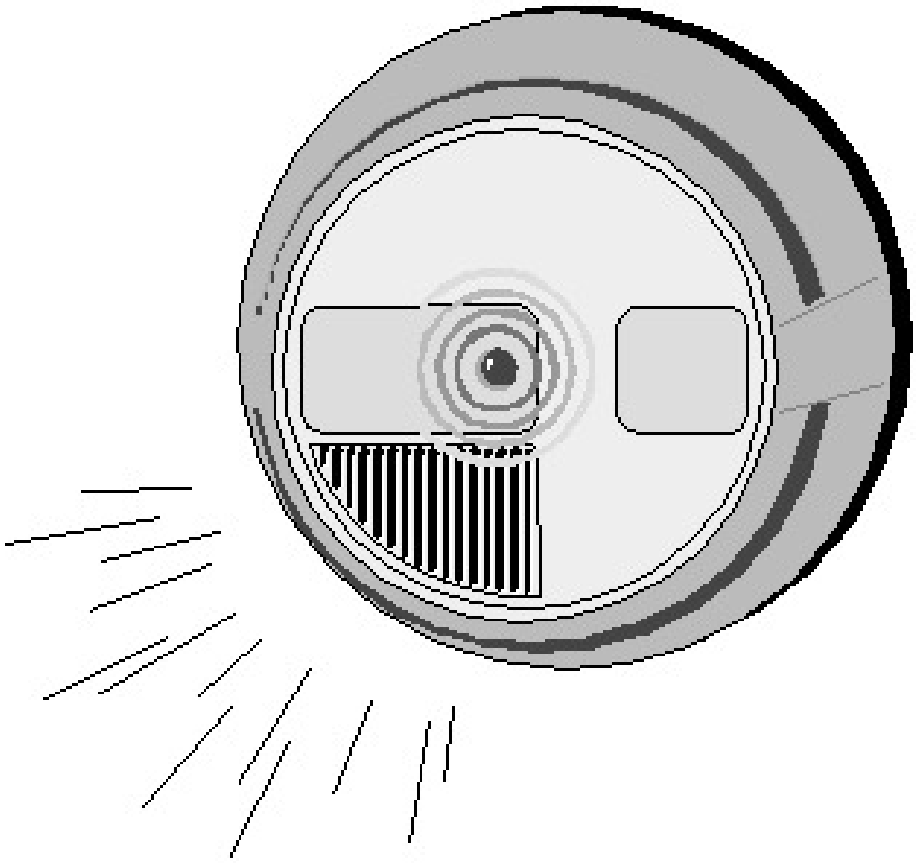
SMOKE ALARM INSTALLATION MANUAL



Installing Lithium Battery and Standard Smoke Alarms

Kentucky Injury Prevention and Research Center
333 Waller Avenue, Suite 202
Lexington, KY 40504-2915

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Introduction

Many people believe that smoke alarm installation is so simple that no training is required. In many cases this is true, if the person installing the alarm reads the instructions provided by the manufacturer and follows them carefully. Unfortunately, that doesn't always happen, and some instructions are not clearly written. This manual will help you understand the two primary types of smoke alarms, how they work, where they should be installed and how to install them. If you need additional information you should contact any of the organizations listed in the final section of this manual.

This manual is intended for two different audiences. It is useful to the person who wants to install a smoke alarm in their own home, or the home of a friend or family member. It is also intended for use by individuals who will be installing smoke alarms in homes in their communities as part of a residential fire safety project conducted in cooperation with the Kentucky Injury Prevention and Research Center (KIPRC). Regardless of which group you are in, this manual can help you do a better job of selecting and installing smoke alarms.

The Purpose of Smoke Alarms

Smoke alarms are designed to warn people in a building when a fire occurs in that building. They are especially useful in residential structures - houses, apartments and mobile homes - or any other building where people may sleep. A smoke alarm that is properly installed and well maintained can warn sleeping individuals of a fire before they are overcome by smoke or toxic gasses produced by the fire.

Residential fires are extremely dangerous. People usually feel safe in their home. This feeling of safety may cause them to relax and become less careful than they might be elsewhere. People are also more vulnerable when they sleep, because they are less able to notice and respond to a potentially dangerous situation when they are asleep. Residential smoke alarms provide around-the-clock protection for people who are at home. Whether someone is awake or asleep, a properly maintained smoke alarm is always awake - ready to sound the alarm if a fire occurs.

Types of Smoke Alarms

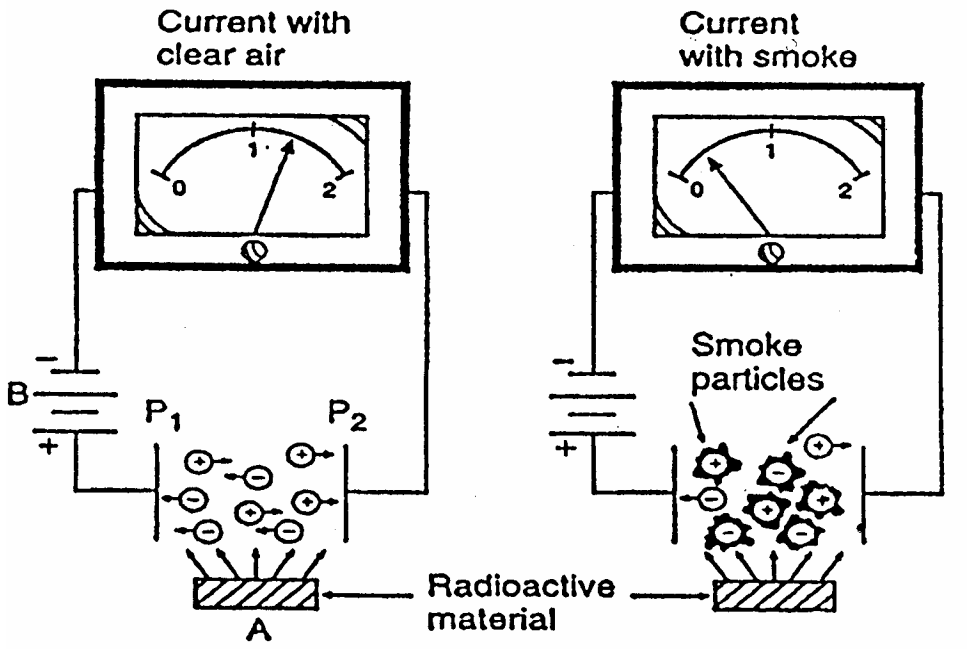
Smoke alarms work by detecting a byproduct of combustion - the particles of smoke given off by burning material. There are two common ways to detect smoke particles. Some smoke alarms use one method, and some use the other. This results in two major types of smoke alarms: ionization alarms and photoelectric alarms.

Ionization Alarms

Ionization alarms are better at detecting fast, flaming fires like grease fires. They detect combustion particles of .01 to 3 microns in diameter. (A human hair is about 50 microns in diameter.) They are most sensitive to dark or black smoke. They are more sensitive to steam than photoelectric alarms, so they may produce nuisance alarms if they are installed in or near a kitchen, bathroom or laundry room.

Ionization detectors work like this:

- A weak radiation source (a small bit of Americium 241) ionizes the air in the detector chamber in the alarm.
- The ionized air conducts a weak electrical current through the chamber.
- This electrical current is sensed by the detector circuit. As long as the current is present, the alarm does not sound.
- When particles of smoke enter the detection chamber, they interfere with the current flow. The current flow is reduced.
- When the current flow is reduced, the detector circuit turns on the alarm horn.

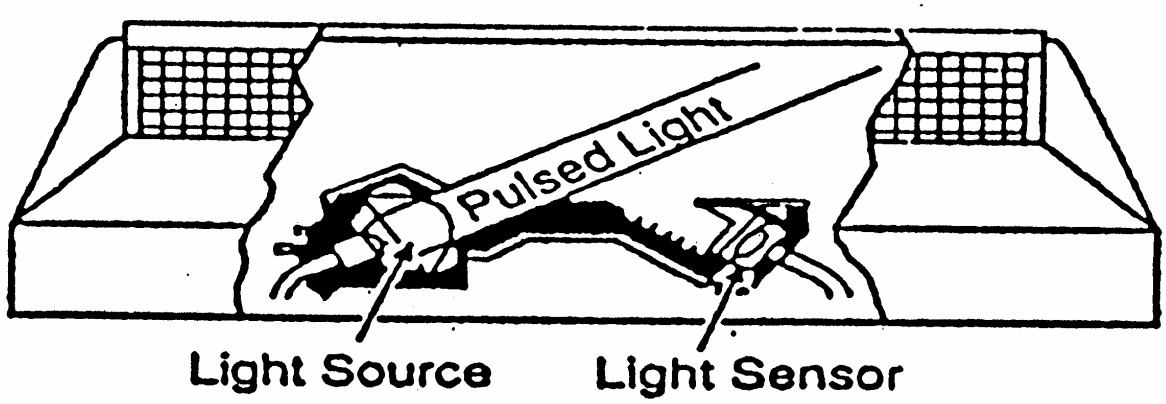


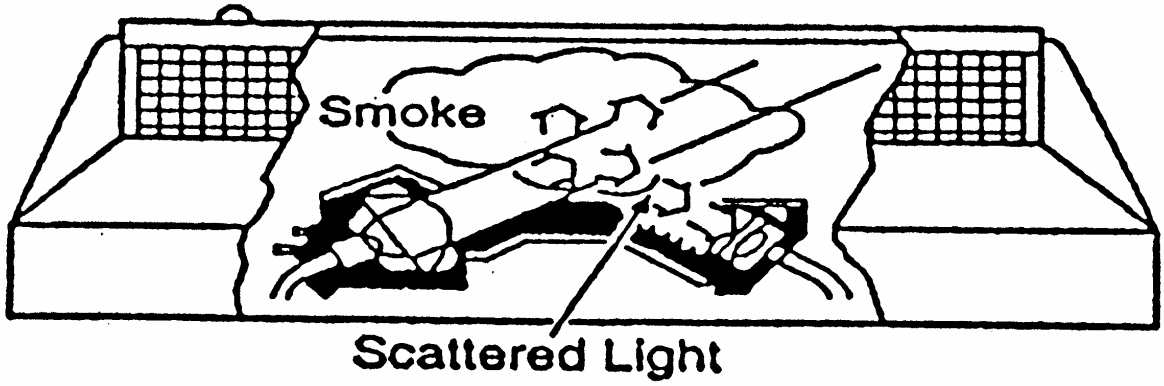
Photoelectric Alarms

Photoelectric alarms are best at detecting slow, smoldering fires such as furniture upholstery ignited by a cigarette. They detect combustion particles from .3 to 10 microns in diameter. Photoelectric alarms are more responsive to light gray smoke.

Photo electric detectors work like this:

- An infrared light emitting diode (LED) shines a beam of light into the detection chamber.
- A receiver senses the small amount of light reflected from the chamber. It does this by converting the light falling on it into an electrical signal.
- When smoke particles enter the chamber they scatter the light beam. This reflects more light back toward the sensor.
- The receiver picks up more light and the electrical signal it produces is increased.
- When the electrical signal increases, the detector circuit turns on the alarm horn.





Combination Alarms

Sometimes two types of detectors are combined in one alarm. You can find alarms that combine both ionization and photoelectric detectors and also ionization smoke alarms that include a carbon monoxide (CO) detector. These alarms are considerably more expensive than standard ionization or photoelectric alarms.

Smoke Alarm Power Sources

All types of smoke alarms require electrical power in order to operate. They can be powered in different ways. The common methods of powering smoke alarms are:

- Hard wired - the alarm is wired into the home's normal AC wiring and draws power from the regular electrical system. Hard wired alarms may or may not have backup battery power, but all hard-wired alarms should have backup batteries that will operate the alarm even if the regular AC power fails.
- 9-volt alkaline or zinc carbon battery - the alarm is powered by a standard 9-volt battery. Alkaline batteries last longer and are more reliable than zinc carbon ("standard duty") batteries. An alkaline battery will power most 9-volt smoke alarms for a full year.
- 9-volt lithium battery - the alarm is powered by a special 9-volt battery that can last up to ten years. The battery is the same size and shape as a standard or alkaline 9-volt battery, but it uses different chemicals to generate electrical energy. (Currently, "ten year" lithium batteries can only be found in ionization-type smoke alarms.)

Smoke Alarm Maintenance

Smoke alarms are electronic devices. Like any other piece of electronic equipment, a smoke alarm may fail due to age or poor maintenance. This section explains how to care for your smoke alarms.

Change the Battery

Smoke alarms must have electrical power to operate. If the battery powering a smoke alarm is dead, the alarm will not work. Many people forget to change the battery regularly. Some people take out the battery to silence a nuisance alarm and then forget (or decide) not to put it back in the alarm. Others may even take the battery out of a smoke alarm to put into a child's toy or other electronic device.

Most modern smoke alarms will beep or chirp when the battery is low. When this happens, the battery should be replaced immediately. If standard zinc carbon batteries are used in a smoke alarm they should be replaced at least twice each year. It is easier to remember to do this if you replace the batteries whenever you change your clocks to and from Daylight Savings Time. Some fire departments and other organizations sponsor “Change your clocks - change your batteries” campaigns to help remind people to change the batteries in their smoke alarms.

If you use alkaline batteries in a smoke alarm they will probably only need to be changed once per year. Lithium batteries may last up to ten years. Always read the smoke alarm instructions when you install an alarm. The instructions will tell you how long you may expect the battery to last. Even if the battery is almost new, change it if the low battery alert (beeps or chirps) sounds.

The backup batteries in hard-wired smoke alarms may need to be changed too. In some cases the backup battery may be a rechargeable battery wired into the system, but in some models the backup battery is simply a 9-volt battery. For these systems the backup battery should be replaced at least once per year, so that it will be fresh and ready to work if needed.

Cleaning

Smoke alarms will not work if they are covered in dust and cobwebs. Dust, cobwebs, insects or similar obstructions can keep smoke from entering the detection chamber by blocking the small vents in the alarm housing. They can also cause nuisance alarms by blocking the ionization process in ionization alarms or by scattering the light beam in photoelectric alarms. Smoke alarms should be cleaned at least once each month to prevent the buildup of dust, cobwebs and other foreign material.

It is easy to clean most smoke alarms. Simply use a vacuum with a hose and wand attachment or a soft feather duster or brush to remove dirt, dust and cobwebs from the smoke alarm. If you use a vacuum you should not need to open the smoke alarm case. You may need to open the case if you clean the alarm with a feather duster

or brush. Gently brush any dust or other foreign material out of the alarm and then close the case. Never use water, spray-on cleaning solutions or any liquid cleaning product to clean a smoke alarm.

Testing the Alarm

A smoke alarm should be tested regularly. Like any other electronic device, a smoke alarm can stop working due to an electrical problem of some kind within the alarm. To make sure that smoke alarms are ready to provide protection when they are needed, they must be tested. Alarms should be tested according to the instructions provided by the manufacturer. Some manufacturers recommend that alarms be tested each week, while others say that once per month is adequate. If you don't have instructions for a smoke alarm, you should assume that it should be tested every week.

To test a smoke alarm, press the "test" button on the alarm and hold it for at least two seconds. If the alarm horn sounds then the smoke alarm is working properly. If the alarm does not sound, change the battery and press the "test" button again. If the smoke alarm still does not sound an alarm, it is broken. Replace it immediately.

Replacing Outdated Smoke Alarms

Smoke alarms are designed to last about ten years. When an alarm becomes ten years old it should be replaced. Older alarms have a much higher chance of failing due to electrical problems within the alarm circuits. If you're not sure how old a smoke alarm is, and it doesn't look relatively new, it's a good idea to replace it.

Smoke alarms are like any other piece of electronic equipment - they require electrical power and regular care to operate properly, and they tend to break down with age. Smoke alarms that are properly maintained should last for ten years, however, and provide critical around-the-clock protection from fires.

Nuisance Alarms

A nuisance alarm occurs whenever a smoke alarm sounds when there is not really a fire. Some people call them “false alarms,” but they really aren’t false - something caused the smoke alarm to sound. Understanding why nuisance alarms occur can help you prevent them.

Many nuisance alarms occur when they are exposed to smoke. If there is smoke in the air a properly working smoke alarm will do just what it was designed to do - sound the alarm. Unfortunately, there are sometimes situations where smoke may be produced by normal household activities. Smoke from a wood stove that is opened for refueling, a fireplace, a candle or cooking food may trigger a smoke alarm. In these cases the problem can usually be solved by airing out the room to clear the smoke.

In some cases nuisance alarms are caused by steam from cooking, bathing or laundry. In these cases it may be harder to clear the area, since the steam will continue to be created as long as the activity continues. Some smoke alarms may also detect the combustion products produced by appliances burning natural gas, especially if the appliance is not vented. Photoelectric detectors may work better in areas where this type of nuisance alarm is likely to occur, because they are less sensitive to steam. A better approach may be to avoid installing smoke alarms too close to areas where cooking, bathing or laundry is done.

Some people deal with nuisance alarms by removing the battery from the smoke alarm. Never disable a working smoke alarm by removing the battery. If the alarm is malfunctioning due to an internal electrical problem, replace the alarm with a new one. If nuisance alarms are a problem, install an alarm with a “silence” or “hush” button that will disable the alarm temporarily while the room is being cleared. If this doesn’t resolve the problem, relocate the alarm further away from the cause of the nuisance alarms.

Problems with Smoke Alarm Use

Several problems have been found with the way smoke alarms are used in the United States. These problems are changing the way smoke alarms are designed and installed.

Problems

Non-functional or "dead" alarms are the biggest problem. The Consumer Product Safety Commission (CPSC) estimates that there are just over 11 million homes in the US that do not have smoke alarms. There are more than 16 million homes that appear to have smoke alarms - but where not a single alarm is actually working. Alarms where alarms are installed but are non-functional are a greater problem than homes with no alarms at all.

The biggest problem is electrical power. Nearly 20 percent (1 of every 5) smoke alarms in the US is without power. Five percent have dead batteries, while 15 percent have missing or disconnected batteries or AC power. Some of the alarms that are disconnected were disconnected by accident, or by a previous occupant of the home, but more than 33 percent (1/3) of them were disconnected deliberately.

Why do people deliberately disconnect alarms? The biggest reason is nuisance alarms. In a study conducted by CPSC in 1994, most people who had disconnected their smoke alarms said that they disconnected them to stop nuisance alarms. In most cases the nuisance alarms were caused by ionization-type detectors that were within 5 feet of the nuisance source, and many of the smoke alarms were not cleaned. Simply cleaning the alarms and moving them a few feet might have solved most of the problems. Instead, people had simply disabled the alarms. The willingness of people to disable smoke alarms rather than try other solutions to nuisance alarms is a major safety problem.

Potential Solutions

Smoke alarm manufacturers and government officials are trying to find ways to solve these problems. Many areas require hard wired smoke alarms in new homes because they are harder to disconnect and they will usually work even if the resident forgets to change the batteries. Most areas do not require that hard-wired alarms be installed in older homes, however, because it is very expensive to retrofit existing buildings with hard-wired alarms. They also do not solve the problem of nuisance alarms.

Alarms with long life lithium batteries also help by reducing the need to change batteries regularly. These alarms still beep or chirp when the battery is low, but in many cases one battery may last for the entire ten year life of the alarm. These alarms also do not solve the problem of nuisance alarms, and they can be disabled by removing the battery just like standard battery powered smoke alarms. There are also not any commonly available photoelectric or combination alarms using lithium batteries.

There are also new types of smoke alarms being developed. These alarms use multiple sensors, “fuzzy logic” and other new technologies to help reduce the number of nuisance alarms. Unfortunately these alarms are not yet readily available for normal residential use. Until those alarms are available, the best way to minimize nuisance alarms will remain the proper selection of installation locations.

Installing Smoke Alarms

The goal when installing smoke alarms is to install them in locations where they can adequately detect fires while avoiding locations that may increase nuisance alarms. This can be a challenge, especially in smaller residences. In a small home it may be impossible to install a smoke alarm far enough from the kitchen or bathroom to prevent steam alarms, for example.

The NFPA's National Fire Alarm Code, NFPA 72, provides guidelines for installing smoke alarms in a home.

- There should be at least one smoke alarm on every occupied level of the home, including the basement. This means that a two-story home with a basement would need an absolute minimum of three smoke alarms. Smoke alarms are not typically installed in unoccupied levels of a home such as crawl spaces or attics.
- A smoke alarm should be installed outside every separate sleeping area. This means that if there is a bedroom on one end of a floor and another bedroom at the opposite end of that floor, two smoke alarms will be needed on that floor.
- In new construction, smoke alarms should be installed in every sleeping room.
- If alarms are in or near a kitchen they must either be photoelectric or have a "silence" button ("hush" button) to temporarily silence the alarm.
- All smoke alarms installed in homes should be tested regularly.
- All residential smoke detectors should be replaced when they are ten years old.

Following these guidelines will help to provide high quality fire detection and warning capabilities while minimizing nuisance alarms.

Alarm Selection

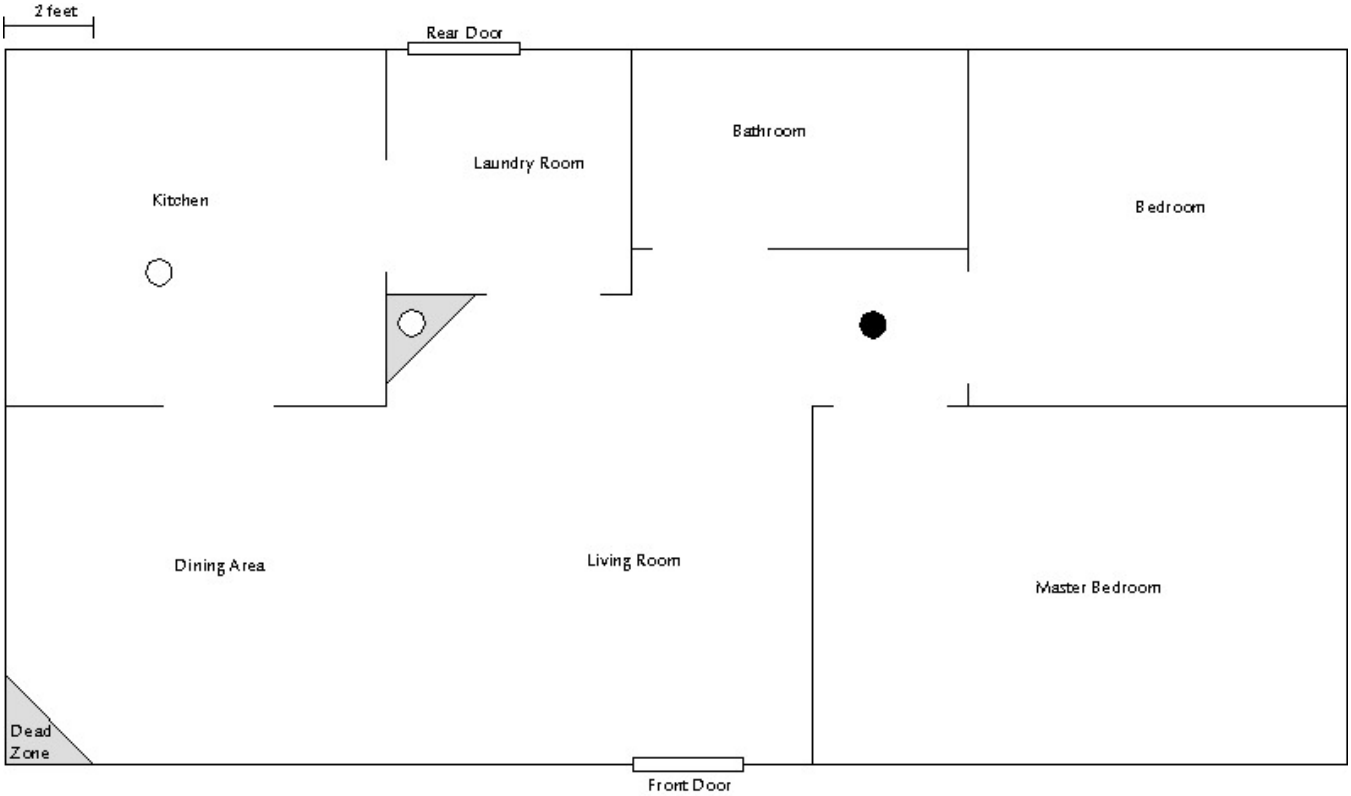
If you want to use a lithium battery powered smoke alarm you are pretty much limited to ionization type alarms. Otherwise, choose whichever alarm is best suited for the particular location (see **Types of Smoke Alarms**). Photoelectric alarms work better near kitchens, bathrooms, laundry rooms or other areas where steam may be present. Both alarm types work well in other areas, so you can choose the one that best fits the décor or your budget, or even use a combination ionization and photoelectric alarm for even better protection. For new homes hard-wired alarms with backup batteries should be used. For existing homes, battery powered alarms may be more practical.

Location

Installing smoke alarms in appropriate locations is important. Remember, there should be at least one smoke alarm on each occupied level of the home, even if there are no sleeping areas on that level. There should also be one smoke alarm outside each separate sleeping area, even if they are on the same level. Sleeping areas are 'separate' if they are in different areas of the house - bedrooms immediately adjacent to each other are not 'separate sleeping areas' for the purpose of installing smoke alarms, while bedrooms on opposite ends of the house are 'separate sleeping areas.'

Avoid installing alarms in or very near kitchens, bathrooms or laundry areas unless the smoke alarm instructions say that it is OK to install the alarm in these locations. Ionization-type alarms often produce nuisance alarms when installed in these areas.

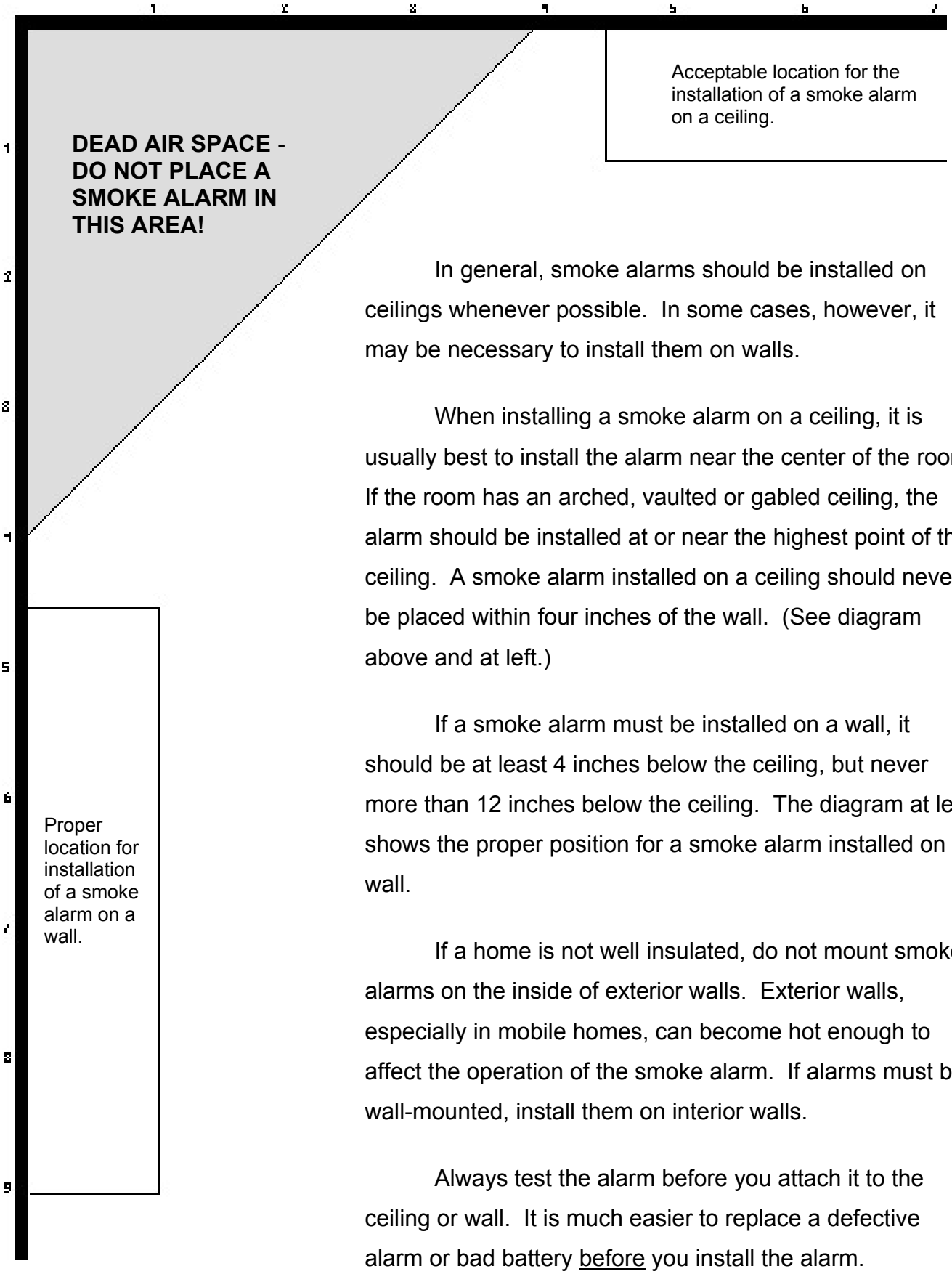
You should also avoid installing alarms in the corners of rooms within 2 feet of the corner. Corners create "dead zones" where air movement is minimized. Always place smoke alarms in areas where air movement is not restricted. The drawing below shows some examples of correct and improper smoke alarm placement.



Examples of correct and improper locations to mount smoke alarms:

○ Improper locations for smoke alarm

● Correct location for smoke alarm



In general, smoke alarms should be installed on ceilings whenever possible. In some cases, however, it may be necessary to install them on walls.

When installing a smoke alarm on a ceiling, it is usually best to install the alarm near the center of the room. If the room has an arched, vaulted or gabled ceiling, the alarm should be installed at or near the highest point of the ceiling. A smoke alarm installed on a ceiling should never be placed within four inches of the wall. (See diagram above and at left.)

If a smoke alarm must be installed on a wall, it should be at least 4 inches below the ceiling, but never more than 12 inches below the ceiling. The diagram at left shows the proper position for a smoke alarm installed on a wall.

If a home is not well insulated, do not mount smoke alarms on the inside of exterior walls. Exterior walls, especially in mobile homes, can become hot enough to affect the operation of the smoke alarm. If alarms must be wall-mounted, install them on interior walls.

Always test the alarm before you attach it to the ceiling or wall. It is much easier to replace a defective alarm or bad battery before you install the alarm.

Methods for Mounting the Alarm

Hard-wired smoke alarms must be installed in electrical mounting boxes just like ceiling lamps. If you are not familiar with home wiring you should have this job performed by a qualified electrician.

Battery powered alarms can be installed easily. Locate the proper location for the alarm and use the mounting screws (if any) provided by the manufacturer or some similar method to attach the alarm to the ceiling or wall. Double-sided mounting tape can be used in situations where screws cannot be used if the tape sticks firmly to both the alarm and the ceiling or wall material. Tape is not recommended if screws will work, however, because the tape might pull free if it becomes hot. The hot gasses produced by a fire can cause the air near the ceiling of a room to reach several hundred degrees Fahrenheit very quickly.

Many smoke alarms have holes for the mount screws in the back of the alarm housing. The alarm housing must be opened to install the alarm. Other alarms have a separate mounting ring or bracket. The bracket is secured to the ceiling or wall and then the alarm snaps into the bracket.

Some smoke alarms have a pin or other device that secures the alarm to the mounting bracket, or that keeps the alarm housing from being opened, to make the removal of the battery difficult. If you are installing alarms with lithium batteries it is usually a good idea to use this tamper-resistant feature if the alarm has one. It will help discourage people from removing the battery in order to silence a nuisance alarm. The tamper-resistant feature should not be used if the alarm uses a standard 9-volt battery, since it will be necessary to open the alarm regularly to replace the battery.

Read the Instructions

Unless you are already personally familiar with a particular model of smoke alarm, you should read the instructions provided by the alarm manufacturer before you install the alarm. The instructions will tell you where and how to install the alarm for best performance.

Fire Safety Resource Agencies

Learning about fire safety and the proper installation and maintenance of smoke alarms can help you protect yourself, your family and others you may know. You can contact any of the following organizations for more information about fire safety and proper smoke alarm installation:

KY Injury Prev. and Research Center	www.kiprc.uky.edu/fire/	(859) 257-4954
Kentucky Firefighters' Association	www.kyfa.org	(270) 746-7461
United States Fire Administration	www.usfa.fema.gov	(866) 274-0960
National Safety Council	www.nsc.org	(630) 285-1121
Natl. Center for Injury Prev. and Control	www.cdc.gov/ncipc/	(770) 488-1506

SECTION II - INSTALLATION OF SMOKE ALARMS FOR THE RESIDENTIAL FIRE INJURY PREVENTION PROGRAM

This section of the manual is intended for individuals who will be installing smoke alarms in homes in their community as part of a joint project between the Kentucky Injury Prevention and Research Center (KIPRC) and their local organization. This section includes information on preparing for, conducting, documenting and closing out a smoke alarm installation trip.

The instructions in this section assume that you will be going to install alarms in homes where people have already signed up to receive alarms. If you are doing door-to-door canvassing, you will not have previously completed enrollment forms for each household that you visit. You need to complete an enrollment form for each household prior to installing smoke alarms in that home.

Preparing for the Installation Trip

You will generally begin each installation trip by meeting with your organization's project coordinator to pick up smoke alarms, installation supplies, educational materials and the list of homes you will visit during that trip. When preparing to start an installation trip you should have the following materials:

- completed enrollment forms for those households you will visit (or blank enrollment forms, if you are doing door-to-door canvassing)
- tools - a screwdriver that fits the installation screws packed with each alarm, a flashlight and a pair of pliers
- smoke alarms - approximately 2.5 alarms per home, with instructions
- double-sided tape - for use in case screws cannot be used to mount an alarm
- 9-volt alkaline batteries - a small number, in case you find nearly new alarms that just need batteries (if available)
- fire safety educational materials
    - *Wake Up, Kentucky!* smoke alarm instruction card — 1 per home
    - *10 Tips for Fire Safety* brochure — 1 per home
    - *E.D.I.T.H.* brochure — 1 per home
    - *Fire Safety for People With Disabilities* brochure — several *
    - *how to prevent fires (Remembering When)* booklet — several *

* These materials are needed only in homes where there is an elderly person and/or a person with a disability. You should take several copies of these materials with you on each installation trip.

In addition to the items already listed, you should always carry a few extra enrollment forms. A neighbor, visitor or other person may be present in a home that you are visiting to install alarms and want to sign up to have alarms installed in their own home. (Be sure that any individuals you enroll live within your organization's project area.)

If your local organization does door-to-door canvassing, be sure to take plenty of enrollment forms with you. KIPRC must have a properly completed and signed enrollment form for each home in which you install smoke alarms.

Doing the Installation

The actual smoke alarm installation process is fairly simple, but you should follow these steps to insure that you don't forget anything during the installation process.

1. Be careful when you arrive - park in an appropriate spot, and wear your uniform, ID or other means of identification. (Some residents may be nervous if you approach their home unexpectedly, especially if you are doing installations during evening hours.)

2. When the door is answered, identify yourself and verify that the person(s) living in the residence have requested smoke alarms. (Some people may have moved, or changed their mind.)

    a. If the current resident(s) want alarms installed and you have a signed enrollment form from them, continue with Step 3.

    b. If the current resident(s) want alarms, but the enrollment form was signed by someone who no longer lives there (or if you do not have an enrollment form for this address), do a new enrollment form and have a person 18 or older sign it. Then continue with Step 3.

    c. If the current resident(s) do not want smoke alarms, mark 'REFUSED' in large letters on the bottom portion of the enrollment form, along with the date and time. Go on to the next home on your list.

    If no one is home, note the date and time of your visit on the margin of the form and go to the next home on your list.

3. Check the home for existing smoke alarms. If the home already has functional smoke alarms on each inhabited level, explain to the residents that they do not need more smoke alarms. Provide them with fire safety education materials, explain the materials, then go to the next home on your list.

    a. If smoke alarms are present in the residence but non-functional, try replacing the batteries. If this makes the alarms functional, provide fire safety education materials, explain the materials, and go to the next home on your list.

    b. If there are no existing smoke alarms, or if the existing alarm(s) do not work after you have tried replacing the batteries, install smoke alarms.

4. Locate appropriate locations for the smoke alarms, using the information provided in this manual and these guidelines:

    a. Place one alarm on each habitable floor of the home. On floors with bedroom areas, place the alarms just outside the bedrooms (in the hall, etc.).

    b. If there are bedroom areas in two separate areas of the home, even if they are on the same floor, place one alarm outside each bedroom area.

    c. Do not place alarms in or very near kitchens or bathrooms, or close to wood-burning stoves, clothes dryers or other appliances which normally become warm or give off dust or steam during operation.

    d. Place alarms on the ceiling at least 4" from the nearest wall, and at least 2' from the nearest corner, or place them on a wall at least 4" below the ceiling, but not more than 12" below the ceiling, and 2' from the nearest corner.

    e. If you need more information, refer to the installation information in this manual and the instructions packed with the smoke alarm.

5. Test each smoke alarm before you install it.

6. Install the smoke alarm(s). If you are using double-sided tape, apply it directly to the back of the alarm, then press the alarm firmly against the mounting surface and hold it in place for approximately 30 seconds. If you are using screws to mount the alarm, follow the instructions provided with the alarm.

7. If there is a preliminary survey included in the installation process, ask one adult in the household to answer the survey questions. Record their answers on the survey form and attach it to the installation record form.

8. Provide fire safety education to the residents. Provide them with copies of the educational materials and brochures, and explain the information in the brochures to them. (Don't just hand them the brochures and leave; many people won't read them if you just leave them and don't explain the information in them.) Residents should receive at least the following materials:

   Wake Up, Kentucky! smoke alarm instruction card

   E.D.I.T.H. brochure

   how to prevent fires brochure, if there is an older adult in the home

   Fire Safety for People With Disabilities brochure, if there is a disabled individual in the home

   Other materials should be provided if they are being used by your organization.

8. Complete the bottom portion of the enrollment form, including the date, time, and number of smoke alarms installed. Sign the form in the section provided for the installer's signature.

9. Give the back (pink) copy of the installation record form to an adult in the household.

10. Thank the residents for participating in the project. Go to the next home on your list.

Finishing Up the Installation Trip

1. Return any unused smoke alarms to your organization's project coordinator. Remember - the number of smoke alarms installed, plus the number returned, must equal the number you received at the beginning of the installation trip.

2. Give the completed enrollment forms, including those marked 'REFUSED' or otherwise not installed, to the person in your organization who is responsible for keeping records of the alarms installed. If you had any problems during the trip, note them on the enrollment forms or attach a note explaining what happened. If you are injured while installing alarms, or someone else is injured, or property damage occurs, notify the head of your organization or your supervisor immediately.

3. Return any unused supplies to their proper location. Clean up any tools provided by your organization and return them to their proper location, or to the person responsible for them.

KIPRC Project Staff Contact

If you have any questions, contact:_____