

NFPA® 720

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

2009 Edition



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

IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA DOCUMENTS

NOTICE AND DISCLAIMER OF LIABILITY CONCERNING THE USE OF NFPA DOCUMENTS

NFPA codes, standards, recommended practices, and guides, of which the document contained herein is one, are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on fire and other safety issues. While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in its codes and standards.

The NFPA disclaims liability for any personal injury, property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this document. The NFPA also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making this document available, the NFPA is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the NFPA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The NFPA has no power, nor does it undertake, to police or enforce compliance with the contents of this document. Nor does the NFPA list, certify, test or inspect products, designs, or installations for compliance with this document. Any certification or other statement of compliance with the requirements of this document shall not be attributable to the NFPA and is solely the responsibility of the certifier or maker of the statement.

ADDITIONAL NOTICES AND DISCLAIMERS

Updating of NFPA Documents

Users of NFPA codes, standards, recommended practices, and guides should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of Tentative Interim Amendments. An official NFPA document at any point in time consists of the current edition of the document together with any Tentative Interim Amendments and any Errata then in effect. In order to determine whether a given document is the current edition and whether it has been amended through the issuance of Tentative Interim Amendments or corrected through the issuance of Errata, consult appropriate NFPA publications such as the National Fire Codes® Subscription Service, visit the NFPA website at www.nfpa.org, or contact the NFPA at the address listed below.

Interpretations of NFPA Documents

A statement, written or oral, that is not processed in accordance with Section 6 of the Regulations Governing Committee Projects shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

Patents

The NFPA does not take any position with respect to the validity of any patent rights asserted in connection with any items which are mentioned in or are the subject of NFPA codes, standards, recommended practices, and guides, and the NFPA disclaims liability for the infringement of any patent resulting from the use of or reliance on these documents. Users of these documents are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

NFPA adheres to applicable policies of the American National Standards Institute with respect to patents. For further information contact the NFPA at the address listed below.

Law and Regulations

Users of these documents should consult applicable federal, state, and local laws and regulations. NFPA does not, by the publication of its codes, standards, recommended practices, and guides, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

This document is copyrighted by the NFPA. It is made available for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of safe practices and methods. By making this document available for use and adoption by public authorities and private users, the NFPA does not waive any rights in copyright to this document.

Use of NFPA documents for regulatory purposes should be accomplished through adoption by reference. The term “adoption by reference” means the citing of title, edition, and publishing information only. Any deletions, additions, and changes desired by the adopting authority should be noted separately in the adopting instrument. In order to assist NFPA in following the uses made of its documents, adopting authorities are requested to notify the NFPA (Attention: Secretary, Standards Council) in writing of such use. For technical assistance and questions concerning adoption of NFPA documents, contact NFPA at the address below.

For Further Information

All questions or other communications relating to NFPA codes, standards, recommended practices, and guides and all requests for information on NFPA procedures governing its codes and standards development process, including information on the procedures for requesting Formal Interpretations, for proposing Tentative Interim Amendments, and for proposing revisions to NFPA documents during regular revision cycles, should be sent to NFPA headquarters, addressed to the attention of the Secretary, Standards Council, NFPA, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

For more information about NFPA, visit the NFPA website at www.nfpa.org.

Copyright © 2008 National Fire Protection Association®. All Rights Reserved.

NFPA® 720

Standard for the

Installation of Carbon Monoxide (CO) Detection and Warning Equipment

2009 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, released by the Technical Correlating Committee on Signaling Systems for the Protection of Life and Property, and acted on by NFPA at its June Association Technical Meeting held June 2–5, 2008, in Las Vegas, NV. It was issued by the Standards Council on July 24, 2008, with an effective date of October 10, 2008, and supersedes all previous editions.

This edition of NFPA 720 was approved as an American National Standard on October 10, 2008.

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 is a complete rewrite of the standard and addresses installations of carbon monoxide detection systems in commercial types of applications as well as the installation of carbon monoxide warning equipment in household applications. This edition is largely extracted from the 2007 edition of NFPA 72, *National Fire Alarm Code*, and is organized in a fashion similar to that of NFPA 72. Paragraphs that have been extracted from NFPA 72 are shown with the extract reference in brackets [] at the end of the paragraph. In some cases, modifications have been 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 encase

the modifying words. In a similar manner, where terms have been deleted, empty brackets are shown, such as where the word *smoke* is removed from the term *smoke alarm*.

Some of the technical changes in the 2009 edition include the introduction of requirements for the placement of carbon monoxide detectors in commercial applications. These requirements are 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 have been updated.

Technical Correlating Committee on Signaling Systems for the Protection of Life and Property

Robert P. Schifiliti, *Chair*
R. P. Schifiliti Associates, Inc., MA [SE]

Lee F. Richardson, *Nonvoting Secretary*
National Fire Protection Association, MA

Douglas M. Aiken, Lakes Region Mutual Fire Aid,
NH [U]
Rep. International Municipal Signal Association
Andrew G. Berezowski, Honeywell Inc., CT [M]
Rep. National Electrical Manufacturers Association
J. Robert Boyer, GE, Security, NJ [M]
Richard W. Bukowski, U.S. National Institute of
Standards and Technology, MD [RT]
Merton W. Bunker, Jr., U.S. Department of State, VA [U]
Stephen J. DiGiovanni, Clark County Fire Department,
NV [E]
Rep. International Fire Marshals Association
John C. Fannin III, SafePlace Corporation, DE [U]
Bruce Fraser, Fraser Fire Protection Services, MA [SE]
John K. Guhl, California State Fire Marshal, CA [E]
Rep. International Association of Fire Chiefs

Vic Humm, Vic Humm & Associates, TN [SE]
Peter A. Larrimer, U.S. Department of Veterans Affairs,
PA [U]
James M. Mundy, Jr., Asset Protection Associates, Ltd.,
NY [M]
Rep. Automatic Fire Alarm Association, Inc.
Lynn Nielson, City of Henderson, NV [E]
Thomas F. Norton, Norel Service Company, Inc., MA [IM]
Rep. U.S. Naval Historical Center
Paul E. Patty, Underwriters Laboratories Inc., IL [RT]
Rodger Reiswig, Tyco/SimplexGrinnell, FL [M]
Tom G. Smith, Cox Systems Technology, OK [IM]
Rep. National Electrical Contractors Association
Lawrence J. Wenzel, Hughes Associates, Inc., CT [SE]

Alternates

Thomas P. Hammerberg, Automatic Fire Alarm
Association, Inc., FL [M]
(Alt. to J. M. Mundy, Jr.)
Bill Hopple, Tyco/SimplexGrinnell, CA [M]
(Alt. to R. Reiswig)
Jack McNamara, Bosch Security Systems, NY [M]
(Alt. to A. G. Berezowski)

Lawrence J. Shudak, Underwriters Laboratories Inc.,
IL [RT]
(Alt. to P. E. Patty)
Frank L. Van Overmeiren, FP&C Consultants, Inc.,
IN [SE]
(Alt. to V. Humm)

Nonvoting

Benjamin B. Aycock, Charlotte-Mecklenburg, NC
(Member Emeritus)
Art Black, Carmel Fire Department/Carmel Fire
Protection Associates, CA [E]
Rep. TC on Supervising Station Fire Alarm Systems
Shane M. Clary, Bay Alarm Company, CA [IM]
Rep. TC on Fundamentals of Fire Alarm Systems
Kenneth W. Dungan, Risk Technologies, LLC, TN [SE]
Rep. TC on Initiating Devices for Fire Alarm Systems
Daniel T. Gottuk, Hughes Associates, Inc., MD [SE]
Rep. TC on Household Fire Alarm Systems
Raymond A. Grill, Arup Fire, DC [SE]
Rep. TC on Notification Appliances for Fire Alarm
Systems
Jeffrey G. Knight, City of Newton Fire Department,
MA [U]
Rep. TC on Public Fire Reporting Systems

J. Jeffrey Moore, Hughes Associates, Inc., OH [SE]
Rep. TC on Protected Premises Fire Alarm Systems
Wayne D. Moore, Hughes Associates, Inc., RI [SE]
Rep. TC on Emergency Communication Systems
Martin H. Reiss, The RJA Group, Inc., MA [SE]
Rep. Safety to Life Correlating Committee
Timothy M. Soverino, Nantucket, MA [U]
Rep. TC on Testing and Maintenance of Fire Alarm
Systems
Evan E. Stauffer, Jr., U.S. Department of the Navy, PA
Rep. TC Public Emergency Service Communications
Dean K. Wilson, Hughes Associates, Inc., PA [SE]
(Member Emeritus)

Lee F. Richardson, NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on the installation, performance, maintenance, testing, and use of signaling components and signaling systems for the protection of life and property.

Technical Committee on Carbon Monoxide Detection

Thomas F. Norton, *Chair*
Norel Service Company, Inc., MA [IM]

Wendy B. Gifford, *Secretary*
Invensys Controls, IL [M]
Rep. National Electrical Manufacturers Association

William J. Aaron, Jr., Code Consultants, Inc., MO [SE]
Blair T. Ames, Montgomery Ames Associates, MA [M]
Denise Beach, National Propane Gas Association, DC [U]
Art Black, Carmel Fire Department/Carmel Fire Protection Associates, CA [E]
H. Wayne Boyd, U.S. Safety & Engineering Corporation, CA [M]
Jeffrey R. Brooks, Tyco/SimplexGrinnell, MA [M]
Shane M. Clary, Bay Alarm Company, CA [M]
Rep. Automatic Fire Alarm Association, Inc.
Bradford T. Cronin, Newport Fire Department, RI [E]
Scott G. Davis, Exponent, Inc., MA [SE]
Lee C. DeVito, FIREPRO Incorporated, MA [SE]
Philip L. Gauthier, Gas Appliance Manufacturers Association, VA [M]
Daniel T. Gottuk, Hughes Associates, Inc., MD [SE]
Deborah Hanson, First Alert BRK Brands Inc., IL [M]
John Knecht, Intertek Testing Services NA, Inc., IL [RT]

Rick L. Manchester, Huntsman Polymers Corporation, TX [U]
John L. Parssinen, Underwriters Laboratories Inc., IL [RT]
James A. Petersen, Petersen Engineering, TX [SE]
Anthony V. Pierce, Forsyth County Planning & Development, GA [E]
Michael J. Pokorny, Montgomery County, MD [E]
Larry Ratzlaff, Kidde Safety, IL [M]
Sarah A. Rice, Schirmer Engineering Corporation, OH [U]
Rep. American Hotel & Lodging Association
Richard Jay Roberts, System Sensor, IL [M]
James M. Rowland, Quality Electric Service, LLC, NJ [IM]
Joseph H. Talbert, Nexus Technical Services Corporation, IL [SE]
Ed Van Walraven, Aspen Fire Protection District, CO [E]

Alternates

Rick Heffernan, SDi, NJ [M]
(Alt. to W. B. Gifford)
Adam H. Hilton, Code Consultants, Inc., MO [SE]
(Alt. to W. J. Aaron, Jr.)
Ed Ledoux, Tyco/SimplexGrinnell, MA [M]
(Alt. to J. R. Brooks)

Paul E. Patty, Underwriters Laboratories Inc., IL [RT]
(Alt. to J. L. Parssinen)
Kurt A. Ruchala, FIREPRO Incorporated, MA [SE]
(Alt. to L. C. DeVito)

Nonvoting

Donald W. Switzer, U.S. Consumer Product Safety Commission, MD [C]

Lee F. Richardson, NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

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

Contents

Chapter 1 Administration	720- 6	6.10 Tactile Appliances	720-30
1.1 Scope	720- 6	6.11 Standard Emergency Service Interface	720-30
1.2 Purpose	720- 6	Chapter 7 Off-Premises Signal Transmission	720-30
1.3 Application	720- 6	7.1 Application	720-30
1.4 Equivalency	720- 6	7.2 General	720-30
1.5 Units of Measure	720- 6	7.3 Prearranged Testing	720-31
Chapter 2 Referenced Publications	720- 6	7.4 Operation and Record Keeping	720-31
2.1 General	720- 6	Chapter 8 Inspection, Testing, and	
2.2 NFPA Publications	720- 6	Maintenance	720-31
2.3 Other Publications	720- 7	8.1 Application	720-31
2.4 References for Extracts in Mandatory		8.2 General	720-31
Sections	720- 7	8.3 Service Personnel Qualifications and	
Chapter 3 Definitions	720- 7	Experience	720-31
3.1 General	720- 7	8.4 Notification	720-31
3.2 NFPA Official Definitions	720- 7	8.5 System Documentation	720-31
3.3 General Definitions	720- 7	8.6 Inspection	720-31
Chapter 4 Fundamentals of Carbon Monoxide		8.7 System Testing of Carbon Monoxide	
Detection Systems	720- 8	Detection Systems	720-31
4.1 Application	720- 8	8.8 Maintenance	720-39
4.2 Purpose	720- 8	8.9 Records	720-39
4.3 Equipment and Personnel	720- 8	8.10 Single- and Multiple-Station Carbon	
4.4 System Fundamentals	720- 9	Monoxide Alarms	720-39
4.5 Documentation	720-13	8.11 Household Carbon Monoxide	
Chapter 5 Protected Premises Carbon		Detection Systems	720-39
Monoxide Detection Systems	720-18	Chapter 9 Single- and Multiple-Station Alarms	
5.1 Application	720-18	and Household Carbon	
5.2 General	720-18	Monoxide Detection Systems	720-43
5.3 System Features	720-18	9.1 Application	720-43
5.4 System Performance and Integrity	720-18	9.2 Purpose	720-43
5.5 System Requirements	720-19	9.3 Basic Requirements	720-43
Chapter 6 Notification Appliances for Carbon		9.4 Required Protection	720-44
Monoxide Detection Systems	720-24	9.5 Power Supplies	720-44
6.1 Application	720-24	9.6 Equipment Performance	720-45
6.2 Purpose	720-25	9.7 Installation	720-46
6.3 General	720-25	9.8 Maintenance and Testing	720-46
6.4 Audible Characteristics	720-25	9.9 Markings and Instructions	720-47
6.5 Visible Characteristics — Public Mode	720-27	Annex A Explanatory Material	720-47
6.6 Visible Characteristics — Private Mode	720-30	Annex B Dangers of Carbon Monoxide	720-58
6.7 Supplementary Visible Signaling		Annex C Informational References	720-59
Method	720-30	Index	720-60
6.8 Textual Audible Appliances	720-30		
6.9 Textual Visible Appliances	720-30		

NFPA 720**Standard for the****Installation of Carbon Monoxide (CO)
Detection and Warning Equipment****2009 Edition**

IMPORTANT NOTE: *This NFPA document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading "Important Notices and Disclaimers Concerning NFPA Documents." They can also be obtained on request from NFPA or viewed at www.nfpa.org/disclaimers.*

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

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 C. 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 C.

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 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 the International System (SI) of units. Where presented, U.S. customary units (inch-pound units) follow the SI units in parentheses.

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

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

1.5.4 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.

1.5.5 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[®], 2008 edition.

NFPA 72[®], National Fire Alarm Code[®], 2007 edition.

NFPA 101[®], Life Safety Code[®], 2009 edition.

NFPA 110, Standard for Emergency and Standby Power Systems, 2005 edition.



NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, 2005 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2008 edition.

NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*, 2007 edition.

NFPA 5000®, *Building Construction and Safety Code*®, 2009 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 S3.2, *Method for Measuring the Intelligibility of Speech over Communication Systems*, 1989 (R1999).

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

2.3.2 IEC Publications. International Electrotechnical Commission, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland.

IEC 60849, *Sound Systems for Emergency Purposes*, 1998.

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

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

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

ANSI/UL 1971, *Standard for Safety Signaling Devices for Hearing Impaired*, 2002, revised May 2004.

ANSI/UL 2034, *Standard for Single and Multiple Station Carbon Monoxide Alarms*, June 28, 2002.

ANSI/UL 2075, *Gas and Vapor Detectors and Sensors*, November 2004.

2.3.5 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 Code*®, 2007 edition.

NFPA 211, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances*, 2006 edition.

NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*, 2007 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, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1 Alarm.

3.3.1.1 Carbon Monoxide Alarm. A single- or multiple-station carbon monoxide alarm responsive to carbon monoxide.

3.3.1.2 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, 2007]

3.3.1.3 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, 2007]

3.3.2 [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, 2007]

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

3.3.4 [Carbon Monoxide] Safety Functions. Building and [carbon monoxide] control functions that are intended to increase the level of life safety for occupants or to control the spread of the harmful effects of [carbon monoxide]. [72, 2007]

3.3.5 [Carbon Monoxide] Warning Equipment. Any detector, alarm, device, or material related to single- and multiple-station alarms or household carbon monoxide detection systems. [72, 2007]

3.3.6 Control Unit. A system component that monitors inputs and controls outputs through various types of circuits. [72, 2007]

3.3.7* 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, 2007]

3.3.8 Dwelling Unit. One or more rooms arranged for the use of one or more individuals living together, providing complete, independent living facilities, including permanent provisions for living, sleeping, eating, cooking, and sanitation.

3.3.9* Emergency Response Agency (ERA). Organizations providing law enforcement, emergency medical, fire, rescue, communications, and related support services. [1221, 2007]

3.3.10 Fireplace. A hearth, fire chamber, or similarly prepared area and a chimney. [211, 2006]

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

3.3.12 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, 2007]

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

3.3.14 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, 2007]

3.3.15 Protected Premises. The physical location protected by a [] system. [72, 2007]

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

3.3.17* Separate Sleeping Area. The area of a dwelling unit where the bedrooms or sleeping rooms are located. [72, 2007]

3.3.18 Signal.

3.3.18.1 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.

3.3.18.2 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.

3.3.18.3 Trouble Signal. A signal initiated by a system or device indicative of a fault in a monitored circuit, system, or component. [72, 2007]

3.3.19 System.

3.3.19.1 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.

3.3.19.2 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.

3.3.19.3* 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, 2007]

3.3.19.4 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, 2007]

3.3.19.5 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 carbon monoxide, and trouble conditions; to alert the occupants; and to summon aid.

4.3 Equipment and Personnel.

4.3.1 Equipment.

4.3.1.1 Equipment constructed and installed in conformity with this standard shall be listed for the purpose for which it is used. [Carbon monoxide detection] system components shall be installed, tested, and maintained in accordance with the manufacturer's published instructions and this standard. [72:4.3.1]

4.3.1.2* 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.

4.3.2 System Designer.

4.3.2.1 [Carbon monoxide detection] system plans and specifications shall be developed in accordance with this standard by persons who are experienced in the proper design, application, installation, and testing of [carbon monoxide detection] systems. [72:4.3.2.1]



4.3.2.2 The system designer shall be identified on the system design documents. Acceptable evidence of experience and qualifications shall be provided when requested by the authority having jurisdiction. Qualified personnel shall be permitted to include, but shall 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
- (2)*Personnel who are certified by a nationally recognized [carbon monoxide] certification organization acceptable to the authority having jurisdiction
- (3) Personnel who are registered, licensed, or certified by a state or local authority [72:4.3.2.2]

4.3.3 System Installer. Installation personnel shall be qualified or shall be supervised by persons who are qualified in the installation, inspection, and testing of [carbon monoxide detection] systems. Acceptable evidence of experience and qualifications or certification shall be provided when requested by the authority having jurisdiction. Qualified personnel shall be permitted to include, but shall not be limited to, one or more of the following:

- (1) Personnel who are factory trained and certified for [carbon monoxide detection] system installation of the specific type and brand of system being installed
- (2)*Personnel who are certified by a nationally recognized [carbon monoxide] certification organization acceptable to the authority having jurisdiction
- (3) Personnel who are registered, licensed, or certified by a state or local authority [72:4.3.3]

4.4 System Fundamentals.

4.4.1 Power Supplies.

4.4.1.1 Scope. The provisions of 4.4.1.2 through 4.4.1.9.7 section shall apply to power supplies used for carbon monoxide detection systems.

4.4.1.2 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. [72:4.4.1.2]

4.4.1.3 Power Supply Sources.

4.4.1.3.1 At least two independent and reliable power supplies shall be provided, one primary and one secondary, each of which shall be of adequate capacity for the application. [72:4.4.1.3.1]

4.4.1.3.2 Monitoring the integrity of power supplies shall be in accordance with 4.4.6.2. [72:4.4.1.3.2]

4.4.1.4 Primary Power Supply.

4.4.1.4.1 Dedicated Branch Circuit. A dedicated branch circuit of one of the following shall supply primary power:

- (1) Commercial light and power
- (2) An engine-driven generator or equivalent in accordance with 4.4.1.9.2, 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 4.4.1.9.2, where a person specifically trained in its operation is on duty at all times [72:4.4.1.4.1]

4.4.1.4.2 Mechanical Protection.

4.4.1.4.2.1 The dedicated branch circuit(s) and connections shall be mechanically protected. [72:4.4.1.4.2.1]

4.4.1.4.2.2 Circuit disconnecting means shall be clearly marked and shall be accessible only to authorized personnel.

4.4.1.4.2.3 The location of the circuit disconnecting means shall be permanently identified at the control unit. [72:4.4.1.4.2.3]

4.4.1.4.3 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. [72:4.4.1.4.3]

4.4.1.5 Secondary Power Supply.

4.4.1.5.1* Secondary Power Supply for Protected Premises [Carbon Monoxide Detection] Systems. 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 4.4.1.8
- (2) An automatic starting, engine-driven generator serving the dedicated branch circuit specified in 4.4.1.4.1 and arranged in accordance with 4.4.1.9.3 and storage batteries dedicated to the [carbon monoxide detection] system with 4 hours of capacity arranged in accordance with 4.4.1.8 [72:4.4.1.5.1]

4.4.1.5.2 Capacity.

4.4.1.5.2.1* Where a combination (fire) system is used, the secondary power supply capacity requirements shall comply with 4.4.1.5.2.3 and with those of *NFPA 72, National Fire Alarm Code*.

4.4.1.5.2.2* Where a combination carbon monoxide detection system is used, the secondary power supply capacity requirements shall comply with 4.4.1.5.2.3 and with the provisions of the applicable NFPA code or standard.

4.4.1.5.2.3 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 5.5.6.5.

Exception: The 12-hour requirement shall be permitted to be reduced to 60 minutes where the system is monitored by a supervising station and emergency response in accordance with 7.2.2 is provided.

4.4.1.5.2.4 For systems not addressed by 4.4.1.5.2.1 through 4.4.1.5.2.3, the secondary power supply capacity required shall include all power supply loads that are not automatically disconnected upon the transfer to secondary power supply.

4.4.1.5.3 Secondary Power Operation. Operation on secondary power shall not affect the required performance of a [carbon monoxide detection] system. The system shall produce the same alarm, supervisory, and trouble signals and indications, excluding the alternating current (ac) power indicator, when operating from the secondary power source as are produced when the unit is operating from the primary power source. [72:4.4.1.5.4]

4.4.1.6* Continuity of Power Supplies.

4.4.1.6.1 The secondary power supply shall automatically provide power to the protected premises [carbon monoxide detection] system within 10 seconds, whenever the primary power supply fails to provide the minimum voltage required for proper operation. [72:4.4.1.6.1]

4.4.1.6.2 Required signals shall not be lost, interrupted, or delayed by more than 10 seconds as a result of the primary power failure. [72:4.4.1.6.3]

4.4.1.6.3 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. [72:4.4.1.6.3.1]

4.4.1.6.4 Where a UPS is employed in 4.4.1.6.3, 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. [72:4.4.1.6.3.2]

4.4.1.7 Power Supply for Remotely Located Control Equipment.

4.4.1.7.1 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 4.4.1.1 through 4.4.1.6 and in accordance with 4.4.6.2. [72:4.4.1.7.1]

4.4.1.7.2 The location of any remotely located power supply shall be identified at the master control unit as well as on the record drawings. Identification on the control unit display shall be acceptable. [72:4.4.1.7.2]

4.4.1.8 Storage Batteries.

4.4.1.8.1* Marking. Batteries shall be permanently marked with the month and year of manufacture, using the month/year format. [72:4.4.1.8.1]

4.4.1.8.2 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. [72:4.4.1.8.2]

4.4.1.8.2.1 Cells shall be suitably insulated against grounds and crosses and shall be mounted securely in such a manner so as not to be subject to mechanical injury. [72:4.4.1.8.2.1]

4.4.1.8.2.2 Racks shall be suitably protected against deterioration. [72:4.4.1.8.2.2]

4.4.1.8.2.3 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. [72:4.4.1.8.2.3]

4.4.1.8.3 Battery Charging.

4.4.1.8.3.1 Adequate facilities shall be provided to automatically maintain the battery fully charged under all conditions of normal operation. [72:4.4.1.8.3.1]

4.4.1.8.3.2 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 4.4.1.5.2. [72:4.4.1.8.3.2]

4.4.1.8.3.3 Upon attaining a fully charged condition, the charge rate shall not be so excessive as to result in battery damage. [72:4.4.1.8.3.3]

4.4.1.8.3.4 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. [72:4.4.1.8.3.5]

4.4.1.8.4 Overcurrent Protection.

4.4.1.8.4.1 The batteries shall be protected against excessive load current by overcurrent devices. [72:4.4.1.8.4.1]

4.4.1.8.4.2 The batteries shall be protected from excessive charging current by overcurrent devices or by automatic current-limiting design of the charging source. [72:4.4.1.8.4.2]

4.4.1.8.5 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. [72:4.4.1.8.5]

4.4.1.8.6 Charger Supervision. Supervision means appropriate for the batteries and charger employed shall be provided to detect a failure of battery charging and initiate a trouble signal in accordance with 4.4.3.6. [72:4.4.1.8.6]

4.4.1.9 Engine-Driven Generators.

4.4.1.9.1 Application and Installation. The application and installation of engine-driven generators shall be as specified in 4.4.1.9.2 through 4.4.1.9.7. [72:4.4.1.9.1]

4.4.1.9.2 Primary Power Supply. Engine-driven generators arranged as the primary supply shall be designed and installed in an approved manner. [72:4.4.1.9.2]

4.4.1.9.3 Secondary Power Supplies. 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. Installation shall be in accordance with NFPA 70, *National Electrical Code*, Article 700. [72:4.4.1.9.3.1(A)]

4.4.1.9.4 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*. [72:4.4.1.9.4]

4.4.1.9.5 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. [72:4.4.1.9.5]

4.4.1.9.6 Fuel. Unless otherwise required or permitted in 4.4.1.9.6.1 through 4.4.1.9.6.2, fuel shall be available in storage sufficient for 6 months of testing plus the capacity specified in 4.4.1.5. [72:4.4.1.9.6]

4.4.1.9.6.1 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. [72:4.4.1.9.6.2]

4.4.1.9.6.2 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*. [72:4.4.1.9.6.3]

4.4.1.9.7 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. [72:4.4.1.9.7]



4.4.2 Compatibility. All detection devices that receive their power from the initiating device circuit or signaling line circuit of a control unit shall be listed for use with the control unit. [72:4.4.2]

4.4.3 System Functions.

4.4.3.1 Distinctive Signals.

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

4.4.3.1.2 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.

4.4.3.2 Carbon Monoxide Safety Function Status Indicators.

4.4.3.2.1 All controls provided specifically for the purpose of manually overriding any automatic [carbon monoxide] safety function shall provide visible indication of the status of the associated control circuits. [72:4.4.3.4.1]

4.4.3.2.2* Where status indicators are provided for emergency equipment or [carbon monoxide] safety functions, they shall be arranged to reflect the actual status of the associated equipment or function. [72:4.4.3.4.2]

4.4.3.3 Alarm Signals.

4.4.3.3.1 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. [72:4.4.3.6.1]

4.4.3.3.2 Carbon monoxide alarm signals shall comply with 5.5.6.5.

4.4.3.4 Alarm Signal Deactivation.

4.4.3.4.1 A means for turning off activated alarm notification appliances shall be permitted only if it complies with 4.4.3.4.3 through 4.4.3.4.6. [72:4.4.3.7.1]

Exception: An initiating device with integral sounder shall be permitted to comply with 5.5.2.8.

4.4.3.4.2 When an alarm signal deactivation means is actuated, both audible and visible notification appliances shall be simultaneously deactivated. [72:4.4.3.7.2]

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

4.4.3.4.4 The alarm signal deactivation means shall provide a visible zone alarm indication or the equivalent as specified in 4.4.5.1. [72:4.4.3.7.4]

4.4.3.4.5 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. [72:4.4.3.7.5]

Exception: If permitted by the authority having jurisdiction, subsequent actuation of another addressable initiating device of the same type in the same room or space shall not be required to cause the notification appliance(s) to reactivate. [72:4.4.3.7.5]

4.4.3.4.6 A means that is left in the “off” position when there is no alarm shall operate an audible trouble signal until the means is restored to normal. [72:4.4.3.7.6]

4.4.3.5 Supervisory Signals.

4.4.3.5.1 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

4.4.3.5.2 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.

4.4.3.5.3 Supervisory Signal Silencing. A means for silencing a supervisory signal notification appliance(s) shall be permitted only if it complies with 4.4.3.5.3.1 through 4.4.3.5.3.3. [72:4.4.3.8]

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

4.4.3.5.3.2 The means shall transfer the supervisory indication to a lamp or other visible indicator, and subsequent supervisory signals in other zones shall cause the supervisory notification appliance(s) to re-sound. [72:4.4.3.8.2]

4.4.3.5.3.3 A means that is left in the “silence” position where there is no supervisory off-normal signal shall operate a visible signal silence indicator and cause the trouble signal to sound until the silencing means is restored to normal position. [72:4.4.3.8.3]

4.4.3.6 Trouble Signals.

4.4.3.6.1 Trouble signals and their restoration to normal shall be indicated within 200 seconds at the locations identified in 4.4.3.6.6. Indication of primary power failure trouble signals transmitted to a supervising station shall be delayed in accordance with 4.4.6.2.3. [72:4.4.3.5.1]

4.4.3.6.2 Trouble signals required to indicate at the protected premises shall be indicated by distinctive audible signals, which shall be distinctive from alarm signals. [72:4.4.3.5.2]

4.4.3.6.3 If an intermittent signal is used, it shall sound at least once every 10 seconds, with a minimum duration of ½ second. [72:4.4.3.5.3]

4.4.3.6.4 An audible trouble signal shall be permitted to be common to several supervised circuits. [72:4.4.3.5.4]

4.4.3.6.5 The trouble signal(s) shall be located in an area where it is likely to be heard. [72:4.4.3.5.5]

4.4.3.6.6 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

4.4.3.7 Audible Trouble Signal Silencing Means.

4.4.3.7.1 A means for silencing the trouble notification appliance(s) shall be permitted only if it complies with 4.4.3.7.1.1 through 4.4.3.7.1.4 [72:4.4.3.5.8.1]

4.4.3.7.1.1 The means shall be key-operated, located within a locked enclosure, or arranged to provide equivalent protection against unauthorized use. [72:4.4.3.5.8.1(A)]

4.4.3.7.1.2 The means shall transfer the trouble indication to a suitably identified lamp or other acceptable visible indicator. [72:4.4.3.5.8.1(B)]

4.4.3.7.1.3 The visible indication in 4.4.3.7.1.2 shall persist until the trouble condition has been corrected. [72:4.4.3.5.8.1(C)]

4.4.3.7.1.4 The audible trouble signal shall sound when the silencing means is in its silence position and no trouble exists. [72:4.4.3.5.8.1(D)]

4.4.3.7.2* An audible trouble signal that has been silenced at the protected premises shall comply with 4.4.3.7.2.1 through 4.4.3.7.2.3. [72:4.4.3.5.8.3]

4.4.3.7.2.1 The audible trouble signal shall automatically re-sound every 24 hours or less until fault conditions are restored to normal. [72:4.4.3.5.8.3(A)]

4.4.3.7.2.2 The audible trouble signal shall sound until it is manually silenced or acknowledged. [72:4.4.3.5.8.3(B)]

4.4.3.7.2.3 The re-sounded trouble signal shall also be automatically retransmitted to any supervising station to which the original trouble signal was transmitted. [72:4.4.3.5.8.3(C)]

4.4.3.7.3 If permitted by the authority having jurisdiction, the requirement for a 24-hour re-sound of an audible trouble signal shall be permitted to occur only at a supervising station that meets the requirements of Chapter 7 and not at the protected premises. [72:4.4.3.5.8.4]

4.4.4 Performance and Limitations.

4.4.4.1 Voltage, Temperature, and Humidity Variation. Equipment other than that addressed by 4.4.4.2.4 and 5.5.5.3.6 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 0°C (32°F) and 49°C (120°F)
- (3) At a relative humidity of 85 percent and an ambient temperature of 30°C (86°F)

4.4.4.2 Installation and Design.

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

4.4.4.2.2 Devices and appliances shall be located and mounted so that accidental operation or failure is not caused by vibration or jarring. [72:4.4.4.2.2]

4.4.4.2.3 All apparatus requiring resetting to maintain normal operation shall be restored to normal as promptly as possible after each alarm and kept in normal condition for operation. [72:4.4.4.2.3]

4.4.4.2.4 Equipment shall be installed in locations where conditions do not exceed the voltage, temperature, and humidity limits specified in 4.4.4.1. [72:4.4.4.2.4]

Exception: Equipment specifically listed for use in locations where conditions can exceed the upper and lower limits specified in 4.4.4.1 shall be permitted. [72:4.4.4.2.4]

4.4.4.3 Transient Protection. To reduce the possibility of damage by induced transients, circuits and equipment shall be

properly protected in accordance with the requirements of *NFPA 70, National Electrical Code*, Article 800. [72:4.4.4.3]

4.4.4.4* Wiring. The installation of all wiring, cable, and equipment shall be in accordance with *NFPA 70, National Electrical Code*, and specifically with Articles 725, 770, and 800, where applicable.

4.4.4.5 Grounding. All systems shall test free of grounds. [72:4.4.4.5]

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. [72:4.4.4.5]

4.4.5 Annunciation and Annunciation Zoning.

4.4.5.1 Alarm Annunciation. The location of an actuated initiating device shall be annunciated by visible means. Visible annunciation shall be by an indicator lamp, alphanumeric display, printout, or other approved means. The visible annunciation of the location of operated initiating devices shall not be canceled by the means used to deactivate alarm notification appliances.

4.4.5.2 Trouble Annunciation. Trouble annunciation shall be annunciated by visible means. Visible annunciation shall be by an indicator lamp, alphanumeric display, printout, or other means. The visible annunciation of trouble conditions shall not be canceled by the means used to deactivate trouble notification appliances.

4.4.5.3* Annunciator Access and Location. All required annunciation means shall be readily accessible to responding personnel and shall be located as required by the authority having jurisdiction to facilitate an efficient response to the [] situation. [72:4.4.6.3]

4.4.5.4 Alarm Annunciation Display. Visible annunciators shall be capable of displaying all zones in alarm. If all zones in alarm are not displayed simultaneously, the zone of origin shall be displayed and there shall be an indication that other zones are in alarm. [72:4.4.6.4]

4.4.5.5 [] Command Center. Annunciation at the [] command center shall be by means of audible and visible indicators. [72:4.4.6.5]

4.4.5.6 Annunciation Zoning.

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

4.4.5.6.2 Where the system serves more than one building, each building shall be annunciated separately. [72:4.4.6.6.2]

4.4.6 Monitoring Integrity.

4.4.6.1* Monitoring Integrity of Installation Conductors and Other Signaling Channels. Unless otherwise permitted or required by 4.4.6.1.1 through 4.4.6.1.8, all means of interconnecting equipment, devices, and appliances and wiring connections shall be monitored for the integrity of the interconnecting conductors or equivalent path so that the occurrence of a single open or a single ground-fault condition in the installation conductors or other signaling channels and their restoration to normal shall be automatically indicated within 200 seconds. [72:4.4.7.1]

4.4.6.1.1 Shorts between conductors shall not be required to be monitored for integrity, unless required by 4.4.6.1.12. [72:4.4.7.1]



4.4.6.1.2 Monitoring for integrity shall not be required for connections to and between supplementary system components, provided that single open, ground, 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. [72:4.4.7.1.4]

4.4.6.1.3 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. [72:4.4.7.1.5]

4.4.6.1.4 Monitoring for integrity shall not be required for a trouble signal circuit. [72:4.4.7.1.6]

4.4.6.1.5* Monitoring for integrity shall not be required for the interconnection between listed equipment within a common enclosure. [72:4.4.7.1.7]

4.4.6.1.6 Monitoring for integrity shall not be required for the interconnection between enclosures containing control equipment located within 6 m (20 ft) of each other where the conductors are installed in conduit or equivalently protected against mechanical injury. [72:4.4.7.1.8]

4.4.6.1.7 Monitoring for integrity shall not be required for the conductors for ground detection where a single ground does not prevent the required normal operation of the system. [72:4.4.7.1.9]

4.4.6.1.8 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 2.4 m (8 ft) 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. [72:4.4.7.1.12]

4.4.6.1.9 Interconnection means shall be arranged so that a single break or single ground fault does not cause a [carbon monoxide] alarm signal. [72:4.4.7.1.14]

4.4.6.1.10 Unacknowledged [carbon monoxide] 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. [72:4.4.7.1.15]

Exception: Circuits used to interconnect [carbon monoxide] detection control units. [72:4.4.7.1.15]

4.4.6.1.11 An open, ground, or short-circuit fault on the installation conductors of one alarm notification appliance circuit shall not affect the operation of any other alarm notification circuit. [72:4.4.7.1.16]

4.4.6.1.12 A wire-to-wire short-circuit fault on any alarm notification appliance circuit shall result in a trouble signal in accordance with 4.4.3.6 and 4.4.3.7, except as permitted by 4.4.6.1.2 or 4.4.6.1.3. [72:4.4.7.1.17]

4.4.6.2 Monitoring Integrity of Power Supplies.

4.4.6.2.1 Unless otherwise permitted or required by 4.4.6.2.1.1 through 4.4.6.2.1.4, all primary and secondary power supplies shall be monitored for the presence of voltage at the point of connection to the system. Failure of either supply shall result in a trouble signal in accordance with 4.4.3.6. 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 this paragraph. [72:4.4.7.3.1]

4.4.6.2.1.1 Monitoring shall not be required for a power supply for supplementary equipment. [72:4.4.7.3.1.1]

4.4.6.2.1.2 Monitoring shall not be required for the neutral of a three-, four-, or five-wire ac or direct current (dc) supply source. [72:4.4.7.3.1.2]

4.4.6.2.1.3 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. [72:4.4.7.3.1.3]

4.4.6.2.1.4 Monitoring shall not be required for the output of an engine-driven generator that is part of the secondary power supply, provided the generator is tested weekly in accordance with Chapter 8. [72:4.4.7.3.1.4]

4.4.6.2.2* Power supply sources and electrical supervision for digital alarm communications systems shall be in accordance with 4.4.1 and 4.4.6. [72:4.4.7.3.2]

4.4.6.2.3* 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.

4.4.6.2.4 Power supervisory devices shall be arranged so as not to impair the receipt of carbon monoxide alarm or supervisory signals. [72:4.4.7.3.4]

4.5 Documentation.

4.5.1 Approval and Acceptance.

4.5.1.1* The authority having jurisdiction shall be notified prior to installation or alteration of equipment or wiring. Where required, 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. [72:4.5.1.1]

4.5.1.2 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. [72:4.5.1.2]

4.5.1.3* The [carbon monoxide detection system] record of completion form, Figure 4.5.2.1, shall be permitted to be a part of the written statement required in 4.5.1.2. 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. [72:4.5.1.3]

4.5.2 Completion Documents.

4.5.2.1* Preparation. The preparation of a [carbon monoxide detection system] record of completion, Figure 4.5.2.1, shall be the responsibility of the qualified and experienced person described in 4.3.3 and shall be in accordance with 4.5.2.1.1 through 4.5.2.1.3. [72:4.5.2.1]

CARBON MONOXIDE DETECTION SYSTEM RECORD OF COMPLETION

To be completed by the system installation contractor at the time of system acceptance and approval.

1. PROTECTED 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. SYSTEM INSTALLATION, SERVICE, AND TESTING INFORMATION

Installation contractor for this equipment: _____

Address: _____

Phone: _____ Fax: _____ E-mail: _____

Service organization for this equipment: _____

Address: _____

Phone: _____ Fax: _____ E-mail: _____

Location of as-built drawings: _____ Location of historical test reports: _____

Location of system operation and maintenance manuals: _____

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. TYPE OF SYSTEM OR SERVICE

NFPA 72 chapter reference for system type: _____

Name of organization receiving alarm signals with phone numbers (*if applicable*):

Alarm: _____ Phone: _____

Supervisory: _____ Phone: _____

Trouble: _____ Phone: _____

Entity to which alarms are retransmitted: _____ Phone: _____

Method of retransmission of alarms to that organization or location: _____

FIGURE 4.5.2.1 Carbon Monoxide Detection System Record of Completion.



3. TYPE OF SYSTEM OR SERVICE (continued)

If Chapter 8 of NFPA 72, note the means of transmission from the protected premises to the central station:

☐ Digital alarm communicator ☐ McCulloh ☐ Multiplex ☐ 2-way radio ☐ 1-way radio ☐ N/A

If Chapter 9 of NFPA 72, note the type of connection: ☐ Local energy ☐ Shunt ☐ Parallel telephone ☐ N/A

3.1 System Software

Operating system (executive) software revision level: _____

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

4. SIGNALING LINE CIRCUITS

Characteristics of signaling line circuits connected to this system (see NFPA 720, Table 5.4.3.1):

Quantity: _____ Style: _____ Class: _____

5. ALARM INITIATING DEVICES AND CIRCUITS

Characteristics of initiating device circuits connected to this system (see NFPA 720, Table 5.4.2):

Quantity: _____ Style: _____ Class: _____

5.1 Automatic Initiating Devices**5.1.1 Carbon Monoxide Detectors**

Number of detectors: _____

Type of devices: ☐ Addressable ☐ Conventional ☐ Coded ☐ Transmitter ☐ N/A

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

6. SUPERVISORY SIGNAL INITIATING DEVICES AND CIRCUITS

Describe: _____ Number of valve supervisory switches: _____

Type of devices: ☐ Addressable ☐ Conventional ☐ Coded ☐ Transmitter ☐ N/A

7. ANNUNCIATORS**7.1 Annunciator 1** ☐ Local ☐ Remote

Type: ☐ Addressable ☐ Directory ☐ Graphic ☐ N/A Location: _____

7.2 Annunciator 2 ☐ Local ☐ Remote

Type: ☐ Addressable ☐ Directory ☐ Graphic ☐ N/A Location: _____

7.3 Annunciator 3 ☐ Local ☐ Remote

Type: ☐ Addressable ☐ Directory ☐ Graphic ☐ N/A Location: _____

8. ALARM NOTIFICATION DEVICES AND CIRCUITS**8.1 Emergency Voice Alarm Service**

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

Number of speakers: _____ Number of speaker zones: _____

FIGURE 4.5.2.1 *Continued*

8. ALARM NOTIFICATION DEVICES AND CIRCUITS (continued)**8.2 Nonvoice Audible System**

Characteristics of notification device circuits connected to this system (see NFPA 720, Table 5.4.2):

Quantity: _____ Style: _____ Class: _____

8.3 Types and Quantities of Nonvoice Notification Appliances Installed:

Bells: _____ With visual device: _____ Horns: _____ With visual device: _____

Chimes: _____ With visual device: _____ Bells: _____ With visual device: _____

Visual devices without audible devices: _____ Other (describe): _____

9. CARBON MONOXIDE SAFETY FUNCTIONS ACTIVATED

Describe: _____

10. SYSTEM POWER SUPPLY**10.1 Primary Power**

Nominal voltage _____ Amps _____

Overcurrent protection: Type _____ Amps _____

Location (of primary supply panelboard): _____

Disconnecting means location: _____

10.2 Secondary Power

Location: _____ Type: _____ Nominal voltage: _____ Current rating: _____

Number of standby batteries: _____ Amp hour rating: _____

Location of emergency generator: _____

Location of fuel storage: _____

Calculated capacity of secondary power to drive the system: _____

In standby mode: _____ In alarm mode: _____

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.

The system has been installed in accordance with the following NFPA standards (note any or all that apply):

☐ NFPA 720 ☐ NFPA 70, Article 725

☐ Manufacturer's instructions ☐ Other (please specify): _____

System deviations from referenced NFPA standards: _____

Signed: _____ Printed name: _____ Date: _____

Organization: _____ Title: _____ Phone: _____

FIGURE 4.5.2.1 Continued

12. RECORD OF SYSTEM OPERATION

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 of:

- ☐ NFPA 720 ☐ NFPA 70, Article 725
☐ Manufacturer's instructions ☐ Other (please specify):
☐ Documentation in accordance with Inspection Testing Form 8.9.2.2 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:

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

Signed: _____ Printed name: _____ Date: _____
Organization: _____ Title: _____ Phone: _____

13.3 Supervising Station:

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

Signed: _____ Printed name: _____ Date: _____
Organization: _____ Title: _____ Phone: _____

13.4 Property 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, its approved sequence of operations, and with all NFPA standards cited herein.

Signed: _____ Printed name: _____ Date: _____
Organization: _____ Title: _____ Phone: _____

FIGURE 4.5.2.1 *Continued*

4.5.2.1.1 Parts 1 through 11 shall be completed after the system is installed and the installation wiring has been checked. Parts 12 and 13 shall be completed after the operational acceptance tests have been completed. [72:4.5.2.1.1]

4.5.2.1.2 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. A final copy shall be provided after completion of the operational acceptance tests. [72:4.5.2.1.2]

4.5.2.1.3 One copy of the record of completion, updated to reflect all system additions or modifications and maintained in a current condition at all times, shall be stored at the [carbon monoxide detection] control unit or other location approved by the authority having jurisdiction. [72:4.5.2.1.3]

4.5.2.2 Revision. All [carbon monoxide detection] systems that are modified after the initial installation shall have the original record of completion revised to show all changes from the original information and shall include a revision date. [72:4.5.2.2]

4.5.2.3 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, a record copy of the site-specific software [72:4.5.2.3]

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. [72:6.2.2.1]

5.2.2.2* All software and firmware shall be protected from unauthorized changes. [72:6.2.2.2]

5.2.2.3 All changes shall be tested in accordance with 8.7.2. [72:6.2.2.3]

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.

5.2.4* Nonrequired (Voluntary) Systems and Components.

5.2.4.1 Nonrequired [carbon monoxide detection] systems and components shall meet the requirements of this standard. [72:6.2.3.1]

5.2.4.2 Nonrequired [carbon monoxide detection] systems and components shall be identified on the record drawings required in 4.5.2.3(2). [72:6.2.3.2]

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. [72:6.3]

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. [72:6.3.1]

5.3.2 Nonrequired Systems. 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. [72:6.3.2]

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. The performance and integrity of carbon monoxide detection systems shall comply with the applicable requirements of 5.4.1 through 5.4.4.

5.4.1 Purpose. Subsection 5.4.1 provides information that shall be used in the design and installation of carbon monoxide detection systems for the protection of life.

5.4.1.1* Circuit Designations. Initiating device circuits, notification appliance circuits, and signaling line circuits shall be designated by class or style, or both, depending on the circuit's capability to continue to operate during specified fault conditions. [72:6.4.2]

5.4.1.1.1 Class.

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

- (1) Initiating device circuits and signaling line circuits that transmit a [carbon monoxide] alarm or supervisory signal, or notification appliance circuits that allow all connected devices to operate during a single open or a nonsimultaneous single ground fault on any circuit conductor, shall be designated as Class A.



- (2) Initiating device circuits and signaling line circuits that do not transmit a [carbon monoxide] alarm or supervisory signal, or notification appliance circuits that do not allow connected devices to operate beyond the location of a single open on any circuit conductor, shall be designated as Class B. [72:6.4.2.1.1]

5.4.1.1.1.2 An open or ground condition shall result in the annunciation of a trouble signal at the protected premise within 200 seconds as required in 4.4.6. [72:6.4.2.1.2]

5.4.1.1.2 Style.

5.4.1.1.2.1 In addition to the requirements shown for Class A or Class B, signaling line circuits shall be permitted to be designated as either Style 4, 6, or 7, depending on their ability to meet the alarm and trouble performance requirements shown in Table 5.4.3.1, during a single open, single ground, wire-to-wire short, simultaneous wire-to-wire short and open, simultaneous wire-to-wire short and ground, and simultaneous open and ground. [72:6.4.2.2.1]

5.4.1.1.2.2* All styles of Class A circuits using physical conductors (e.g., metallic, optical fiber) shall be installed such that the outgoing and return conductors, exiting from and returning to the control unit, respectively, are routed separately. The outgoing and return (redundant) circuit conductors shall not be run in the same cable assembly (i.e., multi-conductor cable), enclosure, or raceway. [72:6.4.2.2.2]

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

- (1) For a distance not to exceed 3 m (10 ft) where the outgoing and return conductors enter or exit the initiating device, notification appliance, or control unit enclosures
- (2) Single conduit/raceway drops to individual devices or appliances
- (3) Single conduit/raceway drops to multiple devices or appliances installed within a single room not exceeding 92.9 m² (1000 ft²) in area [72:6.4.2.2.2]

5.4.1.1.2.3 Where the power to a device is supplied over a separate circuit from the signaling line circuit or initiating device circuit, the operation of the power circuit shall meet the performance requirements of the initiating device circuit or signaling line circuit. [72:6.4.2.2.3]

5.4.1.2 Signaling Paths.

5.4.1.2.1 The class or style of signaling paths (circuits) shall be determined from an evaluation based on the path perfor-

mance detailed in this standard and on engineering judgment. [72:6.4.3.1]

5.4.1.2.2 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 a carbon monoxide detection system on the objectives stated in Section 5.2
- (5) Nature of the hazard 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 [72:6.4.3.2]

5.4.1.2.3 Results of the evaluation required by 5.4.1.2.1 shall be included with the documentation required by 4.5.1.1. [72:6.4.3.3]

5.4.2* 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 of Table 5.4.2. [72:6.5]

5.4.3* Performance of Signaling Line Circuits (SLCs).

5.4.3.1 The assignment of class designations or style designations, or both, to signaling line circuits shall be based on their performance capabilities under abnormal (fault) conditions in accordance with the requirements of Table 5.4.3.1. [72:6.6.1]

5.4.3.2 Where digital communications are used, inability to send or receive digital signals over a signaling line circuit shall be indicated by a trouble signal. [72:6.6.2]

5.4.4 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 of Table 5.4.4. [72:6.7]

5.5 System Requirements.

5.5.1* Actuation Time. Actuation of alarm notification appliances or emergency voice communications, [carbon monoxide] safety functions, and annunciation at the protected premises shall occur within 10 seconds after the activation of an initiating device. [72:6.8.1.1]

Table 5.4.2 Performance of Initiating Device Circuits (IDCs)

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 capacity. X: Indication required at protected premises and as required by Chapter 7. [72: Table 6.5]

Table 5.4.3.1 Performance of Signaling Line Circuits (SLCs)

Class	B			A			A		
Style	4			6			7		
	Alm	Trbl	ARC	Alm	Trbl	ARC	Alm	Trbl	ARC
Abnormal Condition	1	2	3	4	5	7	8	9	10
Single open	—	X	—	—	X	R	—	X	R
Single ground	—	X	R	—	X	—	—	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	—

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 7. [72: Table 6.6.1]

Table 5.4.4 Notification Appliance Circuits (NACs)

Class	B		A	
	Trouble Indication at Protected Premises	Alarm Capability During Abnormal Conditions	Trouble Indication at Protected Premises	Alarm Capability During Abnormal Conditions
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. R: Required capability. [72: Table 6.7]

5.5.2* Carbon Monoxide Detection Control Units.

5.5.2.1 [Carbon monoxide detection] systems shall be permitted to be either integrated systems combining all detection, notification, and auxiliary functions in a single system or a combination of component subsystems. [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.

5.5.2.2 All component subsystems shall be capable of simultaneous, full-load operation without degradation of the required overall system performance. [72:6.8.2.2]

5.5.2.3 The method of interconnection of [carbon monoxide detection] control units shall meet the monitoring requirements of 4.4.6 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 [72:6.8.2.3]

5.5.2.4 Where the signaling line circuit is shared by other premises operating systems, operation shall be in accordance with 5.5.4. [72:6.8.2.4]

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

- (1) The equipment meets the performance requirements of 4.4.4.1.
- (2) The equipment is provided with primary and secondary power and monitored for integrity as required in Section 4.4.



- (3) All programming and configuration ensure a [carbon monoxide detection] system actuation time as required in 5.5.1.
- (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] safety functions 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] safety functions is indicated at the master [carbon monoxide detection] control unit within 200 seconds. [72:6.8.2.4.1]

5.5.2.4.2 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. [72:6.8.2.4.2]

5.5.2.5 Each interconnected [carbon monoxide detection] control unit shall be separately monitored for alarm and trouble conditions. [72:6.8.2.5]

5.5.2.6 Interconnected [carbon monoxide detection] control unit alarm signals shall be permitted to be monitored by zone or by combined common signals. [72:6.8.2.6]

5.5.2.7 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 5.5.2.8.

5.5.2.8 An initiating device with integral sounder shall be permitted to be silenced locally, provided the control panel continues to indicate an alarm function. If the carbon monoxide dissipates, the initiating device shall return to normal mode.

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

5.5.3.1 A protected premises [carbon monoxide detection] system shall be permitted to be interconnected to household [carbon monoxide detection] system(s) for the purpose of activating the notification appliances connected to the household [carbon monoxide detection] system(s). [72:6.8.3.1]

5.5.3.2 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.

5.5.3.3 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.

5.5.3.4 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 4.4.6.

5.5.3.5 An alarm condition occurring at the dwelling unit household carbon monoxide detection system or the opera-

tion 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.

5.5.4 Combination Carbon Monoxide Detection Systems.

5.5.4.1* [Carbon monoxide detection] systems shall be permitted to share components, equipment, circuitry, and installation wiring with [non-carbon monoxide detection] systems. [72:6.8.4.1]

5.5.4.2 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.

5.5.4.3* Short circuits, open circuits, or grounds in this equipment or between this equipment and the carbon monoxide detection system wiring shall not interfere with the monitoring for integrity of the carbon monoxide detection system or prevent alarm, or carbon monoxide safety control signal transmissions.

5.5.4.4* Speakers used as alarm notification appliances on [carbon monoxide detection] systems shall also be permitted to be used for non-emergency purposes, provided that condition (1) or (2) is met:

- (1) The [carbon monoxide] command center is constantly attended by trained personnel and selective paging is permitted by the authority having jurisdiction.
- (2) All of the following conditions are met:
 - (a) The speakers and associated audio equipment are installed or located with safeguards to resist tampering or misadjustment of those components essential for intended emergency notification.
 - (b) The monitoring integrity requirements of 4.4.6 shall continue to be met while the system is used for non-emergency purposes.
 - (c) It is permitted by the local authority having jurisdiction. [72:6.8.4.5]

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

5.5.4.6* 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.

5.5.4.7 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.

5.5.5 Carbon Monoxide Detection System Inputs.

5.5.5.1 General. All initiating devices shall be installed in accordance with 5.5.5 and tested in accordance with Chapter 8.

5.5.5.1.1 Where subject to mechanical damage, an initiating device shall be protected. A mechanical guard used to protect a detector shall be listed for use with the detector.

5.5.5.1.2 Initiating devices shall be supported independently of their attachment to the circuit conductors. [72:5.4.4]

5.5.5.1.3 Initiating devices shall be installed in a manner that provides accessibility for periodic inspection, testing, and maintenance.

5.5.5.1.4* 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. [72:5.4.7]

Exception: Initiating devices connected to a system that provides the required monitoring. [72:5.4.7]

5.5.5.1.5 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.

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

5.5.5.2.1 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. [72:6.8.5.3.1]

Exception: Where the trouble condition is caused by electrical disconnection of the device or by removing the initiating device from its plug-in base. [72:6.8.5.3.1]

5.5.5.2.2* 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. [72:6.8.5.3.2]

5.5.5.3 Requirements for Carbon Monoxide Detectors.

5.5.5.3.1 Carbon monoxide detectors shall be installed in accordance with the manufacturer's published instructions in the following locations:

- (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

5.5.5.3.2 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*.

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

5.5.5.3.4 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.

5.5.5.3.5 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 alarms or improper operation after installation. [72:5.7.1.7]

5.5.5.3.6 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 0°C (32°F)
- (2) Temperature above 38°C (100°F)
- (3) Relative humidity outside the range of 10 percent to 95 percent

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

5.5.5.3.8 Carbon monoxide detectors shall not be installed until after the construction cleanup of all trades is complete and final. [72:5.7.1.11]

Exception: Where required by the authority having jurisdiction for protection during construction. Detectors that have been installed during construction shall be replaced prior to commissioning of the system.

5.5.5.4 Carbon Monoxide Detectors for Control of Carbon Monoxide Spread.

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

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

5.5.6 Carbon Monoxide Alarm Notification System Notification Outputs.

5.5.6.1 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 the requirements of Chapter 6. [72:7.1.3]

5.5.6.2 Occupant Notification.

5.5.6.2.1 Except as permitted in 5.5.6.2.2, occupant notification shall be throughout the protected premises.

5.5.6.2.2 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.

5.5.6.3 Notification Zones.

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

5.5.6.3.2* 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.

5.5.6.4 Circuits for Addressable Notification Appliances.

5.5.6.4.1 Circuit configuration for addressable notification appliances shall comply with the applicable performance requirements for notification zones. [72:6.8.6.4.1]

5.5.6.4.2 In protected premises with more than one notification zone, a single open, short-circuit, or ground on the system installation conductors shall not affect operation of more than one notification zone. [72:6.8.6.4.2]

5.5.6.5 Distinctive Signal.

5.5.6.5.1 The audible carbon monoxide alarm signal shall comply with the following:



- (1) Signals shall be a single tone pattern consisting of four cycles of 100 milliseconds $\pm$ 10 percent “on” and 100 milliseconds $\pm$ 10 percent “off,” followed by 5 seconds $\pm$ 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 $\pm$ 10 percent.
- (3) The alarm signal shall be repeated in compliance with 5.5.6.5.1(1) and 5.5.6.5.1(2) until the alarm resets or the alarm signal is manually silenced.

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

5.5.7 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 Section 6.9 of *NFPA 72, National Fire Alarm Code*, excluding the requirements in 6.9.10.4.

5.5.8 Signal Annunciation.

5.5.8.1 Protected premises [carbon monoxide detection] systems shall be arranged to annunciate [carbon monoxide] alarm, supervisory, and trouble signals in accordance with 4.4.5. [72:6.11.1]

5.5.8.2* 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. [72:6.11.2]

5.5.9 Off-Premises Signals.

5.5.9.1 Systems requiring transmission of signals to continuously attended locations providing supervising station service (e.g., central station, proprietary supervising station, remote supervising station) shall comply with the applicable requirements of Chapter 7. [72:6.13.1]

5.5.9.2 Relays or modules providing transmission of supervisory or trouble signals to a supervising station shall be arranged to provide fail-safe operation. [72:6.13.2]

5.5.9.3 Means provided to transmit supervisory or 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. [72:6.13.3]

5.5.10 Protected Premises Carbon Monoxide Safety Functions. Where provided, the interconnection of safety functions shall comply with the requirements of 5.5.10.1 through 5.5.10.8.

5.5.10.1 Carbon monoxide safety functions shall be permitted to be performed automatically. The performance of automatic carbon monoxide safety control functions shall not preclude the combination of carbon monoxide detection services with other services requiring monitoring of operations.

5.5.10.2* A listed relay or other listed appliance connected to the [carbon monoxide detection] system used to initiate control of protected premises [carbon monoxide] safety functions shall be located within 1 m (3 ft) of the controlled circuit or appliance. [72:6.16.2.2]

5.5.10.3 The relay or other appliance shall function within the voltage and current limitations of the [carbon monoxide detection] control unit. [72:6.16.2.3]

5.5.10.4 The installation wiring between the [carbon monoxide detection] control unit and the relay or other appliance shall be monitored for integrity. [72:6.16.2.4]

Exception: Relays or appliances that operate on loss of power shall be considered self-monitoring for integrity. [72:6.16.2.4]

5.5.10.5 Carbon monoxide safety functions shall not interfere with other operations of the carbon monoxide detection system.

5.5.10.6 The method(s) of interconnection between the [carbon monoxide detection] system and controlled electrical and mechanical systems shall be monitored for integrity in accordance with 4.4.6; shall comply with the applicable provisions of *NFPA 70, National Electrical Code*, Article 725; and shall be achieved by one of 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] or shared with other premises operating systems
- (3) Other listed methods [72:6.16.2.6]

5.5.10.7 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. [72:6.16.2.7]

5.5.10.8 The operation of all [carbon monoxide] safety functions shall be verified by an operational test at the time of system acceptance. [72:6.16.2.8]

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

5.5.11.1* Listing Requirements. Compliance with 5.5.11 shall require the use of low-power radio equipment specifically listed for the purpose. [72:6.17.1]

5.5.11.2 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 signal 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. [72:6.17.2]

5.5.11.3 Carbon Monoxide Alarm Signals.

5.5.11.3.1* When actuated, each low-power radio transmitter shall automatically transmit a [carbon monoxide] alarm signal. [72:6.17.3.1]

5.5.11.3.2 Each low-power radio transmitter shall automatically repeat [carbon monoxide] alarm signal transmission at intervals not exceeding 60 seconds until the initiating device is returned to its nonalarm condition. [72:6.17.3.2]

5.5.11.3.3 [Carbon monoxide] alarm signals shall have priority over all other signals. [72:6.17.3.3]

5.5.11.3.4 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. [72:6.17.3.4]

5.5.11.3.5 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. [72:6.17.3.5]

5.5.11.4 Monitoring for Integrity.

5.5.11.4.1 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). [72:6.17.4.1]

5.5.11.4.2 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. [72:6.17.4.2]

Exception: Where Federal Communications Commission (FCC) regulations prevent meeting the 200-second requirement, 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) Four hours maximum for a transmitter serving a single initiating device
- (2) Four 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 [72:6.17.4.2]

5.5.11.4.3 A single fault on the signaling channel shall not cause a [carbon monoxide] alarm signal. [72:6.17.4.3]

5.5.11.4.4 The periodic transmission required to comply with 5.5.11.4.2 from a low-power radio transmitter shall ensure successful [carbon monoxide] alarm signal transmission capability. [72:6.17.4.4]

5.5.11.4.5 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. [72:6.17.4.5]

Exception: This requirement shall not apply to household [carbon monoxide] detection systems. [72:6.17.4.5]

5.5.11.4.6 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. [72:6.17.4.6]

5.5.11.5 Output Signals from the 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 5.5.11.2.
- (2) All supervision requirements of Chapter 4, Chapter 5, or 5.5.11.4 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 authority having jurisdiction or other governing codes or standards. [72:7.1.1]

6.1.2 The requirements of this chapter shall address the reception of a notification signal and not the signal's information content. [72:7.1.2]

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. [72:7.1.3]

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. [72:7.1.4]

6.1.5* The requirements of this chapter shall apply to the areas, spaces, or system functions where required by other parts of this standard, the authority having jurisdiction, or other codes and standards requiring compliance with this chapter. [72:7.1.5]



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. [72:7.1.6]

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. [72:7.1.7]

6.2 Purpose. Notification appliances shall provide stimuli for initiating emergency action and provide information to users, emergency response personnel, and occupants. [72:7.2]

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. [72:7.3.1]

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. [72:7.3.2.1]

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. [72:7.3.2.2]

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 6.5.2.1 or Section 6.6. [72:7.3.2.3]

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. [72:7.3.3.1]

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. [72:7.3.3.2]

6.3.4* Mechanical Protection.

6.3.4.1 Appliances subject to mechanical damage shall be suitably protected. [72:7.3.4.1]

6.3.4.2 If guards, covers, or lenses are employed, they shall be listed for use with the appliance. [72:7.3.4.2]

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. [72:7.3.4.3]

6.3.5 Mounting.

6.3.5.1 Appliances shall be supported independently of their attachments to the circuit conductors. [72:7.3.5.1]

6.3.5.2 Appliances shall be mounted in accordance with the manufacturer's published instructions. [72:7.3.5.2]

6.3.6* Connections. Terminals, leads, or addressable communication, which provide for monitoring the integrity of the notification appliance connections, shall be provided. [72:7.3.6]

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. [72:7.4.1.1]

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. [72:7.4.1.2]

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. [72:7.4.1.3]

6.4.1.4 Where required, voice communications systems shall be capable of the reproduction of prerecorded, synthesized, or live (e.g., microphone, telephone handset, and radio) messages with voice intelligibility. [72:7.4.1.4]

6.4.1.5 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. [72:7.4.1.5]

6.4.1.6 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 6.4.1.4 where voice intelligibility is required. [72:7.4.1.6]

6.4.1.7 Audible notification appliances used for exit marking 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), except as required by 6.4.6 (Exit Marking Audible Appliance Requirements). [72:7.4.1.7]

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 1.5 m (5 ft) above the floor in the area required to be served by the system using the A-weighted scale (dBA). [72:7.4.2.1]

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. [72:7.4.2.2]

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. [72:7.4.2.3]

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. [72:7.4.2.4]

6.4.2.5 A [carbon monoxide detection] system arranged to stop or reduce ambient noise, when approved by the authority having jurisdiction, shall comply with 6.4.2.5.1 through 6.4.2.5.3. [72:7.4.2.5]

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 1.5 m (5 ft) above the floor in the area required to be served by the system using the A-weighted scale (dBA). [72:7.4.2.5.1]

6.4.2.5.2 Visible notification appliances shall be installed in the affected areas in accordance with Section 6.5 or Section 6.6. [72:7.4.2.5.2]

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. [72:7.4.2.5.3]

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 1.5 m (5 ft) above the floor in the area required to be served by the system using the A-weighted scale (dBA). [72:7.4.3.1]

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. [72:7.4.3.2]

6.4.3.3 A system arranged to stop or reduce ambient noise, when approved by the authority having jurisdiction, shall comply with 6.4.3.3.1 through 6.4.3.3.3. [72:7.4.3.3]

6.4.3.3.1 If approved by the authority having jurisdiction, a system arranged to stop or reduce ambient noise shall be permitted to produce a sound level at least 10 dB above the reduced average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds after reduction of the ambient noise level, whichever is greater, measured 1.5 m (5 ft) above the floor, using the A-weighted scale (dBA). [72:7.4.3.3.1]

6.4.3.3.2 Visible notification appliances shall be installed in the affected areas in accordance with Section 6.5 or Section 6.6. [72:7.4.3.3.2]

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. [72:7.4.3.3.3]

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). [72:7.4.4.1]

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. [72:7.4.4.2]

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. [72:7.4.5.1]

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*. [72:7.4.5.2]

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. [72:7.4.5.3]

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 [72:7.4.5.4]

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 pre-recorded, synthesized, or live messages. [72:7.4.5.5]

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. [72:7.4.5.5.1]

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. [72:7.4.5.5.2]

6.4.6 Exit Marking Audible Notification Appliance Requirements.

6.4.6.1 Exit marking audible notification appliances shall meet or exceed the frequency and sound level settings and guidelines specified in the manufacturer's documented instructions. [72:7.4.6.1]

6.4.6.2 In addition to 6.4.6.1, as a minimum, to ensure that exit marking audible notification appliance signals are clearly heard and produce the desired directional effects for 15.24 m (50 ft) within an unobstructed egress path, they shall meet the



audibility requirements of 6.4.5, Narrow Band Tone Signaling for Exceeding Masked Thresholds, in at least one octave band or one octave band within the effective frequency ranges of the interaural time difference (ITD), interaural level or intensity difference (ILD or IID), and anatomical transfer function or head-related transfer function (ATF or HRTF) localization cues. The signal shall penetrate both the ambient noise and the carbon monoxide alarm signal. [72:7.4.6.2]

6.4.6.3 Where required, exit marking audible notification appliances shall be installed in accordance with the manufacturer's instructions. [72:7.4.6.3]

6.4.6.4* Where required, exit marking audible notification shall be located at the entrance to all building exits and areas of refuge as defined by the applicable building or fire code. [72:7.4.6.4]

6.4.6.5 Where exit marking audible notification appliances are utilized to mark areas of refuge, they shall provide an audible signal distinct from that used for other exits that do not have areas of refuge. [72:7.4.6.5]

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

6.4.7.1 If ceiling heights allow, and unless otherwise permitted by 6.4.7.2 through 6.4.7.5, wall-mounted appliances shall have their tops above the finished floors at heights of not less than 2290 mm (90 in.) and below the finished ceilings at distances of not less than 150 mm (6 in.). [72:7.4.7.1]

6.4.7.2 Ceiling-mounted or recessed appliances shall be permitted. [72:7.4.7.2]

6.4.7.3 If combination audible/visible appliances are installed, the location of the installed appliance shall be determined by the requirements of 6.5.4. [72:7.4.7.3]

6.4.7.4 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. [72:7.4.7.4]

6.4.7.5 Mounting heights other than required by 6.4.7.1 and 6.4.7.2 shall be permitted by the authority having jurisdiction, provided the sound pressure level requirements of 6.4.2 and 6.4.3 are met. [72:7.4.7.5]

6.4.8 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. [72:7.4.8]

6.5* Visible Characteristics — Public Mode.

6.5.1* Visible Signaling. Public mode visible signaling shall meet the requirements of Section 6.5 using visible notification appliances. [72:7.5.1]

6.5.2 Light, Color, and Pulse Characteristics.

6.5.2.1 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. [72:7.5.2.1]

6.5.2.2 A maximum pulse duration shall be 0.2 second with a maximum duty cycle of 40 percent. [72:7.5.2.2]

6.5.2.3 The pulse duration shall be defined as the time interval between initial and final points of 10 percent of maximum signal. [72:7.5.2.3]

6.5.2.4 Lights used for carbon monoxide alarm signaling shall be clear or nominal white or other color as required by the emergency plan and the authority having jurisdiction for the area or building, and shall not exceed 1000 cd (effective intensity).

6.5.2.5 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. [72:7.5.2.6]

6.5.3 Appliance Photometrics. The light output shall comply with the polar dispersion requirements of ANSI/UL 1971, *Standard for Safety Signaling Devices for Hearing Impaired*, or equivalent. [72:7.5.3]

6.5.4 Appliance Location.

6.5.4.1 Wall-mounted appliances shall be mounted such that the entire lens is not less than 2030 mm (80 in.) and not greater than 2440 mm (96 in.) above the finished floor or at the mounting height specified using the performance-based alternative of 6.5.4.5. [72:7.5.4.1]

6.5.4.2 Where low ceiling heights do not permit mounting at a minimum of 2030 mm (80 in.), visible appliances shall be mounted within 150 mm (6 in.) 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 2030 mm (80 in.) and the actual, lower mounting height. [72:7.5.4.2]

6.5.4.3* Spacing in Rooms.

6.5.4.3.1 Spacing shall be in accordance with Table 6.5.4.3.1(a) and Figure 6.5.4.3.1 or Table 6.5.4.3.1(b). [72:7.5.4.3.1]

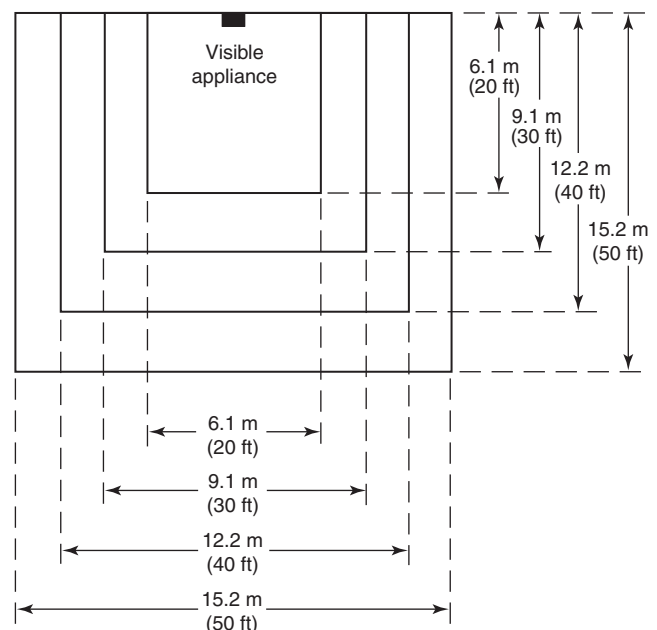


FIGURE 6.5.4.3.1 Room Spacing for Wall-Mounted Visible Appliances. [72: Figure 7.5.4.3.1]

Table 6.5.4.3.1(a) Room Spacing for Wall-Mounted Visible Appliances

Maximum Room Size		Minimum Required Light Output (Effective Intensity, cd)		
m	ft	One Light per Room	Two Lights per Room (Located on Opposite Walls)	Four Lights per Room (One Light per Wall)
6.10 × 6.10	20 × 20	15	NA	NA
8.53 × 8.53	28 × 28	30	Unknown	NA
9.14 × 9.14	30 × 30	34	15	NA
12.2 × 12.2	40 × 40	60	30	15
13.7 × 13.7	45 × 45	75	Unknown	19
15.2 × 15.2	50 × 50	94	60	30
16.5 × 16.5	54 × 54	110	Unknown	30
16.8 × 16.8	55 × 55	115	Unknown	28
18.3 × 18.3	60 × 60	135	95	30
19.2 × 19.2	63 × 63	150	Unknown	37
20.7 × 20.7	68 × 68	177	Unknown	43
21.3 × 21.3	70 × 70	184	95	60
24.4 × 24.4	80 × 80	240	135	60
27.4 × 27.4	90 × 90	304	185	95
30.5 × 30.5	100 × 100	375	240	95
33.5 × 33.5	110 × 110	455	240	135
36.6 × 36.6	120 × 120	540	305	135
39.6 × 39.6	130 × 130	635	375	185

NA: Not allowable.

[72: Table 7.5.4.3.1(a)]

6.5.4.3.2 Visible notification appliances shall be installed in accordance with Table 6.5.4.3.1(a), using one of the following:

- (1) A single visible notification appliance.
- (2) Two visible notification appliances located on opposite walls.
- (3) 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.
- (4) 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. [72:7.5.4.3.2]

6.5.4.3.3 Room spacing in accordance with Table 6.5.4.3.1(a) and Figure 6.5.4.3.1 for wall-mounted appliances shall be based on locating the visible notification appliance at the half-way distance of the wall. [72:7.5.4.3.3]

6.5.4.3.4 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 6.5.4.3.1(a) and Figure 6.5.4.3.1. [72:7.5.4.3.4]

6.5.4.3.5 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. [72:7.5.4.3.5]

6.5.4.3.6* If ceiling heights exceed 9.14 m (30 ft), ceiling-mounted visible notification appliances shall be suspended at

or below 9.14 m (30 ft) or wall-mounted visible notification appliance shall be installed in accordance with Table 6.5.4.3.1(a). [72:7.5.4.3.6]

6.5.4.3.7 Table 6.5.4.3.1(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. [72:7.5.4.3.7]

6.5.4.4* Spacing in Corridors.

6.5.4.4.1 The installation of visible notification appliances in corridors 6.1 m (20 ft) or less in width shall be in accordance with the requirements of either 6.5.4.3 or 6.5.4.4. [72:7.5.4.4.1]

6.5.4.4.2 Subsection 6.5.4.4 shall apply to corridors not exceeding 6.1 m (20 ft) in width. [72:7.5.4.4.2]

6.5.4.4.3 In a corridor application, visible appliances shall be rated not less than 15 cd. [72:7.5.4.4.3]

6.5.4.4.4 Corridors greater than 6.1 m (20 ft) wide shall comply with the spacing requirements for rooms in accordance with 6.5.4.3. [72:7.5.4.4.4]

6.5.4.4.5* Visible notification appliances shall be located not more than 4.57 m (15 ft) from the end of the corridor with a separation not greater than 30.4 m (100 ft) between appliances. [72:7.5.4.4.5]

6.5.4.4.6 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. [72:7.5.4.4.6]



Table 6.5.4.3.1(b) Room Spacing for Ceiling-Mounted Visible Appliances

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

[72: Table 7.5.4.3.1 (b)]

6.5.4.4.7 In corridors where more than two visible notification appliances are in any field of view, they shall flash in synchronization. [72:7.5.4.4.7]

6.5.4.4.8 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 6.5.4.4.5. [72:7.5.4.4.8]

6.5.4.5 Performance-Based Alternative.

6.5.4.5.1 Any design that provides a minimum of 0.4036 lumens/m² (0.0375 lumens/ft²) 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 Safety Signaling Devices for 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 6.5.4, excluding 6.5.4.6. [72:7.5.4.5.1]

6.5.4.5.2 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 Safety Signaling Devices for 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 Safety Signaling Devices for Hearing Impaired*, or equivalent
 - (b) The actual results of laboratory tests of the specific appliance to be used as recorded by the listing organization [72:7.5.4.5.2]

6.5.4.6 Sleeping Areas.

6.5.4.6.1 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.

6.5.4.6.2 Table 6.5.4.6.2 shall apply to sleeping areas. [72:7.5.4.6.2]

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.

Table 6.5.4.6.2 Effective Intensity Requirements for Sleeping Area Visible Notification Appliances

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

[72: Table 7.5.4.6.2]

6.5.4.6.3 For rooms with a linear dimension greater than 4.87 m (16 ft), the visible notification appliance shall be located within 4.87 m (16 ft) of the pillow. [72:7.5.4.6.3]

6.5.5 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. [72:7.5.5]

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. [72:7.6]

6.7 Supplementary Visible Signaling Method. A supplementary visible notification appliance shall be intended to augment an audible or visible signal. [72:7.7]

6.7.1 A supplementary visible notification appliance shall comply with its marked rated performance. [72:7.7.1]

6.7.2 Supplementary visible notification appliances shall be permitted to be located less than 2030 mm (80 in.) above the floor. [72:7.7.2]

6.8 Textual Audible Appliances.

6.8.1 Speaker appliances shall comply with Section 6.4. [72:7.8.1.1]

6.8.2* The sound pressure level, in dBA, of the speaker appliance evacuation tone signals of the particular mode installed (public or private) shall comply with all the requirements in 6.4.2 (public) or 6.4.3 (private). [72:7.8.1.2]

6.9* Textual Visible Appliances.

6.9.1 Application. Textual visible appliances shall be permitted if used in addition to audible or visible, or both, notification appliances. [72:7.9.1]

6.9.2 Performance. The information produced by textual visible appliances shall be legible. [72:7.9.2]

6.9.3 Location.

6.9.3.1 Private Mode. Unless otherwise permitted by the authority having jurisdiction, all textual 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 action initiation and procedure in the areas protected by the system. [72:7.9.3.1]

6.9.3.2 Public Mode. Textual visible notification appliances used in the public mode shall be located to ensure readability by the occupants or inhabitants of the protected area. [72:7.9.3.2]

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. [72:7.10.1]

6.10.2* Performance. Tactile appliances shall meet the performance requirements of ANSI/UL 1971, *Standard for Safety Signaling Devices for Hearing Impaired*, or equivalent. [72:7.10.2]

6.11* Standard Emergency Service Interface. Where required by the authority having jurisdiction, 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.

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.

7.2* General. Connections to supervising stations or communications centers shall be in accordance with *NFPA 72, National Fire Alarm 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 record keeping for a supervising station shall be in accordance with *NFPA 72, National Fire Alarm Code*.

7.4.2 The operation, staffing, and record keeping 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 method or devices are equivalent in effectiveness and safety and meet the intent of the requirements of this chapter.

8.2 General.

8.2.1 The property or building owner or owner's designated representative shall be responsible for the inspection, testing, and maintenance of the system and for alterations or additions to this system. [72:10.2.2.1]

8.2.2 The delegation of responsibility shall be in writing with a copy of such delegation made available to the authority having jurisdiction.

8.2.3 Inspection, testing, and maintenance shall be permitted to be done by an organization other than the owner where conducted under a written contract.

8.3 Service Personnel Qualifications and Experience.

8.3.1* Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of [carbon monoxide detection] systems. Qualified personnel shall 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 service of the specific type and brand of system

- (2)*Personnel who are certified by a nationally recognized [carbon monoxide] alarm certification organization acceptable to the authority having jurisdiction

- (3)*Personnel who are registered, licensed, or certified by a state or local authority

- (4) Personnel who are employed and qualified by an organization listed by a nationally recognized testing laboratory for the servicing of [carbon monoxide detection] systems [72:10.2.2.5.1]

8.3.2 Evidence of qualifications shall be provided to the authority having jurisdiction upon request. [72:10.2.2.5.2]

8.4* Notification.

8.4.1 Before proceeding with any testing, all persons who receive and facilities that receive alarm and trouble signals, and all building occupants, shall be notified to prevent unnecessary response. [72:10.2.3.1]

8.4.2 At the conclusion of testing, those previously notified (and others, as necessary) shall be notified that testing has been concluded. [72:10.2.3.2]

8.4.3 The owner or the owner's designated representative and service personnel shall coordinate system testing to prevent interruption of critical building systems or equipment. [72:10.2.3.3]

8.5 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.

8.6 Inspection.

8.6.1* Visual inspections shall be performed in accordance with the schedules in Table 8.6.1 or more often if required by the authority having jurisdiction. [72:10.3.1]

Exception: Devices or equipment that is inaccessible for safety considerations (e.g., continuous process operations, energized electrical equipment, radiation, and excessive height) shall be inspected during scheduled shutdowns if approved by the authority having jurisdiction. Extended intervals shall not exceed 18 months. [72:10.3.1]

8.6.2 The visual inspection shall be made to ensure that there are no changes that affect equipment performance. [72:10.3.2]

8.7 System Testing of Carbon Monoxide Detection Systems.

8.7.1 Initial Acceptance Testing. All new systems shall be inspected and tested in accordance with the requirements of Chapter 8. The authority having jurisdiction shall be notified prior to the initial acceptance test. [72:10.4.1.1]

8.7.2* Reacceptance Testing.

8.7.2.1 Reacceptance testing shall be performed as required in 8.7.2.1.1 through 8.7.2.1.4. [72:10.4.1.2.1]

8.7.2.1.1 When an initiating device, notification appliance, or control relay is added, it shall be functionally tested. [72:10.4.1.2.1.1]

8.7.2.1.2 When an initiating device, notification appliance, or control relay is deleted, another device, appliance, or control relay on the circuit shall be operated. [72:10.4.1.2.1.2]

Table 8.6.1 Visual Inspection Frequencies

Component	Initial/ Reacceptance	Monthly	Quarterly	Semi- Annually	Annually
1. Control equipment: Carbon monoxide detection systems monitored for carbon monoxide alarm, supervisory, and trouble signals					
(a) Fuses	X	—	—	—	X
(b) Interfaced equipment	X	—	—	—	X
(c) Lamps and LEDs	X	—	—	—	X
(d) Primary (main) power supply	X	—	—	—	X
2. Control equipment: Carbon monoxide detection systems unmonitored for carbon monoxide alarm, supervisory, and trouble signals					
(a) Fuses	X (weekly)	—	—	—	—
(b) Interfaced equipment	X (weekly)	—	—	—	—
(c) Lamps and LEDs	X (weekly)	—	—	—	—
(d) Primary (main) power supply	X (weekly)	—	—	—	—
3. Batteries					
(a) Lead-acid	X	X	—	—	—
(b) Nickel-cadmium	X	—	—	X	—
(c) Primary (dry cell)	X	X	—	—	—
(d) Sealed lead-acid	X	—	—	X	—
4. Transient suppressors	X	—	—	X	—
5. Carbon monoxide detection control unit Trouble signals	X (weekly)	—	—	X	—
6. Fiber-optic cable connections	X	—	—	—	X
7. Emergency voice/alarm communications equipment	X	—	—	X	—
8. Remote annunciators	X	—	—	X	—
9. Initiating devices					
(a) Carbon monoxide detectors (excluding one- and two-family dwellings)	X	—	—	X	—
(b) Air sampling	X	—	—	X	—
(c) Duct detectors	X	—	—	X	—
(d) Electromechanical releasing devices	X	—	—	X	—
(e) Supervisory signal devices	X	—	X	—	—
10. Interface equipment	X	—	—	X	—
11. Alarm notification appliances — supervised	X	—	—	X	—
12. Exit marking audible notification appliances	X	—	—	X	—
13. Special procedures	X	—	—	X	—

8.7.2.1.3 When modifications or repairs to control equipment hardware are made, the control equipment shall be tested in accordance with Table 8.7.3, items 1(a) and 1(d). [72:10.4.1.2.1.3]

8.7.2.1.4 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 4.5.2.1 shall be prepared to reflect these changes. [72:10.4.1.2.1.4]

8.7.2.2 Changes to all control units connected or controlled by 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. [72:10.4.1.2.2]

8.7.3 Test Methods. [Carbon monoxide detection] systems and other systems and equipment that are associated with [carbon monoxide detection] systems and accessory equipment shall be tested according to Table 8.7.3. [72:10.4.2.2]

8.7.4 Testing Frequency.

8.7.4.1 Testing shall be performed in accordance with the schedules in Table 8.7.4.1, except as modified in 8.7.4.2, 8.7.5, and 8.7.6, or more often if required by the authority having jurisdiction. [72:10.4.4]

Exception: Devices or equipment that are inaccessible for safety considerations (e.g., continuous process operations, energized electrical equipment, radiation, and excessive height) shall be tested during scheduled shutdowns if approved by the authority having jurisdiction. Extended interval shall not exceed 18 months. [72:10.4.4]

8.7.4.2 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 8.7.4.1 shall apply. [72:10.4.4.1]

Table 8.7.3 Test Methods

Device	Test Method
1. Control equipment	
(a) Functions	At a minimum, control equipment shall be tested to verify correct receipt of carbon monoxide alarm, supervisory, and trouble signals (inputs), operation of notification circuits and auxiliary functions (outputs), circuit supervision including detection of open circuits and ground faults, and power supply supervision for detection of loss of ac power and disconnection of secondary batteries.
(b) Fuses	The rating and supervision shall be verified.
(c) Interfaced equipment	Integrity of single or multiple circuits providing interface between two or more control units shall be verified. Interfaced equipment connections shall be tested by operating or simulating operation of the equipment being supervised. Signals required to be transmitted shall be verified at the control unit.
(d) Lamps and LEDs	Lamps and LEDs shall be illuminated.
(e) Primary (main) power supply	All secondary (standby) power shall be disconnected and tested under maximum load, including all alarm appliances requiring simultaneous operation. All secondary (standby) power shall be reconnected at end of test. For redundant power supplies, each shall be tested separately.
2. Engine-driven generator	If an engine-driven generator dedicated to the carbon monoxide detection system is used as a required power source, operation of the generator shall be verified in accordance with NFPA 110, <i>Standard for Emergency and Standby Power Systems</i> , by the building owner.
3. Secondary (standby) power supply	All primary (main) power supplies shall be disconnected and the occurrence of required trouble indication for loss of primary power shall be verified. The system's standby and alarm current demand shall be measured or verified and, using manufacturer's data, the ability of batteries to meet standby and alarm requirements shall be verified. Carbon monoxide notification appliances shall be operated for a minimum of 5 minutes. Primary (main) power supply shall be reconnected at end of test.
4. Uninterruptible power supply (UPS)	If a UPS system dedicated to the carbon monoxide detection system is used as a required power source, operation of the UPS system shall be verified by the building owner in accordance with NFPA 111, <i>Standard on Stored Electrical Energy Emergency and Standby Power Systems</i> .

(continues)

Table 8.7.3 Continued

Device	Test Method
5. Batteries — general tests	Prior to conducting any battery testing, the person conducting the test shall ensure that all system software stored in volatile memory is protected from loss.
(a) Visual inspection	Batteries shall be inspected for corrosion or leakage. Tightness of connections shall be checked and ensured. If necessary, battery terminals or connections shall be cleaned and coated. Electrolyte level in lead-acid batteries shall be visually inspected.
(b) Battery replacement	Batteries shall be replaced in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer's recommendations.
(c) Charger test	Operation of battery charger shall be checked in accordance with charger test for the specific type of battery.
(d) Discharge test	With the battery charger disconnected, the batteries shall be load tested following the manufacturer's recommendations. The voltage level shall not fall below the levels specified. <i>Exception: An artificial load equal to the full carbon monoxide detection system load connected to the battery shall be permitted to be used in conducting this test.</i>
(e) Load voltage test	With the battery charger disconnected, the terminal voltage shall be measured while supplying the maximum load required by its application. The voltage level shall not fall below the levels specified for the specific type of battery. If the voltage falls below the level specified, corrective action shall be taken and the batteries shall be retested. <i>Exception: An artificial load equal to the full carbon monoxide detection system load connected to the battery shall be permitted to be used in conducting this test.</i>
6. Battery tests (specific types)	
(a) Lead-acid type	
(i) Charger test	With the batteries fully charged and connected to the charger, the voltage across the batteries shall be measured with a voltmeter. The voltage shall be 2.30 volts per cell ± 0.02 volts at 25°C (77°F) or as specified by the equipment manufacturer.
(ii) Load voltage test	Under load, the battery shall not fall below 2.05 volts per cell.
(iii) Specific gravity	The specific gravity of the liquid in the pilot cell or all of the cells shall be measured as required. The specific gravity shall be 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. A hydrometer that shows only a pass or fail condition of the battery and does not indicate the specific gravity shall not be used, because such a reading does not give a true indication of the battery condition.
(b) Nickel-cadmium type	
(i) Charger test*	With the batteries fully charged and connected to the charger, an ampere meter shall be placed in series with the battery under charge. The charging current shall be in accordance with the manufacturer's recommendations for the type of battery used. In the absence of specific information, $\frac{1}{30}$ to $\frac{1}{25}$ of the battery rating shall be used.
(ii) Load voltage test	Under load, the float voltage for the entire battery shall be 1.42 volts per cell, nominal. If possible, cells shall be measured individually.
(c) Sealed lead-acid type	
(i) Charger test	With the batteries fully charged and connected to the charger, the voltage across the batteries shall be measured with a voltmeter. The voltage shall be 2.30 volts per cell ± 0.02 volts at 25°C (77°F) or as specified by the equipment manufacturer.
(ii) Load voltage test	Under load, the battery shall perform in accordance with the battery manufacturer's specifications.
7. Transient suppressors	Lightning protection equipment shall be inspected and maintained per the manufacturer's published instructions. Additional inspections shall be required after any lightning strikes. Equipment located in moderate to severe areas outlined in NFPA 780, <i>Standard for the Installation of Lightning Protection Systems</i> , Annex L, shall be inspected semiannually and after any lightning strikes.

Table 8.7.3 *Continued*

Device	Test Method
8. Carbon monoxide detection control unit trouble signals	
(a) Audible and visual	Operation of control unit trouble signals shall be verified as well as ring-back feature for systems using a trouble-silencing switch that requires resetting.
(b) Disconnect switches	If control unit has disconnect or isolating switches, performance of intended function of each switch shall be verified and receipt of trouble signal when a supervised function is disconnected shall also be verified.
(c) Ground-fault monitoring circuit	If the system has a ground detection feature, the occurrence of ground-fault indication shall be verified whenever any installation conductor is grounded.
(d) Transmission of signals to off-premises location	An initiating device shall be actuated and receipt of alarm signal at the off-premises location shall be verified. A trouble condition shall be created and receipt of a trouble signal at the off-premises location shall be verified. A supervisory device shall be actuated and receipt of a supervisory signal at the off-premises location shall be verified. If a transmission carrier is capable of operation under a single- or multiple-fault condition, an initiating device shall be activated during such fault condition and receipt of a trouble signal at the off-premises location shall be verified, in addition to the alarm signal.
9. Remote annunciators	The correct operation and identification of annunciators shall be verified. If provided, the correct operation of annunciator under a fault condition shall be verified.
10. Conductors — metallic	
(a) Stray voltage	All installation conductors shall be tested with a volt/ohmmeter to verify that there are no stray (unwanted) voltages between installation conductors or between installation conductors and ground. Unless a different threshold is specified in the published manufacturer's instructions for the installed equipment, the maximum allowable stray voltage shall not exceed 1 volt ac/dc.
(b) Ground faults	All installation conductors other than those intentionally and permanently grounded shall be tested for isolation from ground per the installed equipment manufacturer's published instructions.
(c) Short-circuit faults	All installation conductors other than those intentionally connected together shall be tested for conductor-to-conductor isolation per the published manufacturer's instructions for the installed equipment. These same circuits also shall be tested conductor-to-ground.
(d) Loop resistance	With each initiating and indicating circuit installation conductor pair short-circuited at the far end, the resistance of each circuit shall be measured and recorded. It shall be verified that the loop resistance does not exceed the limits specified in the published manufacturer's instructions for the installed equipment.
(e) Supervision	Introduction of a fault in any circuit monitored for integrity shall result in a trouble indication at the carbon monoxide detection control unit. One connection shall be opened 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.
11. Conductors — nonmetallic	
(a) Circuit integrity	Each initiating device, notification appliance, and signaling line circuit shall be tested to confirm that the installation conductors are monitored for integrity in accordance with the requirements of Chapter 4 and Chapter 5.
(b) Fiber optics	The fiber-optic transmission line shall be tested in accordance with the manufacturer's published instructions 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. This relative figure for each fiber-optic line shall be recorded in the fire alarm control unit. If the power level drops 2 percent or more from the value recorded during the initial acceptance test, the transmission line, section thereof, or connectors shall be repaired or replaced by a qualified technician to bring the line back into compliance with the accepted transmission level per the manufacturer's published instructions.

(continues)

Table 8.7.3 *Continued*

Device	Test Method
11. Conductors — nonmetallic (<i>cont.</i>)	
(c) Supervision	Introduction of a fault in any supervised circuit shall result in a trouble indication at the control unit. One connection shall be opened at not less than 10 percent of the initiating device, notification appliance, and signaling line circuit. Each initiating device, notification appliance, and signaling line circuit shall be tested for correct indication at the control unit. All circuits shall perform as indicated in Table 5.4.2, Table 5.4.3.1, or Table 5.4.4.
12. Initiating devices	
(a) Electromechanical releasing device	(Reserved)
(b) Carbon monoxide detectors	Carbon monoxide detection system detectors shall be functionally tested in accordance with 8.7.5. Carbon monoxide detection system detectors and single- and multiple-station alarms shall be sensitivity tested in accordance with 8.7.6.
(i) Air sampling	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.
(ii) Duct type	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.
(iii) Carbon monoxide detectors with control output functions	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)
13. Alarm notification appliances	
(a) Audible	Sound pressure level shall be measured with sound level meter meeting ANSI S1.4A, <i>Specification for Sound Level Meters</i> , Type 2 requirements. Levels throughout protected area shall be measured and recorded. The sound level meter shall be set in accordance with ANSI S3.41, <i>Audible Emergency Evacuation Signal</i> , using the time-weighted characteristic F (FAST). Record the maximum output when the audible emergency evacuation signal is on.
(b) Audible textual notification appliances (speakers and other appliances to convey voice messages)	Sound pressure level shall be measured with sound level meter meeting ANSI S1.4A, <i>Specification for Sound Level Meters</i> , Type 2 requirements. Levels throughout protected area shall be measured and recorded. The sound level meter shall be set in accordance with ANSI S3.41, <i>Audible Emergency Evacuation Signal</i> , using the time-weighted characteristic F (FAST). The maximum output shall be recorded when the audible emergency evacuation signal is on. Audible information shall be verified to be distinguishable and understandable. In locations where voice intelligibility is required, it shall be verified by one of the following methods: (1) Use of subject-based test methods as described in ANSI S3.2, <i>Method for Measuring the Intelligibility of Speech over Communications Systems</i> (2) Use of methods and instruments that measure certain physical parameters and provide a common intelligibility scale score as described in IEC 60849, <i>Sound Systems for Emergency Purposes</i> (3) Use of other methods acceptable to the authority having jurisdiction
(c) Visible	Test shall be performed in accordance with the manufacturer's published instructions. Appliance locations shall be verified to be per approved layout, and it shall be confirmed that no floor plan changes affect the approved layout. It shall be verified that the candela rating marking agrees with the approved drawing. It shall be confirmed that each appliance flashes.
14. Exit marking audible notification appliance	Tests shall be performed in accordance with manufacturer's published instructions.

Table 8.7.3 *Continued*

Device	Test Method
15. Interface equipment	Interface equipment connections shall be tested by operating or simulating the equipment being supervised. Signals required to be transmitted shall be verified at the control unit. Test frequency for interface equipment shall be the same as the frequency required by the applicable NFPA standard(s) for the equipment being supervised.
16. Carbon monoxide safety functions	Carbon monoxide safety functions (fan control, smoke damper operation, door holder release, door unlocking, etc.) shall be tested by operating or simulating carbon monoxide alarm signals. Testing frequency for carbon monoxide safety functions shall be the same as the frequency required for the initiating device that activates the carbon monoxide safety function.
17. Special procedures — multiplex systems	Communications between sending and receiving units under both primary and secondary power shall be verified. Communications between sending and receiving units under open circuit and short circuit trouble conditions shall be verified. Communications between sending and receiving units in all directions where multiple communications pathways are provided shall be verified. All system functions and features shall be verified in accordance with manufacturer's published instructions.
18. Low-power radio (wireless systems)	The following procedures describe additional acceptance and reacceptance test methods to verify wireless protection system operation: (1) The manufacturer's published instructions and the as-built drawings provided by the system supplier shall be used 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, the system shall be initialized in accordance with the manufacturer's published instructions. A test shall be conducted to verify the alternative path, or paths, by turning off or disconnecting the primary wireless repeater. The alternative communications path shall exist between the wireless control unit and peripheral devices used to establish initiation, indication, control, and annunciation. The system shall be tested for both alarm and trouble conditions. (3) Batteries for all components in the system shall be checked monthly. If the control unit checks all batteries and all components daily, the system shall not require monthly testing of the batteries.

*Example: $4000 \text{ mAh} \times \frac{1}{25} = 160 \text{ mA}$ charging current at 25°C (77°F).

Table 8.7.4.1 **Testing Frequencies**

Component	Initial/ Reacceptance	Monthly	Quarterly	Semi- Annually	Annually	Table 8.7.3 Reference
1. Control equipment — building systems connected to supervising station						1
(a) Functions	X	—	—	—	X	—
(b) Fuses	X	—	—	—	X	—
(c) Interfaced equipment	X	—	—	—	X	—
(d) Lamps and LEDs	X	—	—	—	X	—
(e) Primary (main) power supply	X	—	—	—	X	—
(f) Transponders	X	—	—	—	X	—
2. Control equipment — building systems not connected to a supervising station						1
(a) Functions	X	—	X	—	—	—
(b) Fuses	X	—	X	—	—	—
(c) Interfaced equipment	X	—	X	—	—	—
(d) Lamps and LEDs	X	—	X	—	—	—

(continues)

Table 8.7.4.1 *Continued*

Component	Initial/ Reacceptance	Monthly	Quarterly	Semi- Annually	Annually	Table 8.7.3 Reference
2. Control equipment — building systems not connected to a supervising station (<i>cont.</i>)						
(e) Primary (main) power supply	X	—	X	—	—	—
(f) Transponders	X	—	X	—	—	—
3. Batteries — carbon monoxide detection systems						
(a) Lead-acid type	—	—	—	—	—	6a
(i) Charger test (Replace battery as needed.)	X	—	—	—	X	—
(ii) Discharge test (30 minutes)	X	—	—	X	—	—
(iii) Load voltage test	X	—	—	X	—	—
(iv) Specific gravity	X	—	—	X	—	—
(b) Nickel-cadmium type	—	—	—	—	—	6b
(i) Charger test (Replace battery as needed.)	X	—	—	—	X	—
(ii) Discharge test (30 minutes)	X	—	—	—	X	—
(iii) Load voltage test	X	—	—	X	—	—
(c) Sealed lead-acid type	—	—	—	—	—	6c
(i) Charger test after manufacture (or more frequently as needed.)	X	—	—	—	X	—
(ii) Discharge test (30 minutes)	X	—	—	—	X	—
(iii) Load voltage test	X	—	—	X	—	—
4. Fiber-optic cable power	X	—	—	—	X	11b
5. Control unit trouble signals	X	—	—	—	X	8
6. Conductors — metallic	X	—	—	—	—	10
7. Conductors — nonmetallic	X	—	—	—	—	11
8. Remote annunciators	X	—	—	—	X	9
9. Initiating devices	X	—	—	—	—	12
(a) Duct detectors	X	—	—	—	X	—
(b) Electromechanical releasing device (Reserved)						
(c) Carbon monoxide detection system detectors — functional test (<i>see</i> 8.7.5)						
(d) Carbon monoxide detection system detectors and single- and multiple station carbon monoxide alarms in other than one- and two-family dwellings — sensitivity testing (The requirements of 8.7.6 shall apply.)						
(e) Single- and multiple-station carbon monoxide alarms (<i>see</i> 8.10.1)	—	—	—	—	—	—
(f) Supervisory signal devices (Reserved)	—	—	—	—	—	—
10. Interface equipment and carbon monoxide safety functions	X	—	—	—	X	15, 16
11. Alarm notification appliances	—	—	—	—	—	13
(a) Audible devices	X	—	—	—	X	—
(b) Audible textual notification appliances	X	—	—	—	X	—
(c) Visible devices	X	—	—	—	X	—
12. Exit marking notification appliances	X	—	—	—	X	14
13. Special procedures	X	—	—	—	X	17

8.7.5 Functional Test of Carbon Monoxide Detectors.

8.7.5.1 For all system detectors installed after January 1, 2012, carbon monoxide tests shall be performed at initial acceptance and annually by 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.

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

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

8.7.5.4 All tests and results shall be recorded.

8.7.6 Sensitivity Testing. In other than one- and two-family dwellings, sensitivity of [carbon monoxide detectors] and single- and multiple-station [carbon monoxide] alarms shall be tested in accordance with 8.7.6.1 through 8.7.6.4.5. [72:10.4.4.2]

8.7.6.1 This requirement shall become effective January 1, 2015.

8.7.6.2 Sensitivity shall be checked within 1 year after installation. [72:10.4.4.2.1]

8.7.6.3 Sensitivity shall be checked every alternate year thereafter unless otherwise permitted by compliance with 8.7.6.4. [72:10.4.4.2.2]

8.7.6.4 After the second required calibration test, if sensitivity tests indicate that the device has remained within its listed and marked sensitivity range, the length of time between calibration tests shall be permitted to be extended to a maximum of 5 years. [72:10.4.4.2.3]

8.7.6.4.1 If the frequency is extended, records of nuisance alarms and subsequent trends of these alarms shall be maintained. [72:10.4.4.2.3.1]

8.7.6.4.2 In zones or in areas where nuisance alarms show any increase over the previous year, calibration tests shall be performed. [72:10.4.4.2.3.2]

8.7.6.4.3 To ensure that each [carbon monoxide detector] or [carbon monoxide] alarm is within its listed and marked sensitivity range, it shall be tested using a listed test method. Any of the following methods shall be permitted:

- (1) Calibrated test method
- (2) Manufacturer's calibrated sensitivity test instrument
- (3) Listed control equipment arranged for the purpose
- (4) Control unit arrangement whereby the detector causes a signal at the control unit where its sensitivity is outside its listed sensitivity range
- (5) Other calibrated sensitivity test methods approved by the authority having jurisdiction [72:10.4.4.2.4]

8.7.6.4.4 Detectors or alarms found to have a sensitivity outside the listed and marked sensitivity range shall be cleaned and recalibrated or be replaced. [72:10.4.4.2.5]

Exception: Devices listed as field adjustable shall be permitted to be either adjusted within the listed and marked sensitivity range and cleaned and recalibrated, or they shall be replaced. [72:10.4.4.2.5]

8.7.6.4.5 The detector or alarm sensitivity shall not be tested or measured using any device that administers an unmeasured concentration of [carbon monoxide] into the detector or [] alarm. [72:10.4.4.2.6]

8.8 Maintenance.

8.8.1 [Carbon monoxide detection] system equipment shall be maintained in accordance with the manufacturer's published instructions. [72:10.5.1]

8.8.2 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 []. [72:10.5.4]

8.9 Records.

8.9.1 Permanent Records.

8.9.1.1 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.

8.9.1.2 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.

8.9.1.3 Paper or electronic media shall be permitted.

8.9.2 Maintenance, Inspection, and Testing Records.

8.9.2.1 Records shall be retained until the next test and for one year thereafter. [72:10.6.2.1]

8.9.2.2 System shall be clearly identified by a placard, sticker, or other means to indicate the next regularly scheduled inspection period in accordance with Figure 8.9.2.2.

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.

8.9.2.3 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.

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

8.9.2.5 Paper or electronic media shall be permitted.

8.10 Single- and Multiple-Station Carbon Monoxide Alarms.

8.10.1 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.

8.10.2 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.

8.10.3 Where batteries are used as a source of energy, they shall be replaced in accordance with the alarm equipment manufacturer's published instructions. [72:10.4.8]

8.11 Household Carbon Monoxide Detection Systems.

8.11.1 Testing of Household Carbon Monoxide Detection Systems.

8.11.1.1 Household carbon monoxide detection systems shall be tested by a qualified service technician at least every 3 years according to the methods in Table 8.7.3.

INSPECTION AND TESTING FORM

DATE: _____

TIME: _____

SERVICE ORGANIZATION

Name: _____

Address: _____

Representative: _____

License No.: _____

Telephone: _____

PROPERTY NAME (USER)

Name: _____

Address: _____

Owner Contact: _____

Telephone: _____

MONITORING ENTITY

Contact: _____

Telephone: _____

Monitoring Account Ref. No.: _____

APPROVING AGENCY

Contact: _____

Telephone: _____

TYPE TRANSMISSION

- ☐ McCulloh
☐ Multiplex
☐ Digital
☐ Reverse Priority
☐ RF
☐ Other (Specify) _____

SERVICE

- ☐ Weekly
☐ Monthly
☐ Quarterly
☐ Semiannually
☐ Annually
☐ Other (Specify) _____

Control Unit Manufacturer: _____

Model No.: _____

Circuit Styles: _____

Number of Circuits: _____

Software Rev.: _____

Last Date System Had Any Service Performed: _____

Last Date That Any Software or Configuration Was Revised: _____

ALARM-INITIATING DEVICES AND CIRCUIT INFORMATION

Quantity of Devices Installed	Circuit Style	Quantity of Devices Tested	
_____	_____	_____	Electrochemical
_____	_____	_____	Biomimetic
_____	_____	_____	Metal Oxide Semiconduction (MOS)
_____	_____	_____	Supervisory Switches
_____	_____	_____	Other (Specify): _____

ALARM NOTIFICATION APPLIANCES AND CIRCUIT INFORMATION

Quantity of Appliances Installed	Circuit Style	Quantity of Appliances Tested	
_____	_____	_____	Bells
_____	_____	_____	Horns
_____	_____	_____	Chimes
_____	_____	_____	Strobes
_____	_____	_____	Speakers
_____	_____	_____	Other (Specify): _____

No. of alarm notification appliance circuits: _____

Are circuits monitored for integrity? ☐ Yes ☐ No

FIGURE 8.9.2.2 Example of an Inspection and Testing Form.



SUPERVISORY SIGNAL-INITIATING DEVICES AND CIRCUIT INFORMATION

**Quantity of
Devices Installed**

Circuit Style

**Quantity of
Devices Tested**

Describe: _____

SIGNALING LINE CIRCUITS

Quantity and style of signaling line circuits connected to system (*see NFPA 720, Table 5.4.3.1*):

Quantity _____ Style(s) _____

SYSTEM POWER SUPPLIES

(a) Primary (Main): Nominal Voltage _____ Amps _____
 Overcurrent Protection: Type _____ Amps _____
 Location (of Primary Supply Panelboard): _____
 Disconnecting Means Location: _____

(b) Secondary (Standby):
 _____ Storage Battery: Amp-Hr Rating _____
 Calculated capacity in _____ Amp-Hrs to operate system for _____ hours
 Engine-driven generator dedicated to alarm system: _____
 Location of fuel storage: _____

TYPE BATTERY

- ☐ Dry Cell ☐ Lead-Acid
☐ Nickel-Cadmium ☐ Other (Specify):
☐ Sealed Lead-Acid

- (c) Emergency or standby system used as a backup to primary power supply, instead of using a secondary power supply:
 _____ Emergency system described in *NFPA 70*, Article 700
 _____ Legally required standby described in *NFPA 70*, Article 701
 _____ Optional standby system described in *NFPA 70*, Article 702, which also meets the performance requirements of Article 700 or 701

PRIOR TO ANY TESTING

NOTIFICATIONS ARE MADE

	Yes	No	Who	Time
Monitoring Entity	☐	☐	_____	_____
Building Occupants	☐	☐	_____	_____
Building Management	☐	☐	_____	_____
Other (Specify):	☐	☐	_____	_____
AHJ Notified of Any Impairments	☐	☐	_____	_____

SYSTEM TESTS AND INSPECTIONS

TYPE	Visual	Functional	Comments
Control Unit	☐	☐	_____
Interface Equipment	☐	☐	_____
Lamps/LEDs	☐	☐	_____
Fuses	☐	☐	_____
Primary Power Supply	☐	☐	_____
Trouble Signals	☐	☐	_____
Disconnect Switches	☐	☐	_____
Ground-Fault Monitoring	☐	☐	_____

FIGURE 8.9.2.2 *Continued*

SECONDARY POWER			
TYPE	Visual	Functional	Comments
Battery Condition	☐		
Load Voltage		☐	
Discharge Test		☐	
Charger Test		☐	
Specific Gravity		☐	
TRANSIENT SUPPRESSORS			
	☐		
REMOTE ANNUNCIATORS			
	☐	☐	
NOTIFICATION APPLIANCES			
Audible	☐	☐	
Visible	☐	☐	
Speakers	☐	☐	
Voice Clarity		☐	

INITIATING AND SUPERVISORY DEVICE TESTS AND INSPECTIONS							
Loc. & S/N	Device Type	Visual Check	Functional Test	Factory Setting	Measured Setting	Pass	Fail
		☐	☐			☐	☐
		☐	☐			☐	☐
		☐	☐			☐	☐
		☐	☐			☐	☐
		☐	☐			☐	☐
		☐	☐			☐	☐

Comments: _____

COMBINATION CARBON MONOXIDE SYSTEM	Visual	Device Operation	Simulated Operation
Fire Extinguisher Monitoring Device/System	☐	☐	☐
Building Security	☐	☐	☐
(Specify) _____	☐	☐	☐

INTERFACE EQUIPMENT	Visual	Device Operation	Simulated Operation
(Specify) _____	☐	☐	☐
(Specify) _____	☐	☐	☐
(Specify) _____	☐	☐	☐

Special Procedures: _____

Comments: _____

FIGURE 8.9.2.2 *Continued*

SUPERVISING STATION MONITORING	Yes	No	Time	Comments
Alarm Signal	☐	☐	_____	_____
Alarm Restoration	☐	☐	_____	_____
Trouble Signal	☐	☐	_____	_____
Trouble Signal Restoration	☐	☐	_____	_____
Supervisory Signal	☐	☐	_____	_____
Supervisory Restoration	☐	☐	_____	_____

NOTIFICATIONS THAT TESTING IS COMPLETE	Yes	No	Who	Time
Building Management	☐	☐	_____	_____
Monitoring Agency	☐	☐	_____	_____
Building Occupants	☐	☐	_____	_____
Other (Specify)	☐	☐	_____	_____

The following did not operate correctly: _____

System restored to normal operation: Date: _____ Time: _____

THIS TESTING WAS PERFORMED IN ACCORDANCE WITH APPLICABLE NFPA STANDARDS.

Name of Inspector: _____ Date: _____ Time: _____

Signature: _____

Name of Owner or Representative: _____ Date: _____ Time: _____

Signature: _____

© 2008 National Fire Protection Association NFPA 720 (p. 4 of 4)

FIGURE 8.9.2.2 *Continued*

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

8.11.2 Maintenance of Household Carbon Monoxide Detection Systems. Maintenance of household [carbon monoxide detection] systems shall be conducted according to manufacturer's published instructions. [72:10.4.6.2]

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. [72:11.3.2]

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. [72:11.3.3]

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. [72:11.3.4]

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 and 6.4.4.

9.4.2.2* Alarm Notification Appliances for the Hearing Impaired.

9.4.2.2.1 When alarm notification appliances for the hearing impaired are provided, each initiating device shall cause the operation of a visible alarm signal in accordance with 9.6.3 or the operation of a listed tactile notification appliance.

9.4.2.2.2 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. 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 $\pm$ 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) Any unit that uses a nonrechargeable battery as a primary power supply that is capable of a 10-year or greater service life, including testing, and meets the requirements of 9.5.3 shall not require a replaceable battery.
- (10) A visible “power on” indicator is provided.

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 8 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 $\pm$ 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.

9.6.2 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 be a single tone pattern consisting of four cycles of 100 milliseconds $\pm$ 10 percent “on” and 100 milliseconds $\pm$ 10 percent “off,” followed by 5 seconds $\pm$ 10 percent “off.”

9.6.2.3 After the initial 4 minutes of alarm, the 5-second “off” time shall be permitted to be changed to 60 seconds $\pm$ 10 percent.

9.6.2.4 The alarm signal shall be repeated in compliance with 9.6.2.2 and 9.6.2.3 until the alarm resets or the alarm signal is manually silenced.

9.6.3 Visible Alarm Signals.

9.6.3.1 Visible notification appliances used in sleeping rooms shall have a minimum rating of 110 cd and be mounted within 4.8 m (16 ft) of the pillow.

9.6.3.2 Visible notification appliances in other than sleeping rooms shall have a minimum rating of 15 cd.

9.6.4 Multiple-Purpose Alarms.

9.6.4.1 A fire alarm signal shall take precedence and be distinctively recognizable over any other signal, even when the nonfire signal is initiated first.

9.6.4.2 There shall be a means for distinguishing the carbon monoxide alarm signal from all other signals.

9.6.5 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.

9.6.5.1 Auxiliary components, such as but not limited to relay modules, or notification appliances, listed for use with carbon monoxide alarms shall be permitted providing that an open or short circuit of the wiring leading to these components does not prevent normal operation of the interconnected alarm.

9.6.5.2 Carbon monoxide alarms shall not be interconnected with alarms from other manufacturers unless listed as being compatible with those specific models.

9.6.5.3 A single fault on the wiring connecting the alarms shall not prevent the independent operation of any of the interconnected alarms.

9.6.5.4 The test feature on any alarm device shall cause all interconnected alarms to activate the appropriate alarm signal.

9.6.6 Control Equipment.

9.6.6.1 Control equipment shall be automatically restored upon restoration of electrical power.

9.6.6.2 The control equipment shall be of a type that latches on an alarm condition.

9.6.6.3 When a reset switch is provided, it shall be of a self-restoring type.

9.6.6.4 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.

9.6.6.5 Each electrical carbon monoxide detection system shall have an integral test means to allow testing of the system operation.

9.6.7 Combination Systems.

9.6.7.1 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.

9.6.7.2 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) Distinctive alarm signals shall be obtained between fire alarms and all other functions.
- (3) The use of a common audible notification appliance shall be permitted if distinctive signals are obtained.

9.6.8 Interconnection to Fire Alarm or Combination Control Units.

9.6.8.1 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.

9.6.8.2 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 and 9.6.3.

9.6.9 Supervising Station Systems.

9.6.9.1* 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.

9.6.9.2 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.

9.6.9.3 Where a digital alarm communicator transmitter (DACT) is used to transmit signals from the protected premises to a supervising station, the following shall be permitted:

- (1) The DACT serving the protected premises shall require only a single telephone line and shall require only a call to a single digital alarm communicator receiver (DACR) number.
- (2) The DACT test signals shall be transmitted at least daily.
- (3)*Requirements for indication of central station service shall not be required.

9.6.10 Low-Power Wireless Systems. Low-power radio (wireless) systems shall comply with the requirements of 5.5.11.

Exception: The requirements of 5.5.11.4.5 shall not apply to dwelling units.

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 8.10.

9.8.2 Household carbon monoxide detection systems shall be maintained and tested in accordance with Section 8.11.



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.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.3.3.7 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, 2007]

A.3.3.9 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, 2007]

A.3.3.11 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, and gas lamps.

A.3.3.17 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.4.3.19.3 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: 2007]

A.4.3.1.2 A relay used for carbon monoxide safety functions is one possible example of such a situation.

A.4.3.2.2(2) Nationally recognized [carbon monoxide] alarm certification programs might include those programs offered by the International Municipal Signal Association (IMSA) and the National Institute for Certification in Engineering Technologies (NICET). Note: These organizations and the products or services offered by them have not been independently verified by the NFPA, nor have the products or services been endorsed or certified by the NFPA or any of its technical committees. [72: A.4.3.2.2(2)]

A.4.3.3(2) Nationally recognized [carbon monoxide] alarm certification programs might include those programs offered by the International Municipal Signal Association (IMSA) and National Institute for Certification in Engineering Technologies (NICET). Note: These organizations and the products or services offered by them have not been independently verified by the NFPA, nor have the products or services been endorsed or certified by the NFPA or any of its Technical Committees. [72: A.4.3.3(2)]

A.4.4.1.5.1 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.

The generator does not need to be dedicated to the [carbon monoxide detection] system. [72: A.4.4.1.5.1]

A.4.4.1.5.2.1 A combination system is a fire alarm system and is required to comply with *NFPA 72, National Fire Alarm Code*.

A.4.4.1.5.2.2 An example of another standard is *NFPA 731, Standard for the Installation of Electronic Premises Security Systems*.

A.4.4.1.6 Where a computer system of any kind is used to receive and process alarm 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.

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.4.4.1.6]

A.4.4.1.8.1 Markings for month and year can be applied by the manufacturer or in the field on the basis of the manufacturer's date code. [72: A.4.4.1.8.1]

A.4.4.3.2.2 The operability of controlled mechanical equipment should be verified by periodic testing. Failure to test and properly maintain controlled mechanical equipment can re-

sult in operational failure during an emergency, with potential consequences up to and including loss of life. [72: A.4.4.3.4.2]

A.4.4.3.7.2 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.4.4.3.5.8.3]

A.4.4.4.1(1) The requirement of 4.4.4.1(1) does not preclude transfer to secondary supply at less than 85 percent of nominal primary voltage, provided the requirements of 4.4.1.5 are met. [72: A.4.4.4.1]

A.4.4.4.2.1 [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] 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.4.4.4.2.1]

A.4.4.4.4 The installation of all [carbon monoxide detection] system wiring should take into account the carbon monoxide detection system manufacturer's published installation instructions and the limitations of the applicable product listings or approvals. [72: A.4.4.4.4]

A.4.4.5.3 The primary purpose of [carbon monoxide detection] system annunciation is to enable responding personnel to identify the location of [the carbon monoxide] quickly and accurately and to indicate the status of emergency equipment or [carbon monoxide] safety functions that might affect the safety of occupants in a [carbon monoxide] situation. [72: A.4.4.6.3]

A.4.4.6.1 The provision of a double loop or other multiple path conductor or circuit to avoid electrical monitoring is not acceptable. [72: A.4.4.7.1]

A.4.4.6.1.5 This standard does not have jurisdiction over the monitoring integrity of conductors within equipment, devices, or appliances. [72: A.4.4.7.1.7]

A.4.4.6.2.2 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 4.4.6.1) is considered to be met if the communications channel is peri-

odically tested in accordance with 8.6.3.2.1.5(6) of *NFPA 72, National Fire Alarm Code*. [72: A.4.4.7.3.2]

A.4.4.6.2.3 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.4.5.1.1 Shop drawings for [carbon monoxide detection] systems are intended to provide basic information consistent with the objective of installing a fully operational, code-compliant [carbon monoxide detection] system and to provide the basis for the record drawings required elsewhere in this standard. [72: A.4.5.1.1]

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

Shop drawings should include, to an extent commensurate with the extent of the work being performed, floor plan drawings, riser diagrams (except for systems in single-story buildings), control unit wiring diagrams, point-to-point wiring diagrams, and typical wiring diagrams as described herein. [72: A.4.5.1.1]

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

- (1) Name of owner and occupant
- (2) Location, including street address
- (3) Device legend
- (4) Date
- (5) Input/output programming matrix [72: A.4.5.1.1]

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

- (1) Floor identification
- (2) Point of compass
- (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) Routing for Class A compliance, where applicable
- (11) Ceiling height and ceiling construction details

[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 [72: A.4.5.1.1]

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 [72: A.4.5.1.1]

Typical wiring diagrams should be provided for all initiating devices, notification appliances, remote alarm light emitting diodes (LEDs), remote test stations, and end-of-line and power supervisory devices. [72: A.4.5.1.1]

A.4.5.1.3 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.4.5.2.1 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. [72: A.4.5.2.1]

A.4.5.2.3(1) The owner's manual should include 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) 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
- (3) 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 that are recommended by A.4.5.2.3(1)(3)(b) with the listing recommended by A.4.5.2.3(1)(3)(a)
- (4) Detailed troubleshooting instructions for each trouble condition generated from the monitored field wiring, including opens, grounds, and loop failures [These instructions should include a list of all trouble signals annunciated by the system, a description of the condition(s) that causes such trouble signals, and step-by-step instructions describing how to isolate such problems and correct them (or how to call for service, as appropriate).]
- (5) A service directory, including a list of names and telephone numbers of those who provide service for the system [72: A.4.5.2.3(1)]

A.5.2.1 Carbon monoxide detection for health and worker safety is not addressed in the 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.5.2.2.2 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.6.2.2.2]

A.5.2.4 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 5.2.4.1 mandates that nonrequired (voluntary) systems and components meet the applicable installation, testing, and maintenance requirements of this standard.

A.5.4.1.1 Class A circuits are considered to be more reliable than Class B circuits because they remain fully operational during the occurrence of a single open or a single ground fault, while Class B circuits remain operational only up to the location of an open fault. However, neither Class A nor Class B circuits remain operational during a wire-to-wire short. [72: A.6.4.2]

For both Class A and Class B initiating device circuits, a wire-to-wire short is permitted to cause an alarm on the system based on the rationale that a wire-to-wire short is the result of a double fault (e.g., both circuit conductors have become grounded), while the standard only considers the consequences of single faults. [72: A.6.4.2]

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

tween that of a Style 7 and a minimum function Class A circuit (Style 2). [72: A.6.4.2]

A.5.4.1.1.2.2 A goal of 5.4.1.1.2.2 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 305 mm (1 ft) where the cable is installed vertically and 1.22 m (4 ft) where the cable is installed horizontally. [72: A.6.4.2.2.2]

A.5.4.2 Table 5.4.2 and Table 5.4.3.1 should be used as follows:

- (1) It should be determined whether the initiating devices are directly connected as follows:
 - (a) To the initiating device circuit
 - (b) To a signaling line circuit interface on a signaling line circuit
 - (c) To an initiating device circuit, which in turn is connected to a signaling line circuit interface on a signaling line circuit
- (2) The prime purpose of the tables is to enable identification of minimum performance for styles of signaling line circuits. It is not the intention that the styles be construed as grades. That is, a Style 6 system is not superior to a Style 4 system, or vice versa. In fact, a particular style might better provide adequate and reliable signaling for an installation than a more complex style.
- (3) Table 5.4.2 and Table 5.4.3.1 allow users, designers, manufacturers, and the authority having jurisdiction to identify minimum performance of systems by determining the trouble and [carbon monoxide] alarm signals received at the control unit for the specified abnormal conditions.
- (4) The number of [carbon monoxide] detectors connected to an initiating device circuit is limited by good engineering practice and the listing of the detectors. If a large number of detectors are connected to an initiating device circuit, locating the detector in alarm or locating a faulty detector becomes difficult and time consuming. [72: A.6.5]

On certain types of detectors, a trouble signal results from faults in the detector. When this occurs where there are large numbers of detectors on an initiating device circuit, locating the faulty detector also becomes difficult and time consuming. [72: A.6.5]

A.5.4.3 Subsection 5.4.3.2 requires a trouble indication on the loss of data communications for all styles. Loss of data communications means that a device or subsystem connected to the signaling line circuit is unable to send or receive information to another device or subsystem connected to the same signaling line circuit. In practical operation this means that a device or subsystem cannot be removed from the signaling line circuit or made completely inoperable without a trouble indication at the system. Also refer to A.5.4.2. [72: A.6.6]

A.5.5.1 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 5.5.1 to dictate the time frame for the local safety devices to complete their function.

A.5.5.2 This standard addresses field installations that interconnect two or more listed control units, possibly from differ-

ent manufacturers, that together fulfill the requirements of this standard. [72: A.6.8.2]

Such an arrangement should preserve the reliability, adequacy, and integrity of all alarm and trouble signals and interconnecting circuits intended to be in accordance with the provisions of this standard.

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.6.8.2]

A.5.5.4.1 The provisions of 5.5.4.1 apply to types of equipment used in common for 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.5.5.4.3 When a [non-carbon monoxide detection] system is combined with the [carbon monoxide detection] system using a data transmission method such as EIA232 serial data, isolation of the interconnect circuitry is essential to proper operation. Methods for isolating the [non-carbon monoxide detection] system may include isolation wiring methods or a barrier to prevent failure of the [carbon monoxide detection] system functions due to transfer of wiring faults between the systems. It is also important to consider the adverse impact on the [carbon monoxide detection] system caused by excessive traffic on the communications link. [72: A.6.8.4.3]

A.5.5.4.4 If the building paging system can be controlled by personnel at the carbon monoxide command center, and if permitted by the authority having jurisdiction, the building paging system can be used as a supplementary notification system to provide selective and all-call carbon monoxide alarm.

Dedicated [carbon monoxide] alarm/voice message systems are not required to monitor the integrity of the speaker circuits while active for emergency purposes. [72: A.6.8.4.5]

These circuits must be monitored for integrity while active for nonemergency purposes. The building operator, system designer, and authority having jurisdiction should be aware that in some situations such a system could be subject to deliberate tampering. Tampering is usually attempted to reduce the output of a sound system that is in constant use as a music or paging system and is a source of annoyance to employees. The likelihood of tampering can be reduced through proper consideration of loudspeaker accessibility and system operation. Access can be reduced through the use of hidden or nonadjustable transformer taps (which can reduce playback levels), use of vandal-resistant listed loudspeakers, and placement in areas that are difficult to access, such as high ceilings (any ceiling higher than could be reached by standing on a desk or chair). Nonemergency operation of the system should always consider that an audio system that annoys an employee potentially reduces employee productivity and can also annoy the public in a commercial environment. Most motivations for tampering can be eliminated through appropriate use of the system and employee discipline. Access to amplification equipment and controls should be limited to those in authority to make adjustments to such equipment. It is common practice to install such equipment in a manner that allows adjustment of nonemergency audio signal levels while defaulting to a fixed, preset level of playback when operating in emergency mode. Under extreme circumstances, certain zones of a protected area might require a dedicated emergency voice/alarm communications zone. [72: A.6.8.4.5]

A.5.5.4.6 A combination carbon monoxide detection system, defined in 3.3.19.2, 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 Code*.

A.5.5.5.1.4 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.5.5.5.1.4(a) and Figure A.5.5.5.1.4(b), monitor the presence of the device on the initiating device circuit. [72: A.5.4.7]

A.5.5.5.2.2 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.6.8.5.3.2]

A.5.5.5.3.1(1) Detectors are located on the ceiling above permanently installed fuel-burning appliances because of the 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.5.5.5.3.1(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, barbeque 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.5.5.6.3.2 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.5.5.6.5.2 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. [72: A.6.8.6.5.3]

A.5.5.8.2 Embossed plastic tape, pencil, ink, or crayon should not be considered to be a permanently attached placard. [72: A.6.11.2]