Are photoelectric smoke alarms better than ionization smoke alarms for “adjacent to kitchen” installations, to minimize nuisance alarms?

Information Report

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As well as providing a response to this question, this report includes a sampling of comments and observations from a number of industry and research sources.

Let’s start with the answer: Within the fire protection and prevention industry, it is recognized that neither sensor type, photoelectric nor ionization, is universally better at detecting all types of fires. Why? Each sensor operates on a different principle and therefore may respond differently to various conditions.

Ionization sensors may respond slightly faster to flaming fires, whereas photoelectric sensors may respond slightly faster to smouldering fires.

Notwithstanding these differences, to achieve ULC listing, both alarms must be tested to the same standard and meet the same requirements. Since you can’t predict the type of fire that will occur, installing both types of alarms in your home can enhance fire safety.

Nuisance alarms in homes from typical cooking activities are affected by the properties of the aerosol produced and its concentration, the location of an alarm relative to the source, and the airflow that transports smoke to an alarm. You need to know that there are a variety of options available.

The bottom line: It is not possible to say one sensor type is better that the other for reducing nuisance alarms in kitchen installations. Installing a photoelectric smoke alarm instead of an ionization smoke alarm may be one approach to reducing nuisance alarms. Other approaches might be to relocate the existing alarm a short distance away, replace the unit with a new one, or replace it with a unit that has a hush feature.

Information to support this response:

In the process of preparing this response, numerous insights were found at a number of smoke alarm manufacturer websites, in research reports, and through dialogue with smoke alarm engineering staff and researchers.

Comparison of technologies

Within the fire safety community, it is clearly recognized that the two smoke alarm technologies have distinct operating characteristics that may impact on operation in certain circumstances.

An ionization smoke alarm uses a small amount of radioactive material to ionize air in the sensing chamber. As a result, the air chamber becomes conductive permitting current to flow between two charged electrodes. When products of combustion enter the chamber, the conductivity of the chamber air decreases. When this reduction in conductivity is reduced to a predetermined level, the alarm is set off. Most smoke alarms in use are of this type.

A photoelectric type smoke alarm consists of a light emitting diode and a light sensitive sensor in the sensing chamber. The presence of suspended products of combustion in the chamber scatters the light beam. This scattered light is detected and sets off the alarm.

The two types operate on different principles and therefore may respond differently to various conditions.

Ionization models are best suited for rooms that contain highly combustible materials that can create flaming fires. These types of materials include flammable liquids, newspapers, and paint cleaning solutions.

Photoelectric models are best suited for living rooms, bedrooms and kitchens. This is because these rooms often contain large pieces of furniture, such as sofas, chairs, mattresses, counter tops, etc. which will burn slowly and create more smouldering smoke than flames.

As noted at one manufacturer website, “It's impossible to say one sensor -- photo or ion -- is universally better at detecting all types of fires. Why? Because both sensors are designed to respond to combustion particles produced by smouldering or flaming fires, and because fires themselves are different. The combustion particles produced will vary depending on what starts the fire (matches, electrical fire, etc.) and what burns (paper, fabric, wood).”

Dealing with kitchen nuisance alarms

There is no single solution to deal with kitchen related nuisance alarms. A February 26, 2004 National Institute of Standards and Technology, United States (NIST) news release, ‘Current Smoke Alarms Save Lives If Properly Used’ states “the NIST tests showed that normal cooking activities cause nuisance alarms in both photoelectric and ionization type alarm. Neither type of detector was demonstrably better in reducing nuisance alarms.” There is no statistical data to support one technology over the other.

Further, NIST researchers have identified that “nuisance alarms in residential settings from typical cooking activities, smoking or candle flames are affected by the properties of the aerosol produced and its concentration, the location of an alarm relative to the source, and the air flow that transports smoke to an alarm. This is not surprising, as the same observations have been made in the fire tests here and other studies. This study provides a detailed set of data that can be used to address several issues involving nuisance alarms and reinforces current

suggested practices. Clearly, the advice that alarms not be installed close to cooking appliances if at all possible is valid. These results show that homeowners who are able to move the location of an alarm that frequently experiences nuisance alarm would do well to maximize its distance from cooking appliances while keeping it in the area to be protected. It was observed that ionization alarms had a propensity to alarm when exposed to nuisance aerosols produced in the early stages of some cooking activities, prior to noticeable smoke production."

So, while this U.S. research body does not single out one technology as being "better" than the other, it does identify that relocating an alarm (either senor type) further from cooking appliances, while still providing proper area coverage, may be appropriate. In fact, device location is just one aspect to be considered when dealing with nuisance alarms.

The Building and Fire Research Laboratory at NIST has identified that because there are so many variables associated with kitchen nuisance alarms (such as the sensor type, smoke alarm brand – there may be variations in sensitivities of older units, the cooking activity – frying, toasting, baking, air currents and device location), that it is difficult to focus only on the sensor type.

Rather than relocating a smoke alarm, installing a photoelectric smoke alarm in the kitchen area to minimize nuisance alarms is one option. Many fire safety websites state that photoelectric smoke alarms are less prone to nuisance alarms in the kitchen area than ionization smoke alarms, and also include other options or qualifying comments. One manufacturer has conducted tests at corporate research facilities. Understandably, their activities and findings are not available to the public. Given the unpredictable nature of fire, they do not endorse the use of one technology over the other.

In an illustration of household smoke alarms locations at one website, an "alarm pause" model of smoke alarm is recommended for the kitchen. A photoelectric model is recommended for the bedroom, living room and basement.

At another fire safety website, in description of alarm features, and placement in the home, it is noted that a silence feature is desirable for kitchen applications. Alternately, "Smoke alarms without a silence button should be installed in a room or hallway right next to the kitchen. Photoelectric smoke alarms are excellent choices outside kitchens".

At another site, the concern about nuisance alarms in the kitchen can be minimized with the suggested use of either a photoelectric alarm, or a sealed battery unit (ionization sensor) with the hush feature, so the battery cannot be removed.

While it is recognized that each sensor may be better in particular applications, it is understood within the industry that "you can't be sure what types of fire might

start in your home", so there is a need to install both ionization and photoelectric units in the home.

A NIST researcher commented that because there is not a single solution to nuisance alarms, education is so important. People need to know that they have a variety of options available to them, such as changing the smoke alarm, using a different technology, using a unit with a hush feature, relocating the alarm, etc., as opposed to removing the battery.

Additional Comments from U.S. Researchers

Related to this ionization/photoelectric issue, it is understood that many European nations no longer sell ionization smoke alarms. Although ionization smoke alarms are no longer sold in Sweden, (apparently because the radioactive element in ionization smoke alarms is inconsistent with their "green" environmental strategies) they have not seen a decrease in nuisance alarms.

Mention was also made of an interesting aspect that may be a concern for nuisance alarms in future, as we move towards more smoke alarms being placed in bedrooms because of the performance advantages. Based on information from lodging-type/hotel/motel facilities in the U.S., where photoelectric alarms are typically installed, false alarms occur, many due to lint from linens (which may be changed daily in the case of a hotel) and cat hair.

Most commercial applications in North America involve the use of photoelectric technology. It is only in homes that ionization smoke alarms prevail. There is an obvious cost issue associated with replacing ionization smoke alarms with photoelectric alarms.

Applicable standards and listing:

Despite the pros and cons associated with the two types of smoke detection, regulators, manufacturers and researchers agree that either type of smoke alarm will give adequate warning in either type of fire.

As determined in laboratory and field testing, photoelectric smoke alarms may respond slightly faster to smouldering fires, while ionization alarms respond slightly faster to flaming fires. Notwithstanding these differences, to achieve ULC listing, both alarms must be tested to the same standard and meet the same requirements. Both alarms will detect all types of fires that commonly occur in the home.

It is the consumer's responsibility to assess the circumstances of their household and to select the most appropriate alarm. However, an important consideration in the purchase of a smoke alarm is conformance to the recognized standard. In Ontario, CAN/ULC-S531, "Smoke Alarms", is the recognized standard for both the ionization and photoelectric types of alarms.

To ensure that an alarm has been manufactured and tested to this standard, there should be a marking by the Underwriters Laboratories of Canada (ULC), or Underwriters Laboratories Incorporated ($_c$UL).

There is every reason to believe that alarms listed by a certification agency accredited by the Standards Council of Canada will function as intended.

Smoke Alarm Features

Smoke alarms are available in “basic” models and are also available with a variety of options, such as the following:

- A "missing battery" indicator,
- An optional alarm hush or silence feature,
- The use of a power "on" indicator light to show that ac power is being supplied to 120 volt wired in smoke alarms.
- Dual sensor units
- Sealed long life battery units
- Tamper-proof alarms, and
- Combination hardwired/battery back up units.

Home installations

The Ontario Fire Code requires homes to have working smoke alarms that meet CAN/ULC-S531 on every level and outside all sleeping areas.

The Office of the Fire Marshal also recommends that smoke alarms be installed in every room, for maximum protection. A mix of photoelectric and ionization smoke alarms is desirable.

As stated by manufacturers of smoke alarms, the most important factor in protecting your family is having the recommended number of working smoke alarms installed in the proper locations. It is also recommended that since you can't be sure what types of fire might start in your home, you install both ionization and photoelectric smoke alarms in your home, or choose dual sensor smoke alarms which feature both sensors in one unit.

Additional information can be found at any number of websites. A small sampling of sites includes www.kidde.ca, www.firstalert.com, www.nadi.com, www.nist.gov and http://smokealarm.nist.gov.