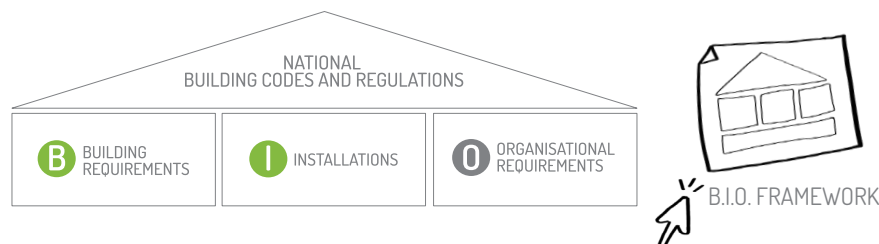


# B.I.O. framework factsheet: DETECTION AND ALARM SYSTEMS

This factsheet focuses on one element of the B.I.O. framework for fire safety of buildings: detection and alarm systems. It aims to illustrate why detection systems are key components for an efficient fire safety strategy and how the technology works.



very important.

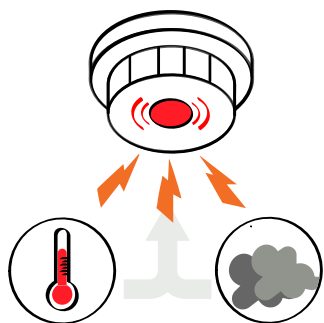
In case of a fire, the detector and alarms systems (e.g. smoke detectors) will effectively detect and warn, or even, wake up occupants and allow for an early evacuation. We must consider that a small fire can become a large one just in a couple of minutes. Every second counts. The early detection of a fire can also minimize the impact on property. Smoke detection systems can be used to protect people's lives and reduce the number and seriousness of injuries.

## How effective are they?

Due consideration should be given to the possibility that many lives can be saved because of effective fire protection measures. In that respect Smoke alarms are key to initiate the evacuation process in case of a fire, especially at night when occupants are sleeping:

- In the U.S., the death rate per 1,000 reported home fires was more than twice as high in homes that did not have any working Smoke alarms compared to the rate in homes with working Smoke alarms (12.3 deaths vs. 5.7 deaths per 1,000 fires). (Source: [Smoke Alarm in U.S. Home Fire. NFPA Research](#). Marty Ahrens. January 2019).
- The expected number of reported fires in houses where smoke detectors are installed is reduced by a factor of 3.5 to 5, and the expected casualties reduced by a factor of 2.5 to 3.5 (Source: [Gilbert, 2018](#)).
- In 2015, UK had around 90% home coverage of smoke detectors, with around 258 annual domestic fire deaths, while France had around 2% coverage, with around 700 annual domestic fire deaths (Source: [Fire Industry Association UK, 2015](#)); the population of both countries is nearly equal. Since smoke alarms became obligatory in France in 2015, official figures show a reduced number of deaths. However, the FFMI estimate that less than 50% of homes are correctly equipped.
- Smoke Alarm Obligation (SAO) in Germany was introduced in different federal states starting in 2003. The effectiveness of SAO was studied by Festag (Source: [Festag, 2020](#)) with a statistical analysis of available fire data from Germany before and after state-wise introduction of SAO. The research concluded that indeed SAO had a positive effect in both new and existing buildings.
- During the period from 2000 to 2004 in Sweden, 61% of fatal residential fires happened in houses without Smoke alarms. (Source: [Fire and fire protection in homes and public buildings. An analysis of Swedish fire statistics and fire protection strategies](#). Kemi report 1/06. February 2006).

## What is a smoke detection and alarm System?

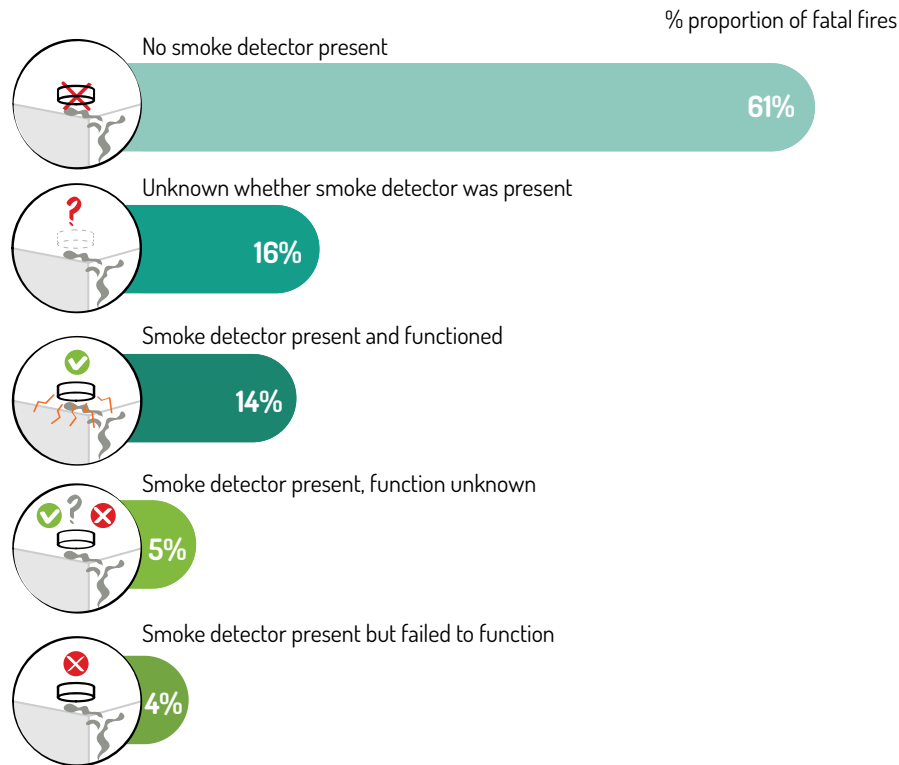


A fire detection and alarm system is one or a group of self-contained detectors that can detect the presence of smoke or heat and emit a warning signal. It can be powered by the home mains circuit, by sealed long life batteries or by replaceable batteries. The acoustic signal (85dB at 3m) sometimes combined with visual or even vibrating devices aims to warn occupants of the presence of a fire and/or smoke hazard in the vicinity to enhance an appropriate reaction (e.g., evacuation of occupants). Connected systems can also trigger acoustic alarms in other parts of the building or even directly alarm fire brigades.

## Why are smoke detection and smoke alarm systems essential in the event of a fire?

Smoke detectors are a type of detector system in building installations and are assigned to the second level of the [7 layers](#) of fire safety in buildings. When a fire occurs despite prevention measures, it is important to detect it as early as possible to give building occupants and fire brigades sufficient time to react. According to fire statistics reports issued in Europe and internationally, smoke is responsible for most fire deaths in buildings with the UK governmental agency stating that 80% of the fire deaths occur in residential areas (Source: [gov.UK/fire statistics 2022](#)). Early evacuation, before the fire grows, is therefore

### Fatal home fires by smoke detector function, Sweden, 2000 - 2004



Source: [Fatal fire statistics, Swedish Rescue Services Agency](#) (2006)

### The use of Smoke detection and Alarm systems in Europe

The requirement to install Smoke alarms varies across Member States and even regions. It also differs from buildings to buildings and depends on the height, typology, occupancy...

In the residential sector, a large group of countries such as France, Scotland, Finland, Norway, Estonia, Latvia, Lithuania, smoke detection systems are mandatory both in existing and new buildings. Other countries require smoke detection in new buildings but not in existing ones (England, Wales, Northern Ireland, and Denmark).

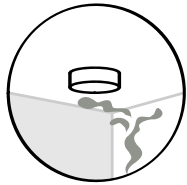
The strategies implemented in countries such as Scotland, Finland, Germany and Norway where Smoke alarms are required in any residential building (including the existing ones) reflect a high level of commitment to provide to the users an early warning in case of fire. However, everybody should install individual smoke alarms, even when it is not mandatory.

Regulations should not just refer to a single device to be installed in homes. Putting devices where the risk is higher (laundry room...) and where people need to be warned (sleeping rooms, living rooms,) make sense. An extra measure will be to keep the doors always closed, most especially at night in homes (single family houses). This contains the fire by limiting the amount of oxygen and by limiting the spread of fire and smoke. As the sound levels of the alarms are attenuated by the closed doors it is best to ensure alarms are positioned not more than 3 meters from each sleeping person or preferably in every sleeping area. When there is more than one alarm in the property it is recommended to interconnect them to ensure the fastest possible warning.

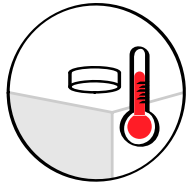
Across Europe there are many educational campaigns to promote the use of Smoke alarms and to explain the benefits that they can provide in case of fire. A good example would be the activities included in the "Prevention Week" conducted in Spain by APTB (Professional Association of Firefighters Technicians) and Mapfre Foundation in cooperation with 35 fire services in Spain where the Smoke alarm was the focus. (Source: APTB website).

## Types of Detectors (smoke, heat...)

Four types of detectors are widely used to detect fire: **smoke detectors**, **heat detectors**, combustion gas detectors and flame detectors.



**Smoke detectors** are mostly installed in the residential area. They are also known as smoke alarms. A modern smoke alarm has a photoelectric sensor contains a source of light and a receiver. When particles from a fire/smoke penetrate the device, the transmission of light towards the receiver decreases and this generates an alarm. They are the most commonly used, notably due to their affordability and ease of mounting.



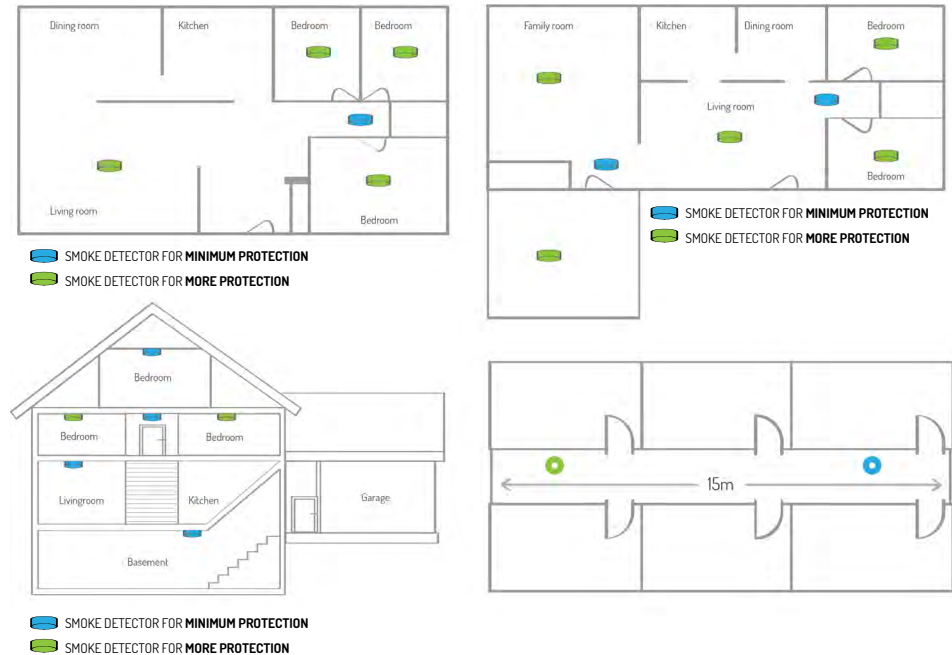
**Heat detectors** are the most commonly used, notably due to their affordability and ease of mounting. They are activated when the temperature rises or exceeds a fixed temperature (between 54°C to 58°C). Such devices, conforming with EN54, should be interconnected with a smoke alarm to ensure early evacuation and to avoid burns.

In the EU, the installation of smoke, heat, or CO detection and alarm systems are guided by national regulation or national building codes. Compliance with EU standards is mandatory for all devices sold on the EU single market. In addition, many countries have national installation and maintenance standards to ensure these products will function correctly throughout their working life.

## Where do I place my detector?

In case of a fire, smoke will be released by the burning content such as fabrics, furniture, mattresses, sofas, etc. Smoke released in a fire tends to ascend to the top part of the room and accumulate under the ceiling. The smoke will quickly fill the room of origin as well as other rooms and corridors. Thus, the best place to install a smoke detector or other types of detectors is in the centre of a ceiling or/and in accordance with the manufacturer's instructions. If the ceiling is not the best option (presence of anti-noise barriers, asbestos...), the detector can be installed on the wall approximately 60cm from the ceiling, away from any obstructions. In the case of a sloped ceiling, the better position is 100 cm from the highest point of the ceiling. The interconnection of smoke devices offers a safer option in case of long distances between devices or limitation in the propagation of the signal.

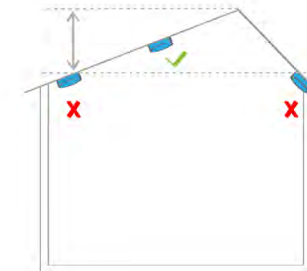
Key factors for sound decision making on selection and application of smoke detection and alarm systems are:



### Sloping Ceilings

With a sloping or peaked ceiling install a Smoke or Multi-Sensor Fire Alarm within 600mm of the peak (measured vertically) and a Heat Alarm within 150mm.

If the height of the peak is less than 600mm in the case of Smoke or Multi-Sensor Fire Alarms or 150mm in the case of Heat Alarms, it is regarded as being flat (see visual on the right).



Source: [CFPA Guideline](#)

Therefore, it is usually recommended that multiple detectors are installed per property and that in more complex buildings, these are interlinked to share the warning immediately. The smoke alarm installation must be well positioned to ensure the earliest possible warning of occupants – especially those who are sleeping, vulnerable or with impaired mobility – with sufficient time to exit the property to a safe place.

**Which type of detector should I install?**

The type of detector to use in a building is dependent on the type of fire you potentially want to detect. Thus, it is advised to contact an expert when deciding what type of smoke detector to use in your house.

Key factors for sound decision making on selection and application of smoke detection and alarm systems are:

- ✓ CE marked to ensure its reliability and compliance with EU standards
- ✓ Installed and placed adequately
- ✓ Powered by a battery or any steady/reliable power supply

In some countries, the battery must be built-in the device and last up to 10 years. In most countries, the Smoke alarm Day promotes a regular inspection / checking of smoke alarms.

Smoke alarm obligation in Europe

- existing
- not existing
- no information



Source: Festag, 2020

**Conclusion - Detection and alarm systems are an important step for an efficient fire safety strategy**

Smoke alarms are essential elements for fire safety in buildings. They have been proven to save lives for over 50 years. Building owners and occupants need to make sure that their Smoke alarms are properly placed, are available in sufficient number and working correctly. Introduction of regulatory requirements and control mechanisms assuring continued function of smoke alarm systems and communication to building owners and occupants about the importance of smoke alarm systems is one part of a range of effective preventative measures and should be further promoted by member states, fire services and consumer groups.

Prevention and detection being the very first steps of any efficient fire safety strategy, and as put forward in our BIO framework, the European institutions via funding programmes should support the organisation of pan European awareness campaigns on the use of smoke detectors and best practices in case of fire.

The EU fire statistics project should record the prevalence of detection system installation in homes and the detection system status (installed/not installed/working/not working) in homes where there have been fires/injuries/deaths. It should then provide absolutely conclusive data of the benefit of detection pan-EU.

**To know more**

1. Modern Building Alliance: EU Fire Safety Guide <https://www.modernbuildingalliance.eu/EU-fire-safety-guide#Alarmanchor>
2. the European Smoke Alarm Day (to be held on the 17th November in 2023) <https://www.smokealarmssavelives.eu>

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November 2018 <https://www.europeanfiresafetyalliance.org/wp-content/uploads/2018/11/20181120-Fatal-residential-fires-in-Europe.pdf>.

4. NFPA. Ionization vs Photoelectric. <https://www.nfpa.org/Public-Education/Staying-safe/Safety-equipment/Smoke-alarms/Ionization-vs-photoelectric>
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14. Sebastian Festag, 'Analysis of the effectiveness of the Smoke alarm obligation - Experiences from practice', Fire Safety Journal, Vol.119, January 2021, <https://doi.org/10.1016/j.firesaf.2020.103263>

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SMOKE MANAGEMENT FACTSHEET



SMOKE ALARMS FACTSHEET



SPRINKLERS FACTSHEET



FAÇADES