Argyll and Bute Council
CPD
February 2016

Loft Conversions and Domestic Extensions: Part 1: Introduction

Dr Bill Hay

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Why are Building Standards relating to fire important when dealing with domestic buildings?

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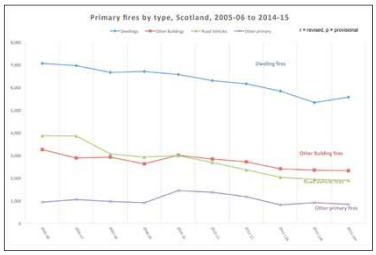
- Scottish Fire and Rescue Service attended 10,629 primary fires in 2014-15.
- 52 per cent were in dwellings (5,571).



(SFRS,2015)

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Casualties & Fatalities

41 fatal fire casualties in 2014-15

31 of 41 were in dwelling fires(approx 76%),
4 were in other building fires,
1 in a road vehicle
5 were 'Other' fires.

947 of 1,098 non-fatal fire casualties in 2014-15 occurred in dwelling fires (86%).

(SFRS, 2015)

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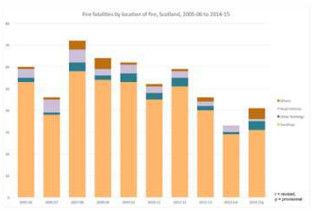

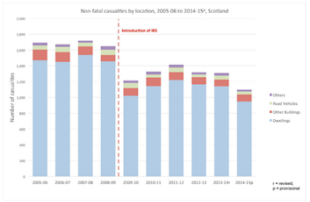

(SFRS, 2015).

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Table 1
Number of fatal fires and deaths recorded in the RFL, 1996–2000 by the purpose group type of the property in which they occurred

Purpose group title	Number of fatal fires	Number of fire deaths
Residential—dwellings	322	358
Mobile property	19	19
Outdoor and other property	18	18
Residential—institutional	5	5
Shop and commercial	3	4
Residential other	4	4
Assembly and recreation	4	4
Storage and other	3	3
Industrial	1	1
Car parks	1	1
Not specified	1	1
All	381	418

$\frac{358}{418}$x100~86%

(Holborna, Nolana & Golt, 2003)

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2007 USA - home fires causing 84% of fire deaths and 77% of the injuries

(NFPA, 2009)

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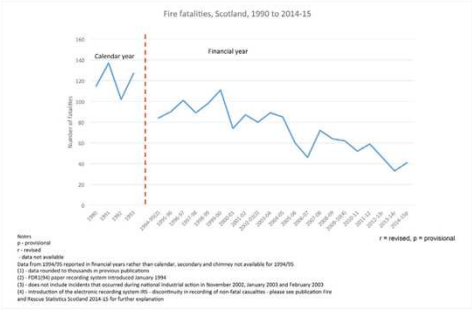

(SFRS, 2015).

Will this downward trend be sustained ?

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Table A: Top ten sources of ignition in accidental dwelling fires, 2013-14, Scotland

Source of ignition	Number [p]	Percentage
Cooking appliance - Cooker incl. oven	1,836	39 per cent
Cooking appliance - Grill/Toaster	444	9 per cent
Electricity supply - Wiring, cabling, plugs	378	8 per cent
Smoking related - Smoking materials	328	7 per cent
Cooking appliance - Ring/hot plate (separate appliance)	306	7 per cent
Cooking appliance - Microwave oven	204	4 per cent
Not known/other	169	4 per cent
Heating equipment - Heating/Fire	117	2 per cent
Candles	99	2 per cent
Other domestic style appliance – Washing machine	82	2 per cent

p-provisional

(The Scottish Government, 2014).

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The occupant characteristics in dwellings are wide ranging and therefore impossible to quantify in building standards. The guidance in the Handbooks assumes that the occupants are capable of moving or being moved to a place of safety.

(BSD, 2015)

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Sequence of events
Early stages

notice cues - ambiguous, often hearing noises, smell

misinterpret , or ignore , or discuss with anyone present.

variation from this initial group of actions is if smoke or the fire is encountered directly.

If cues persist

investigate to find the source of the noise or smell.

both males and females tend to misinterpret ambiguous cues

males more likely to do so and delay investigation. The response of a female may be delayed by interaction with a male if present.

eventually one of them initiates investigative activity. Both males and females are likely to investigate.

(Canter,1996)

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leads to encountering smoke

variability in the likely response sequence

fire dynamics

difference in the roles

men/women, occupant/neighbours.

within the room of fire origin

Outwith the room of fire origin if the smoke is spreading.

people are still likely to enter the room where the fire is.

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If informed by someone who has returned to say there is a fire, the tendency is to check this information for oneself.
This may be more likely if males initially receive a warning from females than vice versa.

Tendency to continue investigation after being informed, is particularly characteristic of domestic as opposed to other building/occupancy types.

Apparently related to the role of the individual in his/her own home and the proximity of a fire.
More responsibility may be felt for the safety of others who are likely to be present and for the prevention of damage.

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Females
more likely to warn others and wait for further instruction (for example, if husband and wife are both present).
Alternatively they will close the door to the room of fire origin and leave the house.
More likely to seek assistance from neighbours

Males
Male occupants are most likely to attempt to fight the fire.
Male neighbours are more likely to search for people in smoke and attempt a rescue

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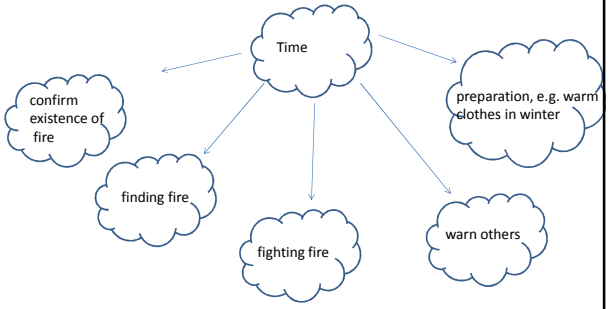
Human Behaviour in domestic fires.



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(Proulx, Cavan and Tonikian, 2006)

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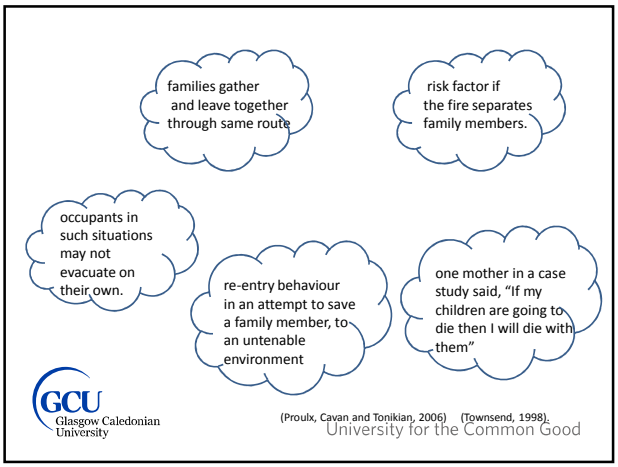

Common risk factors identified in the unintentional dwelling fire fatalities

- Alcohol

(Holborna, Nolana & Golt, 2003)

Scottish Community Fire Safety Study Fatal Fire Survey 2009

Cause	*Number*	*Alcohol Involvement*
Smokers' Materials	54	29
Cooking Appliance	28	18
Electrical	20	15
Candle	7	5
Electrical Heater	2	1
Open Fire	2	2
Other	4	3
Unknown	14	8
Total	**131**	**81**

NB this is for a three year period

(Scotland Together Report, 2010)

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Old Age

'As people get older, it can become more difficult to detect and respond to fires. For example, it can become harder to hear smoke alarms, smell smoke, detect changes in heat and turn off appliances. Anecdotal evidence also suggests that older people may be more likely to possess older appliances, which have a greater potential to be faulty and increase the risk of fire.'

(The Scottish Government, 2013)

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- > half of the victims of accidental dwelling fires ≥ 65.
- Risk of dying in a fire ≥ 80 is more than 4x higher than average.
- People aged 65 - 79 also have higher than average rate.

(UK Government, 2014)

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Improvements in life expectancy at birth are projected to continue, rising to 82.0 years for males and 85.5 years for females by 2037.

(The Registrar General's Annual Review of Scotland's Population - 2014.)

Buildings that consider future flexibility of use also contribute to the creation of a more sustainable housing stock, simplifying alterations. This can allow people to remain longer in their home, through changing circumstances, with the minimum of disruption and inconvenience.

(BSD, 2015)

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Other factors-

Living alone

(Holborna, Nolana & Golt, 2003)

'….As such, an ageing population, with an increasing number of people living alone, has the potential to lead to an increase in accidental dwelling fire deaths.'

(Scotland Together Report, 2010)

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Other factors-

- Smoking
- Disability
- Illness
- Social deprivation

(Holborna, Nolana & Golt, 2003)

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Not having a working smoke alarm fitted.

(Holborna, Nolana & Golt, 2003)

In dwelling fires where a smoke alarm was present, 28% of alarms in 2013-14 failed to operate
(NB this includes both battery and mains powered).

For mains-powered alarms, fire products did not reach the alarms was also the main reason for alarm failure (50% of cases).

Poor sitting of the detector accounted for 12% of alarm failure.

(UK Government, 2014)

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Loft Conversions and Domestic Extensions:
Part 2: Fire Separation and Fire Resistance Below the Roofline.

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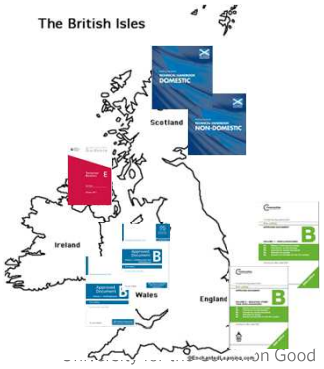
Building Regulation

Performance vs. Prescriptive



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Either

Follow the guidance in the Domestic or Non-Domestic Handbooks

or

Propose an 'Alternative Solution' which still meets the requirements of the Building Regulations by achieving the functional standards

http://www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards/publications/pubtech/th2013domcomp

http://www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards/publications/pubtech/th2013nondomcomp

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Definitive interpretation of whether regulations have been met is the preserve of the Courts.

'Proof of compliance with such a document may be relied on in any legal dispute as 'tending to negate liability' for an alleged contravention of building regulations. For most situations therefore it is expected that designing in accordance with the Technical Handbooks will be the usual way of showing that the functional standards are going to be met.'

(Building Standards Division, 2013)

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Extension

Meet the Standards

Conversion

May not be reasonably practicable to meet the standard ?
Improve where reasonably practicable ?
Don't make it worse than before.

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Professional Judgement ?

'For conversions it is the intention that the standards achieved in the converted building should be broadly similar to those achieved by entirely new buildings.

Schedule 6 to regulation 12 guides the verifier as to where discretion is expected to be necessary. It identifies those standards where it is not expected to be reasonably practicable to have existing buildings fully comply. However for these standards improvement of the existing building is expected where it is reasonably practicable.'

'..... means reasonably practicable having regard to all the circumstances including the expense involved in carrying out the work.'

(BSD, 2015)

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Fire Resistance Below the Roofline

2.2 SEPARATION
Functional Standard

' Every building, which is divided into more than one area of different occupation, must be designed and constructed in such a way that in the event of an outbreak of fire within the building, fire and smoke are inhibited from spreading beyond the area of occupation where the fire originated.'

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What parts of the Standards would apply to Separating Walls, other than Section 2 Fire ?

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0.12.2 Schedule 6

Every conversion, to which these regulations apply, shall meet the requirements of the following standards in schedule 5:

a. Standards 2.1, 2.3, 2.5, 2.9, 2.10, 2.11, 2.13, 2.14, 2.15 in Section 2, Fire

b. Standards 3.5, 3.6, 3.7, 3.8, 3.9, 3.11, 3.12, 3.13, 3.14, 3.17, 3.18, 3.20, 3.21, 3.22, 3.23, 3.24, 3.25, 3.26, 3.27 in Section 3, Environment

c. Standards 4.5, 4.6, 4.7, 4.9, 4.11, 4.12, 4.13 in Section 4, Safety

d. Standards 5.1 and 5.2 in Section 5, Noise, and

e. Standards 6.7, 6.8, 6.10 in Section 6, Energy.

5.2.4 Conversions

Many of the existing wall and floor constructions within a traditional building, will be constructed from materials generally not still in use, for example lathe and plaster. In such cases the sound insulation level will not be known therefore, it is not reasonably practicable for the existing walls or floors to meet the performance levels in clause 5.2.1.

?

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Every conversion, to which these regulations apply, shall meet the requirements of the following standards in schedule 5 in so far as is reasonably practicable, and in no case be worse than before the conversion:

a. the standards in Section 1, Structure

b. Standards 2.2, 2.4, 2.6, 2.7, 2.8, 2.12 in Section 2, Fire

c. Standards 3.1, 3.2, 3.3, 3.4, 3.10, 3.15, 3.16, 3.19 in Section 3, Environment

d. Standards 4.1, 4.2, 4.3, 4.4, 4.8, 4.10 in Section 4, Safety, and

e. Standards 6.2, 6.3, 6.4, 6.5, 6.6 in Section 6, Energy.

Note: Standard 7.1 (Sustainability) does not apply to conversions.

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At least a medium fire resistance duration

- between adjoining dwellings.
- between a dwelling and any other part of the building in common occupation.

No storey > 18m, separating walls may be constructed from combustible materials provided the appropriate fire resistance duration is maintained.

- insulation material exposed in a cavity should be constructed from materials which are non-combustible or of a low risk classification,
- the internal wall linings should be constructed from materials which are non-combustible or of a low risk classification,
- the wall should contain no pipes, wires or other services. Where an opening is created to allow services to pass through the wall, the opening should be constructed in accordance with the guidance in clause 2.2.9.

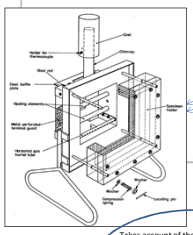
Risk	British Standards	European Standards (1)
Non-combustible	The material is certified non-combustible according to the test specified in BS 476: Part 4: 1970 (1984) throughout, or The material does not flame or cause any rise in temperature on either the centre (specimen) or furnace thermocouples according to the test specified in BS 476: Part 11: 1982 (1988).	The material has achieved a classification of A1 when tested in accordance with BS EN ISO: 1182: 2002 and BS EN ISO: 1716: 2002, or The material has achieved a classification of A2-s3, d2 when tested in accordance with BS EN: 13823: 2002 and BS EN ISO: 1182: 2002 or BS EN ISO: 1716: 2002, or Products made from only 1 or more of the materials considered as Class A1 without the need for testing, as defined in Commission Decision 96/603/EC of 4th October 1996 establishing the list of products belonging to Class A1 "No contribution to fire" provided for in the Decision 94/611/EC implementing Article 20 of the Council Directive 89/106/EEC on the construction products. None of the materials contain more than 1.0% by weight or volume (whichever is the lower) of homogeneously distributed organic material.

The material shall be deemed non-combustible if, during the test, none of the three specimens either
1) causes the temperature reading from either of the two thermocouples to rise by 50 deg C or more above the initial furnace temperature, or
2) is observed to flame continuously for 10 s or more inside the furnace. Otherwise, the material shall be deemed combustible.

None of the materials in the table is allowed to contain more than 1,0 % by weight or volume ►M1 (whichever is the more onerous) ◄ of homogeneously distributed organic material.

Material	Notes
Expanded clay	
Expanded perlite	
Expanded vermiculite	
Mineral wool	
Cellular glass	
Concrete	Includes ready-mixed concrete and precast reinforced and prestressed products
Aggregate concrete (dense and lightweight mineral aggregates, excluding integral thermal insulation)	May contain admixtures and additions (e.g. PFA), pigments and other materials. Includes precast units
Autoclaved aerated concrete units	Units manufactured from hydraulic binders such as cement and/or lime, combined with fine materials (siliceous material, PFA, blast furnace slag), and cell generating material. Includes precast units.
Fibre cement	
Cement	
Lime	
Blast furnace slag/pulverised fly ash (PFA)	
Mineral aggregates	
Iron, steel and stainless steel	Not in finely divided form
Copper and copper alloys	Not in finely divided form
Zinc and zinc alloys	Not in finely divided form
Aluminium and aluminium alloys	Not in finely divided form
Lead	Not in finely divided form

Low risk	The surface material (or where it is bonded throughout to a substrate, the surface material combined with the substrate) has a surface of Class 1 and, when tested in accordance with BS 476: Part 6: 1981 or BS 476: Part 6: 1989 has an index of performance (I) not more than 12 and a sub-index (i_1) not more than 6.	The material has achieved a classification of B-s3, d2 or better when tested in accordance with BS EN: 13823: 2002 and BS EN ISO: 11925-2: 2002.



Takes account of the combined effect of factors such as the ignition characteristics, the amount and the rate of heat release and the thermal properties of the product in relation to their ability to accelerate the rate of fire growth.

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- **12th Century-** Mayor of London
- houses to be built of stone,
- thatched roofs - not permitted,
- party walls minimum height and thickness.
- required in building regulations usually dated to 1189.

(Read & Morris, 1983)

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Following the Great Fire in 1666, the London Building Act called for a solid masonry wall between dwellings of nine inches minimum thickness.

(Smith, Wood & McKenzie, 2006)

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POST-WAR BUILDING STUDIES
NO. 20

FIRE GRADING OF BUILDINGS

PART I
GENERAL PRINCIPLES
AND STRUCTURAL PRECAUTIONS

283. Therefore in recommending that separating walls should generally have a fire resistance of at least 1 hour (Grade D), we are aware that there are other aspects of the question, not directly connected with spread of fire, which should receive consideration and which may make necessary the use of certain types and thicknesses of materials automatically giving a higher standard of fire resistance.

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What do we mean by Fire Resistance ?

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BS 476 fire resistance tests

Fire door assemblies with non-metallic leaves, BS 8214: 1990: Sections 1 and 2
(withdrawn, superseded, by BS 8214: 2008)

Structural steelwork, BS 5950: Part 8: 2003
(withdrawn, superseded-replaced by BS EN 1993-1-2:2005)

'Fire Safe Design: A new approach to multi-storey steel framed buildings' published by The Steel Construction Institute (within the limitations described in the SCI Publication P288)

Structural use of timber, BS 5268: Part 4: Sections 4.1 and 4.2: 1990
(withdrawn, superseded-replaced by BS EN 1995-1-2:2004)
4.1- charring rates
4.2- calculation method fire resistance of a timber framed wall or joisted floor construction is considered to be the sum of the contribution indexes of its various components.

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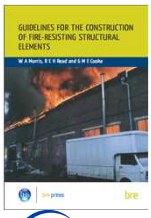
Structural use of concrete, BS 8110: Part 2: 1985, Section 4.3 'Tabulated data (method 1)' (withdrawn, superseded-replaced by BS EN 1992-1-1:2004+A1:2014)

Specification given in the Building Research Establishment Report BR 128 "Guidelines for the Construction of Fire Resisting Structural Elements" (BRE 1988).



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European Standard (BS EN)
BS EN 1363-1: 1999, Fire resistance tests, Part 1- General requirements.
BS EN 1363-2: 1999, Fire resistance tests, Part 2- Alternative and additional procedures.
BS EN 1363-3: 2000, Fire resistance tests, Part 3- Verification of furnace performance.
BS EN 1364-1: 1999, Fire resistance tests for non load-bearing elements - Part 1: Walls.
BS EN 1364-2: 1999, Fire resistance tests for non load-bearing elements - Part 2: Ceilings.
BS EN 1365-1: 1999, Fire resistance tests for load-bearing elements - Part 1: Walls.
BS EN 1365-2: 2000, Fire resistance tests for load-bearing elements - Part 2: Floors and roofs.
BS EN 1365-3: 2000, Fire resistance tests for load-bearing elements - Part 3: Beams.
BS EN 1365-4: 1999, Fire resistance tests for load-bearing elements - Part 4: Columns.
BS EN 1366-1: 1999, Fire resistance tests for service installations - Part 1: Ducts.
BS EN 1366-2: 1999, Fire resistance tests for service installations - Part 2: Fire dampers.
BS EN 1634-1: 2008, Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware, Part 1 – Fire resistance tests for doors, shutters and openable windows.

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BS EN 1634-2: 2008, Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware, Part 2 – Fire resistance characterisation test for elements of building hardware.
BS EN 1634-3: 2004, Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware, Part 3 – Smoke control test for door and shutter assemblies.
BS EN 81-58: 2003, Safety rules for the construction and installation of lifts – Examination and tests - Part 58: landing doors fire resistance test may be used in accordance with Council Directive 95/16/EC of 29/6/1995 implementing the Lifts Regulations 1997 (SI 1997/831).

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Any reference to European Standards for Structure (Structural Eurocodes) must be taken to include the relevant UK National Annex:
BS EN 1991-1-2:2002, Eurocode 1: Actions on structures – Part 1-2: General actions – Actions on structures exposed to fire.
BS EN 1992-1-2:2004, Eurocode 2: Design of concrete structures – Part 1-2: General rules – Structural fire design.
BS EN 1993-1-2:2005, Eurocode 3: Design of steel structures – Part 1-2: General rules – Structural fire design.
BS EN 1994-1-2:2005, Eurocode 4: Design of composite steel and concrete structures – Part 1-2: General rules – Structural fire design.
BS EN 1995-1-2:2004: Eurocode 5: Design of timber structures – Part 1-2: General rules – Structural fire design.
-Annex C where cavity filled with rock or glass fibre insulation permitted by UKNA
BS EN 1996-1-2:2005: Eurocode 6: Design of masonry structures – Part 1-2: General rules – Structural fire design.
BS EN 1999-1-2:2007: Eurocode 9: Design of aluminium structures – Part 1-2: General rules – Structural fire design.

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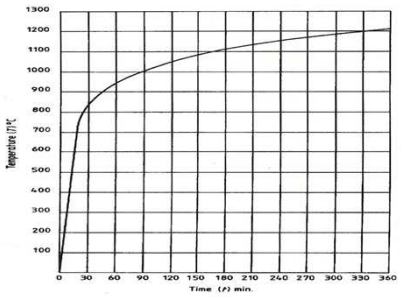
http://www.british-gypsum.com/~/media/files/british-gypsum/fire-book/fire-book-full-publication.pdf



Standard temperature/time curve

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$T = 345 \log_{10}(8t + 1) + 20$

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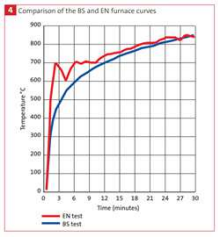
Failure Criteria ?

Insulation (I)
Integrity (E)
Load-bearing Capacity (R)

Are BS & EN tests the same ?



For the UK, the introduction of the plate means that our furnaces have become more severe, especially during the first thirty minutes of exposure. Refer to **Figure 4** - Comparison of the BS and EN furnace curves, which shows the increased temperature measured with a BS thermocouple when a furnace is controlled utilising the EN plate thermometer. This increase in severity is not in itself a problem if national Building Regulations were to be altered to reflect this. The regulations, however, have adopted the new test method but the periods of fire resistance have remained constant. In effect the level of fire safety has been raised in the UK by the adoption of EN test standards within national Building Regulations.

https://www.google.co.uk/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=British+Gypsum+Fire+Tests

'The implication is that the built assembly will behave at least as well in a real fire as the tested assembly did in the full-scale fire test. Obvious differences are that there are many differences between the tested and built assemblies. The tested assemblies nearly always have different sizes and shapes, and different loads or boundary conditions than in real buildings, and the test fire may be very different from a real fire'

(Buchanan, 2001)

'The time recorded in the fire resistance test in respect of these criteria bears no direct relationship to the failure times in real fires. This has been recognized in principle from the inception of the test.'

'Any of the tests used to characterize the reaction to fire, or fire resistance of a material/construction, only represents one of many possible fire scenarios.'

(BS 476-Part 10: 2009)

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Which criteria ?

1 Construction	2 Fire resistance duration	3 British Standards Load bearing capacity (mins)	4 British Standards Integrity (mins)	5 British Standards Insulation (mins)	6 European Standards	7 Test exposure
4. Separating wall or an internal wall or screen used as a protected route of escape (2.0.6) [1, 2]	Short	30 [4]	30	30	REI 30 [4]	Each side separately
	Medium	60 [4]	60	60	REI 60 [4]	
	Long	120 [4]	120	120	REI 120 [4]	

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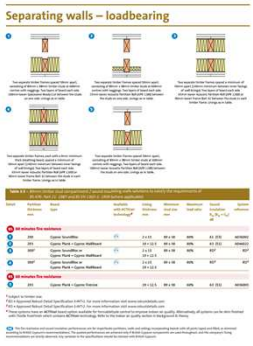
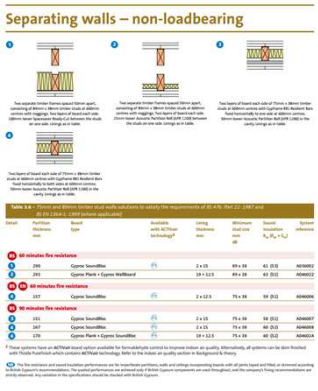
Separating walls – loadbearing



Separating walls – non-loadbearing



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http://www.british-gypsum.com/~/media/Files/British-Gypsum/WHITE-BOOK-Sector-Guides/WBHRMO/WBHRMO-3-Timber-Frame-Solutions-1501.pdf

Building Research Establishment Report BR 128 "Guidelines for the Construction of Fire Resisting Structural Elements" (BRE 1988).

'…. a need remains for simple generic description of fire resisting elements. This report sets down guidelines for the fire resistance of elements of structure and includes tables of notional periods of fire resistance based on consideration of current test data and information'

(BRE, 1988)

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Tabulated minimum material thicknesses to achieve a desired fire resistance

e.g.

Nature of Construction	Minimum thickness (mm), excluding any finish, for fire resistance (hours) of			
	Loadbearing		Non-Loadbearing	
	1/2	1	1/2	1
Bricks of concrete or calcium silicate without finish	90	90	75	75
Blocks of dense concrete without finish	90	90	50	75

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Nature of Construction	Minimum thickness of protection (mm), for fire resistance (hours) of			
	Loadbearing		Non-Loadbearing	
Timber studs at 600mm c/c, Faced on each side with	1/2	1	1/2	1
One layer of plasterboard all joints taped and filled	12.5*	-	12.5	-
Two layers of plasterboard with joints staggered all joints taped and filled to outer layer		25*		25

* Limitation on stud width

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Is there an existing separating wall in the loft space ?

- What is the construction and thickness ?
- What condition is it in ?
- Is it sealed at the roof intersection and boxed eaves ?
- Are there holes in it ?
- Are there services passing through it ?

What if there is no existing separating wall in the loft space ?

- Co-operation of neighbouring occupants to build over boundary ?
- Access to inspect both sides ?
- Timber frame or masonry construction ?
- Don't forget the boxed eaves.

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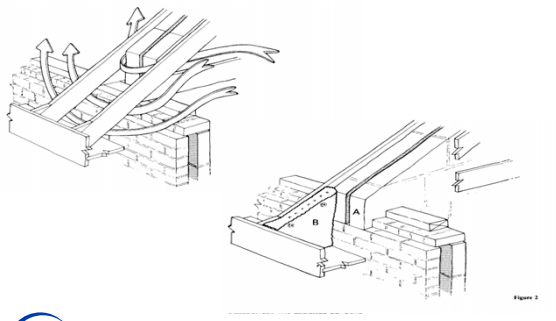

BRE Defects Action Sheet 7, 1982

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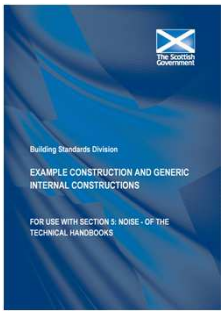

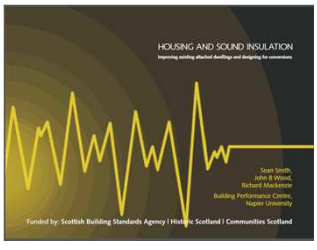

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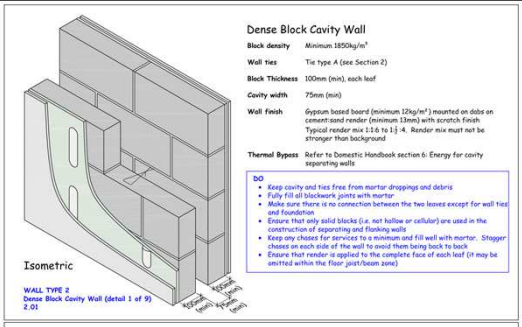

Dense Block Cavity Wall

Block density	Minimum 1850kg/m³
Wall ties	Tie type A (see Section 2)
Block Thickness	100mm (min), each leaf
Cavity width	75mm (min)
Wall finish	Gypsum based board (minimum 12kg/m²) mounted on dabs on cement:sand render (minimum 13mm) with scratch finish Typical render mix 1:1:6 to 1:½:4. Render mix must not be stronger than background
Thermal Bypass	Refer to Domestic Handbook section 6: Energy for cavity separating walls

DO
- Keep cavity and ties free from mortar droppings and debris
- Fully fill all blockwork joints with mortar
- Make sure there is no connection between the two leaves except for wall ties and foundation
- Ensure that only solid blocks (i.e. not hollow or cellular) are used in the construction of separating and flanking walls
- Keep any chases for services to a minimum and fill well with mortar. Stagger chases on each side of the wall to avoid them being back to back
- Ensure that render is applied to the complete face of each leaf (it may be omitted within the floor joist/beam zone)

This detail is a constituent of the BSD guidance document 'Example and Generic Internal Constructions' and should only be used after reference to the Introductory and Example Constructions chapters where the relevance and any limitations on the use of this detail are set out.

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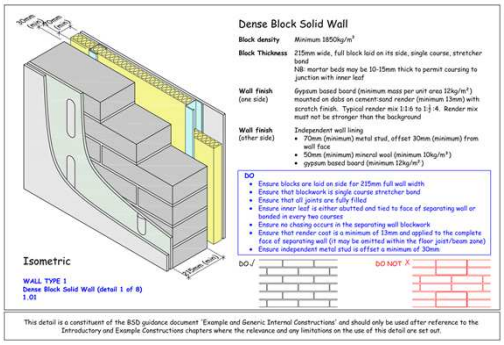

Dense Block Solid Wall

Block density	Minimum 1850kg/m³
Block Thickness	215mm wide, full block laid on its side, single course, stretcher bond NB: mortar beds may be 10-15mm thick to permit coursing to junction with inner leaf
Wall finish (one side)	Gypsum based board (minimum mass per unit area 12kg/m²) mounted on dabs on cement:sand render (minimum 13mm) with scratch finish. Typical render mix 1:1:6 to 1:½:4. Render mix must not be stronger than the background
Wall finish (other side)	Independent wall lining • 70mm (minimum) metal stud, offset 30mm (minimum) from wall face • 50mm (minimum) mineral wool (minimum 10kg/m³) • gypsum based board (minimum 12kg/m²)

DO
- Ensure blocks are laid on side for 215mm full wall width
- Ensure that blockwork is single course stretcher bond
- Ensure that all joints are fully filled
- Ensure inner leaf is either abutted and tied to face of separating wall or bonded in every two courses
- Ensure no chasing occurs in the separating wall blockwork
- Ensure that render coat is a minimum of 13mm and applied to the complete face of separating wall (it may be omitted within the floor joist/beam zone)
- Ensure independent metal stud is offset a minimum of 30mm

This detail is a constituent of the BSD guidance document 'Example and Generic Internal Constructions' and should only be used after reference to the Introductory and Example Constructions chapters where the relevance and any limitations on the use of this detail are set out.

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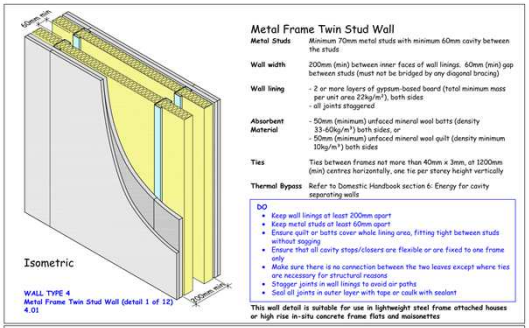

Metal Frame Twin Stud Wall

Metal Studs	Minimum 70mm metal studs with minimum 60mm cavity between the studs
Wall width	200mm (min) between inner faces of wall linings. 60mm (min) gap between studs (must not be bridged by any diagonal bracing)
Wall lining	- 2 or more layers of gypsum-based board (total minimum mass per unit area 22kg/m²), both sides - all joints staggered
Absorbent Material	- 50mm (minimum) unfaced mineral wool batts (density 33-60kg/m³) both sides, or - 50mm (minimum) unfaced mineral wool quilt (density minimum 10kg/m³) both sides
Ties	Ties between frames not more than 40mm x 3mm, at 1200mm (min) centres horizontally, one tie per storey height vertically
Thermal Bypass	Refer to Domestic Handbook section 6: Energy for cavity separating walls

DO
- Keep wall linings at least 200mm apart
- Keep metal studs at least 60mm apart
- Ensure quilt or batts cover whole lining area, fitting tight between studs without sagging
- Ensure that all cavity stops/closers are flexible or are fixed to one frame only
- Make sure there is no connection between the two leaves except where ties are necessary for structural reasons
- Stagger joints in wall linings to avoid air paths
- Seal all joints in outer layer with tape or caulk with sealant

This wall detail is suitable for use in lightweight steel frame attached houses or high rise in-situ concrete frame flats and maisonettes

This detail is a constituent of the BSD guidance document 'Example and Generic Internal Constructions' and should only be used after reference to the Introductory and Example Constructions chapters where the relevance and any limitations on the use of this detail are set out.

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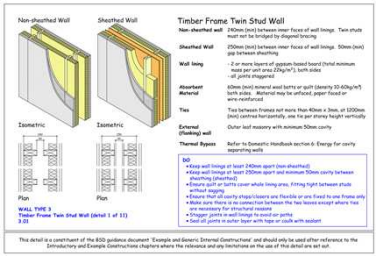
5.1.5 Conversions, Domestic Handbook 2015

The conversion of a roof space into a habitable area, although very common, can present problems as it is unlikely that access to the roof space in the adjoining dwelling can be assured. Where an existing separating wall in a roof space is constructed of a single leaf of masonry only, it would be appropriate to provide one leaf of a free-standing framed construction next to the existing wall as each attic is developed. Example Constructions - detail 3: timber frame twin stud wall; gives a typical arrangement.

U Value ≈ 0.31 W/m²K



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What if the neighbouring loft space is undeveloped ?

6.2.6

Where conversion of an unheated building (e.g. a barn) or part of a dwelling is to be carried out,…….
……the building should work to achieve the same standards to those for an extension to the insulation envelope by following the guidance in clauses 6.2.9 and 6.2.10, meeting the U values in column (b) of the table to clause 6.2.9.

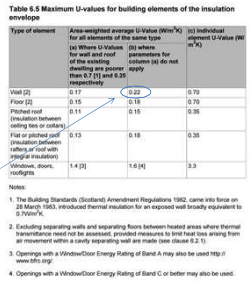

Table 6.5 Maximum U-values for building elements of the insulation envelope

Type of element	Area-weighted average U-Value (W/m^2K) for all elements of the same type (a) Where U-Values for wall and roof of the existing dwelling are poorer than 0.7 [1] and 0.25 respectively	(b) where parameters for column (a) do not apply	(c) Individual element U-Value (W/m^2K)
Wall [2]	0.17	0.22	0.70
Floor [2]	0.15	0.18	0.70
Pitched roof (insulation between ceiling ties or collars)	0.11	0.15	0.35
Flat or pitched roof (insulation between rafters or roof with integral insulation)	0.13	0.18	0.35
Windows, doors, rooflights	1.4 [3]	1.6 [4]	3.3

Notes:

1. The Building Standards (Scotland) Amendment Regulations 1982, came into force on 28 March 1983, introduced thermal insulation for an exposed wall broadly equivalent to $0.7W/m^2K$.
2. Excluding separating walls and separating floors between heated areas where thermal transmittance need not be assessed, provided measures to limit heat loss arising from air movement within a cavity separating wall are made (see clause 6.2.1).
3. Openings with a Window/Door Energy Rating of Band A may also be used http://www.bfrc.org/
4. Openings with a Window/Door Energy Rating of Band C or better may also be used.

(BSD, 2015)

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5.1.9 Post-completion testing

When a conversion of an attached building occurs, for example to a mid terrace dwelling, it may not be possible to gain access to the adjacent dwelling or part of the same building, to carry out tests to the separating wall. In this case, it may not be appropriate to request testing to be carried out. The conversion of a roof space into habitable space, although very common can also present problems. Since it is unlikely that access to the roof space in the adjoining dwelling can be assured it may not be appropriate to test.

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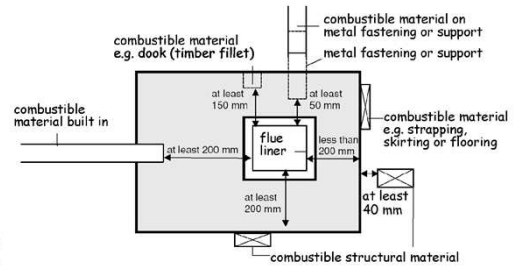
Existing chimneys ?

Figure 3.38 Plan view of masonry chimney



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CPD
February 2016

Loft Conversions and Domestic Extensions: Part 3: Structural Elements & Protected Enclosures

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Table 2.1 Protection of Structural Elements

Height of topmost storey above ground level	Fire resistance duration
Not more than 7.5m	short
More than 7.5m but not more than 18m	medium
More than 18m but not more than 60m	long [1]

- Part of a structural frame(beams and columns)
- Load-bearing (other than self load-bearing)
- A floor

NB a roof is not an element of structure, unless it supports an element of structure, or acts as a floor.

An intermediate floor or floors within a flat or maisonette need only have short fire resistance duration provided the floor or floors do not support or provide lateral restraint to any part of the structure with a medium or long fire resistance duration.

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What is the fire resistance of a lath and plaster ceiling ?

BR 128

Table 14 Timber floors (continued)

(C) Tongued and grooved softwood of not less than 21 mm finished thickness (25 mm nominal)*

Nature of construction and materials 37 mm (minimum) Timber joists (except where indicated) with a ceiling of:	Minimum thickness (mm) of protection for a fire resistance of: modified ½ h	½ h	1 h
C1 Timber lath and plaster – thickness of plaster	15	15†	

* Or (i) sheets of tongued and grooved plywood/wood chipboard 15 mm (minimum) thick; or (ii) square edged sheets of plywood/wood chipboard 15 mm (minimum) thick, with all joists backed by timber sections of 37 mm (minimum) breadth.
† In conjunction with 50 mm (minimum) joists at 400 mm centres.

'Existing ceilings of 15-20mm plaster on wood lath may possibly contribute up to 20 minutes to the fire resistance of a timber floor under BS 476 test conditions, but this will depend on the condition and the key'- BRE Digest 208

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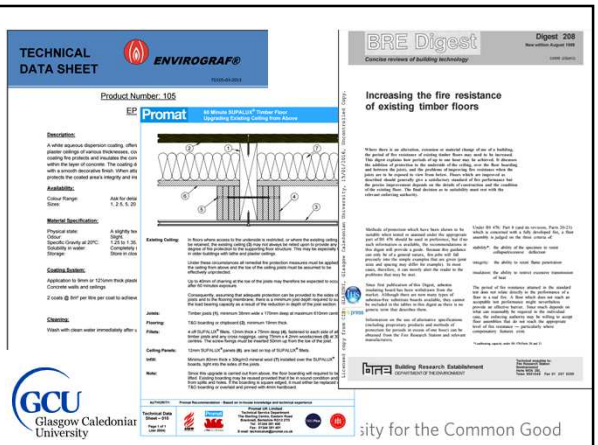


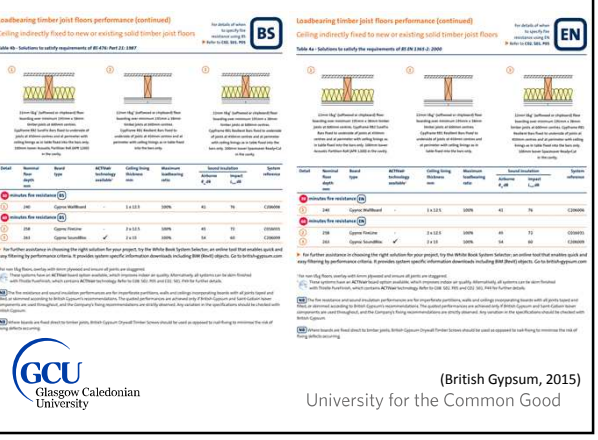
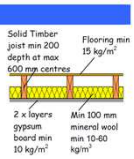


Table 5.5 Table 5.5 Design performance levels

Design performance	Minimum airborne insulation level
Internal walls	40 dB R_w
Intermediate floors	43 dB R_w

Type 1 Timber floor – solid joist

- Flooring - timber or wood-based board, minimum mass per unit area 15 kg/m².
- Solid joists minimum 200 mm depth at maximum 600 mm centres.
- Absorbent layer of mineral wool, minimum thickness 100 mm, minimum density between 10-60 kg/m³ laid between the joists.
- Ceiling - two layers of gypsum based board, each layer minimum mass per unit area 10 kg/m².
- All joints staggered and sealed.



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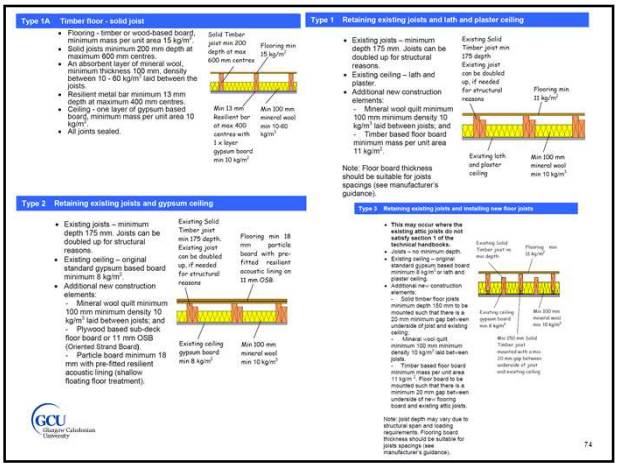
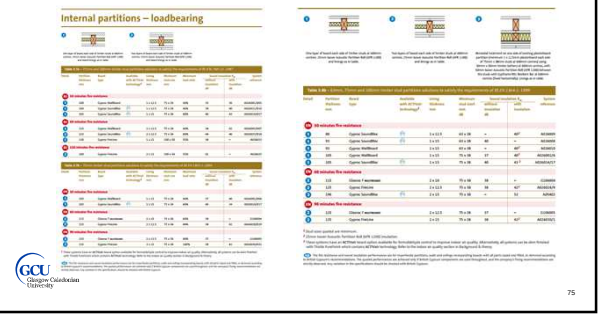
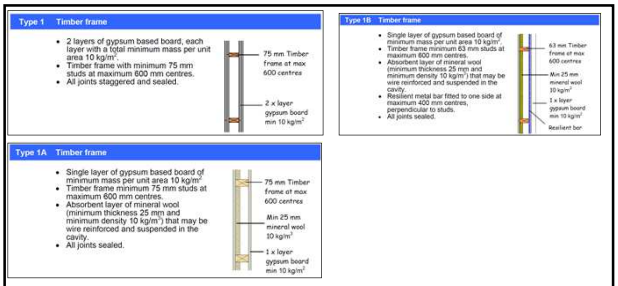


Internal Partitions ?

- Load-bearing
- Protecting enclosures





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Protected enclosures

- The protected enclosure should form a complete enclosure having a short fire resistance duration.

Table 2.7 Fire Resistance

1 Construction	2 Fire resistance duration	3 British Standards Load bearing capacity (mins)	4 British Standards Integrity (mins)	5 British Standards Insulation (mins)	6 European Standards	7 Test exposure
4. Separating wall or an internal wall or screen	Short	30 [4]	30	30	REI 30 [4]	Each side separately
	Medium	60 [4]	60	60	REI 60 [4]	
	Long	120 [4]	120	120	REI 120 [4]	
used as a protected route of escape (2.0.6) [1, 2]						

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- Every door in the wall of a protected enclosure (other than a door serving sanitary accommodation) should be a self-closing fire door with a short fire resistance duration.

- A cupboard door need not be self-closing unless there is an ignition source within the cupboard such as an electrical distribution board or a boiler.

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Easy to specify new partitions, but do existing partitions achieve short fire resistance duration ?

What about services in these partitions ?

Are existing doors being upgraded- specification and certification ?

- Thickness of stiles
- Thickness of panels
- Flat panels or fielded panels
- Is the door twisted
- What about existing ironmongery

If new fire doors are being provided – certification and identification ?

Complete assembly or just door leaf ?

Does the existing frame follow that of the fire test certificate ?

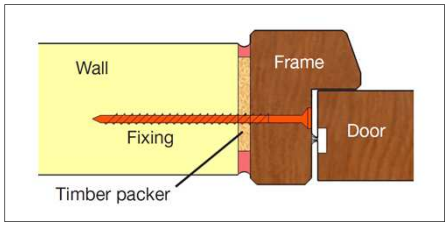
'The dimensions, density and material of timber door frames should be not less than those tested or approved.'

BS 8214:2008

- Dimensions (2 mm - 4 mm gap), wood type, joints, stops, supporting assembly, etc ?

  Compatible Ironmongery ?
- hinges, latches, closers, intumescents ?

The gap between door frame and wall opening can vary greatly and is usually masked with an architrave.



(BWF Certifire – Fire Doors and Doorsets)

Table 2 **Recommendations for the joint between timber door frames and walls to provide 30 min fire resistance**

Wall construction	Maximum frame to wall gap width mm	Architrave condition	Examples of additional protection
Walls unlikely to exhibit significant distortion during fire exposure, e.g. timber stud walls and masonry walls built without fair face	Up to 10	Intimately fitted softwood or hardwood architraves at least 15 mm thick with a 15 mm overlap onto wall and door frame	Nil
		Imperfectly fitted architraves	2 mm × 10 mm of intumescent material as a pre-formed strip or seal or Mineral or glass wool packed to a depth of at least 10 mm or Intumescent paste, mastic or other suitable material
	More than 10	All architrave conditions	
Loading walls likely to exhibit distortion during fire exposure, e.g. steel stud walls	All gap sizes	Fit of architrave cannot be guaranteed due to likely distortion of wall. Seek specialist advice.	
Loadbearing or non-loadbearing walls; fair-faced masonry walls	Up to 10	Intimately fitted 10 mm hardwood quadrant bead	Nil
	More than 10	All architrave conditions	2 mm × 10 mm of intumescent material as a pre-formed strip seal or Mineral or glass wool packed to a depth of at least 10 mm or Intumescent paste, mastic or other suitable material

NOTE. There is a risk that wall finishes with a surface spread of flame rating of Class 3, as defined in BS 476-7:1997, might contribute to ignition and flaming of the architrave on the unexposed face due to leakage of hot gases. For smoke control door assemblies, frame-to-wall gaps should always be packed with mineral or glass wool or sealed with a bead of intumescent paste or mastic.

BS 8214:2008

Where intumescent seals are obtained from a source other than the fire door manufacturer, it is essential that the intumescent seal to be used is of the same formulation, dimensions and configuration as that in the door manufacturer's fire test report.

There a number of different types of smoke seal available, and again the manufacturer's fire test report is expected to identify the most appropriate type for each specific fire type and configuration.

The type of surrounding structure or wall/partition into which a fire door can be installed will have been determined by fire resistance test and should not be changed without agreed expert opinion or test evidence (see BS EN 1634-1 for further guidance).

BS 8214:2008

Fire Doors
serve three main purposes in a building:

- To restrict the initial development of a fire
- To restrict the spread of fire
- To protect escape routes

(Door and Hardware Federation, 2009)

Fire-Resisting Door Certification

Certification schemes e.g.
CERTIFIRE (operated jointly with British Woodworking Federation)
BRE Certification
BM TRADA

Doors are supplied with information covering their installation.

Door hardware is also addressed in these documents, and descriptions are given of the type, material, dimensions and fixings of building hardware which may be used on the door without invalidating the certification.

(Door and Hardware Federation, 2009)

Fire Test Reports:

- relevant to the particular installation being considered,
- name the product clearly and unambiguously,
- relate to doors and frames which are generically the same as the ones proposed in the project,
- current (maximum 10 years, otherwise check the document for a date limiting its validity).

Field of Application Summary:

A digest of relevant information extracted from a fire-resisting door's test report. It is intended for use by regulatory authorities, and gives similar information to that found in door certification data sheets.

Assessments:

Usually written in much more user-friendly language than fire test reports. They are based on test evidence, and the assessor's experience.

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(Door and Hardware Federation, 2009)

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Overseas Test Evidence:

Any fire test evidence from overseas, especially from outside the EU, unless provided by a "NOTIFIED BODY" should be treated with caution as the test methods and fire door construction can vary from country to country, and are therefore unlikely to have directly transferable relevance.

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(Door and Hardware Federation, 2009)

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Documentation-Hardware

• third party certification of the building hardware
• fire-resisting doorsets' third party certification data sheet, field of application summary or
• fire test reports or
• assessment by competent authority.

Durability of building hardware, whether for use on a fire-resisting door or an emergency exit door, may be evidenced (in order of preference) by:

CE marking in accordance with relevant harmonised product standard (where available), or third party BS EN test report,
or third party BS test report,
or manufacturer's declaration.

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(Door and Hardware Federation, 2009)

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Fire Doors- smoke seals ?

Unless the fire door is in an external wall or a lift door or pressurisation techniques following the guidance in BS EN 12101: Part 6: 2005 are used, the fire door should also either:

a. in the case of column 4, have smoke seals fitted unless the leakage rate does not exceed 3 $m^3/m/hour$, head and jambs only, when tested at 25 Pa according to BS476: Part 31: 1983 (Section 31.1) with AMD 8366/ November 1994, or

b. in the case of column 6, attain the additional classification of Sa when tested to BS EN1634-3: 2001.

(Door and Hardware Federation, 2009)

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Hinges : able to achieve the intended fire rating

- CE Marked to BS EN 1935
- preferably, provided with certification by an approved third party certification body.

In all cases reference should be made to the fire test evidence, and the tested condition should be followed. The necessary information should be on the fire door's data sheet.

It is usual for at least 3 hinges to be fitted on fire and escape route doors.

Was intumescent material used when the hinge was fire tested, it is essential that the same material be used in order for the test evidence to be valid and maintain the integrity of the door set.

(Door and Hardware Federation, 2009)

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Door closing device

- close the door leaf reliably from any angle to which it has been opened
- overcome the resistance of a latch or any seals when fitted.

Latched door or unlatched door ?

- CE Marked to BS EN 1154 - Building hardware - Controlled door closing devices, including annex A,
- preferably, provided with additional product certification by an approved third party certification body.

(Door and Hardware Federation, 2009)

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Intumescent products-

The assessment report of a tested product will give information on a range of door options. Product with no valid test evidence should not be considered.

Fire and Smoke Seals - preferred positions are:
• fire protection only - fit into a groove in the frame reveal
• fire and smoke protection - fit into a groove in either the leaf edge or frame. The leaf edge is normally preferred due to the lower resistance the leaf encounters on closing, thus avoiding sticking door leaves on site.

Intumescent materials other than edge strips are used on fire resisting doorsets. For example, thin sheet material can provide insulation and protection:
• behind hinge blades
• around mortise lockcases
• around concealed door closers

(Door and Hardware Federation, 2009)

Intumescent Sizes / Options

The bulk of today's testing is carried out with 15 mm x 4 mm for 30 minutes. The 60 minute ratings have also changed and are favouring two 15 mm x 4 mm sections running parallel, to give the required performance.

The correct size of intumescent strip is specific to the door under consideration, and its size.

Always consult the test evidence.
There are no reliable "rules of thumb".

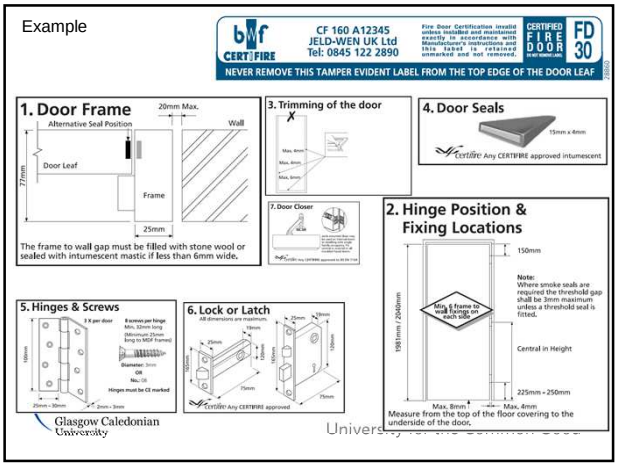
(Door and Hardware Federation, 2009)

The building designer should ensure that all fire doors to be used are of a design that has been tested or assessed for the required fire resistance period, and that documentary evidence exists to that effect.

Where the elements of a fire door are to be obtained from different sources, the building designer should ensure that the elements to be used are compatible and are able to provide the required fire resistance period, and that documentary evidence exists to that effect.

BS 8214:2008

Example



Argyll and Bute Council
CPD
Febuary 2016

Loft Conversions and Domestic Extensions:
Part 3: Fire Separation and Fire Resistance Above the Roofline.

Dr Bill Hay

GCU Glasgow Caledonian University

University for the Common Good

Fire Resistance above the roofline-External Walls

Short fire resistance > 1m from boundary (Load-bearing Capacity and Integrity)
(from the inside only)

Medium fire resistance ≤ 1m from boundary (All three criteria)
(from the inside only)

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External wall cladding ≤ 1m from a boundary should have

- a non-combustible classification (fire resistance from inside) except cladding to a house where:
- the cladding achieves a low risk reaction to fire classification, and
- the wall behind the cladding has the appropriate fire resistance duration from both sides.

Every part of wall should be constructed of non-combustible materials, but structural frame can be low, medium, high or very high ≤ 18m

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Distance from Boundary

Unprotected area

- any part of an external wall (including a door or window opening) which does not attain the appropriate fire resistance duration as recommended in the table to clause 2.6.1.
- Combustible cladding more than 1mm thick

Any wallhead fascia, soffit or barge board, or any cavity vents or solum vents may also be excluded from the unprotected area calculation.

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- 500mm≤ from boundary - no unprotected area
- 1m ≤ Boundary > 500mm but not more than some small openings permitted
- >1m simple geometry method, or enclosing rectangle method or BR 187

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Classification of flat roofs/rooflights.

Classification depends on distance to boundary:

Low vulnerability if not more than 6m from the boundary
Low or a medium vulnerability if more than 6m but not more than 24m from the boundary
More than 24m from the boundary, the roof may be of any material

BS 476-3:2004
Or
BS EN 13501-5:2005

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Argyll and Bute Council
CPD
January 2016

Loft Conversions and Domestic Extensions: Part 4: Fire Means of Escape

Dr Bill Hay

GCU Glasgow Caledonian University

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Mandatory Standard 2.9

'Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, the occupants, once alerted to the outbreak of the fire, are provided with the opportunity to escape from the building, before being affected by fire or smoke.'

Conversions - in the case of conversions,as specified in regulation 4, the building as converted shall meet the requirement of this standard (regulation 12, schedule 6).

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Performance vs. Prescriptive

Either

Follow the guidance in the Domestic or Non-Domestic Handbooks

or

Propose an 'Alternative Solution' which still meets the requirements of the Building Regulations by achieving the functional standards

ASET/RSET ?

http://www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards/publications/pubtech/th2013domcomp

http://www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards/publications/pubtech/th2013nondomcomp

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Steps

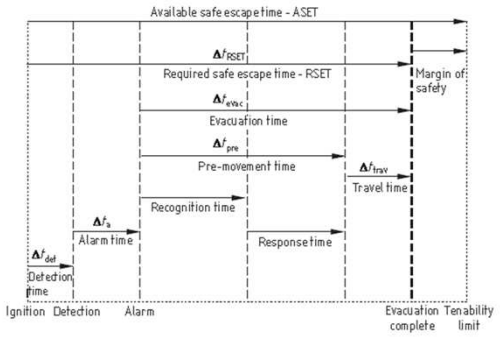

Figure 1 — Simplified schematic of processes involved in escape time compared to available safe escape time

d

Steps

Table 1 — Design behavioural scenarios and occupancy types

Category	Occupant alertness	Occupant familiarity	Occupant density	Enclosures/ complexity	Examples of Occupancy types
A	Awake	Familiar	Low	One or many	Office or industrial
B1	Awake	Unfamiliar	High	One or few	Shop, restaurant, circulation space
B2	Awake	Unfamiliar	High	One with focal point	Cinema, theatre
Ci	Asleep Long term: individual occupancy.	Familiar	Low	Few	Dwelling Without 24 h on site management.

Table C.1 — Suggested pre-times for different design behavioural scenario categories

Scenario category and modifier	First occupants Δt_{pre} (1st percentile)	Occupant distribution Δt_{pre} (90th percentile)[a]
Ci: sleeping and familiar (e.g. dwellings – individual occupancy)		
M2 B1 A1	*5*	*5*
M3 B1 A3	*10*	*>20*
For other units in a block assume one hour		

(PD7974:Pt6-2004)

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During evacuation drills of multi-unit residential buildings, it was found that on hearing a fire alarm without any other fire cue, residents generally engage in approximately three minutes of pre-movement activity before beginning active evacuation. The evacuation movement itself took one minute or less.

(Proulx, Cavan and Tonikian, 2006)

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Domestic Handbook: Escape within dwellings

Risk Factors

- individual storey dwelling area
- occupant characteristics (can't be quantified for dwellings)
- early warning
- number of exit doors
- height of the topmost storey above the ground or depth of the storey below ground.

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increased height = increased risk,

Fire protection measures increase as storey height increases

- time needed for escape
- difficulties posed to the fire and rescue service in attempting to assist evacuation, effect rescue or fight fires.

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House Extensions

- Single or two storey?

Loft Conversions

- Bungalow to two storey?
- Two storey to three storey?
- Flat to maisonette?

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No storey > 4.5m and without basement

- One route of escape
- Early warning (smoke detection & heat detection)
- Escape windows to inner rooms (unless alternative route of escape)
- Escape windows to upper floor apartments (unless alternative route of escape)

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smoke alarm

- every principal habitable room
- every circulation space such as hallways and landings
- every access room serving an inner room.

heat alarm

- installed in every kitchen.

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At least Grade D (BS 5839 Pt 6 :2004)

- integral standby supply
- Interlinked

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a) Ionization chamber smoke detectors,

- electrical current flowing between electrodes in an ionization chamber is reduced when smoke particles enter the chamber
- small particles (rapidly burning flaming fires), less sensitive to steam (circulation spaces adjacent to bathroom/shower)

(BSD, 2015)

Less sensitive to smoke that has travelled some distance from the seat of the fire, during which time smoke particles have coalesced to form larger particles. - therefore, optical smoke detectors are appropriate in circulation spaces, such as hallways and landings.

Ionization chamber detectors might be appropriate in rooms, such as the living room or dining room, where a fast-burning fire might present a greater danger to occupants than a smouldering fire, subject to consideration of the potential for unwanted alarms. More sensitive toasting/frying/grilling-false alarms.

(BS 5839-6:2013)

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b) Optical smoke detectors, which operate by detecting the scattering or absorption of light by smoke particles. Sensitive to the larger, optically active particles found in optically dense smoke.

- smouldering fires
- circulation spaces adjacent to kitchens
- Principal habitable room

Optical detectors are also appropriate in areas in which a likely cause of fire is ignition of furniture or bedding by a cigarette. But more prone to false alarms when exposed to dense tobacco smoke.

(BS 5839-6:2013)

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Heat detectors with fixed-temperature elements are used where ambient temperatures are likely to fluctuate rapidly over short periods (e.g. kitchens)- those using fixed-temperature (static) elements, which operate when they reach a preselected threshold temperature

(BS 5839-6:2013)

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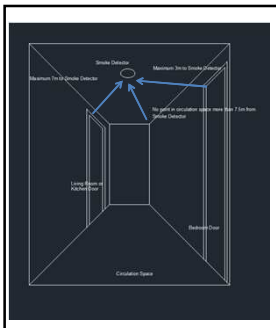

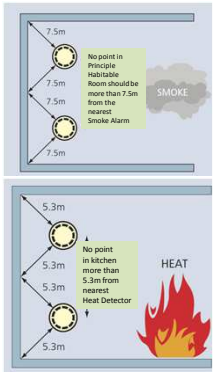

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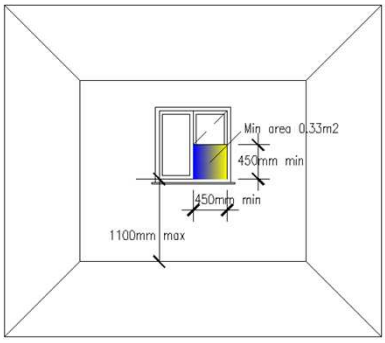
- Escape windows

Basements,
Upper floor apartments and inner rooms



Use as last resort
Windows in a storey > 4.5m, too high above the adjacent ground.

Escape windows should have an unobstructed openable area that is at least 0.33m^2 and at least 450mm high and 450mm wide.
The route through the window may be at an angle rather than straight through and the bottom of the openable area should be not more than 1100mm above the floor.

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- Topmost Storey > 4.5m ≤ 7.5m
- One route of escape and
- Escape windows (inner rooms and upper storeys < 4.5m)
- Early warning (smoke detection &heat detection)
- and either

protected enclosure

suppression system with enhanced early warning system

open plan design with no protected enclosure (kitchen is remote from the exit door)

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suppression system with enhanced early warning system

BS 9251:2005 Sprinkler systems for residential and domestic occupancies

(this BS has been superseded by BS 9251: 2014)

BS 5839: Part 6: 2004

(this BS has been superseded by BS 5839:Pt 6 2013)

LD1 system.

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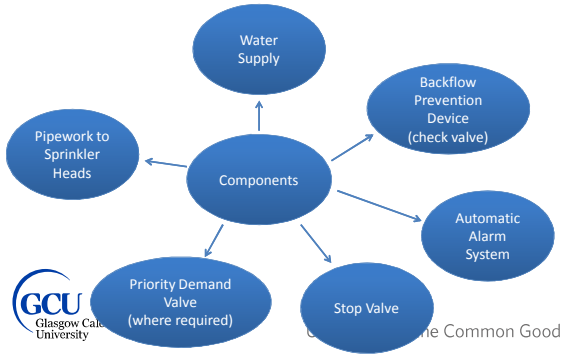
BS 9251:2014

Fire sprinkler systems for domestic and residential occupancies



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'The Welsh Assembly have acted to prevent these needless tragedies and in legislation which received the Royal Assent in April 2011, regulations will be introduced, in 2013 which will require, which will require sprinklers in new and refurbished care homes, hostels and homes in multiple occupation from April 2014 and in all new dwellings from January 2016.'

(http://www.bafsa.org.uk/sprinkler-information/domestic-residential-sprinklers.php, accessed 6/2/2016)

Consultation with Relevant Authorities

Including but not limited to:

- The Water Undertaker
- Fire Authority
- Licencing
- Building Control
- Insurers (dwelling and contents)
- Client

Documentation- Compliance Certificate

On satisfactory completion of the commissioning tests
- compliance certificate issued by the competent person, which attests that the sprinkler system has been designed, installed and commissioned in accordance with BS9251

Design element of the certificate may be provided by another party.

Any variations from BS 9251 should be agreed with the AHJ and should be clearly stated on the compliance certificate.

(BS 9251: 2014)

Competent Person

'person, suitably trained and qualified by knowledge, understanding and practical experience, and provided with the necessary instructions, to enable the required task(s) to be carried out correctly'.

(BS 9251: 2014)

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Documentation

all drawings and documents should bear as a minimum details of the system which should include:

a) the address and location of the premises or, in the case of transportable homes, the chassis or reference number;
b) the name, address and contact details of the competent person;
c) the name and address of the designer if different to the competent person;
d) the date of installation.

(BS 9251: 2014)

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Log book- provided to the occupier, and owner if appropriate, containing:

a) statement of compliance with BS9251 - a signed compliance certificate, together with any variations agreed with the AHJ and justification for the variation;
b) category of system and number of design sprinklers;
c) a general description of the system and a layout drawing of the premises, which should include as-fitted details, showing the extent of the installation, together with a set of the hydraulic calculations, including the system pressure and flow requirements;
d) results of the commissioning tests;
e) a list of components used, identifying the supplier's name and parts reference number;
f) details of the authorities consulted and any response to consultation;
g) details of the water supplies which, if a town main, should include pressure and flow rate data at a specified location for the commissioned installation, with the time and date of the test;
h) a routine inspection and maintenance programme for the system;
i) instructions on the actions to be taken in respect of operation of the system, faults, etc.;
j) a 24 h emergency contact which can be used to obtain assistance;
k) essential information for the user, e.g. "do not paint, cover or in any way impede the operation of a sprinkler head", "no modification should be made to any sprinkler equipment except in accordance with BS 9251:2014"

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(BS 9251: 2014)

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System data label A label or notice should be attached or fixed adjacent to or on the sprinkler riser next to the main sprinkler stop valve as a permanent record of a system's design data.

Example of system data label

Sprinkler system data	
Installed at:	*123 Main Street,* *Town,* *County,* *Postcode*
Installation date	*monthlyear*
Design specification	
Code of practice	*BS 9251:2014*
Category of system	*Category 1*
Hydraulic data	
Sprinklers operating	*2 No.*
Flow/pressure demand	*100 l/min @ 2.5 bar*
Installing contractor	
Name *Address* *Logo*	Contract Reference No. *AB1234*
Third party certification body, if appropriate	*Name*
Certificate URN	*CD5678*

Category of system

Category 1 - Single family dwellings such as:

- Individual dwelling house
- Individual flat
- Individual maisonette
- Blocks of flats 18 m or less in height and with a maximum total floor area of 2400 m^2

Table 2 Minimum design parameters

Category of system (see Table 1)	Minimum design discharge density mm/min	Number of design sprinklers (see 5.5)	Minimum duration of supply min
1	2.04 [A]	1 or 2	10
2	2.80 [B]	1 or 2	30
3	2.80 [C]	2 to 4 [D]	30

[A] Where a sprinkler system is installed as a compensatory feature (see 4.4), the minimum design discharge density should be increased to either:
a) 2.80 mm/min for a single head operation, or 2.04 mm/min through each sprinkler operating simultaneously up to a maximum of two sprinklers in a single area of operation; or
b) 4 mm/min for single head operation, or 2.80 mm/min through each sprinkler operating simultaneously up to a maximum of two sprinklers in a single area of operation.
The increased level of discharge density needed [a) or b) above] should be agreed with the AHJ prior to installation, based on the risk identified.

flow determined by multiplying the discharge density (see Table 2) by the maximum area of operation; or
flow from the sprinkler operation at 0.5 bar; or
approved flow rate specified by the manufacturer for that area of operation.

Sprinkler coverage and positioning

- Maximum area protected by each sprinkler - be in accordance with its approved listing performance or 25 m^2, whichever is the lesser.
- Not more than 5.5 m apart nor more than half the design spacing from any wall or partition.)
- Distance between sprinklers within a compartment not less than 2.4 m, except where there is an intervening constructional feature preventing adjacent sprinklers wetting each other. Sprinklers should be not less than 50 mm or the manufacturer's recommended distance, whichever is greater, from any wall or partition.
- Etc.....see BS 9251:Pt 6 2014

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Exclusions- unless required by a fire strategy or risk assessment, the following may be excluded:

- bathrooms with a floor area < 5 m^2;
- cupboards and pantries with a floor area < 2 m^2 or where the least dimension does not exceed 1 m;
- attached buildings such as garages and boiler houses without direct access from within the protected building;
- crawl spaces;
- ceiling voids;
- external balconies permanently open to the outside;
- uninhabited loft/roof voids.

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Types of supply:

Mains water supply:
- mains pressure only;
- mains water supply boosted by a pump;

Stored water supply:
- pump supplied from a water tank;
- regulated pressurized vessel;
- gravity-fed stored water system.

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Where a pump is used:

a) located such that it is unlikely to be affected by a fire or protected in the event of fire;
b) located where the temperature can be maintained above freezing, or trace heating or lagging applied;
c) protected electrically by suitable fusing. Circuit breakers are not suitable;
d) protected against the effects of fire;
e) of sufficient capacity to ensure that the recommendations given in 5.3.3 are met;
f) operated automatically on demand;
g) continuously rated;
h) constructed from corrosion-resistant material;
i) located such that it is unlikely to be affected by flooding.

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Electrical supply to the pumps- installed have a separately fused connection taken after the meter and from the supply side of the fuse box, using approved fire-resistance cabling.

An alarm device- electrically operated flow switch initiated by the flow of water to a single head with the lowest flow rate.

The alarm device should be either:

a) connected to an internal audible alarm; or
b) interfaced with an automatic fire detection and alarm system.

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Category LD1: a system installed throughout the premises, incorporating detectors in all circulation spaces that form part of the escape routes from the premises, and in all rooms and areas in which fire might start, other than toilets, bathrooms and shower rooms.

Such areas include roof voids, unless it can be determined that there are no significant sources of ignition within the void and no readily combustible materials such as stored items.

The greatest benefit to life safety is given by a full-coverage system (Category LD1).

Such a system will give the earliest practicable warning of fire to occupants, wherever ignition occurs.

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Category LD1 systems might be appropriate as part of a fire engineering solution, in which, for example, structural fire precautions are less than normally required in order to satisfy building regulations or other fire safety legislation.

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Topmost storey >7.5m ≤ 18m

One route of escape and
Early warning (smoke detection &heat detection)
Escape Windows

Houses and Maisonettes

protected enclosure and suppression

or

protected enclosure and alternative exit

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Alternative exits

Offers the opportunity to turn away from the fire on the floor of fire origin and make their escape in the other direction. Where the second route of escape is by way of another private stair, the stair should be enclosed in a protected enclosure which leads to an alternative exit.

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Questions ?

Thank you for your attention.

Comments

email: bill.hay@gcu.ac.uk

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