# NON-FIRE CARBON MONOXIDE INCIDENTS REPORTED IN 2005

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**Abstract**

In 2005, municipal fire departments responded to an estimated 61,100 carbon monoxide incidents, excluding incidents where nothing was found or fire was present. A monthly breakdown of the incidents shows that January and December are the peak months. The peak time of day for these incidents is between 6:00 pm and 9:59 pm.

Keywords: carbon monoxide, non-fire

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We are also grateful to the U.S. Fire Administration for its work in developing, coordinating, and maintaining NFIRS.

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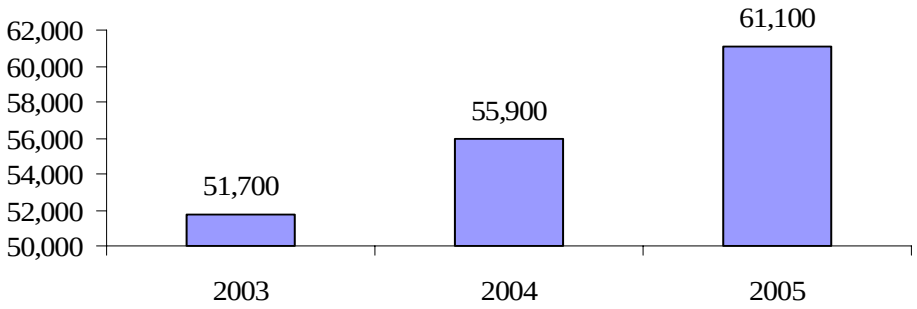
## Non-Fire Carbon Monoxide Incidents Reported in 2005

In 2005, municipal fire departments responded to an estimated 61,100* carbon monoxide incidents, excluding incidents where nothing was found or fire was present. This is a 9% increase from 2004 when fire departments responded to an estimated 55,900* non-fire carbon monoxide incidents, and an 18% increase from 2003, when fire departments responded to an estimated 51,700* non-fire carbon monoxide incidents. (See Figure 1.)

**Figure 1.**

**Non-Fire Carbon Monoxide Incidents Reported by Responding Fire Departments, by Year**

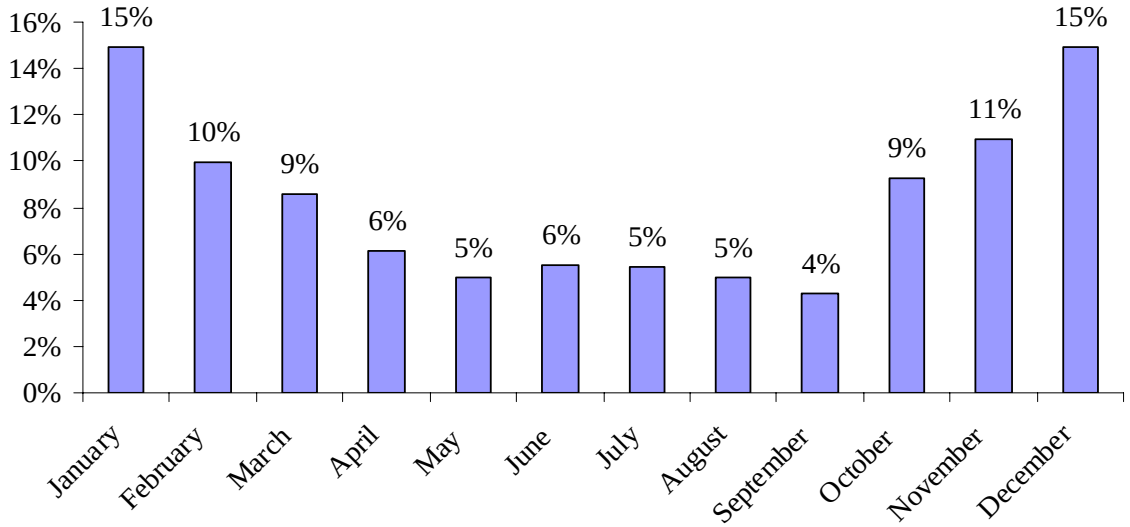



Source: NFIRS and NFPA survey.

A monthly breakdown of non-fire carbon monoxide incidents for 2005 shows that January and December are the peak months for these incidents. (See Figure 2.)

**Figure 2.**

**Non-Fire Carbon Monoxide Incidents Reported by Responding Fire Departments in 2005, by Month**



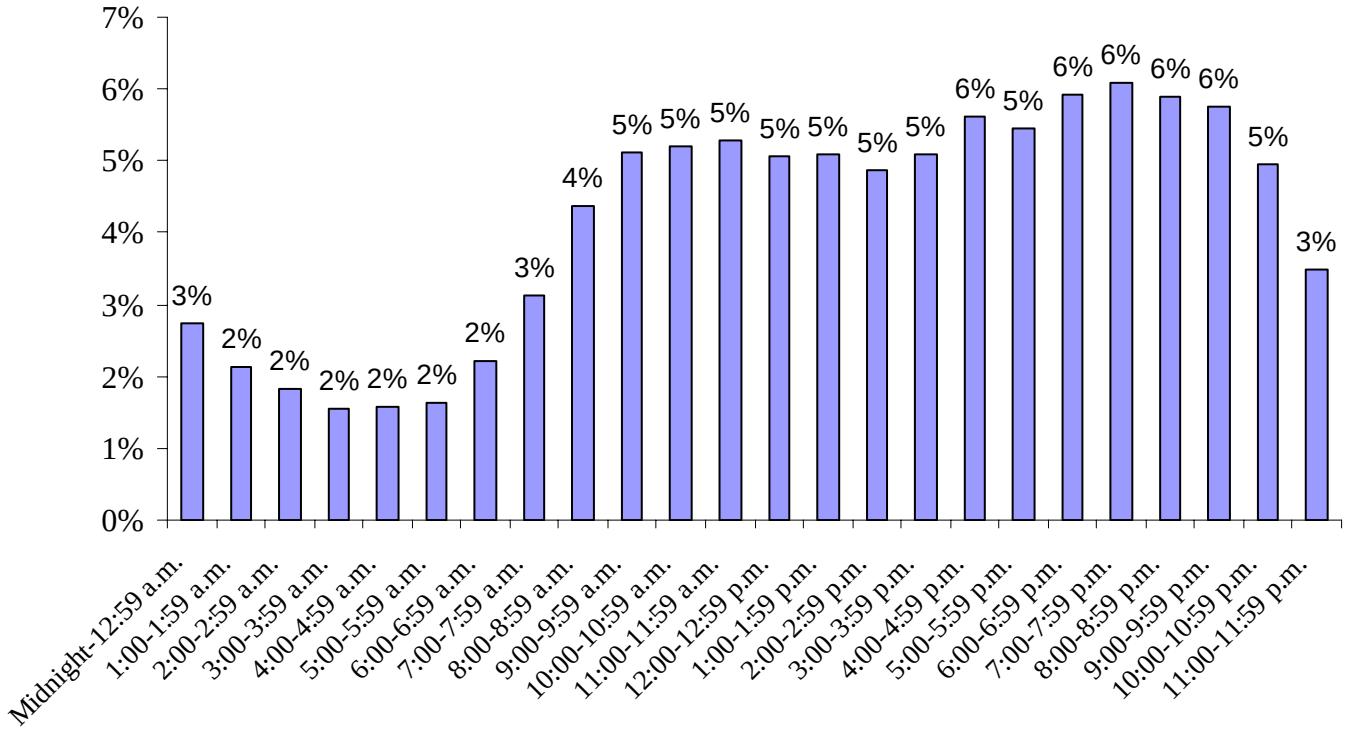

Source: NFIRS and NFPA survey.

* Rounded to the nearest hundred.

The peak time of day for these incidents is between 6:00 p.m. and 9:59 p.m. Overall, 75% of non-fire carbon monoxide incidents are reported between the hours of 9:00 a.m. and 10:59 p.m. (See Figure 3.)

**Figure 3.**

**Non-Fire Carbon Monoxide Incidents Reported by Responding Fire Departments in 2005, by Alarm Hour**




Source: NFIRS and NFPA survey.

Almost 9 out of every 10 (89%) reported non-fire carbon monoxide incidents took place in the home. In contrast, homes account for 75% of the structure fires reported that year.[1] Homes include one- or two-family dwellings, manufactured homes, and multifamily dwellings, including apartments, condos, town houses, row houses, and tenements. (See Table 1.)

[1] Michael J. Karter, Jr., *Fire Loss In The United States During 2005,* Quincy, MA: NFPA Fire Analysis and Research Division, September 2006.

## Table 1.
## Non-Fire Carbon Monoxide Incidents Reported to Fire Departments in 2005, by Occupancy

| Occupancy | Non-Fire Incidents | |
|---|---|---|
| **Public Assembly** | **540** | **(1%)** |
| Fixed use amusement or recreation | 30 | (0%) |
| Variable use amusement or recreation | 30 | (0%) |
| Place of worship or funeral property | 90 | (0%) |
| Club | 40 | (0%) |
| Library, museum, courthouse or other public property | 80 | (0%) |
| Eating or drinking place | 210 | (0%) |
| Passenger terminal | 20 | (0%) |
| Studio or Theater | 20 | (0%) |
| Unclassified or unknown-type public assembly property | 20 | (0%) |
| **Educational** | **260** | **(0%)** |
| Preschool through grade 12 | 150 | (0%) |
| Adult education or college classroom | 20 | (0%) |
| Day care | 70 | (0%) |
| Unclassified or unknown-type public educational property | 20 | (0%) |
| **Institutional, Including Board and Care** | **370** | **(1%)** |
| Nursing home or residential board and care facility | 160 | (0%) |
| Mental retardation or substance abuse | 60 | (0%) |
| Hospital or hospice | 20 | (0%) |
| Clinic or doctor's office | 70 | (0%) |
| Prison, jail or police station | 40 | (0%) |
| Unclassified institutional property | 20 | (0%) |
| **Residential, Excluding Board and Care** | **56,280** | **(92%)** |
| Home | 54,380 | (89%) |
| One- or two-family dwelling | 44,130 | (72%) |
| Apartment or multi-family dwelling | 10,250 | (17%) |
| Other Residential | 1,890 | (3%) |
| Rooming or boarding house, residential hotel, or shelter | 80 | (0%) |
| Hotel or motel | 130 | (0%) |
| Dormitory, fraternity, sorority or barracks | 110 | (0%) |
| Unclassified or unknown-type residential | 1,580 | (3%) |

## Table 1.
## Non-Fire Carbon Monoxide Incidents Reported to Fire Departments in 2005, by Occupancy
## (Continued)

| Occupancy | Non-Fire Incidents | |
|---|---|---|
| **Mercantile and office** | **1,180** | **(2%)** |
| Grocery or convenience store | 190 | (0%) |
| Textile or apparel sales | 40 | (0%) |
| Household goods sales or repairs | 40 | (0%) |
| Specialty shop | 90 | (0%) |
| Personal service, recreation or home repair | 90 | (0%) |
| Laundry, dry cleaning or professional supplies or services | 100 | (0%) |
| Service station or vehicle sales, service or repair | 90 | (0%) |
| Department store or unclassified general retail | 90 | (0%) |
| Office, bank or mail facility | 300 | (0%) |
| Unclassified or unknown-type mercantile or business | 160 | (0%) |
| **Utility, Defense, Agriculture or Mining** | **50** | **(0%)** |
| Energy production plant | 10 | (0%) |
| Laboratory | 10 | (0%) |
| Defense, computer or communications center | 10 | (0%) |
| Utility or distribution system | 10 | (0%) |
| Agriculture | 10 | (0%) |
| Mine or quarry | 0 | (0%) |
| Unclassified or unknown-type utility, defense, agriculture or mining | 10 | (0%) |
| **Manufacturing or Processing** | **180** | **(0%)** |
| **Storage** | **190** | **(0%)** |
| Refrigerated storage | 0 | (0%) |
| Vehicle storage, garage or fire station | 60 | (0%) |
| Warehouse, residential or self-storage | 110 | (0%) |
| Unclassified or unknown-type storage property, including outbuildings, sheds, outside material storage areas | 20 | (0%) |
| **Special Property** | **210** | **(0%)** |
| Dump or sanitary landfill | 0 | (0%) |
| Bridge, tunnel or outbuilding | 0 | (0%) |
| Open land, beach or campsite | 20 | (0%) |
| Water area | 0 | (0%) |
| Railroad area | 0 | (0%) |
| Highway, street or parking area | 140 | (0%) |
| Aircraft area | 0 | (0%) |
| Construction site, oil or gas field, pipeline or industrial plant yard | 20 | (0%) |
| Unclassified or unknown-type special property | 20 | (0%) |

## Table 1.
## Non-Fire Carbon Monoxide Incidents Reported to Fire Departments in 2005, by Occupancy
## (Continued)

| Occupancy | Non-Fire Incidents | |
|---|---|---|
| **Completely Unclassified, Unreported or Unknown-Type Property Use** | **1,840** | **(3%)** |
| **Total** | **61,100** | **(100%)** |

Note: These are national estimates of non-fire incidents reported to U.S. municipal fire departments and so exclude incidents reported only to Federal or state agencies or industrial fire brigades. These national estimates are projections based on the detailed information collected in Version 5.0 of NFIRS. Incidents are rounded to the nearest ten. Totals may not equal sums due to rounding errors.

Source: NFIRS and NFPA survey.

## Appendix A.
## How National Estimates Statistics Are Calculated

The statistics in this analysis are estimates derived from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual survey of U.S. fire departments. NFIRS is a voluntary system by which participating fire departments report detailed factors about the incidents to which they respond. Roughly two-thirds of U.S. fire departments participate, although not all of these departments provide data every year.

NFPA conducts an annual stratified random sample survey of fire departments which enables us to capture a summary of fire department experience on a larger scale. The NFPA survey is based on a stratified random sample of roughly 3,000 U.S. fire departments (or just over one of every ten fire departments in the country). The survey includes the following information: (1) the total number of incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined by the NFPA 901 Standard; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; and (3) information on the type of community protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results.

The NFPA survey begins with the NFPA Fire Service Inventory, a computerized file of about 30,000 U.S. fire departments. The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities protect fewer people per department and are less likely to respond to the survey, so a large number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city departments are so few in number and protect such a large proportion of the total U.S. population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate. The results of the survey are published in the annual report Fire Loss in the United States. To download a free copy of the report visit http://www.nfpa.org/assets/files/PDF/OS.fireloss.pdf.

### Projecting NFIRS to National Estimates

As noted, NFIRS is a voluntary system. Different states and jurisdictions have different reporting requirements and practices. Participation rates in NFIRS are not necessarily uniform across regions and community sizes, both factors correlated with frequency and severity of the incident. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second database - the NFPA survey - is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

Carbon monoxide incidents are reported to the U.S. Fire Administration's (USFA) National Fire Incident Reporting System (NFIRS) as basic incident code 424: Carbon monoxide incident, excluding incidents with nothing found. Only incidents reported to municipal fire departments are included in this statistic, which is derived from the NFIRS basic incident database and NFPA's 2005 fire department experience survey.

Since NFIRS is not a census of incidents, the 2005 NFIRS Version 5.0 percentage for non-fire carbon monoxide incidents is multiplied by the hazardous material total from the NFPA survey. This calculation yields the non-fire carbon monoxide incident national estimate.

It is important to note that these incidents are strictly non-fire incidents reported to fire departments. In other words, any non-fire carbon monoxide incident reported to another entity, such as the heating company, is not included in the statistics.

## CO DEATHS

By Jennifer Flynn
*NFPA Journal*, January/February 2008

Carbon monoxide (CO), also known as the "silent killer", is a colorless, odorless, poisonous gas that results from the incomplete burning of common fuels such as natural or liquefied petroleum (LP) gas, oil, wood, or coal. When CO is inhaled, it enters the blood stream and reduces the ability of the blood to carry oxygen to vital organs, such as the heart and brain.

Fire departments are often called to assist when people suspect that carbon monoxide might be present. Some of these calls are reported after a CO alarm sounds. Some may be in response to symptoms of CO poisoning.

In 2005, U.S. fire departments responded to an estimated 61,100 non-fire CO incidents in which carbon monoxide was found, or an average of seven such calls per hour. The number of incidents increased 18 percent from 51,700 incidents reported in 2003.

In the home, heating and cooking equipment that burn fuel are potential sources of carbon monoxide, which is why installation codes and standards for fueled equipment emphasize arrangements for adjusting venting. Vehicles or generators running in an attached garage can also produce dangerous levels of carbon monoxide.

For example, in March 2004, a carbon monoxide leak from a gas furnace left two families suffering the effects of CO poisoning. The leak began in one family's basement, spread throughout the house and into a neighbor's home. The leak resulted in the CO poisoning and death of a 14 year-old-girl, who lived in the home where the leak originated. Another seven individuals were treated for CO poisoning, including two women, ages 40 and 19 years old, and two males, age 20 and 4 years old, who lived with the 14-year-old girl, and a 24-year-old woman and two boys, ages 3 years old and 1 month, who lived next door. These seven victims were treated for CO poisoning and survived the incident.

In 2005, three children were taken to the hospital and treated for CO poisoning when exhaust fumes from a power generator leaked into the house through a crack in a door for several hours. The children included a 7-year-old boy and two girls, ages 4 and 11. According to the Consumer Product Safety Commission (CPSC), the amount of exhaust from one generator is equivalent to that of hundreds of idling cars. The three children were lucky they were removed from the area and treated early enough that they did not die.

Another little boy was not so lucky. On Christmas Eve, 2004, a generator had been running in 2008the basement of the family's home. That night the 3-year-old was found unresponsive with a CO level above 500 parts per million (ppm). (The Environmental Protection Agency lists the level of CO in air as 3 ppm.) The boy had suffered CO poisoning, cardiac arrest, and died. A 35-year-old neighbor of the boy had gone into the house to help and suffered a headache, nausea, and vomiting and was treated at the hospital for CO poisoning.

**The dangers of CO exposure**
The dangers of CO exposure depend on a number of variables, including the victim's health and activity level. Infants, pregnant women, and people with physical conditions that limit their body's ability to use oxygen (i.e., emphysema, asthma, heart disease) can be more severely affected by lower concentrations of CO than healthy adults would be.

CO poisoning can be confused with flu symptoms, food poisoning and other illnesses. Some symptoms include shortness of breath, nausea, dizziness, light headedness, or headaches. High levels of CO can be fatal, causing death within minutes. Although most CO poisoning happens during a single incident, it is possible to suffer from chronic CO poisoning when a person is exposed to low levels of CO over weeks or months and experiences symptoms over that time.

Even single-incident CO exposures can have long-term health consequences, such as cardiovascular manifestations, neurological dysfunction, or brain damage, occuring days to weeks after the exposure. In 14 percent to 40 percent of serious initial CO poisonings, the individual exposed still faces the prospect of delayed neurologic dysfunction.

According to the Centers for Disease Control and Prevention (CDC), an estimated 15,200 people were treated annually during 2001-2003 in emergency departments for nonfatal, unintentional, non-fire-related CO exposure. During 2001-2002, the CDC estimates 480 people died, on average, each year from unintentional non-fire related carbon monoxide exposure.

The CPSC is a federal regulatory agency that works to reduce the risk of injuries and deaths that result specifically from consumer products. According to them, 166 unintentional non-fire carbon monoxide poisoning deaths were associated with consumer products on average, annually from 2002-2004 . This was a 34 percent increase in unintentional non-fire carbon monoxide poisoning deaths from 1999-2000, in which an average of 124 deaths were reported annually.

Of the CO non-fire deaths related to consumer products in 2003 and 2004, 47 percent were associated with the use of heating systems, most often gas heating systems. Another 35 percent of the CO deaths were associated with engine-driven tools. The CPSC reports that 73 percent of CO deaths occurred in the home, while deaths in tents, campers, and other temporary shelters accounted for an estimated 14 percent of deaths during 2003-2004.

The CPSC examined carbon monoxide incidents associated specifically with engine-driven generators and other engine-driven tools that occurred between 1990 and 2004. During these 15 years, generators resulted in 264 CO potential exposure deaths and were the leading engine-driven consumer products involved in CO exposure incidents.

**NFPA 720 and State legislation**
The applicable NFPA standard is NFPA 720, Standard for the Installation of Carbon Monoxide (CO) Warning Equipment in Dwelling Units . The 2005 edition of the code covers the selection, application, installation, location, testing, and maintenance of CO warning

equipment within dwelling units that contain fuel-burning appliances or fireplaces, or have attached garages. The purpose of the standard is to provide a warning of the presence of CO in sufficient time to allow occupants to either escape or take other appropriate action.

According to NFPA 720, a CO alarm or detector must be centrally located outside each separate sleeping area in the immediate vicinity of the bedrooms. Each alarm or detector should be located on the wall, ceiling, or other location as specified in the installation instructions that accompany the unit.

As of 2007, 15 states and more than 40 other authorities having jurisdiction require some form of carbon monoxide detection. Texas, for example, only requires CO detectors in day care and group homes, while Oklahoma only requires detectors in child care facilities. Many states only require carbon monoxide detectors in newly constructed buildings. Of the 15 states that have adopted requirements for carbon monoxide detection, ten require the installation of carbon monoxide detectors in occupancies not covered by the standard, which only applies to dwelling units.

The NFPA Technical Committee on Carbon Monoxide Detection has expanded the scope and requirement of NFPA 720 to cover all occupancies — not just dwelling units. The newly revised version of NFPA 720 will require CO alarms or detectors outside each separate sleeping area and on every level within the dwelling unit. It will also cover, for the first time, buildings and structures other than dwelling units. The standard is being voted on and should go into effect in 2008.

**Reducing CO deaths and injuries**

NFPA urges individuals to follow these steps to ensure safety in and around their home.

Install CO alarms (listed by an independent testing laboratory) inside to provide early warning of accumulating CO. CO alarms should be installed in a central location outside each separate sleeping area. If bedrooms are spaced apart, each area will need a CO alarm.

Call your local fire department's non-emergency number to find out what number to call if the CO alarm sounds. Post that number by your telephone(s). Make sure everyone in the household knows the difference between the fire emergency and CO emergency numbers (if there is a difference).

If your CO alarm sounds, immediately move to a fresh air location and call for help. Remain at the fresh air location until emergency personnel say it is okay. If the audible trouble signal sounds, check for low batteries or other trouble indicators.

Test CO alarms at least once a month and replace CO alarms according to the manufacturer's instructions. CO alarms are not substitutes for smoke alarms. Know the difference between the sound of your smoke alarms and CO alarms.

Have fuel-burning heating equipment (fireplaces, furnaces, water heaters, wood and coal stoves, space or portable heaters) and chimneys inspected by a professional every year before cold weather arrives.

When purchasing new heating and cooking equipment, select products tested and labeled by an independent testing laboratory. When using a fireplace, open the flue for adequate ventilation. Never use your oven to heat your home.

If you need to warm a vehicle, remove it from the garage immediately after starting it. Do not run a vehicle, generator, or other fueled engine or motor indoors, even if garage doors are open.

During and after a snowstorm, make sure vents for the dryer, furnace, stove, and fireplace are clear of snow build-up.

When camping, remember to use battery-powered lights in tents, trailers, and motor homes.

A generator should be placed well away from the house because carbon monoxide can get pulled into the house through vents or open windows.

**Carbon Monoxide Facts**

•U.S. fire departments responded to an average of seven calls per hour for non-fire carbon monoxide incidents in 2005. That's an 18% increase from 2003, most likely due to an increase in the use of CO detectors.

•In 2005, January and December were the peak months for non-fire carbon monoxide incidents in which CO was found.

•The peak time of day is between 6:00 p.m. and 9:59 p.m.

•Overall, 75 percent of non-fire CO incidents are reported between the hours of 9:00 a.m. and 10:59 p.m.

•Almost 9 out of every 10 (89 percent) reported non-fire CO incidents took place in the home. In contrast, homes accounted for 75 percent of the structure fires reported that year. (Homes include one- or two-family dwellings, manufactured homes, and multifamily dwellings, including apartments, condos, town houses, row houses, and tenements.)

•In 2003, there were an estimated 60,600 unintentional CO detector activations, in which carbon monoxide was not detected, this includes CO detector malfunctions and false alarms. (Due to the increasingly large size of the national database, false alarms and false calls were not included in the publicly released NFIRS data for 2004 and 2005.)

•In 2003, 46 percent of all CO-related non-fire calls reported to fire departments were carbon monoxide incidents, in which carbon monoxide was found. Fifty-four percent of all CO-related non-fire calls reported to fire departments were false alarms, or no CO was found.

Source: NFIRS and NFPA survey