from outside of the building. [**72:**18.5.3.6]

6.5.4 Appliance Photometrics. The light output shall comply with the polar dispersion requirements of ANSI/UL 1971, *Standard for Signaling Devices for the Hearing Impaired*, or equivalent. [**72:**18.5.4]

6.5.5 Appliance Location.

6.5.5.1 Wall-mounted appliances shall be mounted such that the entire lens is not less than 80 in. (2.03 m) and not greater than 96 in. (2.44 m) above the finished floor or at the mounting height specified using the performance-based alternative of 6.5.5.6. [**72:**18.5.5.1]

6.5.5.2 Where low ceiling heights do not permit wall mounting at a minimum of 80 in. (2.03 m), wall-mounted visible appliances shall be mounted within 6 in. (150 mm) of the ceiling. The room size covered by a strobe of a given value shall be reduced by twice the difference between the minimum mounting height of 80 in. (2.03 m) and the actual lower mounting height. [**72:**18.5.5.2]

6.5.5.3* Visible appliances listed for mounting parallel to the floor shall be permitted to be located on the ceiling or suspended below the ceiling. [**72:**18.5.5.3]

6.5.5.4* Spacing in Rooms.

6.5.5.4.1 Spacing shall be in accordance with either Table 6.5.5.4.1(a) and Figure 6.5.5.4.1 or Table 6.5.5.4.1(b). [**72:**18.5.5.4.1]

6.5.5.4.2 Visible notification appliances shall be installed in accordance with Table 6.5.5.4.1(a) or Table 6.5.5.4.1(b) using one of the following:

(1) A single visible notification appliance.
(2) Two groups of visible notification appliances, where visual appliances of each group are synchronized, in the same room or adjacent space within the field of view. This shall include synchronization of strobes operated by separate systems.
(3) More than two visible notification appliances or groups of synchronized appliances in the same room or adjacent space within the field of view that flash in synchronization.

[**72:**18.5.5.4.2]

6.5.5.4.3 Room spacing in accordance with Table 6.5.5.4.1(a) and Figure 6.5.5.4.1 for wall-mounted appliances shall be based on locating the visible notification appliance at the halfway distance of the wall. [**72:**18.5.5.4.3]

6.5.5.4.4 In square rooms with appliances not centered or in nonsquare rooms, the effective intensity (cd) from one visible wall-mounted notification appliance shall be determined by maximum room size dimensions obtained either by measuring the distance to the farthest wall or by doubling the distance to the farthest adjacent wall, whichever is greater, as required by Table 6.5.5.4.1(a) and Figure 6.5.5.4.1. [**72:**18.5.5.4.4]

6.5.5.4.5 If a room configuration is not square, the square room size that allows the entire room to be encompassed or allows the room to be subdivided into multiple squares shall be used. [**72:**18.5.5.4.5]

6.5.5.4.6* 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

Table 6.5.5.4.1(a) Room Spacing for Wall-Mounted Visible Appliances

Maximum Room Size		Minimum Required Light Output [Effective Intensity (cd)]	
ft	m	One Light per Room	Four Lights per Room (One Light per Wall)
20 × 20	6.10 × 6.10	15	NA
28 × 28	8.53 × 8.53	30	NA
30 × 30	9.14 × 9.14	34	NA
40 × 40	12.2 × 12.2	60	15
45 × 45	13.7 × 13.7	75	19
50 × 50	15.2 × 15.2	94	30
54 × 54	16.5 × 16.5	110	30
55 × 55	16.8 × 16.8	115	30
60 × 60	18.3 × 18.3	135	30
63 × 63	19.2 × 19.2	150	37
68 × 68	20.7 × 20.7	177	43
70 × 70	21.3 × 21.3	184	60
80 × 80	24.4 × 24.4	240	60
90 × 90	27.4 × 27.4	304	95
100 × 100	30.5 × 30.5	375	95
110 × 110	33.5 × 33.5	455	135
120 × 120	36.6 × 36.6	540	135
130 × 130	39.6 × 39.6	635	185

NA: Not allowable.
[**72:** Table 18.5.5.4.1(a)]

Table 6.5.5.4.1(b) Room Spacing for Ceiling-Mounted Visible Appliances

Maximum Room Size		Maximum Lens Height*		Minimum Required Light Output (Effective Intensity); One Light (cd)
ft	m	ft	m	
20 × 20	6.1 × 6.1	10	3.0	15
30 × 30	9.1 × 9.1	10	3.0	30
40 × 40	12.2 × 12.2	10	3.0	60
44 × 44	13.4 × 13.4	10	3.0	75
20 × 20	6.1 × 6.1	20	6.1	30
30 × 30	9.1 × 9.1	20	6.1	45
44 × 44	13.4 × 13.4	20	6.1	75
46 × 46	14.0 × 14.0	20	6.1	80
20 × 20	6.1 × 6.1	30	9.1	55
30 × 30	9.1 × 9.1	30	9.1	75
50 × 50	15.2 × 15.2	30	9.1	95
53 × 53	16.2 × 16.2	30	9.1	110
55 × 55	16.8 × 16.8	30	9.1	115
59 × 59	18.0 × 18.0	30	9.1	135
63 × 63	19.2 × 19.2	30	9.1	150
68 × 68	20.7 × 20.7	30	9.1	177
70 × 70	21.3 × 21.3	30	9.1	185

*This does not preclude mounting lens at lower heights.
[**72:** Table 18.5.5.4.1(b)]

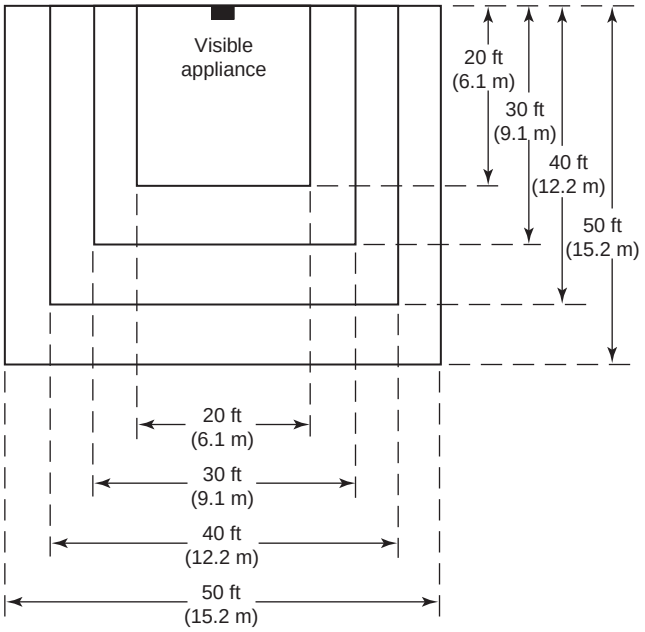

FIGURE 6.5.5.4.1 Room Spacing for Wall-Mounted Visible Appliances. [72:Figure 18.5.5.4.1]

using the performance-based alternative of 6.5.5.6, or wall-mounted visible notification appliances shall be installed in accordance with Table 6.5.5.4.1(a). [**72:**18.5.5.4.6]

6.5.5.4.7 Table 6.5.5.4.1(b) shall be used if the ceiling-mounted visible notification appliance is at the center of the room. If the ceiling-mounted visible notification appliance is not located at the center of the room, the effective intensity (cd) shall be determined by doubling the distance from the appliance to the farthest wall to obtain the maximum room size. [**72:**18.5.5.4.7]

6.5.5.5* Spacing in Corridors.

6.5.5.5.1 The installation of visible notification appliances in corridors 20 ft (6.1 m) or less in width shall be in accordance with the requirements of either 6.5.5.4 or 6.5.5.5. [**72:**18.5.5.5.1]

6.5.5.5.2 Paragraph 6.5.5.5 shall apply to corridors not exceeding 20 ft (6.1 m) in width. [**72:**18.5.5.5.2]

6.5.5.5.3 In a corridor application, visible appliances shall be rated not less than 15 cd. [**72:**18.5.5.5.3]

6.5.5.5.4 Corridors greater than 20 ft (6.1 m) wide shall comply with the spacing requirements for rooms in accordance with 6.5.5.4. [**72:**18.5.5.5.4]

6.5.5.5.5* Visible notification appliances shall be located not more than 15 ft (4.57 m) from the end of the corridor with a separation not greater than 100 ft (30.5 m) between appliances. [**72:**18.5.5.5.5]

6.5.5.5.6 If there is an interruption of the concentrated viewing path, such as a fire door, an elevation change, or any other obstruction, the area shall be treated as a separate corridor. [**72:**18.5.5.5.6]

6.5.5.5.7 In corridors where more than two visible notification appliances are in any field of view, they shall flash in synchronization. [**72:**18.5.5.5.7]

6.5.5.5.8 Wall-mounted visible notification appliances in corridors shall be permitted to be mounted on either the end wall or the side wall of the corridor in accordance with spacing requirements of 6.5.5.5.5. [**72:**18.5.5.5.8]

6.5.5.6 Performance-Based Alternative.

6.5.5.6.1 Any design that provides a minimum of 0.0375 lumens/ft^2 (0.4036 lumens/m^2) of illumination at any point

within the covered area at all angles specified by the polar dispersion planes for wall- or ceiling-mounted visual appliances in ANSI/UL 1971, *Standard for Signaling Devices for the Hearing Impaired*, or equivalent, as calculated for the maximum distance from the nearest visual notification appliance, shall be permitted in lieu of the requirements of 6.5.5, excluding 6.5.5.7. [**72:**18.5.5.6.1]

6.5.5.6.2 Documentation provided to the authority having jurisdiction shall include the following:

(1) Inverse Square Law calculations using each of the vertical and horizontal polar distribution angles in ANSI/UL 1971, *Standard for Signaling Devices for the Hearing Impaired*, or equivalent.
(2) The calculations shall account for the effects of polar distribution using one of the following:
    (a) The percentages from the applicable table(s) in ANSI/UL 1971, *Standard for Signaling Devices for the Hearing Impaired*, or equivalent
    (b) The actual results of laboratory tests of the specific appliance to be used as recorded by the listing organization

[**72:**18.5.5.6.2]

6.5.5.7 Sleeping Areas.

6.5.5.7.1 Combination carbon monoxide detectors and visible notification appliances or combination carbon monoxide alarms and visible notification appliances shall be installed in accordance with the applicable requirements of Chapter 5, Chapter 6, and Chapter 9.

6.5.5.7.2 Table 6.5.5.7.2 shall apply to sleeping areas. [**72:**18.5.5.7.2]

Table 6.5.5.7.2 Effective Intensity Requirements for Sleeping Area Visible Notification Appliances

Distance from Ceiling to Top of Lens		
in.	**mm**	**Intensity (cd)**
≥24	≥610	110
<24	<610	177

[**72:** Table 18.5.5.7.2]

Exception: Where the visible appliance is not used for fire alarm signaling, the effective intensity shall not be required to be greater than 110 cd.

6.5.5.7.3 For rooms with a linear dimension greater than 16 ft (4.87 m), the visible notification appliance shall be located within 16 ft (4.87 m) of the pillow. [**72:**18.5.5.7.3]

6.5.6 Location of Visible Notification Appliances for Wide Area Signaling. Visible notification appliances for wide area signaling shall be installed in accordance with the requirements of the authority having jurisdiction, approved design documents, and the manufacturer's instructions to achieve the required performance. [**72:**18.5.6]

6.6* Visible Characteristics — Private Mode. Visible notification appliances used in the private mode shall be of a sufficient quantity and intensity and located so as to meet the intent of the user and the authority having jurisdiction. [**72:**18.6]

6.7 Supplementary Visible Signaling Methods. A supplementary visible notification appliance shall be intended to augment an audible or visible signal. [**72:**18.7]

6.7.1 A supplementary visible notification appliance shall comply with its marked rated performance. [**72:**18.7.1]

6.7.2 Supplementary visible notification appliances shall be permitted to be located less than 80 in. (2.03 m) above the floor. [**72:**18.7.2]

6.8 Textual Audible Appliances.

6.8.1 Speaker appliances shall comply with Section 6.4. [**72:**18.8.1.1]

6.8.2* The sound pressure level, in dBA, of the tone produced by a signaling speaker shall comply with all the requirements in 6.4.2 (public), 6.4.3 (private), or 6.4.4 (sleeping) for the intended mode, or shall comply with requirements of 6.4.5 (narrow band tone signaling). [**72:**18.8.1.2]

6.9* Textual and Graphical Visible Appliances.

6.9.1 Application.

6.9.1.1 Textual and graphical visible appliances shall be permitted to be used to signal information about [carbon monoxide] or other emergency conditions or to direct intended responses to those conditions. [**72:**18.9.1.1]

6.9.1.2 This section does not apply to means of egress signs, room identification signs, and other signage that could be required by other governing laws, codes, or standards. [**72:**18.9.1.2]

6.9.1.3 Textual visible appliance messages shall be permitted to be static, flashing, or scrolling. [**72:**18.9.1.3]

6.9.2 Location.

6.9.2.1 Private Mode. Unless otherwise permitted or required by other governing laws, codes, or standards, or by other parts of this standard or by the authority having jurisdiction, all textual and graphical visible notification appliances in the private mode shall be located in rooms that are accessible only to those persons directly concerned with the implementation and direction of emergency response in the areas protected by the system. [**72:**18.9.2.1]

6.9.2.2 Public Mode. Textual and graphical visible notification appliances used in the public mode shall be located to ensure visibility to the occupants of the protected area or to the intended recipients. [**72:**18.9.2.2]

6.9.2.3 Mounting. Desktop and surface-mounting textual and graphical appliances shall be permitted. [**72:**18.9.2.3]

6.9.3 Performance. The information produced by textual and graphical visible appliances shall be clear and legible at the intended viewing distance. [**72:**18.9.3]

6.9.4* Character and Symbol Requirements and Viewing Distance.

6.9.4.1 This section applies to visual characters and graphic elements and does not address raised characters or braille that could be required by other governing laws, codes, or standards. [**72:**18.9.4.1]

6.9.4.2* Characters and symbols shall contrast with their background using either positive contrast (light on a dark background) or negative contrast (dark on a light background). [**72:**18.9.4.2]

6.9.4.3 Characters and symbols and their background shall have a nonglare finish. [**72:**18.9.4.3]

6.9.4.4* Characters shall be permitted to be uppercase or lowercase, or a combination of both. [**72:**18.9.4.4]

6.9.4.5 Characters shall be conventional in form and not italic, oblique, script, highly decorative, or of other unusual form and shall use san serif fonts. [**72:**18.9.4.5]

6.9.4.6 Characters shall be selected from fonts where the width of the uppercase letter "O" is 55 percent minimum and 110 percent maximum of the height of the uppercase letter "I". [**72:**18.9.4.6]

6.9.4.7* Character and symbol height for appliances other than desktop monitors or displays shall meet all of the following criteria:

(1) Minimum character height shall comply with Table 6.9.4.7.
(2) Viewing distance shall be measured as the horizontal distance between the character and an obstruction preventing further approach towards the appliance.
(3) Character height shall be based on the uppercase letter "I."

6.9.4.8* All characters and symbols displayed by textual and graphical visible notification appliances shall be a minimum of 40 in. (1.02 m) above the ground or finished floor. [**72:**18.9.4.8]

6.9.4.9 Stroke thickness of the uppercase letter "I" shall be minimum 10 percent and maximum 30 percent of the height of the character. [**72:**18.9.4.9]

6.9.4.10 Character spacing shall be measured between the two closest points of adjacent characters, excluding word spaces. Spacing between individual characters shall be 10 percent and maximum 35 percent of character height. [**72:**18.9.4.10]

6.9.4.11 Spacing between the baselines of separate lines of characters within a message shall be 135 percent minimum and 170 percent maximum of the character height. [**72:**18.9.4.11]

6.10 Tactile Appliances.

6.10.1 Application. Tactile appliances shall be permitted if used in addition to audible or visible, or both, notification appliances. [**72:**18.10.1]

6.10.2* Performance. Tactile appliances shall meet the performance requirements of ANSI/UL 1971, *Standard for Signaling Devices for the Hearing Impaired*, or equivalent. [**72:**18.10.2]

6.11* Standard Emergency Service Interface. Where required by the enforcing authority; governing laws, codes, or standards; or other parts of this standard, 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. [**72:**18.11]

Chapter 7 Off-Premises Signal Transmission

7.1 Application.

7.1.1 The performance, installation, and operation of carbon monoxide detection systems at a continuously attended supervising station or a communications center and between the protected premises and the receiving station shall comply with the requirements of this chapter.

7.1.2 The requirements of Chapters 4, 5, and 8 shall also apply unless they are in conflict with this chapter.

Table 6.9.4.7 Visual Character and Graphic Symbol Heights Based on Height and Distance

Height of Character or Symbol Above Ground or Finished Floor		Horizontal Viewing Distance		Minimum Character or Symbol Height	
in.	m	ft	m	in.	mm
40 in. min. to ≤70 in.	1.02 m to 1.78 m	<6	1.83	5⁄8 in.	16 mm
		≥6	1.83	5⁄8 in., plus 1⁄8 in. per foot of horizontal viewing distance beyond 6 ft	16 mm plus 3 mm per 0.30 m of horizontal viewing distance beyond 1.83 m
>70 in. to ≤120 in.	1.78 m to 3.05 m	<15	4.57	2 in.	51 mm
		≥15	4.57	2 in. plus 1⁄8 in. per foot of horizontal viewing distance beyond 15 ft	51 mm plus 3 mm per 0.30 m of horizontal viewing distance beyond 4.57 m
>120 in.	3.05 m	<21	6.40	3 in.	75 mm
		≥21	6.40	3 in. plus 1⁄8 in. per foot of horizontal viewing distance beyond 21 ft	75 mm plus 3 mm per 0.30 m of horizontal viewing distance beyond 6.40 m

[**72:** Table 18.9.4.7]

7.2* General. Connections to supervising stations or communications centers shall be in accordance with *NFPA 72, National Fire Alarm and Signaling Code*.

7.2.1 Signals.

7.2.1.1 Priority of Signals. A carbon monoxide alarm signal shall take precedence over supervisory or trouble signals.

7.2.1.2 Carbon Monoxide Alarm Signal Disposition.

7.2.1.2.1 The actuation of a carbon monoxide detector or system shall be distinctively indicated as a carbon monoxide alarm signal.

7.2.1.2.2* Servicing of a system in alarm that cannot be reset shall be in accordance with Chapter 8 and shall occur within 4 hours of the carbon monoxide alarm signal.

7.2.1.3 Carbon Monoxide Trouble Signal Disposition.

7.2.1.3.1 Upon receipt of a carbon monoxide trouble signal, the responsible party(s) shall be notified.

7.2.1.3.2 Servicing of a system in trouble shall be in accordance with Chapter 8 and shall occur within 4 hours of the trouble indication.

7.2.2* Supervising Station. Upon receipt of a carbon monoxide alarm signal, supervising station personnel shall perform the following actions in the order listed:

(1) Where required by the emergency response agency, immediately retransmit indication of the carbon monoxide alarm signal to the communications center
(2) Contact the responsible party(s) in accordance with the notification plan

7.2.3* Emergency Response Agency (ERA). Where a carbon monoxide alarm signal is transmitted directly to a communications center, communications center personnel shall perform the following actions in the order listed:

(1) Follow standard operating procedures
(2) Contact the responsible party(s) in accordance with the notification plan

7.3 Prearranged Testing. When the signal results from a prearranged test, the action required by 7.2.2 and 7.2.3 shall not be required.

7.4 Operation and Record Keeping.

7.4.1 The operation, staffing, and recordkeeping for a supervising station shall be in accordance with *NFPA 72, National Fire Alarm and Signaling Code*.

7.4.2 The operation, staffing, and recordkeeping for a communications center shall be in accordance with NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*.

Chapter 8 Inspection, Testing, and Maintenance

8.1 Application. This chapter covers the requirements for the inspection, testing, and maintenance of carbon monoxide alarms, detectors, systems, and their components.

8.1.1 More stringent inspection, testing, or maintenance procedures shall be permitted.

8.1.2 Inspection testing and maintenance programs shall comply with the requirements of this chapter, conform to the equipment manufacturers' published instructions, and verify proper operation of the carbon monoxide alarms, detectors, systems, and their components.

8.1.3 Nothing in this chapter is intended to prevent the use of alternative test methods or testing devices, provided such methods or devices are equivalent in effectiveness and safety and meet the intent of the requirements of this chapter.

8.2 General.

8.2.1 Responsibilities.

8.2.1.1 The property or building or 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. [**72:**14.2.3.1]

8.2.1.2 Where the property owner is not the occupant, the property owner shall be permitted to delegate the authority and responsibility for inspecting, testing, and maintaining the [carbon monoxide] systems to the occupant, management firm, or managing individual through specific provisions in the lease, written use agreement, or management contract. [**72:**14.2.3.2]

8.2.1.3 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. [**72:**14.2.3.3]

8.2.1.4 Where the building or system owner has delegated any responsibilities for inspecting, testing, or maintenance, a copy of the written delegation required by 8.2.1.3 shall be provided to the authority having jurisdiction upon request. [**72:**14.2.3.4]

8.2.1.5* Service Personnel Qualifications and Experience. Service personnel shall be qualified and experienced in accordance with the requirements of 4.4.3. [**72:**14.2.3.6]

8.2.2* Notification.

8.2.2.1 Before proceeding with any testing, all persons and facilities receiving alarm, supervisory, or trouble signals and all building occupants shall be notified of the testing to prevent unnecessary response. [**72:**14.2.3.1]

8.2.2.2 At the conclusion of testing, those previously notified (and others, as necessary) shall be notified that testing has been concluded. [**72:**14.2.3.2]

8.2.2.3 The owner or the owner's designated representative and service personnel shall coordinate system testing to prevent interruption of critical building systems or equipment. [**72:**14.2.3.3]

8.2.3 System Documentation. Prior to system maintenance or testing, the system certificate of completion and the information regarding the system and system alterations, including specifications, wiring diagrams, and floor plans, shall be made available by the owner to a designated representative to the service personnel.

8.3 Inspection.

8.3.1* Unless otherwise permitted by 8.3.2, visual inspections shall be performed in accordance with the schedules in Table 8.3.1 or more often if required by the authority having jurisdiction. [**72:**14.3.1]

Table 8.3.1 Visual Inspection Frequencies

	Initial Acceptance	Periodic Frequency	Method	Reference
1. All equipment	X	Annual	Ensure there are no changes that affect equipment performance. Inspect for building modifications, occupancy changes, changes in environmental conditions, device location, physical obstructions, device orientation, physical damage, and degree of cleanliness.	8.3.4
2. Control equipment:				
(a) Fire alarm systems monitored for alarm, supervisory, and trouble signals			Verify a system normal condition.	
(1) Fuses	X	Annual		
(2) Interfaced equipment	X	Annual		
(3) Lamps and LEDs	X	Annual		
(4) Primary (main) power supply	X	Annual		
(5) Trouble signals	X	Semiannual		
(b) Fire alarm systems unmonitored for alarm, supervisory, and trouble signals			Verify a system normal condition.	
(1) Fuses	X	Weekly		
(2) Interfaced equipment	X	Weekly		
(3) Lamps and LEDs	X	Weekly		
(4) Primary (main) power supply	X	Weekly		
(5) Trouble signals	X	Weekly		
3. Reserved				
4. Emergency voice/alarm communications equipment	X	Semiannual	Verify location and condition.	
5. Reserved				
6. Reserved				
7. Reserved				
8. Batteries			Inspect for corrosion or leakage. Verify tightness of connections. Verify marking of the month/year of manufacture (all types).	4.5.9
(a) Lead-acid	X	Monthly	Visually inspect electrolyte level.	
(b) Nickel-cadmium	X	Semiannual		
(c) Primary (dry cell)	X	Monthly		
(d) Sealed lead-acid	X	Semiannual		
9. Remote annunciators	X	Semiannual	Verify location and condition.	
10. Notification appliance circuit power extenders	X	Annual	Verify proper fuse ratings, if any. Verify that lamps and LEDs indicate normal operating status of the equipment.	4.5
11. Remote power supplies	X	Annual	Verify proper fuse ratings, if any. Verify that lamps and LEDs indicate normal operating status of the equipment.	4.5
12. Transient suppressors	X	Semiannual	Verify location and condition.	

Table 8.3.1 *Continued*

	Initial Acceptance	Periodic Frequency	Method	Reference
13. Reserved				
14. Fiber-optic cable connections	X	Annual	Verify location and condition.	
15. Initiating devices			Verify location and condition (all devices).	
(a) CO air sampling				
(1) General	X	Semiannual	Verify that in-line filters, if any, are clean.	
(2) Sampling system piping and sampling ports	X		Verify that sampling system piping and fittings are installed properly, appear airtight, and are permanently fixed. Confirm that sampling pipe is conspicuously identified. Verify that sample ports or points are not obstructed.	
(b) CO duct detectors				
(1) General	X	Semiannual	Verify that detector is rigidly mounted. Confirm that no penetrations in a return air duct exist in the vicinity of the detector. Confirm the detector is installed so as to sample the airstream at the proper location in the duct.	
(2) Sampling tube	X		Verify proper orientation. Confirm the sampling tube protrudes into the duct in accordance with system design.	
(c) Electromechanical releasing devices	X	Semiannual		
(d) Supervisory signal devices	X	Quarterly		
16. Carbon monoxide alarm control interface and carbon monoxide emergency control function interface	X	Semiannual	Verify location and condition.	
17. Notification appliances			Verify location and condition (all appliances).	
(a) Audible appliances	X	Semiannual		
(b) Audible textual notification appliances	X	Semiannual		
(c) Visible appliances				
(1) General	X	Semiannual		6.5.5
(2) Candela rating	X		Verify that the candela rating marking agrees with the approved drawings.	6.5.5

8.3.2 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. [**72:**14.3.2]

8.3.3 Extended intervals shall not exceed 18 months. [**72:**14.3.3]

8.3.4 The visual inspection shall be made to ensure that there are no changes that affect equipment performance. [**72:**14.3.4]

8.4 Testing.

8.4.1 Initial Acceptance Testing.

8.4.1.1 All new systems shall be inspected and tested in accordance with the requirements of Chapter 8. [**72:**14.4.1.1]

8.4.1.2 The authority having jurisdiction shall be notified prior to the initial acceptance test. [**72:**14.4.1.2]

8.4.2* Reacceptance Testing.

8.4.2.1 When an initiating device, notification, appliance, or control relay is added, it shall be functionally tested. [**72:**14.4.2.1]

8.4.2.2 When an initiating device, notification appliance, or control relay is deleted, another device, appliance, or control relay on the circuit shall be operated. [**72:**14.4.2.2]

8.4.2.3 When modifications or repairs to control equipment hardware are made, the control equipment shall be tested in accordance with Table 8.4.3, items 2(a) and 2(d). [**72:**14.4.2.3]

8.4.2.4 When changes are made to site-specific software, the following shall apply:

(1) All functions known to be affected by the change, or identified by a means that indicates changes, shall be 100 percent tested.

(2) In addition, 10 percent of initiating devices that are not directly affected by the change, up to a maximum of 50 devices, also shall be tested and correct system operation shall be verified.
(3) A revised record of completion in accordance with 4.14.2.1 shall be prepared to reflect these changes.

[**72:**14.4.2.4]

8.4.2.5 Changes to the system executive software shall require a 10 percent functional test of the system, including a test of at least one device on each input and output circuit to verify critical system functions such as notification appliances, control functions, and off-premises reporting. [**72:**14.4.2.5]

8.4.3 Test Methods. [Carbon monoxide detection] systems and associated equipment shall be tested according to Table 8.4.3. [**72:**14.4.3.2]

Table 8.4.3 Testing

Component	Initial Acceptance	Periodic Frequency	Method
1. All equipment	X		See Table 8.3.1.
2. Control equipment and transponder			
(a) Functions	X	Annually	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	X	Annually	Verify rating and supervision.
(c) Interfaced equipment	X	Annually	Verify integrity of single or multiple circuits providing interface between two or more control units. Test interfaced equipment connections by operating or simulating operation of the equipment being supervised. Verify signals required to be transmitted at the control unit.
(d) Lamps and LEDs	X	Annually	Illuminate lamps and LEDs.
(e) Primary (main) power supply	X	Annually	Disconnect and test all secondary (standby) power under maximum load, including all alarm appliances requiring simultaneous operation. Reconnect all secondary (standby) power at end of test. Test redundant power supplies separately.
3. Carbon monoxide detection control unit trouble signals			
(a) Audible and visual	X	Annually	Verify operation of control unit trouble signals. Verify ring-back feature for systems using a trouble-silencing switch that requires resetting.
(b) Disconnect switches	X	Annually	If control unit has disconnect or isolating switches, verify performance of intended function of each switch. Verify receipt of trouble signal when a supervised function is disconnected.
(c) Ground-fault monitoring circuit	X	Annually	If the system has a ground detection feature, verify the occurrence of ground-fault indication whenever any installation conductor is grounded.
(d) Transmission of signals to off-premises location	X	Annually	Actuate an initiating device and verify receipt of alarm signal at the off-premises location. Create a trouble condition and verify receipt of a trouble signal at the off-premises location. Actuate a supervisory device and verify receipt of a supervisory signal at the off-premises location. If a transmission carrier is capable of operation under a single- or multiple-fault condition, activate an initiating device during such fault condition and verify receipt of an alarm signal and a trouble signal at the off-premises location.
4. Reserved			

Table 8.4.3 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
5. Engine-driven generator	X	Monthly	If an engine-driven generator dedicated to the system is used as a required power source, verify operation of the generator in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems,* by the building owner.
6. Secondary (standby) power supply	X	Annually	Disconnect all primary (main) power supplies and verify the occurrence of required trouble indication for loss of primary power. Measure or verify the system's standby and alarm current demand and verify the ability of batteries to meet standby and alarm requirements using manufacturer's data. Operate general alarm systems a minimum of 5 minutes. Reconnect primary (main) power supply at end of test.
7. Uninterruptible power supply (UPS)	X	Annually	If a UPS system dedicated to the system is used as a required power source, verify by the building owner operation of the UPS system in accordance with NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems.*
8. Battery tests			Prior to conducting any battery testing, verify by the person conducting the test that all system software stored in volatile memory is protected from loss.
(a) Lead-acid type			
(1) Battery replacement	X	Annually	Replace batteries in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer's recommendations.
(2) Charger test	X	Annually	With the batteries fully charged and connected to the charger, measure the voltage across the batteries with a voltmeter. Verify the voltage is 2.30 volts per cell ±0.02 volts at 77°F (25°C) or as specified by the equipment manufacturer.
(3) Discharge test	X	Annually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full carbon monoxide alarm load connected to the battery.
(4) Load voltage test	X	Semiannually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery. Verify the battery does not fall below 2.05 volts per cell under load.

Table 8.4.3 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
(5) Specific gravity	X	Semiannually	Measure as required the specific gravity of the liquid in the pilot cell or all of the cells. Verify the specific gravity is within the range specified by the manufacturer. Although the specified specific gravity varies from manufacturer to manufacturer, a range of 1.205–1.220 is typical for regular lead-acid batteries, while 1.240–1.260 is typical for high-performance batteries. Do not use a hydrometer that shows only a pass or fail condition of the battery and does not indicate the specific gravity, because such a reading does not give a true indication of the battery condition.
(b) Nickel-cadmium type			
(1) Battery replacement	X	Annually	Replace batteries in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer's recommendations.
(2) Charger test[a]	X	Annually	With the batteries fully charged and connected to the charger, place an ampere meter in series with the battery under charge. Verify the charging current is in accordance with the manufacturer's recommendations for the type of battery used. In the absence of specific information, use 1/30 to 1/25 of the battery rating.
(3) Discharge test	X	Annually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery.
(4) Load voltage test	X	Semiannually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery. Verify the float voltage for the entire battery is 1.42 volts per cell, nominal, under load. If possible, measure cells individually.
(c) Sealed lead-acid type			
(1) Battery replacement	X	Annually	Replace batteries in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer's recommendations.
(2) Charger test	X	Annually	With the batteries fully charged and connected to the charger, measure the voltage across the batteries with a voltmeter. Verify the voltage is 2.30 volts per cell ±0.02 volts at 77°F (25°C) or as specified by the equipment manufacturer.
(3) Discharge test	X	Annually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery.
(4) Load voltage test	X	Semiannually	Verify the battery performs under load, in accordance with the battery manufacturer's specifications.

Table 8.4.3 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
9. Remote annunciators	X	Annually	Verify the correct operation and identification of annunciators. If provided, verify the correct operation of annunciator under a fault condition.
10. Reserved			
11. Reserved			
12. Reserved			
13. Conductors — metallic			
(a) Stray voltage	X	N/A	Test all installation conductors with a volt/ohmmeter to verify that there are no stray (unwanted) voltages between installation conductors or between installation conductors and ground. Verify the maximum allowable stray voltage does not exceed 1 volt ac/dc, unless a different threshold is specified in the published manufacturer's instructions for the installed equipment.
(b) Ground faults	X	N/A	Test all installation conductors, other than those intentionally and permanently grounded, for isolation from ground per the installed equipment manufacturer's published instructions.
(c) Short-circuit faults	X	N/A	Test all installation conductors, other than those intentionally connected together, for conductor-to-conductor isolation per the published manufacturer's instructions for the installed equipment. Also test these same circuits conductor-to-ground.
(d) Loop resistance	X	N/A	With each initiating and indicating circuit installation conductor pair short-circuited at the far end, measure and record the resistance of each circuit. Verify that the loop resistance does not exceed the limits specified in the published manufacturer's instructions for the installed equipment.
(e) Circuit integrity	X	N/A	For initial and reacceptance testing, confirm the introduction of a fault in any circuit monitored for integrity results in a trouble indication at the fire alarm control unit. Open one connection at not less than 10 percent of the initiating devices, notification appliances and controlled devices on every initiating device circuit, notification appliance circuit, and signaling line circuit. Confirm all circuits perform as indicated in Sections 5.5, 5.6, and 5.7.
	N/A	Annually	For periodic testing, test each initiating device circuit, notification appliance circuit, and signaling line circuit for correct indication at the control unit. Confirm all circuits perform as indicated in Sections 5.5, 5.6, and 5.7.
14. Conductors — nonmetallic			

Table 8.4.3 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
(a) Fiber optics	X	N/A	Test the fiber-optic transmission line by the use of an optical power meter or by an optical time domain reflectometer used to measure the relative power loss of the line. Test result data must meet or exceed ANSI/TIA 568-C.3, *Optical Fiber Cabling Components Standard*, related to fiber-optic lines and connection/splice losses and the control unit manufacturer's published specifications.
(b) Circuit integrity	X	N/A	For initial and reacceptance testing, confirm the introduction of a fault in any circuit monitored for integrity results in a trouble indication at the fire alarm control unit. Open one connection at not less than 10 percent of the initiating devices, notification appliances, and controlled devices on every initiating device circuit, notification appliance circuit, and signaling line circuit. Confirm all circuits perform as indicated in Sections 5.5, 5.6, and 5.7.
	N/A	Annually	For periodic testing, test each initiating device circuit, notification appliance circuit, and signaling line circuit for correct indication at the control unit. Confirm all circuits perform as indicated in Sections 5.5, 5.6, and 5.7.
15. Initiating devices			
(a) Electromechanical releasing device			(Reserved)
(b) Carbon monoxide detectors — functional test			Carbon monoxide detection system detectors shall be functionally tested in accordance with 8.4.4.
(1) Air sampling	X	Annually	Per test methods documented in the manufacturer's published instructions, detector alarm response shall be verified through the end sampling port on each pipe run; airflow through all other ports shall be verified as well.
(2) Duct type	X	Annually	Air duct detectors shall be tested or inspected to ensure that the device will sample the airstream. The test shall be made in accordance with the manufacturer's published instructions.
(3) Carbon monoxide detectors with control output functions	X	Annually	It shall be verified that the control capability shall remain operable even if all of the initiating devices connected to the same initiating device circuit or signaling line circuit are in an alarm state.
(c) Initiating devices, supervisory			(Reserved)
16. Interface equipment	X		Test interface equipment connections by operating or simulating the equipment being supervised. Verify signals required to be transmitted are received at the control unit. Test frequency for interface equipment is the same as the frequency required by the applicable NFPA standard(s) for the equipment being supervised.
17. Alarm notification appliances			

Table 8.4.3 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
(a) Audible[b]	X	N/A	For initial and reacceptance testing, measure sound pressure levels for signals with a sound level meter meeting ANSI S1.4a, *Specifications for Sound Level Meters,* Type 2 requirements. Measure sound pressure levels throughout the protected area to confirm that they are in compliance with Chapter 6. Set the sound level meter in accordance with ANSI S3.41, *American National Standard Audible Evacuation Signal,* using the time-weighted characteristic F (FAST).
	N/A	Annually	For periodic testing, verify the operation of the notification appliances.[c]
(b) Audible textual notification appliances (speakers and other appliances to convey voice messages)	X	N/A	For initial and reacceptance testing, measure sound pressure levels for signals with a sound level meter meeting ANSI S1.4a, *Specifications for Sound Level Meters,* Type 2 requirements. Measure sound pressure levels throughout the protected area to confirm that they are in compliance with Chapter 6. Set the sound level meter in accordance with ANSI S3.41, *American National Standard Audible Evacuation Signal,* using the time-weighted characteristic F (FAST). Verify audible information to be distinguishable and understandable and in compliance with 6.4.8.
	N/A	Annually	For periodic testing, verify the operation of the notification appliances.[c]
(c) Visible	X	N/A	Perform initial and reacceptance testing in accordance with the manufacturer's published instructions. Verify appliance locations to be per approved layout and confirm that no floor plan changes affect the approved layout. Verify that the candela rating marking agrees with the approved drawing. Confirm that each appliance flashes.
	N/A	Annually	For periodic testing, verify that each appliance flashes.
18. Carbon monoxide control functions	X	Annually	For initial, reacceptance, and periodic testing, verify carbon monoxide control function interface device activation. Where a carbon monoxide control function interface device is disabled or disconnected during initiating device testing, verify that the disabled or disconnected carbon monoxide control function interface device has been properly restored.
19. Special procedures			
(a) Multiplex systems	X	Annually	Verify communications between sending and receiving units under both primary and secondary power. Verify communications between sending and receiving units under open-circuit and short-circuit trouble conditions. Verify communications between sending and receiving units in all directions where multiple communications pathways are provided. If redundant central control equipment is provided, verify switchover and all required functions and operations of secondary control equipment. Verify all system functions and features in accordance with manufacturer's published instructions.

Table 8.4.3 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
20. Low-power radio (wireless systems)	X	N/A	The following procedures describe additional acceptance and reacceptance test methods to verify wireless protection system operation: (1) Use the manufacturer's published instructions and the as-built drawings provided by the system supplier to verify correct operation after the initial testing phase has been performed by the supplier or by the supplier's designated representative. (2) Starting from the functional operating condition, initialize the system in accordance with the manufacturer's published instructions. Confirm the alternative communications path exists between the wireless control unit and peripheral devices used to establish initiation, indication, control, and annunciation. Test the system for both alarm and trouble conditions. (3) Check batteries for all components in the system monthly unless the control unit checks all batteries and all components daily.

[a]Example: 4000 mAh × 1/25 = 160 mA charging current at 77°F (25°C).
[b]Chapter 6 would require 15 dB over average ambient sound for public mode spaces. Sometimes the ambient sound levels are different from what the design was based upon. Private operating mode would require 10 dB over average ambient at the location of the device.
[c]Where building, system, or occupancy changes have been observed, the owner should be notified of the changes. New devices might need to be installed and tested per the initial acceptance testing criteria.

8.4.4* Testing Frequency. Unless otherwise permitted by other sections of this standard, testing shall be performed in accordance with the schedules in Table 8.4.3, or more often if required by the authority having jurisdiction. [**72:**14.4.4]

8.4.4.1 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. [**72:**14.4.4.1]

8.4.4.2 If automatic testing is performed at least weekly by a remotely monitored [carbon monoxide detection] control unit specifically listed for the application, the manual testing frequency shall be permitted to be extended to annually. Table 8.4.3 shall apply. [**72:**14.4.4.2]

8.4.5 Functional Test of Carbon Monoxide Detectors.

8.4.5.1 For all system detectors installed after January 1, 2012, carbon monoxide tests shall be performed at initial acceptance and annually by the introduction of carbon monoxide into the sensing chamber or element. An electronic check (magnets, analog values, etc.) is not sufficient to comply with this requirement.

8.4.5.2 The functional test shall be performed in accordance with the manufacturer's published instructions.

8.4.5.3* The result of each carbon monoxide detector test shall be confirmed through indication at the detector and the control unit.

8.4.5.4 All tests and results shall be recorded.

8.5 Maintenance.

8.5.1 [Carbon monoxide detection] system equipment shall be maintained in accordance with the manufacturer's published instructions. [**72:**14.5.1]

8.5.2 All apparatus that require resetting to maintain normal operation shall be restored to normal as promptly as possible after each test and alarm and kept in normal condition for operation. All test signal received shall be recorded to indicate date and time.

8.6 Records.

8.6.1 Permanent Records.

8.6.1.1 After successful completion of acceptance tests satisfactory to the authority having jurisdiction, a set of reproducible as-built installation drawings, operation and maintenance manuals, and a written sequence of operation shall be provided to the building owner or the owner's designated representative.

8.6.1.2 It shall be the responsibility of the owner to maintain these records for the life of the system and to keep them available for examination by any authority having jurisdiction.

8.6.1.3 Paper or electronic media shall be permitted.

8.6.2 Maintenance, Inspection, and Testing Records.

8.6.2.1 A record of all inspections, tests, and maintenance shall be documented and shall include all the applicable information included in Figure 8.6.2.1.

8.6.2.2 Records shall be retained until the next test and for 1 year thereafter. [**72:**14.6.2.1]

8.6.2.3 The system shall be clearly identified by a placard, sticker, or other means to indicate the next regularly scheduled inspection period in accordance with Figure 8.6.2.1.

CARBON MONOXIDE SYSTEM INSPECTION AND TESTING FORM

To be completed by the system inspector or tester at the time of the inspection or test.
It shall be permitted to modify this form as needed to provide a more complete and/or clear record.
Insert N/A in all unused lines.
Attach additional sheets, data, or calculations as necessary to provide a complete record.

Date of this inspection or test: _____ Time of inspection or test: _____

1. PROPERTY INFORMATION

Name of property: _____

Address: _____

Description of property: _____

Occupancy type: _____

Name of property representative: _____

Address: _____

Phone: _____ Fax: _____ E-mail: _____

Authority having jurisdiction over this property: _____

Phone: _____ Fax: _____ E-mail: _____

2. INSTALLATION, SERVICE, AND TESTING CONTRACTOR INFORMATION

Service and/or testing organization for this equipment: _____

Address: _____

Phone: _____ Fax: _____ E-mail: _____

Service technician or tester: _____

Qualifications of technician or tester: _____

A contract for test and inspection in accordance with NFPA standards is in effect as of: _____

The contract expires: _____ Contract number: _____ Frequency of tests and inspections: _____

Monitoring organization for this equipment: _____

Address: _____

Phone: _____ Fax: _____ E-mail: _____

Entity to which alarms are retransmitted: _____ Phone: _____

3. TYPE OF SYSTEM OR SERVICE

❑ Carbon monoxide system (nonvoice)

❑ Carbon monoxide with emergency voice alarm communication system (EVACS)

❑ Combination carbon monoxide detection system, with the following components, describe: _____

_____

_____

NFPA 720 edition: _____ Additional description of system(s): _____

_____

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FIGURE 8.6.2.1 Example of an Inspection and Testing Form.

3. TYPE OF SYSTEM OR SERVICE *(continued)*

3.1 Control Unit

Manufacturer: _____ Model number: _____

3.2 System Documentation

❑ An owner's manual, a copy of the manufacturer's instructions, a written sequence of operation, and a copy of the record drawings are stored on site. Location: _____

3.3 System Software

❑ This system does not have alterable site-specific software.

Software revision number: _____ Software last updated on: _____

❑ A copy of the site-specific software is stored on site. Location: _____

4. SYSTEM POWER

4.1 Control Unit

4.1.1 Primary Power

Input voltage of control panel: _____ Control panel amps: _____

4.1.2 Engine-Driven Generator

❑ This system does not have a generator.

Location of generator: _____

Location of fuel storage: _____ Type of fuel: _____

4.1.3 Uninterruptible Power System

❑ This system does not have a UPS.

Equipment powered by a UPS system: _____

Location of UPS system: _____

Calculated capacity of UPS batteries to drive the system components connected to it:

In standby mode (hours): _____ In alarm mode (minutes): _____

4.1.4 Batteries

Location: _____ Type: _____ Nominal voltage: _____ Amp/hour rating: _____

Calculated capacity of batteries to drive the system:

In standby mode (hours): _____ In alarm mode (minutes): _____

❑ Batteries are marked with date of manufacture.

4.2 Emergency Voice Alarm Communication System

❑ This system does not have an EVACS.

4.2.1 Primary Power

Input voltage of EVACS panel: _____ EVACS panel amps: _____

4.2.2 Engine-Driven Generator

❑ This system does not have a generator.

Location of generator: _____

Location of fuel storage: _____ Type of fuel: _____

FIGURE 8.6.2.1 *Continued*

4. SYSTEM POWER *(continued)*

4.2.3 Uninterruptible Power System ❑ This system does not have a UPS.

Equipment powered by a UPS system: _____

Location of UPS system: _____

Calculated capacity of UPS batteries to drive the system components connected to it:

In standby mode (hours): _____ In alarm mode (minutes): _____

4.2.4 Batteries

Location: _____ Type: _____ Nominal voltage: _____ Amp/hour rating: _____

Calculated capacity of batteries to drive the system:

In standby mode (hours): _____ In alarm mode (minutes): _____

❑ Batteries are marked with date of manufacture.

4.3 Notification Appliance Power Extender Panels ❑ This system does not have power extender panels.

4.3.1 Primary Power

Input voltage of power extender panel(s): _____ Power extender panel amps: _____

4.3.2 Engine-Driven Generator ❑ This system does not have a generator.

Location of generator: _____

Location of fuel storage: _____ Type of fuel: _____

4.3.3 Uninterruptible Power System ❑ This system does not have a UPS.

Equipment powered by a UPS system: _____

Location of UPS system: _____

Calculated capacity of UPS batteries to drive the system components connected to it:

In standby mode (hours): _____ In alarm mode (minutes): _____

4.3.4 Batteries

Location: _____ Type: _____ Nominal voltage: _____ Amp/hour rating: _____

Calculated capacity of batteries to drive the system:

In standby mode (hours): _____ In alarm mode (minutes): _____

❑ Batteries are marked with date of manufacture.

5. ANNUNCIATORS ❑ This system does not have annunciators.

5.1 Location and Description of Annunciators

Annunciator 1: _____

Annunciator 2: _____

Annunciator 3: _____

FIGURE 8.6.2.1 *Continued*

6. NOTIFICATIONS MADE PRIOR TO TESTING

Monitoring organization	Contact: _____	Time: _____
Building management	Contact: _____	Time: _____
Building occupants	Contact: _____	Time: _____
Authority having jurisdiction	Contact: _____	Time: _____
Other, if required	Contact: _____	Time: _____

7. TESTING RESULTS

7.1 Control Unit and Related Equipment

Description	Visual Inspection	Functional Test	Comments
Control unit	❑	❑	
Lamps/LEDs/LCDs	❑	❑	
Fuses	❑	❑	
Trouble signals	❑	❑	
Disconnect switches	❑	❑	
Ground-fault monitoring	❑	❑	
Supervision	❑	❑	
Local annunciator	❑	❑	
Remote annunciators	❑	❑	
Power extender panels	❑	❑	
Isolation modules	❑	❑	
Other (specify)	❑	❑	

7.2 Control Unit Power Supplies

Description	Visual Inspection	Functional Test	Comments
120-volt power	❑	❑	
Generator or UPS	❑	❑	
Battery condition	❑	❑	
Load voltage	❑	❑	
Discharge test	❑	❑	
Charger test	❑	❑	
Other (specify)	❑	❑	

FIGURE 8.6.2.1 ***Continued***

7. TESTING RESULTS *(continued)*

7.3 Emergency Voice Alarm Communications Equipment

Description	Visual Inspection	Functional Test	Comments
Control unit	❑	❑	
Lamps/LEDs/LCDs	❑	❑	
Fuses	❑	❑	
Primary power supply	❑	❑	
Secondary power supply	❑	❑	
Trouble signals	❑	❑	
Disconnect switches	❑	❑	
Ground-fault monitoring	❑	❑	
Panel supervision	❑	❑	
System performance	❑	❑	
Sound pressure levels Occupied ❑ Yes ❑ No Ambient _____ dBA Alarm _____ dBA (attach report with locations, values, and weather conditions)	❑	❑	
System intelligibility ❑ CSI ❑ STI (attach report with locations, values, and weather conditions)	❑	❑	
Other (specify)	❑	❑	

7.4 Notification Appliance Power Extender Panels

Description	Visual Inspection	Functional Test	Comments
Lamps/LEDs/LCDs	❑	❑	
Fuses	❑	❑	
Primary power supply	❑	❑	
Secondary power supply	❑	❑	
Trouble signals	❑	❑	
Ground-fault monitoring	❑	❑	
Panel supervision	❑	❑	
Other (specify)	❑	❑	

FIGURE 8.6.2.1 *Continued*

7. TESTING RESULTS *(continued)*

7.5 Combination Carbon Monoxide Detection Systems

Description	Visual Inspection	Functional Test	Comments
Combination CO/ security system	❑	❑	
Other (specify)	❑	❑	

7.6 Monitored Systems

Description (specify)	Visual Inspection	Functional Test	Comments
Specify	❑	❑	

7.7 Auxiliary Functions

Description	Visual Inspection	Functional Test	Comments
Describe	❑	❑	

7.8 Alarm Initiating Device

❑ Device test results sheet attached listing all devices tested and the results of the testing

7.9 Supervisory Alarm Initiating Device

❑ Device test results sheet attached listing all devices tested and the results of the testing

7.10 Alarm Notification Appliances

❑ Appliance test results sheet attached listing all appliances tested and the results of the testing

7.11 Supervisory Station Monitoring

Description	Yes	No	Time	Comments
Alarm signal	❑	❑		
Alarm restoration	❑	❑		
Trouble signal	❑	❑		
Trouble restoration	❑	❑		
Supervisory signal	❑	❑		
Supervisory restoration	❑	❑		

FIGURE 8.6.2.1 *Continued*

8. NOTIFICATIONS THAT TESTING IS COMPLETE

Monitoring organization	Contact: _____	Time: _____
Building management	Contact: _____	Time: _____
Building occupants	Contact: _____	Time: _____
Authority having jurisdiction	Contact: _____	Time: _____
Other, if required	Contact: _____	Time: _____

9. SYSTEM RESTORED TO NORMAL OPERATION

Date: _____ Time: _____

10. CERTIFICATION

10.1 Inspector Certification:

This system, as specified herein, has been inspected and tested according to all NFPA standards cited herein.

Signed: _____ Printed name: _____ Date: _____

Organization: _____ Title: _____ Phone: _____

10.2 Acceptance by Owner or Owner's Representative:

The undersigned has a service contract for this system in effect as of the date shown below.

Signed: _____ Printed name: _____ Date: _____

Organization: _____ Title: _____ Phone: _____

DEVICE TEST RESULTS

(Attach additional sheets if required)

Device Type	Address	Location	Test Results

FIGURE 8.6.2.1 *Continued*

Exception: If the devices have been tested as part of the normal carbon monoxide alarm testing, the existing means of indicating the next regularly scheduled inspection period shall be permitted.

8.6.2.4 If off-premises monitoring is provided, records of signals, tests, and operations recorded at the monitoring center shall be maintained for not less than 12 months.

8.6.2.5 Upon request, a hard copy record shall be available for examination by the authority having jurisdiction.

8.6.2.6 Paper or electronic media shall be permitted.

8.7 Single- and Multiple-Station Carbon Monoxide Alarms.

8.7.1 Single- and multiple-station carbon monoxide alarms and all connected appliances shall be inspected and tested in accordance with the manufacturer's published instructions at least monthly.

8.7.2 Alarms shall be replaced when either the end-of-life signal is activated or the manufacturer's replacement date is reached. Alarms shall also be replaced when they fail to respond to operability tests.

8.7.3 Where batteries are used as a source of energy, they shall be replaced in accordance with the alarm equipment manufacturer's published instructions.

8.7.4 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. [**72**:14.4.7.2]

8.8 Household Carbon Monoxide Detection Systems.

8.8.1 Testing of Household Carbon Monoxide Detection Systems.

8.8.1.1 Household carbon monoxide detection systems shall be tested by a qualified service technician at least every 3 years according to the methods in Table 8.4.3.

8.8.1.2 Carbon monoxide detectors used in household carbon monoxide detection systems shall be tested in accordance with manufacturer's published instructions.

8.8.1.3 Detectors shall be replaced when the end-of-life signal is activated, the manufacturer's replacement date is reached, or when they fail to respond to operability tests.

8.8.2 Maintenance of Household Carbon Monoxide Detection Systems. Maintenance of household [carbon monoxide detection] systems shall be conducted according to the manufacturer's published instructions. [**72:**14.4.6.2]

Chapter 9 Single- and Multiple-Station Alarms and Household Carbon Monoxide Detection Systems

9.1 Application.

9.1.1 The performance, selection, installation, operation, and use of single- and multiple-station alarms and household carbon monoxide detection systems shall comply with the requirements of this chapter.

9.1.2 Carbon monoxide alarms shall be installed in all occupancies where required by applicable laws, codes, or standards.

9.1.3 The requirements of Chapter 4 through Chapter 6 shall not apply unless otherwise indicated.

9.2 Purpose. Carbon monoxide warning equipment for residential occupancies shall provide a reliable means to notify the occupants of the presence of levels of carbon monoxide that constitute a potential life safety risk and the need for action as a consequence of those levels.

9.3 Basic Requirements.

9.3.1 All devices, combinations of devices, and equipment to be installed in conformity with this chapter shall be listed for the purposes for which they are intended.

9.3.2 [Carbon monoxide] warning equipment shall be installed in accordance with the listing and manufacturer's published instructions. [**72:**29.3.2]

9.3.3* The installation of [carbon monoxide] alarms or [carbon monoxide detection] systems, or combinations of these, shall comply with the requirements of this chapter and shall satisfy the minimum requirements for number and location of [carbon monoxide] alarms or [carbon monoxide] detectors by one of the following arrangements:

(1) The required minimum number and location of [carbon monoxide] detection devices shall be satisfied (independently) through the installation of [carbon monoxide] alarms. The installation of additional [carbon monoxide] alarms shall be permitted. The installation of additional system-based [carbon monoxide] detectors, including partial or complete duplication of the [carbon monoxide] alarms satisfying the required minimum, shall be permitted.
(2) The required minimum number and location of [carbon monoxide] detection devices shall be satisfied (independently) through the installation of system [carbon monoxide] detectors. The installation of additional [carbon monoxide] detectors shall be permitted. The installation of additional [carbon monoxide] alarms, including partial or complete duplication of the [carbon monoxide] detectors satisfying the required minimum, shall be permitted.

[**72:**29.3.3]

9.3.4 Supplementary functions, including the extension of an alarm beyond the residential occupancy, shall be permitted and shall not interfere with the performance requirements of this chapter. [**72:**29.3.4]

9.4 Required Protection.

9.4.1* Carbon Monoxide Alarms and Detectors. The warning functions intended in this standard shall be performed by single- or multiple-station alarms or by detectors connected to a control unit and associated equipment, in accordance with 9.3.3.

9.4.1.1* Carbon monoxide alarms or detectors shall be installed as follows:

(1) Outside of each separate dwelling unit sleeping area in the immediate vicinity of the bedrooms
(2) On every occupiable level of a dwelling unit, including basements, excluding attics and crawl spaces
(3) Other locations where required by applicable laws, codes, or standards

9.4.1.2* Each alarm or detector shall be located on the wall, ceiling, or other location as specified in the manufacturer's published instructions that accompany the unit.

9.4.2 Alarm Notification Appliances.

9.4.2.1 General. Each alarm or detector shall cause the operation of an alarm notification appliance that shall meet the performance requirements of 6.4.2, 6.4.4.1, 6.4.4.2, and, if applicable, 9.4.2.2.

9.4.2.2* Alarm Notification Appliances for the Hearing Impaired.

9.4.2.2.1 Notification appliances provided in sleeping rooms and guest rooms for those with hearing loss shall comply with 9.4.2.2.1.1 and 9.4.2.2.1.2, as applicable. [**72:**29.3.8]

9.4.2.2.1.1* 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
   (b) Where provided voluntarily for those with hearing loss
(2)*The low frequency alarm signal output shall comply with the following:
   (a) The waveform shall have a fundamental frequency of 520 Hz +/-10 percent.
   (b) 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 a duration of at least 60 seconds, whichever is greater.

[**72:**29.3.8.1]

9.4.2.2.1.2* Moderately Severe to Profound Hearing Loss. Visible notification appliances in accordance with the requirements of 6.5.5.7 and tactile notification appliances in accordance with the requirements of Section 6.10 shall be required for those with moderately severe to profound hearing loss in the following situations:

(1)*Where required by governing laws, codes, or standards for people with hearing loss
(2) Where provided voluntarily for those with hearing loss

[**72:**29.3.8.2]

9.4.2.2.2 Signals from notification appliances shall not be required to be synchronized. [**72:**29.3.9]

9.4.2.2.3 When visible appliances are provided, they shall meet the requirements of Section 6.5. 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 party with hearing loss. [**72:**29.3.7]

9.4.2.2.4 Visible notification appliances used with single- or multiple-station carbon monoxide alarms shall be permitted to operate in accordance with 9.5.5.

9.5 Power Supplies.

9.5.1 General.

9.5.1.1 All power supplies shall have sufficient capacity to operate the alarm signal(s) for at least 12 continuous hours.

9.5.1.2 For electrically powered carbon monoxide warning equipment, the primary (main) power source shall be ac along with a secondary power source meeting the specifications of 9.5.4, unless otherwise permitted by the following:

(1) Detectors and alarms shall be permitted to be powered by a monitored dc circuit of a control unit when power for the control unit meets the requirements of Section 9.5 and the circuit remains operable upon loss of primary (main) ac power.
(2) A detector and a wireless transmitter that serves only that detector shall be permitted to be powered from a monitored battery primary (main) source where part of a listed, monitored, low-power radio (wireless) system.
(3) In existing construction, a monitored battery primary (main) power source, as described in 9.5.3, shall be permitted.

9.5.2 Primary Power Supply — ac.

9.5.2.1 An ac primary (main) power source shall be a commercial light and power supply or other dependable source.

9.5.2.2 A visible "power on" indicator shall be provided.

9.5.2.3 Primary (main) ac power shall be supplied from either a dedicated branch circuit or the unswitched portion of a branch circuit also used for power and lighting.

9.5.2.4 All electrical systems designed to be installed by other than a qualified electrician shall be powered from a source not in excess of 30 volts that meets the requirements for Class 2 circuits as defined in Article 725 of *NFPA 70, National Electrical Code*.

9.5.2.5* A restraining means shall be used at the plug-in of any cord-connected installation.

9.5.2.6 Operation of a switch (other than a circuit breaker) or a ground fault circuit interrupter shall not cause loss of primary (main) ac power.

9.5.2.7 The requirement of 9.5.2.6 shall not apply where a ground fault circuit interrupter serves all electrical circuits within the dwelling unit.

9.5.2.8 Neither loss nor restoration of primary (main) ac power shall cause an alarm signal exceeding 2 seconds.

9.5.2.9 The primary (main) ac power supply shall be of sufficient capacity to operate the system under all conditions of loading with any secondary (standby) battery disconnected or fully discharged.

9.5.3 Primary Power Supply — Monitored Battery.

9.5.3.1 Carbon monoxide warning equipment shall be permitted to be powered by a battery, provided that the battery is monitored to ensure that the following conditions are met:

(1) All power requirements are met for at least 1 year of battery life, including monthly testing.
(2) A distinctive audible trouble signal sounds before the battery is incapable of operating the device(s) (from causes such as aging or terminal corrosion) for alarm purposes.
(3) Automatic transfer is provided from alarm to a trouble condition for a unit employing a lock-in alarm feature.
(4) The unit is capable of producing an alarm signal for at least 12 hours at the battery voltage at which a trouble signal is normally obtained, followed by not less than 7 days of trouble signal operation.
(5) After the initial 4 minutes of alarm, the 5-second "off" time of the alarm signal shall be permitted to be changed to 60 seconds ± 10 percent.

(6) The audible trouble signal is produced at least once every minute for 7 consecutive days.
(7) Acceptable replacement batteries are identified by the manufacturer's name and model number on the unit near the battery compartment.
(8) A visible indication is displayed when a primary battery is removed from the unit.
(9) A visible "power on" indicator is provided.

9.5.3.2 If an alarm uses a nonrechargeable, nonreplaceable battery as a primary power supply, the battery shall be capable of powering the unit for its service life, including testing, and shall meet the requirements of 9.5.3.1.

9.5.4 Secondary (Standby) Power Supply.

9.5.4.1 A secondary (standby) power supply shall have sufficient capacity to power the unit for 24 hours, followed by not less than 12 hours of alarm, followed by not less than 7 consecutive days of trouble signals.

9.5.4.2 After the initial 4 minutes of alarm, the 5-second "off" time of the alarm signal shall be permitted to be changed to 60 seconds ± 10 percent.

9.5.4.3 Removal or disconnection of a battery used as a secondary (standby) power source shall cause an audible or visible trouble signal.

9.5.4.4 Permitted replacement batteries shall be identified by manufacturer's name and model number on the unit near the battery compartment.

9.5.4.5 Where required by law for disposal reasons, rechargeable batteries shall be removable.

9.5.4.6 An audible trouble signal shall sound before the battery is incapable of operating the device(s) (from causes such as aging, discharge, or terminal corrosion) for alarm purposes.

9.5.4.7 Automatic recharging shall be provided when a rechargeable battery is used as a secondary (standby) supply.

9.5.4.8 Where automatic recharging is provided, the battery shall be recharged within one of the following time periods:

(1) Within 4 hours where power is provided from a circuit that can be switched on or off by means other than a circuit breaker
(2) Within 48 hours where power is provided from a circuit that cannot be switched on or off by means other than a circuit breaker

9.5.5* Visible notification appliances used with single- or multiple-station carbon monoxide alarms shall not be required to operate without primary ac power.

9.6 Equipment Performance.

9.6.1 Carbon Monoxide Alarms and Detectors.

9.6.1.1* Each carbon monoxide alarm shall be in compliance with ANSI/UL 2034, *Standard for Single and Multiple Station Carbon Monoxide Alarms.*

9.6.1.2 Each carbon monoxide detector shall be in compliance with ANSI/UL 2075, *Gas and Vapor Detectors and Sensors*, and shall meet the sensitivity testing and alarm thresholds of ANSI/UL 2034, *Standard for Single and Multiple Station Carbon Monoxide Alarms.*

9.6.1.3 All signals produced from periodic testing of carbon monoxide alarms or detectors *(see 9.8.2)* shall be identical to the signal produced when the unit is in alarm.

9.6.1.4 Trouble signals shall be distinctive from alarm signals.

9.6.1.5 Unless otherwise recommended by the manufacturer's published instructions, carbon monoxide alarms and detectors shall be replaced when they fail to respond to tests.

9.6.1.6 Alarms and detectors shall be replaced when either the end-of-life signal is activated or the manufacturer's replacement date is reached.

9.6.1.7 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.

9.6.1.8 Combination smoke/carbon monoxide detectors shall be replaced when the end-of-life signal activates or when the manufacturer's replacement date is reached.

9.6.2 Audible Alarm Signals.

9.6.2.1 All alarm-sounding appliances shall have a minimum rating of 85 dBA at 3 m (10 ft).

9.6.2.2 The audible alarm signal for carbon monoxide alarms shall comply with the requirements of 5.8.6.5.1.

9.6.3 Multiple-Purpose Alarms.

9.6.3.1 A fire alarm signal shall take precedence and be distinctively recognizable over any other signal, even when the nonfire signal is initiated first.

9.6.3.2 Distinctively different audible alarm signals shall be provided for each of the following:

(1) Fire alarms
(2) Carbon monoxide alarms
(3) Other alarms

9.6.4 Interconnection of Alarms. When two or more alarms are installed within a dwelling unit, suite of rooms, or similar area, they shall be arranged so that the operation of any alarm causes all alarms within these locations to sound.

Exception: Alarms installed in existing construction shall not be required to cause all alarms to sound.

9.6.4.1 When alarms of different types are interconnected, all interconnected alarms shall produce the appropriate audible response for the phenomena being detected or remain silent. [**72:**29.8.2.2(5)]

9.6.4.2 Auxiliary components, such as, but not limited to, relay modules or notification appliances, listed for use with carbon monoxide alarms shall be permitted, provided that an open or short circuit of the wiring leading to these components does not prevent normal operation of the interconnected alarm.

9.6.4.3 Carbon monoxide alarms shall not be interconnected with alarms from other manufacturers unless listed as being compatible with those specific models.

9.6.4.4 A single fault on the wiring connecting the alarms shall not prevent the independent operation of any of the interconnected alarms.

9.6.4.5 The test feature on any alarm device shall cause all interconnected alarms to activate the appropriate alarm signal.

9.6.5 Control Equipment.

9.6.5.1 Control equipment shall be automatically restored upon restoration of electrical power.

9.6.5.2 The control equipment shall be of a type that latches on an alarm condition.

9.6.5.3 When a reset switch is provided, it shall be of a self-restoring type.

9.6.5.4 An alarm-silencing switch shall not be provided unless one of the following criteria applies:

(1) The silenced position is indicated by a distinctive signal.
(2) The switch is a momentary or self-restoring switch.

9.6.5.5 Each electrical carbon monoxide detection system shall have an integral test means to allow testing of the system operation.

9.6.6 Combination Systems.

9.6.6.1 Where common wiring is employed for a combination system, the equipment for other than a fire warning signaling system shall be permitted to be connected to the common wiring of the system provided that the following conditions are met:

(1) Short circuits, open circuits, or any other ground fault in equipment or interconnection between this equipment and the fire warning system does not interfere with the monitoring for integrity of the fire warning system.
(2) Short circuits, open circuits, or any other ground fault in this equipment or interconnection between this equipment and the fire warning system does not prevent alarm or trouble signal transmissions.

9.6.6.2 In a combination system, the operation shall be as follows:

(1) A fire alarm signal shall take precedence or be distinctively annunciated over any other signal, even when the nonfire or carbon monoxide signal is initiated first.
(2) Distinctively different audible alarm signals shall be provided for each of the following:
    (a) Fire alarms
    (b) Carbon monoxide alarms
    (c) Other alarms
(3) The use of a common audible notification appliance shall be permitted if distinctive signals are obtained.

9.6.6.3 Single- or multiple-station carbon monoxide alarms shall be permitted to be connected to system control equipment located within the dwelling unit. [**72:**29.7.7.1]

9.6.6.4 When connected, the actuation of a single- or multiple-station carbon monoxide alarm shall initiate an alarm signal at the system control equipment located within the dwelling unit. [**72:**29.7.7.2]

9.6.7 Interconnection to Fire Alarm or Combination Control Units.

9.6.7.1 Operation of carbon monoxide alarms or detectors shall not cause fire alarm or combination control units to activate either protected premises or supervising station fire alarm signals.

9.6.7.2 Where carbon monoxide warning equipment is connected to a protected premises fire alarm system, receipt of signals shall initiate the signal required by 9.6.2.

9.6.8 Supervising Station Systems.

9.6.8.1* Carbon monoxide warning equipment signals that are transmitted off-premises shall comply with the requirements of Chapter 7 and the following:

(1) Where required, immediately retransmit indication of the carbon monoxide alarm signal to the communications center.

Exception: The immediate retransmission shall be permitted to be delayed by not more than 90 seconds where the jurisdiction permits the supervising station to first contact the protected premises to determine if the alarm was initiated by the activation of a test.

(2) Contact the responsible party(s) in accordance with the notification plan.

9.6.8.2 Once contacted, the subscriber shall be informed to take action in accordance with the manufacturer's published instructions, or where manufacturer's published instructions are not available, the subscriber shall be advised to take the following actions:

(1) Immediately move to fresh air, either outdoors or by an open door or window.
(2) Verify that all occupants are accounted for.
(3) Do not reenter the premises or move away from an open door or window until the emergency service responders have arrived, the premises have been aired out, and the alarm remains in its normal condition.

9.6.8.3 Supervising Stations.

9.6.8.3.1 Means to transmit alarm signals to a constantly attended, remote monitoring location shall be processed by a household carbon monoxide detection system that shall perform as described in Chapter 7, except as modified by 9.6.8.3.2 through 9.6.8.3.5. [**72:**29.7.9.1]

9.6.8.3.2 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 receiver (DACR) number. [**72:**29.7.9.1.1]

9.6.8.3.3 Where a DACT is used, the DACT test signals shall be transmitted at least monthly. [**72:**29.7.9.1.2]

9.6.8.3.4* Requirements for indication of central station service shall not be required.

9.6.8.3.5 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. [**72:**29.7.9.1.6]

9.6.8.4 Household [ ] alarm systems shall be programmed by the manufacturer to generate at least a monthly test of the communication or transmission means. [**72:**29.7.9.3]

9.6.9 Low-Power Wireless Systems. Low-power radio (wireless) systems shall comply with the requirements of Section 5.12.

Exception: The requirements of 5.12.4.5 shall not apply to dwelling units.

9.6.10 Nonsupervised Wireless Interconnected Alarms.

9.6.10.1* 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:

$$D_{EOAT} = 30.5 \times \left(10^{\frac{L_b}{40}} \right) \qquad \textbf{[9.6.10.1a]}$$

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_{b0} shall assume four walls and two floors and be calculated as follows:

$$L_b = 4 \times L_w + 2 \times L_f \qquad \textbf{[9.6.10.1b]}$$

where:
L_w = attenuation value of a wall = $2 \times L_1 + L_2$
L_f = attenuation value of a floor = $L_1 + L_2 + L_3 + L_4$
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

[**72**:29.7.8.2.1]

9.6.10.2 Fire alarm signals shall have priority over all other signals. [**72:**29.7.8.2.2]

9.6.10.3 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. [**72:**29.7.8.2.3]

9.6.10.4* Wireless interconnected [ ] alarms (in receive mode) shall remain in alarm as long as the originating unit (transmitter) remains in alarm. [**72:**29.7.8.2.4]

9.6.10.5 The occurrence of any single fault that disables a transceiver shall not prevent other transceivers in the system from operating. [**72:**29.7.8.2.5]

9.7 Installation.

9.7.1 General Provisions.

9.7.1.1 All carbon monoxide alarms or detectors shall be installed in accordance with the manufacturer's published instructions.

9.7.1.2 All carbon monoxide alarms or detectors shall be located and mounted so that accidental operation will not be caused by jarring or vibration.

9.7.1.3 All carbon monoxide alarms or detectors shall be supported independently of their attachment to wires.

9.7.1.4 All carbon monoxide alarms or detectors shall be tested in accordance with the instructions provided by the supplier or installing contractor *(see 9.9.2 and 9.9.3)* to ensure operation after installation.

9.7.1.5 All carbon monoxide alarms or detectors shall be restored to their normal mode of operation after each alarm or test.

9.7.1.6 The supplier or installing contractor shall provide the owner with the instructions required in 9.9.3.

9.7.2 Multiple-Station Alarms.

9.7.2.1* Interconnection that causes the other multiple-station alarms or the appropriate notification signal of multiple-purpose alarms within an individual dwelling unit to produce an alarm signal shall be permitted.

9.7.2.2 Remote annunciation from single- and multiple-station alarms shall be permitted provided the devices comply with 9.4.2.1 and 9.6.4.

9.7.2.3 Remote annunciation shall be permitted provided the signal is identifiable for the hazard it annunciates.

9.8 Maintenance and Testing.

9.8.1 Single- and multiple-station carbon monoxide alarms shall be maintained and tested in accordance with Section 8.7.

9.8.2 Household carbon monoxide detection systems shall be maintained and tested in accordance with Section 8.8.

9.9 Markings and Instructions.

9.9.1 General. Carbon monoxide alarms or detectors shall be provided with the information specified in 9.9.2 and 9.9.3.

9.9.2 Markings. The following information shall be marked on the alarms and detectors and shall be provided in the instructions:

(1) Identification of the sensitivity level at which the unit is designed to sense carbon monoxide
(2) Statement that indicates the unit is not suitable as a fire detector
(3) Name and address of the manufacturer or listee
(4) Model number
(5) Mark or certification that the unit has been listed by a nationally recognized testing laboratory
(6) Electrical rating (if applicable)
(7) Explanation of signal indicators
(8) Warning that carbon monoxide is odorless, colorless, and tasteless
(9) Emergency actions to be taken
(10) Manufacturing date or date code
(11) Recommended replacement date

9.9.3 Instructions. The following information shall be included in the printed instructions provided with carbon monoxide alarms and detectors:

(1) Installation instructions
(2) Operating instructions
(3) Testing instructions
(4) Maintenance instructions
(5) Replacement and service instructions
(6) Statement indicating that smoke might not be present during a carbon monoxide alarm condition
(7)*Information on the actions to be taken in case of an alarm
(8) Minimum and recommended distances from fuel-burning appliances

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1 This document does not attempt to cover all equipment, methods, and requirements that might be necessary or advantageous for the protection of lives from carbon monoxide exposure.

The effects of exposure to carbon monoxide vary significantly among different people. Infants, pregnant women, and people with physical conditions that limit their bodies' ability to use oxygen can be affected by low concentrations of carbon monoxide. These conditions include, but are not limited to, emphysema, asthma, and heart disease, all of which are usually indicated by a shortness of breath upon mild exercise.

People in need of warning about low levels of carbon monoxide should explore the use of specially calibrated units or other alternatives.

A.1.1.2 See NFPA 1192, *Standard on Recreational Vehicles*, for equipment for use in recreational vehicles.

A.1.2 Carbon monoxide alarms and detectors are intended to alarm at carbon monoxide levels below those that are known to cause a loss of ability to react to the dangers of carbon monoxide. *(See also Table B.1 and Figure B.1.)*

A.1.3.2 Although carbon monoxide detection and warning equipment might respond to gases produced by unwanted fires, it is not fire detection or warning equipment.

A.1.5.6 Where dimensions are expressed in inches, it is intended that the precision of the measurement be 1 in., thus plus or minus ½ in. The conversion and presentation of dimensions in millimeters would then have a precision of 25 mm, thus plus or minus 13 mm.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.1 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. [**72,** 2013]

In smaller areas, such as those under 400 ft^2 (40 m^2), 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. [**72,** 2013]

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. [**72,** 2013]

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. [**72,** 2013]

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. [**72,** 2013]

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 might require more ceiling-mounted speakers to ensure that all listeners are in a direct sound field *(see Figure A.3.3.1)*. Other ADSs might benefit from the use of alternate speaker technologies, such as line arrays, to achieve intelligibility. [**72,** 2013]

An ADS that differs from another because of the frequency and level of ambient noise might require the use of speakers

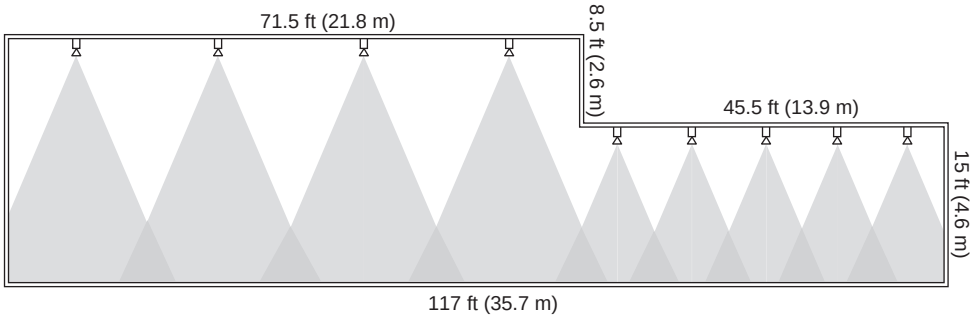


FIGURE A.3.3.1 Illustration Demonstrating the Effect of Ceiling Height. *(Source: R. P. Schifiliti Associates, Inc.)* **[72: Figure A.3.3.6]**

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. [**72,** 2013]

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. [**72,** 2013]

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. [**72**, 2013]

A.3.3.3 [Carbon Monoxide] Control Function Interface Device. The [carbon monoxide] control function interface device is a listed relay or other listed appliance that is part of the [carbon monoxide detection] system. An example of a [carbon monoxide] control function interface device is the [carbon monoxide detection system] control relay that removes power to a fan control unit. [**72,** 2013]

A.3.3.8 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

[**1221,** 2013]

A.3.3.11 Emergency Response Agency (ERA). An ERA includes any public, governmental, private, industrial, or military organization that engages in the operations specified in the definition. [**1221,** 2013]

A.3.3.14 Fuel-Burning Appliance. Fuel-burning appliances include, but are not limited to, devices used for cooking, heating, lighting, or decorative purposes. Examples are wood stoves, portable space heaters, ranges, furnaces, water heaters, clothes dryers, gas refrigerators, gas lamps, and fuel-burning fireplaces.

A.3.3.22 Separate Sleeping Area. Bedrooms or sleeping rooms separated by other use areas, such as kitchens or living rooms, but not bathrooms, are considered as separate sleeping areas for the purposes of this standard.

A.3.3.25.3 Combination System. Examples of non-fire systems are security, card access control, closed circuit television, sound reinforcement, background music, paging, sound masking, building automation, time, and attendance. [**72,** 2013]

A.4.3.3 This requirement does not apply to notification appliance circuits. [**72:** A.10.3.3]

A.4.3.4 A relay used for carbon monoxide safety functions is one possible example of such a situation.

A.4.4.3.1 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. [**72:** A.10.5.3]

A.4.4.3.1.1(1) Factory training and certification is intended to allow an individual to service equipment only for which he or she has specific brand and model training. [**72:** A.10.5.3(1)]

A.4.4.3.1.1(2) Licenses and certifications offered at a state or local level are intended to recognize those individuals who have demonstrated a minimum level of technical competency in the area of fire alarm servicing. [**72:** A.10.5.3(3)]

A.4.5.6.1 The secondary power supply is not required to supply power to the [carbon monoxide detection] system through parallel distribution paths. Automatic transfer switches are commonly used to allow secondary power to be supplied over the same distribution system as the primary power. [**72:** A.10.6.7.3]

The generator does not need to be dedicated to the [carbon monoxide detection] system. [**72:** A.10.6.7.3]

A.4.5.6.2.1 A combination system is a fire alarm system and is required to comply with *NFPA 72, National Fire Alarm and Signaling Code.*

A.4.5.6.2.2 An example of another standard is NFPA 731, *Standard for the Installation of Electronic Premises Security Systems.*

A.4.5.7 Where a computer system of any kind is used to receive and process alarm or supervisory signals, an uninterruptible power supply (UPS) with sufficient capacity to operate the

system until the secondary supply is capable of operating the [carbon monoxide detection] system might be required in order to prevent signal loss or a greater than 10-second signal delay. [**72:** A.10.6.6]

UPS equipment often contains an internal bypass arrangement to supply the load directly from the line. These internal bypass arrangements are a potential source of failure. UPS equipment also requires periodic maintenance. It is, therefore, necessary to provide a means of promptly and safely bypassing and isolating the UPS equipment from all power sources while maintaining continuity of power supply to the equipment normally supplied by the UPS. [**72:** A.10.6.6]

A.4.5.8.1 Example include the following:

(1) A notification appliance circuit power supply located remotely
(2) A power supply for transmitter required to transmit signals off premises
(3) Power over ethernet (PoE), where provided for control units, circuit interfaces, or other equipment essential to system operation, and located remotely from the main control unit

A.4.6.3 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 standard 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. [**72:** A.10.10.4]

A.4.6.4 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 end-of-line supervisory device of initiating device circuits, unless a distinctive signal, different from a trouble signal, is indicated. [**72:** A.10.10.5]

A.4.7.3.7 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. [**72:** A.10.12.4]

A.4.9.8 The purpose of automatic trouble re-sound is to remind owners, or those responsible for the system, that the system remains in a fault condition. A secondary benefit is to possibly alert occupants of the building that the [carbon monoxide detection] system is in a fault condition. [**72:** A.10.15.9]

A.4.10.2 The operability of controlled mechanical equipment [ ] should be verified by periodic testing. Failure to test and properly maintain controlled mechanical equipment can result in operational failure during an emergency, with potential consequences up to and including loss of life. [**72:** A.10.16.2]

A.4.11.1(1) The requirement of 4.11.1(1) does not preclude transfer to secondary supply at less than 85 percent of nominal primary voltage, provided the requirements of 4.5.6 are met. [**72:** A.10.13.5(1)]

A.4.11.2.1 [Carbon monoxide] alarm specifications can include some or all of the following:

(1) Address of the protected premises
(2) Owner of the protected premises
(3) Authority having jurisdiction
(4) Applicable codes, standards, and other design criteria to which the system is required to comply
(5) Type of building construction and occupancy
(6) [Emergency forces] response point(s) and annunciator location(s)
(7) Type of [carbon monoxide detection] system to be provided
(8) Calculations (e.g., secondary supply and voltage drop calculations)
(9) Type(s) of [carbon monoxide] alarm–initiating devices, supervisory alarm–initiating devices, and [ ] notification appliances to be provided
(10) Intended area(s) of coverage
(11) Complete list of detection, [ ] signaling, and annunciator zones
(12) Complete list of [carbon monoxide safety] control functions
(13) Complete sequence of operations detailing all inputs and outputs

[**72:** A.10.4.1]

A.4.12.3 The primary purpose of annunciation is to enable responding personnel to quickly and accurately determine the status of equipment or [carbon monoxide] control functions that might affect the safety of occupants. [**72:** A.10.18.3]

A.4.13.1 The provision of a double loop or other multiple path conductor or circuit to avoid electrical monitoring is not acceptable. [**72:** A.12.6]

A.4.13.1.7 This standard does not have jurisdiction over the monitoring integrity of conductors within equipment, devices, or appliances. [**72:** A.12.6.8]

A.4.13.2.2 Because digital alarm communicator systems establish communications channels between the protected premises and the central station via the public switched telephone network, the requirement to supervise circuits between the protected premises and the central station (see 4.13.1) is considered to be met if the communications channel is periodically tested in accordance with 26.6.3.2.1.5 of *NFPA 72, National Fire Alarm and Signaling Code*. [**72:** A.10.6.9.2]

A.4.13.2.3 This requirement is intended to prevent all of the supervising stations in a given geographic area from transmitting simultaneous trouble signals (and overwhelming the associated supervising stations) in the event of a widespread power failure. A trouble signal is not intended to be transmitted if primary power is restored within the time delay.

A.4.14.1.2 Shop drawings for carbon monoxide detection systems should provide basic information and should provide the basis for the record drawings required elsewhere in this standard.

Shop drawings should include, to an extent commensurate with the extent of the work being performed, floor plan drawings, riser diagrams, control panel wiring diagrams, point-to-point wiring diagrams, conduit, conductor routing, 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 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

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) Room descriptions
(6) Carbon monoxide alarm device/component locations
(7) Locations of carbon monoxide alarm primary power connection(s)
(8) Locations of monitor/control interfaces to other systems
(9) Riser locations
(10) Type and number of carbon monoxide detection system components/devices on each circuit, on each floor or level
(11) Type and quantity of conductors and conduit (if used) used for each circuit
(12) Location of all supply and return air diffusers (where automatic detection is used)

Carbon monoxide detection system riser diagrams should include the following information:

(1) General arrangement of the system in building cross-section
(2) Number of risers
(3) Type and number of circuits in each riser
(4) Type and number of carbon monoxide detection 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 carbon monoxide safety control interfaces

Typical wiring diagrams should be provided for all initiating devices, notification appliances, remote indicators, annunciators, remote test stations, and end-of-line and power supervisory devices.

A.4.14.1.4 Carbon monoxide detection systems are often installed under construction or remodeling contracts. All contractors should complete the portions of the record of completion form for the portions of the connected systems for which they are responsible. Several partially completed forms might be accepted by the authority having jurisdiction provided that all portions of the connected systems are covered in the set of forms.

A.4.14.2.1.1 The requirements of Chapter 8 should be used to perform the installation wiring and operational acceptance tests required when completing the record of completion.

The record of completion form shall be permitted to be used to record decisions reached prior to installation regarding intended system type(s), circuit designations, device types, notification appliance type, power sources, and the means of transmission to the supervising station.

A.4.14.2.3(1) [ ] An owner's manual should contain the following:

(1) A detailed narrative description of the system inputs, [ ] signaling, ancillary functions, annunciation, intended sequence of operations, expansion capability, application considerations, and limitations
(2) A written sequence of operation in matrix or narrative form
(3) Operator instructions for basic system operations, including alarm acknowledgment, system reset, interpretation of system output (LEDs, CRT display, and printout), and [ ] ancillary function controls, and change of printer paper
(4) A detailed description of routine maintenance and testing as required and recommended and as would be provided under a maintenance contract, including testing and maintenance instructions for each type of device installed. This information should include the following:
    (a) Listing of the individual system components that require periodic testing and maintenance
    (b) Step-by-step instructions detailing the requisite testing and maintenance procedures, and the intervals at which these procedures shall be performed, for each type of device installed
    (c) A schedule that correlates the testing and maintenance procedures
(5) A service directory, including a list of names and telephone numbers of those who provide service for the system

[**72:** A.7.5.3(1)]

A.5.2.1 Carbon monoxide detection for health and worker safety is not addressed in this standard. These systems are intended for ventilating spaces such as underground garages with detection levels lower than those addressed by this standard. Where carbon monoxide levels monitored and controlled by these systems reach life safety thresholds, the requirements of this standard should apply. Dual-purpose systems that include life safety thresholds would need to comply with this standard.

A.5.2.2.1.1 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 [carbon monoxide detection] software or firmware that interfaces with software or firmware in another system is compatible. [ ] The term "required" indicates that this compatibility requirement is intended for required functions [ ] and not for supplemental functions that are not part of the required operation of the [ ] 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. [**72:** A.23.2.2.1.1]

A.5.2.2.1.2 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. [**72:** A.23.2.2.1.2]

A.5.2.2.2 A commonly used method of protecting against unauthorized changes 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 a [carbon monoxide] 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 do the following:
    (a) Reconfigure the site-specific data held within the control unit, or controlled by it
    (b) Maintain the control unit in accordance with the manufacturer's published instructions and data
(4) *Access Level 4*. Access by persons who are trained and authorized either to repair the control unit or to alter its site-specific data or operating system program, thereby changing its basic mode of operation

[**72:** A.23.2.2.2]

A.5.3.2 Nonrequired carbon monoxide detection systems and components are those that are not required by building or fire codes and are installed voluntarily by a building owner to meet site-specific safety objectives. There is a need to properly document the nonrequired system and components. Nonrequired components must be operationally compatible in harmony with other required components and should not be detrimental to the overall system performance. It is for this reason that 5.3.2.1 mandates that nonrequired (voluntary) systems and components meet the applicable installation, testing, and maintenance requirements of this standard.

A.5.4.2.2.3.4.2 Technologies that do not use metallic conductors (e.g., wireless or optical fibers) are not affected by ground connections. [**72:** A.12.2.5.2]

A.5.4.3 The following is reprinted from A.12.3 of *NFPA 72* to provide users with an explanation of the new circuit and pathway designations.

The intent of the circuit designations is not to create a hierarchal ranking; rather it is to provide guidance on the levels of performance. [**72:** A.12.3]

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.5.4.3(a), Table A.5.4.3(b), and Table A.5.4.3(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 of *NFPA 72* in conjunction with the requirements of Chapters 10 and 23 of *NFPA 72*. Singular ground-fault conditions that do not affect operation of the pathway are not specifically covered in Chapter 12 of *NFPA 72*, but are covered by the requirements of other chapters. Users of the Chapter 12 of *NFPA 72* designations should review whether there are other abnormal conditions not specified in Chapter 12 of *NFPA 72* that the pathways need to annunciate and operate through for their application. [**72:** A.12.3]

Table A.5.4.3(a) Performance of Initiating Device Circuits (IDCs)

NFPA 72-2007 Class	**B**			**A**		
NFPA 72-2010 Class	**B**			**A**		
	Alm	**Trbl**	**ARC**	**Alm**	**Trbl**	**ARC**
Abnormal Condition	1	2	3	4	5	6
Single open	-	X	-	-	X	R
Single ground	-	X	R	-	X	R

Alm: Alarm. Trbl: Trouble. ARC: Alarm receipt capability during abnormal condition. R: Required capability. X: Indication required at protected premises and as required by Chapter 26 of *NFPA 72*.
[**72:** Table A.12.3(a)]

A.5.4.3.1 The following is reprinted from A.12.3.1 of *NFPA 72* to provide users with an explanation of the new circuit and pathway designations.

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. [**72:** A.12.3.1]

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 of *NFPA 72*. [**72:** A.12.3.1]

A.5.4.3.2 The following is reprinted from A.12.3.2 of *NFPA 72* to provide users with an explanation of the new circuit and pathway designations.

The Class B references for initiating device circuit, signaling 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 of NFPA 72.)* [**72:** A.12.3.2]

A.5.4.3.3 The following is reprinted from A.12.3.3 to provide users with an explanation of the new circuit and pathway designations.

Table A.5.4.3(b) Performance of Signaling Line Circuits (SLCs)

NFPA 72-2007 Class	**B**			**A**			**A**		
Style	**4**			**6**			**7**		
NFPA 72-2010 Class	**B**			**A**			**X**		
	Alarm	**Trouble**	**ARC**	**Alarm**	**Trouble**	**ARC**	**Alarm**	**Trouble**	**ARC**
Abnormal Condition	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Single open	-	X	-	-	X	R	-	X	R
Single ground	-	X	R	-	X	R	-	X	R
Wire-to-wire short	-	X	-	-	X	-	-	X	R
Wire-to-wire short & open	-	X	-	-	X		-	X	-
Wire-to-wire short & ground	-	X	-	-	X	-	-	X	-
Open and ground	-	X	-	-	X	R	-	X	R
Loss of carrier (if used)/ channel interface	-	X	-	-	X	-	-	X	-

ARC: Alarm receipt capability during abnormal condition. R: Required capability. X: Indication required at protected premises and as required by Chapter 26 of *NFPA 72*.
[**72:** Table A.12.3(b)]

Table A.5.4.3(c) Notification Appliance Circuits (NACs)

NFPA 72-2007 Class	**B**		**A**	
NFPA 72-2010 Class	**B**		**A**	
	Trouble Indications at Protective Premise	**Alarm Capability During Abnormal Condition**	**Trouble Indications at Protective Premise**	**Alarm Capability During Abnormal Condition**
Abnormal Condition	1	2	3	4
Single open	X	-	X	R
Single ground	X	R	X	R
Wire-to-wire short	X	-	X	-

X: Indication required at protected premises and as required by Chapter 26 of *NFPA 72. R: Required capability.*
[**72:** Table A.12.3(c)]

The Class C reference is new and is intended to describe technologies that supervise the communicator pathway by polling or continuous communication "handshaking" such as the following:

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

Individual pathway segments are not required to be monitored. Supervision is accomplished by end to end communications. [**72:** A.12.3.3]

A.5.4.3.4 The following is reprinted from A.12.3.4 of *NFPA 72* to provide users with an explanation of the new circuit and pathway designations.

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

[**72:** A.12.3.4]

A.5.4.3.5 The following is reprinted from A.12.3.5 of *NFPA 72* to provide users with an explanation of the new circuit and pathway designations.

The Class E reference is new and is intended to describe pathways that do not require supervision as described in Section 12.6 of *NFPA 72*. [**72:** A.12.3.5]

A.5.4.3.6 The following is reprinted from A.12.3.6 of *NFPA 72* to provide users with an explanation of the new circuit and pathway designations.

The Class X reference is new and is intended to describe pathways as described as Class A Style 7 of the signaling line circuit performance of Table A.5.4.3(b). *(Also see A.5.4.3.)* [**72:** A.12.3.6]

A.5.4.4.2 A goal of 5.4.4.2 is to provide adequate separation between the outgoing and return cables. This separation is required to help ensure protection of the cables from physical damage. The recommended minimum separation to prevent physical damage is 12 in. (300 mm) where the cable is installed vertically and 48 in. (1.22 m) where the cable is installed horizontally. [**72:** A.12.3.7]

A.5.8.1 Actuation of an initiating device is usually the instant at which a complete digital signal is achieved at the device, such as a contact closure. Some initiating devices involve signal processing and analysis by the device or by the control unit software. In these cases, actuation means the instant when the signal analysis requirements are completed by the device or control unit software.

It is not the intent of 5.8.1 to dictate the time frame for the local safety devices to complete their function.

A.5.8.2 This standard addresses field installations that interconnect two or more listed control units, possibly from different manufacturers, that together fulfill the requirements of this standard. [**72:** A.23.8.2]

Such an arrangement should preserve the reliability, adequacy, and integrity of all alarm, supervisory, and trouble signals and interconnecting circuits intended to be in accordance with the provisions of this standard. [**72:** A.23.8.2]

Where interconnected control units are in separate buildings, consideration should be given to protecting the interconnecting wiring from electrical and radio frequency interference. [**72:** A.23.8.2]

A.5.8.4.1 The provisions of 5.8.4.1 apply to types of equipment used in common with carbon monoxide detection systems, such as burglar alarm or coded paging systems, and to methods of circuit wiring common to both types of systems.

A.5.8.4.6 A combination carbon monoxide detection system, defined in 3.3.25.2, excludes fire alarm and mass notification systems. Priority requirements for fire alarm and mass notification systems, including combination fire alarm systems that incorporate carbon monoxide detection, are established in *NFPA 72, National Fire Alarm and Signaling Code*.

A.5.8.5.1.4 The monitoring of circuit integrity relies on the interruption of the wiring continuity when the connection to the initiating device is lost. Terminals and leads, as illustrated in Figure A.5.8.5.1.4(a) and Figure A.5.8.5.1.4(b), monitor the presence of the device on the initiating device circuit. [**72:** A.17.4.6]

A.5.8.5.2.2 Where power is supplied separately to the individual initiating device(s), multiple initiating circuits are not prohibited from being monitored for integrity by a single power supervision device. [**72:** A.23.8.5.3.2]

A.5.8.5.3.1(1) Detectors are located on the ceiling above permanently installed fuel-burning appliances because of the

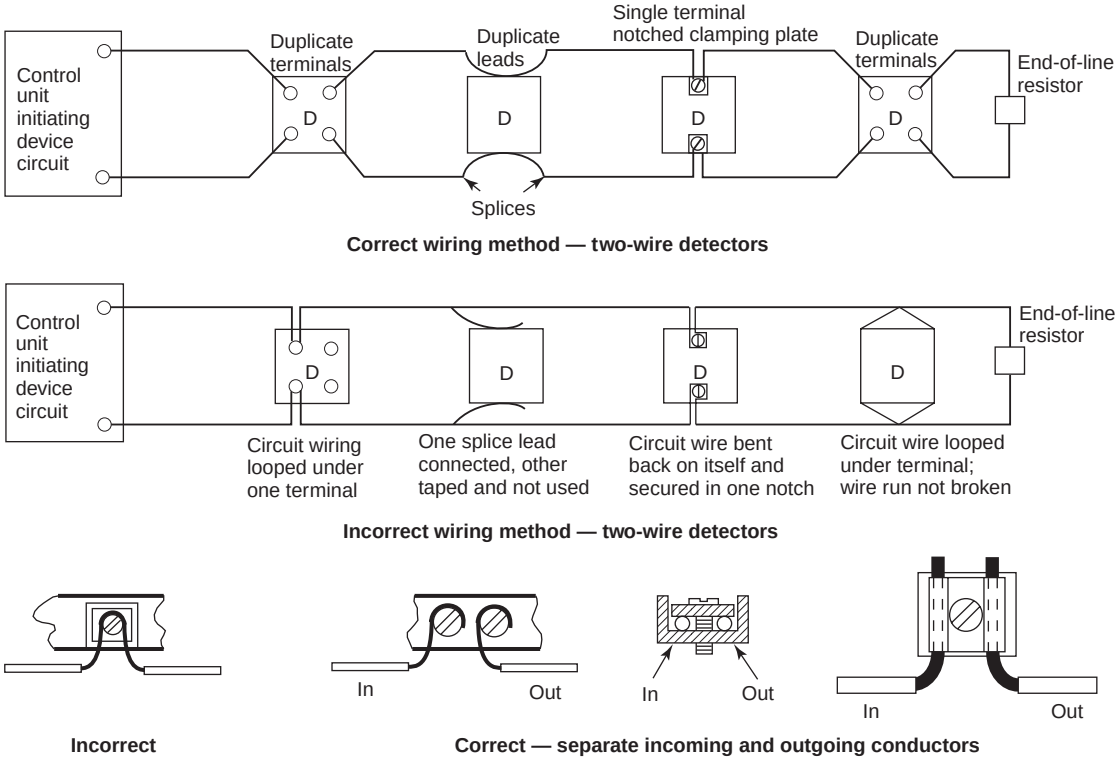
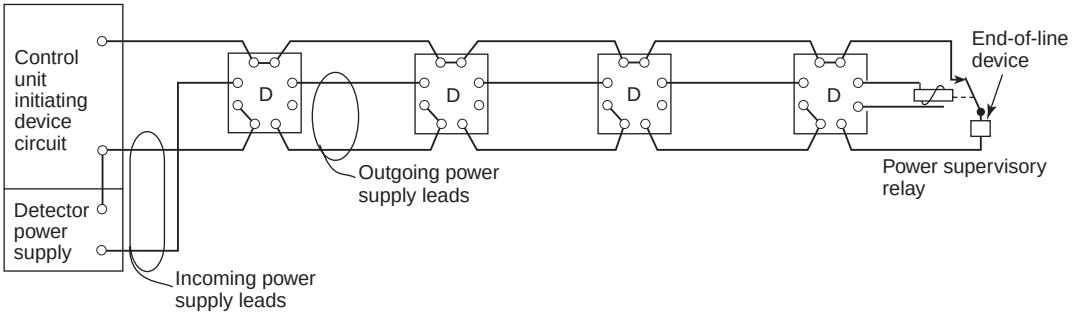
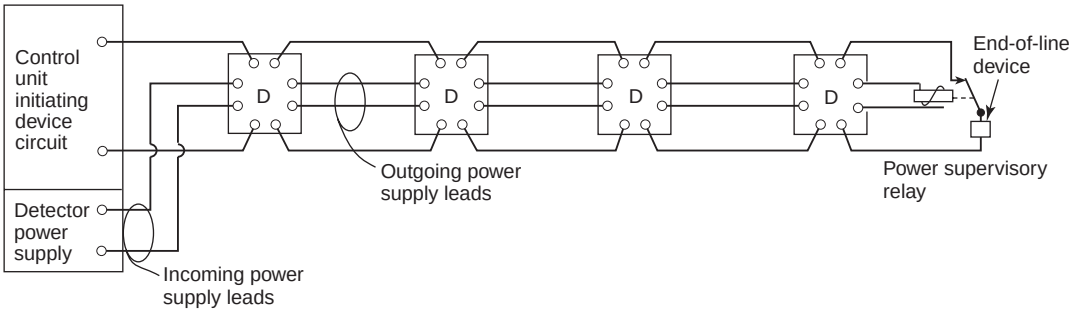


FIGURE A.5.8.5.1.4(a) Correct (and Incorrect) Wiring Methods. [72:Figure A.17.4.6(a)]



Illustrates four-wire [ ] employing a three-wire connecting arrangement. One side of power supply is connected to one side of initiating device circuit. Wire run broken at each connection to [ ] detector to provide supervision.



Illustrates four-wire [ ] detector employing a four-wire connecting arrangement. Incoming and outgoing leads or terminals for both initiating device and power supply connections. Wire run broken at each connection to provide supervision.

D = Detector

FIGURE A.5.8.5.1.4(b) Wiring Arrangements for Four-Wire Detectors. [72:Figure A.17.4.6(b)]

buoyancy of the heated combustion gases as compared to normal ambient temperatures. Detectors should be located as close as practical to the permanently installed fuel-burning appliance consistent with considerations of detector accessibility, sources of detector contamination, and nuisance sources. Siting considerations can include transient backdrafting spillage of flue gases during startup and ventilation supply or exhaust vents.

A.5.8.5.3.1(2) The purpose of detectors centrally located on every habitable level is to detect the migration of carbon monoxide from permanently installed fuel-burning appliances and other sources of carbon monoxide. Other sources of carbon monoxide can include vehicles or other equipment that uses an internal combustion engine, barbecue grills, propane-operated equipment, and systems used to generate hydrogen. Detector location and spacing should be based on an engineering evaluation that considers potential sources and migration of carbon monoxide. HVAC systems should be considered in the locating of carbon monoxide detectors because the HVAC systems provide a good means of mixing and the migration of carbon monoxide. Other considerations when locating carbon monoxide detectors are areas with closed doors and rated demising walls, which can isolate or separate areas within HVAC zones. Additional information for the location of carbon monoxide detectors is available in the Fire Protection Research Foundation (FPRF) technical report, "Development of a Technical Basis for Carbon Monoxide Detector Siting."

A.5.8.6.3.2 The building's emergency response plan might specify occupant notification only in the area(s) of initiation and at the control panel. Whole building evacuation might not be specified in the emergency response plan.

A.5.8.6.5.1 The four-pulse temporal pattern is illustrated in Figure A.5.8.6.5.1.

A.5.8.6.5.2 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.

A.5.9.2 Embossed plastic tape, pencil, ink, or crayon should not be considered to be a permanently attached placard. [**72:** A.17.4.8]

A.5.11.2 [Carbon monoxide] control function interface devices can be located far from the device to be activated, such as air-handling units and exhaust fans located on the roof. The requirement for monitoring installation wiring for integrity only applies to the wiring between the [carbon monoxide] control unit and the [carbon monoxide] control function interface device. For example, it does not apply to the wiring between the [carbon monoxide] control function interface device and a motor stop/start control relay, or between the [carbon monoxide] control function interface device and the equipment to be controlled (e.g., air-handling units and exhaust fans). The location of the [carbon monoxide] control function interface device within 3 ft (0.9 m) applies to the point of interface and not to remotely located equipment. [**72:** A.21.2.4]

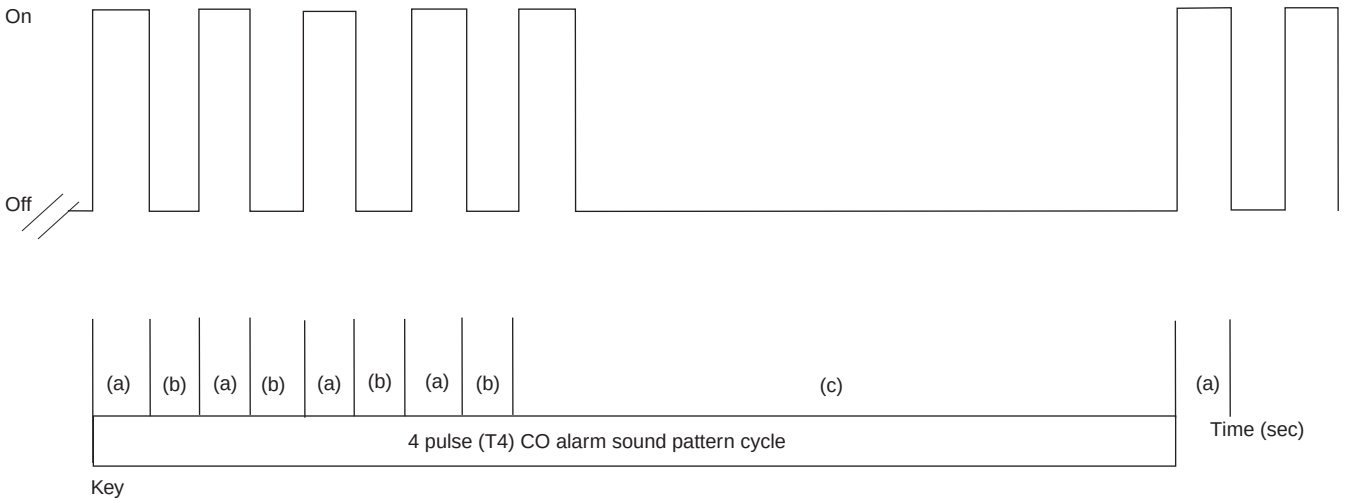


FIGURE A.5.8.6.5.1 Four-Pulse Temporal Pattern.

A.5.12 The term *wireless* has been replaced with the term *low-power radio* to eliminate potential confusion with other transmission media such as optical fiber cables. [**72:** A.23.16]

Low-power radio devices are required to comply with the applicable *low-power* requirements of Title 47, Code of Federal Regulations, Part 15. [**72:** A.23.16]

A.5.12.1 Equipment listed solely for dwelling unit use would not comply with this requirement. [**72:** A.23.16.1]

A.5.12.3.1 This requirement is not intended to preclude verification and local test intervals prior to [carbon monoxide] alarm transmission. [**72:** A.23.16.3.1]

A.6.1 Notification appliances should be sufficient in quantity, audibility, intelligibility, and visibility so as to reliably convey the intended information to the intended personnel during an emergency. [**72:** A.18.1]

Notification appliances in conventional commercial and industrial applications should be installed in accordance with the specific requirements of Section 6.4 and Section 6.5. [**72:** A.18.1]

The standard recognizes that it is not possible to identify specific criteria sufficient to ensure effective occupant notification in every conceivable application. If the specific criteria of Section 6.4 and Section 6.5 are determined to be inadequate or inappropriate to provide the performance recommended, approved alternative approaches or methods are permitted to be used. [**72:** A.18.1]

A.6.1.5 Chapter 6 establishes the means, methods, and performance requirements of notification appliances and systems. Chapter 6 does not require the installation of notification appliances or identify where notification signaling is required. Authorities having jurisdiction, other codes, other standards, and chapters of this standard require notification signaling and might specify areas or intended audiences. [**72:** A.18.1.5]

For example, Chapter 4 requires audible and visible trouble signals at specific locations. A building or fire code might require audible and visible occupant notification throughout all occupiable areas. In contrast, a building or fire code might require complete coverage with audible signaling, but might only require specific areas or spaces to have visible signaling. It is also possible that a referring code or standard might require compliance with mounting and notification appliance performance requirements without requiring complete notification signaling system performance. An example might be where an appliance is specifically located to provide information or notification to a person at a specific desk within a larger room. [**72:** A.18.1.5]

A.6.3.3.2 The intent is to prohibit labeling that could give an incorrect message. Wording such as "Emergency" would be acceptable for labeling because it is generic enough not to cause confusion. Fire alarm systems are often used as emergency notification systems, and therefore attention should be given to this detail. [**72:** A.18.3.3.2]

Combination audible and visible units may have several visible appliances, each labeled differently or not labeled at all. [**72:** A.18.3.3.2]

A.6.3.4 Situations exist where supplemental enclosures are necessary to protect the physical integrity of a notification appliance. Protective enclosures should not interfere with the performance characteristics of the appliance. If the enclosure degrades the performance, methods should be detailed in the manufacturer's published instructions of the enclosure that clearly identify the degradation. For example, where the appliance signal is attenuated, it might be necessary to adjust the appliance spacings or appliance output. [**72:** A.18.3.4]

A.6.3.6 For hardwired appliances, terminals or leads, as described in 6.3.6, are necessary to ensure that the wire run is broken and that the individual connections are made to the leads or other terminals for signaling and power. [**72:** A.18.3.6]

A common terminal can be used for connection of incoming and outgoing wires. However, the design and construction of the terminal should not permit an uninsulated section of a single conductor to be looped around the terminal and to

serve as two separate connections. For example, a notched clamping plate under a single securing screw is acceptable only if separate conductors of a notification circuit are intended to be inserted in each notch. *[See Figure A.5.8.5.1.4(a).]* [**72:** A.18.3.6]

Another means to monitor the integrity of a connection is to establish communication between the appliance and the [carbon monoxide detection] control unit. The integrity of the connection is verified by the presence of communication. Monitoring integrity in this fashion might not require multiple terminals or leads as previously described. [**72:** A.18.3.6]

It should be noted that monitoring the integrity of the installation conductors and their connection to an appliance does not guarantee the integrity of the appliance or that it is operational. Appliances can be damaged and become inoperable or a circuit can be overloaded, resulting in failure when the appliances are called upon to work. Presently, only testing can establish the integrity of an appliance. [**72:** A.18.3.6]

A.6.4.1.3 In determining maximum ambient sound levels, sound sources that should be considered include air-handling equipment and background music in a typical office environment, office cleaning equipment (vacuum cleaner), noisy children in a school auditorium, car engines in an auto shop, conveyor belts in a warehouse, and a running shower and fan in a hotel bathroom. Temporary or abnormal sound sources that can be excluded would include internal or external construction activities (i.e., office rearrangements and construction equipment). [**72:** A.18.4.1.3]

A.6.4.1.4.1 Audibility of a [ ] signal might not be required in all rooms and spaces. For example, a system that is used for general occupant notification should not require audibility of the signal in closets and other spaces that are not considered as occupiable spaces. However, a space of the same size used as a file room would be considered occupiable and should have coverage by notification appliances.

Also, signaling intended only for staff or emergency forces might only have to be effective in very specific locations. [**72:** A.18.4.1.4.1]

A.6.4.1.4.2 See 3.3.18 for the definition of occupiable. [**72:** A.18.4.1.4.2]

A.6.4.2 The typical average ambient sound level for the occupancies specified in Table A.6.4.2 are intended only for design guidance purposes. The typical average ambient sound levels specified should not be used in lieu of actual sound level measurements. [**72:** A.18.4.3]

A.6.4.3.2 For example, in critical care patient areas, it is often desirable to not have an audible [carbon monoxide] alarm even at reduced private mode levels. Each case requires consideration by the governing authority. Another example would be high noise work areas where an audible signal needed to overcome background noise at one time of day would be excessively loud and potentially dangerous at another time of lower ambient noise. A sudden increase of more than 30 dB over 0.5 seconds is considered to cause sudden and potentially dangerous fright. [**72:** A.18.4.4.2]

A.6.4.4.3 The intent of this section is to require the use of the low frequency signal in areas intended for sleeping and in areas that might reasonably be used for sleeping. For example, this section requires a low-frequency audible signal in a bedroom of an apartment and also in the living room area of an apartment as it might have sleeping occupants. However, it would not be required to use the low-frequency signal in the hallways, lobby, and other tenantless spaces. In hotels, the guest rooms would require use of the low-frequency signals, but other spaces that might require audible signals could use any listed audible signal appliances regardless of the frequency content of the signal being produced. This chapter of the standard addresses notification appliances connected to and controlled by a [ ] system. This chapter does not address dwelling unit protection such as [CO] alarms and their audible characteristics. Requirements for single- and multiple-station alarms and household [CO] alarm systems can be found in Chapter 9. [**72:** 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. [**72:** A.18.4.5.3]

Non-voice (e.g., horns) notification appliances should be listed as a "low-frequency alarm" alarm appliance. Voice appliances and systems should be capable of 520 Hz ± 10 percent with the appropriate harmonics. [**72:** A.18.4.5.3]

For increased protection in the sleeping area, tactile notification in accordance with Section 6.10 might be an effective means of awakening those who have normal hearing, as well as those who are hearing impaired. [**72:** A.18.4.5.3]

A.6.4.5 This subsection permits a more rigorous analysis and design for audible signaling. Acoustic design practice and psychoacoustic research have long recognized that for a signal to be audible, it need only penetrate the background noise in a one-third or a one-octave band. The averaging resulting from A-weighted analysis and design is a simplification that often results in systems being overdesigned. This overdesign is not

Table A.6.4.2 Average Ambient Sound Level According to Location

Location	Average Ambient Sound Level (dBA)
Business occupancies	55
Educational occupancies	45
Industrial occupancies	80
Institutional occupancies	50
Mercantile occupancies	40
Mechanical rooms	85
Piers and water-surrounded structures	40
Places of assembly	55
Residential occupancies	35
Storage occupancies	30
Thoroughfares, high-density urban	70
Thoroughfares, medium-density urban	55
Thoroughfares, rural and suburban	40
Tower occupancies	35
Underground structures and windowless buildings	40
Vehicles and vessels	50

[**72:** Table A.18.4.3]

dangerous but can be costly and is certainly not needed for effective system performance. [**72:** A.18.4.6]

A.6.4.5.2 Noise at a lower frequency can mask a signal at an adjacent higher frequency. Thus, it is necessary to calculate the effective masked level of the noise in accordance with established procedures. Figure A.6.4.5.2 shows an example of an octave band analysis of noise along with the calculated effective masked threshold and the proposed alarm signal. [**72:** A.18.4.6.2]

A.6.4.8 See Annex D, Speech Intelligibility, of *NFPA 72*. [**72:** A.18.4.10]

A.6.4.8.1 See the definition of acoustically distinguishable space in 3.3.6 of *NFPA 72*. [**72:** A.18.4.10.1]

A.6.4.8.2.1 For example, based on the system design, the following locations might not require intelligibility. See also Annex D of *NFPA 72*.

(1) Private bathrooms, shower rooms, saunas, and similar rooms/areas
(2) Mechanical, electrical, elevator equipment rooms, and similar rooms/areas
(3) Elevator cars
(4) Individual offices
(5) Kitchens
(6) Storage rooms
(7) Closets
(8) Rooms/areas where intelligibility cannot reasonably be predicted

[**72:** A.18.4.10.2.1]

A.6.4.8.3 ADS assignments should be a part of the original design process. See the discussion in A.3.3.2 of *NFPA 72*. The design drawings should be used to plan and show the limits of each ADS where there is more than one. [**72:** A.18.4.10.3]

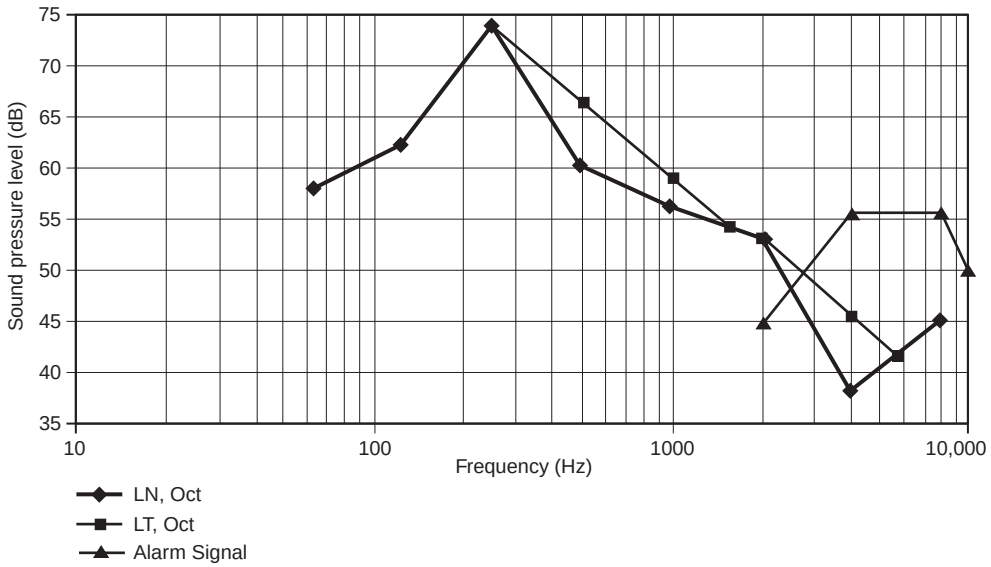
All areas that are intended to have audible occupant notification, whether by tone only or by voice, should be designated as one or more ADSs. Drawings or a table listing all ADSs should be used to indicate which ADSs will require intelligible voice communications and those that will not. The same drawings 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. [**72:** A.18.4.10.3]

A.6.5 The mounting height of the appliances affects the distribution pattern and level of illumination produced by an appliance on adjacent surfaces. It is this pattern, or effect, that provides occupant notification by visible appliances. If mounted too high, the pattern is larger but at a lower level of illumination (measured in lumens per square foot or footcandles). If mounted too low, the illumination is greater (brighter) but the pattern is smaller and might not overlap correctly with that of adjacent appliances. [**72:** A.18.5]

A qualified designer could choose to present calculations to an authority having jurisdiction showing that it is possible to use a mounting height greater than 96 in. (2.44 m) or less than 80 in. (2.03 m), provided that an equivalent level of illumination is achieved on the adjacent surfaces. This can be accomplished by using listed higher intensity appliances or closer spacing, or both. [**72:** A.18.5]

Engineering calculations should be prepared by qualified persons and should be submitted to the authority having jurisdiction, showing how the proposed variation achieves the same or greater level of illumination provided by the prescriptive requirements of Section 6.5. [**72:** A.18.5]

The calculations require knowledge of calculation methods for high-intensity strobes. In addition, the calculations require knowledge of the test standards used to evaluate and list the appliance. [**72:** A.18.5]



At the first octave band center frequency, the masked threshold of hearing, LT, Oct is equal to the noise level. For each subsequent center frequency, LT, Oct is the greater of either the noise level at that octave band, LN, Oct, or the masked threshold of the previous band less 7.5 dB.

FIGURE A.6.4.5.2 Threshold Masking Level Example. [72: Figure A.18.4.6.2]

A.6.5.1 There are two methods of visible signaling. These are methods in which notification of an emergency condition is conveyed by direct viewing of the illuminating appliance or by means of illumination of the surrounding area. [**72:** A.18.5.1]

Visible notification appliances used in the public mode must be located and must be of a type, size, intensity, and number so that the operating effect of the appliance is seen by the intended viewers regardless of the viewer's orientation. [**72:** A.18.5.1]

A.6.5.1.2 Visible appliances for [ ] emergency signaling might not be required in all rooms or spaces. For example, a system that is used for general occupant notification should not require visible signaling in closets and other spaces that are not considered as occupiable areas. However, a space of the same size used as a file room could be considered occupiable and should have coverage by notification appliances. Also, signaling intended only for staff or emergency forces might only have to be effective in very specific locations. [**72:** A.18.5.1.2]

A.6.5.2.2 Occupant notification by visible signaling is not required by NFPA 720 except in high noise areas *(see 6.4.1.1)*. Just as with audible occupant notification, the requirement to have such signaling originates from other governing laws, codes, or standards. Those other governing laws, codes, or standards specify the areas or spaces that require either audible, visible, or both types of occupant notification. NFPA 720 then provides the standards for those systems. [**72:** A.18.5.2.2]

A.6.5.5.3 Visible appliances must be listed for either wall mounting or ceiling mounting. The effectiveness of ceiling-mounted appliances does not depend on them being mounted on a surface. Therefore, the standard permits them to be suspended below the ceiling using proper electrical installation methods. Appliances mounted parallel to the floor, whether on a ceiling or suspended, can sometimes significantly reduce installation costs and provide better coverage. In convention spaces and areas with racking and shelving, wall-mounted appliances are frequently obstructed or subjected to mechanical damage. Ceiling mounting (or suspending) the appliances can prevent problems and increases the ability for the appliance to cover the floor area through direct and indirect signaling. [**72:**18.5.5.3]

A.6.5.5.4 The strobe intensities listed in Table 6.5.5.4.1(a) or Table 6.5.5.4.1(b), 6.5.5.5, Table 6.5.5.7.2 or determined in accordance with the performance requirements of 6.5.5.6 6.5.5.6 are the minimum required intensities. It is acceptable to use a higher intensity strobe in lieu of the minimum required intensity. [**72:** A.18.5.5.4.]

Areas large enough to exceed the rectangular dimensions given in Figure A.6.5.5.4(a) through Figure A.6.5.5.4(c) require additional appliances. Often, proper placement of appliances can be facilitated by breaking down the area into multiple squares and dimensions that fit most appropriately *[see Figure A.6.5.5.4(a) through Figure A.6.5.5.4(d)]*. An area that is 40 ft (12.2 m) wide and 80 ft (24.4 m) long can be covered with two 60 cd appliances. Irregular areas and areas with dividers or partitions need more careful planning to make certain that at least one 15 cd appliance is installed for each 20 ft × 20 ft (6.1 m × 6.1 m) area and that light from the appliance is not blocked. [**72:** A.18.5.5.4]

A.6.5.5.4.6 This subsection is also intended to permit ceiling-mounted strobes to be suspended below the ceiling, provided the strobe height is not below the viewing plane for any ceiling height. [**72:** A.18.5.5.4.6]

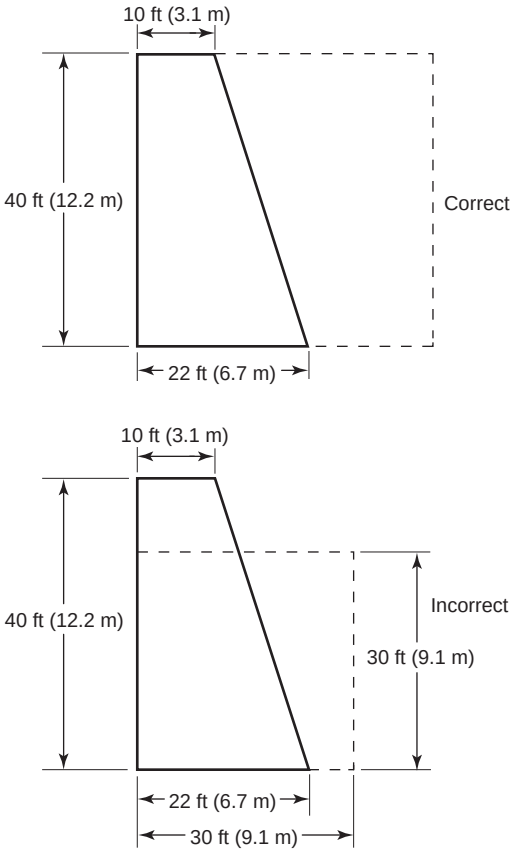
A.6.5.5.5 Because the occupants are usually alert and moving, and because their vision is focused by the narrowness of the space, corridor signaling is permitted to be by direct viewing of lower-intensity (15 cd) appliances. That is, the alerting is intended to be done by direct viewing of the strobe, not necessarily by its reflection off of surfaces (indirect viewing) as required for rooms in 6.5.5.4. [**72:** A.18.5.5.5]

Note that it is acceptable to use 6.5.5.4 (Spacing in Rooms) to determine the number and location of strobes in corridors. If 6.5.5.4 is used, it is not necessary to have a corridor strobe within 15 ft (4.5 m) of the end of the corridor. [**72:** A.18.5.5.5]

See Figure A.6.5.5.5 for corridor spacing for visible appliances. [**72:** A.18.5.5.5]

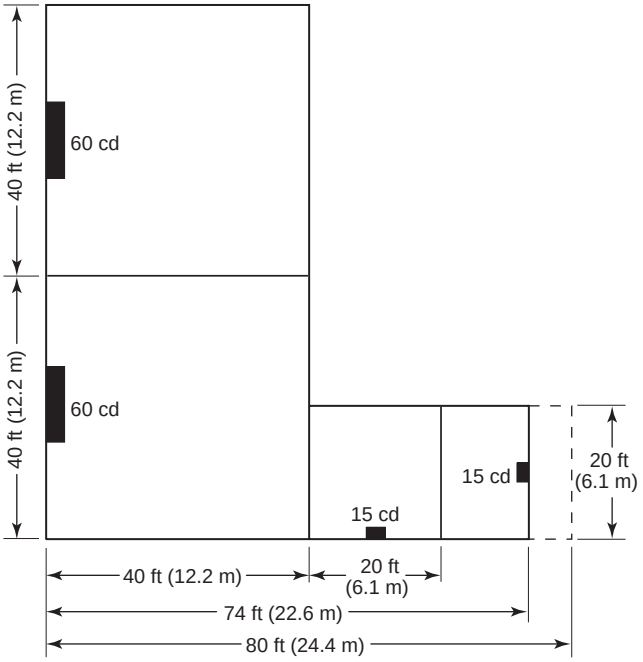
A.6.5.5.5.5 Visible appliances in corridors are permitted to be mounted on walls or on ceilings in accordance with 6.5.5.5. Where there are more than two appliances in a field of view, they need to be synchronized. [**72:** A.18.5.5.5]

Note that it is acceptable to use 6.5.5.4 (Spacing in Rooms) to determine the number and location of strobes in corridors. If 6.5.5.4 is used, it is not necessary to have a corridor strobe within 15 ft (4.5 m) of the end of the corridor. It is not the intent of this section to require strobes at or near every exit or exit access from a corridor. [**72:** A.18.5.5.5.5]



Note: Broken lines represent imaginary walls.

FIGURE A.6.5.5.4(a) Irregular Area Spacing. [72:Figure A.18.5.5.4(a)]



Note: Broken lines represent imaginary walls.

FIGURE A.6.5.5.4(b) Spacing of Wall-Mounted Visible Appliances in Rooms. [72:Figure A.18.5.5.4(b)]

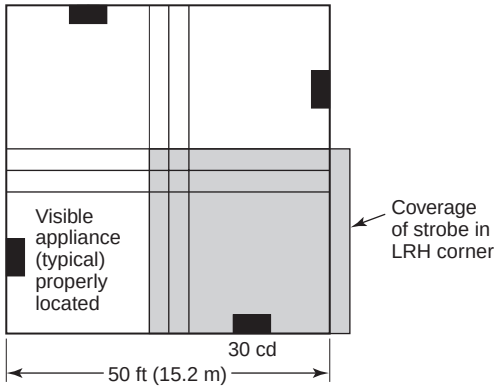


FIGURE A.6.5.5.4(c) Room Spacing Allocation — Correct. [72:Figure A.18.5.5.4(c)]

A.6.6 Though the number of visible notification appliances might be reduced in private operating mode settings, visible notification appliances might still need to be considered in spaces occupied by the public or the hearing impaired or subject to other laws or codes. [**72:** A.18.6]

A.6.8.2 The tone signal is used to evaluate the sound pressure level produced by speaker appliances because of the fluctuating sound pressure level of voice or recorded messages. [**72:** A.18.8.1.2]

A.6.9 Textual and graphical visible appliances are selected and installed to provide temporary text, permanent text, or symbols. Textual and graphical visible appliances are most commonly used in the private mode for [carbon monoxide detection] systems. The use of microprocessors with computer monitors and printers has resulted in the ability to provide detailed information in the form of text and graphics to persons charged with directing emergency response and evacuation. Textual visible appliances are also used in the public mode to communicate emergency response and evacuation information directly to the occupants or inhabitants of the area protected by the system. For both private mode and public mode signaling, text and graphic annunciators can provide information about pre-alarm, alarm, trouble, and supervisory conditions. Because textual and graphical visible appliances do not necessarily have the ability to alert, they should only be used to supplement audible or visible notification appliances. [**72:** A.18.9]

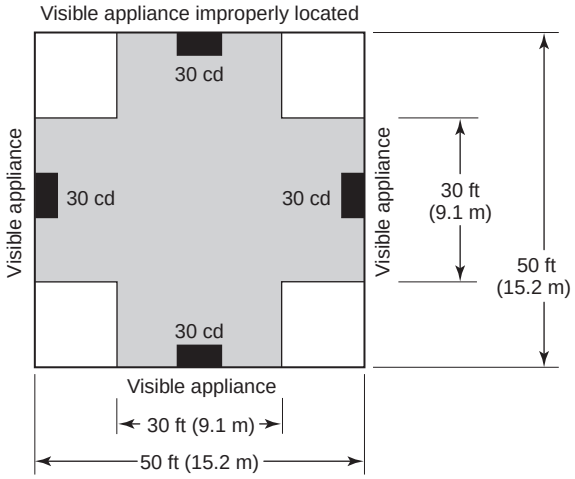


FIGURE A.6.5.5.4(d) Room Spacing Allocation — Incorrect. [72:Figure A.18.5.5.4(d)]

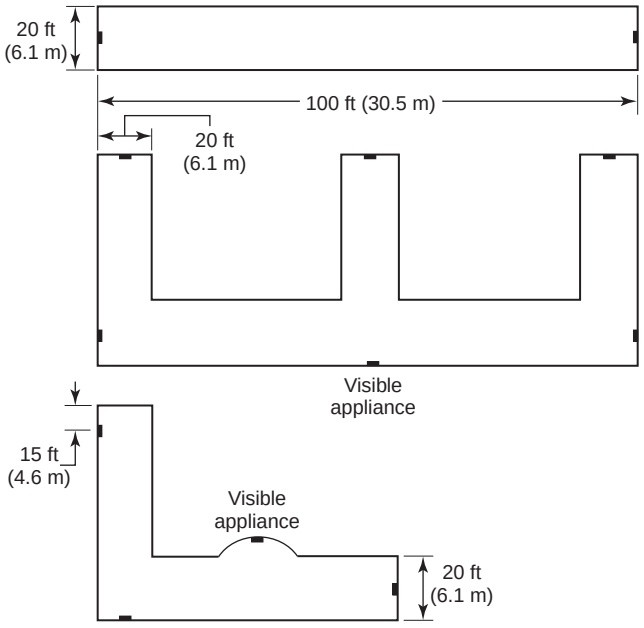


FIGURE A.6.5.5.5 Corridor Spacing for Visible Appliances. [72:Figure A.18.5.5.5]

Textual and graphical visible information should be of a size and visual quality that is easily read. Many factors influence the readability of textual visible appliances, including the following:

(1) Size and color of the text or graphic
(2) Distance from the point of observation
(3) Observation time
(4) Contrast
(5) Background luminance
(6) Lighting
(7) Stray lighting (glare)
(8) Shadows
(9) Physiological factors

While many of these factors can be influenced by the equipment manufacturer and by the building designers, there is no readily available method to measure legibility. [**72:** A.18.9]

A.6.9.4 Parts of this section on text characteristics are based on Section 703.5 of the updated accessibility guidelines in the U.S. Access Board's ADA-ABA-AG, released in 2004. [**72:** A.18.9.4]

A.6.9.4.2 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. Stroke width-to-height ratios are an important part of character legibility and are affected by contrast. Ratios for light characters on a dark background and dark characters on a light background differ because light characters or symbols tend to spread or bleed into the adjacent dark background. To accommodate these differences, recommendations for symbol stroke width-to-character height ratio are as follows:

(1) Positive image — Dark characters on a light background, ratio of 1:6 to 1:8
(2) Negative image — Light characters on a dark background, ratio 1:8 to 1:10

Source: Federal Aviation Administration (FAA) Human Factors Awareness Course available at https://www.hf.faa.gov/webtraining/Intro/Intro1.htm. [**72:** A.18.9.4.2]

A.6.9.4.4 The use of all uppercase characters in messages should be avoided as it decreases legibility. The exception is one- or two-word commands or statements such as stop, go, or exit stair. [**72:** A.18.9.4.4]

A.6.9.4.7 Paragraph 6.9.4.7 and the associated table does not apply to text and graphics displayed on desktop monitors. The standard does not list any specific sizing requirements for desktop monitors. However, 6.9.3 does require them to be clear and legible at the intended viewing distance. Other requirements in 6.9.4 such as contrast, san serif fonts, and so forth should still apply to desktop displays. The specific requirements of Table 6.9.4.7 are taken directly from Section 703.5 of the updated accessibility guidelines in the U.S. Access Board's ADA-ABA-AG, released in 2004. The table has been reformatted to be consistent with other parts of NFPA 720. [**72:** A.18.9.4.7]

A.6.9.4.8 The minimum height for textual and graphical visible appliances is given as 40 in. (1.02 m) above the ground of finished floor. However, the character or symbol sizes should be based on the height of the highest character or symbol displayed by the appliance. [**72:** A.18.9.4.8]

A.6.10.2 Notification appliances are available for the deaf and hard of hearing. These appliances include, but are not limited to, supplemental tactical notification appliances. Such tactile notification appliances may be capable of awakening people. Tactile appliances can initiate in response to the activation of an audible [carbon monoxide] alarm, through hard wiring into the [carbon monoxide detection] system or by wireless methods. [**72:** A.18.10.2]

Some tests show that strobes might not be effective in awakening some sleeping individuals during an emergency. Some tactile devices may be more effective in awakening individuals, regardless of hearing levels, from sleep. [**72:** A.18.10.2]

A.6.11 *Standard Emergency Service Interface.* Annunciators, information display systems, and controls for portions of a system provided for use by emergency service personnel should be designed, arranged, and located in accordance with the needs of the organizations intended to use the equipment. [**72:** A.18.11]

Where annunciators, information display systems, and controls for portions of the system are provided for use by emergency service personnel, these should have a common design and operation to avoid confusion of users. [**72:** A.18.11]

A.7.2 Refer to 8.6.4.11 in *NFPA 72, National Fire Alarm and Signaling Code*, which addresses signal priority for other transmission technologies.

A.7.2.1.2.2 If a carbon monoxide detector cannot be reset in accordance with Chapter 8, that could indicate that carbon monoxide is still present in the premises. Until such time that carbon monoxide can be excluded as the source of the alarm, the assumption should be that carbon monoxide is present and appropriate life safety precautions should be followed.

A.7.2.2 The supervising station should have a notification plan on file, the manufacturer's published instructions, and multiple points of contact with the subscriber when the account is added to their system. Once contacted, supervising station personnel should inform the subscriber to take action in accordance with the manufacturer's published instructions.

A.7.2.3 The communications center should have a notification plan on file, the manufacturer's published instructions, and multiple points of contact for the subscriber when the account is added to their system. Once contacted, the communications center should inform the subscriber of the action to take.

A.8.2.1.5 Service personnel should be able to do the following:

(1) Understand the requirements contained [in this standard] in *NFPA 72, National Fire Alarm and Signaling Code*, and the [relevant] requirements contained in *NFPA 70, National Electrical Code*
(2) Understand basic job site safety laws and requirements
(3) Apply troubleshooting techniques, and determine the cause of [carbon monoxide detection] system trouble conditions
(4) Understand equipment specific requirements, such as programming, application, and compatibility
(5) Read and interpret [carbon monoxide detection] system design documentation and manufacturer's inspection, testing, and maintenance guidelines

(6) Properly use tools and test equipment required for testing and maintenance of [carbon monoxide detection] systems and their components
(7) Properly apply the test methods required by this standard

[**72:** A.14.2.3.6]

A.8.2.2 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. [**72:** A.14.2.4]

A.8.3.1 Equipment performance can be affected by building modifications, occupancy changes, changes in environmental conditions, device location, physical obstructions, device orientation, physical damage, improper installation, degree of cleanliness, or other obvious problems that might not be indicated through electrical supervision. [**72:** A.14.3.1]

The intent of 8.3.1 is to prevent an inspection being made at intervals exceeding those allowed by Table 8.3.1. Annual inspections should be made every 12 months; monthly inspections should be made every 30 days, and so forth. For example, it is not acceptable to conduct an annual inspection in January of year one, and December of year two (23 month frequency) just because Table 8.3.1 requires an inspection once each year. [**72:** A.14.3.1]

A.8.4.2 Reacceptance testing is performed to verify the proper operation of added or replaced devices, appliances, [carbon monoxide safety] 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. [**72:** A.14.4.2]

For example, if a 2 amp fuse is replaced with another 2 amp fuse in the [carbon monoxide detection] 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 [carbon monoxide] detector is replaced with a like [carbon monoxide] detector. [**72:** A.14.4.2]

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. [**72:** A.14.4.2]

A.8.4.4 It is suggested that the annual test be conducted in segments so that all devices are tested annually. [**72:** A.14.4.4]

The intent of 8.4.4 is to prevent a test from being made at intervals exceeding those allowed by Table 8.4.3. Annual tests should be made every 12 months; monthly tests should be made every 30 days, and so forth. For example, it is not acceptable to conduct an annual test in January of year one, and December of year two (23-month frequency), just because Table 8.4.3 requires a test once each year. See the definition of *frequency* in 3.3.13 for minimum and maximum time between testing events. [**72:** A.14.4.4]

A.8.4.5.3 Examples of indication at the detector or the control unit include, but are not limited to, an LED indication or analog output or display.

A.9.3.3 This standard establishes minimum standards for the use of [carbon monoxide–] 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 [carbon monoxide] alarms or [carbon monoxide] detectors that are part of a security/[carbon monoxide] system and existing multiple-station alarms). Though a combination is allowed, one type of equipment must independently meet the requirements of the standard. Compliance with the requirements of the standard cannot rely on the combination of the following [carbon monoxide–] warning equipment:

(1) Single-station alarms
(2) Multiple-station alarms
(3) Household [carbon monoxide detection] system (includes a security/[carbon monoxide] system with [carbon monoxide] alarms or [carbon monoxide] detectors)

[**72:** A.29.3.3]

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 [carbon monoxide detection] system is added to a house that has compliant multiple-station alarms, monitored [carbon monoxide] alarms or [carbon monoxide] detectors should be installed to replace the multiple-station alarms or be installed to provide the same required coverage. [**72:** A.29.3.3]

A.9.4.1 Hazardous concentrations of carbon monoxide can accumulate in a residence, generally from improperly operating heating appliances, insufficient make-up air into the residence or space, or blocked chimneys or vents. However, there are many other potential sources of carbon monoxide within a home, including, but not limited to, the following:

(1) Malfunctioning fossil fuel–burning appliances
(2) Wood stoves
(3) Fireplaces
(4) Idling automobiles in attached garages
(5) Portable equipment such as gasoline-powered lawn and garden equipment and electric power generators
(6) Barbecues

Carbon monoxide is odorless, tasteless, and colorless; therefore, its presence is undetectable by smell, taste, or sight. Carbon monoxide can be mixed and migrate throughout a residence through the HVAC system. Carbon monoxide alarms meeting the requirements of ANSI/UL 2034, *Standard for Single and Multiple Station Carbon Monoxide Alarms*, and installed in accordance with this standard should provide a significant level of protection against fatal carbon monoxide exposure.

The installation of additional carbon monoxide alarms could result in a higher degree of protection. Adding alarms to rooms where fuel-burning appliances are located could provide earlier warning of carbon monoxide hazards caused by those sources. Additional alarms located in rooms normally closed off from the required alarms could increase the escape time, since the carbon monoxide concentration needed to force the carbon monoxide out of the closed rooms to the alarms would not be necessary. As a consequence, the installation of additional carbon monoxide alarms should be considered.

Carbon monoxide alarms or detectors are not substitutes for proper maintenance, inspection, and testing of fuel-burning equipment. Fuel-burning equipment and appliances should be used, maintained, tested, and inspected according to the manufacturers' instructions.

Carbon monoxide detectors/alarms are cross sensitive to hydrogen, an explosive gas that can be given off by recharging lead acid batteries. Where households include recharging stations (e.g., for golf carts), the alarm should be located away from the recharging location.

A.9.4.1.1 Where sleeping areas are separated and the audibility of the alarm or detector to occupants within each sleeping area could be seriously impaired, more than one unit could be needed.

At times, depending on conditions, the audibility of notification appliances could be seriously impaired when occupants are in the bedroom area. For instance, there might be a noisy window air conditioner or room humidifier generating an ambient noise level of 55 dBA or higher. The detection device alarms need to penetrate through the closed doors and be heard over the bedroom's noise levels with sufficient intensity to awaken sleeping occupants. Test data indicate that alarms with ratings of 85 dBA at 3 m (10 ft) that are installed outside the bedrooms can produce about 15 dBA over ambient noise levels of 55 dBA in the bedrooms. This sound pressure is likely to be sufficient to awaken the average sleeping person.

Alarms or detectors located remote from the bedroom area might not be loud enough to awaken the average person. In such cases, it is recommended that units be interconnected in such a way that the operation of the remotely located detector or alarm causes an alarm of sufficient intensity to penetrate the bedrooms. The interconnection can be accomplished by the following:

(1) Installation of a system
(2) Wiring together of multiple-station alarms
(3) Use of line carrier or radio frequency transmitters/receivers
(4) Adding supplemental notification appliances

A.9.4.1.2 The location for effective performance is not generally dependent on mounting height. The density of carbon monoxide is similar to that of air at room temperature, and carbon monoxide generally mixes readily with air.

A.9.4.2.2 Since hearing deficits are often not apparent, the responsibility for advising the appropriate person(s) of the existence of this deficit should be that of the hearing-impaired party.

A.9.4.2.2.1.1 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. [**72:** A.29.3.8.1]

A.9.4.2.2.1.1(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. [**72:** A.29.3.8.1(2)]

A.9.4.2.2.1.2 Tactile notification appliances such as bed shakers have been shown to be effective in waking those with normal hearing to 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 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. [**72:** A.29.3.8.2]

The standard 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. [**72:** A.29.3.8.2]

Low-frequency or tactile notification appliances such as bed shakers have been shown to be effective in waking those with normal hearing to profound hearing loss (CSE NIH report, 2005: Bruck and Thomas, 2009; Bruck, Thomas, and Ball, NFPA RF report, 2007).

A.9.4.2.2.1.2(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. [**72:** A.29.3.8.2(1)]

A.9.5.2.5 Restraining means are not intended to be used where the detector or alarm is designated to be plugged directly into a receptacle.

A.9.5.5 When visible signaling is to be provided, consideration should be given to the use of a household carbon monoxide detection system that has sufficient secondary (battery) power to support the proper operation of visible notification appliances.

A.9.6.1.1 ANSI/UL 2034, *Standard for Single and Multiple Station Carbon Monoxide Alarms,* includes a level below which the alarm should not respond.

A.9.6.8.1 A means of providing emergency access to all areas of the premises should be considered.

A.9.6.8.3.4 Refer to 26.3.4 of *NFPA 72, National Fire Alarm and Signaling Code*, for requirements for indication of central station service.

A.9.6.10.1 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:

$$L_p = 10 \log\left[\frac{D_p^4}{h_{TX}^2 h_{RX}^2}\right] \qquad \textbf{[A.9.6.10.1a]}$$

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 [**72:** A.29.7.8.2.1]

The plane earth propagation model is a practical simplification and requires that h_{TX}, $h_{RX} << D_p$. 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. [**72:** A.29.7.8.2.1]

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.9.6.10.1a), and the loss due to the building materials in the propagation path, L_b, as follows:

$$L_T = 10 \log\left[\frac{D_p^4}{(h_{TX}h_{RX})^2}\right] + L_b \qquad \textbf{[A.9.6.10.1b]}$$

If an equivalent open area test distance D_{EOAT} is defined as follows:

$$L_T = 10 \log\left[\frac{D_{EOAT}^4}{(h_{TX}h_{RX})^2}\right] \qquad \textbf{[A.9.6.10.1c]}$$

then D_{EOAT} can be shown to be:

$$D_{EOAT} = 10^{\frac{-L_T}{40}}\sqrt{h_{TX}}\sqrt{h_{RX}} = D_p \cdot 10^{\frac{-L_b}{40}} \qquad \textbf{[A.9.6.10.1d]}$$

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.9.6.10.1d, 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. [**72:** A.29.7.8.2.1]

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 ft^2 (204 m^2) [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 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. [**72:** A.29.7.8.2.1]

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, 1997. 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,

$$L_b = 4 \times L_w + 2 \times L_f$$

The source for the equation in 9.6.10.1 is Stone, W. *Electromagnetic Attenuation in Construction Materials,* National Institute of Standards and Technology, NISTIR 6055, 1997. [**72:** A.29.7.8.2.1]

A.9.6.10.4 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. [**72:** A.29.7.7.2.4]

A.9.7.2.1 Carbon monoxide alarms or detectors could be susceptible to unwanted alarm signals triggered by vapors from petroleum, alcohols, or aerosols. An alarm for such a condition might be anticipated and tolerated by the occupant of a dwelling unit through routine living experience. An alarm would not be acceptable if it also triggered detectors in other dwelling units or resulted in an alarm of detectors located in common-use areas. Unwanted alarms can occur, and inspection authorities should be aware of the ramifications that could result if the coverage is extended beyond the limits of a single dwelling unit.

A.9.9.3(7) Actions that should be considered include opening of windows and doors and evacuation. Also, the information should provide examples of organizations to be contacted for assistance.

Annex B Dangers of Carbon Monoxide

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Carbon Monoxide. Carbon monoxide is an odorless, tasteless, colorless gas produced by incomplete combustion. Solid, liquid, or gaseous fuels can each, under certain conditions, produce lethal concentrations in the home. *(See Table B.1 and Figure B.1.)*

CAUTION: The values in Table B.1 are approximate values for healthy adults. Children, the elderly, and persons with preexisting physical conditions might be more susceptible to the effects of carbon monoxide exposure. Continued exposure after unconsciousness can cause death.

The dangers of carbon monoxide exposure depend on a number of variables, such as the occupant's health, activity level, time of exposure, and initial carboxyhemoglobin (COHb) level. Due to these variables, Table B.1 and Figure B.1 are to be used as general guidelines and might not appear quantitatively consistent.

Table B.1 Symptoms of Carbon Monoxide Exposure Based on Concentration

Concentration (ppm CO)	Symptoms
50	No adverse effects with 8 hours of exposure
200	Mild headache after 2–3 hours of exposure
400	Headache and nausea after 1–2 hours of exposure
800	Headache, nausea, and dizziness after 45 minutes of exposure; collapse and unconsciousness after 2 hours of exposure
1,000	Loss of consciousness after 1 hour of exposure
1,600	Headache, nausea, and dizziness after 20 minutes of exposure
3,200	Headache, nausea, and dizziness after 5–10 minutes of exposure; collapse and unconsciousness after 30 minutes of exposure
6,400	Headache and dizziness after 1–2 minutes of exposure; unconsciousness and danger of death after 10–15 minutes of exposure
12,800 (1.28% by volume)	Immediate physiological effects; unconsciousness and danger of death after 1–3 minutes of exposure

The following equation for determining the estimated percent of COHb in the blood is from "A proposal for evaluating human exposure to carbon monoxide contamination in military vehicles," by Steinberg and Nielson and "Considerations for the physiological variables that determine the blood carboxyhemoglobin concentration in man" by Coburn, Forster, and Kane:

$$\%\mathrm{COHb}_t = \%\mathrm{COHb}_0\left[e^{-(t/2398B)}\right] + 218\left[1 - e^{-(t/2398B)}\right] \times\left(0.0003 + \frac{\text{ppm CO}}{1316}\right) \quad \textbf{[B.1]}$$

where:

$\%\mathrm{COHb}_t$ = percentage of COHb at time t
$\%\mathrm{COHb}_0$ = percentage of COHb in the blood at time 0
t = time (minutes)
B = 0.0404 (work effort)
ppm CO = parts per million carbon monoxide

Annex C Guidelines for Emergency Responders

This annex is not part of the requirements of this NFPA document but is included for informational purposes.

C.1 Guideline Summary. How public emergency response organizations respond to carbon monoxide (CO) incident calls is essential for the safety of the building occupants and the emergency responders. One reference that can be helpful to emergency responders is the Consumer Product Safety Commission (CPSC) *Guidelines for Fire and other Emergency First Response Personnel.* This guide is designed to help emergency responders to act quickly and effectively when they receive a call concerning CO

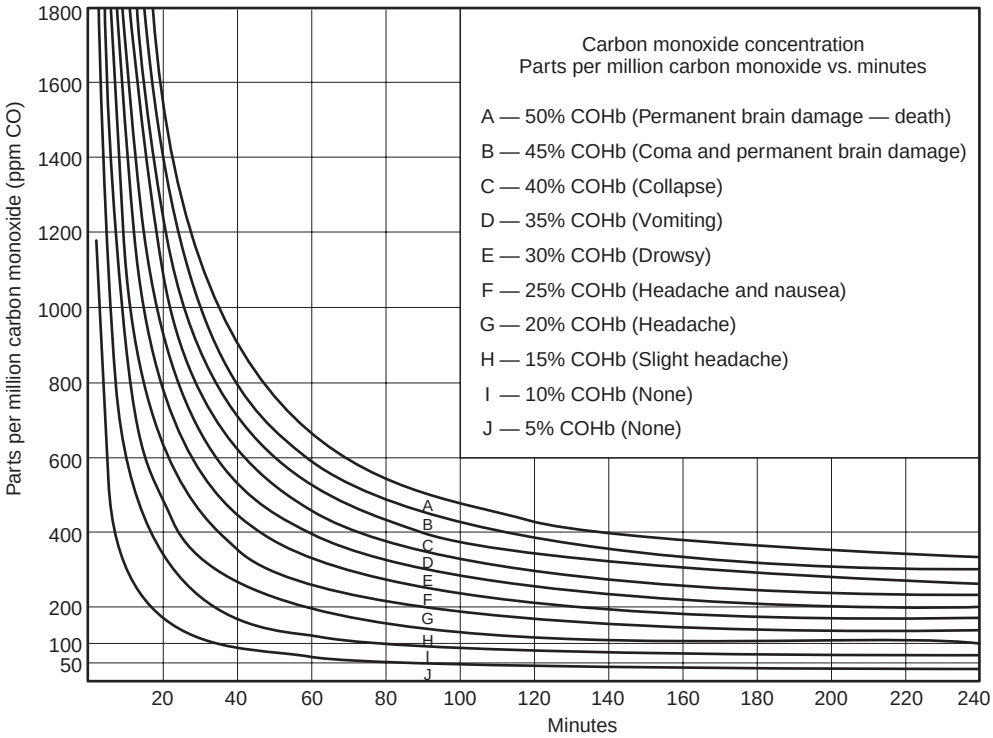


FIGURE B.1 Carbon Monoxide Concentration (ppm CO) Versus Time (Minutes).

poisoning. The guide contains basic information needed when responding to a CO incident and provides procedures for:

(1) Dispatchers answering a call
(2) Incident reporting forms to help emergency responders identify the elevated source of carbon monoxide, the level of care needed by occupants, and when it is safe for occupants to return to the building
(3) Advice and actions to give building occupants

The CPSC guide is available for download at www.cpsc.gov/PageFiles/117067/coguide.pdf.

Annex D Informational References

D.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

D.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 70®, National Electrical Code®, 2014 edition.

NFPA 72®, National Fire Alarm and Signaling Code, 2013 edition.

NFPA 170, *Standard for Fire Safety and Emergency Symbols*, 2012 edition.

NFPA 731, *Standard for the Installation of Electronic Premises Security Systems*, 2015 edition.

NFPA 1192, *Standard on Recreational Vehicles*, 2015 edition.

D.1.2 Other Publications.

D.1.2.1 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 2034, *Standard for Single and Multiple Station Carbon Monoxide Alarms*, 2008, Revised 2009.

D.1.2.2 Other Publications. Ashley, E., DuBois, J., "Waking Effectiveness of Audible, Visual, and Vibratory Emergency Alarms Across All Hearing Levels," Fire Suppression and Detection Research Symposium, Orlando, FL 2005.

Coburn, R. F., Forster, R. E., and Kane, P. G., "Considerations for the physiological variables that determine the blood carboxyhemoglobin concentration in man," *Journal of Clinical Investigation,* 1965, November; 44(11):1899–1910.

CSE NIH report, 2005: Bruck and Thomas, 2009; Bruck, Thomas, and Ball, NFPA RF report, 2007

Fire Protection Research Foundation (FPRF) Report, *Development of Technical Basis for Carbon Monoxide Detector Siting*, prepared by C. Beyler and D. Gottuk, 2007. Available at http://www.nfpa.org/assets/files/PDF/Research/Carbon_MonoxideDetectorSpacing.pdf.

Report of research on emergency signaling devices for use by the hearing impaired (Subject 1971), Underwriters Laboratories, 1991.

Steinberg, S., and Nielson, G. D., "A proposal for evaluating human exposure to carbon monoxide contamination in military vehicles," AMCMS Code 672716.H700011, March 1977.

Stone, W. *Electromagnetic Attenuation in Construction Materials*, National Institute of Standards and Technology, NISTIR 6055, 1997.

Title 47, Code of Federal Regulations, Part 15.

D.2 Informational References. (Reserved)

D.3 References for Extracts in Informational Sections.

NFPA 72®, National Fire Alarm and Signaling Code, 2013 edition.

NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*, 2013 edition.

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