



# FIRE ALARMS IN DWELLINGS

By John Ware

**IN THE UK** around 80% of all fire deaths and injuries occur in dwellings, a total of 450 to 500 deaths and 14,000 injuries per annum, according to BS 5839-6: 2004.

The installation of a fire detection and alarm system can significantly reduce the risk of death or serious injury from fire. The fatality rate in fires in dwellings is three times higher where there is no smoke detector or where it is not working compared to dwellings where a fully functioning smoke detector is fitted. The installation of automatic smoke detectors is, effectively, required in new dwellings to satisfy Building Regulations.

## **BUILDING REGULATIONS**

Approved Document B of the Building Regulations (2000), Fire Safety, deals with the following Requirement from Part B of schedule 1 to the Building Regulations 2000.

### **Means of warning and escape**

**B1.** The building shall be designed and constructed so that there are appropriate provisions for the early warning of fire, and appropriate means of escape in case of fire from the building to a place of safety outside the building capable of being safely and effectively used at all material times.

Approved Document B states, in paragraph 1.2 that in most houses the installation of smoke alarms or automatic fire detection and alarm systems, can significantly increase the level of safety by automatically giving an early warning of fire. The document also states, in paragraph 1.3, that if houses are not protected by an automatic fire detection and alarm system in accordance with the relevant recommendations of BS 5839: Part 1 *Fire detection and alarm systems for buildings, Code of practice for*

*system design, installation and servicing* to at least an L3 standard, or BS 5839: Part 6 *Code of practice for the design and installation of fire detection and alarm systems in dwellings* to at least a Grade E type LD3 standard, they should be provided with a suitable number of smoke alarms installed in accordance with the guidance in paragraphs 1.4 to 1.22 of the Approved Document.

Approved Document B can be downloaded free of charge from the Building Regulations section of the website of the Office of the Deputy Prime Minister at [www.odpm.gov.uk](http://www.odpm.gov.uk)

## **BS 5839-6: 2004**

Electrical designers and contractors with responsibilities for design, installation or maintenance of fire alarm systems in dwellings should be aware of the recommendations given in BS 5839-6: 2004 *Fire detection and fire alarm systems for buildings – Part 6: Code of practice for the design, installation, and maintenance of fire detection and fire alarm systems in dwellings* and should obtain a copy of BS 5839-6 from BSI at 389 Chiswick High Road, London W4 4AL Tel: 0208 996 9000, [www.bsi-global.com](http://www.bsi-global.com). The recommendations given in BS 5839-6 applicable to houses, bungalows and flats are discussed in this article.

## **Grades of system**

The Grades of system for fire alarm systems in dwellings range from Grade A to Grade F. Grade A and B systems are systems of a type described in BS 5839-1. In a Grade C system, the fire detectors are supplied with a common power supply unit with central control equipment and this type of system normally incorporates a secondary rechargeable battery. Fire alarm systems in dwellings are, in most cases, Grade D, E or F which do not employ a control panel.

Grade	Description and explanation
D	<p>A system of one or more mains-powered smoke alarms, each with an integral standby supply. The system may, in addition, incorporate one or more mains-powered heat alarms, each with an integral standby supply.</p> <p>One or more batteries or capacitors is provided to ensure protection is available under loss of mains conditions.</p>
E	<p>A system of one or more mains-powered smoke alarms with no standby supply. The system may, in addition, incorporate one or more heat alarms, with or without standby supplies.</p> <p>The system is potentially more reliable than a Grade F system, because it requires less attention by the user. The cost of the system is higher as a mains supply and interlinking cables are required and the detectors themselves cost slightly more.</p> <p>Loss of mains results in loss of protection.</p>
F	<p>A system of one or more battery-powered smoke alarms. The system may, in addition, incorporate one or more battery-powered heat alarms.</p> <p>Grade F systems are the simplest form of fire detection and alarm system, are low cost and relatively simple to install. Smoke alarms to BS 5446-1 and heat alarms to BS 5446-2 give a low battery warning.</p> <p>A disadvantage of a Grade F system is that removal of the battery disables the protection.</p>

**Categories of system**

Fire alarm systems are usually installed in dwellings to protect life (L) but may also be installed to protect property (P). Fire alarm systems are divided into the following categories:

Grade	Description and explanation
LD  Objective of category L systems is the protection of life (D means dwelling)	LD1 A system installed throughout the dwelling incorporating detectors in all circulation spaces that form part of the escape routes from the dwelling, and in all rooms and areas in which fire might start, other than toilets, bathrooms and shower rooms
	LD2 A system incorporating detectors in all circulation spaces that form part of the escape routes from the dwelling, and in all rooms or areas that present a high fire risk to occupants
	LD3 A system incorporating detectors in all circulation spaces that form part of the escape routes from the dwelling
PD	PD1 A system installed throughout the dwelling incorporating detectors in all areas in which fire might start other than toilets, bath and shower rooms
	PD2 A system incorporating detectors only in defined rooms or areas of the dwelling in which the risk of fire to property is judged to warrant their provision

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The Category of system needs to be defined in the specification and, except for Category LD1 or PD1 systems, the details of the areas of the building to be protected. Statutory requirements imposed by enforcing authorities and any requirements imposed by property insurers should state the Category of system required.

The minimum Grade and Category of fire detection and alarm system for protection of life in typical dwellings is given in the Table below (Part of Table 1 of BS 5839-6. Refer to BS 5839 for full details)

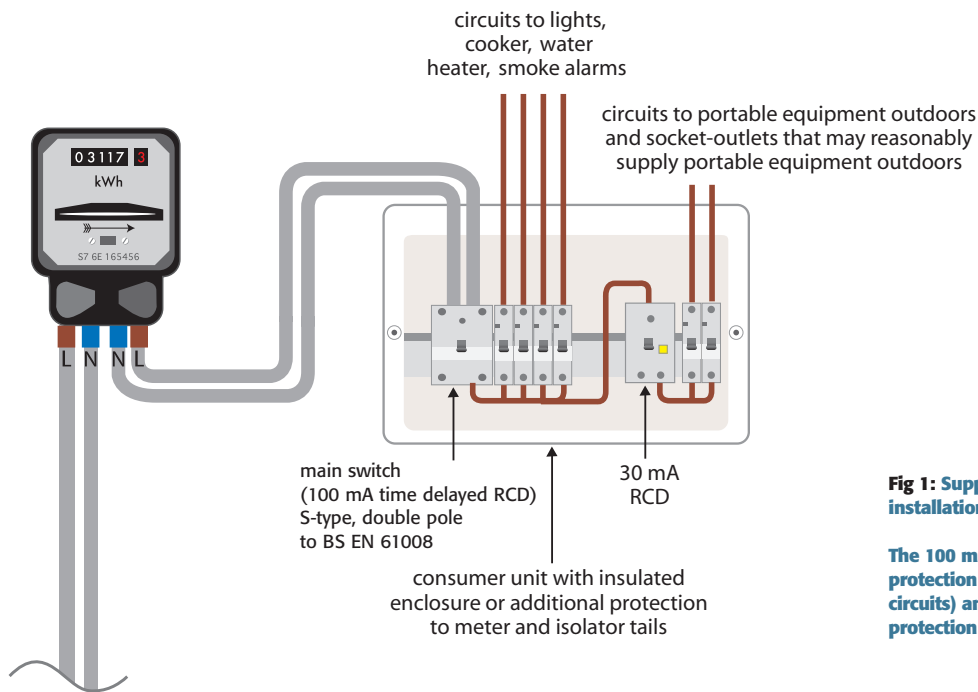
Class of dwelling	Minimum Grade and Category of system to be installed					
	New or materially altered dwelling complying with the recommendations of BS 5588-1 <sup>(a)</sup>		New or materially altered dwelling complying with the recommendations of BS 5588-1 <sup>(a)</sup>		Existing dwelling where the structural fire precautions are of a lower standard than the recommendations of BS 5588-1 <sup>(a)</sup>	
<b>Single family dwelling with no floor area greater than 200 m<sup>2</sup> in area</b>						
Bungalow, flat, or owner-occupied maisonette or 2-storey house	Grade	Category	Grade	Category	Grade	Category
	D	LD2	F <sup>(b)</sup>	LD3	D	LD2
Rented maisonette or 2-storey house	D	LD2	D	LD3	D	LD2
3-storey house	D	LD2	D	LD3	D	LD2
4 or more storey house	B	LD2	D	LD2	B	LD2
<b>Single family dwelling with one or more floors greater than 200 m<sup>2</sup> in area</b>						
Bungalow or flat	D	LD2	D	LD3	D	LD2
Maisonette or 2-storey house	B	LD2	B	LD2	B	LD2
Three (or more) storey house	Grade A Category LD2. Refer to BS 5839-6 for full details					

<sup>(a)</sup> Or guidance that supports national building regulations. For England and Wales see Approved Document B. BS 5588 is entitled Fire precautions in the design, construction and use of buildings  
<sup>(b)</sup> A Grade E system should be fitted if there is any doubt as to whether the occupier will replace batteries. But a Grade D system should be fitted if the electricity supply might be disconnected because the occupier cannot pay for the supply. Batteries in smoke alarms in rented bungalows or flats should have a life of at least 5 years (with normal use) and removal should necessitate a tool.

**Installation of fire alarm systems**  
**Power supplies**

Smoke and heat alarms that are to be

System	Power supply recommendations
Grade D	The mains supply to smoke and heat alarms should either be a single independent circuit from the dwelling's main distribution board or a separately electrically-protected regularly used local lighting circuit.
Grade E	The mains supply to smoke and heat alarms should be a single dedicated independent circuit from the dwelling's main distribution board.  Smoke and heat alarms should be interconnected and, in this case, must be supplied from the same circuit.  The circuit supplying the smoke and heat alarms should preferably not be protected by an RCD unless one is required for reasons of electrical safety, then either the RCD should serve only the circuit supplying the smoke or heat alarms or the RCD protection of the fire alarm system should operate independently of any RCD protection for circuits supplying socket-outlets or portable equipment.
Grade F	The batteries of smoke alarms and any heat alarms should be capable of supplying the normal load, including the additional load from routine weekly testing for at least one year before the battery fault warning is given.  At the point at which the battery fault warning commences, the batteries should have sufficient capacity to give a fire alarm warning signal for at least 4 minutes or, in the absence of a fire, a battery fault warning for at least 30 days.



**Fig 1: Supply to a Grade E system where the installation forms part of a TT system.**

**The 100 mA time-delayed RCD provides protection for the fire alarm system (and other circuits) and operates independently of the RCD protection for the socket-outlets**

interconnected by wiring should be connected on a single final circuit. Note that certain alarms are radio linked and such alarms need not be on the same final circuit

**Wiring systems**

All cables should be selected and installed in accordance with the requirements of BS 7671 and the recommendations of BS 5839-6. Additional recommendations include:

System	Wiring system recommendations
Grade D and Grade E	<p>Cables used for the mains supply to smoke alarms, any heat alarms and any interconnecting wiring may comprise any cable suitable for domestic mains wiring</p> <p>Cables used for interconnecting smoke and heat alarms should be readily distinguishable from those supplying power, (for example by red colour coding). Such cables need not be fire resistant.</p> <p>Cables used for unmonitored circuits should be protected against damage</p>
Grade F	<p>Cables suitable for the voltage or current is suitable.</p> <p>Cables used for unmonitored circuits should be protected against damage</p>

**Installation**

Figs 2 to 4 (overleaf) illustrate the recommendations given in BS 5839-6 for new houses, bungalows and flats where each floor area is not greater than 200 m<sup>2</sup>. Heat detectors should be installed in every kitchen and principle habitable room. Alternatively, the detector in the principle habitable room, but not the kitchen, may be a smoke or carbon monoxide fire detector. Smoke detectors should be installed in halls and landings.

The installation of the fire alarm system should comply with the requirements of BS 7671. Additional recommendations include:

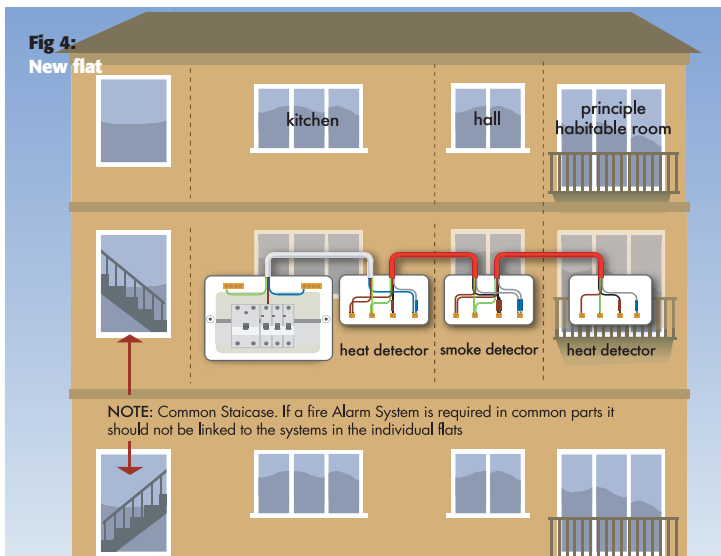
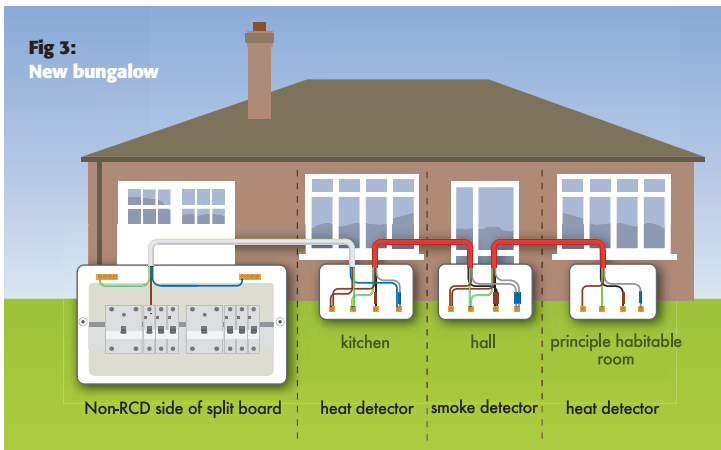
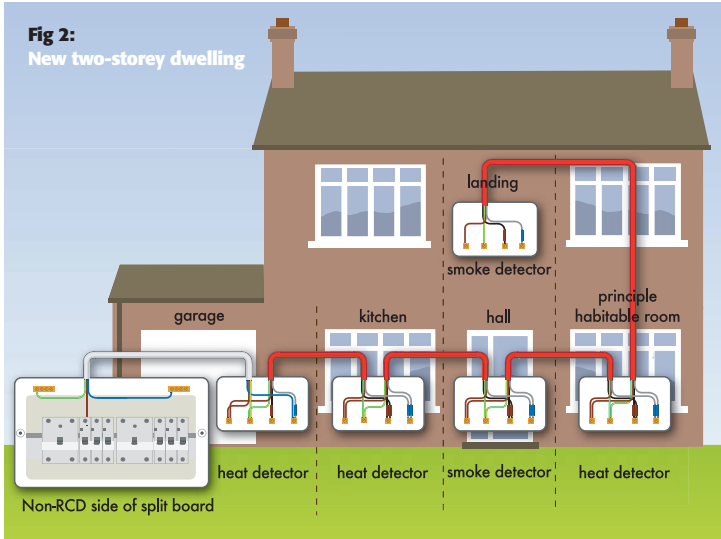
- Sounders should be rigidly fixed to permanent construction. Wiring between detectors should be installed and routed so that mechanical damage is avoided.
- The installer should provide as-fitted drawings.

**Commissioning**

The system should be inspected.

Electrical tests made to the mains supply circuit should include earth continuity, polarity, and earth fault loop impedance. Insulation tests should be made of all installed cables as required by BS 7671.

Electronic equipment should be disconnected to avoid damage.



The entire system should be tested to ensure that it operates satisfactorily and that, in particular, automatic fire detectors and any manual call points function correctly when tested. Smoke detectors should be smoke tested with a simulated smoke aerosol that will not damage the detector. Heat detectors should be tested by means of a suitable heat source unless detector damage would otherwise result. The heat source should not have the ability to cause a fire. A live flame should not be used.

It should be established that any interlinking works and that sounders operate correctly.

Manufacturer's tests should be carried out.

**Certification**

A certificate should have been issued to the user and this should be available for inspection. For Grade F systems a certificate should be issued if installed by a professional installer.

**User instructions**

The supplier of the fire alarm system should provide the user with operating instructions, which should be sufficient to enable a lay person to understand, operate and maintain the system. Silencing and disablement facilities should be explained but it should be stressed that system readiness must not be compromised. Recommended action in the event of a fire must stress the importance of all occupants leaving the building as quickly as possible and that the fire service is summoned immediately regardless of the size of the fire.

**Routine testing and maintenance**

Instructions to users must stress the importance of routine testing. The system should be tested weekly by pushing the test button. If the dwelling has been unoccupied for a period during which the supply (ies) could have failed, the occupier should check that the system has not suffered total power failure and is still operable.

**Maintenance**

Smoke alarms in Grade D, E and F systems should be cleaned periodically in accordance with the manufacturer's instructions. Where experience shows that undue deposits of dust and dirt are likely to accumulate, so affecting the performance of the system before detectors are cleaned or changed, more frequent cleaning or changing should be carried out. ■