smoke detectors

what they are and how they work

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Institute for Applied Technology
Center for Consumer Product Technology

The statistics on the loss of life and property due to fire are grim. However, there is an inexpensive and dependable way to protect your home, yourself, and your family—smoke detectors. They provide a reliable early warning system in the event of fire.

How do smoke detectors work?

Smoke detectors work by sensing the rising smoke from a fire and sounding an alarm. They can detect smoke far from the origin of the fire. Smoke detectors are most valuable at night--alerting family members to the presence of fire when they are asleep.

There are presently two types of smoke detectors on the market: the photoelectric smoke detector and the ionization chamber smoke detector. The photoelectric smoke detector contains a small light source and a photocell. When smoke enters the detector, light is reflected from smoke particles into the photocell, and an alarm is triggered.

The ionization chamber smoke detector contains a small radiation source that produces electrically charged air molecules called ions. The presence of these ions allows a small electric current to flow in the chamber. When smoke particles enter the chamber they attach themselves to these ions, reducing the flow of electric current. The change in the current sets off the alarm.

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Is the radioactive material in an ionization chamber detector a hazard?

No. Before smoke detectors containing radioactive materials are placed on the market, the U.S. Nuclear Regulatory Commission (NRC) performs a radiation safety analysis to make sure that the detectors meet safety requirements.

Which detector is better, the ionization chamber smoke detector or the photoelectric smoke detector?

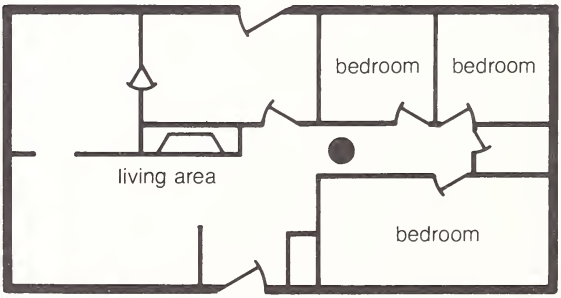
Both types of detectors are equally effective in the home. If properly installed, they can provide adequate warning for the family. Some differences exist between the two when they operate close to the origin of the fire. Ionization detectors will respond more quickly to flaming fires. Photoelectric detectors will generally respond faster to smoldering fires. These differences, however, are not critical. The detector you buy should be approved by a major testing laboratory such as Underwriters Laboratories, Inc. (UL).

Where is the best place to install my detector?

Because smoke rises, the best place to install a detector is on the ceiling or high on an inside wall just below the ceiling. However, if the ceiling is below an uninsulated attic or in a mobile home, the detector should be placed on the wall 15-30 cm (6-12 in.) below the ceiling. In a multi-level air-conditioned home, a detector is needed on each level. On the first floor, the detector should be placed on the ceiling at the base of the stairwell.

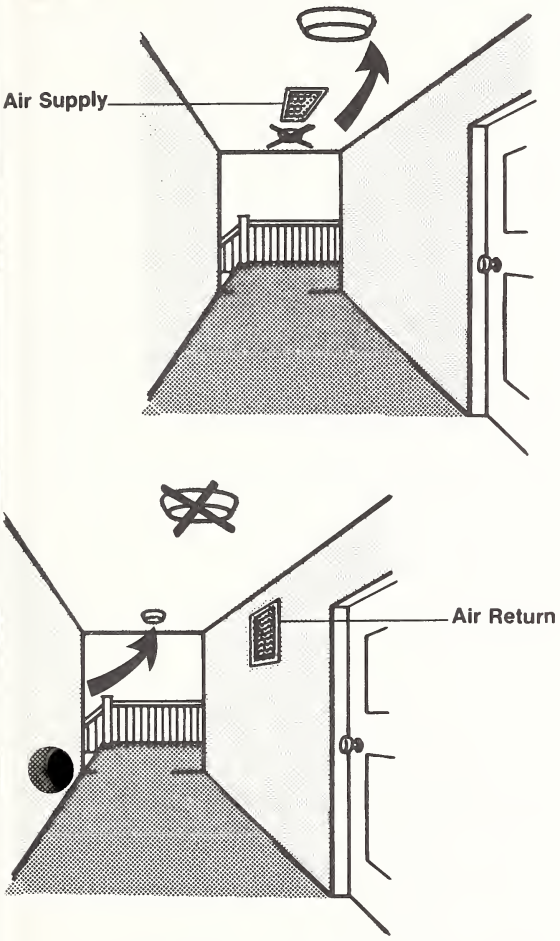
Sleeping Areas. Detectors should be installed close enough to the bedrooms so that the alarm can be heard if the doors are closed. Do not install a smoke detector within 92 cm (3 ft.) of an air supply register that might blow the smoke away from the detector. A detector should not be installed between the air return to the furnace and the sleeping area as the smoke will be recirculated and diluted resulting in a delayed alarm (see diagrams at right). If you usually sleep with your doors closed, you might consider installing an additional detector inside the bedroom. If a fire starts in the bedroom, the detector inside that room will respond faster than the one in the hallway.

Basement. The detector should be located on the basement ceiling at the bottom of the stairway for the best protection.



One bedroom area on one level. Locate smoke detector between the sleeping area and living area.

Location of detectors in relation to air supply and air return registers.



If I have a detector in the basement will I be able to hear it in the bedrooms?

If you are sleeping, it may be difficult to hear a detector located away from the bedroom area. If you are installing more than one detector, consider purchasing units that can be interconnected. That way, when one unit detects smoke, all detectors will sound an alarm.

How are the detectors connected?

Smoke detectors can be connected two ways: by pulling wires through the walls or by a wireless system. Pulling the wires through the walls is a more permanent method and may require the services of an electrician. The wireless system operates on the same principle as home wireless intercoms. Either procedure is effective.

How are smoke detectors powered and installed?

Detectors are powered two ways: by batteries or by household electric current. Battery-operated detectors are the easiest to install. They require no outlets or connections to household wiring. However, the batteries must be replaced approximately once a year to keep the detector operating properly. The cost of replacement batteries is between $2 and $10.

All UL (Underwriters Laboratories, Inc.) approved battery-operated smoke detectors are required to sound a trouble signal when the battery needs to be replaced. This "chirp" signal usually lasts 7 days. If you are away from home for an extended period of time, it is advisable when you return to check your detector, according to manufacturer's instructions, to make sure the battery has not lost power.

Smoke detectors that operate on household current can be powered two ways. The detector, equipped with a 240-270 cm (8-9 ft.) electrical cord, can be plugged into an existing wall outlet. A detector powered this way should not be operated with an on-off switch, as it may be accidentally turned off. It can also be wired permanently into your home's electrical system. This procedure requires an electrician, and the cost is usually between $25 and $50.

Will a fire disable a detector that is wired directly to the household electrical power?

A fire in the home electrical circuit that would interrupt power to a smoke detector is a remote possibility. If an appliance, such as a TV set in the living room, starts the fire, a smoke detector located outside the bedroom area should sound an alarm before the fire reaches the electrical wiring. This is particularly true if the TV set and smoke detector are on different circuits.

How do I get the best service from my detector?

Dirt, extreme changes in temperature, and cooking exhaust smoke can cause a false alarm or a malfunction of a smoke detector. To prevent false alarms, locate the detector away from air vents, air conditioners, and fans. Keep the grillwork of the detector free of dirt by dusting or vacuuming regularly. Check and replace batteries periodically. Test your detectors every 30 days by using the test button, if provided, or by blowing smoke into the unit.

What do I do if the alarm goes off?

The best fire detection equipment can only tell you that there is a fire. All fire alarms should be used with a family escape plan. A smoke detector in working condition will usually give you at least 3 minutes to evacuate the house. Fire drills should be held so that all family members know what to do. Each person should be aware of all escape routes in the home, including bedroom windows. Do not try to fight the fire yourself. Choose a meeting place outside so you'll know everyone in the house has escaped. Don't stop to call the fire department from your home--use a neighbor's phone.

The information in this pamphlet resulted from research performed by the Center for Fire Research, Institute for Applied Technology, National Bureau of Standards, U.S. Department of Commerce.

December 1976
LC 1074