East Sussex
Fire & Rescue Service

Fire Engineering Report

Jo Fowler
Fire Engineer

Sheltered Housing Complex
East Sussex

Date of Fire: 24 April 2013

Contents

1. Summary

1.1 On Wednesday 24th April 2013, East Sussex Fire & Rescue Service (the Service) received a call to the fire alarm sounding at a sheltered housing complex in East Sussex. The cause of alarm was a small fire in one of the main corridors, resulting in unexpectedly heavy smoke-logging and the rescue of a number of occupants. An investigation was undertaken to determine the cause of the fire, and in particular the large amounts of smoke produced.

2. The Premises

2.1 This sheltered housing complex is situated in a coastal town in East Sussex. Built in 1985, the 3 storey building comprises 88 flats and a number of common areas. The building is currently operated by a social landlord.

2.2 The premises falls under the Regulatory Reform (Fire Safety) Order 2005 (the RRO) and was last audited by the Service in 2010, where it was found to be satisfactory. There is a comprehensive fire alarm system throughout the premises including automatic smoke detectors and manual call points. The system is monitored by a remote call centre. The fire doors are all in good condition and include intumescent strips, cold smoke seals and self-closing devices.

2.3 The Service has attended a number of false alarms at the premises over the years, although this has improved in the last 2 years.

3. The Fire

3.1 The first call was received by East Sussex Fire & Rescue Service at 07:22hrs on Wednesday 24 April 2013. This call was from the remote call centre informing us that an alarm had operated at the premises. A second call was received from a neighbouring property informing us that the alarm was sounding. Neither of these callers was aware of an actual fire at the premises. No call was received from the premises itself.

3.2 Two appliances were mobilised from the local fire station, which is a Day Crewed station. This means that between 18:30hrs and 08:30hrs the crews respond to alerters from home. The first appliance arrived at the incident 7mins after the initial

call. The first crew on the scene later said that it was not immediately obvious on arrival that there was a fire as staff did not mention this at first.

3.3 When crews went to investigate the cause of the alarm, they were faced with a heavily smoke-logged corridor. There was no indication on approach to the area of any fire in progress. The whole fire compartment was heavily smoke-logged. The first message from this crew at 07:33hrs was 'Persons Reported'. This means that not all persons at the premises had been accounted for. A third appliance and an officer were then mobilised to the scene.

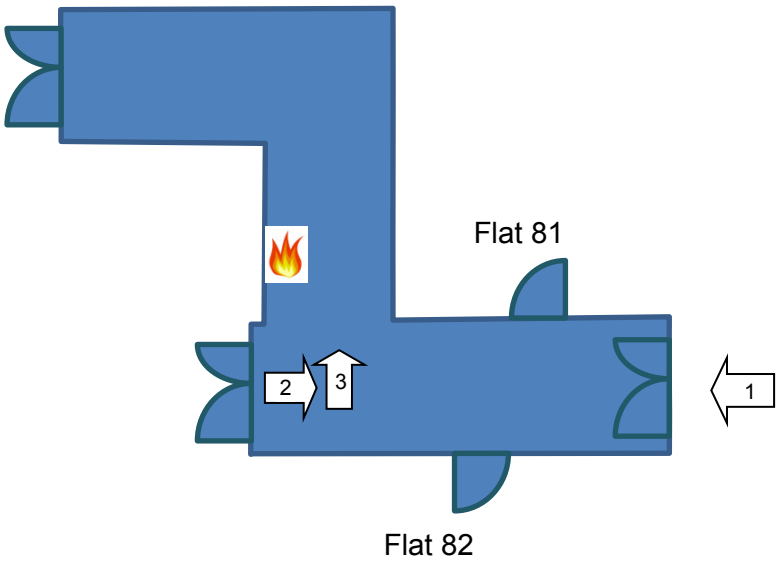
3.4 Once the fire was located, it was quickly and easily extinguished by a breathing apparatus team with a hosereel. Crews assisted the occupants of a number of flats to escape and administered first aid. The incident was upgraded to 4 appliances to assist with evacuation and ultimately 8 occupants were rescued, one of whom was taken to hospital. No serious injuries were sustained and there were no fatalities.

4. The Investigation

4.1 The crews and officers involved were surprised at the significant amount of thick black smoke produced by a relatively small fire in an area that was designed to be 'sterile'. As a protected means of escape, this area should remain free from the products of combustion in the early stages of a fire, allowing occupants to make their own way out of the premises un-aided. The fire safety provisions at the premises appeared to be good, with no obvious reason for the outcome experienced. I was requested to attend and to assist the fire investigation officer to investigate the sequence of events so we could evaluate whether any further action was required by the Service.

Site Visit *(For photographs, see Appendix C)*

4.2 On the morning of the fire, I visited the premises and liaised with the Fire Investigation Officer. Below is a plan of the fire affected area (arrows refer to photo numbers).



4.3 On approach to the fire affected area, there was very little indication of a fire having taken place:-

- some slight smoke staining from fire gases being forced through the doorframe by over-pressure;
- some sooty deposits on the carpet and handrails in the immediate area due to the doors being opened for firefighting;
- a few smudges made by the fire crews *(see Photo 1)*.

4.4 However, on entering the fire compartment there was evidence of significant smoke staining and heavy sooty/carbonaceous deposits on all surfaces *(see photos 2&3)*. The area of burning on the floor was relatively small with a light fitting directly above, recessed into the false ceiling *(see photo 4)*.

4.5 There appeared to be only 2 possibilities for the item first ignited – either the carpet or the light fitting. There were no accidental sources of ignition in the vicinity that could account for the carpet being the item first ignited, and the use of an accelerant on the carpet was discounted by a hydrocarbon dog. Therefore, the most likely item first ignited was the light fitting.

4.6 There was no diffuser on the light fitting or any indication of debris in the seat of fire except 3 or 4 small metal clips. However, examination of a lighting diffuser from a neighbouring light showed that it was held in place by 6 metal clips similar to those found in the seat of fire *(see photo 5)*.

4.7 Although deliberate ignition of the light fitting could not be ruled out, the most likely cause of ignition appeared to be a fault in the light fitting igniting the diffuser, which eventually fell out of the light and onto the carpet below, burning away completely (apart from the metal clips) and leaving only the carpet burning. This would explain why the crews reported that the fire was easy to extinguish. However, this still did not explain why this relatively small fire had produced such heavy sooting and so quickly. We took away a large sample of un-burnt carpet and 2 identical diffusers from neighbouring lights with a view to re-creating the sequence of events.

Product Information

Carpet

4.8 The dark red pile was identified as all synthetic, e.g. acrylic/polyester type. The construction appeared to be of the twisted pile/tufted type and the loose woven backing was also all synthetic with a latex binding adhesive. When tested as a floor covering the sample did not appear to promote rapid flame spread across its pile surface but could continue to burn where ignited. Only moderate smoke was produced. It is my opinion that, if fully tested using the method in BS 4790, it would be likely to achieve a 'Low radius or Medium radius of effects of ignition'. It is likely to be easier to burn than, say, an 80% wool: 20% nylon pile carpet.

4.9 I note that Approved Document B (AD B) to the Building Regulations (see 4.11 and 4.20 below) makes no specific recommendations in respect of floor coverings.

Lighting Diffuser

4.10 The open grid waffle-type diffuser *(see photo 6)* was identified as all thermoplastic – most likely polystyrene; there was no evidence of PVC material or polycarbonate. The sample had no resistance to ignition. Once heated or ignited, the material softened and flowed forming molten flaming drips that spread flame downwards. Large amounts of black smoke were produced during burning.

4.11 Part B2 of the Building Regulations is concerned with internal fire spread (linings). Information provided in section B2 of AD B provides details of the requirements for materials used in respect of resistance to ignition and rate of fire growth (see extracts provided in Appendix A to this report). A lighting diffuser normally forms part of the ceiling lining but they are given special attention in AD B and are not required to meet the same classification for surface spread of flame as the ceiling

lining itself. Appendix A of AD B describes a fire testing process for thermoplastic materials that can result in a classification of TP(a) rigid or flexible, or TP(b) i. or ii., with TP(a) being the most favourable in terms of restricting fire spread and growth. Based on the descriptions of the testing process given in AD B, I would not expect this lighting diffuser to meet the test requirements to satisfy TP(a) rigid. Furthermore, as it is not a polycarbonate sheet, I would not expect it to meet the test requirements to satisfy comply with TP(b) i. Compliance with TP(b) ii. depends on tests using a 3 mm thick solid test specimen that burns when tested at a rate not exceeding 50 mm per minute. We do not have a 3mm thick sample of the material used available to us for fire testing but, given my observations of the fire tests that we did conduct, I would not expect it to comply with the requirements for TP(b) ii.

4.12 It is clear that the requirements in AD B have been included as a means of restricting the growth and spread of fire in parts of the building used for escape. Further information is given from paragraph 4.20 below.

4.13 We noted that the ceiling layout in the corridor of the sheltered housing block complied with Table 11 and Diagram 27 in AD B, as the area of each diffuser was small (0.25m^2) and at least 3m away from neighbouring diffusers. In this respect, the arrangement at the premises appeared to be reasonably compliant.

Test Burns *(For photographs, see Appendix C)*

4.14 Two test burns were carried out. The first took place in the base of the drill tower at the local fire station on the day of the fire and was intended as a quick test to confirm that the assumed sequence of events was possible.

4.15 The second test burn was carried out in the hot fire unit at the Service's Training Centre. It was intended to better simulate the circumstances at the premises and was allowed to burn for longer to investigate how much debris was left.

Test Burn 1 – Fire Station

4.16 A diffuser was balanced across 2 crates approximately 1m high above a section of carpet from the premises *(see photo 7)*. The diffuser ignited readily using a blowtorch and started giving off thick black smoke almost immediately. It then started to drop flaming droplets of molten plastic within 20 secs which ignited the carpet below *(see photo 8)*. The area quickly became uncomfortable to be in due

to the smoke produced and the camera was left recording while we moved outside. After 4 mins 10 secs, the diffuser had melted sufficiently to drop out of the light fitting to the floor, where it continued to burn easily. However, there was minimal fire spread, confirming that the carpet made little contribution to fire growth. After approximately 6 mins the fire was extinguished as the drill tower had not been prepared for a live burn of any significance. Due to the early intervention, there were remnants of unburnt/partially burnt diffuser in the debris *(see photo 9)*.

Test Burn 2 – Training Centre

4.17 The second burn was set up in a metal shipping container, simulating a section of corridor *(see photo 10)*. The doors were open at the end furthest from the test area. The diffuser was hung between 2 chains at approximately 2.1m high and another section of carpet was placed underneath. Again it ignited readily, despite only using a match. The video camera placed inside the unit, but within 2 mins of the diffuser being ignited, the conditions were too uncomfortable to stay due to the airborne particles being generated by the fire. The camera was moved outside the unit for the remainder of the test.

4.18 Similar to the first test burn, flaming droplets started falling at approximately 17 secs, with the diffuser falling to the floor after about 4 min 30 sec. This footage shows the large quantity and poor quality of smoke very well *(see photo 10)*, and supports the evidence from the incident. The fire was eventually extinguished approximately 15 mins after ignition. As reported by the crews at the incident, the fire was easily extinguished, using a short spray of water from a hosereel.

4.19 The carpet looked very similar to that from the incident, containing little debris except the metal clips from the edge of the diffuser *(see photo 11)*.

Legislation & Guidance

Building Regulations *(see Appendix A)*

4.20 The first set of national building standards were introduced in 1965, called The Building Regulations 1965. A major overhaul of these standards occurred in 1985 and the new Building Act 1984 was introduced on 11 November 1985, along with the first set of supporting Approved Documents. Therefore, when this premises was built in 1985, it is likely that the guidance we are using today, in the form of Approved Documents, did not exist.

4.21 I have been unable to view the standards applicable at the time the premises was built to see what was required, if anything, in respect of surface spread of flame. However, Table 10 in the current version of Approved Document B[1] (AD B) requires the surface linings of walls and ceilings in common areas of blocks of flats to be National class 0 or European class B-s3, d2. Note 4 of this table states *"When a classification includes 's3, d2', this means that there is no limit set for smoke production and/or flaming droplets/particles"*.

4.22 AD B does allow the use of some thermoplastic materials which cannot meet the performance required by Table 10 in some instances. This includes lighting diffusers in suspended ceilings, subject to limitations given in paragraphs 6.13-6.15, along with Table 11 and Diagram 27. There is no limit on the use of thermoplastics which, when tested, are found to meet the requirements of a standard referred to as TP(a), whilst some limitations exist on those tested as TP(b). No other thermoplastics may be used.

4.23 In the introduction to section B2 of AD B, it is stated that it is the Secretary of State's view that *"…the requirements of B2 will have been met if the spread of flame over the internal linings of the building is restricted by making provision for them to have low rates of surface spread of flame and, in some cases, to have a low rate of heat release, so as to limit the contribution that the fabric of the building makes to fire growth."* The paragraphs that follow refer to the choice of materials for walls and ceilings and explain how they can affect the spread of a fire and its rate of growth. It also states that this is particularly important in circulation spaces where ***rapid spread*** *is most likely to prevent occupants from escaping*. The same paragraph states that the document does not give detailed guidance on other properties such as *the generation of smoke and fumes*.

4.24 Evidence from the incident at the premises shows that a small fire ignited by a light fitting, which did not spread beyond the item first ignited (the plastic diffuser), was able to seriously compromise the means of escape, rendering it unusable to residents in the block. This was entirely due to the generation of smoke and fumes from a very small fire. This is contradictory to the information given in AD B and appears to be outside of the type of incident considered by the authors of the current version of AD B.

[1] (2006 edition with 2007, 2010 and 2013 amendments)

4.25 Paragraph B2.ii states *"The provisions do not apply to the upper surfaces of floors and stairs because they are not significantly involved in a fire until well developed and thus do not play an important part in fire spread in the early stages of a fire that are most relevant to the safety of occupants".*

4.26 Evidence from this and other similar incidents would suggest that these assertions are not correct. If a floor covering made from materials more flammable than was the case at the premises were to be used in the circulation area, it is quite conceivable that it would be possible to generate a similar volume of smoke and fumes.

LACORS guide: Housing – Fire Safety *(see Appendix B)*

4.27 This guide also refers to the same National and European classes as AD B. It recommends only class 0, B s3 d2 for use in escape routes and stairways. It lists thermosetting plastics as class 3, which are not acceptable on escape routes and stairways. No relaxation is given for limited use in certain circumstances, unlike AD B.

Industry Engagement

4.28 A representative of the Lighting Industry Association was contacted. Their representative informed us that their organisation has been concerned about the issue of polystyrene diffusers for some time. Some 12-15 years ago a company called Insuclear attempted to get Approved Document B amended to only allow polycarbonate and PVC diffusers, which are self-extinguishing. However, there was deemed insufficient evidence at the time to justify this proposal.

4.29 Despite concerns from respondents at the consultation stage, the recent revision of AD B actually saw a relaxation on the restrictions of the use of acrylic and polystyrene diffusers on the grounds that the fire safety track record for luminaires found that they are safe and that the improved light transmission factors with these materials would contribute to energy savings in buildings. Therefore, it is likely that these types of diffusers are very common in means of escape.

Fire & Rescue Experience

4.30 During the course of our investigation, brief details of the incident at the premises were circulated to other UK Fire & Rescue Services via the CFOA Communities. Several responses were received from a number of Services, relaying details of

similar incidents. Of particular note was an incident in Devon & Somerset, where a very similar fire was captured by in-situ CCTV footage. In the video, a light fitting can be seen flickering, shortly followed by burning droplets of plastic from the diffuser, shortly after which the picture is obscured by rapidly spreading smoke. A copy of the CCTV footage is included in Appendix D to this report.

5. Conclusions

5.1 The issue under investigation here was how a fire in a 'sterile' means of escape route could generate so much smoke and fumes so quickly as to prevent occupants from making their own escape unaided. Having ascertained the most likely sequence of events, it was important to determine whether a similar incident could occur in a similar premises built in accordance with current Building Regulations guidance. Furthermore, are there any lessons to be learnt in the thousands of similar premises currently in use today?

5.2 The availability of escape routes in the event of a fire is governed by a number of things:

i. The assumption that fires will only occur in areas other than the escape route by:
   a. limiting the fire loading in the escape route; and
   b. minimising ignition sources in the escape route.

ii. Providing fire resistance between the fire and the escape route.

5.3 In the case of this recent fire in East Sussex, a light fitting in the escape route was the source of ignition and the fire was spread in a localised area by the diffuser and sustained by the carpet. Although AD B places some restrictions on diffusers by limiting the acceptable rate of fire growth of the product, it places no limitation on smoke production and/or flaming droplets/particles, which were the main issues in this incident. Both the lighting and the carpet are not subject to any limitations under AD B, and it must be noted that in this instance the carpet involved actually had a limited rate of burning. If this were not the case, the situation could have been significantly worse.

5.4 Polystyrene type thermoplastic diffusers are still available and in wide-spread use today in a variety of premises. Some websites list them as not suitable for use in means of escape, but with no explanation as to why.

6. Recommendations

East Sussex Fire & Rescue Service recommends that the following actions be taken:

6.1 Share the evidence from this incident with the BRE to encourage further research of the issue. A copy of the report has been sent to David Crowder at BRE.

6.2 Share the evidence from this this incident with DCLG to encourage a review of Approved Document B to ensure this situation does not continue to be supported in new build/altered premises. A copy of the report has been sent to Brian Martin at DCLG.

6.3 Share the evidence from this this incident with colleagues in other Fire & Rescue Services via CFOA Communities to disseminate through education and advice for responsible persons undertaking fire risk assessments under the RRO. A copy of the report has been posted to the CFOA Communities, with a link to the Black Museum (see below).

6.4 Add the incident to the Black Museum Website:-
http://www.esfrs.org/blackmuseum/fluorescentLight.shtml
A Black Museum article has been added to the web site and a copy of the associated video footage has been included.

APPENDIX A – EXTRACT FROM APPROVED DOCUMENT B

(2006 edition with 2007, 2010 & 2013 amendments)

B2

Guidance

Performance

In the Secretary of State's view the Requirements of B2 will be met if the spread of flame over the internal linings of the building is restricted by making provision for them to have low rates of surface spread of flame and, in some cases, to have a low rate of heat release, so as to limit the contribution that the fabric of the building makes to fire growth. In relation to the European fire tests and classification system, the requirements of B2 will be met if the heat released from the internal linings is restricted by making provision for them to have a resistance to ignition and a rate of fire growth which are reasonable in the circumstances.

The extent to which this is necessary is dependent on the location of the lining.

Introduction

Fire spread and lining materials

B2.i The choice of materials for walls and ceilings can significantly affect the spread of a fire and its rate of growth, even though they are not likely to be the materials first ignited.

It is particularly important in circulation spaces where linings may offer the main means by which fire spreads and where rapid spread is most likely to prevent occupants from escaping.

Several properties of lining materials influence fire spread. These include the ease of ignition and the rate at which the lining material gives off heat when burning. The guidance relating to the European fire tests and classification provides for control of internal fire spread through control of these properties. This document does not give detailed guidance on other properties such as the generation of smoke and fumes.

Floors and stairs

B2.ii The provisions do not apply to the upper surfaces of floors and stairs because they are not significantly involved in a fire until well developed and thus do not play an important part in fire spread in the early stages of a fire that are most relevant to the safety of occupants.

However, it should be noted that the construction of some stairs and landings is controlled under Section 5, paragraph 5.19 and in the case of firefighting stairs, Section 17, paragraph 17.11.

Other controls on internal surface properties

B2.iii There is also guidance on the control of flame spread inside buildings in two other Sections. In Section 8 there is guidance on surfaces exposed in concealed spaces above fire-protecting suspended ceilings and in Section 10 on enclosures to above ground drainage system pipes.

Note: External flame spread is dealt with in Sections 12 to 14; the fire behaviour of insulating core panels used for internal structures is dealt with in Appendix F.

Furniture and fittings

B2.iv Furniture and fittings can have a major effect on fire spread but it is not possible to control them through Building Regulations and they are not dealt with in this Approved Document. Fire characteristics of furniture and fittings may be controlled in some buildings under legislation that applies to a building in use, such as licensing conditions.

Classification of performance

B2.v Appendix A describes the different classes of performance and the appropriate methods of test (see paragraphs 7 to 20).

The National classifications used are based on tests in BS 476 *Fire tests on building materials and structures*, namely Part 6: *Method of test for fire propagation for products* and Part 7: *Method of test to determine the classification of the surface spread of flame of products*. However, Part 4: *Non-combustibility test for materials* and Part 11: *Method for assessing the heat emission from building products* are also used as one method of meeting Class 0. Other tests are available for classification of thermoplastic materials if they do not have the appropriate rating under BS 476-7 and three ratings, referred to as TP(a) rigid and TP(a) flexible and TP(b), are used.

The European classifications are described in BS EN 13501-1:2007, *Fire classification of construction products and building elements*, Part 1 – *Classification using data from reaction to fire tests*. They are based on a combination of four European test methods, namely:

- BS EN ISO 1182:2002 *Reaction to fire tests for building products – Non combustibility test;*
- BS EN ISO 1716:2002 *Reaction to fire tests for building products – Determination of the gross calorific value;*
- BS EN 13823:2002 *Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning item;* and
- BS EN ISO 11925-2:2002, *Reaction to fire tests for building products. Ignitability when subjected to direct impingement of flame.*

For some building products, there is currently no generally accepted guidance on the appropriate procedure for testing and classification in accordance with the harmonised European fire tests. Until such a time that the appropriate European test and classification methods for these building products are published, classification may only be possible using existing national test methods.

Table A8, in Appendix A, gives typical performance ratings which may be achieved by some generic materials and products.

Section 6: Wall and ceiling linings

Classification of linings

6.1 Subject to the variations and specific provisions described in paragraphs 6.2 to 6.16, the surface linings of walls and ceilings should meet the following classifications:

Table 10 Classification of linings

Location	National class [1]	European class [1][3][4]
Small rooms [2] of area not more than: a. 4m² in residential accommodation b. 30m² in non-residential accommodation	3	D-s3, d2
Other rooms [2] (including garages)	1	C-s3, d2
Circulation spaces within dwellings		
Other circulation spaces, including the common areas of blocks of flats	0	B-s3, d2 [5]

Notes:

1. See paragraph B2.v.
2. For meaning of room, see definition in Appendix E.
3. The National classifications do not automatically equate with the equivalent classifications in the European column, therefore, products cannot typically assume a European class, unless they have been tested accordingly.
4. When a classification includes 's3, d2', this means that there is no limit set for smoke production and/or flaming droplets/particles.
5. Wallcoverings which conform to BS EN 15102:2007 *Decorative wallcoverings – roll and panel form products*, which achieve at least Class C-s3,d2 and are bonded to a Class A2-s3,d2 substrate will also be acceptable.

Definition of walls

6.2 For the purpose of the performance of wall linings, a wall includes:

a. the surface of glazing (except glazing in doors); and

b. any part of a ceiling which slopes at an angle of more than 70° to the horizontal.

But a wall does not include:

c. doors and door frames;

d. window frames and frames in which glazing is fitted;

e. architraves, cover moulds, picture rails, skirtings and similar narrow members; or

f. fireplace surrounds, mantle shelves and fitted furniture.

Definition of ceilings

6.3 For the purposes of the performance of ceiling linings, a ceiling includes:

a. the surface of glazing;

b. any part of a wall which slopes at an angle of 70° or less to the horizontal;

c. the underside of a mezzanine or gallery; and

d. the underside of a roof exposed to the room below.

But a ceiling does not include:

e. trap doors and their frames;

f. the frames of windows or rooflights (see Appendix E) and frames in which glazing is fitted; or

g. architraves, cover moulds, picture rails, exposed beams and similar narrow members.

Variations and special provisions

Walls

6.4 Parts of walls in rooms may be of a poorer performance than specified in paragraph 6.1 and Table 10 (but not poorer than Class 3 (National class) or Class D-s3, d2 (European class)), provided the total area of those parts in any one room does not exceed one half of the floor area of the room; and subject to a maximum of 20m² in residential accommodation and 60m² in non-residential accommodation.

Fire-protecting suspended ceilings

6.5 A suspended ceiling can contribute to the overall fire resistance of a floor/ceiling assembly. Such a ceiling should satisfy paragraph 6.1 and Table 10. It should also meet the provisions of Appendix A, Table A3.

Fire-resisting ceilings

6.6 Cavity barriers are needed in some concealed floor or roof spaces (see Section 9); however, this need can be reduced by the use of a fire-resisting ceiling below the cavity. Such a ceiling should comply with Diagram 35.

Rooflights

6.7 Rooflights should meet the relevant classification in 6.1 and Table 10. However plastic rooflights with at least a Class 3 rating may be used where 6.1 calls for a higher standard, provided the limitations in Table 11 and Table 18 are observed.

Note: No guidance is currently possible on the performance requirements in the European fire tests as there is no generally accepted test and classification procedure.

Special applications

6.8 Any flexible membrane covering a structure (other than an air supported structure) should comply with the recommendations given in Appendix A of BS 7157:1989.

6.9 Guidance on the use of PTFE-based materials for tension-membrane roofs and structures is given in a BRE report *Fire safety of PTFE-based materials used in buildings* (BR 274, BRE 1994).

Thermoplastic materials

General

6.10 Thermoplastic materials (see Appendix A, paragraph 17) which cannot meet the performance given in Table 10, can nevertheless be used in windows, rooflights and lighting diffusers in suspended ceilings if they comply with the provisions described in paragraphs 6.11 to 6.15. Flexible thermoplastic material may be used in panels to form a suspended ceiling if it complies with the guidance in paragraph 6.16. The classifications used in paragraphs 6.11 to 6.16, Table 11 and Diagram 27 are explained in Appendix A, paragraph 20.

Note: No guidance is currently possible on the performance requirements in the European fire tests as there is no generally accepted test and classification procedure.

Windows and internal glazing

6.11 External windows to rooms (though not to circulation spaces) may be glazed with thermoplastic materials, if the material can be classified as a TP(a) rigid product.

Internal glazing should meet the provisions in paragraph 6.1 and Table 10 above.

Note 1: A "wall" does not include glazing in a door (see paragraph 6.2).

Note 2: Attention is drawn to the guidance on the safety of glazing in Approved Document N *Glazing – safety in relation to impact, opening and cleaning*.

Rooflights

6.12 Rooflights to rooms and circulation spaces (with the exception of protected stairways) may be constructed of a thermoplastic material if:

a. the lower surface has a TP(a) (rigid) or TP(b) classification;

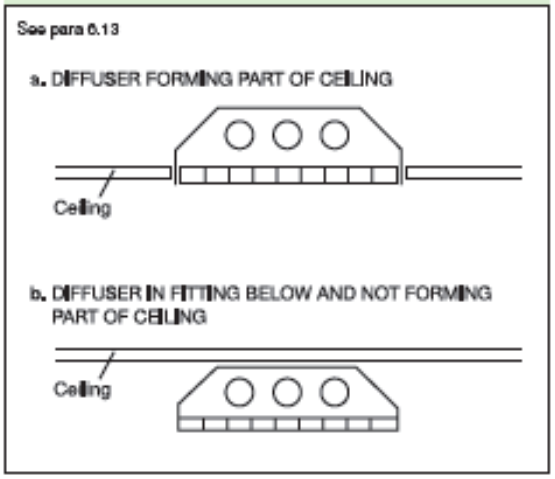
b. the size and disposition of the rooflights accords with the limits in Table 11 and with the guidance to B4 in Tables 17 and 18.

Lighting diffusers

6.13 The following provisions apply to lighting diffusers which form part of a ceiling and are not concerned with diffusers of light fittings which are attached to the soffit of, or suspended beneath, a ceiling (see Diagram 26).

Lighting diffusers are translucent or open-structured elements that allow light to pass through. They may be part of a luminaire or used below rooflights or other sources of light.

Diagram 26 Lighting diffuser in relation to ceiling



6.14 Thermoplastic lighting diffusers should not be used in fire-protecting or fire-resisting ceilings, unless they have been satisfactorily tested as part of the ceiling system that is to be used to provide the appropriate fire protection.

6.15 Subject to the above paragraphs, ceilings to rooms and circulation spaces (but not protected stairways) may incorporate thermoplastic lighting diffusers if the following provisions are observed:

a. Wall and ceiling surfaces exposed within the space above the suspended ceiling (other than the upper surfaces of the thermoplastic panels) should comply with the general provisions of paragraph 6.1 and Table 10, according to the type of space below the suspended ceiling.

b. If the diffusers are of classification TP(a) (rigid), there are no restrictions on their extent.

c. If the diffusers are of classification TP(b), they should be limited in extent as indicated in Table 11 and Diagram 27.

Suspended or stretched-skin ceilings

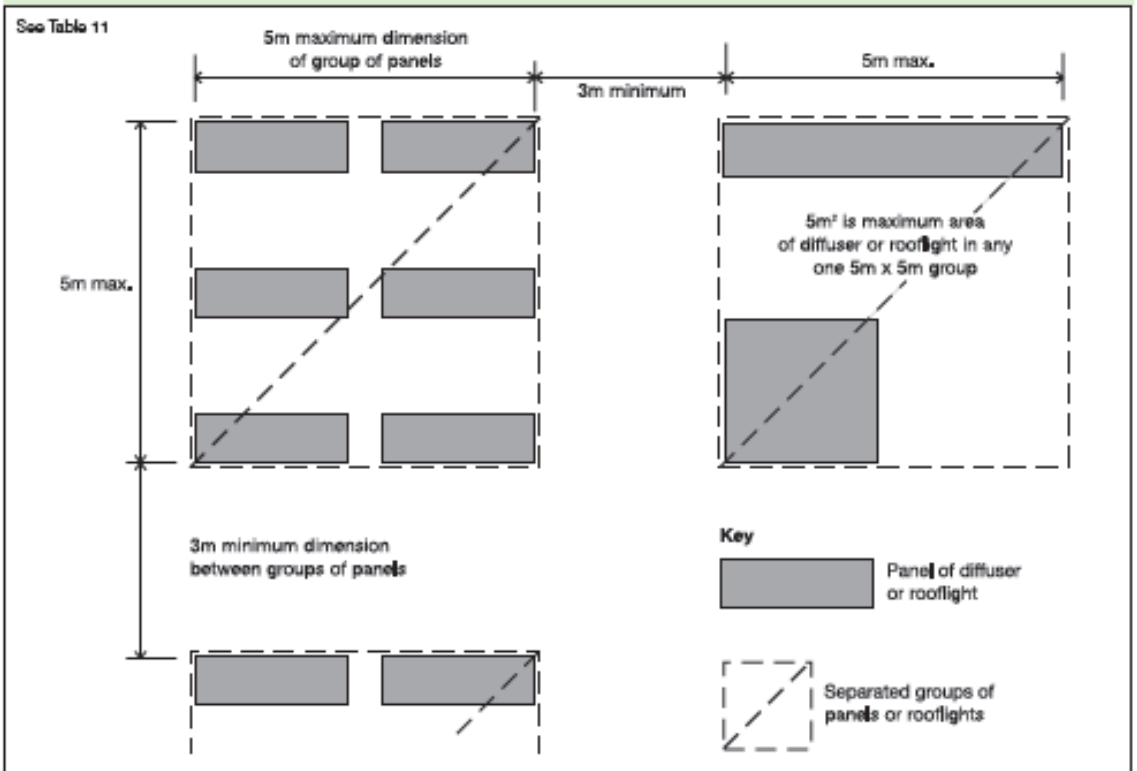
6.16 The ceiling of a room may be constructed either as a suspended or as a stretched skin membrane from panels of a thermoplastic material of the TP(a) flexible classification, provided that it is not part of a fire-resisting ceiling. Each panel should not exceed 5m^2 in area and should be supported on all its sides.

Table 11 Limitations applied to thermoplastic rooflights and lighting diffusers in suspended ceilings and Class 3 plastic rooflights

Minimum classification of lower surface	Use of space below the diffusers or rooflight	Maximum area of each diffuser panel or rooflight [1] (m^2)	Max total area of diffuser panels and rooflights as percentage of floor area of the space in which the ceiling is located (%)	Minimum separation distance between diffuser panels or rooflights [1] (m)
TP(a)	Any except protected stairway	No limit [2]	No limit	No limit
D-s3, d2 or Class 3 [3] or TP(b)	Rooms	1	50 [4][5]	A distance equal to the largest plan dimension of the largest diffuser or roof light (see diagram 27A)
		5	50 [4][5]	3 [5]
	Circulation spaces except protected stairways	5	15 [4]	3

Notes:
1. Smaller panels can be grouped together provided that the overall size of the group and the space between one group and any others satisfies the dimensions shown in Diagram 27 or 27A.
2. Lighting diffusers of TP(a) flexible rating should be restricted to panels of not more than 5m² each, see paragraph 6.16.
3. There are no limits on Class 3 material in small rooms. See paragraph 6.1, Table 10.
4. The minimum separation between each panel should be maintained. Therefore, in some cases it may not also be possible to use the maximum percentage quoted.
5. Class 3 / D-s3, d2 rooflights to rooms in industrial and other non-residential purpose groups may be spaced 1800mm apart provided the rooflights are evenly distributed and do not exceed 20% of the area of the room.
6. This table is not relevant to products which meet the provisions in Table 10.

Diagram 27 Layout restrictions on Class 3 plastic rooflights, TP(b) rooflights and TP(b) lighting diffusers



Notes:
a Upper and lower surface of suspended ceiling, between plastic panels, to comply with paragraph 5.1
b No restriction on Class 3 rooflights in small rooms
c See Note 5 to Table 11

Method of test to determine the classification of the surface spread of flame of products under which materials or products are classified 1, 2, 3 or 4 with Class 1 being the highest.

Under the European classifications, lining systems are classified in accordance with BS EN 13501-1:2007, *Fire classification of construction products and building elements,* Part 1 – *Classification using data from reaction to fire tests.* Materials or products are classified as A1, A2, B, C, D, E or F, with A1 being the highest. When a classification includes "s3, d2", it means that there is no limit set for smoke production and/or flaming droplets/particles.

12 To restrict the use of materials which ignite easily, which have a high rate of heat release and/or which reduce the time to flashover, maximum acceptable 'fire propagation' indices are specified, where the National test methods are being followed. These are determined by reference to the method specified in BS 476-6:1981 or 1989 *Method of test for fire propagation of products.* Index of performance (I) relates to the overall test performance, whereas sub-index (i1) is derived from the first three minutes of test.

13 The highest National product performance classification for lining materials is Class 0. This is achieved if a material or the surface of a composite product is either:

a. composed throughout of materials of limited combustibility; or

b. a Class 1 material which has a fire propagation index (I) of not more than 12 and sub-index (i1) of not more than 6.

Note: Class 0 is not a classification identified in any British Standard test.

14 Composite products defined as materials of limited combustibility (see paragraph 9 above and Table A7) should in addition comply with the test requirement appropriate to any surface rating specified in the guidance on requirements B2, B3 and B4.

15 The notional performance ratings of certain widely used generic materials or products are listed in Table A8 in terms of their performance in the traditional lining tests BS 476 Parts 6 and 7 or in accordance with BS EN 13501-1:2007, *Fire classification of construction products and building elements,* Part 1 – *Classification using data from reaction to fire tests.*

16 Results of tests on proprietary materials are frequently given in literature available from manufacturers and trade associations.

Any reference used to substantiate the surface spread of flame rating of a material or product should be carefully checked to ensure that it is suitable, adequate and applicable to the construction to be used. Small differences in detail, such as thickness, substrate, colour, form, fixings, adhesive etc, may significantly affect the rating.

To reduce the testing burden on manufacturers, BS EN 13238 Reaction to fire tests for building products – conditioning procedures and general rules for the selection of standard substrates, defines a number of standard substrates that produce test results representative of different end use applications. The standard substrate selected for testing should take account of the intended end use applications (field of application) of the product and represent end use substrates which have a density of at least 75% of its nominal density. The reaction to fire classification achieved during testing is only valid when the product is used within this field of application i.e. when the product is fixed to a substrate of that class in its end use.

Standard substrates include, Gypsum plasterboard (BS EN 520) with a density of 700+/-100 Kg/m^3, Calcium silicate board (BS EN 14306) 870+/-50 Kg/m^3 and Fibre cement board 1800+/-200 Kg/m^3.

Note: Standard calcium silicate board is not representative of gypsum plasterboard end use (due to the paper layer), but would be representative of most gypsum plasters (with densities of more than 650 Kg/m^3). Classifications based on tests using a plasterboard substrate would also be acceptable for products bonded to a gypsum plaster end use substrate.

Thermoplastic materials

17 A thermoplastic material means any synthetic polymeric material which has a softening point below 200ºC if tested to BS EN ISO 306:2004 method A120 *Plastics – Thermoplastic materials – Determination of Vicat softening temperature.* Specimens for this test may be fabricated from the original polymer where the thickness of material of the end product is less than 2.5mm.

18 A thermoplastic material in isolation can not be assumed to protect a substrate, when used as a lining to a wall or ceiling. The surface rating of both products must therefore meet the required classification. If however, the thermoplastic material is fully bonded to a non-thermoplastic substrate, then only the surface rating of the composite will need to comply.

19 Concessions are made for thermoplastic materials used for window glazing, rooflights and lighting diffusers within suspended ceilings, which may not comply with the criteria specified in paragraphs 11 onwards. They are described in the guidance on requirements B2 and B4.

20 For the purposes of the requirements B2 and B4 thermoplastic materials should either be used according to their classification 0-3, under the BS 476: Parts 6 and 7 tests as described in paragraphs 11 onwards, (if they have such a rating), or they may be classified TP(a) rigid, TP(a) flexible, or TP(b) according to the following methods:

TP(a) rigid:

i. rigid solid PVC sheet;

ii. solid (as distinct from double- or multiple-skin) polycarbonate sheet at least 3mm thick;

iii. multi-skinned rigid sheet made from unplasticised PVC or polycarbonate which has a Class 1 rating when tested to BS 476-7:1971, 1987 or 1997; or

iv. any other rigid thermoplastic product, a specimen of which (at the thickness of the product as put on the market), when tested to BS 2782-0:2004 Method 508A *Rate of burning, Laboratory method*, performs so that the test flame extinguishes before the first mark and the duration of flaming or afterglow does not exceed 5 seconds following removal of the burner.

TP(a) flexible:

Flexible products not more than 1mm thick which comply with the Type C requirements of BS 5867-2:1980 *Specification for fabrics for curtains and drapes – Flammability requirements* when tested to BS 5438:1989 *Methods of test for flammability of textile fabrics when subjected to a small igniting flame applied to the face or bottom edge of vertically oriented specimens*, Test 2, with the flame applied to the surface of the specimens for 5, 15, 20 and 30 seconds respectively, but excluding the cleansing procedure; and

TP(b):

i. rigid solid polycarbonate sheet products less than 3mm thick, or multiple-skin polycarbonate sheet products which do not qualify as TP(a) by test; or

ii. other products which, when a specimen of the material between 1.5 and 3mm thick is tested in accordance with BS 2782-0:2004 Method 508A, has a rate of burning which does not exceed 50mm/minute.

Note: If it is not possible to cut or machine a 3mm thick specimen from the product then a 3mm test specimen can be moulded from the same material as that used for the manufacture of the product.

Note: Currently, no new guidance is possible on the assessment or classification of thermoplastic materials under the European system since there is no generally accepted European test procedure and supporting comparative data.

Fire test methods

21 A guide to the various test methods in BS 476 and BS 2782 is given in PD 6520: *Guide to fire test methods for building materials and elements of construction* (available from the British Standards Institution).

A guide to the development and presentation of fire tests and their use in hazard assessment is given in BS 6336:1998 *Guide to development and presentation of fire tests and their use in hazard assessment.*

rooms in HMOs should be marked 'Fire door keep shut' (see figure C9). Doors to cupboards, stores and boiler rooms opening onto the escape route should be marked 'Fire door keep locked shut'. These provisions can be relaxed in normal-risk shared houses.

27.6 Where fire safety signs are provided they should be in accordance with BS 5499 and the Health and Safety (Safety Signs and Signals) Regulations 1996.

27.7 To comply, directional signs must be pictographic (see examples C7 and C8 below). The pictogram can be supplemented by text to make the sign easily understood, but it cannot contain only text. 'Pictogram only' and 'pictogram with text' sign types should not be mixed in the same premises. Whilst either type of sign is acceptable, the pictogram with text style (figure C7) is thought to be more readily understood.

Figure C7: Directional escape sign (pictogram with text)

Figure C8: Directional escape sign (pictogram only)

Figure C9: Notice for fire resisting doors

27.8 Where the risk is such that directional signs indicating the escape route are considered necessary, they should meet the following criteria:

- they should provide clear, unambiguous information to enable people to safely leave a building in an emergency;
- every escape route sign should, where necessary, either incorporate or be accompanied by a directional arrow (arrows should not be used on their own);
- in long or complex escape routes, signs should be positioned so that a person escaping will always have the next escape route sign in sight;
- signs should be fixed above the door in the direction of escape and not be fixed to doors, as they will not be visible if the door is open;
- signs mounted above doors should be at a height of between 2m and 2.5m above the floor;
- signs on walls should be mounted between 1.7m and 2m above the floor;
- mounting heights greater than 2.5m may be used for hanging signs (for example in large open spaces or for operational reasons) but care should be taken to ensure that such signs are both conspicuous and legible. In such cases larger signs may be necessary;
- signs within the same premises should follow a consistent design pattern or scheme throughout; and
- signs should be sited at the same height throughout the escape route, as far as is reasonably practicable.

28. Surface finishes

28.1 In the early stages of a fire, the safety of a building's occupants can be affected by the properties of surface linings and the finishes of walls, ceilings and soffits. Rapid spread of flame across surfaces allows the fire to spread more quickly through the building, thereby reducing the time for escape. This is of particular concern in escape routes, especially in single staircase buildings. Arson is a particular problem in this respect: fires started deliberately can be particularly dangerous because they generally develop much faster. In multi-occupancy buildings they are often started in escape routes, as access is more easily gained to these areas.

28.2 In single household occupancy and some shared houses where the occupiers have exclusive control of the escape route, the risk may be low. No specific measures will therefore be required in respect of surface finishes. However, good practice would be to reduce the risk further by avoiding combustible surface finishes within the escape route.

28.3 In multiple-occupancy buildings the risk is usually higher. Combustible surface finishes should not be permitted within the escape route and should, as far as is practicable, also be avoided in other locations. However, in some HMOs the risk may be lowered by other fire precautions, such as in:

- two-storey buildings with suitable escape windows from all risk rooms (see paragraph 14);
- buildings where there is a second staircase or secondary means of escape which meets certain standards (see paragraphs 17-18); and

- buildings with additional fire safety measures such as a water suppression system.

In such cases the premises may be considered lower risk and the precautions outlined below in respect of surface finishes and floor coverings could be varied accordingly.

28.4 Materials are classified for combustibility and surface spread of flame by BS 476: parts 6 and 7 or under the European system by BS EN 13501-1.

28.5 Fire spread across surface finishes is classified as set out in table C6 below, with class 0 being the most resistant and class 3 the least. Classes 0-3 (or A-D) are suitable in multi-occupied residential accommodation, but should be restricted in some locations. Table C6 outlines their suitability for different locations within a multi-occupied property.

Table C6: Suitable classes of surface finish in certain locations in multi-occupied residential buildings

Class 0, B s3, d2
These are non-combustible materials and materials of limited combustibility such as brickwork, concrete, plasterboard and plastered finishes.
Acceptable in all locations including protected routes, circulation routes, escape routes and stairways.

Class 1, C s3, d2
These include timber, particleboard, hardboard and surfaces covered with heavy flock wallpaper, provided they have been treated with flame retardant materials.
Acceptable in rooms.

Class 3, D s3, d2
These include those specified in class 1 with the addition of thermosetting plastics and surfaces covered with polystyrene wall and ceiling tiles.
Not acceptable on escape routes and stairways.
Acceptable in small rooms and parts of other rooms if the total area does not exceed more than one half of the floor area up to a maximum of 20m².

Not acceptable on escape routes and stairways.

28.6 It is very difficult to identify the classification of existing coverings on-site unless the trade name of the product can be traced. Table C6 illustrates acceptable locations for materials and products commonly encountered.

28.7 Multiple layers of gloss paint: surfaces may be found where multiple layers of gloss paint have been applied. These surfaces may present a risk of fire spread. Therefore it is recommended that the paint is removed from locations requiring a class 1 (or C s3, d2) or class 0 (C s3, d2) classification. Proprietary products may be available which can cover the paint, thereby providing an acceptable classification for the surface. These should only be used subject to a satisfactory fire test report but may not be suitable for areas subject to heavy wear and tear.

29. Floor coverings

29.1 Floor coverings throughout the protected route (i.e. stairways, hallways, landings and lobbies) of all categories of HMO should conform to low radius of fire spread (up to 35mm) when tested in accordance with BS 4790 or the European equivalent. It is good practice to adhere to this in all categories of HMO, although in lower risk shared houses this requirement may be relaxed.

29.2 BS 5287 Specification for assessment and labelling of textile floor coverings tested to BS 4790 specifies how these tested floor coverings should be labelled.

29.3 It is, of course, difficult to assess existing floor coverings in HMOs unless the supplier/manufacturer can be traced. As a general guide for existing carpets, those comprising a mix of 80% wool and 20% synthetic fibre (commonly referred to as 80/20 carpets) will comply. Many vinyl, linoleum and laminate floor coverings may not be suitable and will need replacing.

29.4 When considering the suitability of new floor coverings for protected routes it is sufficient to ensure they are labelled to BS 5287 or the European equivalent as low radius of fire spread (up to 35mm). Suppliers/manufacturers will be able to verify this (or otherwise).

30. Special provisions relating to 'back-to-back' houses

30.1 In certain areas of the country there remain a significant number of 'back-to-back' houses. These typically back directly onto one another at the party

APPENDIX C – PHOTOGRAPHS

Photo 1 – Corridor immediately outside the fire compartment

Photo 2 – Inside the fire compartment

Photo 3 – Seat of fire and light fitting above

Photo 4 – Light fitting above seat of fire showing heavy sooty deposits

Photo 5 – Neighbouring light fitting showing diffuser in place

Photo 6
Lighting diffuser used

Photo 7 – Test Burn 1
Test set-up

Photo 8 – Test Burn 1
Flaming molten droplets

Photo 9 – Test Burn 1
Fire debris

Photo 10 – Test Burn 2
Hot Fire Unit

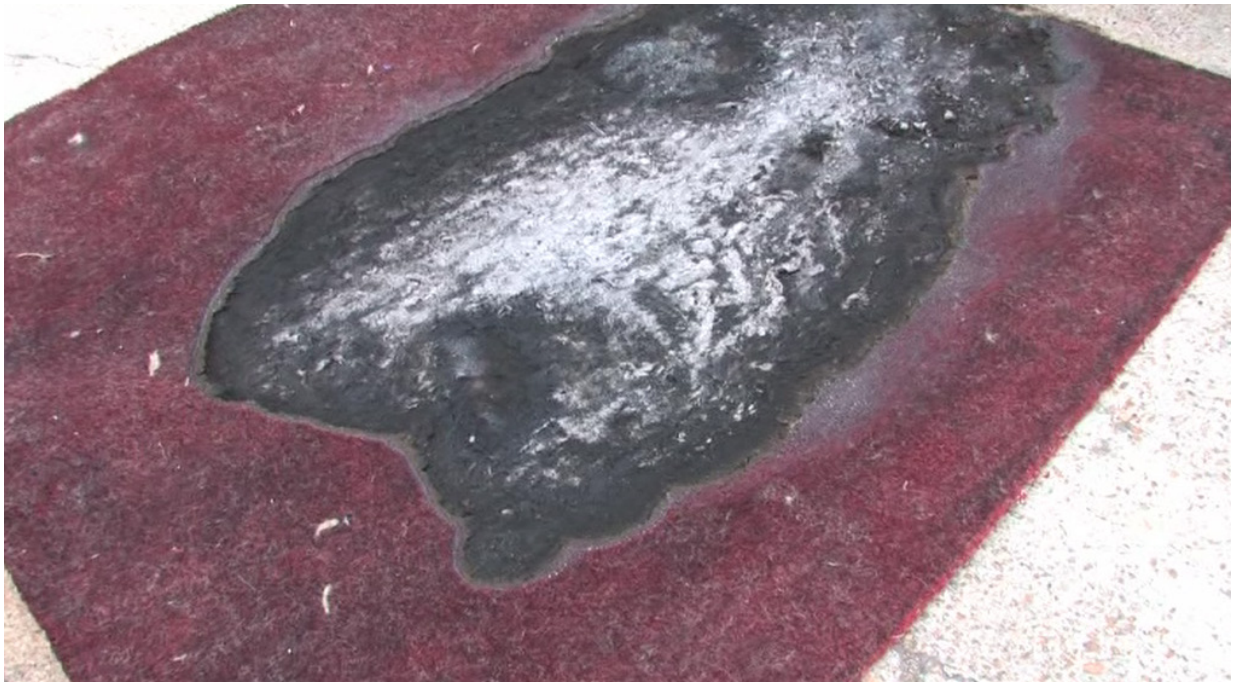


Photo 11 – Test Burn 2
Test specimen

APPENDIX D – DVD

Contents:

1. Test Burn 1 – Fire Station
2. Premises walk round
3. Test Burn 2 – ESFRS Training Centre
4. CCTV footage – Devon & Somerset FRS

Report by:

Jo Fowler
Fire Engineer

Tel: (01323) 462404
Email: jo.fowler@esfrs.org

ESFRS Headquarters
20 Upperton Road
Eastbourne
BN21 1EU

Black Museum case for this incident available for public viewing at:
http://www.esfrs.org/blackmuseum/fluorescentLight.shtml