Transactions of the VŠB - Technical university of Ostrava Vol. VII, No. 2, 2012
Safety Engineering Series p. 63 - 68, DOI 10.2478/v10281-012-0013-x

DOMESTIC SMOKE ALARMS AND SPRINKLERS

Frank SWANN[1]

Review article

Abstract: Making further inroads into the reduction of fire deaths and injuries in the home is a clear ambition of the UK Chief Fire Officers Association (UK CFOA) and fire-fighters alike.

Despite significant falls in the number of people whose lives are blighted by the effects of a domestic fire, the UK still feels it can do more to eradicate fired deaths and injuries.

As this paper will show a consistent campaign to get smoke detectors installed in all properties, existing and new build, has had a dramatic effect. However the UK CFOA has now identified that the next steps to achieve their ambition of 0 fire deaths is to ensure that properties have installed domestic sprinkler systems that will activate in the early stages of a fire.

The campaign has started and the evidence is already starting to build that more lives can be saved!

Key words: Fire Safety, Smoke Alarms, Sprinklers.

Introduction

Legislative change in the UK in 2004 formally gave a responsibility to the Fire and Rescue Service for the delivery of Fire Safety messages for the home. The Fire and Rescue Services Act 2004 (Section 6, Paragraphs 1 and 2) placed a duty upon Fire and Rescue Services to make "provision for the purpose of promoting fire safety in its area" as well as making arrangements for "the provision of information, publicity and encouragement in respect of the steps to be taken to prevent fire and death or injury by fire", and the "giving of advice on request" about how to "prevent fires and restrict their spread in buildings and other property" and advising on the "means of escape from property in case of fire".

The UK Fire and Rescue Services embraced this challenge and began an education programme which included (and still includes today) the fitting of 10 years life battery smoke detectors in any home that requested it. As part of a home fire safety check initiative, fire crews visit dwellings and give their advice on how the occupants can remain safe from fire.

To date thousands of such inspections have been undertaken across the UK and the impact has been significant. In 2010-11 there were 388 fire related deaths in UK, down from 416 in 2009-10 and down from a peak in 1979 of 865.

The majority of fire deaths still occur in dwellings (three-quarters) with 306 of the 388 taking place within the home, so there is still more to do if the approach is to be considered successful.

As a consequence, the UK Chief Fire Officers Association (CFOA) is now lending its weight towards a campaign for a change in legislation to ensure that all new properties being built are fitted with a domestic sprinkler system. Such legislation has been passed in Wales recently. Additionally, campaigns to retrospectively fit sprinklers into some properties has commenced with some positive responses from Local Authority housing managers.

This paper will look at the history behind the good results, what takes place in a home fire risk assessment and why the UK CFOA believes domestic sprinklers is the way forward if fire deaths in the home are to be eradicated.

Materials and methods

Legislative impact

There are two key pieces of legislation which affect domestic fire safety in the UK, and help keep citizens safe within their homes.

The first is the Building Regulations, and the second is the elements of the Fire and Rescue Services Act 2004 which place a duty on local Fire and Rescue Authorities (municipalities) to promote fire safety. The details of both aspects are summarised below.

- Building Regulations

The aspects of building regulations that cover fire safety are contained within Approved Document

[1] Nottinghamshire Fire & Rescue Service, England, United Kingdom, Frank.Swann@notts-fire.gov.uk

B - Fire Safety. Aspect 1 relates to dwelling houses and there are five fundamental parts:

B1 - Relates to means for giving warning and escape routes.

B2 - Relates to internal fire spread (linings).

B3 - Relates to internal fire spread (structure).

B4 - Relates to external fire spread.

B5 - Access for Fire and Rescue Services.

These regulations came into effect in the current guise in April 2007. They also set standards for various aspects of fire safety measures. For example all new dwelling houses must have a fire detector fitted to BS 5839 which has a standby power supply.

Further information on this and more detailed aspects can be found at: www.planningportal.gov.uk/buildingregulations/approveddocuments/.

- Fire and Rescue Services Act 2004 (Act, 2004)

Part 2, Paragraphs 6 (1) and (2) detail the following requirements on Fire and Rescue Services in the UK.

They must make provision for the purposes of promoting fire safety in their area, and they must make arrangements for the provision of information, publicity and advice, advice on how to prevent fires and also on means of escape.

A National Framework (National framework, 2012) issued under Section 21 of the Act also requires Fire Services to identify local risks and make provision for the prevention of those risks, and also to demonstrate how they will mitigate the impact of those risks on the community.

As a consequence of this legislative change in 2004, Fire and Rescue Services across the country engaged in the development of a process called home fire safety checks to meet their new statutory obligation.

Results

Home Fire Safety Checks

Home fire safety checks are delivered by a combination of staff and other arrangements in each service but primarily by on duty firefighters who go out and about within their community whilst they are on duty.

The fire fighters are trained to give advice on fire safety within the home and undertake a form based risk assessment. Fire fighters will fit battery operated smoke detectors (10 year life) free of charge in most areas, and give advice on anything they might find that is not safe. The check is always done at the request of the occupier.

If the property is considered high risk, this may be because the occupant is elderly and less mobile, other agencies and charities may be contacted so that necessary support for the individual can be found.

In more rural areas where firefighters may not be full time, other arrangements with local community workers, charities, or even other employed staff can be used.

All premises visited are retained on a database so that the service can recognise high risk areas and properties within those areas. It also allows the service to monitor if it has incidents at properties where a visit and advice has previous been given to measure the effectiveness of the programme.

Fire fighters now see this as a key element of their role and along with all of their other training at recruit level input in working within the community and advising on smoke detectors, cooking techniques and keeping an escape plan are all given. This ensures that he firefighter is not only trained in how to deal with the fire but is also trained with how to try and prevent it occurring in the first place.

Primary Dwelling fires account for over half of all building fires and around 80 % of all casualties occur in fires in the home. The majority of the fires occurring in dwellings are accidental and the main cause of fires in dwellings remains the misuse of equipment or appliances. Other occurrences include:

- Chip/fat pan fires,
- Playing with matches.

Tab. 1 overleaf, taken from the Fire Statistics Great Britain 2010-11 publication, shows the detail behind these figures.

It is important to note that overall the number of primary dwelling fires fell by 5 % to 44,700 in 2010-11, continuing a downward trend since 1999. 86 % of these were deemed to be accidental in 2010-11, a fall of 4x % from 40300 in 2009-10. This is the lowest number of such fires recorded in more than three decades.

In terms of the causes the misuse of equipment accounted for 14700 cases which were 7 % more than in 2008-09 which was the lowest figure for the decade.

Tab. 2 overleaf (also taken from Fire Statistics GB 2010-11) shows more detail on the sources of ignition recorded.

This shows that cooking appliances were the main source of ignition in accidental dwelling firers (over half in 2010-11). These fires fell by 8 % to 19700 in 2010-11, the sixth consecutive annual fall and a total fall of around a third from the peak of 32000 in 2000-01. Other key changes since 2000-01 were:

Tab. 1 Fires in dwellings and other buildings by cause 2000/01 - 2010/11

Great Britain												Fires (thousands)
Year	Total	Cause										
		Deliberate[2]	Accidental or unspecified causes									
			Total	Faulty fuel supplies	Faulty appliances and leads	Misuse of equipment or appliances	Chip/fat pan fires	Playing with fire	Careless handling of fire or hot substances	Placing articles too close to heat	Other accidental	Un-specified cause
Dwellings[3]												
2000/01	67.4	13.3	54.1	2.0	7.2	19.0	10.3	0.7	4.7	4.7	4.8	0.7
2001/02	66.5	14.3	52.2	2.1	7.4	18.2	8.9	0.7	4.9	4.9	4.6	0.5
2002/03	59.7	12.6	47.1	1.9	6.7	16.3	8.3	0.6	4.3	4.7	3.8	0.5
2003/04	61.7	13.2	48.5	1.8	7.0	17.0	8.1	0.6	4.8	4.3	4.2	0.6
2004/05	57.1	11	46.1	1.8	6.9	16.4	7.0	0.5	4.3	4.2	4.3	0.6
2005/06	55.9	9.8	46.1	1.8	7.0	16.3	6.6	0.5	4.3	4.2	4.6	0.7
2006/07	53.8	9.5	44.3	1.7	7.1	16.2	5.7	0.4	4.2	3.9	4.4	0.7
2007/08	50.4	8.6	41.8	1.6	7.1	14.5	5.2	0.3	4.2	4.1	4.1	0.6
2008/09	47.5	7.9	39.6	1.3	6.0	11.1	4.1	0.2	3.4	3.4	9.4	0.7
2009/10	47.2	..	..	..	..	..	..	..	..	..	..	..
2010/11	44.7	6.2	38.5	2.8	5.8	14.7	2.8	0.3	3.9	4	4	0.1
Other buildings												
2000/01	39.9	17.1	22.8	2.2	6	4.5	0.8	0.1	2.3	1.7	4.5	0.7
2001/02	42.3	19.4	22.9	2.0	6.1	4.6	0.8	0.1	2.2	1.5	4.8	0.8
2002/03	38.1	16.7	21.4	1.6	6.1	3.9	0.8	0.1	2.1	1.7	4.3	0.8
2003/04	40.4	18.3	22.1	1.9	6.2	3.8	0.8	0.1	2.2	1.6	4.8	0.8
2004/05	35.8	14.7	21.1	1.8	6.3	3.9	0.8	0.1	1.8	1.4	4.2	0.8
2005/06	33.8	13.3	20.5	1.7	6.2	3.8	0.7	0.1	1.6	1.4	4.3	0.9
2006/07	31.7	12.4	19.3	1.7	5.9	3.3	0.5	0.0	1.5	1.3	4.1	0.9
2007/08	29.2	11.1	18.1	1.5	5.8	3.0	0.5	0.0	1.4	1.4	3.7	0.8
2008/09	26.1	9.2	16.9	1.2	5.0	2.0	0.3	0.0	1.0	1.1	5.3	0.9
2009/10	26.5	..	..	..	..	..	..	..	..	..	..	..
2010/11	24.9	7.3	17.5	2.1	4.4	2.8	0.5	0.1	1.5	1.4	4.7	0.1

[1] Figures are rounded and the components do not necessarily sum to the independently rounded totals.
[2] Deliberate fires include fires where deliberate ignition was merely suspected (see explanatory note 11).
[3] Includes caravans, houseboats and other non-building structures used solely as a permanent dwelling (see explanatory note 24).

Tab. 2 Accidental fires in dwellings and other buildings by source of ignition 2000/01 - 2010/11

Great Britain													Fires (thousands)
Year	Total	Source of ignition											
		Smokers' materials	Cigarette lighters	Matches	Cooking appliances	Space heating appliances	Central and water heating appliances	Blowlamps, welding and cutting equipment	Electrical distribution	Other electrical appliances	Candles	Other	Un-specified
Dwellings[1]													
2000/01	54.1	3.9	0.5	0.7	32.0	2.3	1.3	0.7	2.7	5.6	1.9	1.8	0.7
2001/02	52.2	4.0	0.6	0.7	29.5	2.0	1.3	0.7	2.7	6.0	2.0	2.0	0.8
2002/03	47.1	3.6	0.5	0.4	27.1	1.7	1.2	0.6	2.5	5.2	1.8	1.8	0.7
2003/04	48.5	4.0	0.5	0.5	27.7	1.5	1.3	0.6	2.7	5.4	1.8	2.0	0.6
2004/05	46.1	3.2	0.4	0.4	26.4	1.6	1.1	0.6	2.8	5.3	1.7	1.8	0.7
2005/06	46.1	3.0	0.4	0.4	26.1	1.7	1.2	0.5	3.0	5.3	1.6	1.9	0.9
2006/07	44.2	3.0	0.5	0.3	25.0	1.6	1.0	0.5	2.9	5.4	1.4	2.0	0.8
2007/08	41.8	3.0	0.4	0.3	23.0	1.5	1.0	0.5	2.9	5.3	1.3	1.9	0.8
2008/09	39.6	2.7	0.3	0.3	21.3	1.6	0.9	0.3	3.2	5.2	1.3	1.9	0.7
2009/10	40.3	..	..	..	..	..	..	..	..	..	..	..	..
2010/11	38.5	2.7	0.3	0.3	19.7	1.7	0.5	0.2	4.0	4.8	1.1	2.2	1.1
Other buildings													
2000/01	22.8	2.0	0.1	0.3	0.8	5.4	0.6	1.1	2.4	5.9	0.3	3.1	0.8
2001/02	22.8	1.9	0.1	0.2	0.9	5.4	0.5	1.1	2.1	5.9	0.2	3.5	1.0
2002/03	21.5	1.9	0.1	0.2	0.7	4.9	0.5	0.8	2.1	5.8	0.2	3.3	1.0
2003/04	22.1	1.9	0.1	0.2	0.7	4.7	0.5	0.7	2.5	5.8	0.2	3.8	1.0
2004/05	21.1	1.5	0.1	0.1	0.6	5.1	0.5	0.7	2.5	6.0	0.2	2.8	0.9
2005/06	20.5	1.3	0.1	0.2	0.7	4.7	0.6	0.6	2.4	5.8	0.2	2.9	1.1
2006/07	19.4	1.2	0.1	0.1	0.5	4.1	0.5	0.6	2.6	5.6	0.1	2.9	1.0
2007/08	18.0	1.1	0.1	0.1	0.6	3.4	0.5	0.7	2.4	5.3	0.2	2.7	1.0
2008/09	16.9	0.7	0.1	0.1	0.5	2.5	0.3	0.5	1.9	4.2	0.1	2.1	3.7
2009/10	..	..	..	..	..	..	..	..	..	..	..	..	..
2010/11	17.5	1.1	0.1	0.2	3.4	0.8	0.2	0.5	3.0	3.3	0.2	3.7	1.3

[1] Includes caravans, houseboats and other non-building structures used solely as a permanent dwelling (see explanatory note 24).

Fires where the source of ignition was smokers materials (cigarettes) fell by around one third. Candle fires are around a third less than the 2000-01 high. (1100 compared to 1900).

- Impact on casualties and fatalities

The impact of the change of approach to prevention has clearly had a noticeable impact on the number of casualties and fatalities that have occurred. These obviously correspond with the reduction in the number of incidents although not directly so.

In 2010-11 there were 388 fire-related deaths in Great Britain, down from 416 in 2009-10. The majority of these deaths occur in dwelling fires (over three-quarters). In 2010-11 11306 deaths were recorded in dwellings down by 13 from 2009-10. The peak in dwelling deaths occurred in 1979 with 865 deaths in dwellings recorded that year.

As in previous years, dwellings also had more fire related deaths per 1000 fires than any other location. In 2010-11 there were 6.8 deaths per 1000 dwelling fires, compared with 1 per 1000 fires in other buildings and 1.4 per 1000 road vehicles (see Fig. 1 below).

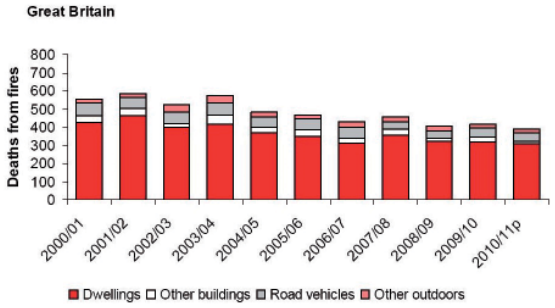

Fig. 1 Deaths from fires by location group 2000/01 - 2010/11

The predominant cause of death from a fire incident is being overcome by gas or smoke. In 2010-11 fire and rescue services reported that 132 people died this way accounting for 34 % of all deaths. A further 69 (18 %) deaths were attributed jointly to burns and overcome by gas and smoke, whilst 95 (24 %) were due to burns alone.

In terms of non-fatal casualties there was a 5 % decrease to 11000 in 2010-11, maintaining a continual fall and is now at its lowest since the mid 1980's. Even so dwelling fires were responsible for the majority of fatal and non-fatal casualties (80 % in 2010-11). Noticeably there were 8900 non-fatal casualties in dwelling fires in 2010-11 which was 13 % higher than in the previous year.

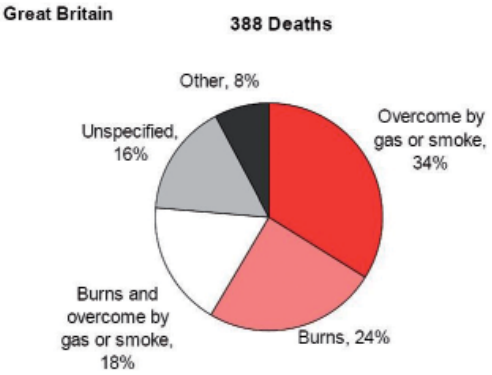

Fig. 2 Deaths by cause 2010/11

- The case for sprinklers

Despite the success that the data shows in terms of reducing fire deaths and injuries overall, further analysis of the type and nature of these incidents and the relationship between smoke detector ownership shows interesting figures.

Survey research shows that the proportion of households with a smoke detector increased rapidly from 8 % in 1988 to 70 % in 1994, but has risen more slowly in later years up to 86 % in 2008 (Source English Housing Survey).

The other interesting factor is that despite such a high ownership ration no smoke detector was present in 37 % of (16400) dwelling fires in 2010-11. These fires accounted for 112 deaths and 2500 non-fatal casualties.

Among the 63 % of dwelling fires where an alarm was present:

- An alarm operated and raised the alarm in 16200 dwelling fires (36 %) resulting in 78 deaths and 3700 casualties.
- An alarm operated and did not raise the alarm in 4400 cases (10 %) resulting in 40 deaths and 1115 casualties.
- An alarm failed to operate in 7800 cases (17 %) resulting in 76 deaths and 1500 casualties.

So in 2010-11 (Fire Statistics Great Britain, 2011) despite overall success in reducing the numbers of those killed or injured in fires, of 306 fatalities, 194 occurred in dwellings where a smoke detector was fitted. (63 %), and of 8918 casualties, 6373 (71 %) took place in dwellings with smoke detectors.

Of those properties considered as dwellings more people therefore die or are injured in properties with smoke detectors than those without, even though the presence of smoke detectors has brought the overall figures down in both areas.

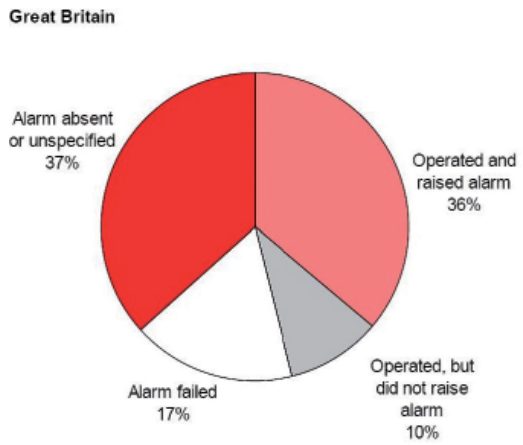

Fig. 3 Fires in dwellings by smoke alarm presence and operation 2010-11

Further work is undertaken in many services to look at contributory factors relating to these figures, such as the reasons behind the alarm failures, why the occupant did not escape in time etc., and whilst each has unique aspects there are some correlations between the findings.

Obvious factors are the siting on the detector, battery failure, faulty systems etc. but services are starting now to explore the social factors. Alcohol dependency, drug usage, mental health issues and mobility are all becoming evident in the investigations carried out (Incident Recording system, 2009).

It is for this reason that the UK Chief Fire Officers Association commissioned BRE Global (Cost Benefit Analysis of residential sprinklers, 2012) to undertake a project to look at the cost benefit analysis of residential sprinklers.

The specific objectives of the project were to update a previous BRE cost benefit analysis published in 2004 and to consider sprinkler protection in new build residential premises related to the impact of future trends of fires and their potential consequences. The sprinkler systems considered were those designed, installed and maintained to British Standard BS 9251:2005 - sprinklers for residential and domestic occupancies.

Parties to this project who formed a stakeholder group were the Chief Fire Officers Association (CFOA), The National Fire Sprinkler Network (NFSN), British Automatic Fire Sprinkler Association (BAFSA), European Fire Sprinkler Network (EFSN), Association of British Insurers (ABI) and the Department for Communities and Local Government (DCLG).

The project took in two phases, phase 1 - life loss and injury (and property protection), phase 2 - economic factors.

Following a comprehensive study the report was published on 1st March 2012, and based upon the cost data supplied by the industry as part of this work and detailed analysis within the report, the provision of residential sprinklers as an additional safety measure are cost effective for:

- All residential care homes for elderly people, children and disabled people (including those with single bedrooms.
- Most blocks of purpose built flats and larger blocks of converted flats where costs are shared.
- Traditional bedsit type houses in multiple occupations where there are at least six units per building and the costs are shared.

As if to prove this in September 2011 Sheffield Homes undertook a project to retro fit sprinklers into a building named Callow Mount (Seaber, 2012). Callow Mount is a high rise block of flats of which there are over 4000 owned or managed by local authorities across the UK. A primary objective of the project was to determine the practicality of installing a complete system without the need to decant residents.

The project commenced on 30 August and was finished by 28 September. Taking less than four weeks to complete the final cost of the project produced an average cost per flat of just under £1150 (Fire Times, 2012).

Conclusion

The UK Chief Fire Officers Association is still pressing for legislative change to include the installation of domestic sprinklers in all new build properties, and following the outcome of the BRE report is working with local housing providers to increase the provision within existing properties identified as being cost effective by the BRE report.

Fire safety advice to people who live in their own homes works, the decline in fire deaths and injuries over the last ten years in the UK proves this. If we are to take this to the next level and eliminate accidental deaths from fire in the home, then sprinklers must for the next phase.

References

Cost Benefit Analysis of residential sprinklers, 2012. Final report. 2012, BRE Global, Client report No. 264227, rev1.1.

Fire Statistics Great Britain, 2011. National Statistics, 2010 - 2011. ISBN 978-1-4098-3235-5.

Fire Times, 2012. New Report From BAFSA busts sprinkler myths. Fire Times. 2012, Vol. 14, No. 4. ISSN 1465-8798.

Incident Recording system - Questions & Lists, Version 1.4 - (XML Schemas v1-0n), 2009. Department for Communities and Local Government. ISBN 978-1-4098-1864-9.

SEABER, S. (2012). Safer High Rise Living. The Callow Mount sprinkler refit project, British Automatic Fire Sprinkler Association 2012.

The Fire and Rescue National framework for England, 2012. HM Government, UK. ISBN 978-1-4098-3569-1.

The Fire & Rescue Services Act, 2004. HM Government, HMSO, UK. ISBN 010542104.9.