# NFPA 720
# Recommended Practice for the Installation of Household Carbon Monoxide (CO) Warning Equipment

## 1998 Edition


National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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**NFPA 720**

**Recommended Practice for the**

# Installation of Household Carbon Monoxide (CO) Warning Equipment

**1998 Edition**

This edition of NFPA 720, *Recommended Practice for the Installation of Household Carbon Monoxide (CO) Warning Equipment*, was prepared by the Technical Committee on Carbon Monoxide (CO) and Fuel Gas Detectors and acted on by the National Fire Protection Association, Inc., at its Fall Meeting held November 17–19, 1997, in Kansas City, MO. It was issued by the Standards Council on January 16, 1998, with an effective date of February 6, 1998.

This edition of NFPA 720 was approved as an American National Standard on April 2, 1998.

## 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. NFPA 720 is similar in organization to Chapter 2 of NFPA 72, *National Fire Alarm Code®*.

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Carmel-by-the-Sea Fire Dept., CA [E]

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Cerberus Pyrotronics, NY
Nat'l Fire Alarm Code Committee

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**Ronald M. Brave,** Snow Country Development LLC, CO [IM]
Rep. Nat'l Assn. of Home Builders
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### Alternate

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(Alt. to L. Chavez)

### Nonvoting

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**Merton W. Bunker, Jr.,** NFPA Staff Liaison

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

## Contents

**NFPA 720**

**Recommended Practice for the**

# Installation of Household Carbon Monoxide (CO) Warning Equipment

**1998 Edition**

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

Information on referenced publications can be found in Chapter 3 and Appendix C.

## Chapter 1 General

**1-1* Scope.** This document contains recommendations for the selection, installation, operation, and maintenance of equipment that detects concentrations of carbon monoxide that could pose a risk to the health of most occupants in family living units. This document is limited to carbon monoxide warning equipment for use in family living units.

**1-2 General Provisions.**

**1-2.1*** This document is primarily concerned with life safety, not with protection of property. The intent is to provide a warning of the presence of carbon monoxide in sufficient time to allow occupants to either escape or take other appropriate action.

**1-2.2** The functions intended in this document can be performed by single- or multiple-station alarms or by detectors connected to a control unit and associated equipment, or any combination thereof.

**1-2.3** This document covers carbon monoxide warning equipment for use within the family living unit. See NFPA 501C, *Standard on Recreational Vehicles*, for equipment for use in recreational vehicles. Although this equipment may respond to gases produced in unwanted fires, it is not fire warning equipment and should not be used in lieu of fire warning equipment required by NFPA 72, *National Fire Alarm Code®*, or NFPA *101®*, *Life Safety Code®*.

*Exception: A family living unit is not applicable to hotels, motels, and similar occupancies.*

**1-2.4** Supplementary functions, including the transmission of an alarm beyond the household, should be permitted and should not interfere with the performance recommendations of this document.

**1-2.5** Where the authority having jurisdiction requires both the alarm transmission beyond the household and the total system to comply with the applicable sections of NFPA 72, *National Fire Alarm Code*, the recommendations of Section 2-1 and 2-4.2 of this document should be followed.

**1-2.6 Equivalency.** Nothing in this document is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, sensitivity, effectiveness, durability, and safety over those prescribed by this document, provided technical documentation is submitted to the authority having jurisdiction to demonstrate equivalency, and the system, method, or device is approved for the intended purpose.

**1-3 Approval.**

**1-3.1 Equipment.**

**1-3.1.1** All alarms or detectors and related equipment to be installed in conformity with this document should be listed or approved for the purpose for which they are used.

**1-3.1.2** All alarms or detectors and related equipment having materials or forms different from those detailed in this document should be examined and tested in accordance with applicable standards and, if found equivalent, should be permitted to be approved.

**1-4 Definitions.**

**Alarm Signal.** A signal indicating a concentration of carbon monoxide that could pose a risk to the life safety of the occupants in the family living unit, requiring immediate action.

**Approved.*** Acceptable to the authority having jurisdiction.

**Authority Having Jurisdiction.*** The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

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

*Single-Station Alarm.* An assembly incorporating a sensor, control components, and an alarm notification appliance in one unit operated from a power supply either located in the unit or obtained at the point of installation.

*Multiple-Station Alarm.* A single-station alarm with the added capability 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.

**Carbon Monoxide Detector.** A device suitable for connection to a circuit having a sensor that responds to carbon monoxide and does not contain an integral notification appliance.

**Family Living Unit.** As used in this recommended practice, a family living unit is one or more rooms in a single-family detached dwelling, single-family attached dwelling, multifamily dwelling, or mobile home for the use of one or more persons as a housekeeping unit with space for eating, living, and sleeping and permanent provisions for cooking and sanitation. This definition is meant to cover living areas only and not common usage areas in multifamily dwellings such as corridors, lobbies, or basements.

**Fireplace.** A fire chamber and hearth or similar prepared assembly or place, vented or unvented, for use with fuels.

**Fuel-Burning Appliance.*** A device that burns solid, liquid, and/or gaseous fuel.

**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.

**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 identified standards or has been tested and found suitable for a specified purpose.

**Multiple-Purpose Detector.** A detector that incorporates detection capabilities for more than one hazardous condition, such as fire, fuel gas, or carbon monoxide.

**Notification Appliance.** An alarm system component such as a bell, horn, speaker, strobe, or printer that provides an audible or visible output, or both.

**Reliable Component.** A component that is not expected to fail or be periodically replaced and is not monitored.

**Response Plan.** The action to be taken in response to an alarm signal.

**Separate Sleeping Area.** An area of the family living unit where the bedrooms (or sleeping rooms) are located. 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 purposes of this document.

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

**System.** One or more detectors that are interconnected with remotely located devices or components and that have the ability to function interdependently.

**Trouble Signal.** An indication distinct from the alarm signal that warns of a malfunction or failure.

## Chapter 2 Household Carbon Monoxide Warning Equipment

### 2-1 Recommended Protection.

#### 2-1.1* Carbon Monoxide Alarm.

**2-1.1.1** A carbon monoxide alarm or detector should be installed in any family living unit containing a fuel-burning appliance or fireplace or having an attached garage.

**2-1.1.2*** A carbon monoxide alarm or detector should be centrally located outside of each separate sleeping area in the immediate vicinity of the bedrooms. Where bedrooms are separated and the audibility of the alarm or detector to occupants within the bedroom area could be seriously impaired, more than one unit could be needed. Each alarm or detector should be located on the wall, ceiling, or other location as specified in the installation instructions that accompany the unit.

**2-1.2 Alarm Notification Appliances.** Each alarm or detector should cause the operation of an alarm notification appliance that should be clearly audible in all bedrooms over background noise levels and with all intervening doors closed.

**2-1.3 Alarm Notification Appliances for the Hearing Impaired.** In a household occupied by one or more hearing impaired persons, each initiating device should cause the operation of a visible alarm signal(s) in accordance with 2-3.2.3. The responsibility for compliance should be that of the householder.

*Exception: A listed tactile signal should be permitted to be employed.*

### 2-2 Power Supplies.

#### 2-2.1 General.

**2-2.1.1** All power supplies should have sufficient capacity to operate the alarm signal(s) for at least 12 continuous hours.

*Exception: After the initial 4 minutes of alarm, the 5-second "off" time of the alarm signal should be permitted to be changed to 60 seconds ± 10 percent.*

**2-2.1.2** For electrically powered household carbon monoxide warning equipment, the primary (main) power source should be ac.

*Exception No. 1: Detectors and alarms that are powered from a monitored dc circuit of a control unit when power for the control unit meets the requirements of Section 2-2 and the circuit remains operable upon loss of primary (main) ac power are permitted.*

*Exception No. 2: A detector and a wireless transmitter that serves only that detector should be permitted to be powered from a monitored battery primary (main) source when part of a listed, monitored, low-power radio (wireless) system.*

*Exception No. 3: In existing construction, a monitored battery primary (main) power source, as described in 2-2.3, is permitted.*

*Exception No. 4: Visible notification appliances required by 2-3.2.3 are permitted.*

#### 2-2.2 Primary Power Supply — ac.

**2-2.2.1** An ac primary (main) power source should be a commercial light and power supply or other dependable source. A visible "power on" indicator should be provided.

**2-2.2.2** All electrical systems designed to be installed by other than a qualified electrician should be powered from a source not in excess of 30 volts that meets the requirements for Class 2 circuits as defined in NFPA 70, *National Electrical Code®*, Article 725.

**2-2.2.3** A restraining means should be used at the plug-in of any cord-connected installation.

**2-2.2.4** Primary (main) ac power should be supplied from either a dedicated branch circuit or the unswitched portion of a branch circuit also used for power and lighting. Operation of a switch (other than a circuit breaker) or a ground-fault circuit interrupter should not cause loss of primary (main) power.

*Exception: Where a ground-fault circuit interrupter serves all electrical circuits within the household.*

**2-2.2.5** Neither loss nor restoration of primary (main) power should cause an alarm signal.

*Exception: An alarm signal should be permitted within the household but should not exceed 2 seconds.*

**2-2.2.6** Where a secondary (standby) battery is provided, the primary (main) power supply should be of sufficient capacity to operate the system under all conditions of loading with any secondary (standby) battery disconnected or fully discharged.

**2-2.3 Primary Power Supply — Monitored Battery.** Household carbon monoxide warning equipment should be permitted to be powered by a battery, provided that the battery is monitored to ensure that the following conditions are met:

(a) All power requirements are met for at least 1 year of battery life, including monthly testing.

(b) 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.

(c) For a unit employing a lock-in alarm feature, automatic transfer is provided from alarm to a trouble condition.

(d) 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.

*Exception: After the initial 4 minutes of alarm, the 5-second "off" time of the alarm signal should be permitted to be changed to 60 seconds ± 10 percent.*

(e) The audible trouble signal is produced at least once every minute for 7 consecutive days.

(f) Acceptable replacement batteries are clearly identified by the manufacturer's name and model number on the unit near the battery compartment.

(g) A readily noticeable, visible indication is displayed when a primary battery is removed from the unit.

(h) 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 2-2.3(b) through (e) should not be required to have a replaceable battery.

(i) A visible "power on" indicator should be provided.

**2-2.4 Secondary (Standby) Power Supply.**

**2-2.4.1** When provided, a secondary (standby) power supply should 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.

*Exception: After the initial 4 minutes of alarm, the 5-second "off" time of the alarm signal should be permitted to be changed to 60 seconds ± 10 percent.*

**2-2.4.2** Removal or disconnection of a battery used as a secondary (standby) power source should cause a distinctive audible or visible trouble signal.

**2-2.4.3** Acceptable replacement batteries should be clearly identified by manufacturer's name and model number on the unit near the battery compartment.

**2-2.4.4** Where required by law for disposal reasons, rechargeable batteries should be removable.

**2-2.4.5** A distinctive audible trouble signal should sound before the battery is incapable of operating the device(s) (from causes such as aging, discharge, or terminal corrosion) for alarm purposes.

**2-2.4.6 Automatic Recharging.**

**2-2.4.6.1** Automatic recharging should be provided when a rechargeable battery is used as the secondary (standby) supply.

**2-2.4.6.2** The battery should be recharged within 4 hours when power is provided from a circuit that can be switched on or off by means other than a circuit breaker, or within 48 hours when power is provided from a circuit that cannot be switched on or off by means other than a circuit breaker.

**2-3 Equipment Performance.**

**2-3.1 Carbon Monoxide Alarms.** Each carbon monoxide alarm or detector should detect abnormal carbon monoxide levels that could occur in a family living unit, should properly operate in the normal environmental conditions of a household, and should be in compliance with UL 2034, *Standard for Safety Single and Multiple Station Carbon Monoxide Detectors.* UL 2034 includes a level below which the alarm should not respond.

**2-3.2 Alarm Signals.**

**2-3.2.1** All alarm sounding appliances should have a minimum rating of 85 dBA at 10 ft (3 m).

*Exception: An additional audible alarm appliance intended to notify persons in the same room should be permitted to have a sound pressure level as low as 75 dBA at 10 ft (3 m).*

**2-3.2.2 Carbon Monoxide Alarm Notification Pattern.** The audible alarm signal for carbon monoxide alarms should be a single tone pattern consisting of 4 cycles of 100 milliseconds "on" ± 10 percent and 100 milliseconds ± 10 percent "off," followed by 5 seconds ± 10 percent "off." The signal should be repeated until the alarm resets or the alarm signal is manually silenced.

*Exception: After the initial 4 minutes of alarm, the 5-second "off" time of the alarm signal should be permitted to be changed to 60 seconds ± 10 percent.*

**2-3.2.3** Visible notification appliances used in rooms where a hearing impaired person(s) sleeps should have a minimum rating of 110 candela for a maximum room size of 14 ft × 16 ft (4.27 m × 4.88 m). For larger rooms, the visible notification appliance should be located within 16 ft (4.88 m) of the pillow. Visible notification appliances in other areas should have a minimum rating of 15 candela.

**2-3.3 Multiple-Purpose Alarms.** Multiple-purpose alarms should operate as follows:

(a) A fire alarm signal should take precedence or be clearly recognizable over any other signal, even when the non–fire alarm signal is initiated first.

(b) There should be a means for distinguishing the carbon monoxide alarm signal from all other alarm signals.

**2-3.4 Interconnecting Initiating Devices.** Multiple-station alarms should be permitted to be interconnected provided that the following conditions are met:

(a) The multiple-station alarm devices are compatible.

(b) A single fault on the wiring connecting the alarms will not prevent the independent operation of any of the interconnected alarms.

(c) The test feature on any alarm will cause all interconnected alarms to activate the appropriate notification signal.

**2-3.5 Control Equipment.**

**2-3.5.1** Control equipment should be automatically restored upon restoration of electrical power.

**2-3.5.2** The control equipment should be of a type that "locks in" on an alarm condition.

**2-3.5.3** Where a reset switch is provided, it should be of a self-restoring type.

**2-3.5.4** An alarm silencing switch should not be provided unless its silenced position is indicated by a readily apparent signal.

*Exception: Momentary or self-restoring switches should be permitted.*

**2-3.5.5** Each electrical carbon monoxide system should have an integral test means to permit the householder to test system operation.

**2-3.6 Combination Systems.**

**2-3.6.1** Where common wiring is employed for a combination system, the equipment for other than a fire warning signaling system should be permitted to be connected to the common wiring of the system so that short circuits, open circuits, or any other ground-fault in this equipment or interconnection between this equipment and the fire warning system wiring should not interfere with the monitoring for integrity of the fire warning system or prevent alarm or trouble signal transmissions.

**2-3.6.2** In a fire/burglar/carbon monoxide warning system, the operation should be as follows:

(a) A fire alarm signal should take precedence or be clearly recognizable over any other signal, even when the non–fire or carbon monoxide signal is initiated first.

(b) Distinctive alarm signals should be obtained between fire alarms and all other functions. The use of a common sounding notification appliance should be permitted if distinctive signals are obtained.

**2-3.7 Interconnection to Fire Alarm or Combination Control Units.**

**2-3.7.1** Where carbon monoxide alarms or detectors are interconnected to fire alarm or combination control units, connections should be via supervisory circuits only. Operation of carbon monoxide alarms or detectors should not cause fire alarm or combination control units to activate either protected premises or supervising station fire alarm signals.

**2-3.7.2 Supervising Station Fire Alarm Systems.**

**2-3.7.2.1** Supervising station systems requiring transmission of signals to continually staffed locations providing supervising station service (e.g., central station, proprietary, remote station) should also comply with the applicable requirements of Chapter 4 of NFPA 72, *National Fire Alarm Code*. Where carbon monoxide alarms, detectors, multipurpose detectors, or combination or multiple-station alarms or systems are connected to supervising station fire alarm systems, receipt of alarm signals should be clearly indicated as a "supervisory signal carbon monoxide" or other non–fire alarm signal designation acceptable to the authority having jurisdiction.

**2-3.7.2.2 Disposition of Signals.** Signals received by the supervising station fire alarm systems should meet the following requirements:

(a) Immediately retransmit the supervisory signal to the public fire service communication center.

(b) Notify the subscriber by the quickest available method.

*Exception: When the signal results from a prearranged test, action required by 2-3.7.2.2 (a) and (b) is not necessary.*

**2-3.7.3** Where carbon monoxide alarms, detectors, multipurpose detectors, or combination or multiple-station alarms or systems are connected to a protected premises fire alarm system, receipt of alarm signals should clearly indicate the signal as required by 2-3.2.2.

**2-3.8 Low-Power Wireless Systems.** Carbon monoxide warning systems utilizing low-power wireless transmission of signals within the protected household should comply with the requirements of Section 3-13 of NFPA 72, *National Fire Alarm Code*, except that monitoring for placement as required in 3-13.4.5 should not be required.

**2-4 Installation.**

**2-4.1 General Provisions.**

**2-4.1.1** All carbon monoxide alarms or detectors should be installed in a competent manner and in accordance with the manufacturer's installation instructions.

**2-4.1.2** All carbon monoxide alarms or detectors should be located and mounted so that accidental operation will not be caused by jarring or vibration.

**2-4.1.3** All carbon monoxide alarms or detectors should be supported independently of their attachment to wires.

**2-4.1.4** All carbon monoxide alarms or detectors should be tested in accordance with the instructions provided by the supplier or installing contractor *(see 2-5.2 and 2-6.3)* to ensure operation after installation.

**2-4.1.5** All carbon monoxide alarms or detectors should be restored to their normal mode of operation as promptly as possible after each alarm or test.

**2-4.1.6** The supplier or installing contractor should provide the owner with the instructions specified in 2-6.3.

**2-4.2 Multiple-Station Alarm.**

**2-4.2.1*** Interconnection that causes the other multiple-station alarms or the appropriate notification signal of multiple-purpose alarms within an individual family living unit to produce an alarm signal should be permitted. Remote annunciation from single- and multiple-station alarms should be permitted provided the device(s) complies with 2-1.2 and 2-3.3.

**2-4.2.2** Remote annunciation should be permitted provided the signal is clearly identifiable for the hazard it annunciates.

**2-5 Maintenance and Tests.**

**2-5.1 Maintenance.** If batteries are used as a source of energy, they should be replaced in accordance with the recommendations of the alarm equipment manufacturer.

**2-5.2 Periodic Testing.** Alarms, systems, and all connected notification appliances should be inspected and tested in accordance with the manufacturer's instructions at least once a month. The signal(s) produced by testing the carbon monoxide alarm should be identical with the signal produced when the unit is in alarm. Homeowners should have every household carbon monoxide detection system with a control panel tested by a qualified service technician at least every 3 years.

**2-6 Markings and Instructions.**

**2-6.1 General.** Carbon monoxide alarms or detectors should be provided with the information specified in 2-6.2 and 2-6.3.

**2-6.2 Markings.** The following information should be marked on the alarms and detectors and should be provided in the instructions:

(a) Identification of the sensitivity level at which the unit is designed to sense carbon monoxide, and a statement that indicates that the unit is not suitable as a fire detector

(b) The name and address of the manufacturer or listee and the model number

(c) A mark or certification that the unit has been listed by a nationally recognized testing laboratory

(d) An electrical rating (if applicable)
(e) An explanation of signal indicators
(f) A warning that carbon monoxide is odorless, colorless, and tasteless
(g) The proper emergency actions
(h) A manufacturing date or date code
(i) A suggested replacement date

**2-6.3 Instructions.** The following information should be included in the printed instructions provided with the alarms and detectors:
(a) Installation instructions
(b) Operating instructions
(c) Test instructions
(d) Maintenance instructions
(e) Replacement and service instructions
(f) A statement indicating that smoke might not be present during a carbon monoxide alarm condition
(g) *Printed information on the actions that should be taken in case of an alarm

## Chapter 3 Referenced Publications

**3-1** The following documents or portions thereof are referenced within this recommended practice and should be considered as part of its recommendations. The edition indicated for each referenced document is the current edition as of the date of the NFPA issuance of this recommended practice. Some of these documents might also be referenced in this recommended practice for specific informational purposes and, therefore, are also listed in Appendix C.

**3-1.1 NFPA Publications.** National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 70, *National Electrical Code®,* 1996 edition.
NFPA 72, *National Fire Alarm Code®,* 1996 edition.
NFPA *101®, Life Safety Code®,* 1997 edition.
NFPA 501C, *Standard on Recreational Vehicles,* 1996 edition.

**3-1.2 UL Publication.** Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

UL 2034, *Standard for Safety Single and Multiple Station Carbon Monoxide Detectors,* October 29, 1996.

## Appendix A Explanatory Material

*Appendix A is not a part of the requirements of this NFPA document but is included for informational purposes only. This appendix 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 body's 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-1-2.1** Carbon monoxide 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. Refer also to Table B-1 and Figure B-1.

**A-1-4 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-1-4 Authority Having Jurisdiction.** The phrase "authority having jurisdiction" 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-1-4 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-1-4 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-2-1.1** Experience has shown that hazardous concentrations of carbon monoxide can accumulate in a residence, generally from improperly operating heating appliances, insufficient make-up air into the residence or space, or blocked chimneys or vents. However, there are many other potential sources of carbon monoxide within a home, including malfunctioning fossil fuel appliances; wood stoves; fireplaces; idling automobiles in attached garages; portable equipment, such as gasoline-powered lawn and garden equipment, operated within a garage; and barbecues.

Carbon monoxide is odorless, tasteless, and colorless; therefore, its presence is undetectable by smell, taste, or sight. Carbon monoxide alarms meeting the requirements of UL 2034,

*Standard for Safety Single and Multiple Station Carbon Monoxide Detectors*, and installed in accordance with this document should provide a significant level of protection against fatal carbon monoxide exposure.

The installation of additional carbon monoxide alarms could result in a higher degree of protection. Adding alarms to rooms where fuel-burning appliances are located could provide earlier warning of a carbon monoxide hazard caused by those sources. Additional alarms located in a room normally closed off from the recommended alarms could increase the escape time, since the carbon monoxide concentration needed to force the carbon monoxide out of the closed room to the alarm is not necessary. As a consequence, it is recommended that the installation of additional carbon monoxide alarms be considered.

Carbon monoxide alarms or detectors are not substitutes for proper maintenance, inspection, and testing of fuel-burning equipment. Fuel-burning equipment should be used, maintained, inspected, and tested according to the manufacturer's recommendations.

**A-2-1.1.2** At times, depending on conditions, the audibility of notification appliances could be seriously impaired when occupants are within the bedroom area. For instance, there might be a noisy window air conditioner or room humidifier generating an ambient noise level of 55 dBA or higher. The detection devices' alarms need to penetrate through the closed doors and be heard over the bedroom's noise levels with sufficient intensity to awaken sleeping occupants therein. Test data indicate that detection devices having sound pressure ratings of 85 dBA at 10 ft (3 m) and installed outside the bedrooms can produce about 15 dBA over ambient noise levels of 55 dBA in the bedrooms. This is likely to be sufficient to awaken the average sleeping person.

Alarms or detectors located remote from the bedroom area might not be loud enough to awaken the average person. In such cases, it is recommended that units be interconnected in such a way that the operation of the remote detector causes an alarm of sufficient intensity to penetrate the bedrooms. The interconnection can be accomplished by the installation of a system, by the wiring together of multiple-station alarms, by the use of line carrier or radio frequency transmitters/receivers, or by adding supplemental notification appliances.

**A-2-4.2.1** Carbon monoxide alarms or detectors could be susceptible to unwanted alarm signals triggered by vapors from petroleum, alcohols, or household aerosols. An alarm for such a condition might be anticipated and tolerated by the occupant of a family living unit through routine living experience. An alarm would not be acceptable if it also triggered detectors in other family living units or resulted in an alarm of detectors located in common use spaces. Unwanted alarms can occur and inspection authorities should be aware of the ramifications that could result if the coverage is extended beyond the limits of a single-family living unit.

**A-2-6.3(g)** Actions that should be considered include opening of windows and doors, evacuation, and organization(s) to be contacted for assistance.

## Appendix B Dangers of Carbon Monoxide

*This appendix is not a part of the recommendations of this NFPA document but is included for informational purposes only.*

**B-1 Carbon Monoxide.** Carbon monoxide is an odorless, tasteless, colorless gas produced by incomplete combustion. Solid, liquid, or gaseous fuels can each, under certain conditions, produce lethal concentrations in the home. Each year, there are nearly 300 unintentional carbon monoxide deaths from fuel-burning consumer products in American homes. These losses are readily preventable. *(See Table B-1 and Figure B-1.)*

The dangers of carbon monoxide exposure depend on a number of variables, such as the occupant's health, activity level, time of exposure, and initial carboxy hemoglobin (COHb) level. Due to these variables, Table B-1 and Figure B-1 are to be used as general guidelines and might not appear quantitatively consistent.

The following is an equation for determining the estimated percent of COHb in blood.[1]

$$\%\mathrm{COHb}_t = \%\mathrm{COHb}_0[e^{-(t/2398B)}] + 218\ [1 - e^{-(t/2398B)}] \times \left[0.0003 + \left(\frac{\mathrm{ppmCO}}{1316}\right)\right]$$

where:

$\%\mathrm{COHb}_t$ = percentage of COHb at time $t$

$\%\mathrm{COHb}_0$ = percentage of COHb in the blood at time 0

t = time in minutes

$B = 0.0404$ (work effort)

**Table B-1 Symptoms of Carbon Monoxide Exposure**

| Concentration (Parts per Million) | Symptoms |
|---|---|
| 50 | No adverse effects with 8 hours of exposure. |
| 200 | Mild headache after 2–3 hours of exposure. |
| 400 | Headache and nausea after 1–2 hours of exposure. |
| 800 | Headache, nausea, and dizziness after 45 minutes; collapse and unconsciousness after 2 hours of exposure. |
| 1,000 | Loss of consciousness after 1 hour of exposure. |
| 1,600 | Headache, nausea, and dizziness after 20 minutes of exposure. |
| 3,200 | Headache, nausea, and dizziness after 5–10 minutes; collapse and unconsciousness after 30 minutes of exposure. |
| 6,400 | Headache and dizziness after 1–2 minutes; unconsciousness and danger of death after 10–15 minutes of exposure. |
| 12,800 (1.28% by volume) | Immediate physiological effects, unconsciousness, and danger of death after 1–3 minutes of exposure. |

**CAUTION:** These are approximate values for healthy adults. Children, the elderly, and persons with preexisting physical conditions can be more susceptible to the effects of carbon monoxide exposure. Continued exposure after loss of consciousness can cause death.

[1]"A proposal for evaluating human exposure to carbon monoxide contamination in military vehicles," Steinberg, Nielson, March 1977, AMCMS Code 672716.H700011; Coburn, R. F., Forster, R. E., and Kane, P. G., "Considerations for the physiological variables that determine the blood carboxy hemoglobin concentration in man," *Journal of Clinical Investigation,* 1965, 44, 1899–1910.

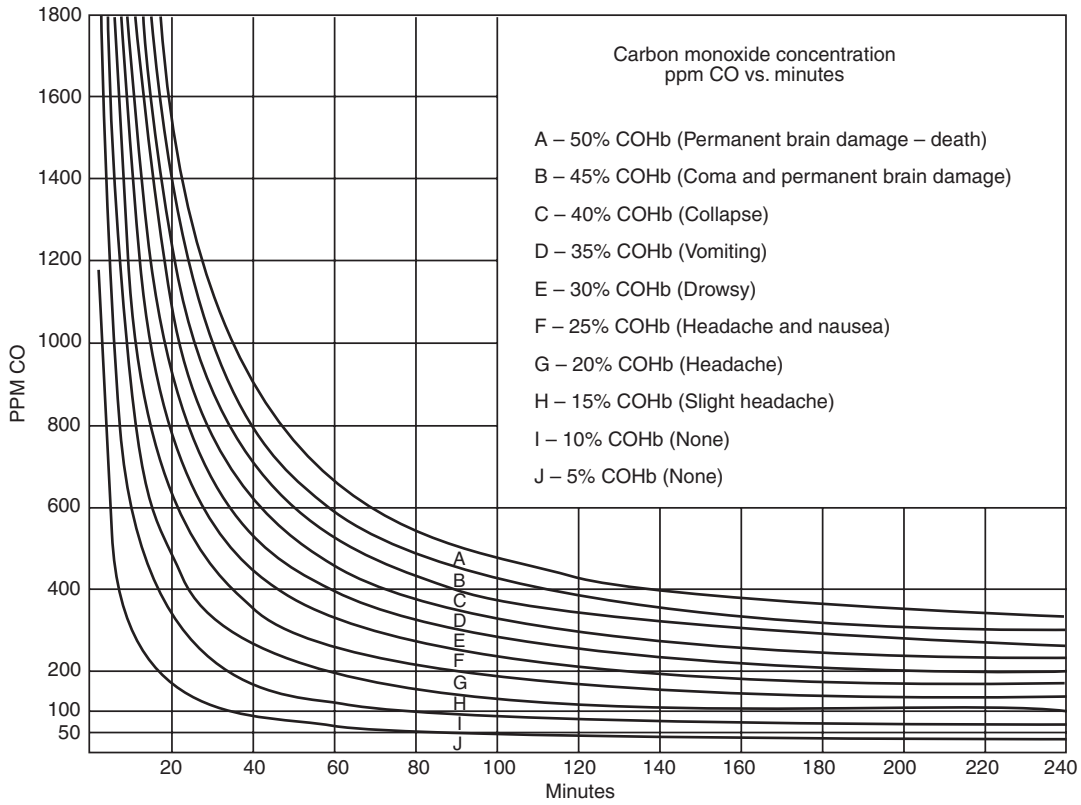


**Figure B-1 Carbon monoxide concentration (ppm CO) versus time (minutes).**

## Appendix C Referenced Publication

**C-1** The following document or portion thereof is referenced within this recommended practice for informational purposes only and is thus not considered part of its recommendations. The edition indicated here is the current edition as of the date of the NFPA issuance of this recommended practice.

**C-1.1 UL Publication.** Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

UL 2034, *Standard for Safety Single and Multiple Station Carbon Monoxide Detectors,* October 29, 1996.