The Rosepark carehome fire: investigation, research, and finding the lessons to be learned: 6 December 2011 - BRE, Watford

Full Scale Reconstructions of the Rosepark Fire

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BRE Fire and Security

Background

- On 31st January 2004 a fire occurred in the Rosepark Care Home, Glasgow.
- M Shipp and D Purser (BRE) attended the scene the same week on behalf of CLG.
- BRE was commissioned by the Scottish Building Standards Agency and, later, separately, by the Crown Office and Procurator Fiscal Service, to carry out research to assist in the understand of the incident.
- This presentation is intended to provide a brief overview of the research projects carried out by BRE.

Fire Investigation by BRE Global Fire Safety Group

- BRE carries out fire investigations for Government and other agencies to learn lessons to improve regulations
- Since 1989 - BRE FI remit on behalf of CLG Building Regulations Division;
  - fires with implications for current regulations, codes and standards (successes and failures)
  - fires which have implications for current research
  - special interest by ministers or other officials
- Fire investigation fully integrated into the research programme
- Gratefully acknowledge assistance of Fire and Rescue Service, and other agencies.

Fire Investigation by BRE Global Fire Safety Group

- BRE has well-established capability to assess the effects and implications of the fire (the “lessons learned”) – not the cause.
  - BRE provides FRSs and other agencies with scientific support; experimental and/or modelling work.
  - Act as expert witnesses in Criminal Court, Coroner’s Court, Sheriff's Court, Fatal Accident Enquires, etc.
- Findings feed into Building Regulations guidance and other guidance, and/or into research and/or knowledge base.

Major fire investigations that BRE has supported

- Summerland, August 1973
- Flixborough (Nypro UK) Explosion, June 1974
- Woolworths (Manchester), May 1979 - Reconstruction
- Stardust Disco (Dublin), February 1981 - Reconstruction
- Summit Tunnel, December 1984
- Bradford City Football Ground, May 1985 – investigation into the rapid spread of fire through the wooden grandstands at the football stadium
- King's Cross, November 1987 – Modelling and laboratory tests
- Piper Alpha, July 1988 – On-site investigation of ERQ on Flotta for Inquiry
- Windsor Castle, November 1992 - Laboratory tests for Inquiry
- The Channel Tunnel, November 1996 - On-site investigation for the CTSA
- Ladbrook Grove, October 1999 - On-site investigation for Railtrack
- Yarl's Wood, February 2002 - On-site investigation for Beds. Police
- Rosepark, January 2004. - Large scale reconstruction for Scottish Executive and Procurator Fiscal
- Bethnal Green, July 2004. - Computer modelling for LFCDA
- Stevenage, February 2005. - Computer modelling for Herts FRS
- Bristol, December 2006. - Computer modelling
- Cutty Sark, June 2007
- Newquay, August 2007. - Computer modelling planned
- Atherstone on Stour, November 2007
- Royal Marsden, January 2008. Laboratory tests

Manchester Woolworth's 1979

Stardust Disco 1981

Rosepark 2004; introduction

- Scottish Executive needed to fully understand why the fire occurred; distil lessons learned, for example, about causes, equipment / human failures etc.
- Inform policy formulation in relation to care home fire regulations (existing premises), assist preparation of guidance offered under the Building Regulations / Technical Standards and contribute to the safe management of such premises.
- Issues regarding potential value of sprinklers in such premises.

Proposed programme of work - 1

- Task 1: Convene Steering Group (scheduled for 31 March 2004)
- Task 2: Identify and seek critical information (in hand and on going)
- Task 3: Design building for recreation (plan to be submitted to SG)
- Task 4: Identify initiating scenario, carry out trials (information being gathered)
- Task 5: Construct building shell at BRE NE Middlesbrough (contractor on stand by)
- Task 6: Fit out building with services & furnishings (plan to be submitted to SG)
- Task 7: Install instrumentation for recreation monitoring
- Task 8: Carry out Rosepark fire recreation (provisional date 17 June 2004)
- Task 9: Design appropriate sprinkler system (outline plan to be submitted to SG)
- Task 10: Refurbish building and fit sprinkler system
- Task 11: Carry out recreation with sprinklers (date to be advised)

Proposed programme of work - 2

- Task 12: Demolition and removal of building (immediately after sprinkler recreation)
- Task 13: Process and analyse results
- Task 14: Seek information from fires Tenby and St Neots etc. (in hand and on-going)
- Task 15: Review general fire safety guidance for Care Homes (completion date subject to completion of other tasks)
- Task 16: Draft report
- Task 17: Review current knowledge on residential sprinklers (in hand and ongoing)
- Task 18: Carry out scoping study on the value of sprinklers as compensatory features in alternative design strategies (start on hold until after recreation)
- Task 19: Extend RIA for existing high-risk premises and premises housing vulnerable groups (start on hold until after recreation)
- Task 20: Draft report
- Task 21: Re-convene Steering Group to ratify findings; revise and publish Report(s)

The Fire Research Steering Group

– Organisations invited on the Group by the Scottish Executive (Scottish Building Standards Agency) were:

– Fiona Mackenzie	Scottish Executive (Scottish Building Standards Agency)
– Dr Paul Stollard	Scottish Executive (Scottish Building Standards Agency)
– Colin Hird	Scottish Executive (Scottish Building Standards Agency)
– Ian Snedden	Scottish Executive
– Anthony Burd	Office of the Deputy Prime Minister, Buildings Division (ODPM)
– Darren Hobbs	ODPM
– Murdoch Mactaggart	COPF (Procurator Fiscal)
– Bob McCann	Strathclyde Police
– Hugh Adie	Strathclyde Fire Brigade
– Tony Kilpatrick	Glasgow Caledonian University/BSAC Fire WP
– Douglas Philp	HSE
– Martin Shipp	BRE/FRS
– Peter Field	BRE/FRS

General Objectives - 1

- How quickly will the fire initiate?
- How will the materials present burn?
- How or why will the fire spread?
- Does the fire spread? How quickly?
- Does wallpaper, handrail, carpet contribute?
- How hot will it get?
- How long will it last?

General Objectives - 2

- What will it look like?
- How smoky will it be? How will the smoke spread?
- How toxic does it get?
- How do the construction materials respond?
- Will the materials behave as would be expected?
- Will the building design, or a design feature, contribute?
- Are there any unusual features of the fire?
- How quickly does a detector operate?
- Will a sprinkler system help?
- Will fire doors help?

Specific Objectives - 1

- How long will combustion be present before sufficient smoke is produced to trigger the automatic detector in the cupboard? Or trigger the automatic detection in the corridor outside the cupboard?
- The period of time it takes to smoke log the corridor and make conditions untenable with regards to evacuations?
- What fire temperatures are reached and how quickly within:
- The cupboard? The corridor? The bedrooms?
- The rate of fire development in the cupboard?
- The rate of fire development in the corridor?

Specific Objectives - 2

- What part does the fire loading within the cupboard contribute to the development of fire?
- What part does the furnishings and fittings within the corridor contribute to the spread of fire?
- Using life safety sprinklers; what will be the period of time before they are activated?
- To what extent would sprinklers in the cupboard (if any) and in the corridor limit the spread of fire and dilute the toxicity and density of smoke?

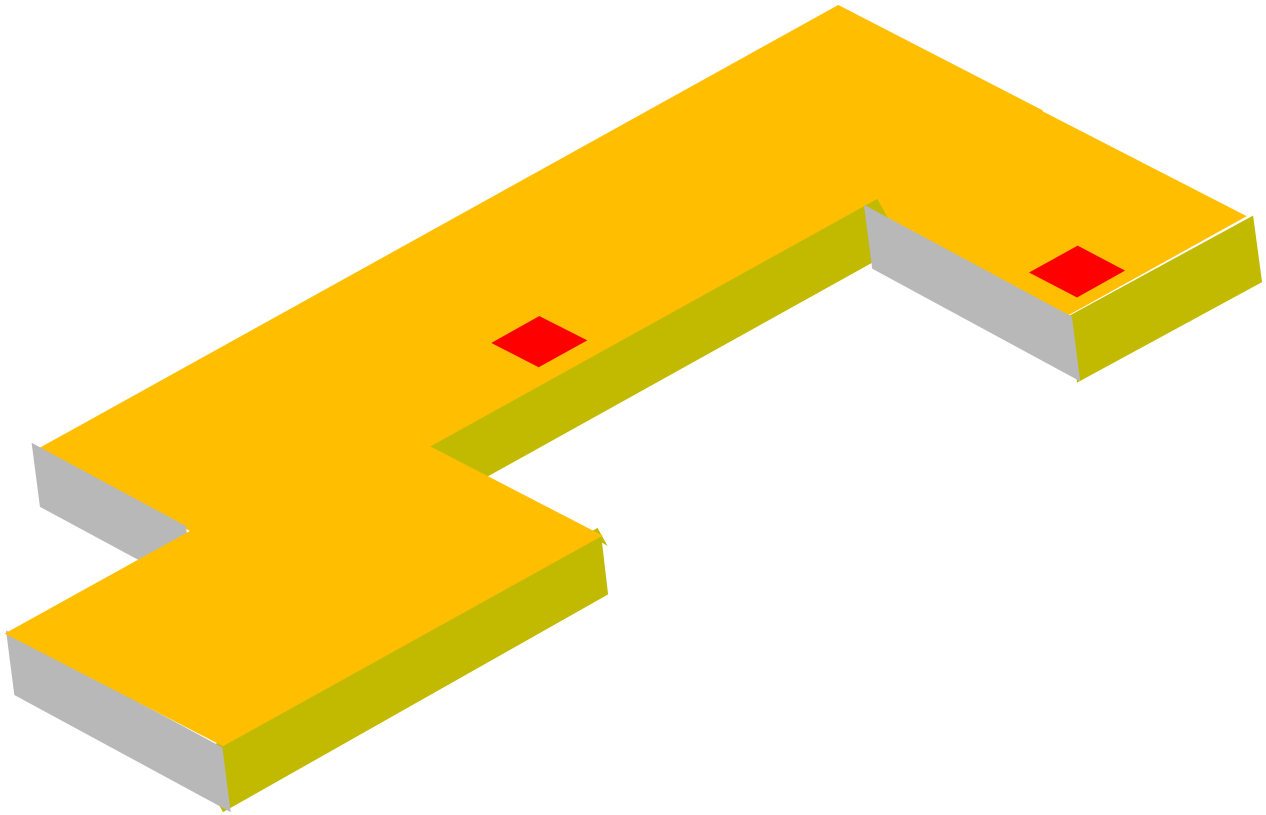
Specific Objectives - 3

- To what extent will the sprinklers help to contain the fire and limit the smoke travel?
- Is it possible to gauge the spread of the smoke and fire gases in the 30 minute test duration?
- Is it possible to record the levels of toxic gas in each room and explain why the levels vary (if indeed they do)?
- One window in the affected area is to be left open. What effect will this have on the development of the fire?
- What role will the contents of the cupboard have on the development of the fire in the cupboard - in causing it to spread to the corridor.

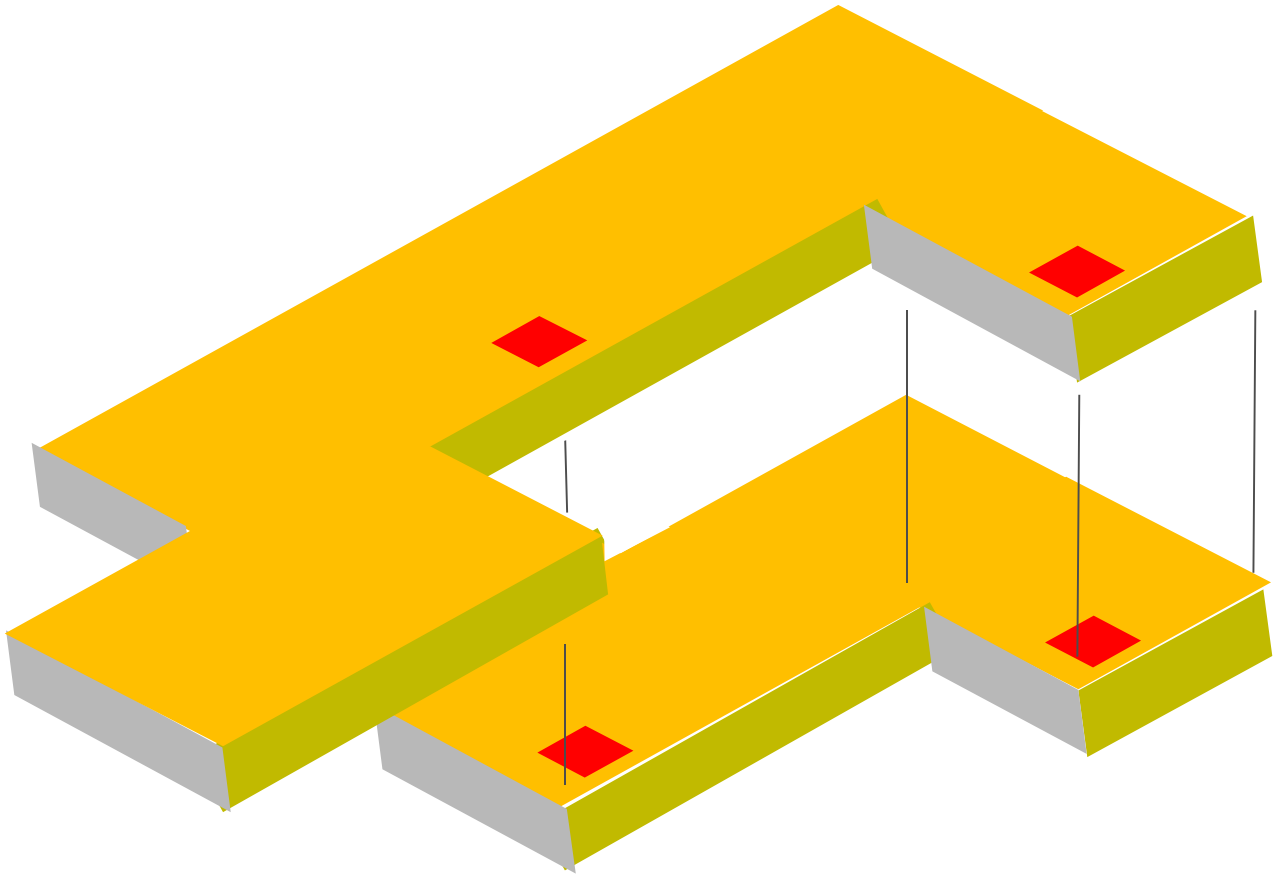
Specific Objectives - 4

- To what extent does the position (i.e. whether open or closed) of bedroom doors contribute to or restrict the passage of smoke?
- What role do the materials used in the filling of the chairs in the corridor play in the production of smoke and/or gases?
- How long into the fire development will it be before the fire breaches the cupboard doors and enters the corridor? (A cupboard door is to be left open)
- Is there an explosive element caused by the ignition of the aerosol cans? Does this force the cupboard doors open?

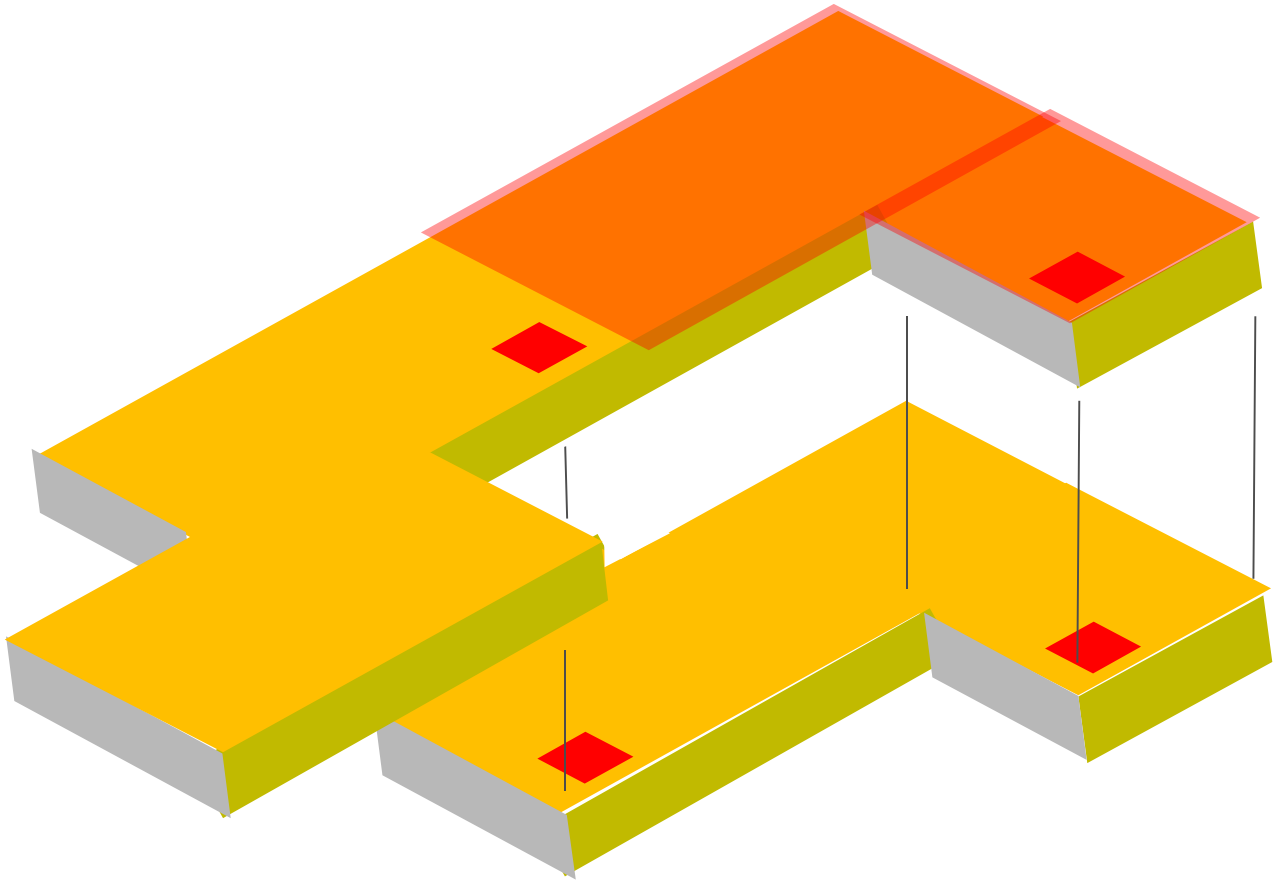
The building



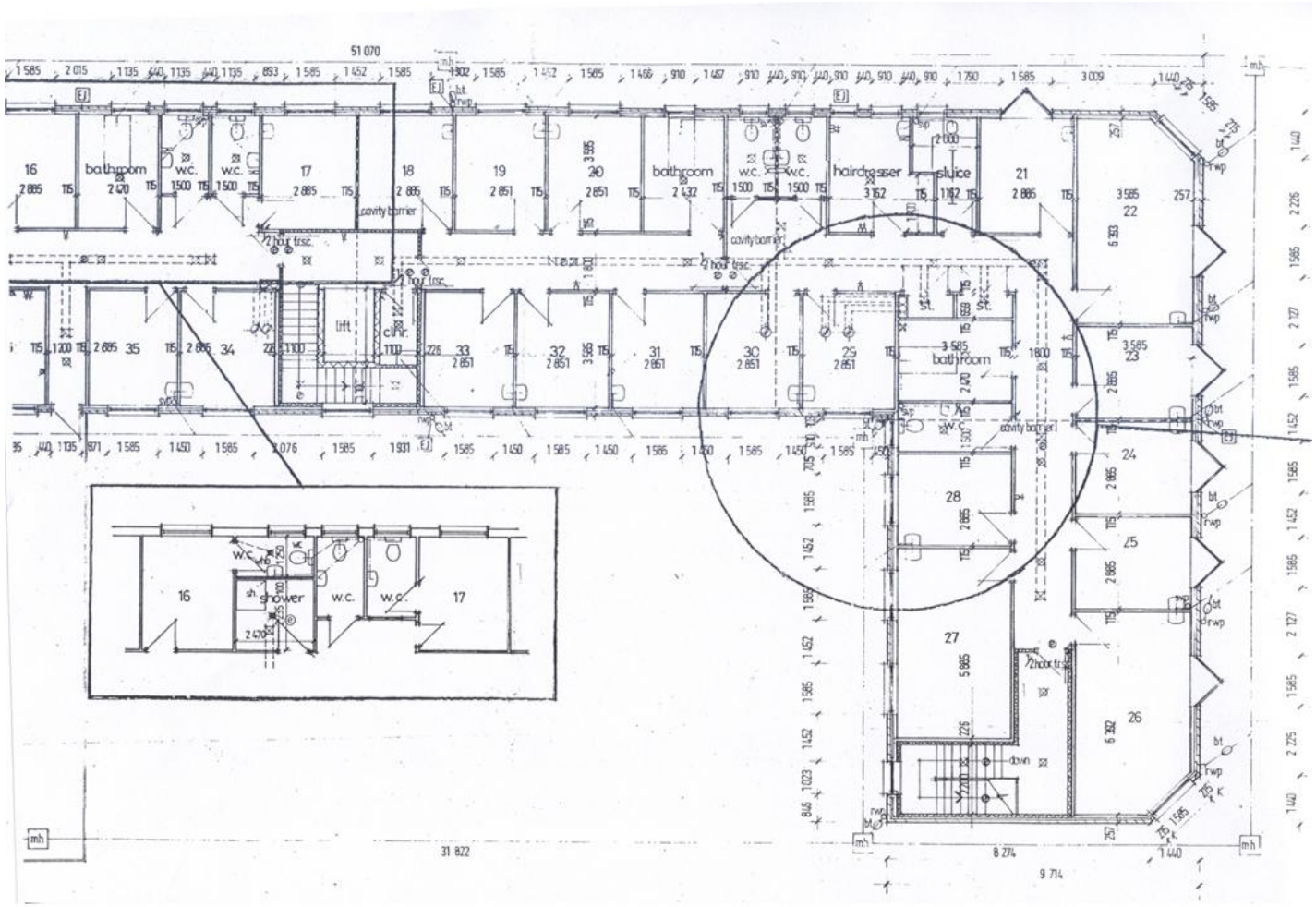
The building

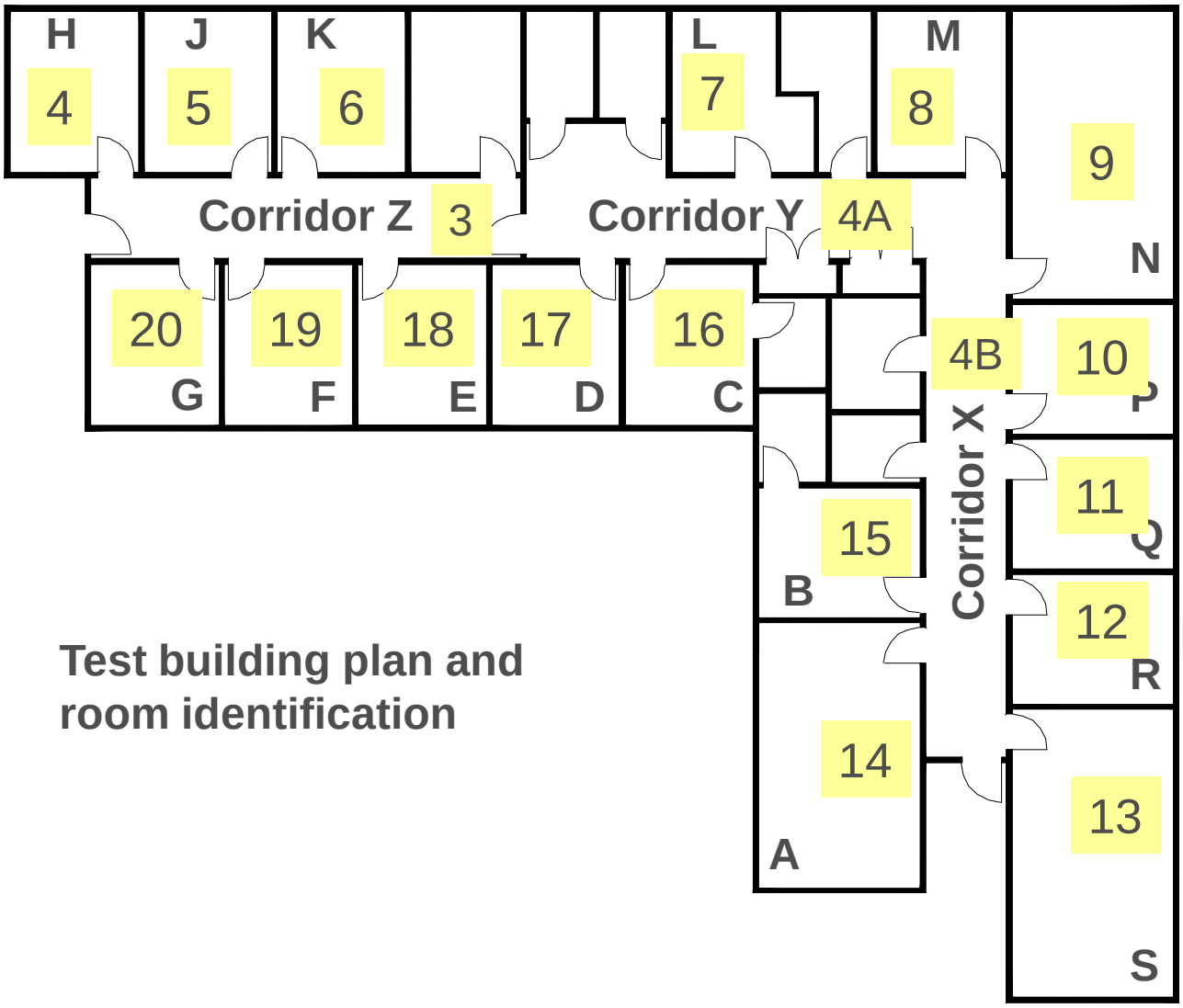


The building



The building layout





Test building plan and room identification

Exterior view of the laboratory

Location test rig was constructed at the BRE NE research and testing facility, Middleborough:

- *AV Dawson, Dawsons Wharf*
- *North Sea Supply Base, Riverside Park Road*
- *Middlesbrough, TS2 1UT*

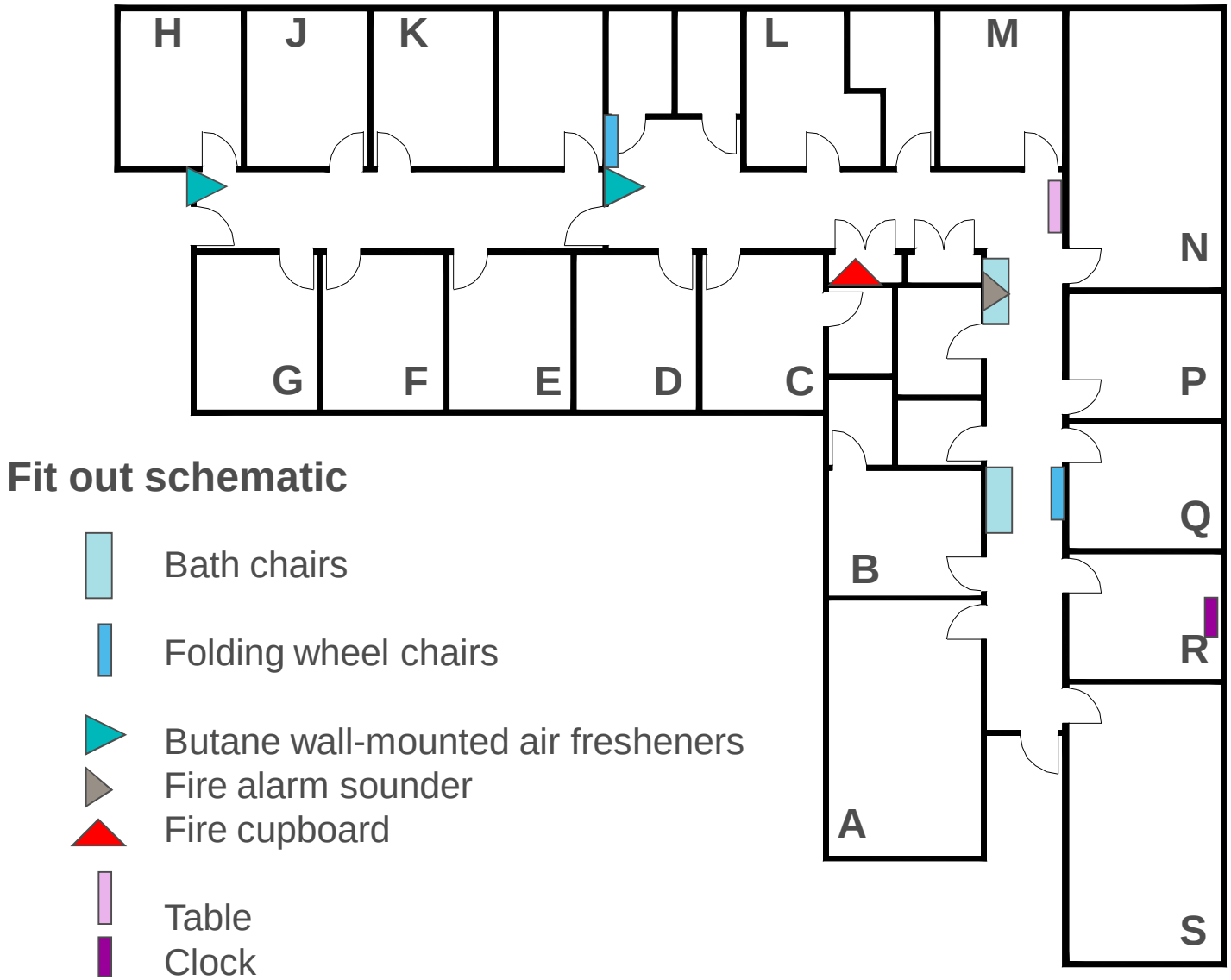
Photo by D Smit, (BRE)

Interior view of the laboratory

Photo by D Smit, (BRE)

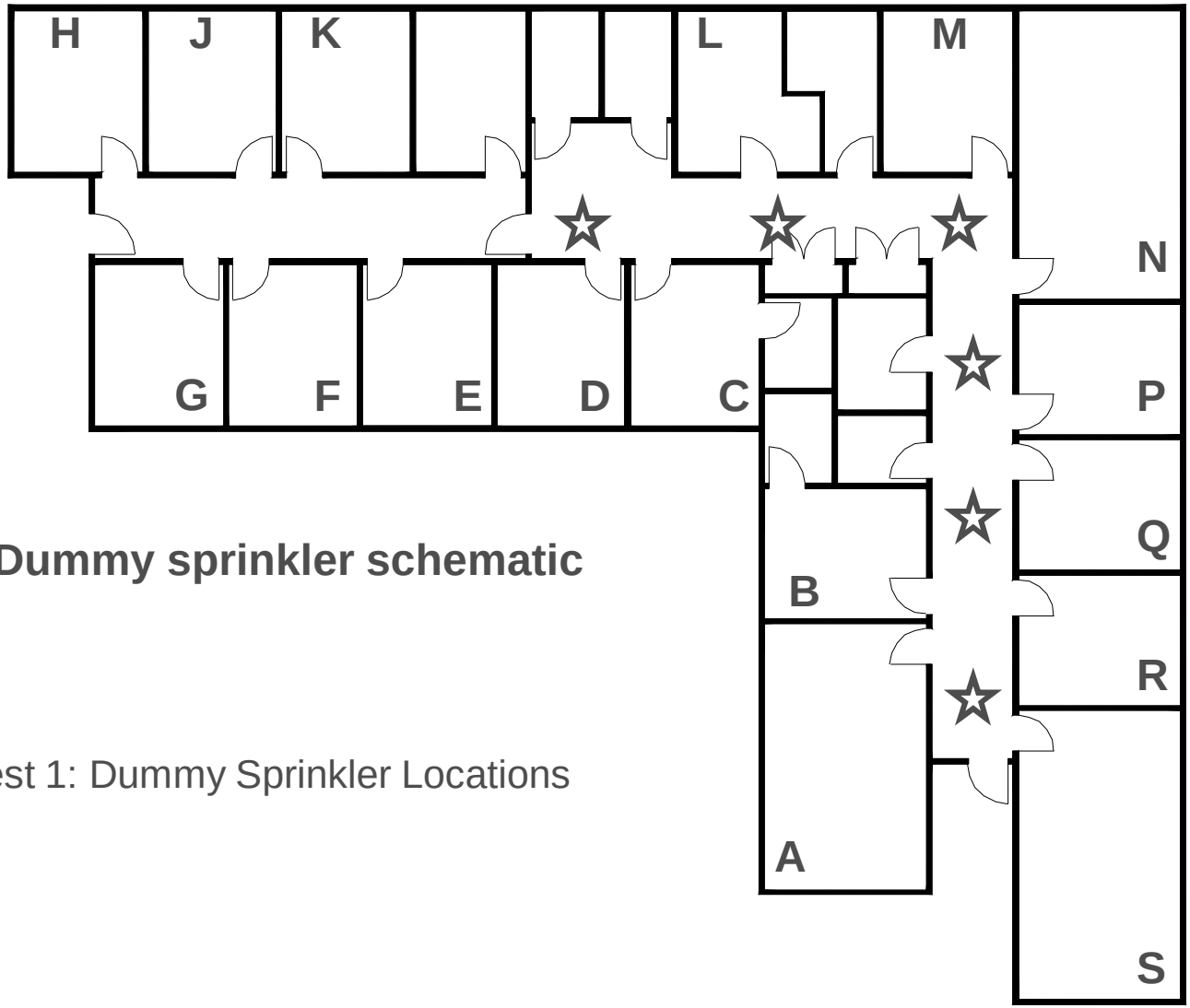
Views of the test rig

Photos by David Thurley and
Jill Cummings, Strathclyde Police



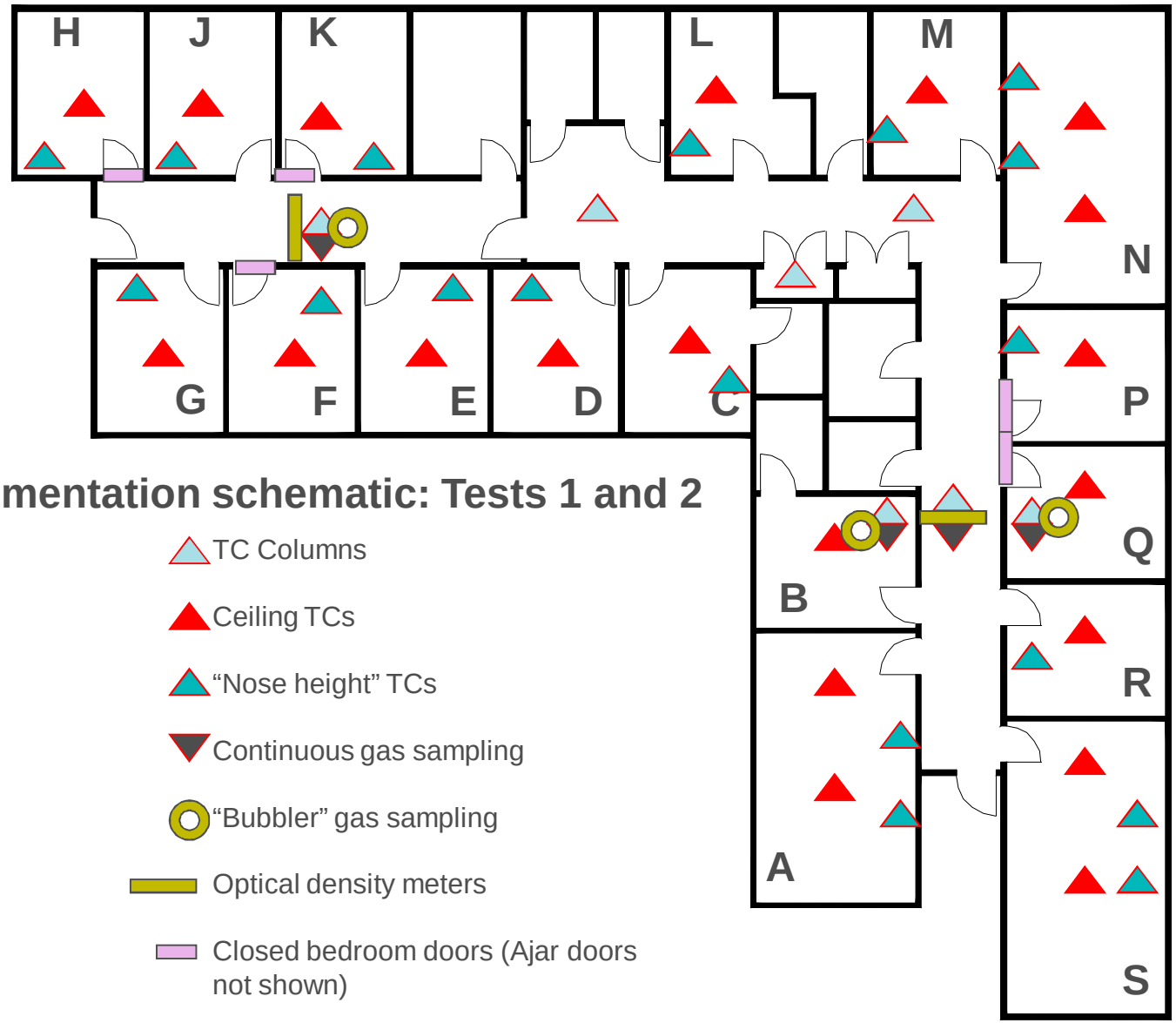
Fit out schematic

- Bath chairs
- Folding wheel chairs
- Butane wall-mounted air fresheners
- Fire alarm sounder
- Fire cupboard
- Table
- Clock



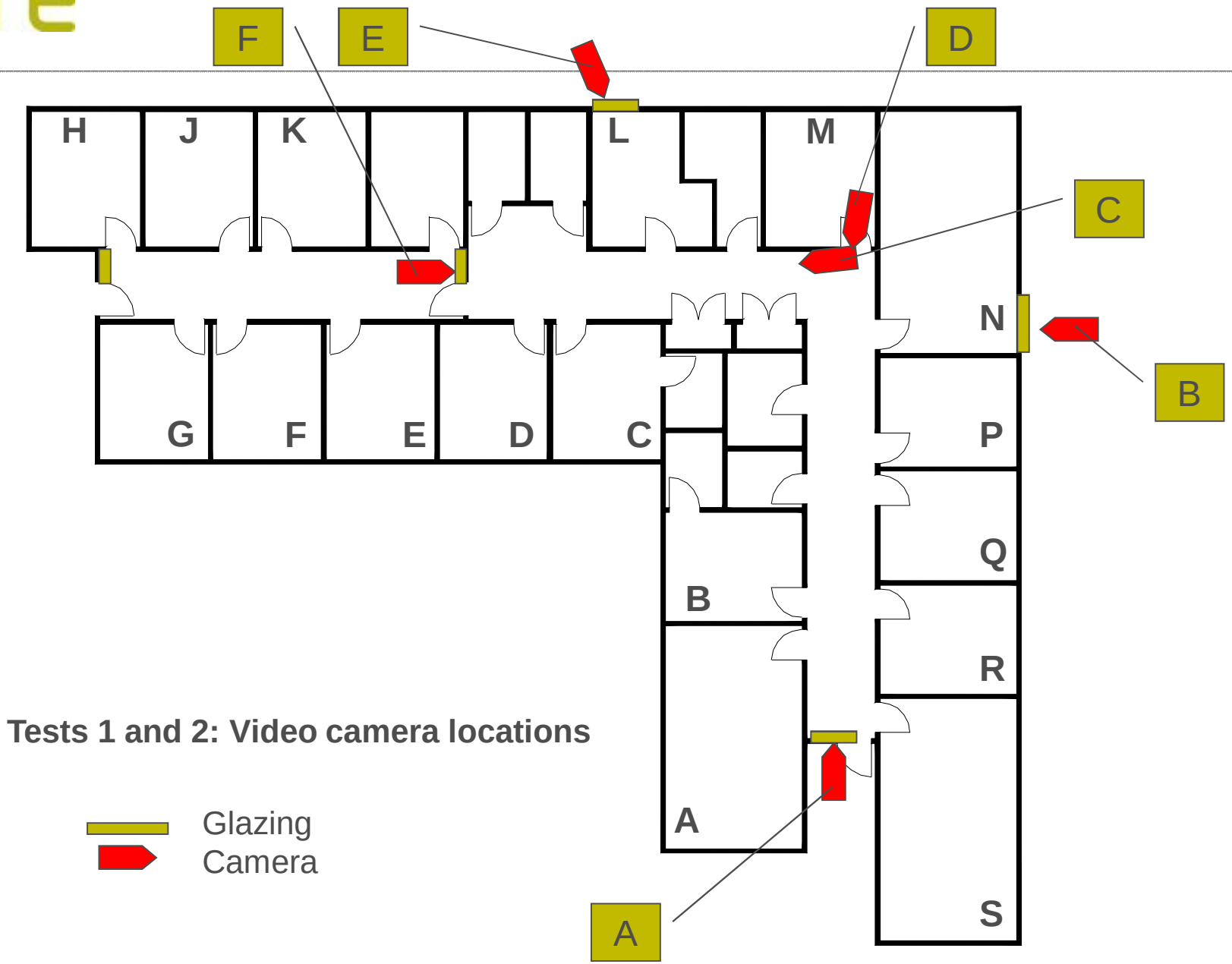
Test 1 Dummy sprinkler schematic

☆ Test 1: Dummy Sprinkler Locations



Instrumentation schematic: Tests 1 and 2

- TC Columns
- Ceiling TCs
- “Nose height” TCs
- Continuous gas sampling
- “Bubbler” gas sampling
- Optical density meters
- Closed bedroom doors (Ajar doors not shown)

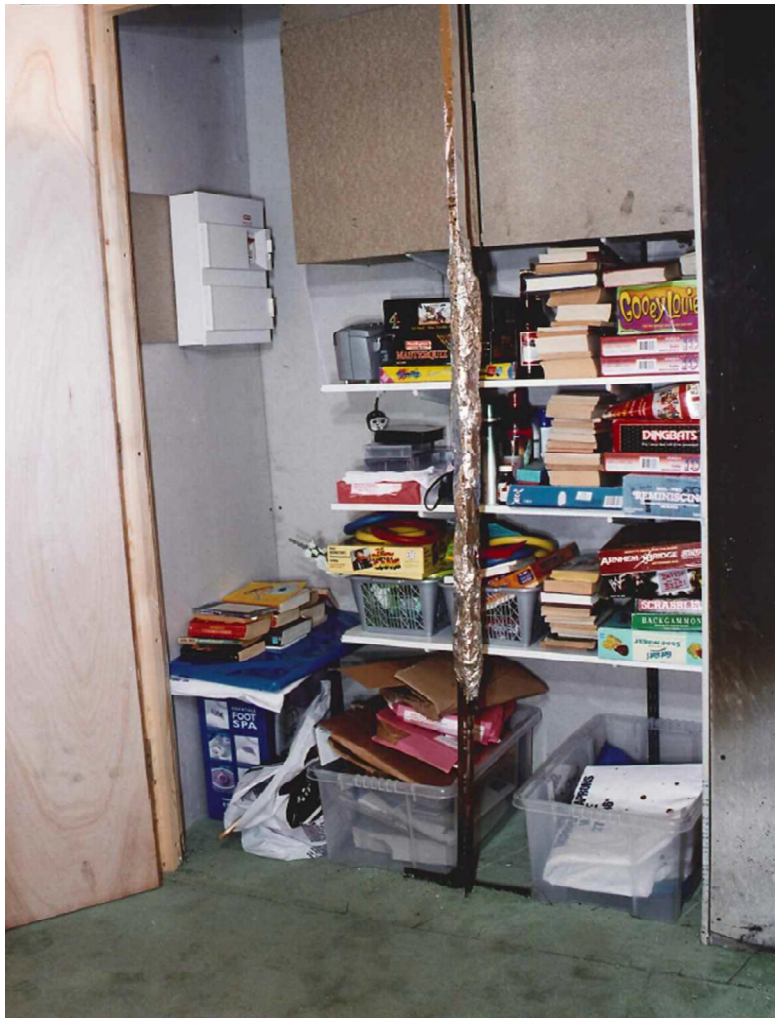


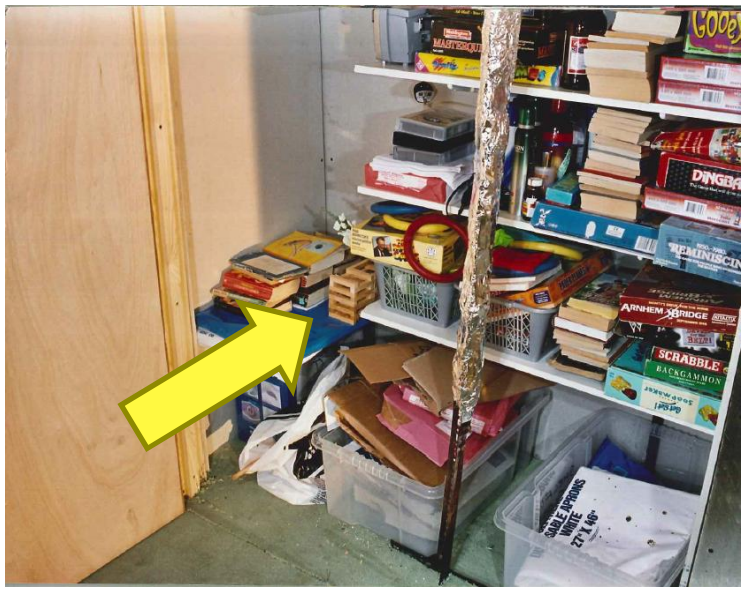
Tests 1 and 2: Video camera locations

Programme

- First Cupboard Test (Test A), Garston: 3rd June 2004
- Test 1 Middlesbrough: 17th June 2004 (Reconstruction)
- Test 2 Middlesbrough: 1st July 2004 (Sprinklers)
- Test 3 Middlesbrough: 28th July 2004 (Closed fire doors)

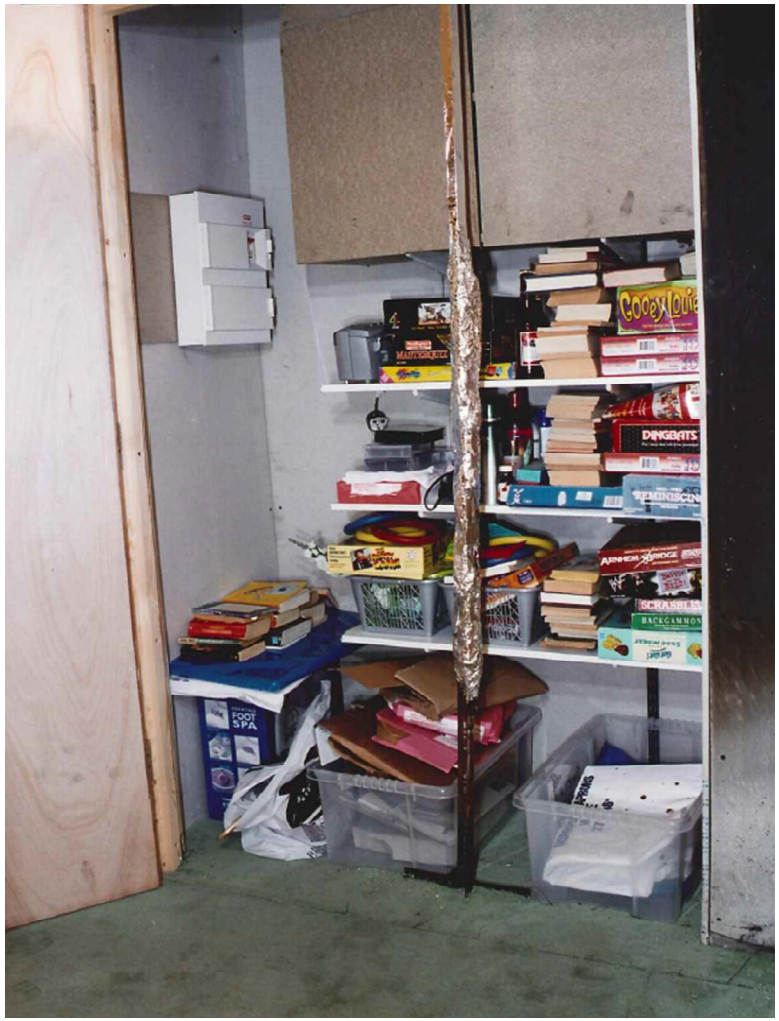
Ignition source

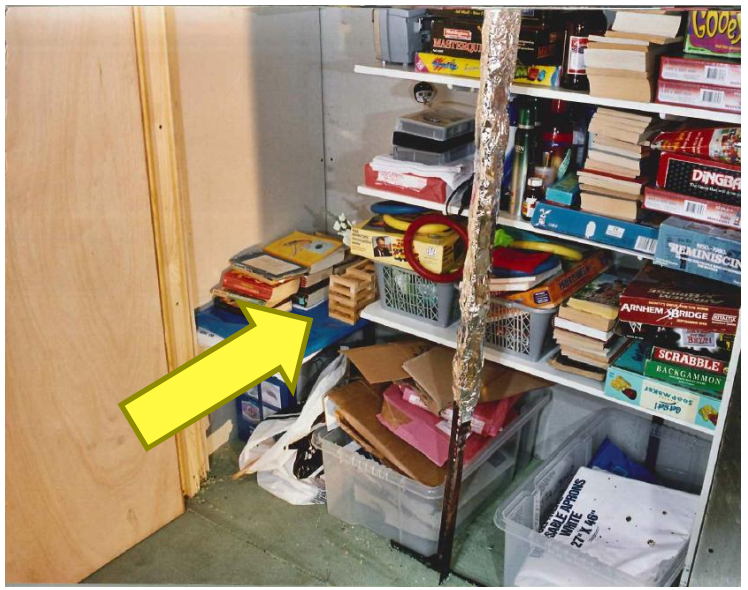




Two Number 7 cribs

Ignition source





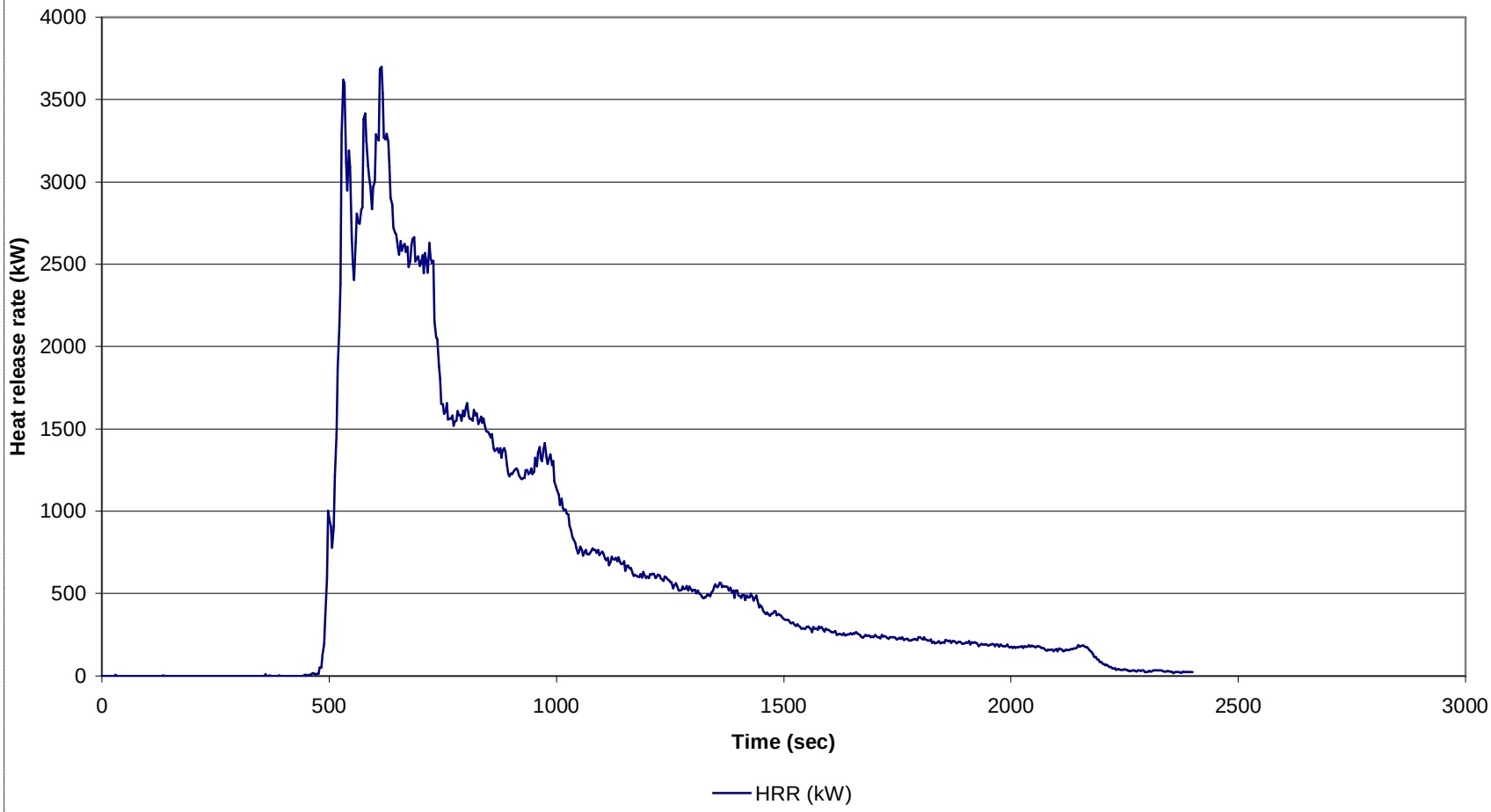
Two Number 7 cribs

Cupboard Test A – before test

Cupboard Test A - rear view

Photos by M Pearce, (FRS)

Cupboard test A - heat release rate



Test 1: Benchmark test

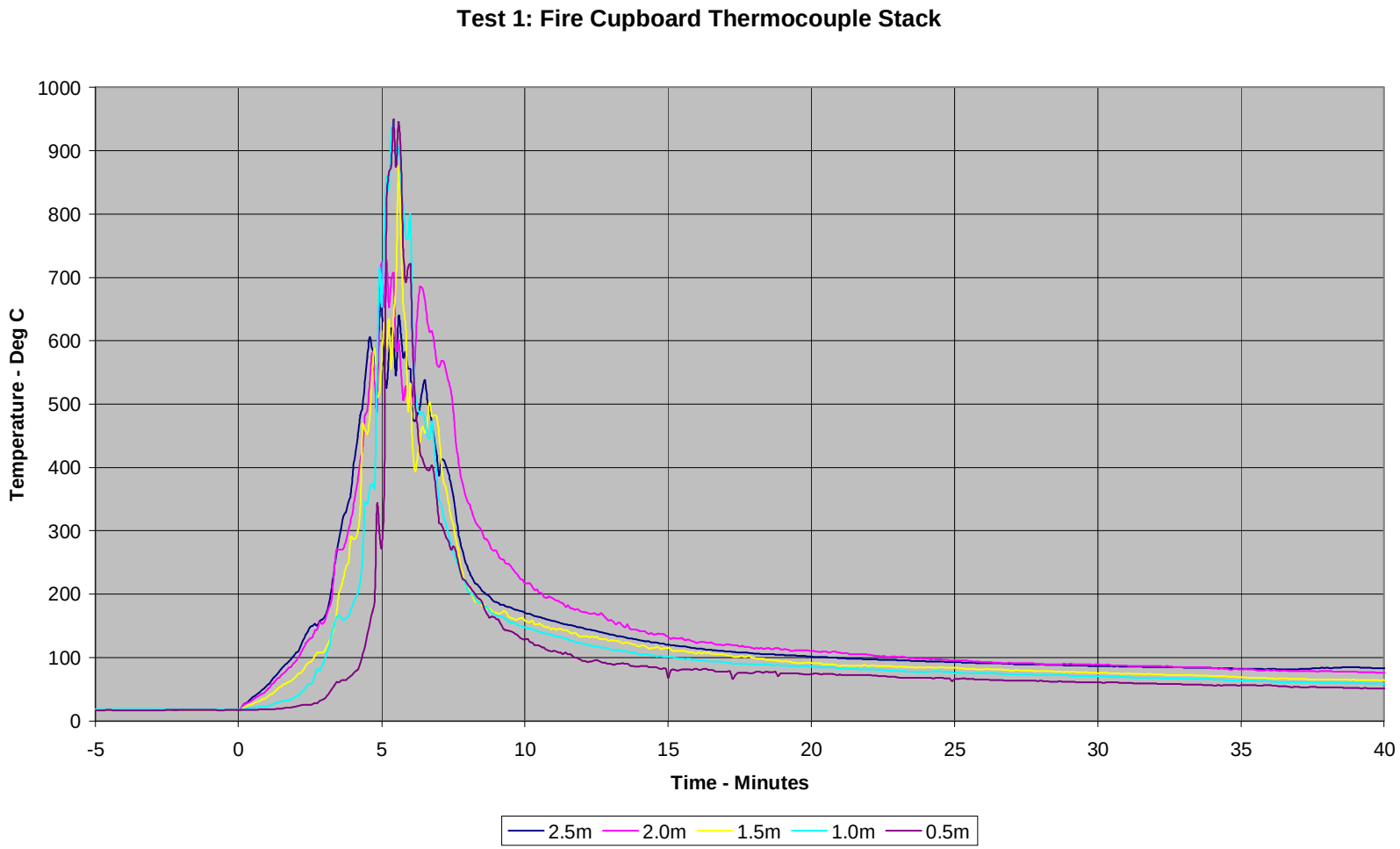
- Establish benchmark conditions for the chosen fire scenario

- Represented a fire in a care home with specified fire protection measures in place, including a comprehensive smoke detection system and protected escape routes.

View of the test rig during test

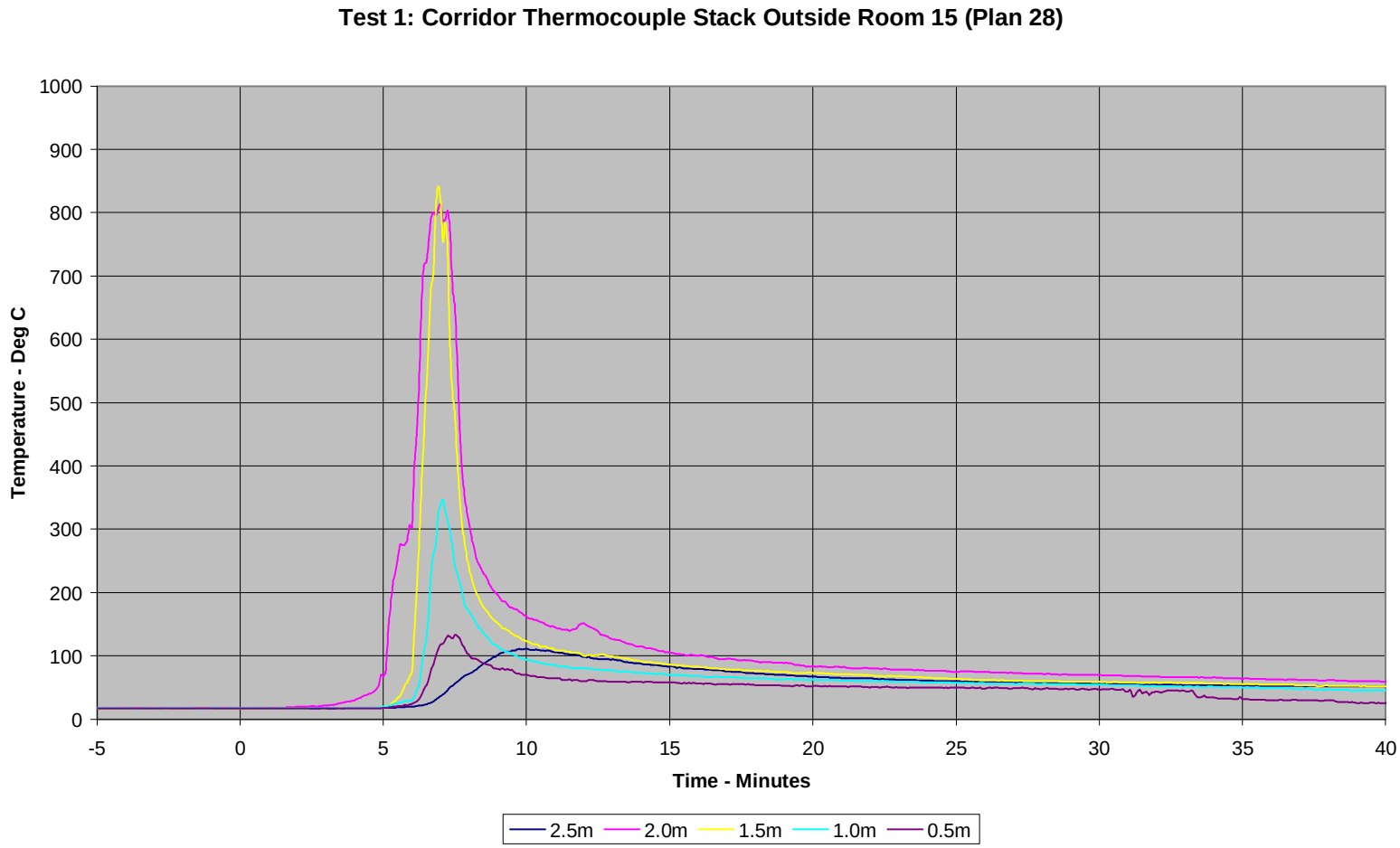
Photo by D Smit, (FRS)

Test 1: Fire Cupboard Thermocouple Stack

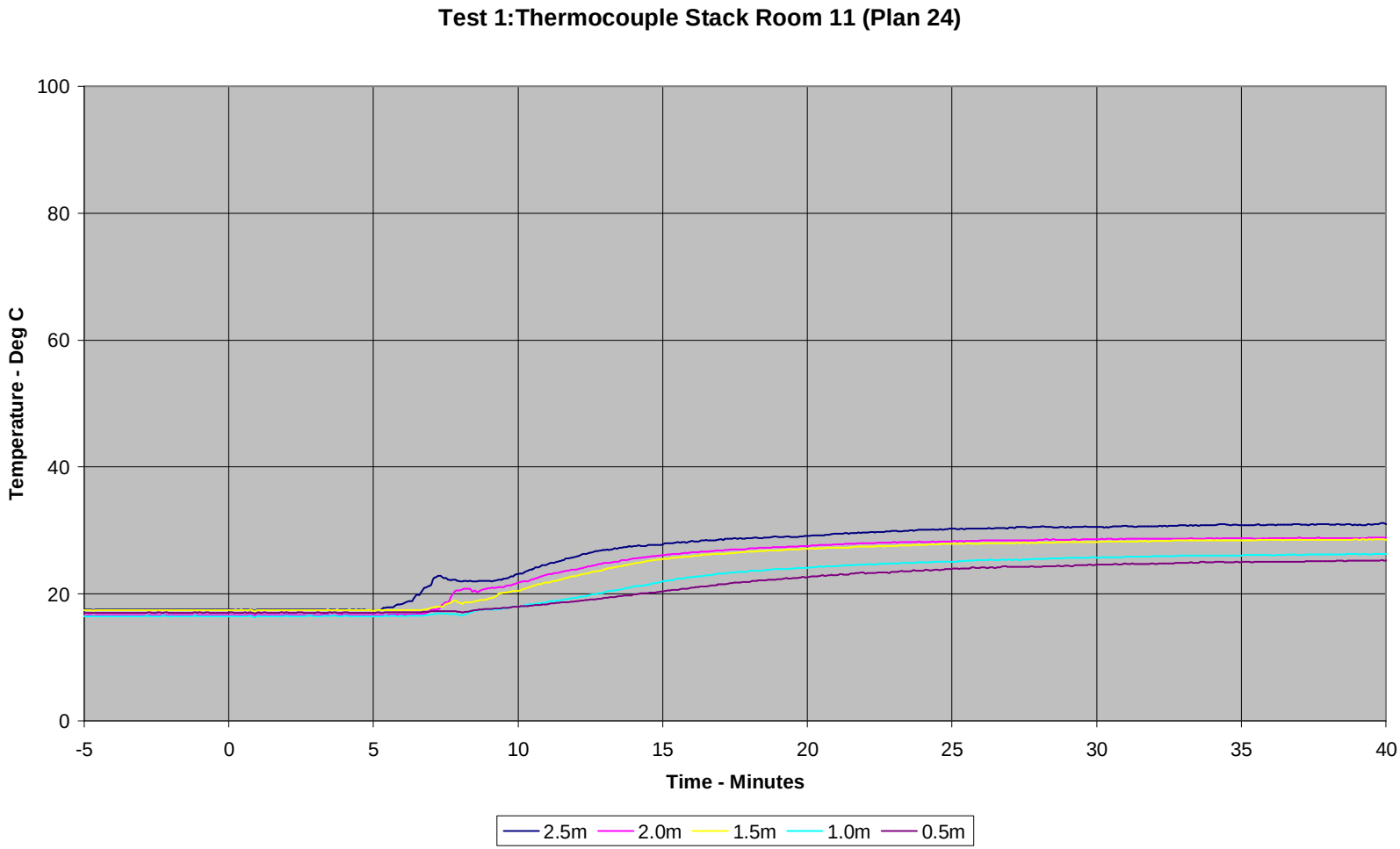


Test 1: Corridor Thermocouple Stack Outside Room B

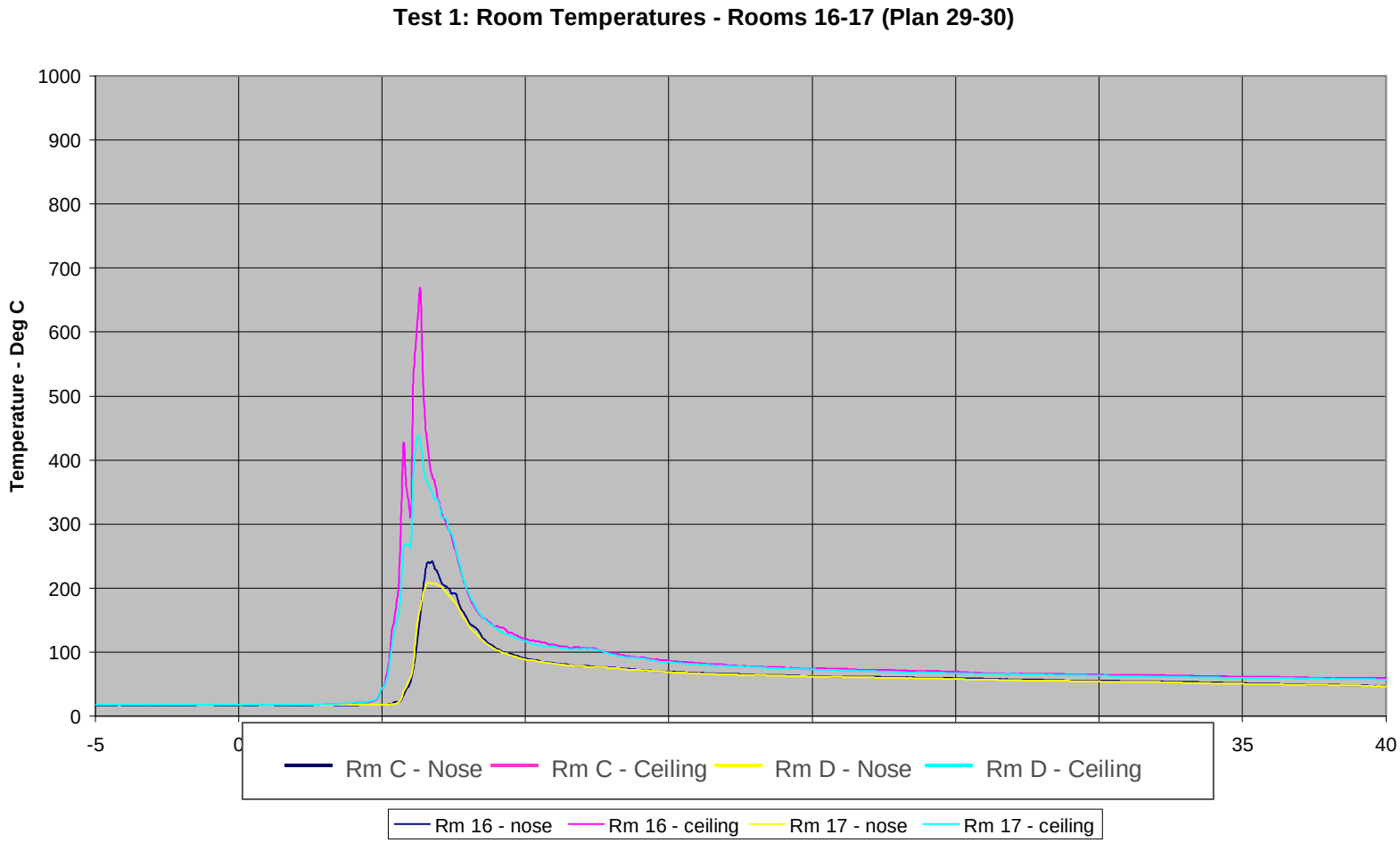
Outside Room 15



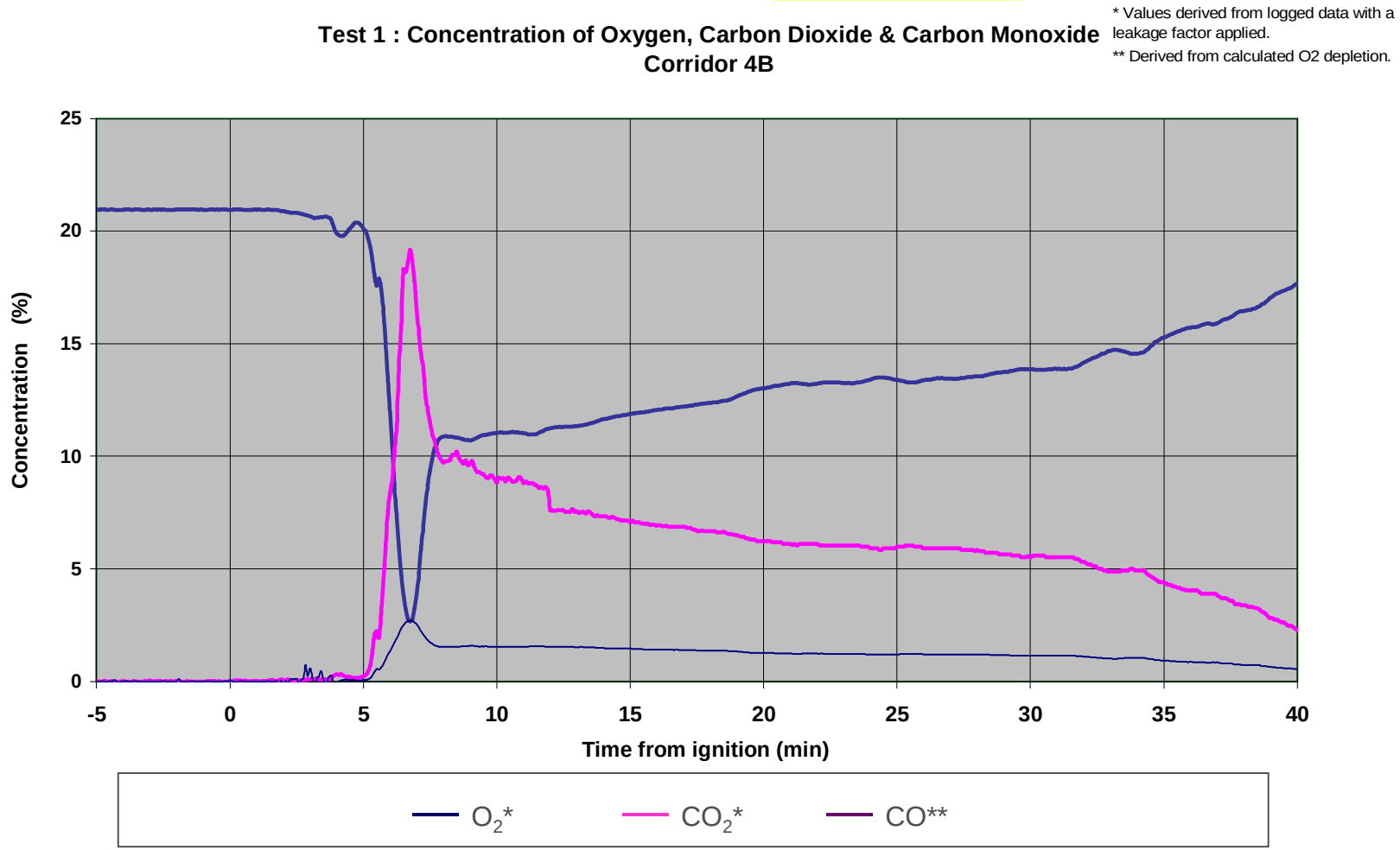
Test 1: Thermocouple Stack Room Q Room 11



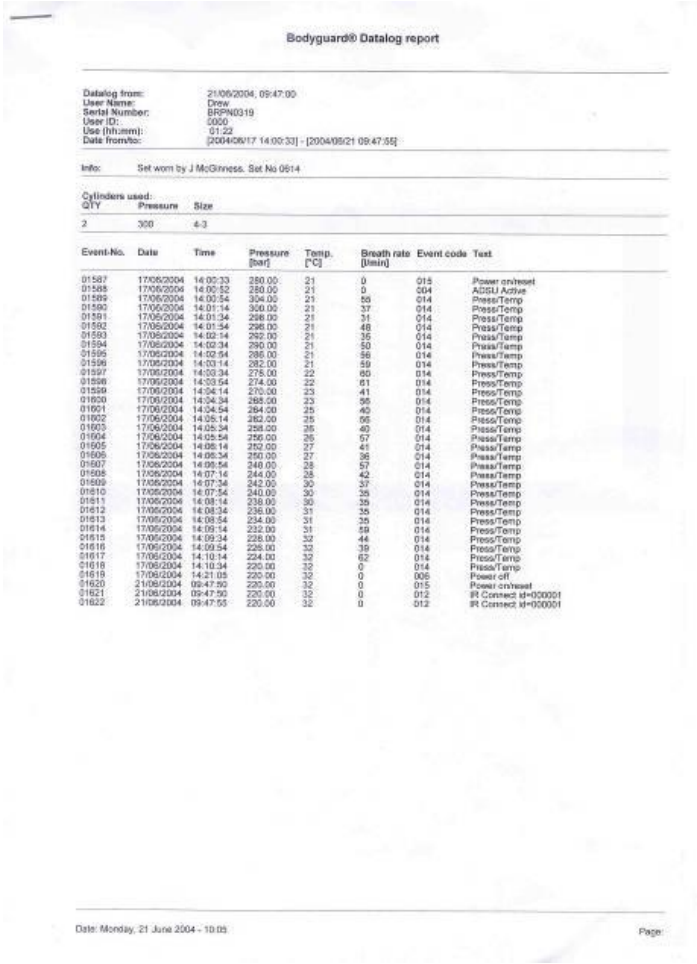
Test 1: Room Temperatures - Rooms C - D Rooms 16 and 17



Test 1: Concentration of Oxygen, Carbon Dioxide & Carbon monoxide - Corridor X Corridor 4B



Test 1 - Fire fighter data logs



Bodyguard® Datalog report

Datalog from: 21/06/2004, 09:47:00
User Name: Drew
Serial Number: BRPN0319
User ID: 0000
Use (hh:mm): 01:22
Date from/to: [2004/06/17 14:00:33] - [2004/06/21 09:47:55]

Info: Set worn by J McGinness. Set No 0614

Cylinders used:

QTY	Pressure	Size
2	300	4-3

Event-No.	Date	Time	Pressure [bar]	Temp. [°C]	Breath rate [l/min]	Event code	Text
01587	17/06/2004	14:00:33	280.00	21	0	015	Power on/reset
01588	17/06/2004	14:00:52	280.00	21	0	004	ADSU Active
01589	17/06/2004	14:00:54	304.00	21	55	014	Press/Temp
01590	17/06/2004	14:01:14	300.00	21	37	014	Press/Temp
01591	17/06/2004	14:01:34	298.00	21	31	014	Press/Temp
01592	17/06/2004	14:01:54	296.00	21	48	014	Press/Temp
01593	17/06/2004	14:02:14	292.00	21	35	014	Press/Temp
01594	17/06/2004	14:02:34	290.00	21	50	014	Press/Temp
01595	17/06/2004	14:02:54	286.00	21	56	014	Press/Temp
01596	17/06/2004	14:03:14	282.00	21	59	014	Press/Temp
01597	17/06/2004	14:03:34	278.00	22	60	014	Press/Temp
01598	17/06/2004	14:03:54	274.00	22	61	014	Press/Temp
01599	17/06/2004	14:04:14	270.00	23	41	014	Press/Temp
01600	17/06/2004	14:04:34	265.00	23	56	014	Press/Temp
01601	17/06/2004	14:04:54	264.00	25	40	014	Press/Temp
01602	17/06/2004	14:05:14	262.00	25	56	014	Press/Temp
01603	17/06/2004	14:05:34	258.00	26	40	014	Press/Temp
01604	17/06/2004	14:05:54	256.00	26	57	014	Press/Temp
01605	17/06/2004	14:06:14	252.00	27	41	014	Press/Temp
01606	17/06/2004	14:06:34	250.00	27	36	014	Press/Temp
01607	17/06/2004	14:06:54	248.00	28	57	014	Press/Temp
01608	17/06/2004	14:07:14	244.00	28	42	014	Press/Temp
01609	17/06/2004	14:07:34	242.00	30	37	014	Press/Temp
01610	17/06/2004	14:07:54	240.00	30	35	014	Press/Temp
01611	17/06/2004	14:08:14	238.00	30	35	014	Press/Temp
01612	17/06/2004	14:08:34	236.00	31	35	014	Press/Temp
01613	17/06/2004	14:08:54	234.00	31	35	014	Press/Temp
01614	17/06/2004	14:09:14	232.00	31	59	014	Press/Temp
01615	17/06/2004	14:09:34	228.00	32	44	014	Press/Temp
01616	17/06/2004	14:09:54	226.00	32	39	014	Press/Temp
01617	17/06/2004	14:10:14	224.00	32	62	014	Press/Temp
01618	17/06/2004	14:10:34	220.00	32	0	014	Press/Temp
01619	17/06/2004	14:21:05	220.00	32	0	006	Power off
01620	21/06/2004	09:47:50	220.00	32	0	015	Power on/reset
01621	21/06/2004	09:47:50	220.00	32	0	012	IR Connect id=000001
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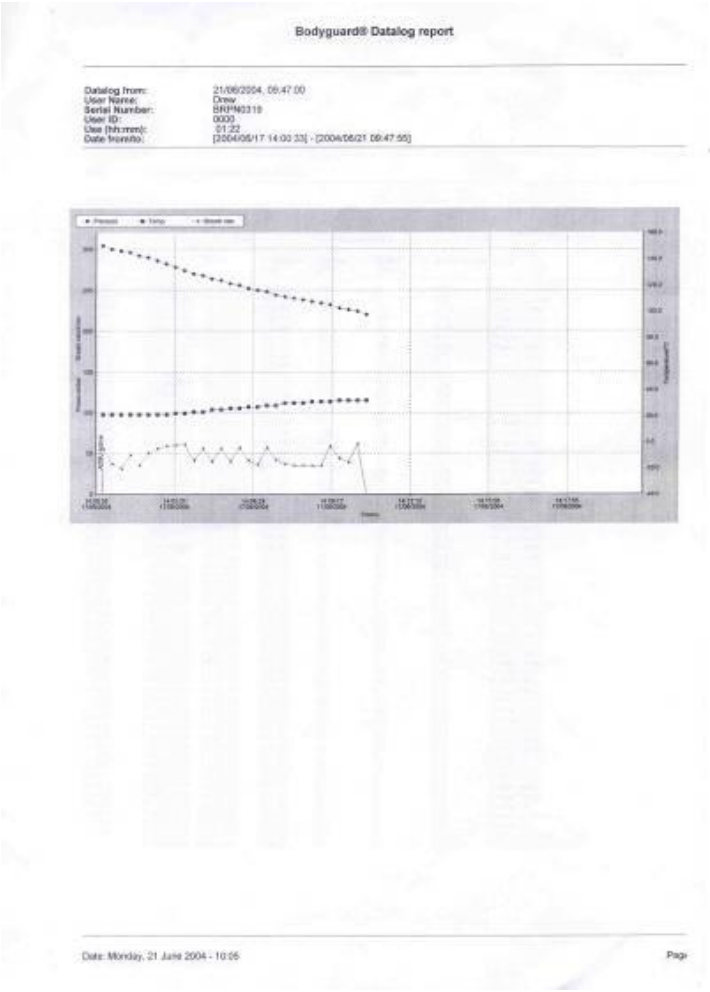
Date: Monday, 21 June 2004 - 10:05

Page:



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User Name: Drew
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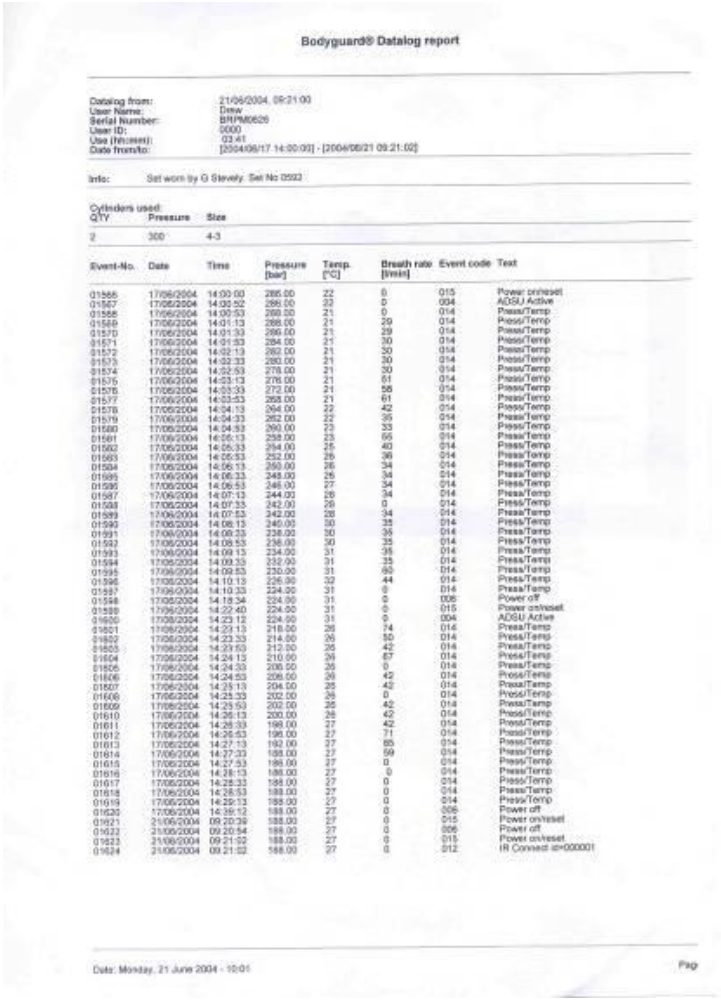
Date: Monday, 21 June 2004 - 10:05

Page

Test 1 - Fire fighter data logs



Bodyguard® Datalog report

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Serial Number: BRPM0626
User ID: 0000
Use (hh:mm): 03:41
Date from/to: [2004/06/17 14:00:00] - [2004/06/21 09:21:02]

Info: Set worn by G Stevely. Set No 0502

Cylinders used:

QTY	Pressure	Size
2	300	4-3

Event-No.	Date	Time	Pressure [bar]	Temp. [°C]	Breath rate [l/min]	Event code	Text
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01567	17/06/2004	14:00:02	286.00	22	0	004	ADSU Active
01568	17/06/2004	14:00:53	286.00	21	0	014	Press/Temp
01569	17/06/2004	14:01:13	286.00	21	29	014	Press/Temp
01570	17/06/2004	14:01:33	286.00	21	29	014	Press/Temp
01571	17/06/2004	14:01:53	284.00	21	30	014	Press/Temp
01572	17/06/2004	14:02:13	282.00	21	30	014	Press/Temp
01573	17/06/2004	14:02:33	280.00	21	30	014	Press/Temp
01574	17/06/2004	14:02:53	278.00	21	30	014	Press/Temp
01575	17/06/2004	14:03:13	276.00	21	61	014	Press/Temp
01576	17/06/2004	14:03:33	272.00	21	58	014	Press/Temp
01577	17/06/2004	14:03:53	268.00	21	61	014	Press/Temp
01578	17/06/2004	14:04:13	264.00	22	42	014	Press/Temp
01579	17/06/2004	14:04:33	262.00	22	36	014	Press/Temp
01580	17/06/2004	14:04:53	260.00	23	33	014	Press/Temp
01581	17/06/2004	14:05:13	258.00	23	66	014	Press/Temp
01582	17/06/2004	14:05:33	254.00	25	40	014	Press/Temp
01583	17/06/2004	14:05:53	252.00	26	36	014	Press/Temp
01584	17/06/2004	14:06:13	250.00	26	34	014	Press/Temp
01585	17/06/2004	14:06:33	248.00	26	34	014	Press/Temp
01586	17/06/2004	14:06:53	246.00	27	34	014	Press/Temp
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01588	17/06/2004	14:07:33	242.00	28	0	014	Press/Temp
01589	17/06/2004	14:07:53	242.00	28	34	014	Press/Temp
01590	17/06/2004	14:08:13	240.00	30	35	014	Press/Temp
01591	17/06/2004	14:08:33	238.00	30	35	014	Press/Temp
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01594	17/06/2004	14:09:33	232.00	31	35	014	Press/Temp
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01596	17/06/2004	14:10:13	226.00	32	44	014	Press/Temp
01597	17/06/2004	14:10:33	224.00	31	0	014	Press/Temp
01598	17/06/2004	14:18:34	224.00	31	0	006	Power off
01599	17/06/2004	14:22:40	224.00	31	0	015	Power on/reset
01600	17/06/2004	14:23:12	224.00	31	0	004	ADSU Active
01601	17/06/2004	14:23:13	218.00	28	74	014	Press/Temp
01602	17/06/2004	14:23:33	214.00	26	50	014	Press/Temp
01603	17/06/2004	14:23:53	212.00	26	42	014	Press/Temp
01604	17/06/2004	14:24:13	210.00	26	67	014	Press/Temp
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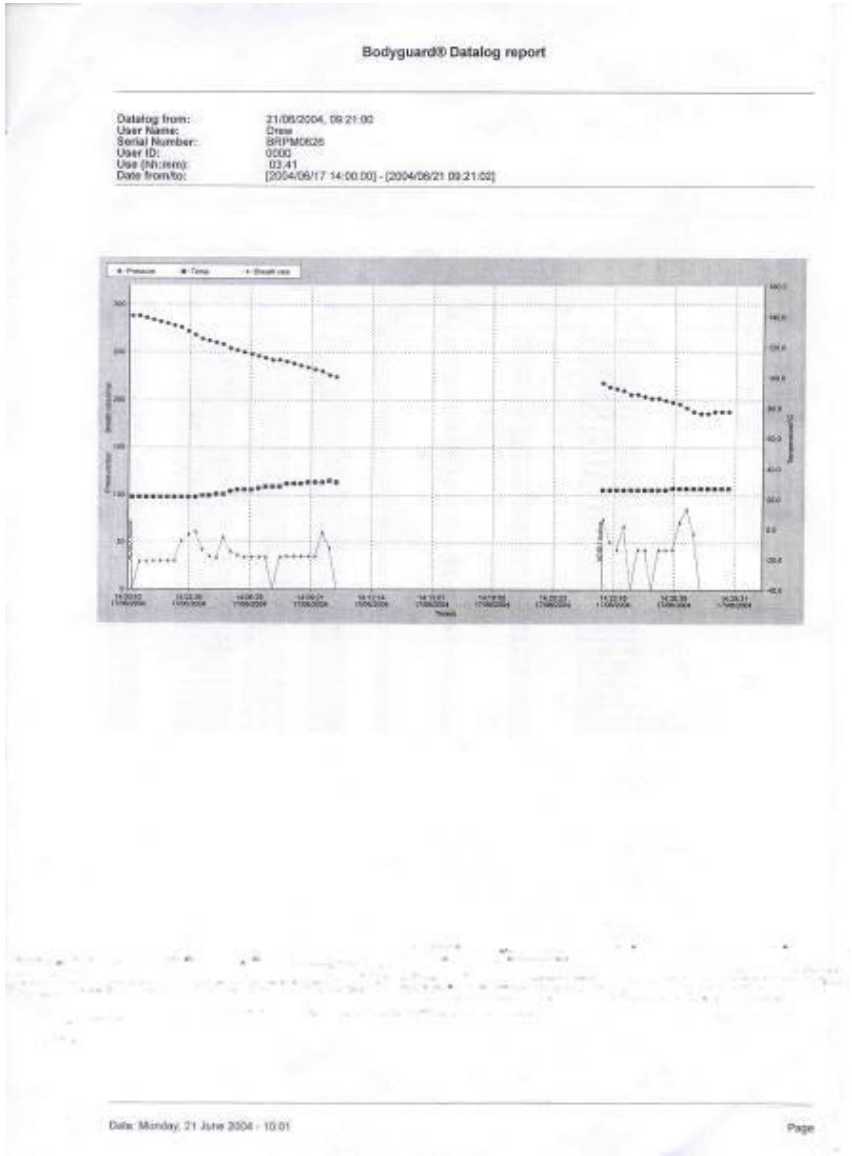
01606	17/06/2004	14:24:53	206.00	26	42	014	Press/Temp
01607	17/06/2004	14:25:13	204.00	26	42	014	Press/Temp
01608	17/06/2004	14:25:33	202.00	26	0	014	Press/Temp
01609	17/06/2004	14:25:53	202.00	26	42	014	Press/Temp
01610	17/06/2004	14:26:13	200.00	26	42	014	Press/Temp
01611	17/06/2004	14:26:33	198.00	27	42	014	Press/Temp
01612	17/06/2004	14:26:53	196.00	27	71	014	Press/Temp
01613	17/06/2004	14:27:13	192.00	27	85	014	Press/Temp
01614	17/06/2004	14:27:33	188.00	27	59	014	Press/Temp
01615	17/06/2004	14:27:53	188.00	27	0	014	Press/Temp
01616	17/06/2004	14:28:13	188.00	27	0	014	Press/Temp
01617	17/06/2004	14:28:33	188.00	27	0	014	Press/Temp
01618	17/06/2004	14:28:53	188.00	27	0	014	Press/Temp
01619	17/06/2004	14:29:13	188.00	27	0	014	Press/Temp
01620	17/06/2004	14:39:12	188.00	27	0	006	Power off
01621	21/06/2004	09:20:39	188.00	27	0	015	Power on/reset
01622	21/06/2004	09:20:54	188.00	27	0	006	Power off
01623	21/06/2004	09:21:02	188.00	27	0	015	Power on/reset
01624	21/06/2004	09:21:02	188.00	27	0	012	IR Connect id=000001

Date: Monday, 21 June 2004 - 10:01

Page



Bodyguard® Datalog report

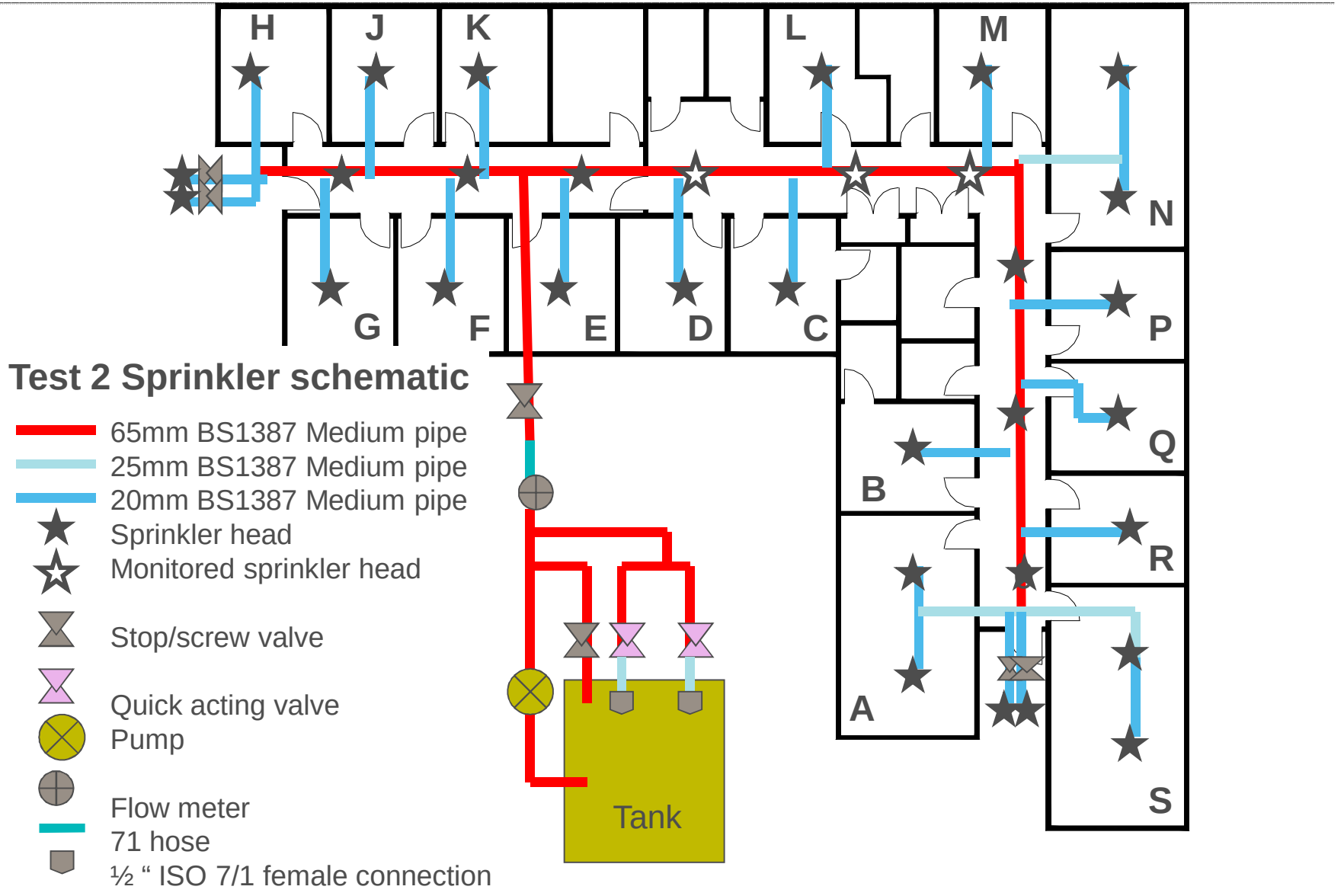
Datalog from: 21/06/2004, 09:21:00
User Name: Drew
Serial Number: BRPM0626
User ID: 0000
Use (hh:mm): 03:41
Date from/to: [2004/06/17 14:00:00] - [2004/06/21 09:21:02]

Date: Monday, 21 June 2004 - 10:01

Page

Test 2: Carry out test with sprinklers

- Refurbish rig
- Replace fire-damaged components
- Add fresh plasterboard
- Refurnish (e.g. wall paper)
- Fit sprinkler system
- Replace any damaged furniture
- Carry out test with sprinklers


H
J
K
L
M
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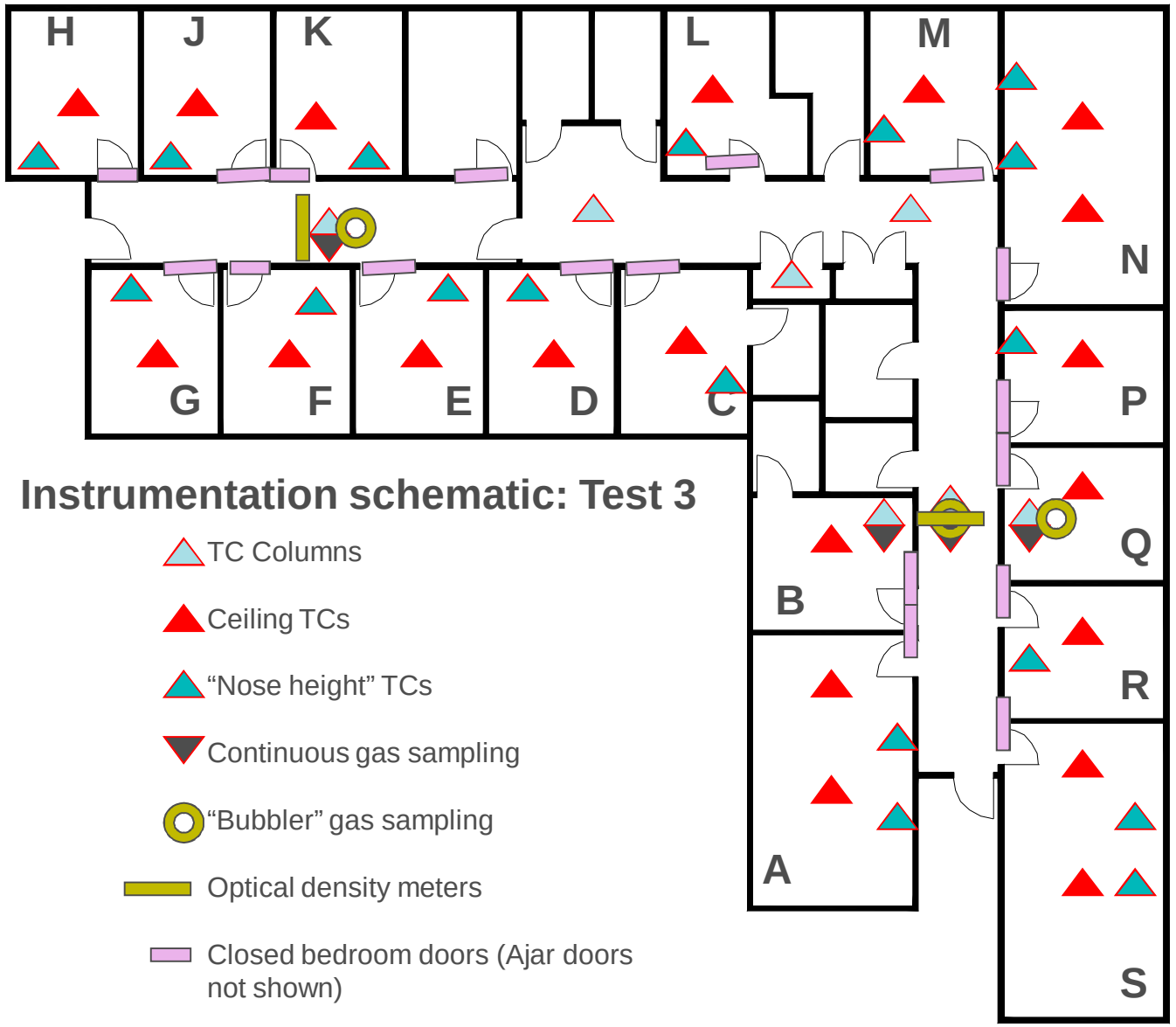
F
E
D
C
P
Q
B
R
A
S
Tank
Test 2 Sprinkler schematic
65mm BS1387 Medium pipe
25mm BS1387 Medium pipe
20mm BS1387 Medium pipe
Sprinkler head
Monitored sprinkler head
Stop/screw valve
Quick acting valve
Pump
Flow meter
71 hose
½ “ ISO 7/1 female connection

Test 2 – View E; Before ignition

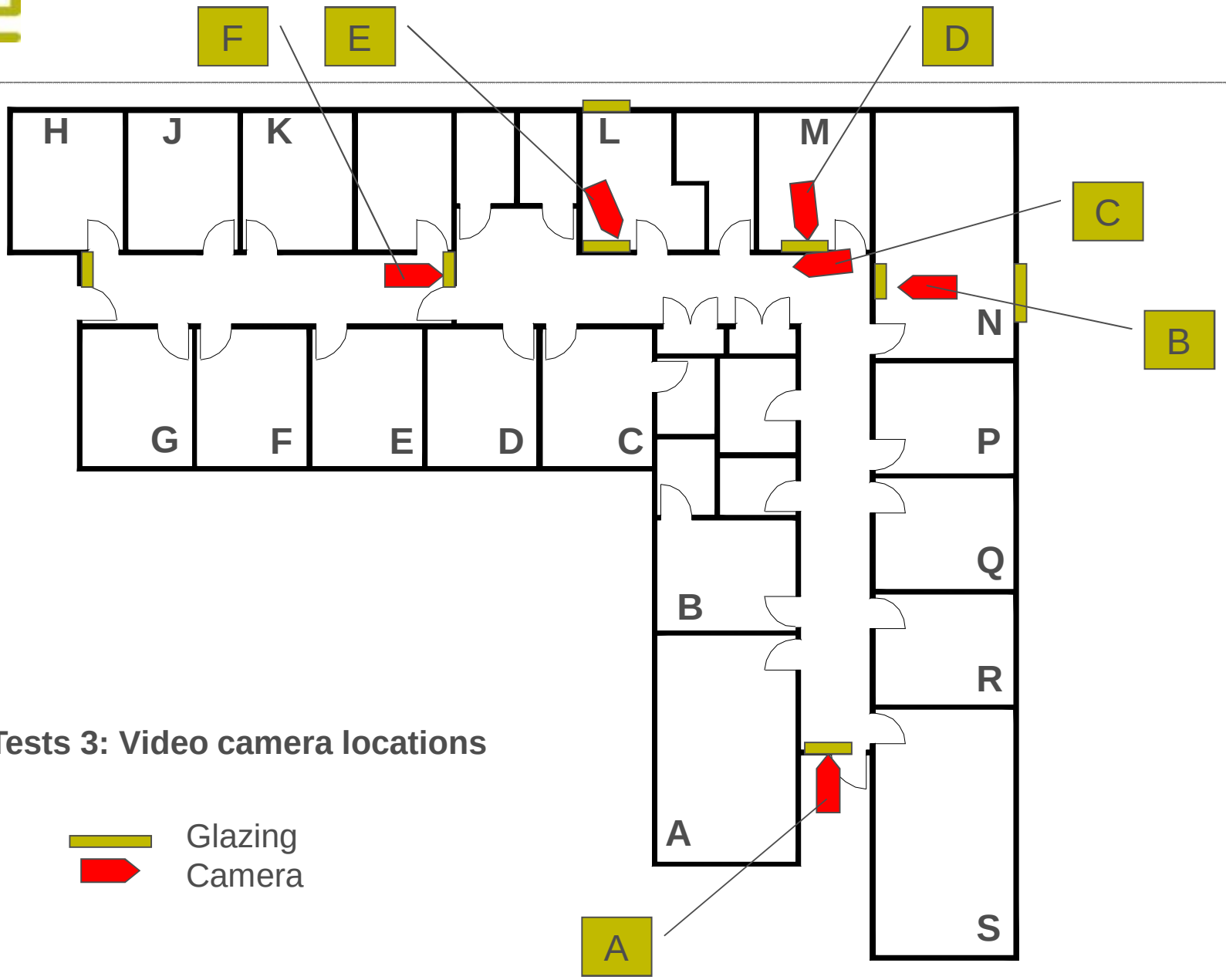
Test 3: Carry out test with closed fire doors

- Refurbish rig
- Replace fire-damaged components
- Add fresh plasterboard
- Refurnish (e.g. wall paper)
- Fit fire doors
- Replace any damaged furniture
- Carry out test with closed fire doors



Instrumentation schematic: Test 3

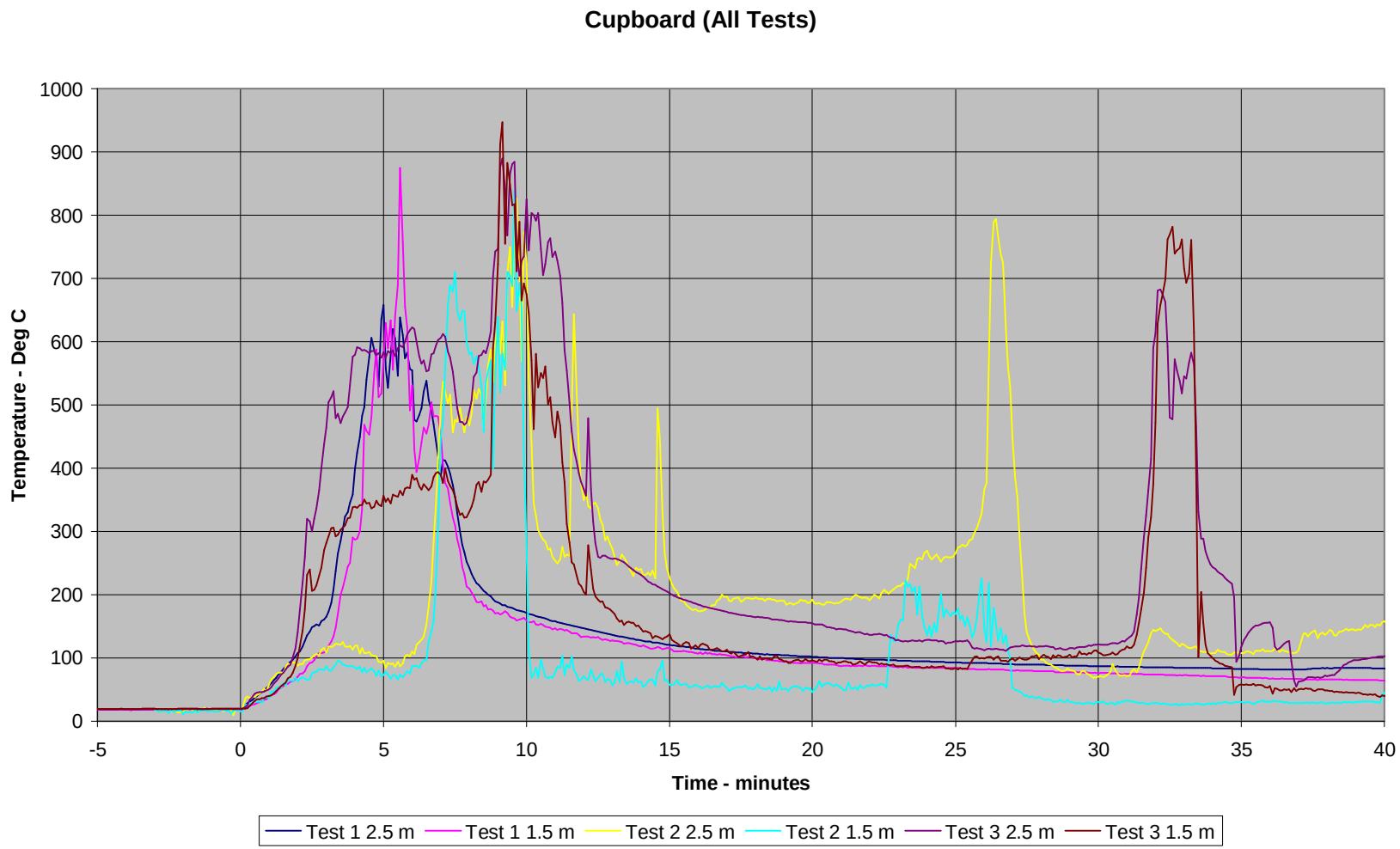
- TC Columns
- Ceiling TCs
- "Nose height" TCs
- Continuous gas sampling
- "Bubbler" gas sampling
- Optical density meters
- Closed bedroom doors (Ajar doors not shown)



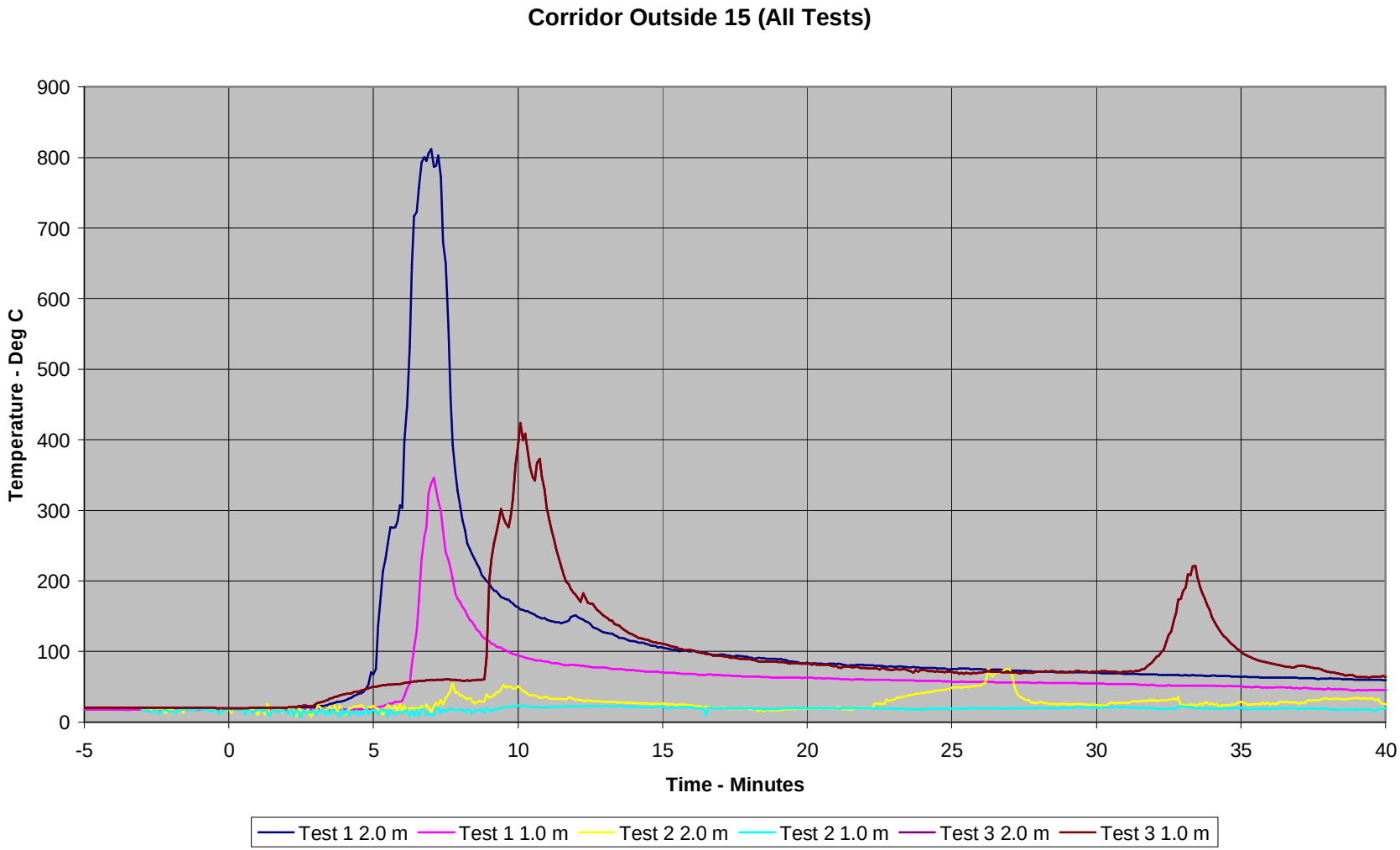
Tests 3: Video camera locations

Comparison of results

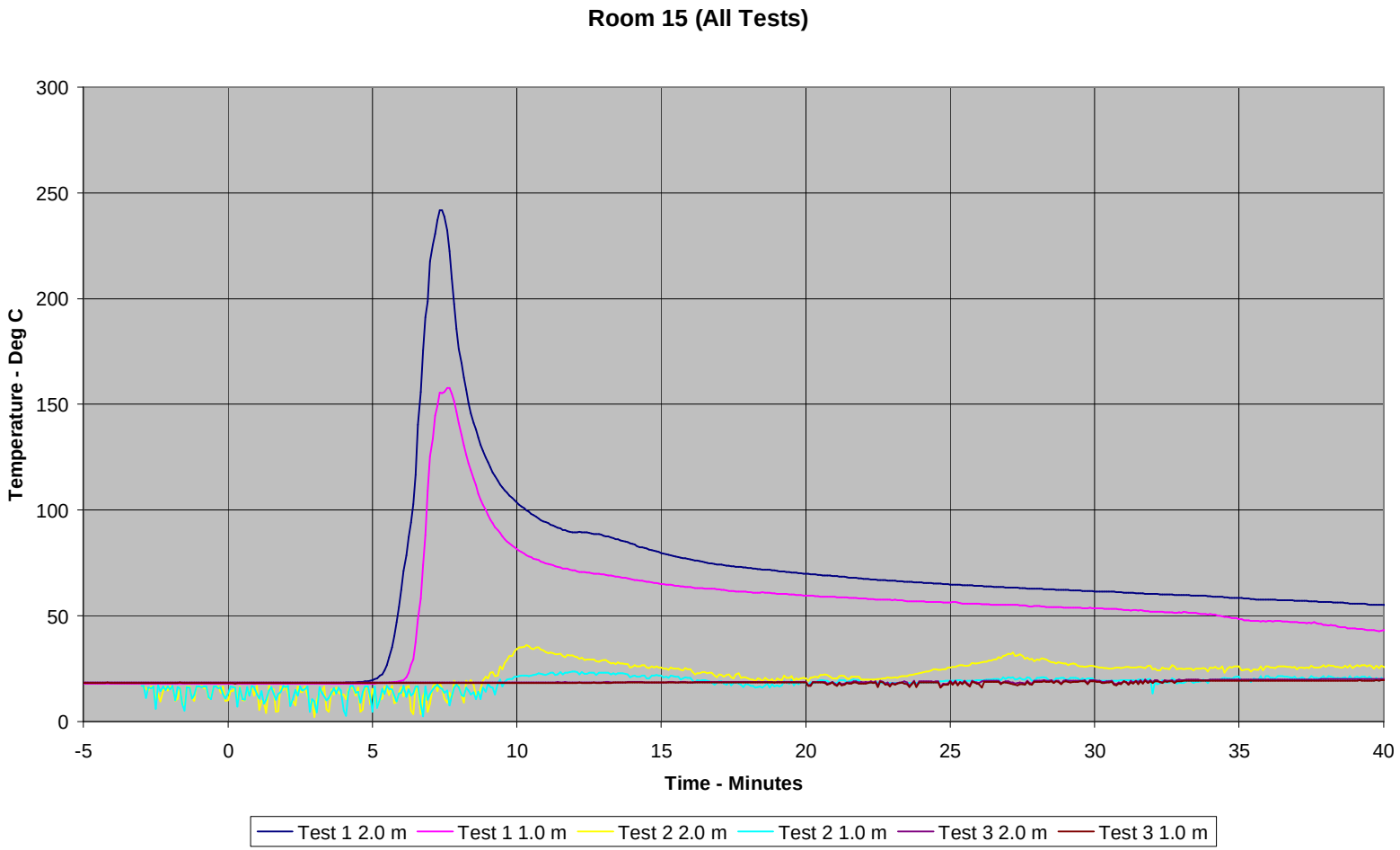
Cupboard (All Tests)



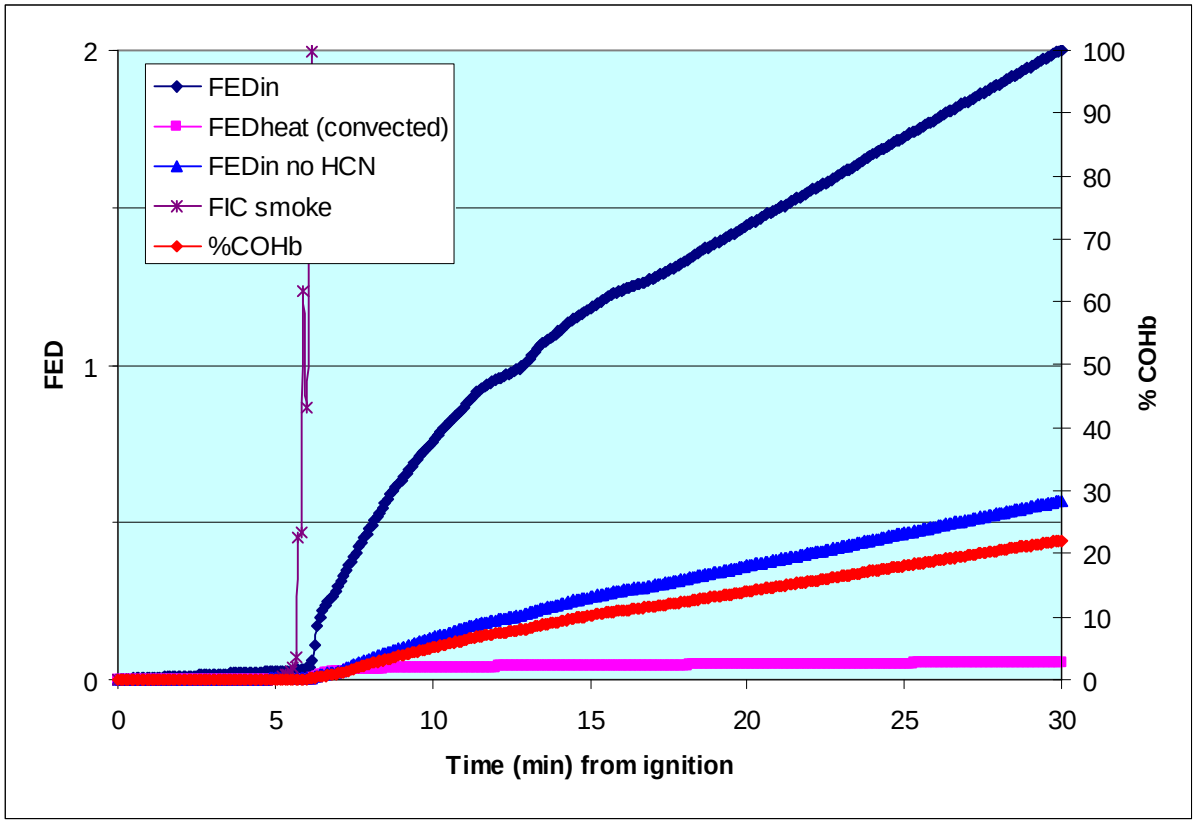
Corridor Outside Room B (All Tests) Outside Room 15



Room B (All Tests) Room 15



Predicted times to incapacitation endpoints for a subject in the in the corridor beyond the partly closed fire resisting door (Corridor Z) Corridor 3



Comparison views – Real building vs before tests vs Test 1

Real building– Lower Ground Floor (i.e. as if before the fire)

Real building – after fire

Test 1 – Before ignition

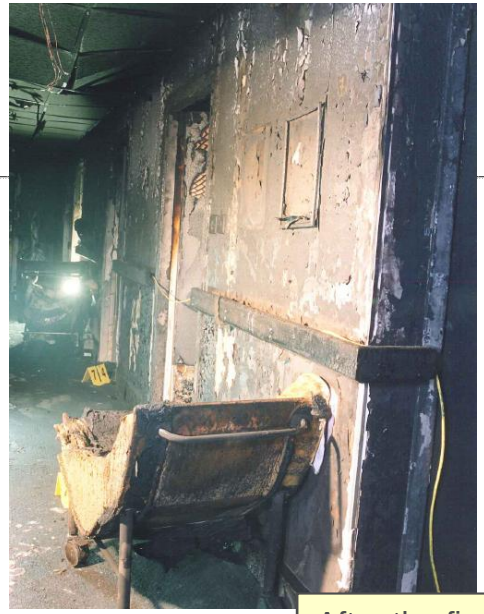
Test 1 – After fire

Lower Ground Floor – view A

Lower Ground Floor – view A

Before Test 1 – view A

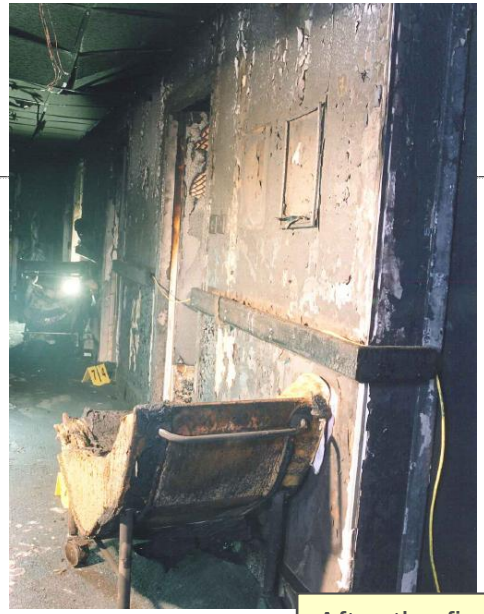
Lower Ground Floor – view A



After the fire – view A

Before Test 1 – view A

Lower Ground Floor – view A



After the fire – view A

Before Test 1 – view A

After Test 1 – view A

Lower Ground Floor – view B

Lower Ground Floor – view B

Before Test 1 – view B

Lower Ground Floor – view B

After the fire – view B

Before Test 1 – view B

Lower Ground Floor – view B

After the fire – view B

Before Test 1 – view B

After Test 1 – view B

Lower Ground Floor – view C

Lower Ground Floor – view C

Before Test 1 – view C

Lower Ground Floor – view C

After the fire – view C

Before Test 1 – view C

Lower Ground Floor – view C

After the fire – view C

Before Test 1 – view C

After Test 1 – view C

Comparison views - Tests

Test 1 – Before ignition

Test 1 – After fire

Test 2 – After fire

Test 3 – After fire

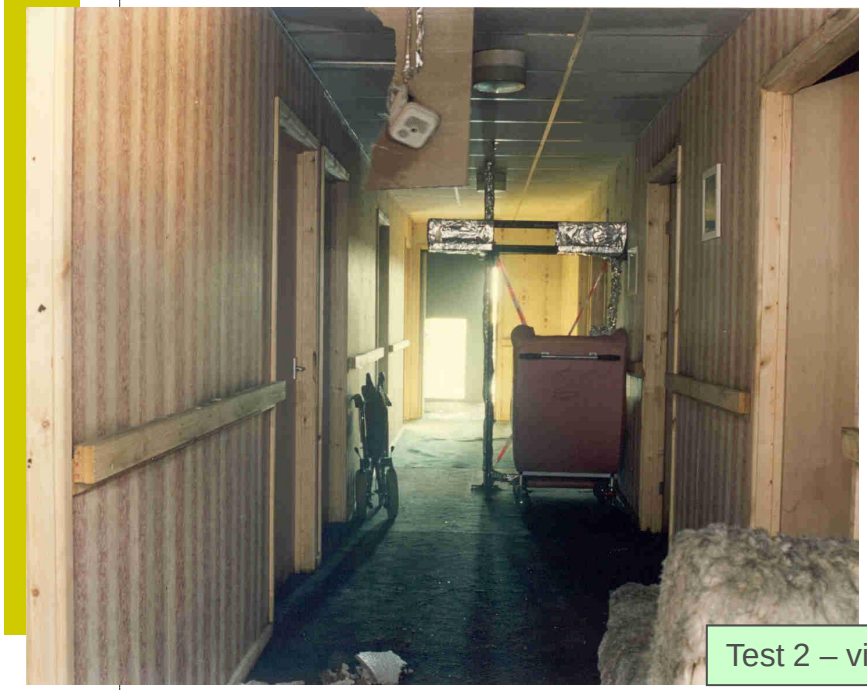
Before Test 1 – view A

Before Test 1 – view A

Test 1 – view A

Before Test 1 – view A

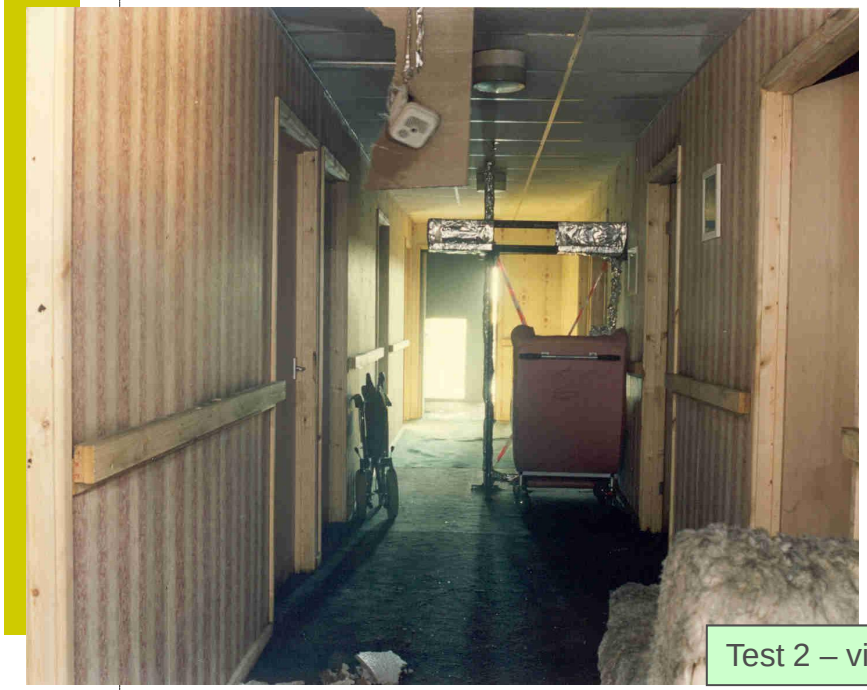
Test 1 – view A



Test 2 – view A

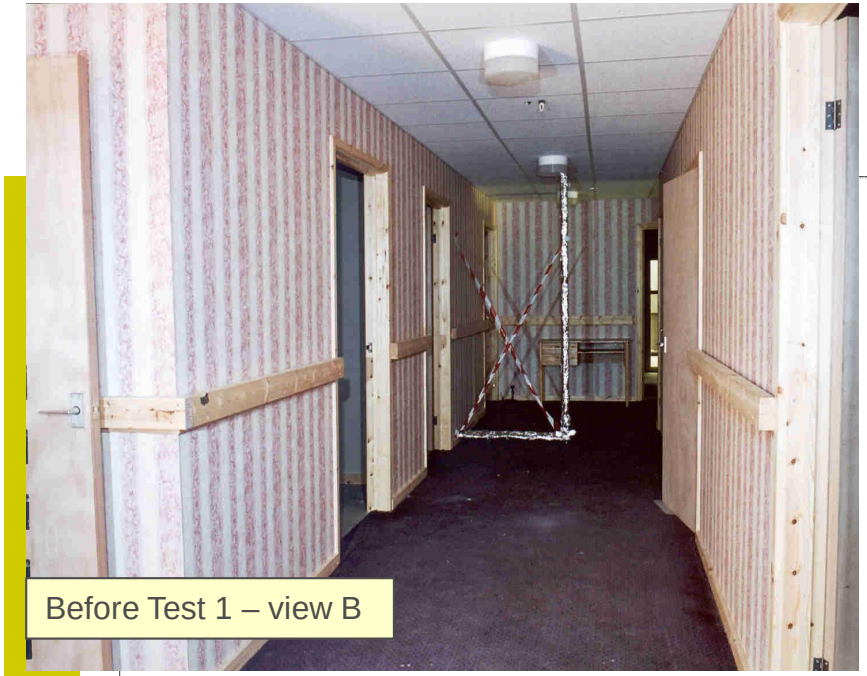
Before Test 1 – view A

Test 1 – view A

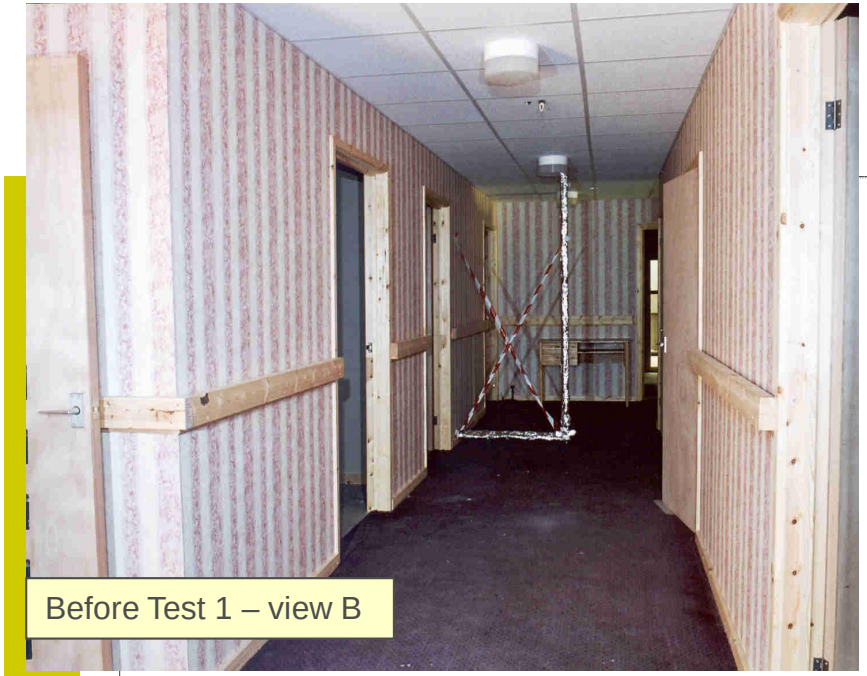


Test 2 – view A

Test 3 – view A

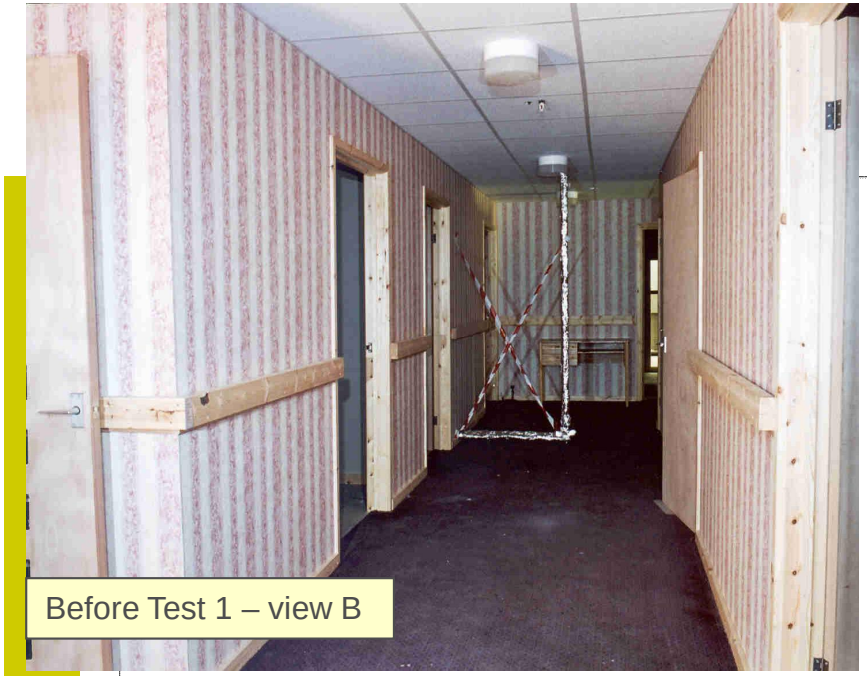


Before Test 1 – view B



Before Test 1 – view B

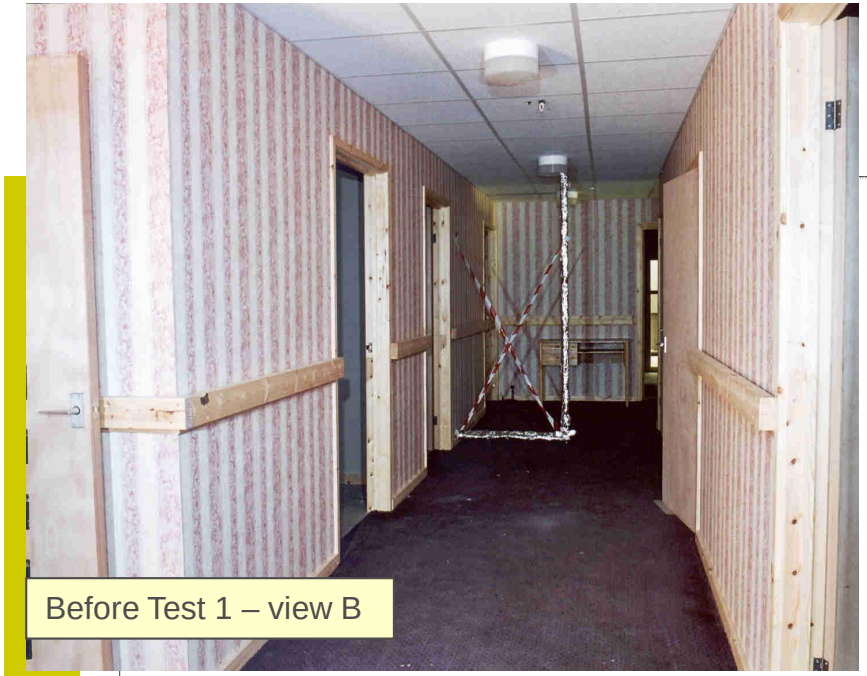
Test 1 – view B



Before Test 1 – view B

Test 1 – view B

Test 2 – view B



Before Test 1 – view B

Test 1 – view B

Test 2 – view B

Test 3 – view B

Before Test 1 – view C

Before Test 1 – view C

Test 1 – view C

Before Test 1 – view C

Test 1 – view C

Test 2 – view C

Before Test 1 – view C

Test 1 – view C

Test 2 – view C

Test 3 – view C

Summary of key findings

- This reconstruction was the biggest in scale ever attempted by BRE (not the biggest fire)
- The Rosepark fire was a rapidly developing short duration fire lasting around 7 minutes involving cupboard contents, made worse by the presence of aerosols in the cupboard and combustible items, furniture and equipment in the corridor.
- The combined effects of heat and asphyxiant gases and open/partially open bedroom doors provides an explanation for the fatality of all occupants in Corridor 4a/4b, possibly within some 7 to 8 minutes after the fire started.

Summary of key findings

- The reportedly poor fitting fire door separating Corridor 3 from Corridor 4a/4b would have allowed the penetration of heat and potentially asphyxiant gases into the corridor and associated open bedrooms. (Alternatively, this door was blown open by exploding aerosols and became stuck open).
- The presence of a residential sprinkler system, if available on the night of the incident, would not have extinguished the fire but would probably have rendered conditions in all areas tenable for at least 1 hour.
- The fitting of fire doors with smoke seals to all bedrooms, and keeping them closed during the fire, would not have prevented untenable conditions in the corridor but would largely have prevented heat and asphyxiant gases penetrating the bedrooms. Occupants in bedrooms behind closed doors would probably have escaped incapacity for up to 2 hours.

Summary of key findings

- If the fire door separating Corridors 3 and 4a/4b had been closed and had been a good fit, heat and asphyxiant gases would have been less likely to have penetrated into Corridor 3 and the associated bedrooms, although the door was blown open by the aerosol blasts, which allowed smoke and hot gases through.
- The fitting of fire doors to the cupboard, and keeping them closed/latched with no internal ventilation would probably have resulted in the fire self extinguishing and being contained within the cupboard, despite the presence of aerosol canisters. Ventilation of the cupboard would have negated the benefits of closed fire doors, allowing the fire to develop.

Report

- The BRE research is at ..

- http://www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards/publications/pubresearch/researchfire

- http://www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards/publications/pubresearch/researchfire/resroprk

- http://www.scotland.gov.uk/Resource/Doc/175356/0119308.pdf

Work for COPFS

- A programme of laboratory research was carried out during July 2006 by BRE Fire and Security, commissioned by the Crown Office and Procurator Fiscal Service (COPFS)

Objectives: COPFS ducting test

- How did Corridor 2 became smoke logged?
- What explanations are there which would explain the timescale?
- Could the smoke logging in Corridor 2 have been caused by smoke passing through the ventilation ducts?
- Could smoke have passed through the ventilation duct into Corridor 3?

Objectives: COPFS ducting test

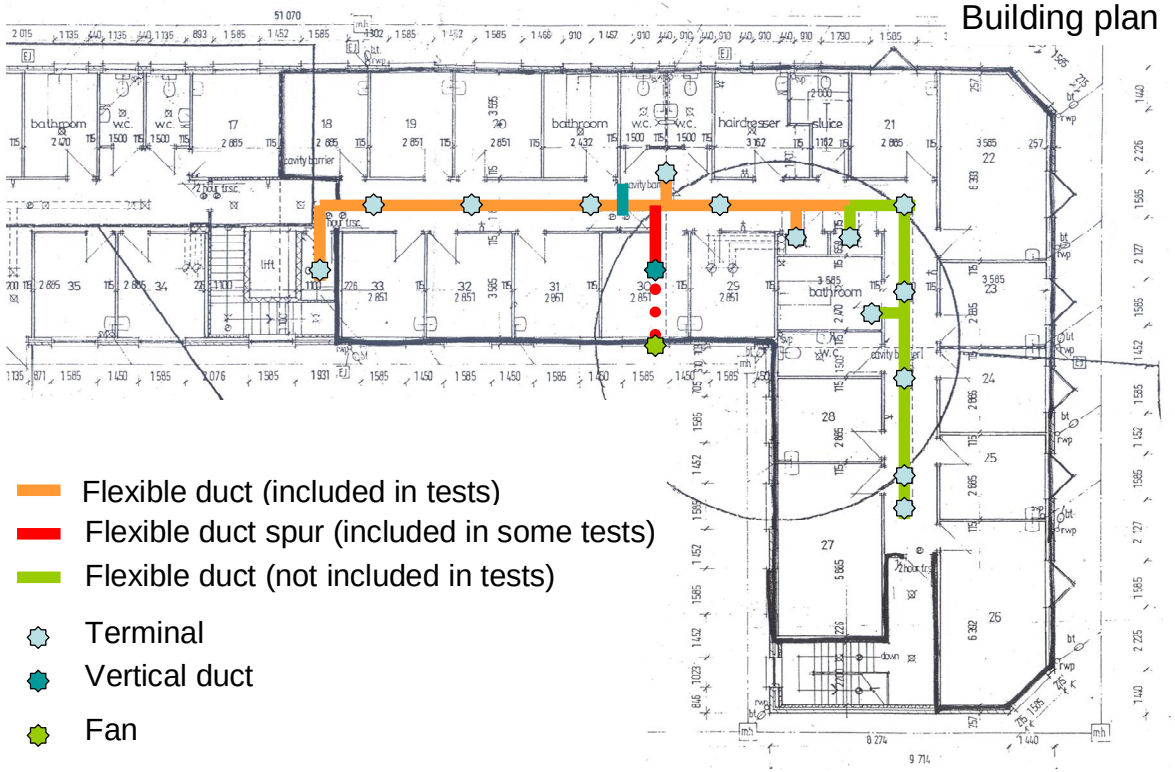
- Would the volume of smoke passing through the ventilation system into Corridor 3 have presented any hazard to the safety of the residents in the bedrooms there?Would a fire damper in the duct at the wall between Corridors 4 and 3 have had any effect on the flow of smoke into the Corridors 3 or 2?
- How long would it have taken before the fire damper would activate?
- How fast would smoke pass through the system; how much smoke could travel in this manner?

Programme

- Cupboard tests: Monday 10th July 2006, Tuesday 11th July 2006, Wednesday 12th July 2006 and Tuesday 18th July 2006. BRE Garston, Burn Hall.
- Aerosol demonstration tests: Tuesday 18th July 2006. BRE Garston, Burn Hall.
- Bedroom Doors test: Thursday 27th July 2006. BRE Garston, Furnace Laboratory.

COPFS ducting test

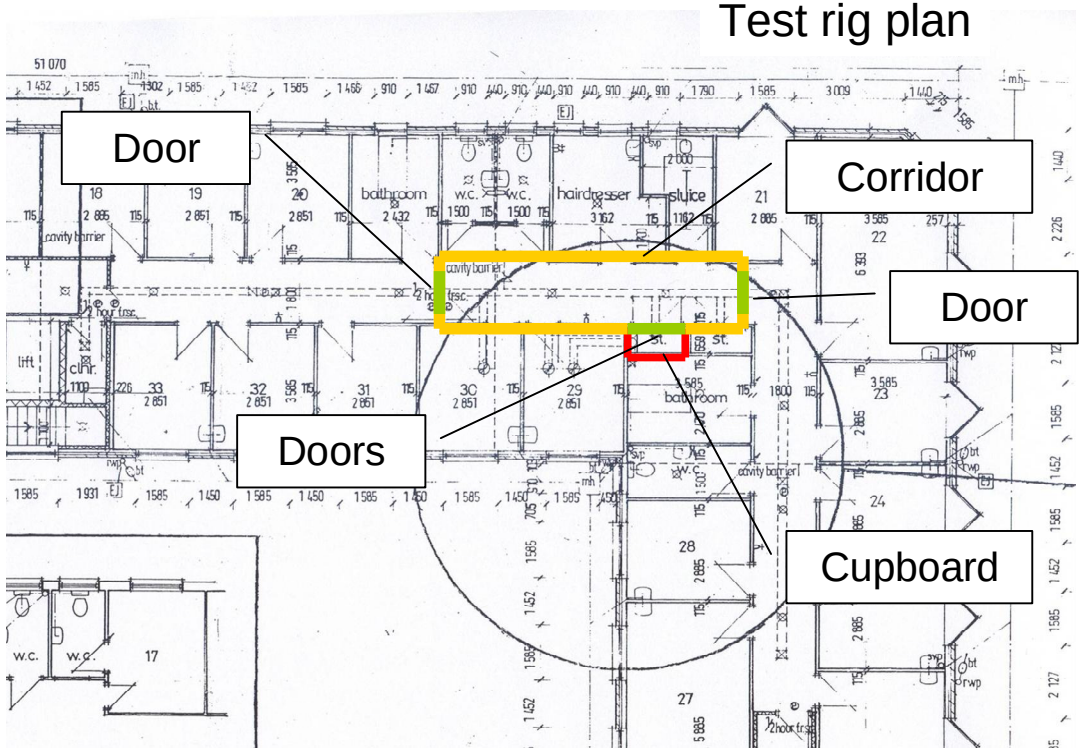
Building plan

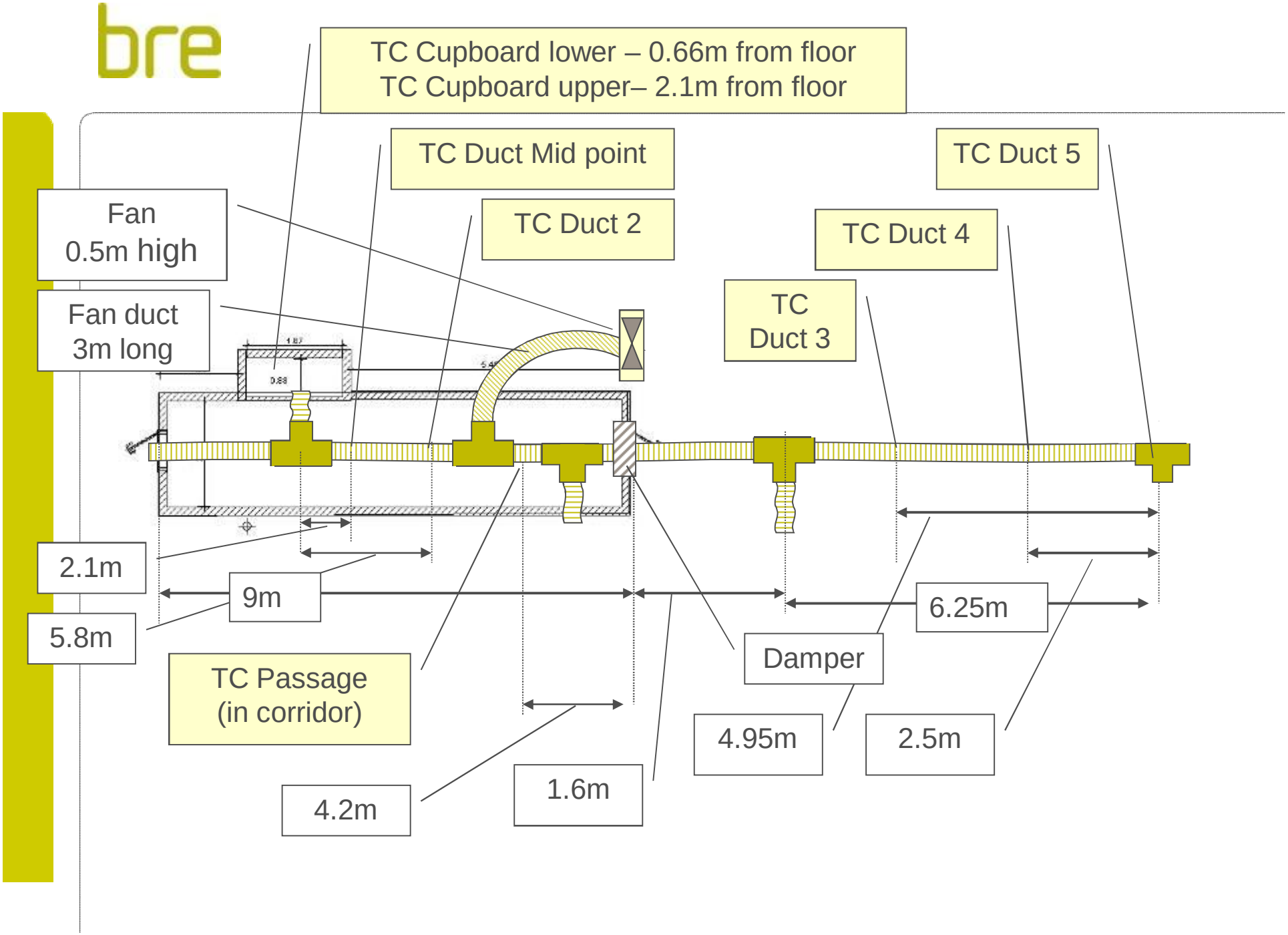


- Flexible duct (included in tests)
- Flexible duct spur (included in some tests)
- Flexible duct (not included in tests)
- Terminal
- Vertical duct
- Fan
- Damper

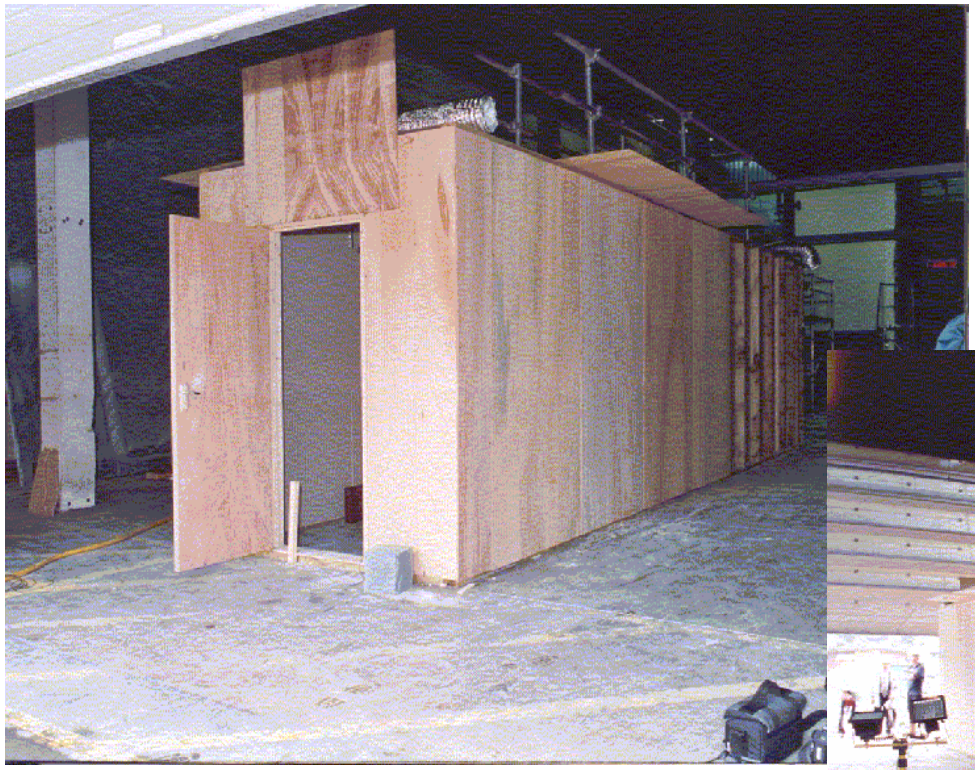
COPFS ducting test

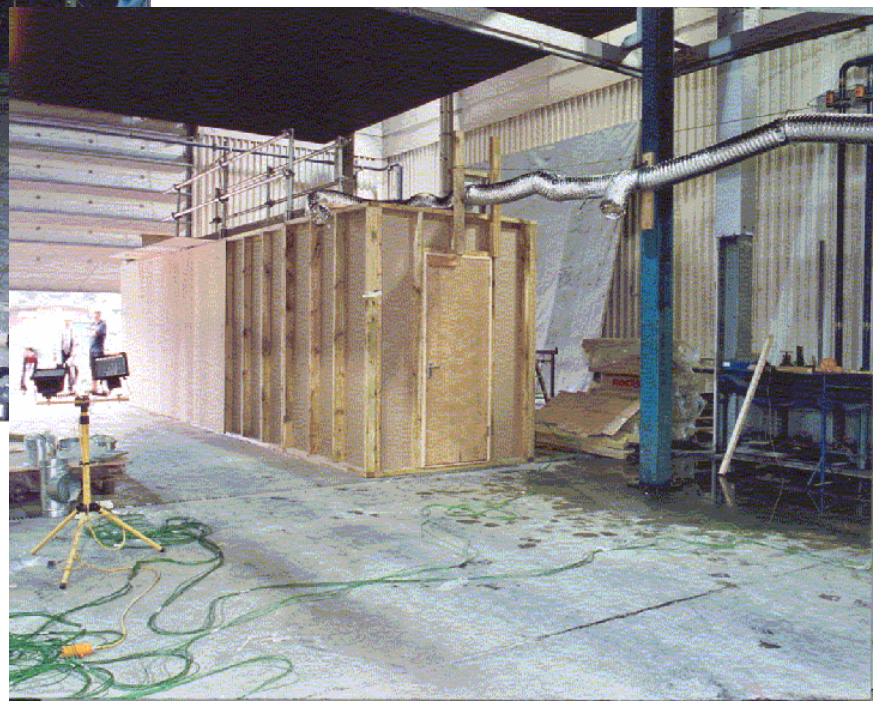
Test rig plan




TC Cupboard lower – 0.66m from floor
TC Cupboard upper– 2.1m from floor
TC Duct Mid point
TC Duct 5
Fan
0.5m high
TC Duct 2
TC Duct 4
Fan duct
3m long
TC
Duct 3
2.1m
9m
6.25m
5.8m
TC Passage
(in corridor)
Damper
4.95m
2.5m
4.2m
1.6m

COPFS ducting test





Cupboards

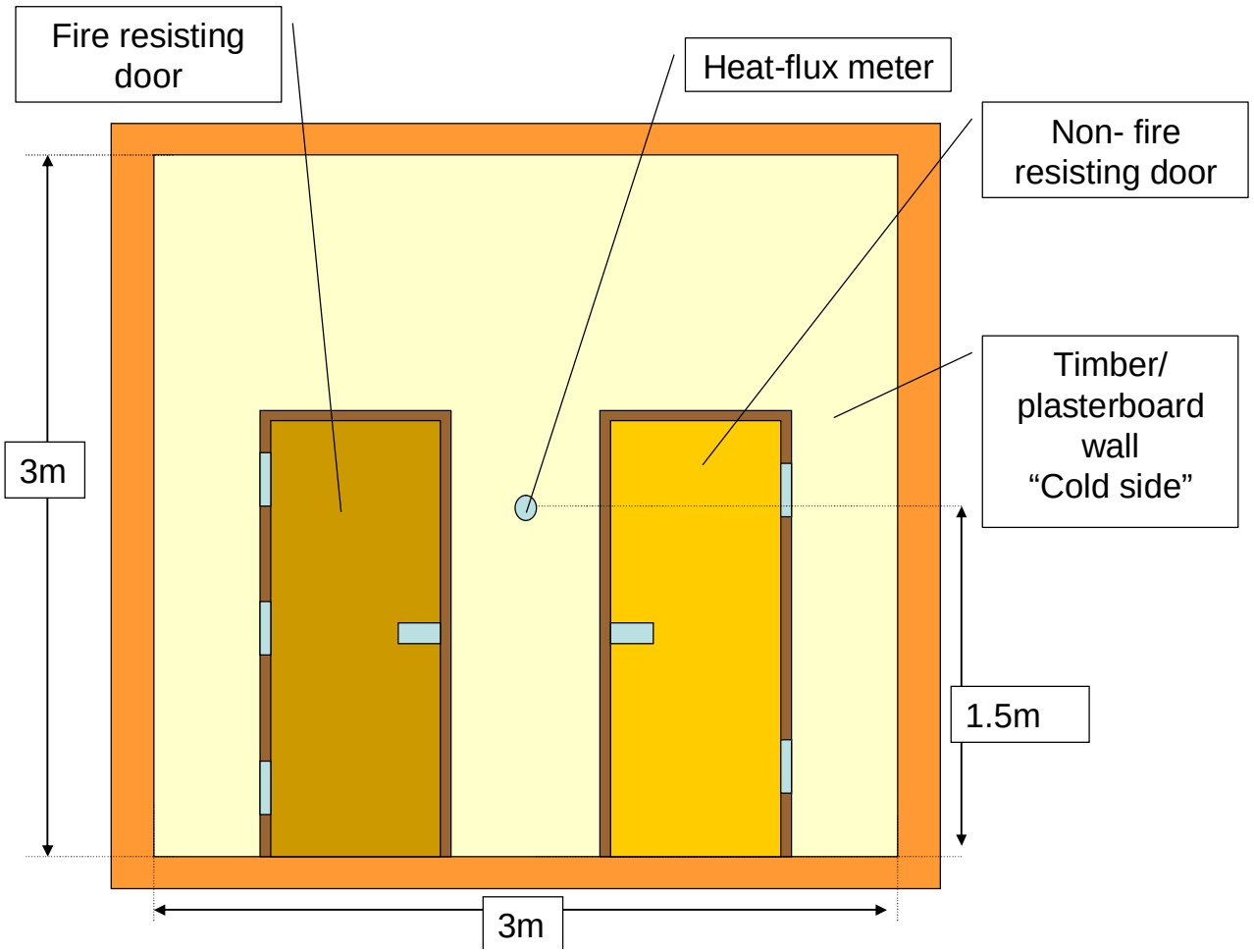

STOPWATCH CHALLENGE
MIDLIFE CRISIS
GUESS WHO?
60 Games
BLOCKBUSTERS


60 Games

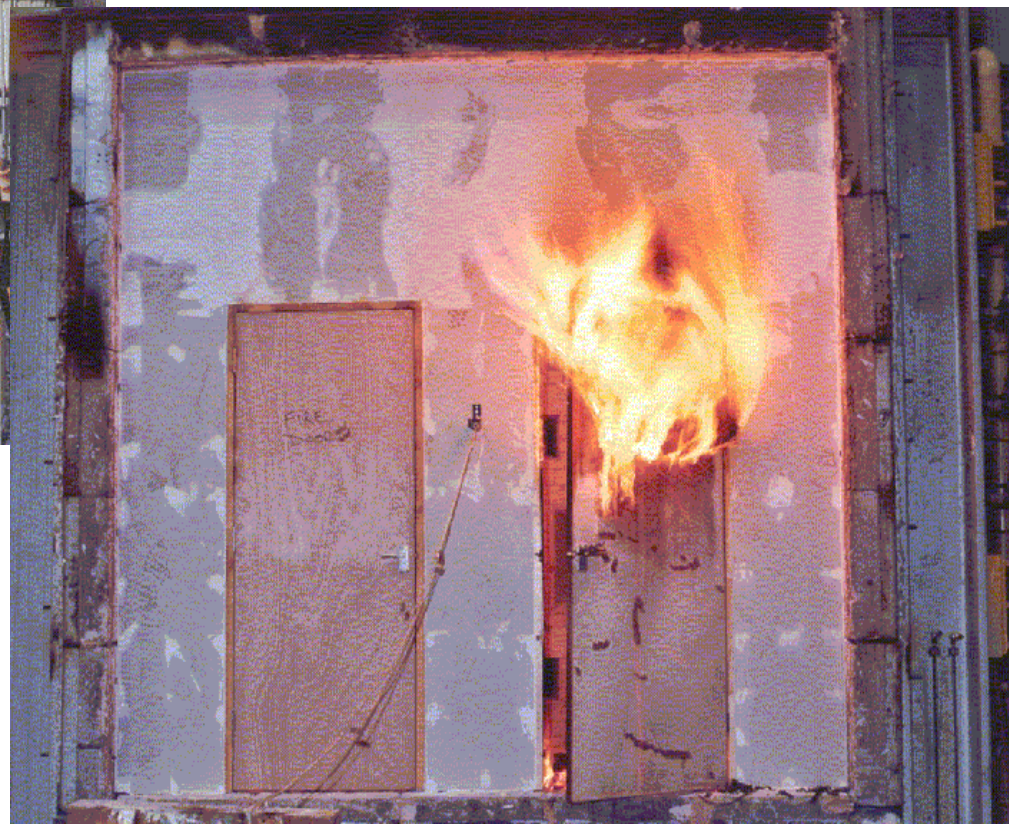
Objectives: COPFS door test

– What difference would it have made on the night of the actual fire if all the bedroom doors had been shut?

COPFS door test



COPFS door test



Key findings: COPFS ducting test

- Would the volume of smoke passing through the ventilation system into Corridor 3 have presented any hazard to the safety of the residents in the bedrooms there?Would a fire damper in the duct at the wall between Corridors 4 and 3 have had any effect on the flow of smoke into the Corridors 3 or 2?
- The tests indicated that the volume of smoke that is likely to have travelled from the initial cupboard in Corridor 4 to Corridor 3 via the ventilation ducting may not, by itself, have been hazardous, i.e. noting that fatalities occurred in rooms off Corridor 3, the quantity of smoke that passed through the ventilation ducting was probably supplemented by smoke that travelled by another or other routes, most probably via the Corridor 4/3 fire door.

Key findings: COPFS ducting test

- How long would it have taken before the fire damper would activate?
- In Test 1 the fire damper located in the duct between Corridors 4 and 3 operated after 3 minutes 58 seconds from ignition, in Test 2, in 4 minutes 13 seconds and in Test 3 after 7 minutes 58 seconds. In Test 4 the fire damper operated after 10 minutes 40 seconds minutes from ignition. In Tests 3 (and 4) the extract fan was operating for the first 6 minutes, which would have reduced or prevented any spread of hot gases towards the damper during this time.

Key findings: COPFS ducting test

- How fast would smoke pass through the system; how much smoke could travel in this manner?
- The tests have demonstrated that smoke is likely to have travelled from the initial cupboard in Corridor 4 to Corridor 2 and Corridor 3 via the ventilation ducting within 3 or 4 minutes of ignition. If the fan had been operating then this may have stopped smoke travelling into Corridor 2 and Corridor 3 and smoke would only have travelled into Corridor 2 after the ventilation system fan (in the roof) failed.

Key findings: COPFS Door test

- What difference would it have made on the night of the actual fire if all the bedroom doors had been shut?
- Test 6 demonstrated that an “egg box” door can withstand the test conditions of a fire resistance test for a period of only 7 minutes.
- It was my opinion that it is likely that most, and probably all, of the non-fire-resisting doors (had they all been closed) would have withstood the fire in the corridor for a period sufficient for the fire to die back from lack of air, such that fire penetration into any of the bedrooms is not likely to have occurred.

Report

– The BRE research is at ..

– http://www.bre.co.uk/page.jsp?id=2729

The FAI and the Determination

- This work was presented to the Fatal Accident Inquiry over three and a half days in April 2010.
- The Sheriff makes reference to the BRE work in a number of Chapters throughout the Determination, in particular:
- 31: The Development of the Fire: The BRE Work
- 32: Development of the Fire from Ignition to Flaming Combustion
- 33: BRE Test 1 – a Reasonable Representation of the Fire at Rosepark

Key lessons

Amongst others …

- Aerosol explosions can blow open fire doors
- Difficulties of evacuation through smoke
- Importance of rapid response to a fire alarm
- Importance of (closed) fire doors
- Importance of self-closers, and hold-open devices
- Potential for smoke to travel through ducts – importance of dampers
- Sprinklers work

Acknowledgments

- Scottish Building Standards Agency: Fiona Mackenzie, Colin Hird and colleagues.
- The Steering Group.
- Strathclyde Police: Kenneth MacLeod, Carol-Ann Murdock, David Thurley, Jill Cummings and Scott Cathro.
- Strathclyde Fire Brigade: Douglas Naismith, Kevin Rooney, Frank Kelly, John Hannah, Eric Heeps. Firefighters.
- Crown Office and Procurator Fiscal Service: Murdoch MacTaggart and Brian Duffy
- Cleveland Fire Brigade.
- Hertfordshire Fire Brigade.
- Stuart Mortimore - Burgoynes .
- Hamish Brodie – Jacobs.
- Paul White and Mike Backham, Ruskin Air Management Ltd.
- BRE: Peter Field, Richard Colwell, Richard Huntley, Dave Smit, Phil Clark, Kelvin Annable, John Raybould, Rob Hugil, Steve Howard, Mark Pearce, Dave Purser, Jenny Purser, Mark Pearce, Dick Jones, Bill Sturt, Kevin Fardell, Nigel Smithies.

Thank you

Martin Shipp

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