

# **ICC Code Technology Committee (CTC)**

## **Carbon Monoxide Detectors**

### **ICC Code Change History 2000-2004/2005**

**Final action indicated next to code change number**

# F87-00 - D

## 914

**Proponent:** Patrick N.C. Nnaji, Fairfax County, Virginia

**Add new text as follows:**

### **Section 914** **Carbon Monoxide Alarm and Detection Systems**

**914.1 Scope.** This section covers the application, installation, performance, and maintenance of carbon monoxide detection and alarm systems.

#### **914.2 Definitions**

**Multiple Station Carbon Monoxide Alarm.** Two or more single station alarm devices that are capable of interconnection such that actuation of one causes all audible alarms to operate.

**Single Station Carbon Monoxide Alarm.** An assembly incorporation the detector, control equipment and alarm sounding device in one unit that is operated from a power supply in the unit or obtained at the point of installation.

**914.3 Equipment.** Carbon monoxide alarm systems and components that comply with UL 2034 shall be listed and labeled for the purpose for which they are installed.

**914.4 Where Required.** Approved automatic carbon monoxide detection and alarm systems that comply with UL 2034 shall be installed and maintained where indicated in Sections 911.4.3.

**914.4.1 Group I-1.** Single or multiple stations alarms shall be installed and maintained in the following locations in Group I-1 Occupancy buildings which contain fuel-burning appliances or fireplaces or attached garages:

1. In sleeping areas, or
2. In open common areas or living rooms where there are no intervening doors. At least one alarm shall be located in a common area or living room in each story or basement; or
  1. In the room or adjoining space where a fuel-burning appliance is located; and
  2. At a location near the entrance to the living space from an attached garage.

#### **Exceptions:**

1. An approved carbon monoxide alarm shall not be required in the space where a fuel-burning appliance is located if the fuel-burning appliance is equipped with an integral carbon monoxide alarm that complies with UL 2034.
2. Where there is no intervening door between the location of the fuel-burning appliance and an adjoining common area or space, an alarm located in any part of the combined space shall be sufficient.
3. In buildings with non-ducted heating systems without attached garages, an alarm located in a regularly monitored area near the location of the fuel-burning appliance shall be sufficient.

**914.4.2 Groups R-1, R-2, R-3 and R-4.** Single or multiple station alarms shall be installed nad maintained in the following ocatons in R-1, R-2, R-3 and R-4 Occupancy buildings which contain fuel-burning appliances or fireplaces or attached garages:

1. sleeping areas, or
2. In open common areas or living rooms where there are no intervening doors. At least one alarm shall be located in a common area or living room in each story within the guestroom or suite including basements. For guestrooms or suites with split levels and without an intervening door between adjacent levels, the lower level shall be considered as part of the upper level provided that the lower level is less than one full story below the upper level, or
3. In the room or adjoining space where a fuel-burning appliance is located; and

4. At a location near the entrance to the living space from an attached garage.

**Exceptions:**

1. An approved carbon monoxide alarm shall not be required in the space where a fuel-burning appliance is located if the fuel-burning appliance is equipped with an integral carbon monoxide alarm that complies with UL 2034.
2. Where there is no intervening door between the location of the fuel-burning appliance and an adjoining common area or space, an alarm located in any part of the combined space shall be sufficient.
3. In buildings with non-ducted heating systems without attached garages, an alarm located in a regularly monitored area near the location of the fuel-burning appliance shall be sufficient.

**914.4.3 Additions, Alterations or repairs to Group R.** Where an addition or alteration in a dwelling unit includes an addition of a bedroom, such addition shall comply with the provisions of Section 911.4.2.

**914.5 Installation.** Access shall be provided to carbon monoxide alarms for inspection and maintenance.

**914.6 Interconnection.** Where more than one carbon monoxide alarm is required to be installed within an individual dwelling unit in Group R-2, R-3, or R-4; within an individual guestroom or suite in Group R-1; or on individual stories of Group I-1 Occupancies, the carbon monoxide alarms shall be interconnected in such a manner that the actuation of one alarm will activate all of the alarms in the dwelling unit or on the same story.

**914.7 Power Source.** In new construction, required carbon monoxide alarms shall receive their primary power from the building wiring where such wiring is served from a commercial source and shall be equipped with a battery backup. The alarm shall emit a signal when the batteries are low. Wiring shall be permanent and without a disconnecting means other than those required for over-current protection. Carbon monoxide alarm devices that are solely battery operated shall be permitted in existing buildings; or in buildings not served from a commercial source; or in buildings that undergo alterations, repairs or additions regulated by Section 2802.4.3.

**Exception.** Carbon monoxide alarms that are integral parts of a fuel-burning appliance shall be permitted to receive their power from either source alone.

**Reason:** The purpose of this code change is to introduce a new requirement mandating the installation of carbon monoxide (CO) is an odorless, colorless, and deadly gas. Carbon monoxide is a by-product of incomplete combustion of carbon-containing materials such as fossil fuels. It is therefore produced in varying quantities in all homes equipped with fuel-burning appliances as well as in homes housing automobiles in attached garages. Improperly used or malfunctioning appliances may result in seriously incomplete combustion and over a period of time, produce dangerous levels of CO. The CO combines readily with blood forming carboxyhemoglobin (COHb). At COHb level greater than 20%, coma, loss of consciousness, or death can occur.

The U.S. Consumer Product Safety Commission (CPSC) reports that, on the average, between 1994 and 1998, approximately 10,6000 people were treated annually in hospital emergency rooms for non-fatal non-fire related CO poisoning injuries. Between 1992 and 1996, the total number of unintentional non-fire related CO poisoning deaths, including both deaths associated with consumer products and deaths associated with motor vehicle exhaust averaged 544 annually. Of this number, 331 were attributed to motor vehicle exhaust and 213 deaths were attributed to consumer products. Most of the 213 deaths associated with consumer products were related to the use of heating systems. Most of these accidental CO poisonings could have been prevented if the buildings were equipped with CO alarms.

CO alarms are very inexpensive and their manufacturers are producing reliable products that are based on recent standards developed by International Approval Services and Underwriters Laboratories. Many lives will be saved by mandatory installation of CO alarm systems in single-family, multifamily dwelling places, and institutional occupancies where fuel-burning equipment are used.

## F87-00

**Committee Action:**

**Disapproval**

**Committee Reason:** The proposal is inconsistent with recommended practices. The document referenced is a recommended practice, not a standard. There still is no installation standard available, and there is a concern over reliability in the installation of those devices.

**Assembly Action:**

**No Motion**

## RB48-00 - D

## R318

**Proponent:** Donald LeBrun, CBO, County of Steuben, representing Indiana Association of Building Officials

**Add new section as follows:**

### **SECTION R318** **CARBON MONOXIDE DETECTORS/ALARMS**

**R318.1 Carbon monoxide detectors required.** Carbon monoxide detectors shall be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms and on each additional story of the dwelling, including basements and cellars, but not including crawl spaces and uninhabitable attics. In dwellings or dwelling units with split levels, a carbon monoxide detector need be installed only on the upper level, except that if there is a door between levels then a detector is required on each level. All detectors shall be interconnected such that the actuation of one alarm will activate all alarms in the individual unit and shall provide an alarm which will be audible in all sleeping areas. All detectors shall be approved and listed and shall be installed in accordance with the manufacturer's installation instructions.

**R318.1.1 Alterations, repairs and additions.** When alterations, repairs or additions requiring a permit occur, or when one or more sleeping rooms are added or created in existing dwellings, the entire building shall be provided with carbon monoxide detectors located as required for new dwellings.

**Exception:** Detectors shall not be required to be interconnected and hard wired where the alterations, repairs or additions do not result in the exposure of electrical wiring by the removal of interior wall and ceiling finishes.

**R318.2 Power source.** In new construction, required carbon monoxide detectors shall receive their primary power from the building wiring when such wiring is served from a commercial source, and when primary power is interrupted, shall receive power from a battery. Wiring shall be permanent and without a disconnecting switch other than those required for overcurrent protection. Carbon monoxide detectors shall be permitted to be battery operated when installed in buildings without commercial power or in buildings which undergo alterations, repairs or additions regulated by Section R318.1.1

(Renumber current Section R318 and succeeding ones)

**Reason:** Carbon monoxide, the "Silent Killer", is a poisonous gas which gives no warning of its presence. It can sneak up on its victim and kill a person without warning.

When inhaled, carbon monoxide enters the bloodstream and replaces the oxygen molecules carried to our bodies by the hemoglobin. This replacement deprives the heart and brain of oxygen to function normally. This systemic poisoning leads to difficulty in breathing, cardiac trauma, brain damage, coma and eventually, death.

Those lucky enough to survive over-exposure to this toxic gas are often left with permanent neurological and cardiovascular difficulties.

Technology exists today to provide ample warning to at-risk building occupants prior to their being exposed beyond permissible personal exposure levels. UL listed and labeled residential carbon monoxide detectors/alarms are widely available and priced along the lines of residential smoke detectors.

## RB48-00

**Committee Action:**

**Disapproval**

**Committee Reason:** Too many flaws in proposal. Carbon monoxide standards are not the same as Smoke Detector Standards.

**Assembly Action:**

**No Motion**

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## RB42-01 - D

### R318

**Proponent:** Donald LeBrun, CBO, representing Indiana Association of Building Officials

**Add new text as follows:**

**SECTION R318**  
**CARBON MONOXIDE ALARMS**

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**R318.1 Single- and multiple-station carbon monoxide alarms.** Single- and multiple-station carbon monoxide alarms shall be installed in the following locations:

1. Outside of each separate sleeping area in the immediate vicinity of the bedrooms.
2. On each additional story of the dwelling, including basements and cellars, but not including crawl spaces and uninhabitable attics. In dwellings or dwelling units with split levels and without an intervening door between the adjacent levels, a carbon monoxide alarm installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.

When more than one carbon monoxide alarm is required to be installed within an individual dwelling unit the alarm devices shall be interconnected in such a manner that the actuation of one alarm will activate all alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed.

All carbon monoxide alarms shall be listed and installed in accordance with the provisions of this code.

**R318.1.1 Alterations, repairs and additions.** When interior alterations, repairs or additions requiring a permit occur, or when one or more sleeping rooms are added or created in existing dwellings, the individual dwelling unit shall be provided with carbon monoxide detectors located as required for new dwellings; the carbon monoxide alarms shall be interconnected and hardwired.

**Exceptions:**

1. Carbon monoxide alarms in existing areas shall not be required to be interconnected and hard wired where the alterations, repairs or additions do not result in the removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space, or basement available which could provide for hard wiring and interconnection without the removal of interior finishes.
2. Repair to the exterior surfaces of dwellings are exempt from the requirements of this section.

**R318.2 Power source.** In new construction, the required carbon monoxide alarms shall receive their primary power from the building wiring when such wiring is served from a commercial source, and when primary power is interrupted, shall receive power from a battery. Wiring shall be permanent and without a disconnecting switch other than those required for over-current protection. Carbon monoxide alarms shall be permitted to be battery operated when installed in buildings without commercial power or in buildings that undergo alterations, repairs or additions regulated by Section R318.1.1

(Renumber current Section 318 and succeeding ones)

**Reason:** Carbon monoxide, the "Silent Killer", is a poisonous gas that gives no warning of its presence. It can sneak up on its victim and kill of main without warning.

When inhaled, carbon monoxide enters the bloodstream and replaces the oxygen molecules carried to our bodies by the hemoglobin. This replacement deprives the heart and brain of oxygen to function normally. This systemic poisoning leads to difficulty in breathing, cardiac trauma, brain damage, coma and eventually, death.

Those lucky enough to survive over-exposure to this toxic gas are often left with permanent neurological and cardiovascular difficulties.

Technology exists today to provide ample warning to at-risk building occupants prior to their being exposed beyond permissible personal exposure levels. UL listed and labeled residential carbon monoxide detectors/alarms are widely available and priced along the lines of residential smoke detectors.

## RB42-01

**Committee Action:**

**Disapproved**

**Committee Reason:** There is too much conflict in the industry regarding whether or not carbon monoxide alarms are needed. The UL Standard for these has not received ANSI approval. There is concern about installation location of these alarms. The proponent is encouraged to rework the proposal and bring it back next year.

**Assembly Action:**

**No Motion**

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## F134-02 - D

### 909 (New), [IBC 909 (New)], [IRC M1401 (New)], [IPMC 608 (New)]

**Proponent:** Steven Rocklin, State of New York, Department of State, Division of Code Enforcement; representing State of New York, Department of State, Division of Code Enforcement

**THIS PROPOSAL IS ON THE AGENDA OF THE IFC, IPMC AND THE IRC BUILDING/ENERGY CODE DEVELOPMENT COMMITTEES. SEE THE TENTATIVE HEARING ORDERS FOR THESE COMMITTEES.**

**1. Add new text as follows:**

**SECTION 909**  
**CARBON MONOXIDE ALARMS**

**909.1 General.** Single station carbon monoxide alarms shall be installed and maintained in buildings containing one or more fuel-fired appliances or attached garage, as provided in Sections 909.1.1 through 909.1.6. For the purposes of this section, fuel-fired appliances shall be deemed to include factory-built and site built fireplaces.

**909.1.1 Where required - new buildings and structures.** Single station carbon monoxide alarms shall be installed in dwelling units and sleeping units in buildings of Group R, Group I-1 and Group I-4 occupancies. Required alarms shall be provided on each floor level containing habitable space. On any floor level containing bedrooms, the required carbon monoxide alarm shall be installed in the immediate vicinity of bedrooms. At least one required alarm in each dwelling unit or sleeping unit shall be equipped with a digital readout of carbon monoxide concentration. The readout shall display carbon monoxide levels continuously or when in alarm condition, and shall have provision to display the maximum carbon monoxide concentration recorded since the memory was last reset.

**Exceptions:**

1. Carbon monoxide alarms shall not be required in buildings where all fuel-fired appliances are provided with an approved, listed device that will shut off the fuel supply when a carbon monoxide concentration of 400 parts per million is detected for 15 minutes.
2. Carbon monoxide alarms shall not be required where:
  - 2.1. The dwelling unit or sleeping unit contains no fuel-fired appliances and is located two or more stories above or below any story containing a fuel-fired appliance or having an attached garage;
  - 2.2. The dwelling unit or sleeping unit contains no fuel-fired appliances and is not connected by a ventilation system to any space containing a fuel-fired appliance or having an attached garage; and
  - 2.3. The building is provided with a common area carbon monoxide alarm system. Initiating devices shall be located in the immediate vicinity of spaces containing fuel-fire appliances or attached garage. Initiating devices shall also be located in the immediate vicinity of any shaft connected to a story containing fuel-fired appliances, and within two stories above or below such story. The system shall be provided with remote alarm notification to an approved supervising station.

**909.1.2 Where required - additions and alterations.** Where an addition or alteration to a Group R occupancy adds bedrooms or sleeping units, carbon monoxide alarms shall be installed as provided in Section 909.1.1 in the addition and in the portion of the building being altered.

**909.1.3 Where required - existing buildings.** At least one single station carbon monoxide alarm shall be installed in each dwelling unit and sleeping unit in existing Group R occupancies. The required carbon monoxide alarm shall be installed in the immediate vicinity of bedrooms.

**909.1.4 Equipment and installation.** Carbon monoxide alarms shall conform with Sections 909.1.4.1 through 909.1.4.3.

**909.1.4.1 Standard.** Carbon monoxide alarms shall be listed, labeled and installed in conformance with UL 2034 and this code.

**909.1.4.2 Power source.** Carbon monoxide alarms shall receive their primary power from a lighting circuit of the building wiring system, provided that such wiring system is served from a commercial source, and shall be equipped with a battery backup. Carbon monoxide alarms shall emit a signal when batteries are low. Wiring shall be permanent and without a disconnecting switch other than as required for overcurrent protection.

**Exception:** Carbon monoxide alarms required to be installed in existing buildings by Section 909.1.3 are permitted to be cord connected or battery operated.

**909.1.4.3 Supervisory service.** Where carbon monoxide alarms are monitored by an approved supervising station, a distinctive alarm signal shall be used to differentiate between the carbon monoxide alarms and other alarm system functions. Activation of a carbon monoxide alarm shall not activate a fire alarm signal.

**909.1.5 Maintenance.** Carbon monoxide alarms shall be maintained in conformance with the manufacturer's instructions. Where a backup battery is of a removable type, it shall be replaced in conformance with the manufacturer's instructions.

**909.1.6 Alarm disabling prohibited.** Required carbon monoxide alarms shall not be removed or disabled, except for replacement, service or repair purposes.

Add new standard and reference as follows:

**CHAPTER 45  
REFERENCED STANDARDS**

**UL**

2034-96	Single and Multiple Station Carbon Monoxide Alarms Second Edition (October 29, 1996) - with Revisions thru June 2, 1999
	909.1.4.1

1. Add new section to the IRC as follows:

**[F] SECTION M1401  
GENERAL**

**M1401.5 Carbon monoxide alarms.** Carbon monoxide alarms shall be installed and maintained as provided in Sections M1401.5.1 through M1401.5.5. For the purposes of this section, fuel-fired appliances shall be deemed to include factory-manufactured and site built fireplaces.

**M1401.5.1 Where required - new buildings ad structures.** Single station carbon monoxide alarms shall be installed indwelling units. Required alarms shall be provided on each floor level containing habitable space. On any floor level containing bedrooms, the required carbon monoxide alarm shall be installed in the immediate vicinity of bedrooms. At least one required alarm in each dwelling unit shall be equipped with a digital readout of carbon monoxide concentration. The readout may display carbon monoxide levels continuously or when in alarm condition, and shall have provision to display the maximum carbon monoxide concentration recorded since the memory was last reset.

**Exceptions:**

1. Carbon monoxide alarms shall not be required in buildings where all fuel-fired appliances are provided with an approved, listed device that will shut off the fuel supply when a carbon monoxide concentration of 400 parts per million is detected for 15 minutes.
2. Carbon monoxide alarms shall not be required where:
  - 2.1 The dwelling unit is located two or more stories above or below any story containing a fuel-fired appliance or an attached garage; and

2.2. The dwelling unit is not connected by a ventilation system to any space containing a fuel-fired appliance or an attached garage.

**M1401.5.2 Where required - additions and alterations.** Where an addition or alteration adds bedrooms, carbon monoxide alarms shall be installed as provided in Section M1401.5.1 in the addition and in the portion of the building being altered.

**M1401.5.3 Equipment and installation.** Carbon monoxide alarms shall conform with Sections M1401.5.3.1 through M1401.5.3.3.

**M1401.5.3.1 Standard.** Carbon monoxide alarms shall be listed, labeled and installed in conformance with UL 2034.

**M1401.5.3.2 power source.** Carbon monoxide alarms shall receive their primary power from a lighting circuit of the building wiring, provided that such wiring is served from a commercial source, and shall be equipped with a battery backup. Carbon monoxide alarms shall emit a signal when batteries are low. Wiring shall be permanent and without a disconnecting switch other than as required for overcurrent protection.

**M1401.5.3.3 Supervisory service.** Where carbon monoxide alarms are monitored by an approved supervising station, a distinctive alarm signal shall be obtained between carbon monoxide alarms and other functions. Activation of a carbon monoxide alarm shall not activate a fire alarm signal.

**M1401.5.4 Maintenance.** Carbon monoxide alarms shall be maintained in conformance with the manufacturer's instructions. Where a backup battery is of a removable type, it shall be replaced in conformance with the manufacturer's instructions.

**M1401.5.5 Alarm disabling prohibited.** Required carbon monoxide alarms shall not be removed or disabled, except for replacement, service or repair purposes.

Add new standard and reference as follows:

**CHAPTER 43  
REFERENCED STANDARDS**

**UL**

2034-96 Single and Multiple Station Carbon Monoxide Alarms Second Edition (October 29, 1996) - with Revisions thru June 2, 1999  
1401.5.3.1

3. Add new section to the IPMC as follows:

**[F] SECTION 608  
CARBON MONOXIDE ALARMS**

**608.1 General.** At least one carbon monoxide alarm shall be installed in each dwelling unit or sleeping unit in existing Group R occupancies and in existing dwellings not regulated as Group R occupancies, where dwelling units or sleeping units are not already provided with carbon monoxide alarms. Required carbon monoxide alarms shall be in accordance with Sections 608.2 through 608.4, and shall be installed in the immediate vicinity of bedrooms. For the purposes of this section, fuel-fired appliances shall be deemed to include factory-manufactured and site built fireplaces.

**Exceptions:**

1. Carbon monoxide alarms shall not be required in buildings where all fuel-fired appliances are provided with an approved, listed device that will shut off the fuel supply when a carbon monoxide concentration of 400 parts per million is detected for 15 minutes.
2. Carbon monoxide alarms shall not be required where:



- 2.1. The dwelling unit or sleeping unit is located two or more stories above or below any story containing a fuel-fire appliance or an attached garage;
- 2.2. The dwelling unit or sleeping unit is not connected by a ventilation system to any space containing a fuel-fired appliance or an attached garage; and
- 2.3. The building is provided with a common area carbon monoxide alarm system. Initiating devices shall be located in the immediate vicinity of space containing fuel-fired appliances or attached garage. Initiating devices shall also be located in the immediate vicinity of any ventilated shaft connected to a story containing fuel-fired appliances, and within two stories above or below such story. The system shall be provided with remote alarm notification to an approved supervising station.

**608.2 Equipment and installation.** Carbon monoxide alarms shall conform with Sections 608.2.1 through 608.2.3.

**608.2.1 Standard.** Carbon monoxide alarms shall be listed, labeled and installed in conformance with UL 2034.

**608.2.2 Power source.** Carbon monoxide alarms required by Section 608.1 are permitted to be wired to a lighting circuit, cord connected or battery operated. Where carbon monoxide alarms receive their primary power from a lighting circuit of the building wiring, such wiring shall be served from a commercial source. Carbon monoxide alarms having a battery shall emit a signal when batteries are low.

**608.2.3 Supervisory service.** Where carbon monoxide alarms are monitored by an approved supervising station, a distinctive alarm signal shall be obtained between carbon monoxide alarms and other functions. Activation of a carbon monoxide alarm shall not activate a fire alarm signal.

**608.3 Maintenance.** Carbon monoxide alarms shall be maintained in conformance with the manufacturer's instructions. Where a backup battery is of a removable type, it shall be replaced in conformance with the manufacturer's instructions.

**608.4 Alarm disabling prohibited.** Required carbon monoxide alarms shall not be removed or disabled, except for replacement, service or repair purposes.

**Add new standard and reference as follows:**

**CHAPTER 8  
REFERENCED STANDARDS**

**UL**

2034-96	Single and Multiple Station Carbon Monoxide Alarms Second Edition (October 29, 1996) - with Revisions thru June 2, 1999
	608.2.1

**Reason:** The proposed code sections would add provisions requiring the installation of carbon monoxide (CO) alarms in Group R, I-1 and I-4 occupancies, and in dwellings regulated under the *International Residential Code*. CO is an invisible, odorless gas that is generated by the incomplete combustion of carbonaceous fuels such as fuel oil, natural gas, kerosene and wood. As CO is not detectable by the senses, its presence and concentration can only be determined by instruments.

The initial effect of CO poisoning is impairment of judgment. CO poisoning results from displacement of oxygen in the blood supply by carboxyhaemoglobin. In an article in the *American Journal of Forensic Medicine and Pathology* (Vol. 10, No. 1, 19889), I.R. Hill notes that fine discriminatory functions begin to be impaired at 5 percent saturations, with significant decrements being noted at the 10 percent saturation level. Hill also notes that headaches occur at 20 to 30 percent saturation, and that nausea, dizziness and muscular weakness occur at 30 to 40 percent. Thus, CO poisoning will affect the judgment and capability of persons to evacuate or take other appropriate actions well before concentrations reach fatal levels.

A number of different sources were reviewed to develop an estimate of the annual number of fatalities attributable to unintentional, non-fire, building source carbon monoxide poisoning. The sources reviewed contain estimates ranging between 200 and 1200.

The U.S. Consumer Product Safety Commission (CPSC) in an October, 2000 review estimated 207 deaths annually; this estimate was based on CPSC Death Certificate File, CPSC Injury or Potential Injury File, and National Center for Health Statistics Mortality File, 1993-1997. This is a consistent with a 1996 release from the California Environmental Protection Agency Air Resources Board (CARB), which estimated 45 deaths annually in California.

In a report in the *Journal of the American Medical Association* (Vol.279, No. 9, March 4, 1998), Yoon et. Al. Estimate that half of the approximately 2100 annual deaths from CO poisoning in the United States could be prevented by the installation of CO detectors. The study was based on the examination 136 fatalities investigated by the New Mexico Office of the Medical Investigator from 1980 to 1995. Yoon found that

80 of these deaths, approximately 60 percent, occurred in residences, with the remaining 56 occurring in motor vehicles. Dr. Yoon is on the staff of the Epidemiology Progra Office, Epidemic Intelligence Service, U.S. Centers for Disease Control (CDC).

CDC also publishes a weekly bulletin, the *Morbidity and Mortality Weekly* (MMWR), in which a number of short articles on carbon monoxide poisoning have been found. The 10/8/82 issue estimated 1,500 fatalities annually from accidental exposures, allowing for a projection of 600 accidental fatalities in residential premises. The 11/27/92 issue carried an article based on fatalities in Michigan from 1987 to 1989. Based on this report, it is project that there were an average of 315 fatalities nationally for the period. An editorial note in the same issue allows for a projection of approximately 350 fatalities annually. The 10/28/94 issue reported on findings of the Colorado Department of Public Health and Environment; for the years 1986 to 1991, they estimated 590 fatalities annually.

Dr. David Penney, Professor of Physiology at Wayne State University School of Medicine, maintains a web site on carbon monoxide poisoning. Based on CDC data, he estimated 525 unintentional fatalities for 1996. Using the same data, he estimated approximately 250 unintentional carbon monoxide fatalities in New York State, for the years 1988 to 1996. Based on this, we could anticipate 27.8 fatalities statewide annually.

Give the wide divergence in unintentional fatality estimates from the sources reviewed, it is difficult to provide a reliable estimate of annual fatalities in the United States. However, exclusion of the lowest and highest estimates would leave a range of 315 to 500 annual fatalities nationally. As a test of this estimate, we extrapolated the national data to New York State. If the most conservative of the fatality estimates (315) is used, we would expect approximately 12.5 annual unintentional fatalities statewide, excluding New York City, based on 1999 population estimates. The New York State Department of Health (DOH) has estimated 14 fatalities annually, based on specific coding in the Vital Statistics Death File, which was prepared by the Bureau of Injury Prevention.

In addition to death, CO poisoning may cause significant injuries and long term health consequences. In an observation in *Archives of Neurology* (Vol. 57, No. 8, August 2000), Sohn et. Al. Noted the incidence of parkinsonism and intellectual impairment in a married couple who experienced CO poisoning simultaneously. While it was noted that both individuals showed complete recovery after thirteen months, the observation is suggestive of additional potential consequences. It should also be noted that CPSC has estimated an average of 10,000 injuries or hospital emergency room visits annually from carbon monoxide poisoning.

Technical questions have been raised about false alarm incidence and sensitivity of CO alarms. As a result, Underwriters Laboratories revised UL 2034, effective for alarms manufactured after October 1, 1998. The stability test requires an alarm signal after different time periods, based on CO concentrations, as shown below.

Time (minutes)	Concentration (parts per million)
189	70
50	150
15	400

Formerly, the alarm signal was required within 90 minutes at 100 ppm and 35 minutes at 200 ppm. In addition, listed CO alarms are required to ignore 30 ppm concentrations for at least 30 days, and 70 ppm concentrations for at least one hour. Audible signals are also eliminated for low level exposures (30 ppm). UL made further technical revisions, effective June 2, 1999, primarily with regard to alarms for recreational boats; however, these do not substantially affect CO alarms for buildings.

UL has reported that it is working on a white paper describing a three year study conducted on CO alarms. The paper should be available for distribution by the end of the year. Representatives of UL have stated that the study is showing that CO alarms are performing in a very effective manor. Over the test period, with 70 to 75 units in the field, two separate alarms have activated in two separate homes with CO problems. The problems were reported to have been corrected. One dwelling needed a new furnace. Two units have indicated supervised failures with audible trouble signals. No false positives have been recorded throughout the entire period. The units were brought in for sensitivity testing twice a year, and the test results were reported as favorable. No false negatives have been experienced and all of the units provided alarm signals that would allow the occupants of the house to react to elevated levels of CO.

**Costs:** It is projected that carbon monoxide alarms will be required primarily in one- and two-family dwellings and townhouses, as most multiple dwellings do not contain fuel-fired appliances within or directly adjacent to the dwelling units or sleeping accommodations, and most use terminal units for heating and air conditioning. Data from the National Association of Home Builders (NAHB) indicates that 1,270,000 one-family dwellings were constructed during 1999, having an average size of 2,228 square feet. National cost data from HAHB indicates that the average cost of residential construction in 1999 was \$68.80 per square foot, excluding the value of an improved lot. Based on these reports, the average house cost approximately \$153,000, and the approximate value of all one-family residential construction during 1999 was approximately \$195 billion.

For the purpose of this analysis, it is assumed that approximately 1.5 million dwelling units and sleeping units in which a carbon monoxide alarm would be required are constructed annually. It is further assumed that each one-family dwelling will require the installation of two carbon monoxide alarms and that all other subject units will require one alarm to be installed; thus, approximately 3.4 million carbon monoxide alarms would be required annually in new construction. It is estimated that the average cost of a carbon monoxide alarm that will comply with the proposed amendment is approximately \$50 per unit, and that the installation will cost approximately \$25 per unit. Thus, the annual cost in new construction would be approximately \$210 million. For a typical one-family dwelling, the installed cost of carbon monoxide alarms would represent 0.1 percent of construction costs.

Carbon monoxide alarms conforming with UL 2034 used metal oxide semiconductor (MOS) and electrochemical detection technologies. In both cases, there is a useful life of approximately ten years. Thus, we can anticipate increased costs over time. Data from NAHB indicate that the only consistent trend in production of one-family dwellings has been to track population growth. If we assume an annual growth rate of 3 percent, it can be projected that approximately 3.4 million new dwelling units that would require the installation of carbon monoxide alarms will be constructed in 2030. For the same year, approximately 4.5 million dwelling units will require replacement carbon monoxide alarms. The projected cost of installing carbon monoxide alarms in new construction and replacing them in existing construction at that time would be approximately \$900 million, in current dollars, which would be shared by approximately 8 million dwellings. This projection assumes no significant changes in detection technology or unit cost. It further assumes that combustion of carbonaceous fuels will remain the primary source for domestic space heating and water heating.

For the 2000 census, the Census Bureau in the U.S. Department of Commerce reports that there are approximately 116 million housing units in the United States. Cord connected and battery operated carbon monoxide alarms are widely available for as little as \$25. Since there are no installation costs associated with these devices, the ten year cost for installing one carbon monoxide alarm in every housing unit in the United States would be approximately \$2.9 billion, or less that \$300 million annually.

The total projected annual cost for carbon monoxide alarms in new and existing housing in 2030 is thus estimated at approximately \$1.2 billion. The commonly used dollar value for fatalities in liability cases is \$2.7 million. If there are 315 annual fatalities avoided as a result of the proposal, the annual social cost of carbon monoxide fatalities would be approximately \$850 million. However, if there are 500 annual fatalities, the annual

social cost would increase to \$1.35 billion. In that there is uncertainty concerning the number of fatalities, and the cost of injuries has been neglected in this analysis, requiring the installation of carbon monoxide alarms in all residential buildings containing fuel-fired appliances would be prudent.

## F134-02

### ITEM 1 (IFC), ITEM 2 (IBC), ITEM 3 (IPMC)

#### Committee Action:

**Disapproved**

**Committee Reason:** The code change is a good concept, but needs refinement, clarification, and simplification.

#### Assembly Action:

**No Motion**

### ITEM 4 (IRC )

#### Committee Action:

**Disapproved**

**Committee Reason:** To be consistent with the action taken, on Item 1, by the IFC Committee. Also, the proposal is flawed and the proponent should rework and bring it back next year.

#### Assembly Action:

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## RB66-02 - D

### R318

**Proponent:** Donald Lebrun, County of Steuben, representing Indiana Association of Building Officials

#### Add new text as follows:

**SECTION R318**  
**CARBON MONOXIDE ALARMS**

**R318.1 Single- and multiple-station carbon monoxide alarms.** Single- and multiple-station carbon monoxide alarms shall be installed in the following locations:

1. Outside of each separate sleeping area in the immediate vicinity of the bedrooms.
2. On each additional story of the dwelling, including basements and cellars, but not including crawl spaces and uninhabitable attics. In dwellings or dwelling units with split levels and without an intervening door between the adjacent levels, a carbon monoxide alarm installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.

When more than one carbon monoxide alarm is required to be installed within an individual dwelling unit the alarm devices shall be interconnected in such a manner that the actuation of one alarm will activate all alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed.

All carbon monoxide alarms shall be listed and installed in accordance with the provisions of this code.

**R318.1.1 Alterations, repairs and additions.** When interior alterations, repairs or additions requiring a permit occur, or when one or more sleeping rooms are added or created in existing dwellings, the individual dwelling unit shall be provided with carbon monoxide detectors located as required for new dwellings; the carbon monoxide alarms shall be interconnected and hardwired.

#### **Exceptions:**

1. Carbon monoxide alarms in existing areas shall not be required to be interconnected and hard wired where the alterations, repairs or additions do not result in the removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space, or basement available which could provide for hard wiring and interconnection without the removal of interior finishes.
2. Repair to the exterior surfaces of dwellings are exempt from the requirements of this section.

**R318.2 Power source.** In new construction, the required carbon monoxide alarms shall receive their primary power from the building wiring when such wiring is served from a commercial source, and when primary power is interrupted, shall receive power from a battery. Wiring shall be permanent and without a disconnecting switch other than those required for over-current protection. Carbon monoxide alarms shall be permitted to be battery operated when installed in buildings without commercial power or in buildings that undergo alterations, repairs or additions regulated by Section R318.1.1

(Renumber current Section 318 and succeeding ones)

**Reason:** Carbon monoxide, the "Silent Killer", is a poisonous gas that gives no warning of its presence. It can sneak up on its victim and kill of main without warning.

When inhaled, carbon monoxide enters the bloodstream and replaces the oxygen molecules carried to our bodies by the hemoglobin. This replacement deprives the heart and brain of oxygen to function normally. This systemic poisoning leads to difficulty in breathing, cardiac trauma, brain damage, coma and eventually, death.

Those lucky enough to survive over-exposure to this toxic gas are often left with permanent neurological and cardiovascular difficulties.

Technology exists today to provide ample warning to at-risk building occupants prior to their being exposed beyond permissible personal exposure levels. UL listed and labeled residential carbon monoxide detectors/alarms are widely available and priced along the lines of residential smoke detectors.

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## **F115-03/04 - D**

### **907.2.10 (IBC [F] 907.2.10); IRC R313**

**Proponent:** Carl R. Eriksson, Park City Municipal Corporation/Murray City Corporation, representing Utah Chapter of ICC

**THIS PROPOSAL IS ON THE AGENDA OF THE IFC AND THE IRC BUILDING/ENERGY CODE DEVELOPMENT COMMITTEES. SEE THE TENTATIVE HEARING ORDER FOR THESE COMMITTEES.**

#### **1. (IFC) Revise Section 907.2.10 as follows:**

**907.2.10 Single- and multiple-station ~~smoke~~ alarms.** Listed single- and multiple-station smoke alarms shall be installed in accordance with the provisions of this code and the household fire-warning equipment provisions of NFPA 72. Listed single- and multiple-station carbon monoxide detectors shall be installed in accordance with the provisions of this code and NFPA 720.

**907.2.10.1 ~~Where required~~ **Smoke alarms.**** Single- or multiple-station smoke alarms shall be installed in the locations described in Sections 907.2.10.1.1 through 907.2.10.1.4.

**907.2.10.1.1 Group R-1.** (No change to current text)

**907.2.10.1.2 Groups R-2, R-3, R-4 and I-1.** (No change to current text)

**907.2.10.1.3 Group I-1.** (No change to current text)

**907.2.10.2 Carbon monoxide alarms.** Carbon monoxide alarms shall be installed on each habitable level of a dwelling unit or sleeping unit in Groups R-2, R-3, R-4 and I-1 equipped with fuel burning appliances.

~~907.2.10.2~~ **907.2.10.3 Power source.** In new construction, required ~~smoke~~ alarms shall receive their primary power from the building wiring where such wiring is served from a commercial source and shall be equipped with a battery backup. ~~Smoke~~ Alarms shall emit a signal when the batteries are low. Wiring shall be permanent and without a disconnecting switch other than as required for overcurrent protection.

**Exception:** ~~Smoke~~ Alarms are not required to be equipped with battery backup in Group R-1 where they are connected to an emergency electrical system.

~~907.2.10.3~~ **907.2.10.4 Interconnection.** Where more than one ~~smoke~~ alarm is required to be installed within an individual dwelling unit or sleeping unit in Group R-2, R-3 or R-4, or within an individual sleeping unit in Group R-1, the ~~smoke~~ alarms shall be interconnected in such a manner that the activation of one alarm will activate all of the alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed. Approved combination smoke- and carbon-monoxide-detectors shall be allowed.

~~907.2.10.4~~ **907.2.10.5 Acceptance testing.** When the installation of the alarm devices is complete, each detector and interconnecting wiring for multiple-station alarm devices shall be tested in accordance with the household fire warning equipment provisions of NFPA 72 and NFPA 720, as applicable.

**2. (IFC) Add new referenced standard to Chapter 45 as follows:**

<u>NFPA 720-03 Recommended Practice for the</u>	
<u>Installation of Household Carbon</u>	
<u>Monoxide (CO) Warning</u>	
<u>Equipment</u>	<u>907.2.10.1, 907.2.10.5</u>

**3. (IRC) Revise Section R313 as follows:**

**SECTION R313  
SMOKE ALARMS**

**[F] R313.1 Smoke alarms.** Smoke alarms shall be installed in the following locations:

1. through 3. (No change to current text)

~~When more than one smoke alarm is required to be installed within an individual dwelling unit the alarm devices shall be interconnected in such a manner that the actuation of one alarm will activate all of the alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed.~~

All smoke alarms shall be listed and installed in accordance with the provisions of this code and the household fire warning equipment provisions of NFPA 72.

**R313.2 Carbon monoxide alarms.** Carbon monoxide alarms shall be installed on each habitable level of a dwelling unit equipped with fuel burning appliances. All carbon monoxide detectors shall be listed and installed in accordance with the provisions of this code and NFPA 720.

**R313.3 Interconnection of alarms.** When multiple alarms are required to be installed within an individual dwelling unit the alarm devices shall be interconnected in such a manner that the actuation of one alarm will activate all of the alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed. Approved combination smoke- and carbon-monoxide-detectors shall be allowed.

**[F] ~~R313.2~~ R313.4 Power source.** In new construction, the required alarms shall receive their primary power from the building wiring when such wiring is served from a commercial source, and when primary power is interrupted, shall receive power from a battery. Wiring shall be permanent and without a disconnecting switch other than those required for overcurrent protection. ~~Smoke~~ Alarms shall be permitted to be battery operated when installed in buildings without commercial power or in buildings that undergo alterations, repairs or additions regulated by Section ~~R317.4.1.5~~ R313.5.

**[EB] ~~R313.4.4~~ R313.5 Alterations, repairs and additions.** When interior alterations, repairs or additions requiring a permit occur, or when one or more sleeping rooms are added or created in existing dwellings, the individual dwelling unit shall be provided with ~~smoke~~ alarms located as required for new dwellings; the ~~smoke~~ alarms shall be interconnected and hard wired.

**Exceptions:**

1. ~~Smoke~~ Alarms in existing areas shall not be required to be interconnected and hard wired where the alterations or repairs do not result in the removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space, or basement available which could provide access for hard wiring and interconnection without the removal of interior finishes.

2. Repairs to the exterior surfaces of dwellings are exempt from the requirements of this section.

**4. (IRC) Add new referenced standard to Chapter 43 as follows:**

<u>NFPA 720-03 Recommended Practice for the</u>	
<u>Installation of Household Carbon</u>	
<u>Monoxide (CO) Warning</u>	
<u>Equipment</u>	<u>R313.2</u>

**Reason:** With the increasing energy efficiency of homes, and the rising incidents of carbon monoxide poisoning, many of them fatal, it is time to require these low-cost life savers in buildings. Even as this is written, a report of two deaths from CO poisoning is being reported on the news. Nationwide, over 200 deaths per year are attributed to carbon monoxide poisoning in homes with fuel burning appliances, according to the Consumer Produce Safety Commission. Wholesale costs of CO detectors are as little as \$20.00, and installation could be combined with the already-required smoke detectors.

**Analysis:** The current content of IRC Section R313 is indicated as being maintained by the International Fire Code [F] and International Existing Building Code [EB] Development Committees. However, the ICC Code Correlating Committee has determined that this new subject of carbon monoxide alarms for residences within the scope of the IRC is to be considered by the IRC Building and Energy Code Development committee.

Staff had not reviewed the referenced standard prior to the printing of the monograph. Staff will review it and provide the results to the committee members prior to the code change hearings.

**Cost Impact:** This code change will increase the cost of construction.

**F207-03/04 - D  
IBC 1211**

**Proponent:** Steven Rocklin, New York State Department of State, Division of Code Enforcement

**1. (IBC) Add new text as follows:**

**SECTION 1211**  
**CARBON MONOXIDE ALARMS**

**1211.1 Single- and multiple-station carbon monoxide alarms.** Single- and multiple-station carbon monoxide alarms shall be installed in the following locations in Group R-2, R-3 and R-4 occupancies:

1. Outside of each separate sleeping area in the immediate vicinity of the bedrooms.
2. On each additional story of the dwelling, including basements but not including crawl spaces and uninhabitable attics.

When more than one carbon monoxide alarm is required to be installed within an individual dwelling unit or sleeping unit, the alarm devices shall be interconnected in such a manner that the actuation of one alarm will activate all of the alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed.

Carbon monoxide alarms shall be listed and labeled as complying with UL 2034 or CAN/CSA 6.19 and shall be installed in accordance with the manufacturer's installation instructions.

**1211.2 Combination smoke and carbon monoxide alarms.** Nothing in this section shall preclude the installation of listed combination smoke and carbon monoxide alarms. Combination alarms shall have voice warnings or distinct alarm signals for smoke and carbon monoxide alarm signals. Combination alarms shall be installed in locations and as otherwise required for smoke alarms.

**1211.3 Power source.** The required carbon monoxide alarms shall receive their primary power from the building wiring when such wiring is served from a commercial source, and is equipped with a battery backup. Carbon monoxide alarms shall emit a signal when the batteries are low. Wiring shall be permanent and without a disconnecting switch other than those required for overcurrent protection.

**2. (IBC) Add new referenced standards to Chapter 35 as follows:**

**Underwriter's Laboratories, Inc.**

UL2034-02 Standard for Single and Multiple Station Carbon Monoxide Alarms . . . . . 608.1

**Canadian Standards Association**

CAN/CSA 6.19-01 Residential Carbon Monoxide Alarming Devices . . . . . 608.1

**Reason:** The proposed code section would add provisions requiring the installation of carbon monoxide (CO) alarms in dwelling units and sleeping units regulated under the International Building Code. Carbon monoxide is an invisible, odorless gas that is generated by the incomplete combustion of carbonaceous fuels such as fuel oil, natural gas, kerosene and wood. CO poisoning results from displacement of oxygen in the blood supply by carboxyhaemoglobin, reducing oxygen supply to the brain. In non-fire, unintentional events, elevated CO levels may be caused by improperly installed or maintained fuel-fired appliances, motor vehicles operated in enclosed garages, or the use of appliances intended for outdoor use indoors during power failures. As CO is not detectable by the senses, its presence and concentration can only be determined by instruments.

The proposed code section provides that carbon monoxide alarms shall be listed and labeled as complying with UL 2034-2002, which is the consensus standard for single and multiple station carbon monoxide alarms in the United States. With the publication of the 2002 edition, it is an American National Standard. Although UL 2034 does not contain alarm longevity and time-of-manufacture testing standards found in CSA 6.19-01 (Standard for Residential CO Alarms), alarms available in the U.S. are generally UL listed rather than CSA listed. It is necessary to require listing of alarm devices in order to assure their safety and compliance with performance standards. The sensitivity standard in UL 2034 is based on an alarm response to specified concentrations of carbon monoxide (in parts per million) within specified time frames. These are based on limiting carboxyhaemoglobin saturation to 10 percent, which earlier studies indicated would have no significant effects on human subjects. As noted below, Hill identified impairments at 5 percent saturation level. As the curves are based on a proposal for evaluating CO exposure in military vehicles, they may be based on a selected population that is more resistant to the effects of CO than more vulnerable persons, such as infants, pregnant women and the elderly.

A number of different sources were reviewed to develop an estimate of the annual number of fatalities attributable to unintentional, non-fire, building source carbon monoxide poisoning. The sources reviewed contain estimates ranging between 200 and 1200, nationally. The sources include the U.S. Consumer Product Safety Commission (CPSC), California Air Resources Board, the Journal of the American Medical Association, the Morbidity and Mortality Weekly Report (published by the U.S. Centers for Disease Control) and Dr. David Penney (Wayne State University School of Medicine).

Given the wide divergence in unintentional fatality estimates from the sources reviewed, it is difficult to provide a reliable estimate of annual fatalities in the United States. However, exclusion of the lowest and highest estimates would leave a range of 315 to 500 annual fatalities nationally. As a test of this estimate, we extrapolated the national data to New York State. If the most conservative of the fatality estimates (315) is used, we would expect approximately 12.5 annual unintentional fatalities statewide, excluding New York City, based on 1999 population estimates. The New York State Department of Health (DOH) has estimated 14 fatalities annually, based on specific coding in the Vital Statistics Death File, which was prepared by the Bureau of Injury Prevention.

Although an accurate estimate of unintentional, non-fire fatalities caused by CO poisoning may not be feasible, it is clear that it is approximately one order of magnitude less than fire fatalities. Given the protections built into the codes to protect occupants against the dangers of fire, it is entirely reasonable to require substantially lower expenditures to protect against CO poisoning.

In addition to death, CO poisoning may cause significant injuries and long term health consequences. In an observation in Archives of Neurology (Vol. 57, No. 8, August 2000), Sohn et. al. noted the incidence of parkinsonism and intellectual impairment in a married couple who experienced CO poisoning simultaneously. While it was noted that both individuals showed complete recovery after thirteen months, the observation is suggestive of additional potential consequences. It should also be noted that CPSC has estimated an average of 10,000 injuries or hospital emergency room visits annually from carbon monoxide poisoning.

In an article in the American Journal of Forensic Medicine and Pathology (Vol. 10, No. 1, 1989), I.R. Hill notes that fine discriminatory functions begin to be impaired at 5 percent saturations, with significant decrements being noted at the 10 percent saturation level. Hill also notes that headaches occur at 20 to 30 percent saturation, and that nausea, dizziness and muscular weakness occur at 30 to 40 percent. Thus, CO poisoning will affect the judgment and capability of persons to evacuate or take other appropriate actions well before concentrations reach fatal levels.

Technical questions have been raised about false alarm incidence and sensitivity of CO alarms. As a result, Underwriters Laboratories revised UL 2034, effective for alarms manufactured after October 1, 1998. There have been continuing questions concerning the reliability of CO alarms. While reports of research to date are inconsistent, all parties have reported that reliable alarm devices are available on the market.

It is estimated that the proposed code modification will have minimal cost impacts on the construction of Group R occupancies. While there are many variables that affect the cost of construction, most new residential construction is anticipated to be low-rise, not more than four stories in height. Depending upon size, construction and other features, square foot costs range from \$70 to \$100 per square foot. In general, not more than two alarm devices will typically be required in dwelling units; for sleeping units, one alarm device will normally be required. Direct wired devices with interconnection capability cost up to \$80; installation costs in new construction are estimated to be not more than \$50 per device. Thus, the proposed modification would add up to \$250 to the cost of a typical dwelling unit. For a typical 1,000 square foot dwelling unit, CO alarms would add approximately 0.25 to 0.35 percent to construction costs.

**Analysis:** The ICC Code Correlating Committee has determined that this new subject of carbon monoxide alarms is to be considered by the IFC Code Development committee.

Staff had not reviewed the referenced standards prior to the printing of the monograph. Staff will review them and provide the results to the committee members prior to the code change hearings.

**Cost Impact:** This code change will increase the cost of construction.

## F207-03/04

Committee Action:

Disapproved

**Editorial Note:** A review of the proposed referenced standard disclosed that it is in compliance with Section 3.6 of the ICC Code Development Process for the International Codes. The proposed referenced standard CAN/CSA 6.19 was not submitted for review by the proponent.

**Committee Reason:** CO alarms are not yet ready for mandatory installation since there is very little information available on their reliability under the ambient conditions (such as humidity levels) to which they would be exposed in different parts of the country. Also, reliability tends to decrease as the alarm device ages. Testing and maintenance requirements are not covered in the proposal. The provisions make no exception for occupancies that use non-fuel-fired heating equipment. It is unclear why Group R-1 is not included in the proposal. Attached garages are a CO hazard but are also not included.

Assembly Action:

None

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## F210-03/04 - D

### IPMC 608

**Proponent:** Steven Rocklin, New York State Department of State, Division of Code Enforcement

1. (IPMC) Add new text as follows:

#### **IPMC SECTION 608** **CARBON MONOXIDE ALARMS**

**608.1 Single- and multiple-station carbon monoxide alarms.** Single- and multiple-station carbon monoxide alarms shall be installed in the following locations in one- and two-family dwellings, townhouses, and in Group R-3 and R-4 occupancies:

1. Outside of each separate sleeping area in the immediate vicinity of the bedrooms.
2. On each additional story of the dwelling, including basements but not including crawl spaces and uninhabitable attics.

Carbon monoxide alarms shall be listed and labeled as complying with UL 2034 or CAN/CSA 6.19 and shall be installed in accordance with the manufacturer's installation instructions.

**608.2 Combination smoke and carbon monoxide alarms.** Nothing in this section shall preclude the installation of listed combination smoke and carbon monoxide alarms. Combination alarms shall have voice warnings or distinct alarm signals for smoke and carbon monoxide alarm signals. Combination alarms shall be installed in locations and as otherwise required for smoke alarms.

**608.3 Power source.** The required carbon monoxide alarms shall receive their primary power from the building wiring when such wiring is served from a commercial source, and is equipped with a battery backup. Carbon monoxide alarms shall emit a signal when the batteries are low. Wiring shall be permanent and without a disconnecting switch other than those required for overcurrent protection.

**Exception:** Carbon monoxide alarms are permitted to be solely battery operated in buildings where no construction is taking place, buildings that are not served from a commercial power source and in existing areas of buildings undergoing alterations or repairs that do not result in the removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space or basement available which could provide access for building wiring without the removal of interior finishes.

**608.4 Interconnection.** Where more than one carbon monoxide alarm is required to be installed within an individual dwelling unit, the carbon monoxide alarms shall be interconnected in such a manner that the activation of one alarm



will activate all of the alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed.

**Exceptions:**

1. Interconnection is not required in buildings which are not undergoing alterations, repairs, or construction of any kind.
2. Carbon monoxide alarms in existing areas are not required to be interconnected where alterations or repairs do not result in the removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space or basement available which could provide access for interconnection without the removal of interior finishes.

**IPMC [F] SECTION 704  
FIRE PROTECTION SYSTEMS**

**704.4 Combination smoke and carbon monoxide alarms.** Nothing in this section shall preclude the installation of listed combination smoke and carbon monoxide alarms. Combination alarms shall have voice warnings or distinct alarm signals for smoke and carbon monoxide alarm signals. Combination alarms shall be installed in locations and as otherwise required for smoke alarms.

**2. Add new referenced standards to IPMC Chapter 8 as follows:**

**Underwriter’s Laboratories, Inc.**

<u>UL2034-02</u>	<u>Standard for Single and Multiple Station Carbon Monoxide Alarms</u>		<u>.608.1</u>
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**Canadian Standards Association**

<u>CAN/CSA 6.19-01</u>	<u>Residential Carbon Monoxide Alarming Devices</u>		<u>608.1</u>
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**Reason:** The proposed code section would add provisions requiring the installation of carbon monoxide (CO) alarms in dwelling units and sleeping units regulated under the International Building Code. Carbon monoxide is an invisible, odorless gas that is generated by the incomplete combustion of carbonaceous fuels such as fuel oil, natural gas, kerosene and wood. CO poisoning results from displacement of oxygen in the blood supply by carboxyhaemoglobin, reducing oxygen supply to the brain. In non-fire, unintentional events, elevated CO levels may be caused by improperly installed or maintained fuel-fired appliances, motor vehicles operated in enclosed garages, or the use of appliances intended for outdoor use indoors during power failures. As CO is not detectable by the senses, its presence and concentration can only be determined by instruments.

The proposed code section provides that carbon monoxide alarms shall be listed and labeled as complying with UL 2034-2002, which is the consensus standard for single and multiple station carbon monoxide alarms in the United States. With the publication of the 2002 edition, it is an American National Standard. Although UL 2034 does not contain alarm longevity and time-of-manufacture testing standards found in CSA 6.19-01 (Standard for Residential CO Alarms), alarms available in the U.S. are generally UL listed rather than CSA listed. It is necessary to require listing of alarm devices in order to assure their safety and compliance with performance standards. The sensitivity standard in UL 2034 is based on an alarm response to specified concentrations of carbon monoxide (in parts per million) within specified time frames. These are based on limiting carboxyhaemoglobin saturation to 10 percent, which earlier studies indicated would have no significant effects on human subjects. As noted below, Hill identified impairments at 5 percent saturation level. As the curves are based on a proposal for evaluating CO exposure in military vehicles, they may be based on a selected population that is more resistant to the effects of CO than more vulnerable persons, such as infants, pregnant women and the elderly.

A number of different sources were reviewed to develop an estimate of the annual number of fatalities attributable to unintentional, non-fire, building source carbon monoxide poisoning. The sources reviewed contain estimates ranging between 200 and 1200, nationally. The sources include the U.S. Consumer Product Safety Commission (CPSC), California Air Resources Board, the Journal of the American Medical Association, the Morbidity and Mortality Weekly Report (published by the U.S. Centers for Disease Control) and Dr. David Penney (Wayne State University School of Medicine).

Given the wide divergence in unintentional fatality estimates from the sources reviewed, it is difficult to provide a reliable estimate of annual fatalities in the United States. However, exclusion of the lowest and highest estimates would leave a range of 315 to 500 annual fatalities nationally. As a test of this estimate, we extrapolated the national data to New York State. If the most conservative of the fatality estimates (315) is used, we would expect approximately 12.5 annual unintentional fatalities statewide, excluding New York City, based on 1999 population estimates. The New York State Department of Health (DOH) has estimated 14 fatalities annually, based on specific coding in the Vital Statistics Death File, which was prepared by the Bureau of Injury Prevention.

Although an accurate estimate of unintentional, non-fire fatalities caused by CO poisoning may not be feasible, it is clear that it is approximately one order of magnitude less than fire fatalities. Given the protections built into the codes to protect occupants against the dangers of fire, it is entirely reasonable to require substantially lower expenditures to protect against CO poisoning.

In addition to death, CO poisoning may cause significant injuries and long term health consequences. In an observation in Archives of Neurology (Vol. 57, No. 8, August 2000), Sohn et. al. noted the incidence of parkinsonism and intellectual impairment in a married couple who experienced CO poisoning simultaneously. While it was noted that both individuals showed complete recovery after thirteen months, the

observation is suggestive of additional potential consequences. It should also be noted that CPSC has estimated an average of 10,000 injuries or hospital emergency room visits annually from carbon monoxide poisoning.

In an article in the American Journal of Forensic Medicine and Pathology (Vol. 10, No. 1, 1989), I.R. Hill notes that fine discriminatory functions begin to be impaired at 5 percent saturations, with significant decrements being noted at the 10 percent saturation level. Hill also notes that headaches occur at 20 to 30 percent saturation, and that nausea, dizziness and muscular weakness occur at 30 to 40 percent. Thus, CO poisoning will affect the judgment and capability of persons to evacuate or take other appropriate actions well before concentrations reach fatal levels.

Technical questions have been raised about false alarm incidence and sensitivity of CO alarms. As a result, Underwriters Laboratories revised UL 2034, effective for alarms manufactured after October 1, 1998. There have been continuing questions concerning the reliability of CO alarms. While reports of research to date are inconsistent, all parties have reported that reliable alarm devices are available on the market.

The proposed code modification will not impact the costs of construction. Cord or plug connected and battery operated carbon monoxide alarms are broadly available in home centers and over the internet for \$20 to \$50; there are no required installation costs.

**Analysis:** The ICC Code Correlating Committee has determined that this new subject of carbon monoxide alarms for one- and two-family dwellings, townhouses and Group R-3 and R-4 occupancies within the scope of the IPMC is to be considered by the IFC Code Development committee.

Staff had not reviewed the referenced standard(s) prior to the printing of the monograph. Staff will review them and provide the results to the committee members prior to the code change hearings.

**Cost Impact:** None

## F210-03/04

**Committee Action:**

**Disapproved**

**Editorial Note:** A review of the proposed referenced standard, UL 2034, disclosed that it is in compliance with Section 3.6 of the ICC Code Development Process for the International Codes. The proposed referenced standard CAN/CSA 6.19 was not submitted for review by the proponent.

**Committee Reason:** For consistency with the action taken on F207-03/04.

**Assembly Action:**

**None**

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## RB95-03/04 - D R313 & R313.3

*Proposed Change as Submitted:*

**Proponent:** Edmund Domian, West Valley City, Utah, representing Bonneville Chapter ICC/ICBO

**Add new text as follows:**

### **SECTION R313 SMOKE AND CARBON MONOXIDE ALARMS**

**R313.3. Garage Warnings.** In private garages a sign with the international poison symbol must be posted which states in letters 1-inch high:

WARNING: CARBON MONOXIDE  
Unconscious in Seconds!! Kills in Minutes!!  
Never Run Your Automobile Without  
the Garage Door Completely Open!!

**Reason:** You don't have to look very far each year to find innocent individuals who accidentally die every year due to carbon monoxide poisoning from working on their personal automobile in an enclosed private garage. Sometimes whole families perish when an unsuspecting adult idles the family car inside the garage trying to warm the vehicle engine before driving out into the wintry cold. The Consumer Products Safety Commission (CPSC) reports that approximately 200 people are killed each year by accidental carbon monoxide poisoning with an additional 5000 people injured by this silent killer. This change has almost zero impact on the cost of construction but a huge impact on the life/safety of the home. The codes have always recognized the effectiveness of a well-placed, well-worded sign in code enforcement and life/safety. This proposal asks very little but gives back something immeasurable – a huge reduction in these senseless deaths.

Cost Impact: None

Committee Action:

Approved as Submitted

Committee Reason: Based on proponent's published reason.

Assembly Action:

None

### *Individual Consideration Agenda*

**This item is on the agenda for individual consideration because public comments were submitted.**

*Public Comment 1:*

**Rick Davidson, City of Hopkins, MN, representing the Assoc. of MN Building Officials, requests Disapproval.**

**Commenter's Reason:** The primary reason that this proposal should be disapproved is that the statements on the sign are false. Exposure to carbon monoxide will not render a person unconscious in seconds or kill anyone in minutes. The sign unnecessarily alarms the public and will only lead to further misunderstanding of this problem. Furthermore, the proponent provided no statistics regarding how many of the approximately 200 people who die each year from carbon monoxide poisoning die in a garage. Since the statements on the sign are false and no substantiation was provided, this proposal should be disapproved.

*Public Comment 2:*

**Thomas Meyers, City of Cherry Hills Village, CO, representing the CO Chapter ICC, requests Disapproval.**

**Commenter's Reason:** Although we agree that carbon monoxide in garages can be a risk to the life safety of the occupants, we feel that the warning sign methodology is inappropriate for this code. If the perceived problem cannot be "fixed" by modifying and regulating the construction, we will now just put up a sign and hope the first occupant does not immediately discard it.

We fear that approval of this change will open the door for similar warning sign proposals in other locations within a home. Soon we may see proposals for steep stairways, slip-fall risks in bathtubs and showers, and potential for burns caused by cooking appliances. Eventually, every room and every surface will require warning signage to satisfy every special interest group and tort lawyer in the country. Let's not set this precedent. We encourage the membership to overturn the committee.

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## **RB96-03/04 - D**

### **R313, [F]R313.1, [EB]R313.1.1, [F]R313.2, R313.3**

**Proponent:** Mike Kerner, West Valley City, Utah, representing Bonneville Chapter ICC/ICBO

**Revise as follows:**

#### **SECTION R313 SMOKE AND CARBON MONOXIDE ALARMS**

**[F]R313.1 Smoke and carbon monoxide alarms.** Smoke and carbon monoxide alarms shall be installed in the following locations.

(No change to Items 1 through 3)

4. Each furnace room shall be provided with a combination smoke and carbon monoxide detector.

When more than one smoke alarm is required to be installed within an individual dwelling unit the alarm devices shall be interconnected in such a manner that the actuation of one alarm will activate all of the alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed.

All smoke and carbon monoxide alarms shall be listed and installed in accordance with the provisions of this code and the household fire warning equipment provisions of NFPA 72.

**[EB]R313.1.1 Alterations, repairs and additions.** When interior alterations, repairs, or additions requiring a permit occur, or when one or more sleeping rooms are added or created in existing dwellings, the individual dwelling unit shall be provided with smoke and carbon monoxide alarms located as required for new dwellings; the smoke and carbon monoxide shall be interconnected and hard wired.

**Exceptions:**

1. Smoke and carbon monoxide alarms in existing areas shall not be required to be interconnected and hard wired where the alterations or repairs do not result in the removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space, or basement available which could provide access for hard wiring and interconnection without the removal of interior finishes.
2. (No change)

**[F]R313.2 Power source.** In new construction, the required smoke and carbon monoxide alarms shall receive their primary power from the building wiring when such wiring is served from a commercial source, and when primary power is interrupted, shall receive power from a battery. Wiring shall be permanent and without a disconnecting switch other than those required for overcurrent protection. Smoke and carbon monoxide shall be permitted to be battery operated when installed in buildings without commercial power or in buildings that undergo alterations, repairs or additions regulated by Section R313.1.1.

**R313.3 Garage Warnings.** In private garages a sign with the international poison symbol must be posted which states in letters 1-inch high:

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**WARNING: CARBON MONOXIDE**  
**Unconscious in Seconds!! Kills in minutes!!**  
**Never Run Your Automobile Without the Garage Door Completely Open!!**

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**Reason:** The consumer Products Safety Commission (CPSC) reports that approximately 200 people are killed each year by accidental carbon monoxide poisoning with an additional 5000 people injured by this silent killer. These accidents are caused by faulty mechanical vent piping or unsuspecting people idling their personal automobiles inside their private garages with the doors closed or only partly open. This change has minimal impact on the cost of construction by a huge impact on the life/safety of the home.

**Analysis:** The content of these code sections are indicated as being maintained by the *International Fire Code* [F] and *International Existing Building Code* [EB] Development Committees. However, the ICC Code Correlating Committee has determined that the subject of carbon monoxide alarms for residences within the scope of the IRC is to be considered by the IRC Building and Energy Code Development Committee.

**Cost impact:** This proposal will increase the cost of construction.

## RB96-03/04

**Committee Action:** **Disapproved**

**Committee Reason:** New houses with proper ventilation are not where deaths due to carbon monoxide poisoning are occurring. Most of the carbon monoxide poisoning deaths are occurring in old housing stock.

**Assembly Action:** **None**

## RB97-03/04 - D

### R313, [F]R313.1, [EB]R313.1.1, [F]R313.2, R313.3

*Proposed Change as Submitted:*

**Proponent:** Mike Kerner, representing West Valley City, Utah

**Revise as follows:**

## **SMOKE AND CARBON MONOXIDE ALARMS**

**[F]R313.1 Smoke and carbon monoxide.** Smoke and carbon monoxide alarms shall be installed in the following locations:

(No change to Items 1 and 2)

3. On each additional story of the dwelling, including basements but not including crawl spaces and uninhabitable attics. In dwellings or dwelling units with split levels and without an intervening door between the adjacent levels, a smoke and carbon monoxide alarm installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.

When more than one smoke and carbon monoxide alarm is required to be installed within an individual dwelling unit the alarm devices shall be interconnected in such a manner that the actuation of one alarm will activate all of the alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed.

All smoke and carbon monoxide alarms shall be listed and installed in accordance with the provisions of this code and the household fire warning equipment provisions of NFPA 72.

**[EB] R313.1.1 Alterations, repairs, and additions.** When interior alterations, repairs, or additions requiring a permit occur, or when one or more sleeping rooms are added or created in existing dwellings, the individual dwelling unit shall be provided with smoke and carbon monoxide alarms located as required for new dwellings; the smoke and carbon monoxide alarms shall be interconnected and hard wired.

### **Exceptions:**

1. Smoke and carbon monoxide alarms in existing areas shall not be required to be interconnected and hard wired where the alterations or repairs do not result in the removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space, or basement available which could provide access for hard wiring and interconnection without the removal of interior finishes.
2. (No change)

**[F] R313.2 Power Source.** In new construction, the required smoke and carbon monoxide alarms shall receive their primary power from the building wiring when such wiring is served from commercial source, and when primary power is interrupted, shall receive power from a battery. Wiring shall be permanent and without a disconnecting switch other than those required for overcurrent protection. Smoke and carbon monoxide alarms shall be permitted to be battery operated when installed in buildings without commercial power or in buildings that undergo alterations, repairs or additions regulated by Section R313.1.1.

**R313.3. Garage Warnings.** In private garages, a sign with the international poison symbol must be posted which states in letters 1-inch high:

WARNING: CARBON MONOXIDE  
Unconscious in Seconds!! Kills in Minutes!!  
Never Run Your Automobile Without  
the Garage Door Completely Open!!

**Reason:** The Consumer Products Safety Commission (CPSC) reports that approximately 200 people are killed each year by accidental carbon monoxide poisoning with an additional 5000 people injured by this silent killer. These accidents are caused by faulty mechanical vent piping or unsuspecting people idling their personal automobiles inside their private garages with the doors closed or only partly open. This change has minimal impact on the cost of construction but a huge impact on the life/safety of the home.

**Cost Impact:** This proposal will increase the cost of construction.

**Committee Action:**

**Approved as Modified**

**Modify proposal as follows:**

**Sections R313.1, R313.1.1 and R313.2 as proposed**

~~R313.3. Garage Warnings. In private garages, a sign with the international poison symbol must be posted which states in letters 1-inch high:~~

~~WARNING: CARBON MONOXIDE  
Unconscious in Seconds!! Kills in Minutes!!  
Never Run Your Automobile Without the  
Garage Door Completely Open!!~~

**Committee Reason:** Based on proponent's published reason. The modification was made to delete the warning sign.

**Assembly Action:**

**Disapproved**

### *Individual Consideration Agenda*

**This item is on the agenda for individual consideration because an assembly action was successful and public comments were submitted.**

*Public Comment 1:*

**Richard A. Morris, representing NAHB, requests Disapproval.**

**Commenter's Reason:**

- a) Assembly action disapproved RB97-03/04.
- b) The *International Fire Code* Committee disapproved F115-03/04, a similar proposal (did not include alterations, repairs and additions), by a vote of 16-0, for reasons that **"No product standard to which CO alarms must be listed was included in the proposal"** and **"Combining CO alarm and smoke alarm requirements in one section will create confusion and enforcement problems"**, which are also true to RB97-03/04.
- c) **CO alarms are not yet reliable.** A 2003 study, "Evaluating the Performance of Residential CO Alarms", performed by Mosaic Industries and commissioned by the Gas Research Institute, tested 70 commercially available CO alarms of ten retail brands and found that only three performed well, and that two of these three have since been withdrawn from the market. 79% failed to detect at least one dangerous situation at 5% relative humidity, and 47% failed to detect at 50% relative humidity, 30% gave a false alarm when exposed to another gas, such as acetone, ammonia, ethanol, toluene, trichloroethane, CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>2</sub>, and 8% gave a false alarm in clean air. Digital displays were inaccurate within plus or minus 30% of the true CO concentrations on all but three brands. Reliability declines with the age of the alarm. The standard to which most are manufactured, UL 2034, does not require time-of-manufacturing testing.
- d) **CO fatalities are declining sharply.** The U.S. Consumer Product Safety Commission (CPSC) in October 2000 reported that consumer product related fatalities declined 47%, from 340 in 1982 to 180 in 1997, while auto-related CO fatalities declined 16%, from 350 to 294. During that period, the U.S. population increased by more than 15% from 231 million to 267 million. In 1996, according to CPSC, there were 207 consumer product related fatalities in the U.S. from heating and cooking equipment: 48% from space heaters, 10% from liquid fueled heating equipment, 9% from charcoal grills, and 5% from fireplaces and wood Stoves. Gas furnaces, water heaters and ranges accounted for 58 fatalities (28%), fewer than occur each year in the U.S. from lightning, and many of these resulted from old, poorly maintained equipment.
- e) **Most CO fatalities occur in older homes from use of space heaters and charcoal grills,** as opposed to safe central heating in new homes. In RB96-03/04, the Committee reason for disapproval was, "New houses with proper ventilation are not where deaths due to carbon monoxide poisoning are occurring. Most of the carbon monoxide poisoning deaths are occurring in old housing stock." New homes are well insulated to stay warm longer during power outages, and have efficient central heat so that they do not rely on individual space heaters and ranges for year-round heat. New furnaces and water heaters in new homes are far safer than old, poorly maintained equipment. Fireplaces in new homes have outside air supplies that supply oxygen to the fire. Energy and fire protection requirements in new homes minimize airflow from attached garages into houses. The result is that the odds of dying from CO in a new home are extremely low.
- f) **Alarms should not be required in homes without garages and combustion equipment,** where fatalities are even lower.
- g) **Combination fire alarms may reduce fire safety** if occupants confuse the smoke alarm with the CO alarm and if false alarms occur because occupants may ignore the smoke alarm during a fire. Also, it seems that it would be more effective to install CO alarms in the occupant breathing zone than at locations optimum for smoke detection (near the ceiling).
- h) **Training fire department and rescue squad personnel** and requiring them to find and eliminate CO sources and to identify false alarms may detract from their other duties.
- i) **CO warning signs in garages,** which the committee approved in RB95-03/04, as well as warnings already provided on consumer products such as charcoal, space heaters, appliances, grills, hibachis, generators, etc., will continue to reduce CO fatalities in the future. Such warnings, as well as public service announcements and a good educational program directed toward owners and tenants of older homes would have a much greater impact where the need really is, in older homes.

*Public Comment 2:*

**James Ranfone, American Gas Assoc., representing the Building Energy Codes and Standards Committee of the American Gas Assoc., requests Disapproval.**

**Commenter's Reason:**

1. Proposals to the International Fire Code (IFC) for mandatory CO alarm installation requirements were disapproved by the IFC Committee unanimously or, in one case, by a strong majority (15-1). The IFC Committee, representing first responder interests and experience,

understands the persisting issues of low reliability of commercially available CO alarms and public safety risks of inappropriately operating safety devices. The disapproval of IFC Committee for mandatory CO alarm requirements calls for similar action on proposals to the International Residential Code.

2. The International Residential Code (IRC) Committee disapproved mandatory CO alarm installation requirements under RB96-03/04 with the following Committee Reason: "New houses with proper ventilation are not where deaths due to carbon monoxide poisonings are occurring. Most of the carbon monoxide poisoning deaths are occurring in old housing stock." This accurate assessment of the locations of residential CO poisonings is a general reason for disapproval of mandatory CO alarm installation requirements, including the subject proposal, which would mainly apply only to new houses where the risk of CO poisoning is low. The IRC Committee should have applied the same logic to its consideration of the subject proposal and voted for its disapproval.
3. CO alarms have not demonstrated sufficient reliability off the shelf or in the field to justify their mandatory installation. A 2003 laboratory study, "Evaluating the Performance of Residential CO Alarms", performed by Mosaic Industries and commissioned by the Gas Research Institute, tested 70 commercially available CO alarms from ten retail brands and found that only three performed well, and that two of these three have since been withdrawn from the market. Seventy-nine percent failed to detect at least one dangerous situation at 5% relative humidity, and 47% failed to detect at 50% relative humidity. Thirty percent gave a false alarm when exposed to another gas, such as acetone, ammonia, ethanol, toluene, trichloroethane, CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>2</sub>, and 8% gave a false alarm in clean air. Digital displays were inaccurate within plus or minus 30% of the true CO concentrations on all but three brands. Reliability declines with the age of the alarm. The standard to which most are manufactured, UL 2034, does not require adequate time-of-manufacturing testing and does not require testing for lifetime or accuracy over time. Given the persisting poor reliability of these devices, mandatory installation requirements are not justified.
4. The proponent's statistical information from the U. S. Consumer Product Safety Commission (CPSC) is outdated and inaccurate in representing the national risk of residential CO poisonings. In 2003, non-intentional, non-fire carbon monoxide (CO) fatalities due to household appliances continued to decline as they have for the past five decades. Average annual CO fatalities involving gas heating systems declined from 106 per year for 1994-1998 to 59 per year for 1999-2000. This decline, 44%, would be larger if fatalities involving heating systems "not specified" include gas heating-related fatalities. Fatalities involving gas water heaters declined from 7 per year for 1994-1998 to 2 per year for 1999-2000. Fatalities involving gas ranges and ovens remained relatively unchanged at 7 per year for 1994-1998 and 6 and 11 in 1999 and 2000, respectively. Overall, fatalities associated with all fuel-burning consumer appliances declined from 200 per year to 124 per year, a 38% decline. These declines are consistent with the historical trend for declines in CO fatalities since World War II and appear to be the result of change out of older combustion equipment, newer housing stock, and increased awareness of combustion appliance safety. CO poisonings due to automobiles, including autos in attached garages, are similarly declining, although CPSC does not publish statistics on this source. CO injury estimates cited by the proponent are no longer published by CPSC mainly because of poor estimation methods used in the past. From these trends, calls for mandatory CO alarm are not justified as an appropriate public health or safety response.
5. The assembly voted to overturn the IRC Committee vote, which itself voted approval by a small majority.
6. At the conclusion of the IRC Hearing, the IRC Committee requested the ICC Board of Directors to form an Ad-Hoc Committee to evaluate the issue of CO and CO alarm requirements. In view of this action at the end of the hearing, and since it reveals the need to gather and evaluate more information, promulgation of mandatory CO alarm requirements under the IRC is premature.

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<sup>1</sup>" 2003 ICC Public Hearing Results: 2003/2004 International Residential Code - Building & Energy Code Development Committee. "

## **RB98-03/04 - WP**

### **R313, R313.2, R313.2.1, R313.3, [F]R313.4**

#### *Proposed Change as Submitted:*

**Proponent:** Steven Rocklin, representing New York State Department of State, Division of Code Enforcement

**Add new text as follows:**

Add new sections R313.2 and R313.3, and renumber existing section R313.2 as R313.4:

**SECTION R313**  
**SMOKE ALARMS AND**  
**CARBON MONOXIDE ALARMS**

**R313.2 Single- and multiple-station carbon monoxide alarms. Single- and multiple-station carbon monoxide alarms shall be installed in the following locations:**

1. Outside of each separate sleeping area in the immediate vicinity of the bedrooms.

2. On each additional story of the dwelling, including basements but not including crawl spaces and uninhabitable attics.

When more than one carbon monoxide alarm is required to be installed within an individual dwelling unit, the alarm devices shall be interconnected in such a manner that the actuation of one alarm will activate all of the alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed.

Carbon monoxide alarms shall be listed and labeled as complying with UL 2034-2002 or CSA 6.19-01, and shall be installed in accordance with the manufacturer's installation instructions.

**313.2.1 Alterations, repairs and additions.** When interior alterations, repairs or additions requiring a permit occur, or when one or more bedrooms are added or created in existing dwellings, the individual dwelling unit shall be provided with carbon monoxide alarms located as required for new dwellings; the carbon monoxide alarms shall be interconnected and hard wired.

**Exceptions:**

1. Carbon monoxide alarms in existing areas shall not be required to be interconnected and hardwired where the alterations or repairs do not result in the removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space or basement available which could provide access for hard wiring and interconnection without the removal of interior finishes.
2. Repairs to the exterior surfaces of dwellings are exempt from the requirements of this section.

**R313.3 Combination smoke and carbon monoxide alarms.** Nothing in this section shall preclude the installation of listed combination smoke and carbon monoxide alarms. Combination alarms shall have voice warnings or distinct alarm signals for smoke and carbon monoxide alarm signals. Combination alarms shall be installed in locations and as otherwise required for smoke alarms.

~~[F]R313.2~~ **[F] R313.4 Power source.** The required smoke and carbon monoxide alarms shall receive their primary power from the building wiring when such wiring is served from a commercial source, and when primary power is interrupted, shall receive power from a battery. Wiring shall be permanent and without a disconnecting switch other than those required for overcurrent protection. Smoke and carbon monoxide alarms shall be permitted to be battery operated when installed in buildings without commercial power or in buildings that undergo alterations, repairs or additions regulated by Sections R313.1.1 and R313.2.1.

**Reason:** The proposed code section would add provisions requiring the installation of carbon monoxide (CO) alarms in dwellings regulated under the International Residential Code. Carbon monoxide is an invisible, odorless gas that is generated by the incomplete combustion of carbonaceous fuels such as fuel oil, natural gas, kerosene and wood. CO poisoning results from displacement of oxygen in the blood supply by carboxyhaemoglobin, reducing oxygen supply to the brain. In non-fire, unintentional events, elevated CO levels may be caused by improperly installed or maintained fuel-fired appliances, motor vehicles operated in enclosed garages, or the use of appliances intended for outdoor use indoors during power failures. As CO is not detectable by the senses, its presence and concentration can only be determined by instruments.

The proposed code section provides that carbon monoxide alarms shall be listed and labeled as complying with UL 2034-2002, which is the consensus standard for single and multiple station carbon monoxide alarms in the United States. With the publication of the 2002 edition, it is an American National Standard. Although UL 2034 does not contain alarm longevity and time-of-manufacture testing standards found in CSA 6.19-01 (Standard for Residential CO Alarms), alarms available in the U.S. are generally UL listed rather than CSA listed. It is necessary to require listing of alarm devices in order to assure their safety and compliance with performance standards. The sensitivity standard in UL 2034 is based on an alarm response to specified concentrations of carbon monoxide (in parts per million) within specified time frames. These are based on limiting carboxyhaemoglobin saturation to 10 percent, which earlier studies indicated would have no significant effects on human subjects. As noted below, Hill identified impairments at 5 percent saturation level. As the curves are based on a proposal for evaluating CO exposure in military vehicles, they may be based on a selected population that is more resistant to the effects of CO than more vulnerable persons, such as infants, pregnant women and the elderly.

A number of different sources were reviewed to develop an estimate of the annual number of fatalities attributable to unintentional, non-fire, building source carbon monoxide poisoning. The sources reviewed contain estimates ranging between 200 and 1200, nationally. The sources include the U.S. Consumer Product Safety Commission (CPSC), California Air Resources Board, the *Journal of the American Medical Association*, the *Morbidity and Mortality Weekly Report* (published by the U.S. Centers for Disease Control) and Dr. David Penney (Wayne State University School of Medicine).

Given the wide divergence in unintentional fatality estimates from the sources reviewed, it is difficult to provide a reliable estimate of annual fatalities in the United States. However, exclusion of the lowest and highest estimates would leave a range of 315 to 500 annual fatalities nationally. As a test of this estimate, we extrapolated the national data to New York State. If the most conservative of the fatality estimates (315) is used, we would expect approximately 12.5 annual unintentional fatalities statewide, excluding New York City, based on 1999 population estimates. The New York State Department of Health (DOH) has estimated 14 fatalities annually, based on specific coding in the Vital Statistics Death File, which was prepared by the Bureau of Injury Prevention.



Although an accurate estimate of unintentional, non-fire fatalities caused by CO poisoning may not be feasible, it is clear that it is approximately one order of magnitude less than fire fatalities. Given the protections built into the codes to protect occupants against the dangers of fire, it is entirely reasonable to require substantially lower expenditures to protect against CO poisoning.

In addition to death, CO poisoning may cause significant injuries and long term health consequences. In an observation in *Archives of Neurology* (Vol. 57, No. 8, August 2000), Sohn et. al. noted the incidence of parkinsonism and intellectual impairment in a married couple who experienced CO poisoning simultaneously. While it was noted that both individuals showed complete recovery after thirteen months, the observation is suggestive of additional potential consequences. It should also be noted that CPSC has estimated an average of 10,000 injuries or hospital emergency room visits annually from carbon monoxide poisoning.

In an article in the *American Journal of Forensic Medicine and Pathology* (Vol. 10, No. 1, 1989), I.R. Hill notes that fine discriminatory functions begin to be impaired at 5 percent saturations, with significant decrements being noted at the 10 percent saturation level. Hill also notes that headaches occur at 20 to 30 percent saturation, and that nausea, dizziness and muscular weakness occur at 30 to 40 percent. Thus, CO poisoning will affect the judgment and capability of persons to evacuate or take other appropriate actions well before concentrations reach fatal levels.

Technical questions have been raised about false alarm incidence and sensitivity of CO alarms. As a result, Underwriters Laboratories revised UL 2034, effective for alarms manufactured after October 1, 1998. There have been continuing questions concerning the reliability of CO alarms. While reports of research to date are inconsistent, all parties have reported that reliable alarm devices are available on the market.

It is estimated that the proposed code modification will have minimal cost impacts on the construction of one- and two-family dwellings. In that the IRC limits construction to three stories, not more than four alarms will be required in any dwelling. Data from the National Association of Home Builders (NAHB) for 1999 indicates that the average size of a new one-family dwelling was 2,228 square feet, and the average cost of residential construction was \$68.80 per square foot, excluding the value of an improved lot. Based on these reports, the average house cost approximately \$153,000. Direct wired devices with interconnection capability cost up to \$80; installation costs in new construction are estimated to be not more than \$50 per device. Thus, the proposed modification would add up to \$500 to the cost of a typical one-family dwelling, approximately 0.3 percent.

**Analysis:** The content of [F]R313.2 code section is indicated as being maintained by the *International Fire Code* [F] Development Committee. However, the ICC Code Correlating Committee has determined that this new subject of carbon monoxide alarms for residences within the scope of the IRC is to be considered by the IRC Building and Energy Code Development Committee.

**Cost Impact:** None

**Committee Action:**

**Approved as Submitted**

**Committee Reason:** Based on proponent's published reason.

**Assembly Action:**

**Disapproved**

### *Individual Consideration Agenda*

**This item is on the agenda for individual consideration because an assembly action was successful and public comments were submitted.**

*Public Comment 1:*

**Richard A. Morris, representing NAHB, requests Disapproval.**

**Commenter's Reason:**

- a) Assembly action disapproved RB98-03/04.
- b) The *International Fire Code* Committee disapproved F207-03/04, a nearly identical proposal (did not include alterations, repairs and additions) by a vote of 15-1. Their reason was, "CO alarms are not yet ready for mandatory installation since there is very little information available on their reliability under the ambient conditions (such as humidity level) to which they would be exposed in different parts of the country. Also, reliability tends to decrease as the alarm device ages. Testing and maintenance requirements are not covered in the proposal. The provisions make no exception for occupancies that use non-fuel-fired heating equipment..."
- c) RB98-03/04 combines CO alarm and smoke alarm requirements in one section, which the Fire Code Committee stated in its reason for denying F207-03/04 would "create confusion and enforcement problems."
- d) Also see the reasons for RB97-03/04:
  - CO alarms are not yet reliable.
  - CO fatalities are declining sharply.
  - Most CO fatalities occur in older homes from use of space heaters and charcoal grills.
  - Alarms should not be required in homes without garages and combustion equipment, where fatalities are even lower.
  - Combination fire alarms may reduce fire safety if occupants confuse the smoke alarm with the CO alarm.
  - Training fire department and rescue squad personnel and requiring them to find and eliminate CO sources and to identify false alarms may detract from their other duties.
  - CO warning signs in garages, warnings on consumer products, public service announcements, and education programs will continue to reduce CO fatalities.

*Public Comment 2:*

**James Ranfone, American Gas Assoc., representing the Building Energy Codes and Standards Committee of the American Gas Assoc., requests Disapproval.**

**Commenter's Reason:**

1. Proposals to the International Fire Code (IFC) for mandatory CO alarm installation requirements were disapproved by the IFC Committee unanimously or, in one case, by a strong majority (15-1). The IFC Committee, representing first responder interests and experience, understands the persisting issues of low reliability of commercially available CO alarms and public safety risks of inappropriately operating safety devices. The disapproval of IFC Committee for mandatory CO alarm requirements calls for similar action on proposals to the International Residential Code.
2. The International Residential Code (IRC) Committee disapproved mandatory CO alarm installation requirements under RB96-03/04 with the following Committee Reason: "New houses with proper ventilation are not where deaths due to carbon monoxide poisonings are occurring. Most of the carbon monoxide poisoning deaths are occurring in old housing stock."<sup>1</sup> This accurate assessment of the locations of residential CO poisonings is a general reason for disapproval of mandatory CO alarm installation requirements, including the subject proposal, which would mainly apply only to new houses where the risk of CO poisoning is low. The IRC Committee should have applied the same logic to its consideration of the subject proposal and voted for its disapproval.
3. CO alarms have not demonstrated sufficient reliability off the shelf or in the field to justify their mandatory installation. A 2003 laboratory study, "Evaluating the Performance of Residential CO Alarms", performed by Mosaic Industries and commissioned by the Gas Research Institute, tested 70 commercially available CO alarms from ten retail brands and found that only three performed well, and that two of these three have since been withdrawn from the market. Seventy-nine percent failed to detect at least one dangerous situation at 5% relative humidity, and 47% failed to detect at 50% relative humidity. Thirty percent gave a false alarm when exposed to another gas, such as acetone, ammonia, ethanol, toluene, trichloroethane, CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>2</sub>, and 8% gave a false alarm in clean air. Digital displays were inaccurate within plus or minus 30% of the true CO concentrations on all but three brands. Reliability declines with the age of the alarm. The standard to which most are manufactured, UL 2034, does not require adequate time-of-manufacturing testing and does not require testing for lifetime or accuracy over time. Given the persisting poor reliability of these devices, mandatory installation requirements are not justified.
4. The proponent's statistical information from the U. S. Consumer Product Safety Commission (CPSC) is outdated and inaccurate in representing the national risk of residential CO poisonings. In 2003, non-intentional, non-fire carbon monoxide (CO) fatalities due to household appliances continued to decline as they have for the past five decades. Average annual CO fatalities involving gas heating systems declined from 106 per year for 1994-1998 to 59 per year for 1999-2000. This decline, 44%, would be larger if fatalities involving heating systems "not specified" include gas heating-related fatalities. Fatalities involving gas water heaters declined from 7 per year for 1994-1998 to 2 per year for 1999-2000. Fatalities involving gas ranges and ovens remained relatively unchanged at 7 per year for 1994-1998 and 6 and 11 in 1999 and 2000, respectively. Overall, fatalities associated with all fuel-burning consumer appliances declined from 200 per year to 124 per year, a 38% decline. These declines are consistent with the historical trend for declines in CO fatalities since World War II and appear to be the result of change out of older combustion equipment, newer housing stock, and increased awareness of combustion appliance safety. CO poisonings due to automobiles, including autos in attached garages, are similarly declining, although CPSC does not publish statistics on this source. CO injury estimates cited by the proponent are no longer published by CPSC mainly because of poor estimation methods used in the past. From these trends, calls for mandatory CO alarm are not justified as an appropriate public health or safety response.
5. The assembly voted to overturn the IRC Committee vote, which itself voted approval by a small majority.
6. At the conclusion of the IRC Hearing, the IRC Committee requested the ICC Board of Directors to form an Ad-Hoc Committee to evaluate the issue of CO and CO alarm requirements. In view of this action at the end of the hearing, and since it reveals the need to gather and evaluate more information, promulgation of mandatory CO alarm requirements under the IRC is premature.

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<sup>1</sup>"2003 ICC Public Hearing Results: 2003/2004 International Residential Code - Building & Energy Code Development Committee."

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**RB99-03/04 - D**  
**R314, R314.1, R314.1.1, R314.2**

*Proposed Change as Submitted:*

**Proponent:** Donald LeBrun, County of Steuben, IN, representing Indiana Association of Building Officials

**Add new text as follows:**

**SECTION R314**  
**CARBON MONOXIDE ALARMS**

**R314.1 Single- and multiple-station carbon monoxide alarms.** Single- and multiple-station carbon monoxide alarms shall be installed in the following locations:

1. Outside each separate sleeping area in the immediate vicinity of the bedrooms.
2. On each additional story of the dwelling, including basements and cellars, but not including crawl spaces and uninhabitable attics. In dwellings or dwelling units with split levels and without an intervening door between the adjacent levels, a carbon monoxide alarm installed on the level with sleeping areas shall suffice for both the upper and lower level provided that less than one full story separates the upper and lower levels.

When more than one carbon monoxide alarm is required to be installed within an individual dwelling unit the alarms devices shall be interconnected in such a manner that the actuation of one alarm will activate all alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed.

All carbon monoxide alarms shall be listed and installed in accordance with the provisions of this code.

**R314.1.1 Alterations, repairs and additions.** When interior alterations, repairs or additions requiring a permit occur, or when one or more sleeping rooms are added or created in existing dwellings, the individual dwelling unit shall be provided with carbon monoxide alarms located as required for new dwellings; the carbon monoxide alarms shall be interconnected and hardwired.

**Exceptions:**

1. Carbon monoxide alarms in existing areas shall not be required to be interconnected and hardwired where the alterations, repairs or additions do not result in the removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space or basement which could provide for the hardwiring and interconnection without the removal of interior finishes.
2. Repair to the exterior surfaces of dwellings are exempt from the requirements of this section.

**R314.2 Power source.** In new construction, the required carbon monoxide alarms shall receive their primary power from the building wiring when such wiring is served from a commercial source, and when primary power is interrupted, shall receive power from a battery. Wiring shall be permanent and without a disconnecting switch other than those required for over-current protection. Carbon monoxide alarms shall be permitted to be battery operated when installed in buildings without commercial power or in buildings that undergo alterations, repairs or additions regulated by Section R314.1.1.

(Renumber current Section R314 and succeeding sections accordingly)

**Reason:** Carbon monoxide, the “Silent Killer”, is a poisonous gas that gives no warning of its presence. It sneaks up on its victim, killing and maiming without warning.

When inhaled, carbon monoxide enters the bloodstream and replaces the oxygen molecules that are carried to our bodies by the hemoglobin. This replacement deprives the heart and brain of their ability to function normally. The ensuing systemic poisoning leads to difficulty in breathing, cardiac trauma, brain damage, coma and eventually, death.

Those lucky enough to survive over-exposure to the toxic gas are often left with permanent neurological and cardiovascular difficulties.

The technology exists today to provide ample warning to at-risk building occupants prior to their being exposed beyond permissible personal exposure levels. UL listed and labeled residential carbon monoxide detectors/alarms are widely available and priced along the lines of residential smoke detectors.

Our jurisdiction has had a local ordinance in place requiring CO alarms in all new residential construction, remodeling and additions for 4 years and have not experienced a single reported false alarm. During this period, there have been eleven instances where the alarms have sounded and subsequent investigations by the servicing fire department have shown CO levels above the threshold for human exposure.

The days of questioning the reliability of these units are long past. It is time that these proven life saving devices are required for our homes.

**Cost Impact:** Anticipated additional costs for these units will range from \$100 to \$300 per house.

**Committee Action:**

**Approved as Submitted**

**Committee Reason:** Based on proponent’s published reason.

**Assembly Action:**

**Disapproved**

*Individual Consideration Agenda*

**This item is on the agenda for individual consideration because an assembly action was successful and public comments were submitted.**

*Public Comment 1:*

**Richard A. Morris, representing NAHB, requests Disapproval.**

**Commenter's Reason:**

- a) Assembly action disapproved RB99-03/04.
- b) The *International Fire Code* Committee stated in its reason for disapproving F115-03/04 that "No product standard to which CO alarms must be listed was included in the proposal," which also applies to RB99-03/04. In disapproving F207-03/04, the committee gave equally applicable reasons: "CO alarms are not yet ready for mandatory installation since there is very little information available on their reliability under the ambient conditions (such as humidity levels) to which they would be exposed in different parts of the country. Also, reliability tends to decrease as the alarm device ages. Testing and maintenance requirements are not covered in the proposal. The provisions make no exception for occupancies that use non-fuel-fired heating equipment::"
- c) Also see the reasons for RB97-03/04:
  - CO alarms are not yet reliable.
  - CO fatalities are declining sharply.
  - Most CO fatalities occur in older homes from use of space heaters and charcoal grills.
  - Alarms should not be required in homes without garages and combustion equipment, where fatalities are even lower.
  - Combination fire alarms may reduce fire safety if occupants confuse the smoke alarm with the CO alarm.
  - Training fire department and rescue squad personnel and requiring them to find and eliminate CO sources and to identify false alarms may detract from their other duties.
  - CO warning signs in garages, warnings on consumer products, public service announcements, and education programs will continue to reduce CO fatalities.

*Public Comment 2:*

**James Ranfone, American Gas Assoc., representing the Building Energy Codes and Standards Committee of the American Gas Assoc., requests Disapproval.**

**Commenter's Reason:**

1. Proposals to the International Fire Code (IFC) for mandatory CO alarm installation requirements were disapproved by the IFC Committee unanimously or, in one case, by a strong majority (15-1). The IFC Committee, representing first responder interests and experience, understands the persisting issues of low reliability of commercially available CO alarms and public safety risks of inappropriately operating safety devices. The disapproval of IFC Committee for mandatory CO alarm requirements calls for similar action on proposals to the International Residential Code.
2. The International Residential Code (IRC) Committee disapproved mandatory CO alarm installation requirements under RB96-03/04 with the following Committee Reason: "New houses with proper ventilation are not where deaths due to carbon monoxide poisonings are occurring. Most of the carbon monoxide poisoning deaths are occurring in old housing stock." This accurate assessment of the locations of residential CO poisonings is a general reason for disapproval of mandatory CO alarm installation requirements, including the subject proposal, which would mainly apply only to new houses where the risk of CO poisoning is low. The IRC Committee should have applied the same logic to its consideration of the subject proposal and voted for its disapproval.
3. CO alarms have not demonstrated sufficient reliability off the shelf or in the field to justify their mandatory installation. A 2003 laboratory study, "Evaluating the Performance of Residential CO Alarms", performed by Mosaic Industries and commissioned by the Gas Research Institute, tested 70 commercially available CO alarms from ten retail brands and found that only three performed well, and that two of these three have since been withdrawn from the market. Seventy-nine percent failed to detect at least one dangerous situation at 5% relative humidity, and 47% failed to detect at 50% relative humidity. Thirty percent gave a false alarm when exposed to another gas, such as acetone, ammonia, ethanol, toluene, trichloroethane, CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>2</sub>, and 8% gave a false alarm in clean air. Digital displays were inaccurate within plus or minus 30% of the true CO concentrations on all but three brands. Reliability declines with the age of the alarm. The standard to which most are manufactured, UL 2034, does not require adequate time-of-manufacturing testing and does not require testing for lifetime or accuracy over time. Given the persisting poor reliability of these devices, mandatory installation requirements are not justified.
4. The proponent's statistical information from the U. S. Consumer Product Safety Commission (CPSC) is outdated and inaccurate in representing the national risk of residential CO poisonings. In 2003, non-intentional, non-fire carbon monoxide (CO) fatalities due to household appliances continued to decline as they have for the past five decades. Average annual CO fatalities involving gas heating systems declined from 106 per year for 1994-1998 to 59 per year for 1999-2000. This decline, 44%, would be larger if fatalities involving heating systems "not specified" include gas heating-related fatalities. Fatalities involving gas water heaters declined from 7 per year for 1994-1998 to 2 per year for 1999-2000. Fatalities involving gas ranges and ovens remained relatively unchanged at 7 per year for 1994-1998 and 6 and 11 in 1999 and 2000, respectively. Overall, fatalities associated with all fuel-burning consumer appliances declined from 200 per year to 124 per year, a 38% decline. These declines are consistent with the historical trend for declines in CO fatalities since World War II and appear to be the result of change out of older combustion equipment, newer housing stock, and increased awareness of combustion appliance safety. CO poisonings due to automobiles, including autos in attached garages, are similarly declining, although CPSC does not publish statistics on this source. CO injury estimates cited by the proponent are no longer published by CPSC mainly because of poor estimation methods used in the past. From these trends, calls for mandatory CO alarm are not justified as an appropriate public health or safety response.
5. The assembly voted to overturn the IRC Committee vote, which itself voted approval by a small majority.
6. At the conclusion of the IRC Hearing, the IRC Committee requested the ICC Board of Directors to form an Ad-Hoc Committee to evaluate the issue of CO and CO alarm requirements. In view of this action at the end of the hearing, and since it reveals the need to gather and evaluate more information, promulgation of mandatory CO alarm requirements under the IRC is premature.

<sup>1</sup>“2003 ICC Public Hearing Results: 2003/2004 International Residential Code - Building & Energy Code Development Committee.”

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2004/2005 Cycle: No proposals