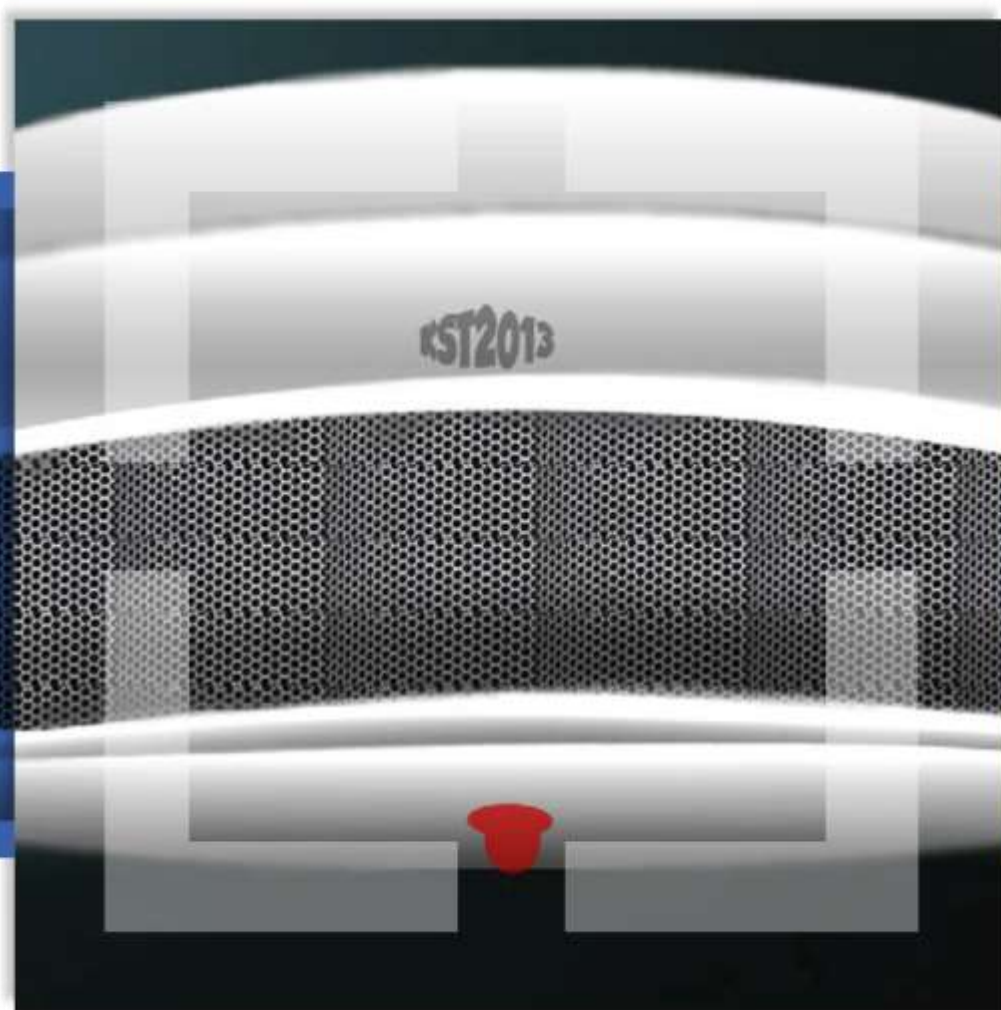




# Smoke alarms in the home

CFPA-E Guideline No 10:2022 F





**The CFPA Europe develops and publishes common guidelines about fire safety, security, and natural hazards with the aim to achieve similar interpretation and to give examples of acceptable solutions, concepts, and models. The aim is to facilitate and support fire protection, security, and protection against natural hazards across Europe, and the whole world.**

**Today fire safety, security and protection against natural hazards form an integral part of a modern strategy for survival, sustainability, and competitiveness. Therefore, the market imposes new demands for quality.**

**These Guidelines are intended for all interested parties and the public. Interested parties includes plant owners, insurers, rescue services, consultants, safety companies and the like so that, in the course of their work, they may be able to help manage risk in society.**

**The Guidelines reflect best practice developed by the national members of CFPA Europe. Where these Guidelines and national requirements conflict, national requirements shall apply.**

**This Guideline has been compiled by the Guidelines Commission and is adopted by the members of CFPA Europe.**

**More information: [www.cfpa-e.eu](http://www.cfpa-e.eu)**



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Key words:

## **1 Introduction**

The guideline is primarily intended for the public and those responsible for safety in companies and organisations. It is also addressed to the rescue services, consultants, safety companies etc. so that, in the course of their work, they may be able to help companies and organisations to increase the levels of fire safety.

Early warning is essential if you expect to escape and prevent a tragedy for your family when fire is breaking out.

A glow from a cigarette or overheated electrical wires in the walls of your home can smoulder for hours without your ever knowing it. If you are warned at this level of the fire your chances for escape or put out the fire would be very good. Once flames break out, your home can be changed to a terrible inferno in a few minutes and the chances for saving the lives of your family or yourself will be gone. A smouldering fire, which creates toxic gases is also a great threat to your life. Escape is only possible if you are warned of the fire in time.

Statistics indicate that the incidence of home fires is increasing steadily in recent years with the most serious fires occurring between midnight and 6 am, when most people are asleep and consequently when there is the greatest danger to the occupants of the house.

The best facility to secure an early warning of a fire is installing one or more smoke alarms in your home. In some European countries, installation of smoke alarms has become obligatory.

Consider that a smoke alarm is only one mean among others. In some countries, other kinds of detections systems may be allowed. It is suggested that smoke alarms yearly reduces the loss of lives in fires with about 20 – 30% in Norway.

Smoke alarms shall meet the requirements in EN 14604 and be tested as described in this document and meet the requirements of the tests. CO-detectors shall comply with the requirements of CEN standard EN 50291.

## **2 Scope**

The aim of this guideline is to prevent injuries, loss of lives and property in fires in the homes. Domestic smoke alarms are suitable for dwellings, cottages, cabins and mobile homes. In some countries, they are also recommended to be used in smaller kindergartens as compensation for professional fire detectors.

It is important for the user to prevent fire from initiating in the homes by basic prevention measures. For larger blocks of flats and similar buildings with poor emergency exits, professional fire detector installations are recommended.

However all buildings for accommodation purposes are recommended for professional fire detection systems.

## **3 Definitions**

(See also EN 14604 (2005): Smoke alarms for further terms and definitions)

**Smoke alarm devices:** A detector operating with its own electricity source (battery) or mains powered and warns with its own alarm-horn when it detects smoke. The smoke alarm contains all the components necessary for detecting smoke and for giving an audible alarm. An internal power source shall be replaceable by the user unless its operating life in the smoke alarm is 10 years time of use.

**Single-station heat alarm:** A device containing all the components, except possibly the energy source, necessary for detecting heat and giving an audible alarm. They are applicable in kitchens and garages where smoke alarms cannot be used. They must be connected to smoke alarms.

**Optical smoke alarm (OSA):** The detector is based on detection by means of scattered or transmitted light and contains no radioactive source.

**Ionic smoke alarm (ISA):** The detector is based on detection of smoke by means of a small radioactive source.

*Note: Ionic smoke alarms are not permitted in some European countries. The national requirements for radiation protection differ from country to country and they are not specified in this guideline. Such smoke alarms should however, comply with the applicable national requirements.*

**CO-detector:** A detector designed to give an alarm when CO levels reach a certain level in a short time. Also long term exposure to low level are of concern, especially for the elderly and those with heart and respiratory problems.

*Note: CO-detectors are designed for special purposes and do not replace smoke alarms.*

**Travellers smoke alarm:** The smoke detector is made for travel purposes and is not recommended for fixed mounting.

**Combined smoke alarm:** The smoke alarm consists of both an optical and an ionic detector.

**Light indicator:** The smoke detector has an oscillating light, which shows that the detector has battery voltage. If more than one light-emitting indicator is provided on the smoke alarm, the mains-on indicator shall be green, an alarm indicator shall be red, and a fault indicator shall be amber or yellow.

**Emergency light:** Some smoke alarms are equipped with a built-in lamp, which lightens up together with the alarm signal.

**Relay:** The smoke detector is equipped with a relay output with a switch-function, which may activate other equipment on alarm.

**Inter-connected smoke alarm:** Smoke alarm, which may be interconnected with other smoke alarms to provide a common alarm. Information for inter-connected smoke alarms shall state the maximum number that may be interconnected.

**Wireless smoke alarm:** The smoke alarm contains a small radio-transmitter or transceiver, which can transmit the alarm-signal wireless to a central unit or to other equivalent units. Some can be remotely tested, hushed or the unite in alarm is located with a central control.

**Low-frequency:** The smoke alarm has an alarm-signal with a low-frequency sound which is perceived better by hearing-inhibited people.

**Connected central:** Some smoke alarms might be connected with a central unit for power supply. Ancillary central units exist in more performances with different functions and possibilities.

**Power source:** The power source may be internal or external to the smoke alarm housing. Internal power source (battery) shall operate the smoke alarm for at least one year. An audible fault signal shall be given before the battery is incapable of operating the smoke alarm. This signal should last for minimum 30 days. Mains powered smoke alarms with battery back-up (especially with rechargeable cells) are particularly reliable as each unit has a dual power supply and the back-up supplies are all independent of each other.

**10 year battery unit:** The smoke alarm has a built-in battery which cannot be changed. The unit has an expected lifetime of about 10 years.

**Test facility:** All smoke alarms shall be provided with a routine test facility to simulate the presence of smoke in the sensing chamber. The test feature shall be accessible from outside the smoke alarm devices.

## 4 Description of the subject and recommendations

### 4.1 Generally

Most of the fatalities in fires occur in the victims own flats following smoke poisoning. Especially during nighttime when most people are sleeping, the danger of being killed in a fire is imminent. It is therefore important to install smoke alarms in all homes. The smoke alarms have to be installed in a way so that the alarm signal is being heard where the people are sleeping.

The smoke alarms should have a user's guide in the present language. The user guide should inform about the detection principle, suitable application field, placing, inspection, cleaning and regularly testing.

### 4.2 Detection principle

Smoke alarms are defined as small independent units with a built-together system for detecting and alerting a fire. Detection of a fire in these units is based on the content of particles from smoke spreading in the air and moving into the detection chamber. The detection of these small particles is possible in two different ways:

- **Optical smoke alarm (OSA)** is based on the scattering of smoke from burning objects entering in a dark chamber and is there lightened by a small beam of light. The reflection from the particles is catch by a light-sensitive unit, which is triggering the alarm (see figure 1).

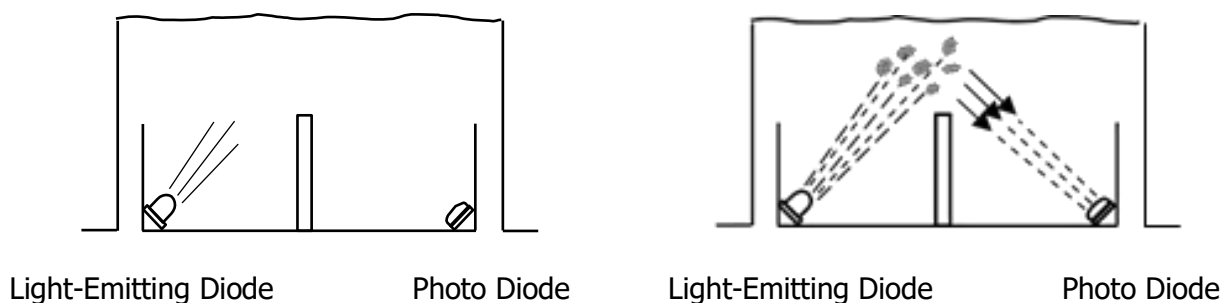


Figure 1: Diodes (Source: Reproduced by permission of BRE Electronics)

- Ionic smoke alarm (ISA)** is based on ionisation of smoke particles passing into a chamber with a small radioactive source and thus is electrical loaded. Because some of these chambers are made so that the entering air is part of an electrical circuit, the electrical loaded smoke particles will reduce the intensity in the electrical circuit and the detector will alert. All these detectors shall be marked with an international symbol for radiation and can be recognized in that way. It is however important to follow the national requirements for radiation protection (see figure 2).

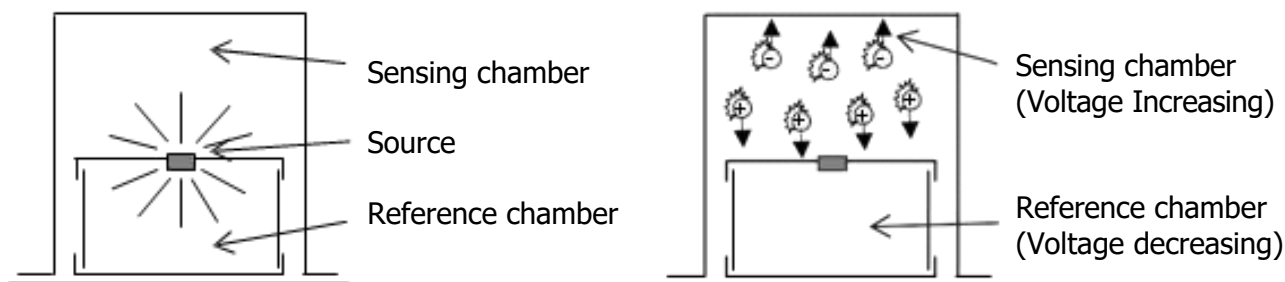


Figure 2: Chambers (Source: Reproduced by permission of BRE Electronics)

These two systems have different ability to react on certain types of smoke particles. Particularly the size of the particles is an important parameter for the ability of detection. OSA depends on the size and the optical scattering properties, while the response of ISA relies on the number of smoke particles in the volume.

Both types of smoke alarms are usually equipped with battery, which provides for energy to electronics and the alarm unit, but some models have also the possibility to be connected together and have energy from the main power supply.

With the common use of combustible interior with textiles and upholstered furniture and the installation of a lot of electrical equipment, the experience shows that a fire can start as a smouldering fire. This is a typical smoke-producing fire from glowing material that develops and spreads rather slowly. The smoke development can however be strong and contain large amount of carbon monoxide. The smoke distributes slowly in the surroundings and develops large soot particles that often cools to room temperature and does not reach the ceiling.

In fires like this, it has turned out that both ISA and OSA have failed to alert. If there is only one detector in the house, the smoke might have to move a long distance before it reaches the smoke

alarm. This speaks for the installation of more than one smoke alarm. The OSA will detect smouldering fires considerably faster than ISA.

Some fires also starts in easily ignitable and combustible materials like paper, textiles like curtains, decorations around candles or in inflammable liquids. Then we will have a fire with an open flame, fast temperature development, and smoke with relatively high temperature and small particles, which are spreading rapidly. It is not unusual, that a flash over will occur in 3 minutes after the start of the fire. Under such conditions, an ionic detector is efficient with its sensitiveness for small smoke particles.

*Note: Ionic smoke alarms are not permitted in some European countries.*

#### **4.3 Premises where OSA or ISA may give false alarms**

In surroundings where the smoke alarm might be exposed to strong draught, damp air or air from a kitchen stove or bath room, smoke alarms might mistake this with an alarm-situation. It is therefore strongly recommended to keep smoke alarms away from such rooms. In such premises, heat alarms should be installed. They should be interconnected to smoke alarms. In closed kitchens they will normally respond faster than smoke detectors mounted in a nearby room.

To reduce false alarms or damage to the smoke alarm, they should not be installed:

- in unheated basements or garages,
- in rooms with high humidity, such as bathrooms or shower rooms,
- in locations where they are exposed to chemical solvents or cleaners,
- near vents, flues and chimneys,
- near heating and cooking appliances,
- in kitchens.

#### **4.4 CO-detectors**

*Note: CO-detectors are not defined as an ordinary smoke alarm and they are only used for special purposes.*

CO (carbon monoxide) is a colourless and odourless gas. Because it cannot be smelled or seen, the gas can affect you before you even know it is there. CO is harmful because it will rapidly accumulate in the blood, depleting the ability of blood to carry oxygen. CO is the dominant poisonous gas in a fire and is the direct cause of most fatalities.

CO-detectors are specifically designed detectors that respond quickly on low levels of CO (e.g. 40 ppm CO).

#### **4.5 How many smoke alarms do I need?**

The reliability of a fire alarm installation increases with the use of both types of smoke alarms. The mounting and location of a smoke alarm and which type of detector is appropriate in the different places, must be thoroughly evaluated. Generally it is recommended to use more alarms than the minimum requirement states. A shorter distance from the fire to the detector gives a quicker alarm.

Dwellings with a great number of rooms and perhaps more floors might be equipped with smoke alarms connected together so if one gives an alarm all will alert at the same time. It is to be recommended that a system of smoke alarms like this get a central power supply, e.g. an accumulator battery that is charged automatically from the main supply. This will relieve the follow-up supervision and you avoid the changing of battery in each detector, but it assumes that the main supply is continuously monitored.



*Note: If you use interconnected smoke alarms you must notice the maximum number of alarms allowed by the manufacturer.*

#### **4.6 Detection systems for the elderly and disabled people**

For people with special nursing or care needs, who also may have help to evacuate the flat, the alarm might be connected directly to an alarm-central by way of automatic warning aid. The warning alone will in most cases not give necessary time to evacuate the disabled. Solutions like this have therefore to be looked at in connection with the choice of smoke alarms and the distance to standby personnel. It is to prefer that detector systems for elderly and disabled people be combined with automatic extinguishing systems like home-sprinklers or water mist (see also Guideline no 6: Fire safety in Residential Homes for the Elderly).

#### **4.7 Mounting – placing**

Fire alarms shall be mounted in accordance with the manufacturer's instructions.

In general, the best placing of a smoke alarm is as close to the centre of the ceiling as possible. Central placing is the best location for sensing a fire in any part of the room. Wall placing is in general not to recommended.

Dwellings over more floors ought to have at least one alarm on each floor connected with each other. The best solution in most cases is to place alarms in every room and connect them with each other.

In rooms with peaked or sloped ceiling the detector must be mounted away from the highest point of the room. The best placing is about 100 cm from the highest point measured horizontally (see figure 3, next page).

Installing an interconnected smoke alarm in the master bedroom can be particularly effective as it helps ensure the alarm will be heard by a responsible person

CO-detectors should be interconnected to the smoke alarms. As the CO-gas roughly has the same weight as air and distributes evenly throughout a room, the detector can be placed at any height in any location as long as its alarm can be heard.



Figure 3: Mounting (Source: Reproduced by permission of BRE Electronics)

#### 4.8 Radiation exposure from ionic smoke alarms

In some European countries, the authorities have forbidden ionic smoke alarms because of its radiation from the radioactive source.

Most ionic smoke alarms contains the radioactive source Americium 241 with an activity of 130 kBq. This element creates an electrical current in the sensing chamber. When tiny smoke particles enter the chamber, the flow of electricity is interrupted and the alarm goes off. Americium 241 is harmless outside the body because the radiation it emits is too weak to penetrate the human skin. The alpha particles emitted by Americium 241 in smoke alarms have a very short range, and are so weak that they can be stopped by a single sheet of paper

Numerous studies show the amount of radiation you would get from standing next to an ionic smoke alarm constantly for one full year, would be less than watching television, wearing a luminous wristwatch or cooking on a natural gas range over a year.

#### **4.9 Testing**

Smoke alarms should be tested weekly or at least monthly to secure proper function. The built-in test switch will simulate smoke and test all the detectors functions. Never use an open flame to test the detector as this can ignite or cause damage the smoke alarm.

Batteries must be replaced yearly or immediately when the low battery warning sounds.

#### **4.10 Maintenance (see the manufacturers manual)**

Clean the smoke alarm at least yearly by vacuuming the dust off the cover and sensing chamber openings. Power to the detector must be removed – remove the battery or disconnect AC power supply before cleaning.

After you have disabled power for maintenance purposes, be sure to restore power and test the detector.

If repeated false alarms are experienced, clean the detector and move it if it is not properly located.

Replace the smoke alarm when it no longer functions. Smoke alarms that do not work offer no protection!

#### **4.11 Replace of batteries**

Batteries, unless they are built in 10 years batteries or are rechargeable cells, must be replaced regularly in accordance to the instruction manual, normally once a year. All batteries have to be changed immediately when the low battery warning sounds. The removal of any battery used to power, or provide back-up power to the smoke alarm, shall result in a visual, mechanical or audible warning that the battery has been removed.

*Warning: Most smoke alarms are mounted in the ceiling and you need a stepladder or any other safe equipment to stand on to reach the detector. Never use an unstable chair or other tottering furniture when changing batteries. Accidents in the home occur too often!*

It is also possible to obtain a wall-mounted battery housing with cable connection to the smoke alarm. Thus, the replacing of batteries will be easier.

#### **4.12 Sound output**

For battery operated smoke alarms the sound output shall be at least 85 dB(A) at a distance of 3m from the alarm after 1 Min of alarm operation and at least 82 dB(A) after 4 Min.

Main powered smoke alarms shall have an output of at least 85 dB(A) at 3m distance after 4 Min of alarm operation.

The maximum sound output for both battery powered and main powered smoke alarms shall not exceed 110 dB(A).

#### 4.13 Quality requirements

Every smoke alarm must have a CE-marking, based on an attestation of conformity by a notified body. The smoke alarm shall comply with the EU-mandated European standard EN 14604, as well as meeting any relevant local applications standards and recommendations.

Smoke alarms for use in mobile homes should have an additional test and certification accordance Annex L of the EN 14604.

CO-detectors shall comply with the requirements of CEN standard EN 50 291: electrical apparatus for the detection of carbon monoxide premises.

#### 4.14 Replacement of the smoke alarms

A Finnish test campaign<sup>1</sup> has shown that the smoke sensitivity and sound volume of home detectors can be affected by age and environmental conditions. It has been shown that a poorly maintained, old or damaged home smoke alarm may not work in the event of a fire. In accordance with EN 14604, the manufacturer's recommended replacement date is indelibly marked on the device.

The lifetime of the device is generally estimated at 10 years (excluding batteries). It is strongly recommended that residential smoke detectors are replaced after 10 years of operation.

Used detectors must be taken to a waste disposal site and treated as electronic waste. Used ion detectors may never be disposed of with household waste!

### 5 Reference Publications

- The Directorate for Civil Protection and Emergency Planning (DSB): Smoke alarms – mounting and maintenance, (only in Norwegian).
- The Norwegian Fire Protection Ass.: The smoke alarm "Røykvarslere" (only in Norwegian).
- SINTEF Bygg og miljø, Norges branntekniske laboratorium: Røykvarslere for bruk i boliger (Smoke alarms for residential use). Only in Norwegian.
- EN 14604 Smoke alarms devices

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<sup>1</sup> Finnish Safety and Chemicals Agency (Tukes), <https://tukes.fi/etusivu>

- Ppalovaroitimien ikääntymisselvitys jatkohanke 2020: loppuraportti / Meurman Karoliina - Helsinki (FIN), Tukes, 2020 (Ageing on smoke alarms: follow-on project)

- Ageing study on smoke alarms final report 2018 / Meurman Karoliina - Helsinki (FIN), Tukes, 2018

**European guidelines***Fire*

- Guideline No 1 F - Internal fire protection control
- Guideline No 2 F - Panic & emergency exit devices
- Guideline No 3 F - Certification of thermographers
- Guideline No 4 F - Introduction to qualitative fire risk assessment
- Guideline No 5 F - Guidance signs, emergency lighting and general lighting
- Guideline No 6 F - Fire safety in care homes
- Guideline No 7 F - Safety distance between waste containers and buildings
- Guideline No 8 F - Preventing arson – information to young people
- Guideline No 9 F - Fire safety in restaurants
- Guideline No 10 F - Smoke alarms in the home
- Guideline No 11 F - Recommended numbers of fire protection trained staff
- Guideline No 12 F - Fire safety basics for hot work operatives
- Guideline No 13 F - Fire protection documentation
- Guideline No 14 F - Fire protection in information technology facilities
- Guideline No 15 F - Fire safety in guest harbours and marinas
- Guideline No 16 F - Fire protection in offices
- Guideline No 17 F - Fire safety in farm buildings
- Guideline No 18 F - Fire protection on chemical manufacturing sites
- Guideline No 19 F - Fire safety engineering concerning evacuation from buildings
- Guideline No 20 F - Fire safety in camping sites
- Guideline No 21 F - Fire prevention on construction sites
- Guideline No 22 F - Wind turbines – Fire protection guideline
- Guideline No 23 F - Securing the operational readiness of fire control system
- Guideline No 24 F - Fire safe homes
- Guideline No 25 F - Emergency plan
- Guideline No 26 F - withdrawn*
- Guideline No 27 F - Fire safety in apartment buildings
- Guideline No 28 F - Fire safety in laboratories
- Guideline No 29 F - Protection of paintings: transports, exhibition and storage
- Guideline No 30 F - Managing fire safety in historic buildings
- Guideline No 31 F - Protection against self-ignition and explosions in handling and storage of silage and fodder in farms
- Guideline No 32 F - Treatment and storage of waste and combustible secondary raw materials
- Guideline No 33 F - Evacuation of people with disabilities
- Guideline No 34 F - Fire safety measures with emergency power supply
- Guideline No 35 F - Fire safety in warehouses
- Guideline No 36 F - Fire prevention in large tents
- Guideline No 37 F - Photovoltaic systems: recommendations on loss prevention
- Guideline No 38 F - Fire safety recommendations for short-term rental accommodations
- Guideline No 37 F - Fire protection in schools
- Guideline No 38 F - Fire safety recommendations for short-term rental accommodations
- Guideline No 39 F - Fire protection in schools
- Guideline No 40 F - Procedure to certify CFPA-E Fire Safety Specialists in Building Design

*Natural hazards*

- Guideline No 1 N - Protection against flood

- Guideline No 2 N - Business resilience – An introduction to protecting your business
- Guideline No 3 N - Protection of buildings against wind damage
- Guideline No 4 N - Lighting protection
- Guideline No 5 N - Managing heavy snow loads on roofs
- Guideline No 6 N - Forest fires
- Guideline No 7 N - Demountable / Mobile flood protection systems

*Security*

- Guideline No 1 S - Arson document
- Guideline No 2 S - Protection of empty buildings
- Guideline No 3 S - Security systems for empty buildings
- Guideline No 4 S - Guidance on keyholder selections and duties
- Guideline No 5 S - Security guidelines for museums and showrooms
- Guideline No 6 S - Security guidelines emergency exit doors in non-residential premises
- Guideline No 7 S - Developing evacuation and salvage plans for works of art and heritage buildings
- Guideline No 8 S - Security in schools
- Guideline No 9 S - Recommendation for the control of metal theft
- Guideline No 10 S - Protection of business intelligence
- Guideline No 11 S - Cyber security for small and medium-sized enterprises





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