

# **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 2005-2009, smoke alarms were present in less than three-quarters (72%) of all reported home fires and operated in half (51%) of the reported home fires. (“Homes” includes one- and two-family homes, apartments, and manufactured housing.) More than one-third (38%) of all home fire deaths resulted from fires in homes with no smoke alarms, while one-quarter (24%) resulted from fires in 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. Recent telephone surveys, including 2008 and 2010 surveys conducted for NFPA by Harris and a Consumer Product Safety Commission's (CPSC's) 2004-2005 survey found that 96-97% of the surveyed U.S. households reported having at least one smoke alarm.

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

In 2005-2009, smoke alarms were present in almost three-quarters (72%) of reported home fires and sounded in half (51%) of the home fires reported to U.S. fire departments. Homes include one- and two-family homes, apartments or other multi-family housing, and manufactured housing. More than one-third (38%) of home fire deaths resulted from fires in which no smoke alarms were present at all. One-quarter (24%) of the deaths were caused by fires in properties in which smoke alarms were present but failed to operate. Smoke alarms operated in fires that caused roughly one-third (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 should have operated but did not do so, it was 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.

Half of the households surveyed in a 2010 Harris Poll done for NFPA reported they had smoke alarms in their kitchen. Two out of every five (43%) households reported their smoke alarms had gone off at least once in the past year. Almost three-quarters (73%) said the activation was due to cooking. Eight percent mentioned low battery chirps.

If a smoke alarm in the kitchen is sounding too often, the problem could be solved by moving the smoke alarm. Unless designed specifically for the area, all smoke alarms should be at least 10 feet away from cooking appliances. If space requires you to have a smoke alarm within 10-20 feet of the kitchen stove, install either a photoelectric alarm or an alarm with a hush feature that can be temporarily silenced without disabling the 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. Unfortunately, the 1992 CPSC study with home visits and smoke alarm tests, has not been done again at a national level.

**Most homes do not yet have the protection recommended in recent editions of NFPA 72®.**

Both the 2007 and 2010 editions of [NFPA 72®, National Fire Alarm and Signaling Code®](#) require 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. New homes should have hardwired smoke alarms. Most homes do not yet have this level of protection. A 2010 Harris Interactive survey done for the NFPA found that roughly two out of every five households had smoke alarms in all bedrooms. Only one-quarter of all homes had interconnected smoke alarms.

**Most homes still have smoke alarms powered by batteries only.**

In the 2009 *American Housing Survey* (AHS), almost two-thirds (65%) of the respondents who reported having smoke alarms said their alarms were powered by batteries only, slightly more than one-quarter (28%) said their alarms were powered by electricity and batteries, and 8% had alarms powered 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 more than one-third (36%) of homes less than five years old that had working smoke alarms, the smoke alarms were powered by battery only. The death rate per 100 reported fires is twice as high in fires

with smoke alarms powered by batteries as it is in fires with hardwired smoke alarms. To be effective, the codes must be adopted and enforced.

**CPSC found that households that had fires had somewhat less smoke alarm protection.**

The CPSC's *2004-2005 National Sample Survey of Unreported Residential Fires* asked about all fires, including incidents that were not attended by the fire service. Based on respondents' reports, 82% of the households that had unreported fires and 84% of non-fire households had smoke alarms on every level. Less than one-quarter (22%) of fire households had smoke alarms in all bedrooms. In contrast, almost one-third (31%) of non-fire households had the devices in all bedrooms. Thirteen percent of the fire households and 19% of the non-fire households had interconnected smoke alarms.

**CPSC study also showed how important interconnected smoke alarms were in providing early warnings.**

When interconnected smoke alarms were present, they operated in half (53%) of the incidents and provided the only alert in one-quarter (26%) of the fires. When the smoke alarms were *not* interconnected, they operated in only one-quarter (27%) of the fires and provided the only alert in 8%. 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 smoke alarms did not operate, it was typically reported that smoke did not reach the alarm.

**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 2010 Harris Interactive survey found that among households with smoke alarms, 12% 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.

A 2008 Harris survey, also done for NFPA, asked for perceptions of how often smoke alarms should be replaced. Only 12% reported that smoke alarms should be replaced every 10 years. One-third (35%) 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 2010 edition of [NFPA 72®, National Fire Alarm and Signaling Code](#), requires audible notification appliances used in bedrooms for those with mild to severe hearing loss to produce a low frequency signal. Another new provision requires 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.

**Progress has been made but more work is needed.**

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. In the 2010 Harris poll, only one in five respondents 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.

**Follow safety 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. A condensed list is below. Appendix C of this report contains additional tips with supporting material to explain and back-up the tips.

- 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.
- For the best protection, interconnect all smoke alarms throughout the home. When one sounds, they all sound.
- 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.
- Smoke alarms with non-replaceable (long-life) batteries are designed to remain effective for up to 10 years. If the alarm chirps, warning that the battery is low, replace the entire smoke alarm.

For smoke alarms with any other type of battery, replace batteries at least once a year. If that smoke alarm chirps, replace only the battery.

- 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, or where extra time is needed to awaken or assist others, both types of alarms, or combination ionization and photoelectric alarms, are recommended

For safety tip sheets on a variety of topics, go to [www.nfpa.org/safetytips](http://www.nfpa.org/safetytips). For all EMAC tips, go to [www.nfpa.org/emac](http://www.nfpa.org/emac).

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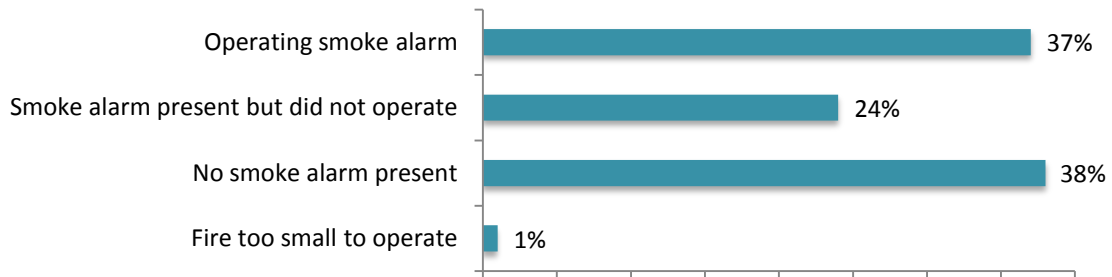
Ninety-six percent of all homes have at least one smoke alarm, according to a 2010 telephone survey. Overall, three-quarters of all U.S. homes have at least one *working* smoke alarm.

## Smoke Alarm Presence and Performance

In 2005-2009, smoke alarms sounded in half of the home fires reported to U.S. fire 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 more than one-third (38%) of the home fire deaths.
  - In one-quarter (24%) of the home fire deaths, smoke alarms were present but did not sound.

**Home Structure Fire Deaths by Smoke Alarm Performance  
 2005-2009**



## Interconnected smoke alarms increase safety

in a Consumer Product Safety Commission (CPSC) survey of households with any fires, including fires in which the fire department was not called, interconnected smoke alarms were more likely to operate and alert occupants to a fire.<sup>1</sup> People may learn about or be alerted to a fire without hearing a smoke alarm.

- When smoke alarms (interconnected or not) were on all floors, they 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.

Michael A. Greene and Craig Andres. 2004-2005 National Sample Survey of Unreported Residential Fires. U.S. Consumer Product Safety Commission, July 2009.



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

## Home Fires with Smoke Alarms

In reported home fires with smoke alarms:

- Half the alarms were powered by battery only.
- Two-thirds of the fatal fire injuries were caused by fires in homes with smoke alarms powered by battery only.

In fires considered large enough to activate the alarm,

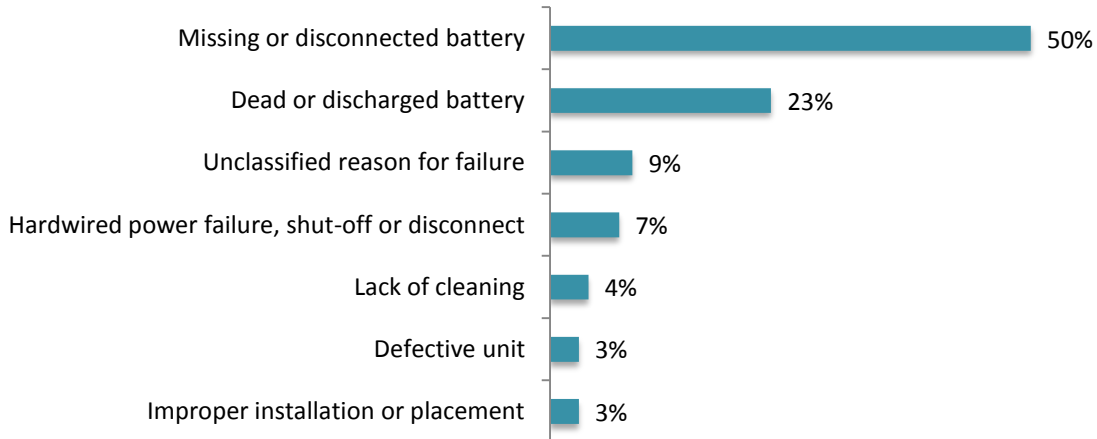
- Hardwired smoke alarms operated 92% of the time.
- Battery-powered smoke alarms operated in three-quarters (77%) of the fires.

## Reasons that Smoke Alarms Did Not Operate

In reported home fires<sup>1</sup> in which the smoke alarms were present but did not operate,

- Half of the smoke alarms had missing or disconnected batteries. Nuisance alarms were the leading reason for disconnected smoke alarms.
- Almost one-quarter (23%) of the smoke alarm failures was due to dead batteries.
- Only 7% 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  
2005-2009**



*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 calculations of the reasons for smoke alarm failure.*

# Smoke Alarm Safety at Home



Smoke alarms are an important part of a home fire escape plan. When there is a fire, smoke spreads fast. Working smoke alarms give you early warning so you can get outside quickly.

## SAFETY TIPS

- » INSTALL smoke alarms inside every bedroom, outside each sleeping area and on every level of the home, including the basement.
- » Larger homes may need ADDITIONAL smoke alarms to provide enough protection.
- » For the best protection, INTERCONNECT all smoke alarms so when one sounds they all sound.
- » 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 combination ionization and photoelectric alarms (also known as dual sensor alarms) are recommended.
- » Smoke alarms should be INSTALLED away from the kitchen to prevent false alarms. Generally, they should be at least 10 feet (3 meters) from a cooking appliance.
- » REPLACE all smoke alarms when they are 10 years old.

## FACTS

- ! Roughly **two thirds** of home fire deaths happen in homes with no smoke alarms or no working smoke alarms.
- ! Working smoke alarms cut the risk of dying in reported home fires in **half**.

**AND DON'T FORGET...**  
All smoke alarms should be tested at least once a month using the test button.



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