

The Rosepark Fire: Ignition and early development

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HSL involvement



- Incident investigated by Strathclyde Police and HSE
- HSL commissioned by Mr J Madden, Specialist Electrical Inspector, HSE

HSL objectives

Examine early stages of fire while confined to cupboard, in particular:

- Examine potential for electrical faults to ignite other fuels in cupboard.
- Examine resulting pattern of burning.
- Examine early stages of fire growth and specify fire on break out from cupboard, identify critical timings and compare resulting damage pattern with incident.

This presentation and test programme



- Brief recap of damage in cupboard.
- Tests on distribution board materials.
- Test fires within distribution board casing.
- Fires with cupboard mock-up.
- Spark ignition tests with potential fuels.

Additional testing was also carried out to examine the role played by two upholstered chairs found in the corridor.

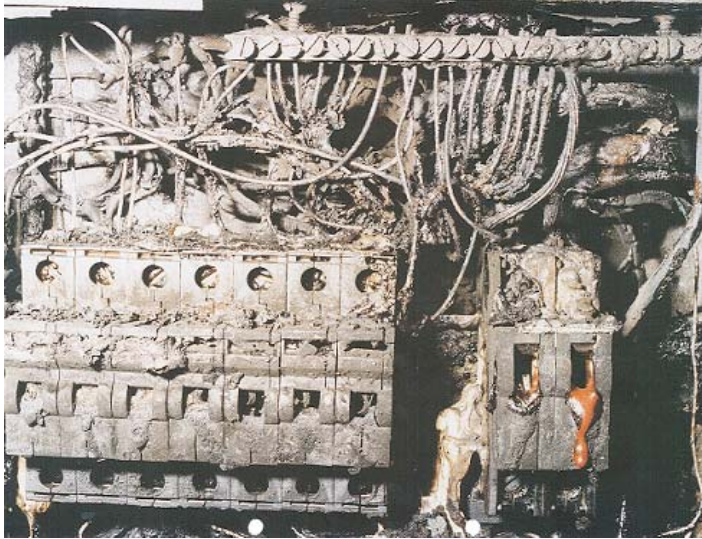
Damage to incident cupboard



**Doors not totally consumed
but greater damage higher
up**

**Major damage on lower LHS
– evidence for fire in plastic
items**

Incident distribution board



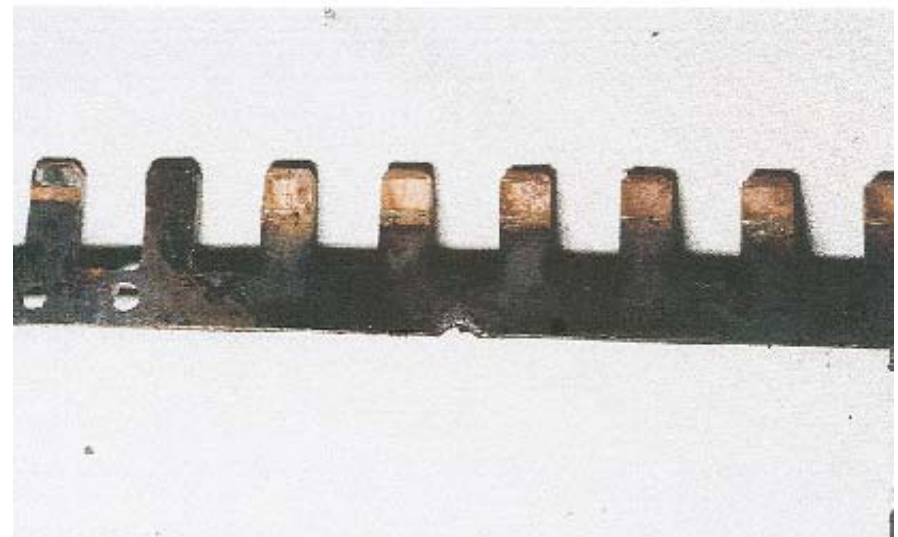
Some evidence for damage to electrical wiring in distribution board casing

Some erosion of copper bus bar

Erosion of a rear cable entry point

Coincident with cable melting/erosion

Possible arcing locations



Tests with distribution board materials 1

- **Laboratory analysis of distribution board materials**

FTIR, GC and MS to identify materials

eg MCB material – glass reinforced nylon 6-6 with added fire retardant

- **Conclusion**

Materials were as specified and fit for purpose

Tests with distribution board materials 2

Glow wire testing - BS 6458-2.1 (1984)

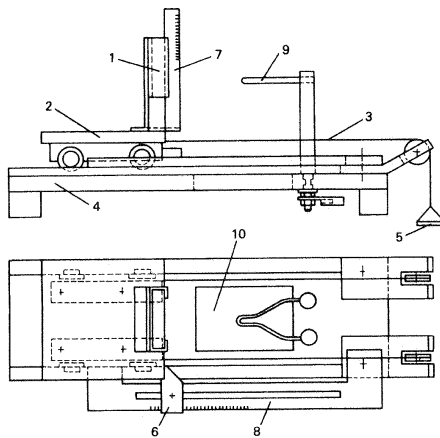
Electrically heated glow wire at temperatures up to 960°C.

Tip of the glow wire is pressed into surface of the plastic component.

Parameters such as penetration depth and presence of flame, smoke noted.

To be compliant, plastics used for parts of the distribution board must withstand a range of glow wire temperatures, dependent on proximity to conducting metal parts.

Tests here went beyond the standard



- | | |
|---------------------|--|
| 1 positioning clamp | 6 stop |
| 2 carriage | 7 scale for measure of flame |
| 3 tensioning cord | 8 scale for penetration |
| 4 base plate | 9 glow-wire (Fig. 1) |
| 5 weight | 10 break-through in base plate for particles falling from the specimen |

Conclusion: All materials fit for purpose

Tests with distribution board materials 3

- **Bus bar temperature tests**

Check if bus bar could attain a temperature sufficient to damage PVC insulation

Board fitted out as in incident

6 hours @ 83 a (normal) – temp 27.7°C

14 hours @ 102 a (overload) – temp 36.5°C

- **Conclusion**

No melting of PVC insulation

Fires in distribution board

- Two forms of testing

Flame impingement on mcbs

Fires internal to the distribution board casing

MCB flame impingement tests

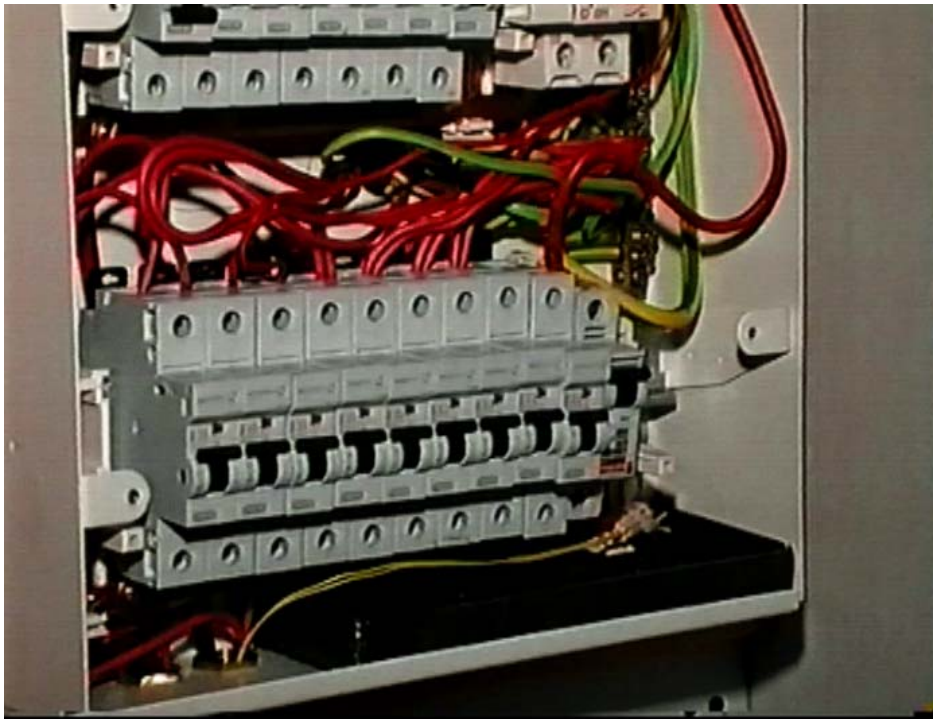


- Test to examine behaviour of mcbs to open flaming
- Merlin Gerin and MEM mcbs under load
- Exposed to 2 of BS No 7 cribs
- Both mcbs tripped
- Damage consistent with incident mcbs

Fires inside distribution board 1

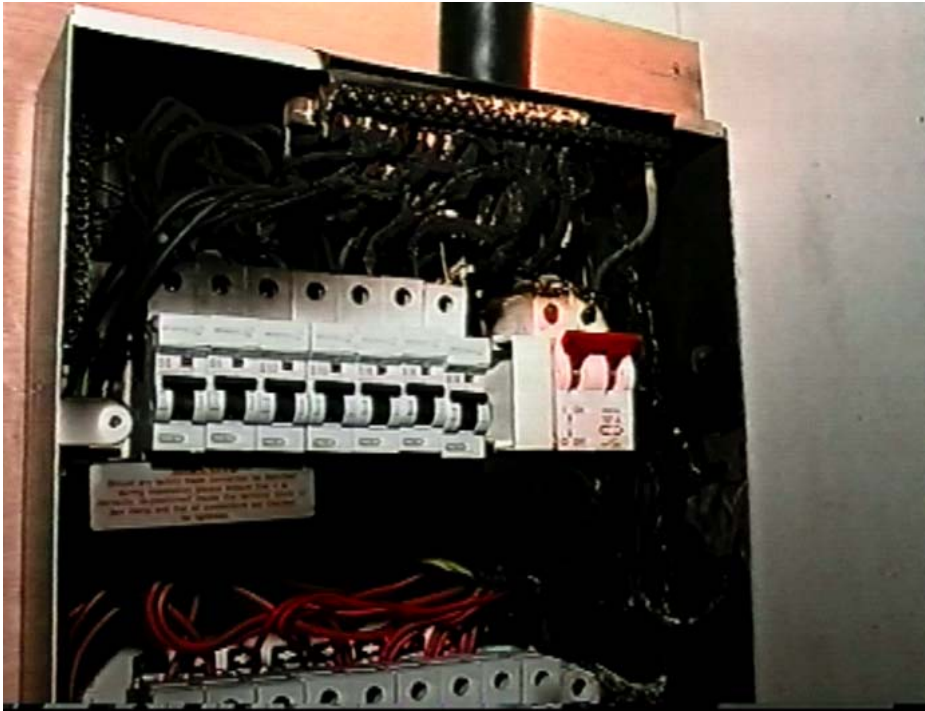
- Examine potential for fires inside distribution board to grow and spread externally
- Examine for potential to self-extinguish
- Board set up as in incident using new equipment
- Fire source - small tray of diesel
- Ignition source – electric match surrounded by 5 conventional matches.

Fires inside distribution board 2



- 2 tests carried out
- Test 1- fire broke out of box after ca 4 minutes
- Caused melting of mcbs
- Fire extinguished
- Damage unlike that of incident
- Initiating fire deemed too large

Fires inside distribution board 3



- **Smaller initiating fire – 4cm² diesel soaked pad**
- **Pad placed close to erosion damage on top of lower row of mcbs**
- **No spread of fire, died out after 2 minutes**
- **Damage very confined and unlike that seen in incident**

Conclusion: Unlikely fire started in casing & spread out

Fires with cupboard mock-up 1

- Test carried out with cupboard mock-up to examine character of fire involving likely fuels present and response of distribution board.
- Construction:
 - *Plasterboard walls on softwood frame*
 - *Two standard panels doors*
 - *Shelves and toiletries cupboard installed*
- Contents:
 - *Shelves loaded with paper, cardboard, plastic items including trays & buckets*
 - *Toiletries cupboard left empty – no aerosols or FLs*
- Electrical:
 - *Distribution board under load*

Fires with cupboard mock-up 2

- Ignition source - 2 of No 7 cribs on top of box of plastic aprons
- Cupboard doors left open
- Test videoed and still record taken
- mcbs under load and connected through light bulbs during test



Fires with cupboard mock-up 3

<i>Time, minutes:seconds</i>	<i>Event</i>
00:00	Cribs lit, flames licking up around distribution board
03:10	Plastic mcb covers begin to melt and run
05:30	Flames begin to die back and pool fire beginning to form
11:00	Polythene aprons begin catch fire
12:05	Dripping molten burning polythene transmits fire to floor at front of cupboard
14:45	Cardboard box under polythene aprons catches fire
17:15	Residual current device casing begins to melt
18:03	Residual current device casing falls to floor
18:10	Bulbs go out within 2s of each other
19:55	Fire extinguishers arrive to tackle fire



Fires with cupboard mock-up 4



Damage similar to incident cupboard in terms of pattern and extent

Damage to mcbs and shelf contents similar

Some wooden components exhibited only minor crocodiling possibly due to a less severe test fire



Fires with cupboard mock-up 5

Conclusion: Damage pattern and extent similar

Fire more likely to have started in cupboard rather than distribution board

Likely to have broken out of cupboard at a similar time

Aerosols involved in incident fire

Potential for sparks to ignite cupboard combustibles 1

- **Spark generation inside distribution board**
 - *Short circuit between casing & live supply cable at knock out hole*
 - *Earth to bus bar fault at lower bus bar*
- **Sparks produced on demand by a length of PVC sleeving attached to conductor routed out of casing. When pulled from the rear the necessary circuit was made.**

Potential for sparks to ignite cupboard combustibles 2



- Sparks escaped from a nominally closed case
- Sparks escaped from both induced faults
- More sparks escaped from short circuit to case fault rather than earth to bus bar fault

Potential for sparks to ignite cupboard combustibles 3

- **Initial test series**

Paper, plastics, cardboard

No ignitions obtained for both faults with 80 a cartridge fuse

- **Second test series**

Cartridge fuse replaced with rewirable fuse wired with 1mm² copper

One ignition obtained with tissue paper

Potential for sparks to ignite cupboard combustibles 4



Potential for sparks to ignite cupboard combustibles 5



- Test series 3

*Earth to casing fault with live fed through 50 a
Merlin-Gerin mcb*

*Fuels used included rigid PU foam, cotton cloth,
'Bluewipe', tissue paper, polyester wadding.*

No ignition obtained from 118 tests

Potential for sparks to ignite cupboard combustibles 6

- **Fourth test series**

Tests with materials impregnated with flammable liquid - acetone

83 tests with paper, foam, carpet, card

Height of target varied

One ignition obtained with foam



Potential for sparks to ignite cupboard combustibles 7

- **Fifth test series**

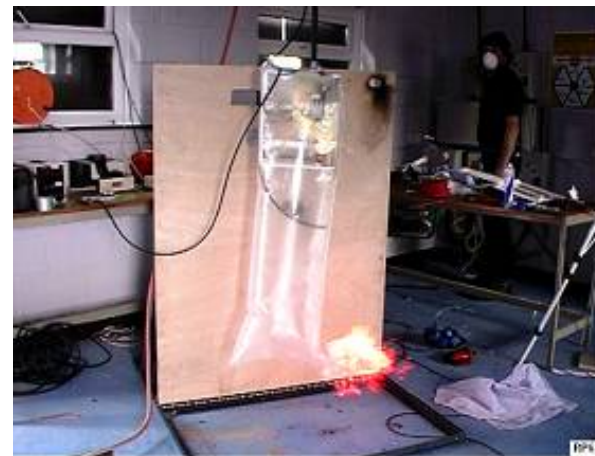
Tests involving contents of aerosol cans – flammable liquids and liquefied gases eg butane

Aerosol can failure simulated by

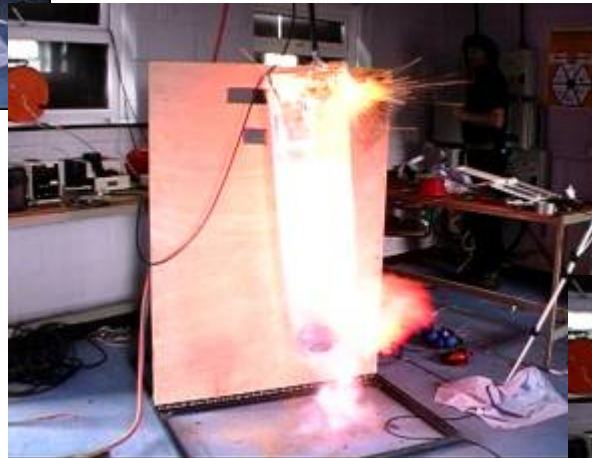
(a) injecting butane into a bag

(b) Spraying hairspray into the bag

Ignitions easily obtained in both cases



Potential for sparks to ignite cupboard combustibles 8



Acetone-soaked acrylic

Conclusions 1

It is difficult to produce conditions leading to an electrical fault

It proved difficult to damage the insulation or initiate an arc

- Unlikely that the fire began within the distribution board

If a fire occurred it is difficult to involve other fuels

- Damage more likely to have occurred as a result of a fire external to the unit

Testing and the damage support this

- It was difficult to ignite adjacent materials from faults in the unit excepting the contents of aerosol cans – gas or liquid

Conclusions 2

- The cupboard mock-up test was carried out

The fire initiated with two No 7 cribs grew to involve the cupboard contents over a period of about 20 minutes through the formation of a pool fire in plastic items.

At this stage the intermittent flaming extended to the full height of the cupboard and the electrical units were under severe attack.

The damage had some resemblance to that in the incident

However, it appeared that, in the incident cupboard the wooden distribution board mounting board and internal cupboard doors had experienced more severe exposure.

It is likely that the initial fire at Rosepark was to some extent under ventilation control with high temperatures, copious smoke but limited flaming.



Thanks for listening