



# Position Paper

## Smoke Alarms – Ionization and Photoelectric Technology

**Summary** - The Fire and Life Safety Section (FLSS) of the International Association of Fire Chiefs (IAFC) is providing this summary of current information regarding the use of ionization and photoelectric smoke alarms for its members to use in their public education programs. The goal is to explain the different response characteristics of these two types of smoke alarms and offer advice relating to what to tell the public about smoke alarm use. It is important to note that smoke alarms are only one component of a comprehensive residential fire protection plan that also includes the installation of residential fire sprinklers and fire escape planning. For the best protection, all smoke alarms should be interconnected throughout the home.

In April 2007, Underwriters Laboratories (UL) and the NFPA Fire Protection Research Foundation (FPRF) published a report of the UL Smoke Characterization Project which stated that residential smoke alarms provide a critically important notification to occupants that there is a presence of smoke and/or fire.

The study by UL reported that fires in either a flaming or a smoldering phase provide several cues for smoke alarms, including:

- smoke particulates
- heat
- gasses such as carbon monoxide, also known as CO.

The study explained that current smoke alarms use two types of smoke sensing technologies: photoelectric or ionization. The photoelectric type has a light source and detects the scattering or obscuration caused by smoke particulates. The ionization type detects changes in local ionization field within the detection chamber resulting from the presence of smoke. Both types of alarms activate when a set threshold is reached.

A copy of UL's study may be found at:

<http://www.nfpa.org/assets/files/PDF/Research/SmokeCharacterization.pdf>

The UL Smoke Characterization Project followed a 2004 study conducted by the National Institute of Standards and Technology (NIST) that indicated fires in today's homes

smolder longer and then burn hotter and faster than what was typical when smoke alarms were first introduced a number of years ago. The NIST study also concluded that because fires could be more aggressive, the time needed to escape some types of fires has been reduced significantly from approximately seventeen (17) minutes, at the time of the original study in the 1970s, to as little as three (3) minutes under certain conditions today. While current technology smoke alarms were found in the NIST study to operate within the established performance criteria, there was a difference in activation times for the different sensing technologies (photoelectric or ionization) depending upon the type of fire development (fast-flaming fires verses smoldering fires).

The link to published work on the NIST website is: <http://smokealarm.nist.gov/>

Early detection and notification of fires is critical to escape time, because the time to arrive at untenable conditions in residences can be as little as three minutes for typical flaming fire scenarios. Both ionization and photoelectric smoke alarm technologies quickly alert occupants in most fire scenarios.

**In the controlled experiments conducted by NIST, ionization alarms react earlier than photoelectric alarms in fast-flaming fires, such as those involving paper or flammable liquids, while photoelectric alarms tend to react substantially earlier than ionization alarms in smoldering fires, such as those ignited by cigarettes in upholstered furniture, bedding materials, and mattresses.**

While it is generally recognized that each sensing technology may be better in particular applications, it is impossible to predict what type of fire will occur in a typical residence. Therefore, fire safety experts recommend that a home have a combination of both ionization and photoelectric smoke alarms or dual sensor smoke alarms that incorporate both type of sensing technologies in one unit to ensure the fastest response to both flaming and smoldering fires. It is vitally important to note that smoke alarms are only effective when they work. Smoke alarms should never be disabled, and must be tested, cleaned, maintained and replaced according to manufacturers' instructions.

**The IAFC, through its Fire & Life Safety Section (FLSS), recommends that IAFC members include the following information when they educate the public about the use of smoke alarms:**

- There are two main types of technologies used in smoke alarms to detect smoke. Both technologies detect all types of growing fires. Ionization alarms, which sell for about \$5 for battery-operated models, respond faster to flaming fires, such as those involving paper or flammable liquids. Photoelectric alarms, which sell for about \$20, respond faster to smoldering fires, such as those ignited by cigarettes in upholstered furniture, bedding materials, and mattresses. Dual sensor smoke alarms use both ionization and photoelectric sensors and cost about \$30.
- Smoke alarms that use either type of sensing technology have been proven to save lives, prevent injuries, and minimize property damage by detecting and alerting residents to fires early in their development, and that the risk of dying from fires in a home without smoke alarms is twice as high as in homes that have working smoke alarms.

- ❖ Since it cannot be predicted what type of fire will start in a home, it is important that both smoldering and flaming fires are detected as quickly as possible. The best protection is to have both types of smoke alarms installed, or install dual sensing technology smoke alarms that incorporate both ionization/photoelectric sensors.
- ❖ Working smoke alarms should be installed on every level of the home, outside sleeping areas and inside bedrooms, as per manufacturer's specifications. Furthermore, smoke alarms can only offer protection if they are working, and as such, they should be tested, and maintained in accordance with the manufacturer's specifications.
- ❖ If smoke alarms are battery operated or have battery back-up, the batteries should be replaced at least once a year during the IAFC's "Change your clock, change your battery" program in October. In addition, experts say that the entire smoke alarm itself should be replaced every 10 years.
- ❖ Batteries should never be removed to disable a smoke alarm, even if you experience "nuisance" alarms, such as while cooking or showering. Simply fan the detector with a newspaper or towel to stop the alarm. Clean the smoke alarm according to the manufacturer's instructions, and consider relocating it away from the kitchen or bathroom. Some smoke alarms have a silencing or "hush" feature, so nuisance alarms can be stopped quickly and easily. Other smoke alarms use a long-life sealed battery unit so the battery cannot be removed.
- ❖ Studies have shown that some children may not awaken from the sound of a smoke alarm for a variety of reasons. Parents and care providers should conduct a fire drill when their children are sleeping so they can assess their children's ability to awaken and respond appropriately. If children, or any other family members, do not awaken or do not react appropriately to the smoke alarm, the home escape plan should be modified accordingly to ensure that all family members are able to get out safely. The IAFC is aware of certain types of alarms that project a recording of the parents' voice or some other sound to which children may be more responsive than the traditional alarm.
- ❖ For elderly people, those who have impaired hearing or those who have other disabilities that make the alarm difficult to hear, there are smoke alarms that use strobe lights and vibrators in addition to sound. Exploring alternative approaches such as these may make sense in those households.
- ❖ Consider the installation of a residential fire sprinkler system. Fire protection involves a complex, multi-faceted approach that does not rely upon any one measure for safety.

- ❖ The National Fire Protection Association (NFPA) reports that the provision of both smoke alarms and residential fire sprinklers increases survivability of a fire in a home by 82% over having neither.
- ❖ Develop and regularly rehearse an escape plan with all members of your household, so that when the smoke alarm sounds, everyone will move to a safe location outside the home. For information on how to develop a home escape plan, see <http://www.nfpa.org/assets/files/PDF/FPWgrid03.pdf>.

Furthermore, we encourage all stakeholders involved in the manufacture, listing, labeling or distribution of smoke alarms to work collectively to bring uniformity and standardization to their recommendations for the selection, placement and interconnection of these appliances by using the most current data and technology, thus bringing more clarity to the end users.

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The IAFC and the FLSS is grateful to Underwriters Laboratories, The NFPA Fire Protection Research Foundation, NFPA, and the National Association of State Fire Marshals for their contributions to this document, and hopes that the membership of the IAFC find this information useful when offering advice about smoke alarms to the public we so proudly serve.

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