

Smoke Alarms in U.S. Home Fires

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Abstract

Almost all households in the U.S. have at least one smoke alarm, yet in 2003-2006, smoke alarms were present in only two-thirds (69%) of all reported home fires and operated in just under half (47%) of the reported home fires. (“Homes” includes one- and two-family homes, apartments, and manufactured housing.) Forty percent of all home fire deaths resulted from fires in homes with no smoke alarms, while 23% resulted from homes in which smoke alarms were present but did not operate. The death rate per 100 reported fires was twice as high in homes without a working smoke alarm as it was in home fires with this protection. Hardwired smoke alarms are more reliable than those powered solely by batteries.

These estimates are based on data 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 fire department experience survey.

Keywords: fire statistics, home fires, residential fires, smoke alarms, smoke detectors

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Executive Summary

Smoke alarms have become such a common feature in U.S. homes that it is easy to take them for granted. Newspapers often report fires in which blaring smoke alarms alerted sleeping occupants to danger. These devices alert countless others to fires just as they are starting. A 2008 survey conducted for NFPA by Harris Interactive found that 24 of every 25 (96%) U.S. homes had at least one smoke alarm. Homes include one- and two-family homes, apartments, and manufactured housing.

Almost two-thirds of home fire deaths resulted from fires in properties without sounding smoke alarms.

In 2003-2006, smoke alarms were present in roughly two-thirds (69%) of reported home fires and sounded in roughly half (47%) of the home fires reported to U.S. fire departments. Forty percent of home fire deaths resulted from fires in which no smoke alarms were present at all. Twenty-three percent of the deaths were caused by fires in properties in which smoke alarms were present and but failed to operate. Smoke alarms operated in fires that caused 37% of the deaths. One percent of the deaths resulted from fires that were too small to activate the smoke alarm.

Smoke alarm failures usually result from missing, disconnected, or dead batteries.

When smoke alarms fail to operate, it is usually because batteries are missing, disconnected or dead. People are most likely to remove or disconnect batteries because of nuisance activations. Sometimes the chirping to warn of a low battery is interpreted as a nuisance alarm. Smoke alarms should be tested at least once every month to ensure that both the batteries and the units themselves are still working. Replaceable batteries should be replaced in accordance with the manufacturer's instructions, at least once every year.

In one-fifth of all homes with smoke alarms, none were working.

In 1992, the U.S. Consumer Product Safety Commission (CPSC) sent surveyors to people's homes to find out how common smoke alarms were and what portion of these devices were working in the general population's homes. In one of every five homes that had at least one smoke alarm installed, not a single one was working. Including homes without smoke alarms and homes with only non-working alarms, one-quarter of U.S. households do not have the protection of even one working smoke alarm. In follow-up visits after smoke alarm installation programs, typically a substantial portion of the installed alarms were not working.

Most homes do not yet have the protection recommended in the 2007 edition of NFPA 72.

The 2007 edition of NFPA 72, *National Fire Alarm Code*® required smoke alarms in every bedroom, outside each sleeping area, and on every level. They should also be interconnected so that when one sounds, they all sound. Most homes do not have this level of protection. The CPSC's 2004-2005 Residential Fire Survey asked about all fires, including incidents that were not attended by the fire service. Based on respondents' reports, 82% of the households that had fires and 84% of non-fire households had smoke alarms on every level. Only 22% of fire households had smoke alarms in all bedrooms compared to 31% of households without fires. Thirteen percent of the fire households and 19% of the non-fire households had interconnected smoke alarms. When interconnected smoke alarms were present, they operated in 53% of the

incidents and provided the only alert in 26% of the fires. In many cases, people are in the room or nearby when a fire starts and notice it before the smoke alarm sounds. In cases where the smoke alarms provided the only alert, the occupants had not been aware of the fire until the smoke alarm sounded. When the smoke alarms were *not* interconnected, they operated in only 27% of the fires and provided the only alert in 8%. When smoke alarms did not operate, it was typically reported that smoke did not reach the alarm.

Most homes still have smoke alarms powered by batteries only.

In the 2007 *American Housing Survey* (AHS), 67% of the respondents who reported having smoke alarms said their alarms were powered by batteries only, 24% said their alarms were powered by electricity and batteries, and 9% by electricity only. For many years, NFPA 72 has required smoke alarms in new construction to be hardwired with battery backup. Yet the AHS found that in 37% of homes less than five years old that had working smoke alarms, the smoke alarms were powered by battery only. To be effective, the codes must be adopted and enforced.

People 55 or older were more likely to have smoke alarms that were more than 10 years old.

NFPA has long recommended that smoke alarms be replaced every ten years. The previously mentioned 2008 survey Harris Interactive survey found that, among households with smoke alarms, 10% of respondents of all ages and 17% of those at least 55 years old reported that their smoke alarms were more than ten years old.

The same survey asked for perceptions of how often smoke alarms should be replaced. Only 12% reported that smoke alarms should be replaced every 10 years. Thirty-five percent simply did not know or refused to answer the question. Four percent thought these devices never need replacing. Roughly two in five believe that smoke alarms should be replaced at least every 4-6 years, if not more often. Some of the confusion about how often smoke alarms should be replaced is likely due to different recommendations for replacement schedules of devices that detect smoke *and* carbon monoxide. Manufacturers of carbon monoxide alarms and combination smoke/carbon monoxide alarms often recommend more frequent replacement.

Fire Protection Research Foundation study found that strobe lights, used alone, were ineffective in waking people who were hard of hearing.

The Fire Protection Research Foundation studied the waking effectiveness of different types of alarm signals for various high risk groups. The authors of the 2007 report found that a loud low frequency square wave auditory signal was most effective in waking those with moderate to severe hearing loss. This signal performed better than bed or pillow shakers and strobe lights. Strobe lights, when used alone, were not effective in waking this population. The renamed 2010 edition of NFPA 72, *National Fire Alarm and Signaling Code*, will require that audible notification appliances used in bedrooms for those with mild to severe hearing loss produce a low frequency signal. Another new provision will require tactile notification appliances in addition to strobes for individuals with profound hearing loss. These provisions will take effect immediately upon adoption of the new code.

Follow these tips.

The Educational Messages Advisory Committee (EMAC) to NFPA's Public Education Division developed the following tips for the testing and maintenance of smoke alarms.

- Choose a smoke alarm that bears the label of a recognized testing laboratory.
- Install a smoke alarm in every bedroom, outside each sleeping area, and on every level of your home, including the basement.
- Interconnect all smoke alarms throughout the home. When one sounds, they all sound.
- Replace batteries in all smoke alarms at least once a year. If an alarm “chirps,” warning the battery is low, replace the battery right away.
- Replace all smoke alarms, including alarms that use 10-year batteries and hard-wired alarms, when they are 10 years old or sooner if they do not respond properly when tested.
- Test your smoke alarms at least every month, using the test button or an approved smoke substitute and clean the units, both in accordance with the manufacturers’ instructions.
- An ionization smoke alarm is generally more responsive to flaming fires and a photoelectric smoke alarm is generally more responsive to smoldering fires. For the best protection, both types of alarms, or a combination alarm (photoelectric and ionization), should be installed in homes.

The households with smoke alarms that don’t work now outnumber the households with no alarms by a substantial margin. Any program to ensure adequate protection must include smoke alarm maintenance. Only one in four people reported testing their smoke alarms at least once a month. Although most homes have at least one smoke alarm, many homes do not have a unit on every floor. It is easy to forget that a smoke alarm’s sole function is to sound the warning. People need to develop and practice escape plans so that if the alarm sounds, they can get out quickly. Because smoke alarms alert occupants to fires that are still relatively small, some people attempt to fight these fires themselves. Unfortunately, some of these attempts are unsuccessful due to either rapid fire spread or inappropriate methods of fire control. Meanwhile, precious escape time is lost.



Smoke Alarms in Reported U.S. Home Fires



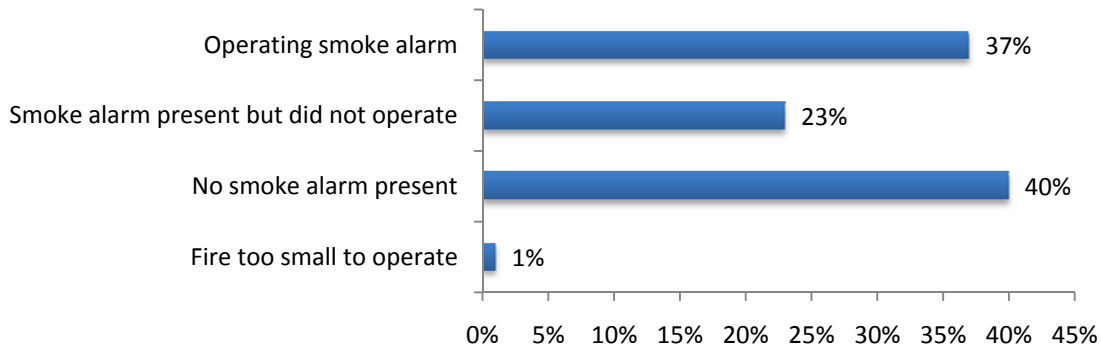
Ninety-six percent of all homes have at least one smoke alarm, according to a 2008 telephone survey. Overall, three-quarters of all U.S. homes have at least one *working* smoke alarm.

Smoke Alarm Presence and Performance

In 2003-2006, smoke alarms sounded in roughly half of the home fires reported to U.S. departments.

- Almost two-thirds of home fire deaths resulted from fires in homes with no smoke alarms or no working smoke alarms.
 - No smoke alarms were present in 40% of the home fire deaths.
 - In 23% of the home fire deaths, smoke alarms were present but did not sound.

**Home Structure Fire Deaths by Smoke Alarm Performance
 2003-2006**



Interconnected smoke alarms on all floors increase safety

Interconnected smoke alarms were more likely to operate and alert occupants to a fire in a U.S. Consumer Product Safety Commission (CPSC) survey of households with any fires, including fires in which the fire department was not called.¹

- When on all floors, alarms sounded in 37% of fires and alerted occupants in 15%.
- When smoke alarms were not on all floors, they sounded in only 4% of the fires and alerted occupants in only 2%.
- In homes that had interconnected smoke alarms, the alarms sounded in half (53%) of the fires and alerted people in one-quarter (26%) of the fires.
 - People may learn about or be alerted to a fire without hearing a smoke alarm.

¹Michael A. Greene and Craig D. Andres, *2004-2005 Residential Fire Survey*, Presentation to the Public-Private Fire Safety Council, May 15, 2008.



Homes include one- and two-family dwellings, manufactured homes, apartments, townhouses, rowhouses, and condominiums.

Home Smoke Alarm Power Sources

More than half of the smoke alarms found in reported fires and two-thirds of the alarms found in homes with fire deaths were powered by battery only.

In fires considered large enough to activate the alarm,

- Hardwired smoke alarms operated 91% of the time.
- Battery-powered smoke alarms operated in 75%.

Little causal detail is required about certain categories of minor fires, identified by incident type and collectively called confined fires, by the U.S. Fire Administration’s National Fire Incident Reporting System (NFIRS). Confined fires were omitted from these calculations

Reasons for Smoke Alarm Failure

In more than half of the reported home fires¹ in which the smoke alarms were present but did not operate, batteries were missing or disconnected. Nuisance alarms were the leading reason for disconnected smoke alarms.

- Roughly one of every five smoke alarm failures was due to dead batteries.
- Only 8% of the failures were due to hardwired power source problems, including disconnected smoke alarms, power outages and power shut-offs.

**Reason Smoke Alarm Failed to Operate in Home Structure Fires
2003-2006**

