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Your first line of defence
in an uncertain world

smoke & heat alarms

a specifiers guide to regulations & standards

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Introduction

Kidde is committed to helping housing providers, specifiers and installers make the best use of its products, to ensure that homes are safe over the longer term.

About this Guide

We believe that, in an uncertain world, domestic smoke and heat alarms are the first line of defence against fire in homes. They can provide critical early warning for occupants at low costs, irrespective of other fire protection measures, and should be the first consideration in all types of housing – new or old.

This guide summarises and reviews recommendations for the provision of smoke and heat alarms, found in the Code of Practice BS 5839-6:2019 (which applies to all types of housing whether new or existing) and also current national Building Regulations guidance (where these are applicable), largely based on previous editions of the Code.

What alarms are included?

This document provides guidance on the use of smoke and heat alarms incorporating both detectors and sounders. Although other guidance focuses on fire detection, effective audibility of alarm sounders is equally important. Smoke alarms may be used on their own or interconnected with others and/or heat alarms to form a system that does not require central control. The guide does not apply to 'panel systems' made up of separate detectors and sounders with a central control.

Current context

Following the Grenfell Tower fire in June 2017, Dame Judith Hackitt's interim report on English Building Regulations and related guidance considers that: *"the whole system of regulation, covering what is written down and the way in which it is enacted in practice, …is not fit for purpose. The government should consider how the suite of Approved Documents could be structured and ordered to provide a more streamlined, holistic view while retaining the right level of relevant technical detail"*. But with Building Regulation changes in England still unresolved at the time of writing, what should be done in the meantime? As the report goes on to recommend, all those involved with housing should now take responsibility and rethink fire safety measures, rather than rely on prescribed regulations.

While this guide considers that the latest edition of the Code still offers the best available guidance on minimum safe standards in most situations, it does identify issues of concern. It also raises conflicts between the Code and Regulations guidance, notably Approved Document B (England and Wales). These issues and conflicts are highlighted as 'Talking points', helping specifiers to question guidance and make their own judgements.

Code of Practice BS 5839-6:2019

BS5839-6:2019 'Fire detection and fire alarm systems for buildings – Part 6: Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises' took effect from 1st May 2019 and replaces the 2013 version.

Standards such as the Code take the form of guidance and recommendations, and are not in themselves mandatory – although they may be referred to in specifications and used as a benchmark in many situations including legal proceedings. They often form the basis for Building Regulations requirements (such as Approved Document B) and also provide important guidance where Regulations do not apply (such as existing properties).

2019 Changes

Various amendments have been made to the new edition of the Code that do not need to be covered in this guide. However, important changes are focused on alarm system 'Grades' (the reliability of a system in terms of its power sources) and 'Categories' (in which areas smoke/heat alarms are required for detection), discussed on pages 5-6. Minimum recommended Grades and Categories for various types of housing are set out in Table 1 –the key part of the Code.

As recommended by Kidde, the 2019 Code also anticipates combined installations and a systematic approach to carbon monoxide and fire alarms in homes, as discussed on page 14. It states that: *"Mains powered CO alarms conforming to BS EN 50291 and installed in accordance with BS EN 50292 may also be interlinked with the fire detection and alarm system if the manufacturer of all the components makes such a recommendation"*.

Scope

The Code provides guidance for all housing and recommends that:

> a fire alarm system, as described in the Code, should be installed in **all new** and **existing dwellings**.

However, it does not propose the upgrading of existing systems installed in accordance with previous editions. The Code covers:

- single family dwellings, including purpose-built flats and maisonettes
- houses in multiple occupation (HMOs) consisting of self-contained units (but not hostels)
- sheltered housing (both individual units and common parts).

Code of Practice BS 5839-6:2019

Alarm Types and Applications

The Code of Practice reviews various types of detector/alarm units including the following most commonly used. Selection is generally determined by the type of fire anticipated, balanced against minimisation of nuisance alarms in different environments. Both types of smoke alarm can be used with flexibility to suit particular situations. Heat alarms have more specific applications and should not generally be used as alternatives to smoke alarms.

Optical (aka Photoelectric) Smoke Alarms

Optical smoke alarms are sensitive to larger particles from smouldering fires and less prone to nuisance alarms than ionisation alarms, especially from kitchens.

Typical applications:

Circulation areas generally, **Living Rooms** and **Bedrooms**.

Ionisation Smoke Alarms

Ionisation smoke alarms are sensitive to small smoke particles from rapidly burning, flaming fires but less so for smouldering fires and smoke that has travelled some distance. They are less prone to nuisance alarms from steam or dust than optical alarms.

Typical applications:

Living Rooms (particularly used by heavy smokers), **Circulation** close to poorly ventilated **bathrooms** and unconverted **Lofts.**

Heat Alarms

Heat Alarms respond more slowly to fires than smoke alarms but are less likely to give nuisance alarms and require less maintenance. They must always be interlinked with smoke alarms elsewhere in the property.

Typical applications:

Garages and all **Kitchens**

Code of Practice BS 5839-6:2019

BS 5839-6:2019 defines and discusses 'Grades' and 'Categories' of systems comprising smoke and heat alarms. These classifications are used to determine minimum recommendations in the BS and requirements in national Building Regulations. They should also be clearly stated on system certificates and Regulation, system design or insurance requirements.

Grades

Essentially, 'Grade' addresses the reliability of a system in terms of its power sources. Normally, alarms should be interconnected by wireless RF or by wiring. The 2019 Code now subdivides Grades D and F, as summarised below.

Grades	
Grades A-C	more complex systems (outside the scope of this guide)
Grade D1	mains-powered alarms, each with a tamper-proof standby battery*
Grade D2	mains-powered alarms, each with a "loose" user-replaceable standby battery
Grade E	mains smoke/heat alarms, no back-up power (now discounted from the Code)
Grade F1	battery-powered alarms each with a tamper-proof primary battery*
Grade F2	battery-powered alarms, each with a "loose" user-replaceable battery

*A 'tamper-proof battery' is defined as one that: *"is not designed to be removed…for example, cells soldered to a printed circuit board."*

Code of Practice BS 5839-6:2019

Categories

'Category' defines in which areas smoke/heat alarms are required for detection. It does not address the issue of audibility of the alarm for occupants, despite its importance. Although principally concerned with systems for the protection of life (Categories LD, covering 'Life' and 'Dwellings'), it also offers guidance on property protection (Categories PD) not covered here.

Although LD1 is the ideal, a good level of protection can generally be obtained using LD2.

Categories	
Category LD1	throughout the dwelling (but not sanitary accommodation)
Category LD2	all escape route circulation areas and any areas of high fire risk to occupants (such as Kitchens and Living Rooms)
Category LD3	all escape route circulation areas only

LD2 is now considered the **norm** for the majority of domestic properties

How to Apply Grades and Categories

BS 5839-6:2019 is based on an individual risk assessment approach although it recognises that, in most cases, its guidance can be applied as a minimum recommendation. Minimum recommended Grades and Categories for various types of housing are set out in Table 1: this is the key part of the Code.

Talking Point

Grades and Categories

The Code sets out the minimum Categories and Grades recommended for different types of housing in Table 1. This has been simplified in the 2019 edition with just two property type columns, covering 'existing' and 'new or materially altered' properties. The third, confusing column from the 2013 edition has been removed, at Kidde's instigation.

Table 1 applies where occupants or their characteristics are unknown (such as new housing) but it also sets the minimum for other housing. It may be modified to a higher standard resulting from a risk assessment (but not lower). If there is any doubt about the appropriate system, specialist advice should be sought and a risk assessment carried out.

Code of Practice BS 5839-6:2019

Minimum Protection

The minimum standards recommended by the Code applicable to most properties with no single floor over 200m^2 can generally be summarised as follows.

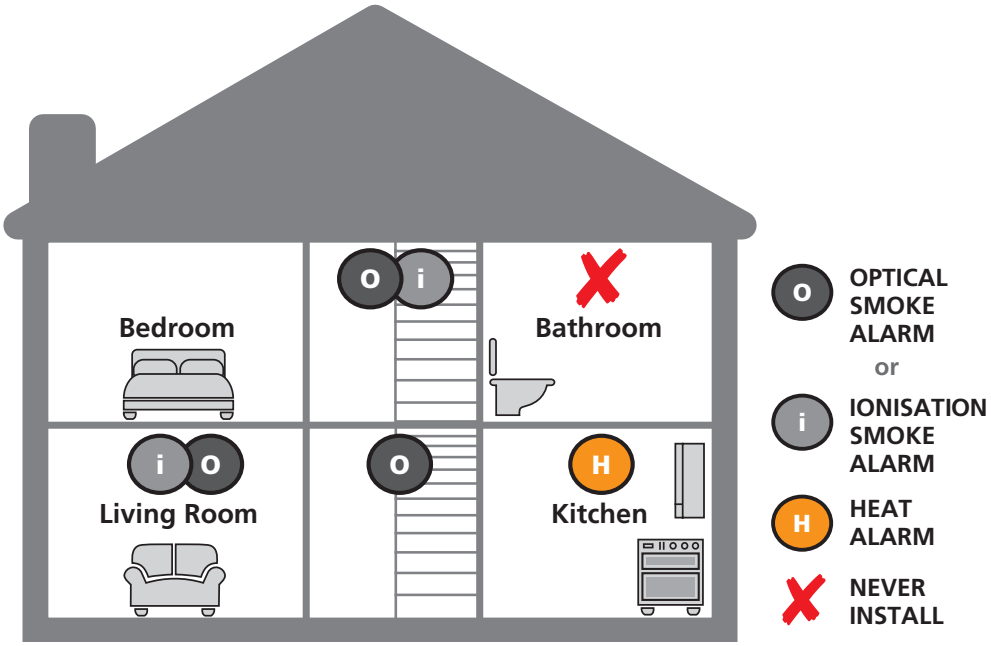
Minimum Grade

Grade D1 – all rented properties
Grade D2 – owner-occupied, new and 4-storey or more existing, or in place of Grade F2 during rewiring
Grade F1 – not mentioned in Table 1 but used in place of Grade F2 (if there is doubt about battery replacement, as noted in footnote E)
Grade F2 – owner-occupied existing properties, up to 3-storey

Minimum Category

For properties up to three storeys, **Category LD2** is generally recommended.

This means smoke alarms in living rooms, as well as escape routes, and also heat alarms in every kitchen. Category LD3 is not recommended in any new homes (although this conflicts with the current Approved Document B, discussed later) or in any rented properties, and will not be allowed at all in Scotland from February 2021.



Talking Point

Bedrooms

In contrast to I.S. 3218:2013, neither the BS 5839-6 Code nor any of the national Building Regulations guidelines include recommendations for alarms or sounders in bedrooms.

The essential issue of alarm audibility, enabling occupants to be awoken and alerted wherever they are in the property, is not fully addressed by much current guidance, as discussed later.

Irish Standard I.S. 3218:2013

I.S. 3218:2013, *'Fire detection and alarm systems for buildings - System design, installation, commissioning, servicing and maintenance'* – Section 10 covers domestic systems and refers substantially to the BS 5839-6 Code. However, it differs by recommending applying only Category LD1 or LD2 (not Category LD3, discussed later) to a Grade D system. It also includes smoke alarms inside *"all bedrooms"* within its definition of Category LD2.

Talking Point

Flats

Therefore, a common fire alarm system that interlinks all dwellings and communal spaces is not recommended by the Code. This is confirmed by the LGA's *'Fire safety in purpose-built blocks of flats'* which also recommends against dedicated alarm systems in communal areas.

This approach will inevitably be reviewed following the Grenfell Tower and other residential block fires. Relying on assumed fire-safe construction to reduce or eliminate alarm provision is a serious mistake.

Flats and Maisonettes

Purpose-built flats and maisonettes are designed as compartments so that fire can be contained within the dwelling of origin for a prolonged period. This has been used to justify a 'stay put' policy whereby only occupants of the affected flat need evacuate.

Where to install within the Room

For all Categories, there should be:

- smoke alarms in every circulation space on each storey
- not more than 3m from every bedroom door to a smoke alarm
- no point within the circulation space should be more than 7.5m from the nearest smoke alarm
- a smoke alarm between every bedroom and every other room (excluding sanitary accommodation)
- on the ground floor of a multi-storey house, a smoke alarm between each staircase and every other room (excluding sanitary accommodation).

Where relevant for Categories LD1 and LD2, within rooms:

- no point should be more than 7.5m from a smoke alarm
- no point should more than 5.3m from a heat alarm.

Smoke and heat alarms should preferably be ceiling-mounted at least 300mm (horizontally) from walls or light fittings, and away from heaters and vents, but accessible for maintenance. The Code offers additional guidance covering sloping ceilings, beams and wall-mounting.

Power Supply

Hard-wired mains smoke and heat alarms can be powered via an independent circuit at the premises' main distribution board or a regularly used local lighting circuit.

Information Requirements

All specifications, statutory requirements by enforcing authorities, instructions and the relevant system certificate from the installer should clearly state:

- The Grade of System
- The Category of System
- For Category LD2, the rooms in which alarms should be located.

National Building Regulations

Mandatory for new buildings, extensions, changes of use and some alterations

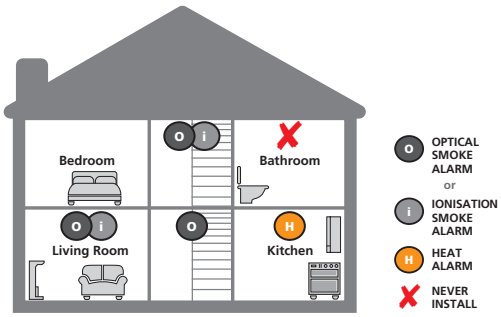
Different Regulations apply in England, Wales, Scotland, Northern Ireland and, of course, the Republic of Ireland. The Regulations themselves are non-specific but, to assist with compliance, approved documents provide more specific solutions as a minimum requirement. However, alternatives to approved documents can be adopted if approved by Building Control Officers.

The approved documents are not suitable guidance for smoke and heat alarms in existing properties where Building Regulations do not apply. As BS 5839-6 makes clear, a **higher** level of protection from smoke and heat alarms may be needed in existing homes to take into account older building fabric. Building Regulation guidelines refer to previous editions of the BS 5839-6 Code of Practice, repeating much of its recommendations. Generally, they are consistent in all requiring a **Grade D** system. Differences appear with the number, type and locations of alarms – identified here – and other details.

Scotland

Domestic Technical Handbook

The following minimum requirements apply to all houses, except sheltered housing with central control equipment (Grade C). The Handbook discusses use of different smoke alarm types for various situations, including ionisation alarms as an alternative to optical alarms close to bathrooms or in living rooms for heavy smokers.



Grade D system (interconnected mains alarms with back-up) and based on **Category LD2**:

smoke alarm in every circulation space on each storey, not more than 7m from the door to a living room or kitchen, or 3m from every bedroom door. No point within the circulation space should be more than 7.5m from the nearest smoke alarm

smoke alarm in the principal habitable room (most frequently used room by the occupants for general daytime living purposes) with no point more than 7.5m from an alarm

heat alarm in every kitchen with no point more than 5.3m from an alarm

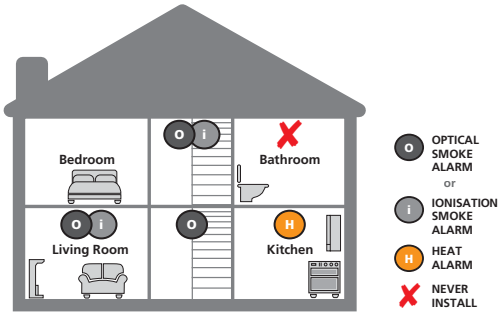
in addition to the Code, smoke alarm in every access room serving an inner room, no more than 3m from the door of the inner room.

National Building Regulations

Northern Ireland

Technical Booklet E

The following minimum requirements apply to houses, other than to larger, 2 or more storey houses (with any storey exceeding 200m^2 requiring Grade A or B systems, outside the scope of this document).



Grade D system (interconnected mains alarms with back-up) and based on **Category LD2**:

smoke alarm in every circulation space on each storey, not more than 7.5m from the door to a living room or kitchen, or 3m from every bedroom door, or 15m from another smoke alarm in that circulation space

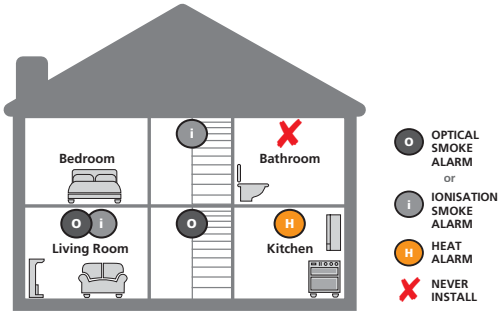
smoke alarm in the principal habitable room with no point more than 7.5m from an alarm

heat alarm in every kitchen with no point more than 5.3m from an alarm.

Republic of Ireland

Technical Guidance Document B

Document B refers substantially to the BS 5839-6 Code of Practice and suggests that adhering to its detailed recommendations will provide compliance. The following minimum requirements apply to houses and individual flats with up to three storeys above ground level.



Grade D system (interconnected mains alarms with back-up) and **Category LD2** (including detailed position recommendations):

smoke alarm in every circulation space on each storey, not more than 7.5m from the door to a habitable room

smoke alarm in any high risk room, such as a living room, and a heat alarm in every kitchen.

However, this interpretation of Category LD2 conflicts with Irish Standard I.S. 3218:2013 which, as discussed earlier) includes smoke alarms in all bedrooms. Document B also proposes that: *"dwelling houses with more than three storeys, large houses, or where the fire risk so warrants, should be provided with LD1 systems"*. This differs from the recommendations of BS 5839-6.

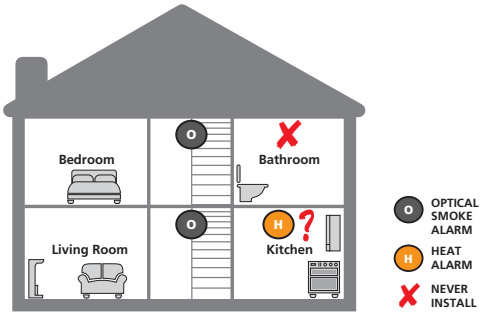
In addition to the above minimum requirements, Category LD1 includes smoke alarms in all habitable rooms including bedrooms, and also attics.

National Building Regulations

England and Wales

Approved Document B

The following minimum requirements apply to houses, other than to larger, 2 or more storey houses (with any storey exceeding 200m^2 requiring Grade A or B systems, outside the scope of this document). They also apply to individual flats (in Approved Document B, Volume 2). The Approved Documents have been amended in Wales to include requirements for automatic fire suppression systems in residential buildings.



Grade D system (interconnected mains alarms with back-up)

Category LD3 with smoke alarms in circulation spaces within 7.5m of every habitable room door and at least one on each floor

plus a heat alarm where the kitchen is not separated from the stairway or circulation by a door.

The need for Heat Alarms

Over 60% of domestic fires start in kitchens. Despite this, and contrasting with BS 5839-6, the current Approved Document B only requires heat alarms in some kitchens, open to circulation areas as part of the policy of protecting escape routes only. Adopting this approach is pure folly and heat alarms should be a priority in all homes. Importantly, heat alarms must be interconnected with smoke alarms elsewhere in the property so that all the alarms sound as soon as one is triggered.

Talking Point

Living Rooms

As the Code stresses, with Category LD3 the evacuation time once fire is detected in the escape route *"might not prevent death or serious injury of occupants of the room where fire originates"*. Also, the Scottish Technical Standards point out that: *"a significant number of fire related deaths (62%), occur from fires started in living rooms and kitchens."*

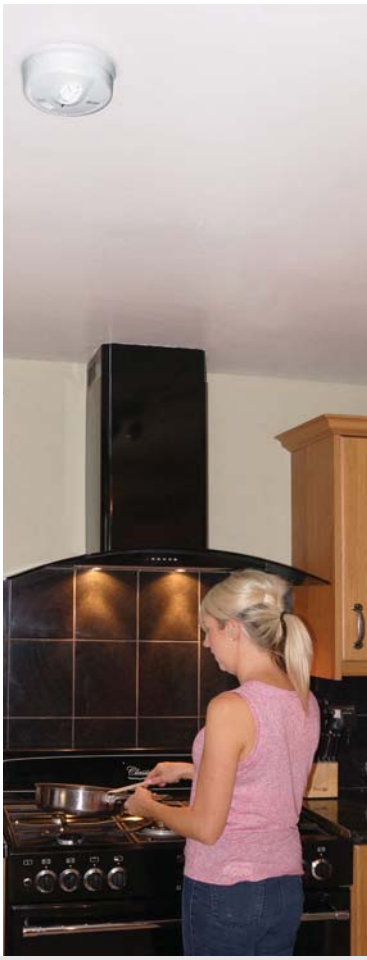
Smoke alarms in living rooms are an important consideration for all types of housing and their omission to make small financial savings to be avoided.

Talking Point

Kitchens

It has been argued that occupants are active in the room and generally become quickly aware of any fire. While some kitchen fires are started accidentally by occupants, other less obvious sources can go unnoticed – notably faulty electrical appliances. This is a particularly dangerous situation with appliances operating at night on low tariff electricity while occupants sleep.

Heat alarms are essential in all kitchens and utility rooms.



Existing Housing

Talking Point

Rental Properties

The English private rental regulations conflict with BS 5839-6 recommendations that no rented properties should have a battery-only (Grade F1/2) alarm system and even fall below Approved Document B requirements.

All landlords should adopt BS 5839-6 as a minimum benchmark.

As we have seen, mandatory Building Regulations apply to new buildings, extensions, changes of use and some alterations. Generally, they require Grade D1/2 mains-powered (with back-up) interconnected smoke and heat alarms. It is worth noting that any subsequent changes to properties with alarms installed under Building Regulations – for example when replacing time-expired alarms – should not reduce the alarm provision. Otherwise, further consent would be required for a 'material change' and, probably, refused.

Private Rented Properties

Increasingly, national regulatory requirements are also being applied to other existing properties, notably privately rented. For example, existing private rented properties in England are subject to the 2015 'Smoke and Carbon Monoxide Alarm (England) Regulations', which call just for a smoke alarm on each floor without specifying the number, location or type of alarms. Therefore, a single, battery-only alarm on each floor would comply – an unacceptable situation.

A Fresh Approach

Following the Grenfell Tower fire, the Scottish Government brought forward its consultation on fire and smoke alarms, as well as CO alarms, in housing. The result is a major change to the 'Tolerable Standard' for all housing tenures, taking effect from February 2021. In essence, the minimum safety standards currently in place for private rented properties will be extended to all other tenures, including social housing, and owner-occupied homes.

These requirements are based on the BS 5839-6 Code of Practice, 'Category LD2' level of protection, mirroring Scottish Building Regulations for new-builds, changes of use and extensions. This means a system of interconnected smoke and heat alarms, including smoke alarms in principal living rooms and heat alarms in kitchens, as well as smoke alarms in circulation areas on each storey.

In addition, CO alarms will also be required in all homes with combustion appliances. The Scottish proposals consider that: *"it makes practical sense to combine installation programmes for … smoke alarms and carbon monoxide alarms together"*. This enlightened approach is explored further on page 14.

Audibility to Alert Occupants

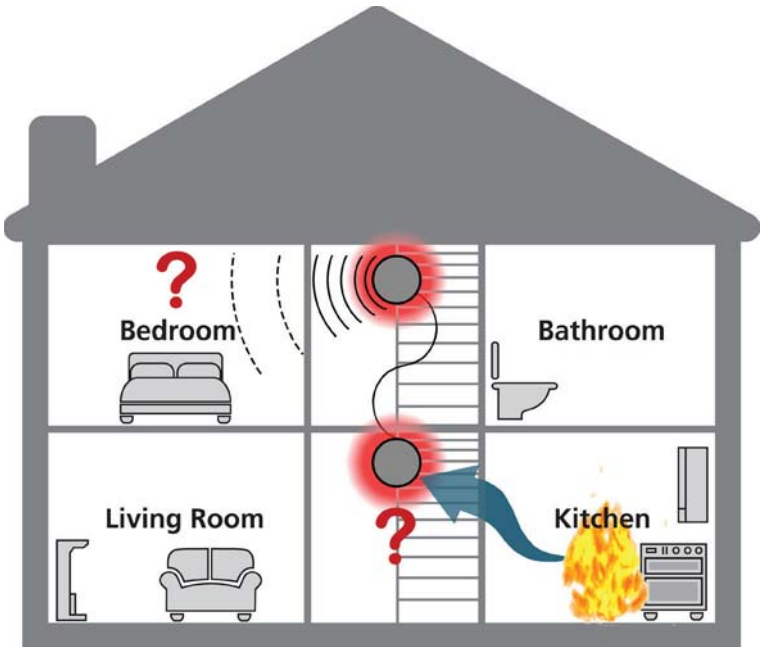
Talking Point

Although the Code recognises that the required sound level cannot be achieved, it then dismisses the need for alarms or sounders in bedrooms, justified by an assertion that: 'There appears to be no evidence to show that lives are being lost…'.

This reactive justification of a recommendation that fails to meet another standard should be challenged.

A system of interconnected smoke and heat alarms provides early warning of fire at low cost – an essential first line of defence. To make this effective, occupants (and therefore also the fire and rescue services when called) need to be alerted to fires as soon as possible and at an earlier stage in fire development, reducing risk of injuries, deaths and property damage.

At the heart of the matter is the humble internal door which, when closed, reduces the passage of smoke through to the other side and delays triggering a smoke alarm there. Similarly, it also reduces the passage of sound from an alarm, limiting the ability of occupants on the other side of the closed door to hear it.

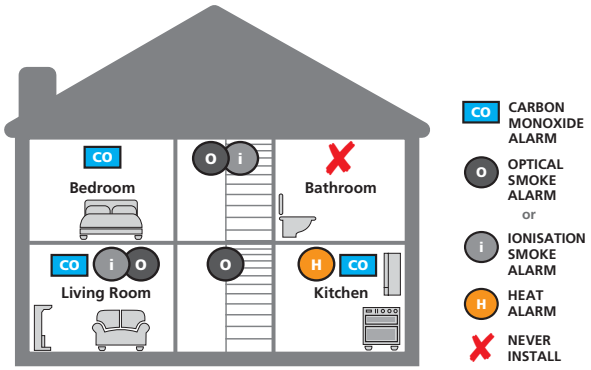


BS 5839-6:2019 does acknowledge that there is a substantial reduction in sound level resulting from closed doors which might prevent sleeping occupants being awoken. Sound reductions could be at least 20dB at the bedhead from a landing-located alarm generating 85dB, despite BS 5839 Part 1 recommending at least 75dB at the bedhead which, clearly, cannot be achieved. This sound reduction could well be more with modern doorsets, fire doors, or smoke seals.

More attention should be paid to the positioning of alarms for audibility, as well as early detection of fire or carbon monoxide – something that current standards and guidelines fail to address properly. Combining smoke, heat and CO alarms can provide more coverage cost-effectively, ensuring that occupiers are awoken and alerted wherever they are in the property, whatever the risk.

Smart Solutions

Smart Interconnection

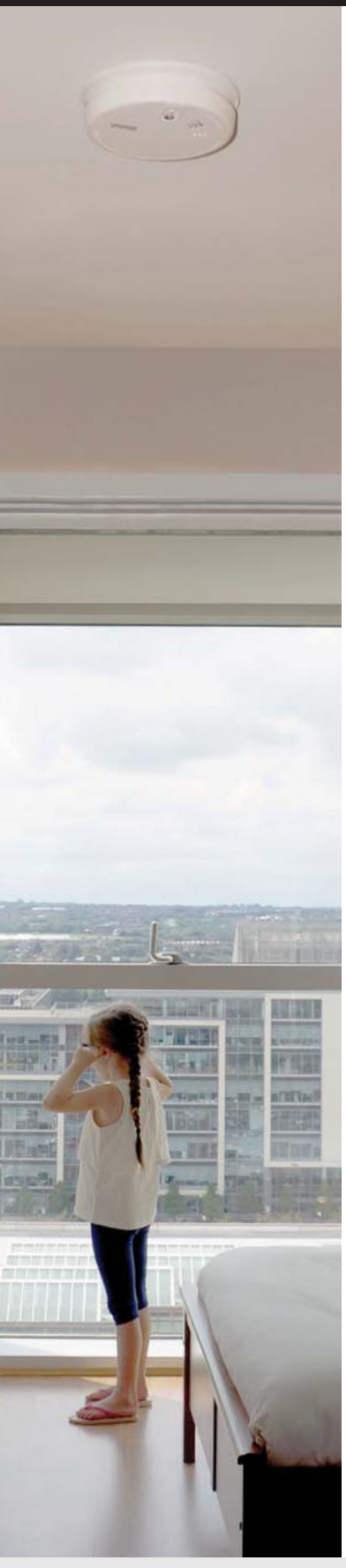


Opportunities to provide low cost, effective whole-home protection are available with some hard-wired mains CO alarms that not only interlink with each other but also with compatible smoke and heat alarms. CO alarms are a legal requirement in some situations and a sensible precaution against carbon monoxide poisoning in any home. As recommended by Kidde, the 2019 edition of the Code now recognizes facilities such as Smart Interconnect, stating that: *"Mains powered CO alarms conforming to BS EN 50291 and installed in accordance with BS EN 50292 may also be interlinked with the fire detection and alarm system if the manufacturer of all the components makes such a recommendation"*.

Here, all the interconnected alarms can act as sounders to alert of either risk, forming comprehensive systems. Crucially, the alarms must have different, distinct alarm sounder patterns for carbon monoxide and fire, as required by BS 5839-6. Some also display alternative warning messages on digital models. System design is based around positioning smoke and heat alarms for fire detection (in accordance with the Code) and CO alarms (in accordance with BS EN 50292:2013), then addressing audibility needs with additional alarms where required to provide whole-home protection.

Automatically Identifying the Hazard

Such systems can therefore automatically alert occupants of the specific hazard that confronts them, without panel control, switches or other additional hardware. They allow occupants to respond quickly, making the right choice from the very different alternative actions for either fire or carbon monoxide. This is a particularly useful solution to the issue of alarm audibility in bedrooms, discussed on page 7.



Moving Forward

Clearly, the reactive stance of the Code and Building Regulation guidelines – particularly Approved Document B – should be challenged and a unified approach taken for all housing, notably addressing audibility issues.

In the meantime, housing providers, specifiers and installers should take a proactive approach and treat current guidelines as an absolute minimum base to work up from, bearing in mind that:

- relying on assumed fire-safe construction to reduce or eliminate alarm provision is a serious mistake
- smoke alarms or sounders should be a consideration in the main, or ideally all bedrooms
- smoke alarms in living rooms are important
- heat alarms are essential in all kitchens and utility rooms.

As a straightforward, low-cost, early warning, wider installation of smoke and heat alarms should be considered as an essential first step for fire safety, whatever other measure are taken, to make all housing safer.

About Kidde

Kidde Safety Europe is one of the world's leading manufacturers of smoke, heat and carbon monoxide alarms – recently marking a century of working in fire detection and suppression, equipping fire brigades, aviation, the military and industry. The Kidde Company was founded in 1917 and has grown from a small, family-run business to today's multi-national company.

As a member of the United Technologies Corporation (UTC), Kidde sits alongside iconic brands such as Chubb fire and security systems, Carrier heating and air conditioning, Collins Aerospace, Otis elevators and escalators, Pratt & Whitney aircraft engines and UTC Power fuel cells.

The company offers an extensive choice of smoke, heat and carbon monoxide alarm ranges, accessories and other safety products for all types of housing.

Continuing Professional Development

To request an accredited CPD presentation on carbon monoxide alarms or smoke and heat alarms in housing, email: **cpd@kiddesafety.co.uk**. An additional 'Specifiers Guide' to carbon monoxide alarms is also available at **kiddesafetyeurope.co.uk**.

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