



# OHIO BOARD OF BUILDING STANDARDS

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## Smoke Alarms and Fire Safety

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## UNDERSTANDING THE TERMINOLOGY

**Detector.** An initiation device suitable for connection to a circuit that has a sensor that responds to a physical stimulus such as heat or smoke.

### Examples of Detector Types:

Air Sampling	Automatic Fire	Combination	Electrical Conductivity
Fire-Gas	Heat	Flame	Fixed-Temperature
Projected Beam	Rate Compensation	Rate-of-Rise	Radiant
Energy Sensing	Spark/Ember	Spot-Type	

**Household fire alarm system.** A system of devices that uses a fire alarm control unit to produce an alarm signal in the household for the purpose of notifying the occupants of the presence of a fire so that they will evacuate the premises.

**Multiple Station Alarm Device.** Two or more single station alarm devices that can be interconnected so that actuation of one causes all integral or separate audible alarms to operate; or one single station alarm device having connections to other detectors or to a manual fire alarm box.

**Nuisance Alarm.** An alarm caused by mechanical failure, malfunction, improper installation, or lack of proper maintenance, or an alarm activated by a cause that cannot be determined.

**Single Station Alarm Device.** An assembly that incorporates the detector, the control equipment, and an alarm-sounding device in one unit operated from a power supply either located in the unit or obtained at the point of installation.

**Smoke Alarm.** A single or multiple station alarm device responsive to smoke.

Often, individuals use the terms “smoke alarm” and “smoke detector” interchangeably. While a common practice, these terms describe very different systems and should not be used as synonyms. Although smoke alarms and smoke detectors may share a few characteristics, they are used for very different purposes.

“Smoke alarms” identify fires through the detection of smoke using various technologies, as contrasted with devices that detect the presence of heat or distinctive gases. Smoke alarms also include an integrated alarm horn in a single unit. Several of these units may be interconnected, by being wired together or incorporating the ability to communicate wirelessly, to provide an area-wide alarm.

This is in contrast to smoke detection systems that have separate smoke detection devices connected to a central alarm panel. When the control panel is notified by the detection devices of a change of state (e.g. the detection of smoke), the panel initiates emergency processes such as local and remote notification, sounding of audible and visual alarm devices, etc.

## WHY SHOULD I HAVE A WORKING SMOKE ALARM?

A properly installed and maintained smoke alarm is the first thing in your home that can alert individuals to a fire 24 hours a day, seven days a week. Home fire sprinklers, which can also alert occupants, are a few seconds slower than smoke alarms because the temperature needed to activate a sprinkler takes more time to develop but detectable smoke is present before that temperature threshold is reached. Whether occupants are awake or asleep, a working smoke alarm is constantly sampling the air for the presence of fire and smoke.

According to the National Fire Protection Association, almost two-thirds of home fire deaths resulted from fires in properties without working smoke alarms. A working smoke alarm significantly increases the chances of surviving a deadly home fire.



## WHAT TYPES OF SMOKE ALARMS ARE AVAILABLE?

There are many different brands of smoke alarms and several different technologies used in alarms available on the market today, but there are two primary types of technology: **ionization-** and **photoelectric-**based detection units.

Ionization detection technology uses a small amount of radioactive material to ionize the air between two differently charged electrodes to sense the presence of smoke particles. Ionization type alarms are more responsive to small smoke particles (less than 1 micron) produced by most flaming fires such as might happen in a kitchen grease fire. It is somewhat less responsive to the larger particles typically produced by most smoldering fires. Ionization models are best suited for rooms that contain highly combustible materials that can create flaming fires. These types of materials include synthetics, flammable liquids, newspapers, and paint cleaning solutions.

Photoelectric detection technology uses a light source and a photosensitive sensor. When smoke particles enter the light path, some of the light is scattered and some is absorbed, thereby reducing the light reaching the sensor. These alarms are somewhat less responsive to the smaller smoke particles typical of most flaming fires and some types of photoelectric alarms respond better to light colored smoke than to black smoke because black particles absorb light. Photoelectric models are best suited for living rooms, bedrooms, and kitchens. This is because these rooms often contain large pieces of upholstered furniture, such as sofas, chairs, mattresses, and counter tops, etc. which will burn slowly and create more smoldering smoke than flames.

It *cannot* be stated definitively that one type is better than the other in *every* fire situation that could arise in a residence. Because both ionization and photoelectric smoke alarms are better at detecting distinctly different, yet potentially fatal fires, and because no one can predict what type of fire might start in a home, the **United States Fire Administration (USFA)**, the **National Fire Protection Association (NFPA)**, the **National Institute of Standards and Technology (NIST)**,

the Consumer Product Safety Commission, Underwriters laboratory (UL), the Home Safety Council, the International Association of Fire Chiefs (IAFC), the International Association of State Fire Marshals (IASFM), and the Consumers Union (publisher of Consumer Reports) recommend that every residence and place where people sleep be equipped with:

- Both ionization AND photoelectric smoke alarms, OR
- Dual sensor smoke alarms, which contain both ionization and photoelectric smoke sensors.

Installing smoke alarms utilizing both technologies will provide individuals with the earliest possible warning and the longest possible escape time, regardless of the type of fire encountered.

In addition to the basic types of smoke alarms, there are alarms made to meet the needs of people with hearing disabilities. These alarms may incorporate low frequency sound or strobe lights that flash and/or vibrate to assist in alerting those who are unable to hear standard smoke alarms when they sound. Other developing technologies may be more effective as they enter the market. There are indications that future alarm systems may incorporate lasers or acoustic sensors to sense the presence of smoke or fire.

Local ordinances that mandate one technology over another or that prohibit multi-sensor alarms may inadvertently constrain these new technologies from being developed or from being effectively used. Rather, the proper use of listed and labeled smoke alarm devices, installed as required in the codes and in the referenced standards, can be effective in providing the public with valuable early warning systems. This is especially true in light of the substantial number of homes in our communities that have **no** working smoke alarms present of **any** technology type.

#### WHAT POWERS A SMOKE ALARM?



Smoke alarms are powered by a battery or they are “hardwired” (connected with electrical wire) into the home's electrical system. If the smoke alarm is powered by battery, it operates on either a disposable 9-volt battery or a non-replaceable 10-year lithium (“long-life”) battery. A backup battery is usually present in hardwired alarms and may need to be replaced.

These batteries must be tested on a regular basis and, in most cases, should be replaced at least once each year (except for lithium batteries). It is always important to read the

manufacturer’s Smoke Alarm Maintenance information that accompanies the alarm for more information.

## ARE SMOKE ALARMS EXPENSIVE?

Smoke alarms are not expensive and are worth the small cost for the lives they can help save. The USFA reports average costs for smoke alarms as:

Smoke Alarm type	Cost
Ionization and photoelectric	\$6 and up
Dual sensor	\$24 and up
Smoke alarms with a microprocessor (faster to alert, fewer false alarms)	\$30 and up
Radio frequency/wireless (communicates without wires)	\$40 and up

Some building or fire departments offer reduced price, or even free, smoke alarms. Contact your local building department or your fire department's non-emergency phone number for more information.

The State Fire Marshal sponsors a program to provide smoke alarms at no charge to be installed in homes without working smoke alarms. The Fire Prevention Bureau's S.A.F.E. (Smoke Alarms for Everyone) Program helps to provide smoke detectors to those who otherwise can't afford them. Some local building or fire departments will install battery-operated smoke alarms in homes at no cost. Contact your local building department or your local fire department's non-emergency phone number for more information.

## WHERE DO I INSTALL SMOKE ALARMS IN MY HOME?

Perhaps no other issue is of more important than proper placement of the smoke alarms in the home at the time of installation. Each smoke alarm purchased contains the manufacturer's installation guidelines in the unit's packaging complete with instructions and diagrams.

Because homes have many different wall and ceiling configurations, room arrangements, and space configurations, proper placement becomes important to assure that the units provide optimal performance. This includes consideration of proper placement based upon which technology is selected; an especially important consideration for designers, builders, and building department inspection personnel as well.





Figure 1 illustrates the critical limits for various building component configurations when installing smoke alarms. Placement is important if an alarm is to operate properly. Four general conditions, as described in the standard referenced in the Residential Code of Ohio (RCO) and the Ohio Building Code (OBC) - the National Fire Protection Association's *National fire Alarm and Signaling Code* (NFPA 72, 2010 edition) - are illustrated below. Additionally, whenever installing smoke alarms, the manufacturer's installation guidelines should always be followed because these guidelines are for the actual smoke alarm that is being installed.

The provisions in RCO Chapter 3, Section 314 for smoke alarms, give the requirements for a proper installation as well as provide the

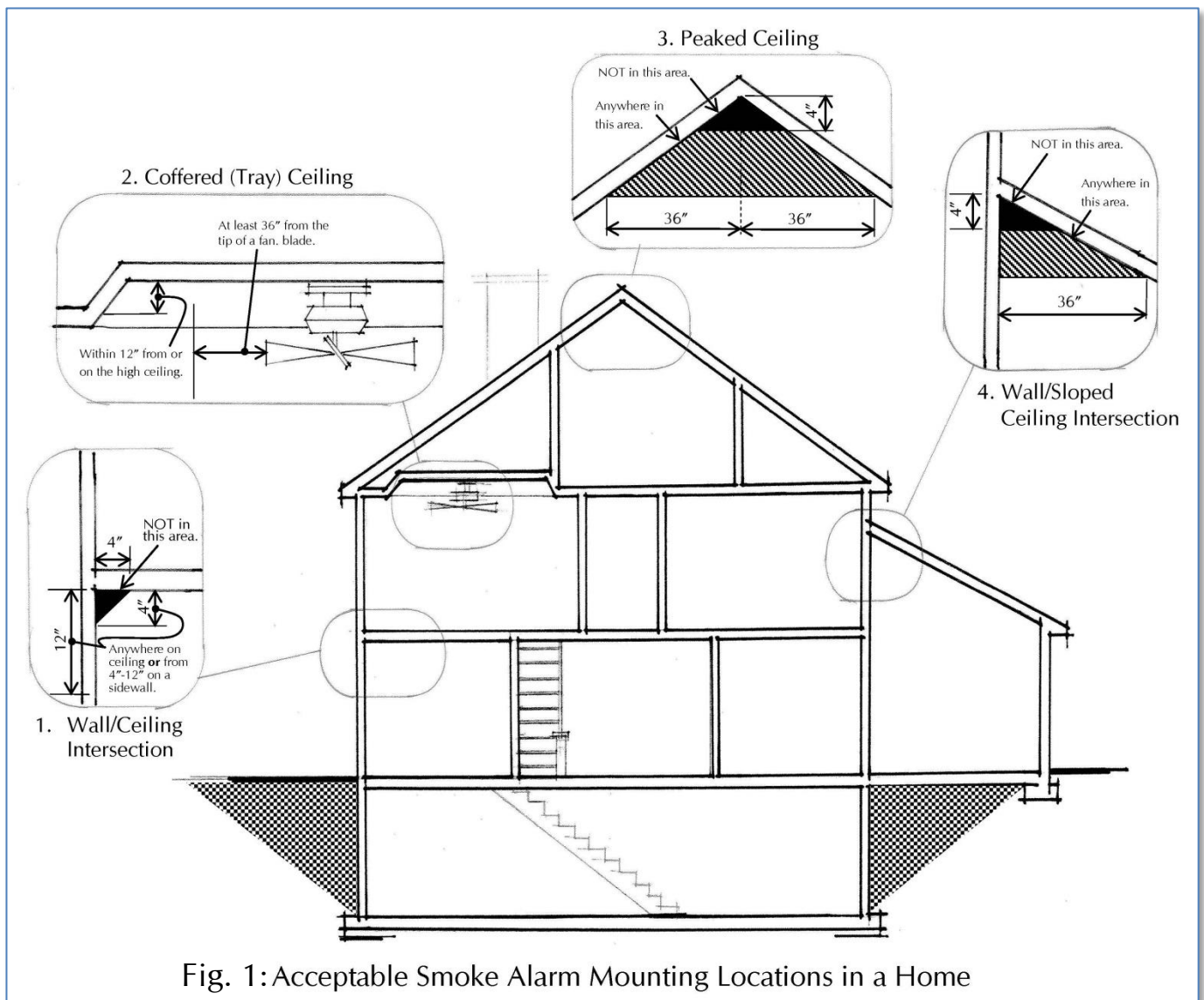


Fig. 1: Acceptable Smoke Alarm Mounting Locations in a Home

referenced standards with which they must comply. These code requirements are summarized below.

**GENERAL REQUIREMENTS:**

1. All smoke alarms shall be listed in accordance with UL 217 and installed in accordance with the provisions of this code and the household fire warning equipment provisions of NFPA 72.
2. Household fire alarm systems that include smoke alarms, or a combination of smoke detector and audible notification device installed as required by RCO Section 314 for smoke alarms, is permitted.
3. When more than one smoke alarm is required to be installed within an individual dwelling unit the alarm devices must be interconnected in such a manner that the actuation of one alarm will activate all of the alarms in the individual unit.

**SMOKE ALARM LOCATIONS:**

1. **In new dwellings**, smoke alarms must be installed in the following locations:
  - a.) A smoke alarm utilizing photoelectric and ionization technologies on each level within each dwelling unit,
  - b.) A smoke alarm in each sleeping room.
  - c.) A smoke alarm that includes photoelectric technology outside each separate sleeping area, *such as in the corridors* in the immediate vicinity of the *sleeping rooms*.
  - d.) A smoke alarm on the upper level of dwellings or dwelling units with split levels without an intervening door between the adjacent levels shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.
2. **In existing dwellings**, smoke alarms must be provided in the following locations:
  - a.) Smoke alarms must be provided when alterations or repairs are made to sleeping rooms or outside each separate sleeping area as required for a new dwelling.
  - b.) Smoke alarms must be provided when one or more sleeping rooms are added or created in existing dwellings in the new sleeping rooms and in the immediate vicinity outside each sleeping room as required for new dwellings.

**SMOKE ALARM POWER SOURCES:**

1. Smoke alarms must receive their *primary* power from the building wiring when the wiring is served from a commercial source (i.e. an electric utility) for the following conditions:
  - a.) In new dwelling units.
  - b.) In existing dwelling units where there is an attic, crawl space, or basement available which could provide access for hard-wiring.
  - c.) In existing dwelling units where the existing interior finishes are removed, exposing the structure.
2. There are conditions in which these smoke alarm power source requirements cannot be met. In those cases the code provides alternate power requirements, as summarized below:



- a.) Smoke alarms are permitted to be battery operated when installed in buildings without commercial power.
- b.) Hard-wiring of new smoke alarms installed in existing finished areas is not required where there is not access to an attic, crawl space, or basement, and where the removal of interior wall or ceiling finishes exposing the structure, is not otherwise proposed. Listed conventional battery operated smoke alarms or listed battery operated low-power radio (wireless) alarms are permitted to be installed in these existing finished areas.

Even if there are no alterations being considered that would possibly trigger the requirement for the installation of smoke alarms, owners and tenants should install smoke alarms in the prescribed locations and of the proper types to assure that occupants will be notified in case of a fire emergency. The majority of fire deaths in Ohio occur in dwellings with no operating smoke alarms present. These battery operated smoke alarms provide a high level of safety when installed and installed properly. For more information refer to the Consumer Products Safety Commission document on smoke alarms at: <http://www.cpsc.gov/pagefiles/119012/smokealarms.pdf>.

In dwellings with smoke alarms already installed, the devices should be checked or tested for operation regularly as directed by the manufacturer and the placement of the smoke alarms should be examined to assure that they located properly. These simple steps will provide a level of protection that may prove life-saving in the event of a fire.

#### **INTERCONNECTION:**

Where more than one smoke alarm is required to be installed within an individual dwelling unit of one alarm will activate all of the alarms in the individual dwelling unit. Physical interconnection of smoke alarms is not required where listed, low-power radio (wireless) alarms as described above, the alarm devices must be interconnected in such a manner that the actuation are installed and all alarms sound upon activation of one alarm.

This interconnection of smoke alarms in existing areas is not required when alterations or repairs do not result in the removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space, or basement available which could provide access for interconnection without the removal of interior finishes.

Residential smoke alarms are susceptible to nuisance alarms: alarms that sound because of something other than an emergency situation. This occurs when alarms are placed too close to a cooking area or a bathroom and cooking or steam triggers the devices. Frequent nuisance alarms can result in occupants choosing to disable the alarm. As the distance from a cooking appliance or a bathroom increases, the frequency of nuisance alarms decreases. Thus, location of alarms as recommended by the manufacturer becomes important for their proper operation.

Figures 2, 3a, 3b, 3c, and 4 illustrate complaint smoke alarm locations required by the RCO and NFPA-72. Because of the prevalence of nuisance alarms, the standards have limited the proximity of smoke alarms to stationary, fixed, or portable cooking appliances. Based upon studies of cooking nuisance alarms, the exclusion zone extends in a 10 foot radius from the closest edge of a fixed cooking appliance. This zone is not intended to pass through walls or doorways.

Figure 4 indicates general smoke alarm placement in a multi-story home as required in the code's referenced standard regulating alarms (NFPA 72). For detailed information on the requirements for smoke alarms, refer to NFPA 72 Chapter 29, *Single- and Multiple-Station Alarms and Household Fire Alarm Systems*. NFPA standards are available on-line at no charge at:

<http://www.nfpa.org/codes-and-standards/document-information-pages>



Figure 2: Complaint Alarm Placement in a Small

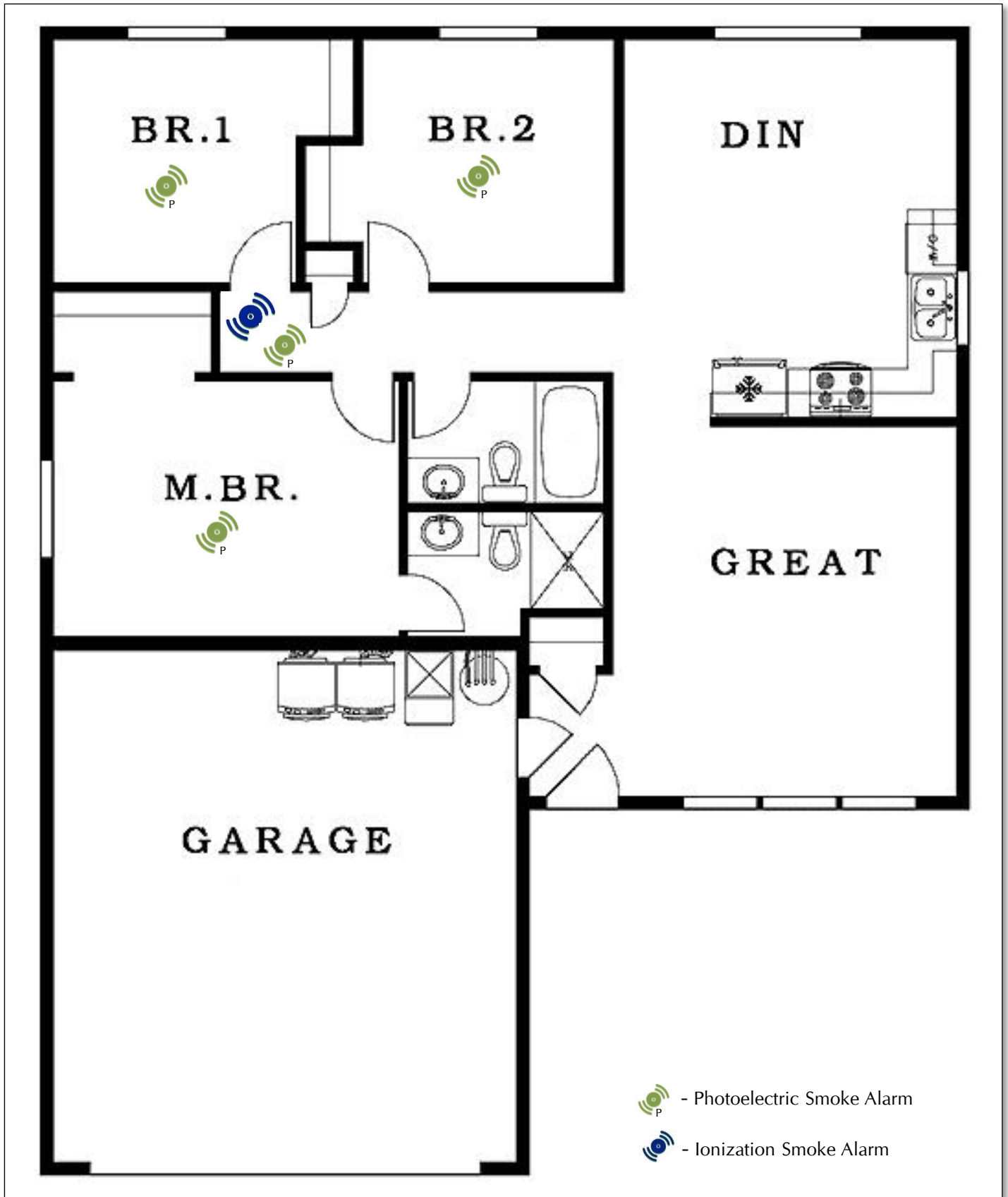


Figure 3a: Complaint Alarm Placement in a Larger Home

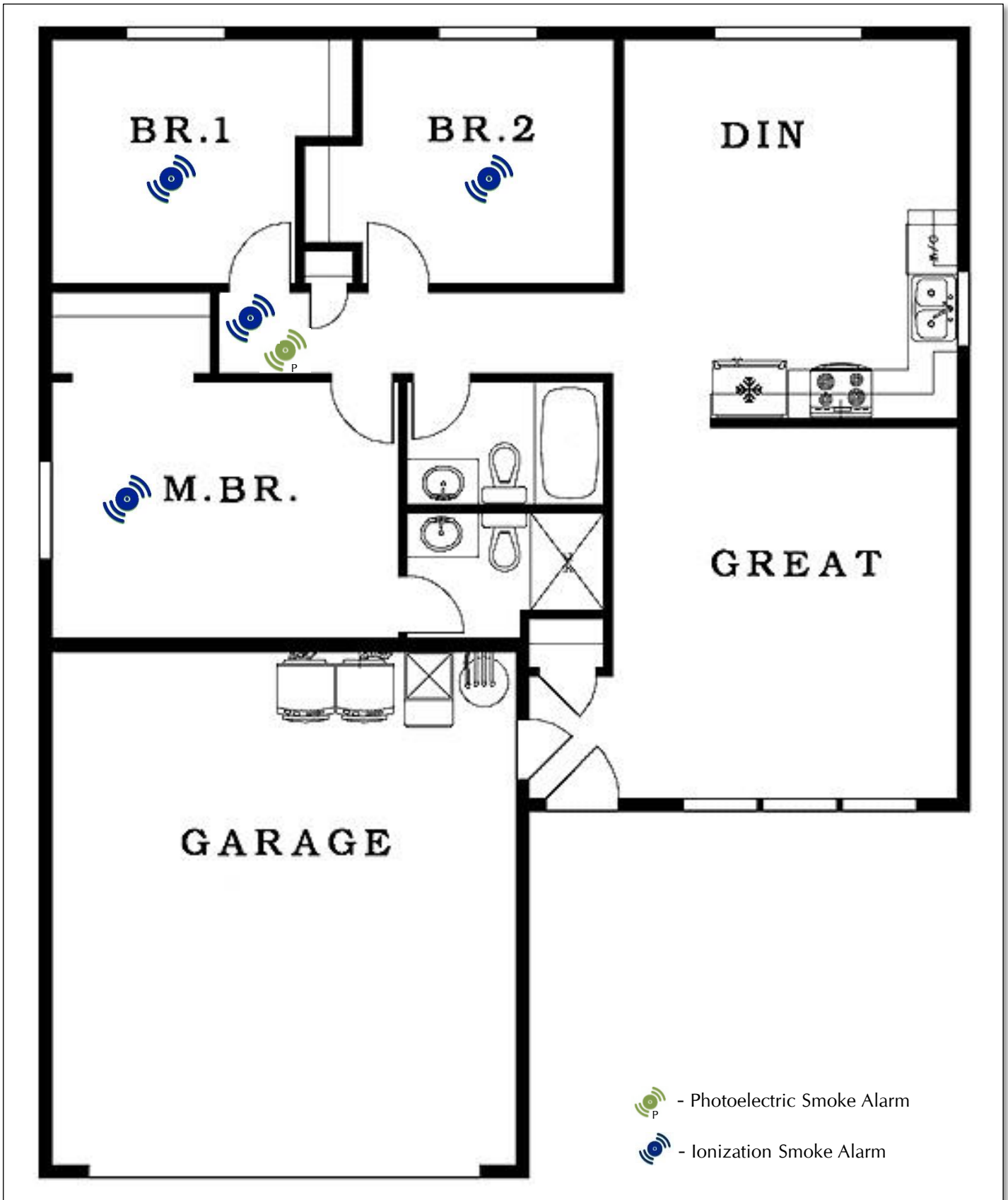


Figure 3b: Complaint Alarm Placement in a Larger Home

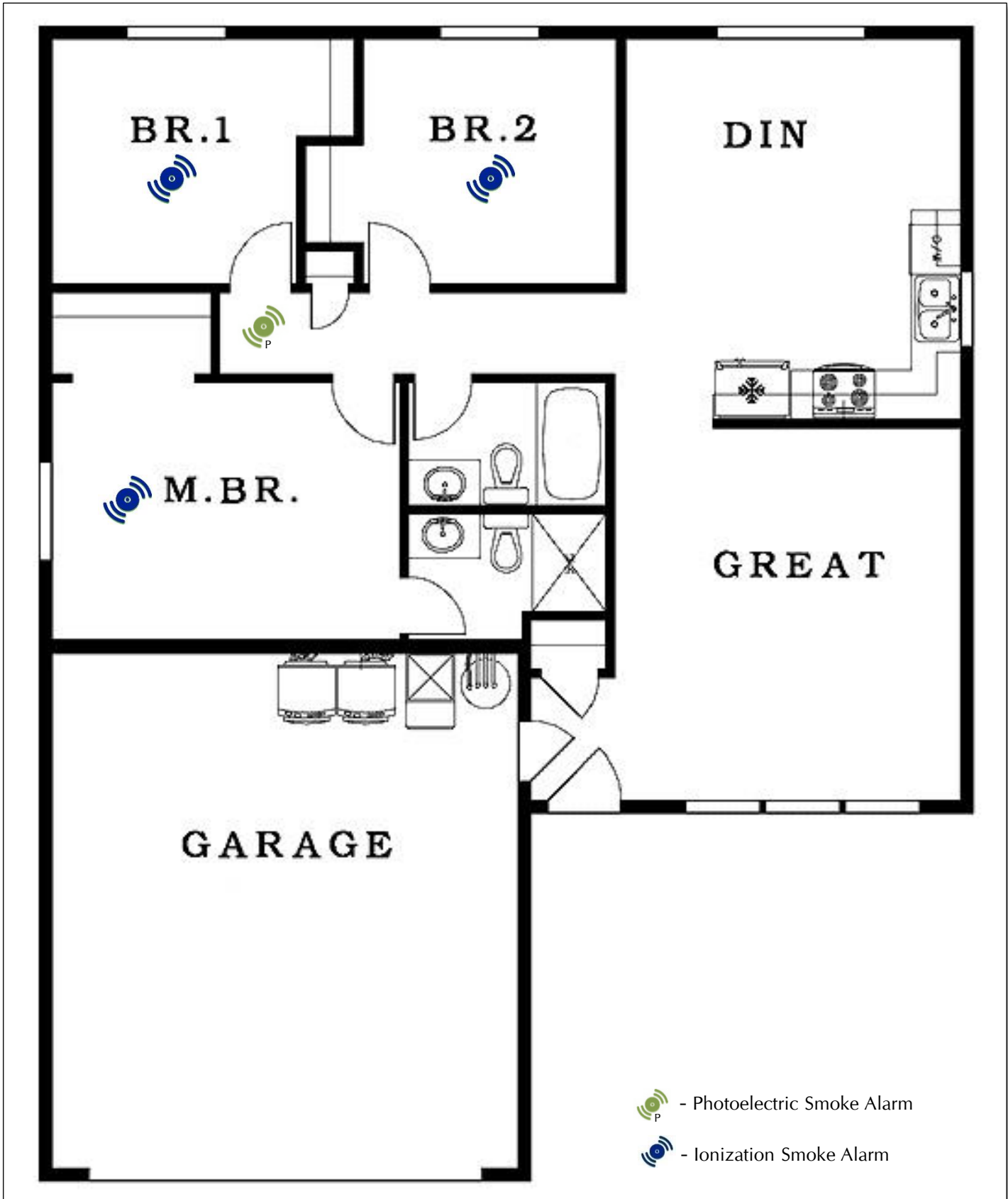


Figure 3c: Complaint Alarm Placement in a Larger Home

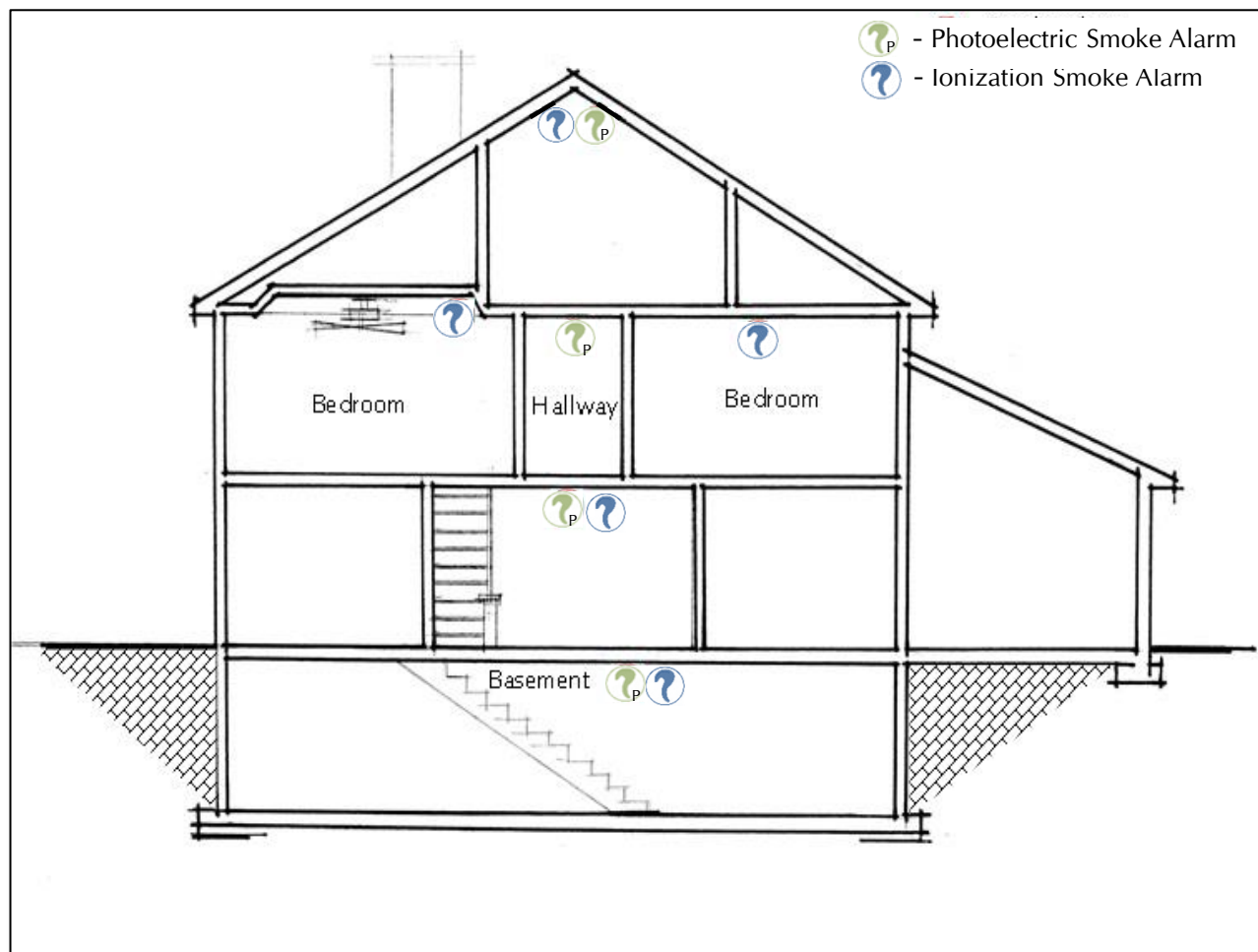


Figure 4: Complaint Alarm Placement in a Multi-Story Home

#### HOW DO I TAKE CARE OF MY SMOKE ALARM?

Smoke alarms *must* be maintained! A smoke alarm with a dead or missing battery is the same as having no smoke alarm at all. A smoke alarm works as desired when it is properly installed **and** maintained. Depending on how your smoke alarm is powered (9-volt, 10-year lithium, or hardwired), you'll have to maintain it according to manufacturer's instructions.

General guidelines for smoke alarm maintenance:

##### **Smoke alarm powered by a 9-volt battery**

- Test the alarm monthly. (There is usually a test button on the smoke alarm to allow you to perform a short test if the alarm.)
- Replace the batteries at least once per year.
- The *entire* smoke alarm unit should be replaced every 8-10 years.

##### **Smoke alarm powered by a 10-year lithium (or "long life") battery**

- Test the alarm monthly. (There is usually a test button on the smoke alarm to allow you to perform a short test if the alarm.)



- Since you cannot (and should not) replace the lithium battery, the *entire* smoke alarm unit should be replaced according to manufacturer's instructions.

#### Smoke alarm that is hardwired into the home's electrical system

- Test the alarm monthly. (There is usually a test button on the smoke alarm to allow you to perform a short test if the alarm.)
- The backup battery should be replaced at least once per year.
- The *entire* smoke alarm unit should be replaced every 8-10 years.

**Most importantly, REMEMBER to replace smoke alarms older than 10 years!** Smoke alarms do have an effective life after which the sensitivity or effectiveness diminish making it less functional in protecting the home.



#### WHAT DO I DO IF MY SMOKE ALARM ALERTS WHILE I'M COOKING?

Never disable a smoke alarm while cooking! A smoke alarm is just doing its job when it sounds while you're cooking or taking a shower with lots of steam. If a smoke alarm sounds while you're cooking or taking a shower with lots of steam, **do not** remove the battery. You should:

- Open a window or door and press the "hush" button if it is so equipped,
- Wave a towel at the alarm to clear the air, or
- Move the entire alarm several feet away from the location to a point outside the exclusion radius for the device.

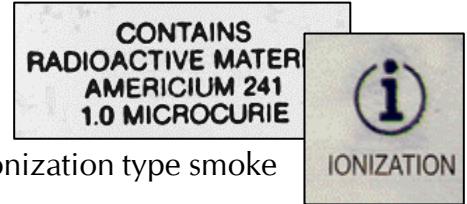




## HOW DO I KNOW WHICH TYPE OF SMOKE ALARM I HAVE?

There are several ways to determine the specific technology or type of smoke alarm – whether ionization or photoelectric. If new, the packaging will usually indicate the type of smoke alarm inside on the packaging materials or in the manufacturer’s installation guidelines accompanying the unit.

If you are examining an existing smoke alarm, turn the unit over and look for an indication that the unit contains radioactive material. If these words are used or if the lower case letter “i” enclosed in a circle is present, the unit is an ionization type smoke alarm.



If the lower case letter “p” enclosed in a square is present on the reverse side of the unit, it is a photoelectric smoke alarm. The word “photoelectric” is most likely also be printed on the rear label as well.



Additionally, more frequently available are combination smoke alarms that incorporate both technologies. If so, there is usually an indication on the unit that it was manufactured using both ionization and photoelectric technologies.

**Ionization & Photoelectric Smoke Alarm**

## Typical Smoke Alarms

