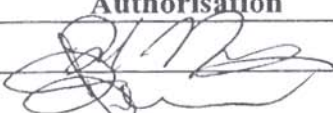



CONFIDENTIAL REPORT

**FIRE-RESISTANCE TEST ON THE SEALING
OF COPPER PIPE, ELECTRICAL CABLES,
TELECOMMUNICATION CABLES AND 2-OFF
EXPANSION JOINTS PENETRATING A
CONCRETE BLOCK WALL IN ACCORDANCE
WITH AS1530.4-1997 AND AS4072.1-1992
AS APPROPRIATE**

Report for

H.B Fuller Company Pty. Ltd.
16-22 Redgum Drive
Dandenong South
VIC 3175

Report	Name	Signature/* Authorisation	Date
Prepared by:	C. M. McLean		4-09-03
Reviewed by:	J. A. Bowen		4-09-03

* For and on behalf of Warrington Fire Research Group.

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4/09/03
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FIRE-RESISTANCE TEST ON THE SEALING OF COPPER PIPE, ELECTRICAL CABLES, TELECOMMUNICATION CABLES AND 2-OFF EXPANSION JOINTS PENETRATING A CONCRETE BLOCK WALL IN ACCORDANCE WITH AS1530.4-1997 AND AS4072.1-1992 AS APPROPRIATE

<i>Report Sponsor</i>	H.B Fuller Company Pty. Ltd.16-22 Redgum Drive Dandenong South VIC 3175
<i>Test Laboratory</i>	Warrington Fire Research (Aust) Pty Ltd, Unit 2, 409-411 Hammond Road, Dandenong South, Victoria, 3175.
<i>Test Date</i>	15 th August 2003.
<i>Test standards prescribed</i>	Sections 2, 3 and 10 of AS1530.4-1997, and AS4072.1-1992 as appropriate.
<i>General description of tested specimens</i>	The test assembly comprised 5-off locations for penetrations through a concrete block wall, that were designated as Services A, B, C to F, G & H for the purpose of this report. The services penetrating the wall were: a cable tray supporting the standard configuration of telecommunications cables recommended by AS4072.1-1992 (Service A), a 100mm diameter copper pipe (Service B), a cable tray supporting the standard configuration of PVC insulated power cables recommended by AS4072.1-1992 (Services C to F), two expansion joints (Services G & H) 30 & 10mm wide respectively sealed on the non-fire side, with Service G backed with urethane foam backing rod nominal 30mm x 20mm. Services A to F holes were filled with 20mm thick foam strips and sealed both sides of the wall with Rocor Fire-Sound New Grey Joint Sealant. All services extended nominally 100mm on the fire exposed side and nominally 800mm on the non-fire exposed side. A more detailed description of test construction is contained within Appendix 1.

Service Ref.	Designation	Description
A	Cable tray supporting telecommunication cables	Service A comprised one bundle of 60 pair 0.5 PVC indoor telephone cables length extending nominal 100mm into the furnace and nominal 800mm exposed side.
B	100mm diameter copper pipe	Service B comprised one nominal 100mm diameter copper pipe with a wall thickness of 1.8mm extending nominal 100mm into the furnace and nominal 800mm on the non-fire exposed side. The pipe end within the furnace was capped using Kao wool.
C to F	Cable tray supporting electrical cables	Service C comprised 8-off 3 Core plus earth PVC insulated, PVC sheathed 16mm ² 7 x 1.7mm conductors. Service D comprised 3-off 3 Core plus earth PVC insulated, PVC sheathed 6mm ² 7 x 1.04mm conductors. Service E comprised 1-off 3 Core plus earth PVC insulated, PVC sheathed 185mm ² 37 x 2.52mm conductors. Service F comprised 1-off single core PVC insulated, PVC sheathed 630mm ² 127 x 2.52mm conductors.

G	30mm Expansion Joint	Service G was sealed on non-exposed side with Rocor Fire-Sound New Grey Joint Sealant 30mm wide x 15mm deep, and backed with urethane foam backing rods nominal 30mm x 20mm.
H	10mm Expansion Joint	Service H was sealed on non-exposed side with Rocor Fire-Sound New Grey Joint Sealant 10mm wide x 5mm deep.

Note: Services A-F extended nominal 100mm exposed side and nominal 800mm on non-exposed side.

<i>Separating Element</i>	The separating element comprised a nominal 1300mm long x 1350mm wide x 140mm thick concrete block wall, where a nominal area of 1200mm long x 1200mm wide was exposed to the furnace.
<i>Instrumentation</i>	Instrumentation was provided in accordance with AS1530.4-1997 and AS4072.1-1992 as appropriate. The position of thermocouples are summarised in Table A2.1 and shown on Drg No's 41003-TS-02, 41003-TS-03 and 41003-TS-04.
<i>Test Procedures</i>	Test procedures were as specified in AS1530.4-1997 and AS4072.1-1992 as appropriate. Control of the furnace temperature was maintained within the prescribed limits of variance from the time/temperature curve that are specified in Clause 2.9.2 of AS1530.4-1997 for the duration of the fire test. The furnace pressure was measured level with lowest penetration, which was approximately 360mm from the nominal floor level of the furnace and was maintained at approximately 15 Pa above the laboratory atmosphere after the first 5 minutes and then for the duration of the fire-resistance test. Heating was terminated after 181 minutes at the request of the test sponsor.
<i>Test Duration</i>	181 minutes.

Test Results	
<i>Ambient Air Temperature</i>	Approximately 17°C at the start of the test, with no significant variations during the test.
<i>Temperatures Measured versus Time</i>	Refer to tables and graphs in Appendix 2.
<i>Observations</i>	Refer to Table A2.2 in Appendix 2.
<i>Performance Against the Criteria Specified in AS1530.4-1997</i>	Refer to Table 1 for the results judged against each of the performance criteria specified in AS1530.4-1997.
<i>Fire Resistance Level (FRL) designation</i>	For the purposes of the Building Code of Australia in Australia the specimen may be regarded as having achieved the fire resistance levels (FRL's) as shown in Table 2.

Table 1: Summary of the Performance of the Test Specimens based on the Criteria Specified in AS1530.4-1997

Test Specimen Designation	Description	Structural Adequacy	Integrity (minutes)	Insulation (minutes)
Service A	Cable tray supporting the standard configuration of telecommunications cables recommended by AS4072.1-1992.	NA	No failure at 181 minutes	116
Service B	100mm diameter copper pipe capped on the fire exposed side.	NA	No failure at 181 minutes	14
Services C-F	Cable tray supporting the standard configuration of PVC insulated power cables recommended by AS4072.1-1992.	NA	No failure at 181 minutes	118
Service G	30mm wide x 15mm deep bead of sealant protecting Vertical Joint in wall	NA	No failure at 181 minutes	75
Service H	10mm wide x 5mm deep bead of sealant protecting Vertical Joint in wall	NA	No failure at 181 minutes	141

Table 2: Summary of Fire Resistance Levels ascertained for the Purpose of the Building Code of Australia of the tested Specimen

Test Specimen Designation	Description	FRL
Service A	Cable tray supporting the standard configuration of telecommunications cables recommended by AS4072.1-1992	-/180/90
Service B	100mm diameter copper pipe capped on the fire exposed side.	-/180/-
Services C-F	Cable tray supporting the standard configuration of PVC insulated power cables recommended by AS4072.1-1992	-/180/90
Service G	30mm wide x 15mm deep bead of sealant protecting Vertical Joint in wall	-/180/60
Service H	10mm wide x 5mm deep bead of sealant protecting Vertical Joint in wall	-/180/120

LIMIT OF APPLICATION

The results of this fire test may be used to directly assess fire hazard, but it should be recognised that a single test method does not provide a full assessment of fire hazard under all fire conditions.

The results of this fire test apply to the configuration as tested. Any variations to the test configuration may achieve different results. It is therefore recommended that any proposed variation to the tested configuration should be referred to Warrington Fire Research (Aust) Pty Ltd in the first instance.

WFRA

APPENDIX 1

DESCRIPTION OF THE SPECIMEN

A1.1 GENERAL DESCRIPTION

- A1. 1 The test assembly comprised 5-off locations for penetrations through a concrete block wall, that were designated as Services A, B, C to F, G & H for the purpose of this report. The services penetrating the wall were: a cable tray supporting the standard configuration of telecommunications cables recommended by AS4072.1-1992 (Service A), a 100mm diameter copper pipe (Service B), a cable tray supporting the standard configuration of PVC insulated power cables recommended by AS4072.1-1992 (Services C to F), two expansion joints (Services G & H) 30 & 10mm wide respectively sealed on the non-fire side, with Service G backed with urethane foam backing rod nominal 30mm x 20mm. Services A to F holes were filled with 20mm thick foam strips and sealed both sides of the wall with Rocor Fire-Sound New Grey Joint Sealant. All services extended nominally 100mm on the fire exposed side and nominally 800mm on the non-fire exposed side.
- A1.1.2 All services extended nominally 100mm on the fire exposed side and nominally 500mm on the non-fire exposed side
- A1 .3 Details of the test construction are shown schematically on Drawing No's 41003-TS-01 to 41003-TS-04.
- A1 .4 The services were supplied and installed by staff of Warrington Fire Research (Aust) Pty Ltd, and the sealant was applied by representatives from HB Fuller. Staff of Warrington Fire Research (Aust) Pty Ltd attached thermocouples after the specimen construction had been completed.

A1.2 SEPARATING ELEMENT

- A1.2.1 The separating element comprised a nominal 1300mm long x 1350mm wide x 140mm thick concrete block wall, where a nominal area of 1200mm long x 1200mm wide was exposed to the furnace.

A1.3 PENETRATING SERVICES

- A1.3. Penetration A. A 180mm wide x 140mm high hole was positioned 430mm from west edge and 965mm from the bottom and comprised 1-off bundle of 60 pair 0.5 PVC communication cable lengths, extending nominal 100mm into the furnace and nominal 800mm exposed side. The area around the service through the wall had been filled with urethane foam backing rods nominal 30mm x 20mm positioned 20mm back from both faces of the wall and sealed with Rocor Fire-Sound New Grey Joint Sealant in fillet style.

- A1.3.2 **Penetration B.** A 175mm wide x 175mm high hole was positioned 725mm from west edge and 735mm from the bottom and comprised one (1-off) nominal 100mm diameter copper pipe with a wall thickness of 1.8mm extending nominal 100mm into the furnace and nominal 800mm on the non-fire exposed side. The pipe end within the furnace was capped using Kao wool. The area around the service through the wall had been filled with urethane foam backing rods nominal 30mm x 20mm positioned 20mm back from both faces of the wall and sealed with Rocor Fire-Sound New Grey Joint Sealant in fillet style.
- A1.3.3 **Penetration C-F.** A 320mm wide x 75mm high hole was positioned 430mm from west edge and 435mm from the bottom and comprised 8-off three core plus earth PVC insulated, PVC sheathed 16mm² 7 x 1.7mm conductors, 3-off three core plus earth PVC insulated, PVC sheathed 6mm² 7 x 1.04mm conductors, 1-off three core plus earth PVC insulated, PVC sheathed 185mm² 37 x 2.52mm conductors and 1-off single core PVC insulated, PVC sheathed 630mm² 127 x 2.52mm conductors. The area around the service through the wall had been filled with urethane foam backing rods nominal 30mm x 20mm positioned 40mm back from both faces of the wall and sealed with Rocor Fire-Sound New Grey Joint Sealant in fillet style.
- A1.3.2 **Penetration G.** A 30mm wide x 1155mm high expansion joint was built into the concrete block wall 205mm from west edge 115mm from the bottom and comprised Rocor Fire-Sound New Grey Joint Sealant on the non-fire side to a nominal depth of 15mm with a urethane foam backing rod nominal 30mm x 20mm positioned directly behind the sealant prior to applying the sealant.
- A1.3.2 **Penetration H.** A 10mm wide x 1155mm high expansion joint was built into the concrete block wall 1090mm from west edge 115mm from the bottom and comprised Rocor Fire-Sound New Grey Joint Sealant on the non-fire side to a nominal depth of 5mm.

Note: All penetrations extended nominal 100mm on the exposed side, and minimum 500mm on the non-exposed side.

A1.4 METHOD OF SUPPORT

- A1.4.1 The penetrating services were installed in the horizontal orientation.
- A1.4.2 A steel support frame was constructed such that the services were supported from a steel restraint frame at two positions from the face of the non-exposed side of the wall.
- A1.4.3 The telecommunications cables (Service A) were supported on a galvanized slotted cable tray and were supported from the steel support frame by angle iron and threaded rod hangers 200mm and 600mm from the face of the wall.

- A1.4.4 The copper pipe (Service B) was supported by pipe clamps that were fixed to the steel support frame by threaded rods attached to pipe clips 200mm and 600mm from the face of the wall.
- A1.4.5 The electrical cables (Services C-F) were supported on a galvanized slotted cable tray (minimum width 300mm) and were supported from the steel support frame by angle iron and threaded rod hangers 200mm and 600mm from the face of the wall.

A1.5 MATERIALS

A1.5.1 Services

- A1.5.1.1 1-off bundle of 60 pair 0.5 PVC indoor telephone cable lengths
- A1.5.1.2 1-off nominal 100mm diameter copper pipe with a wall thickness of 1.8mm
- A1.5.1.3 8-off three core plus earth PVC insulated, PVC sheathed 16mm² 7 x 1.7mm conductors.
- A1.5.1.4 3-off three core plus earth PVC insulated, PVC sheathed 6mm² 7 x 1.04mm conductors.
- A1.5.1.5 1-off three core plus earth PVC insulated, PVC sheathed 185mm² 37 x 2.52mm conductors
- A1.5.1.6 1-off single core PVC insulated, PVC sheathed 630mm² 127 x 2.52mm conductors.

A1.5.2 Sealing Systems

- A1.5.2.1 Urethane foam backing rods nominal 30mm x 20mm
- A1.5.2.2 Rocor Fire-Sound New Grey RCR 600 MX15 Joint Sealant Batch No. 3630100490

A1.5.3 Separating Element

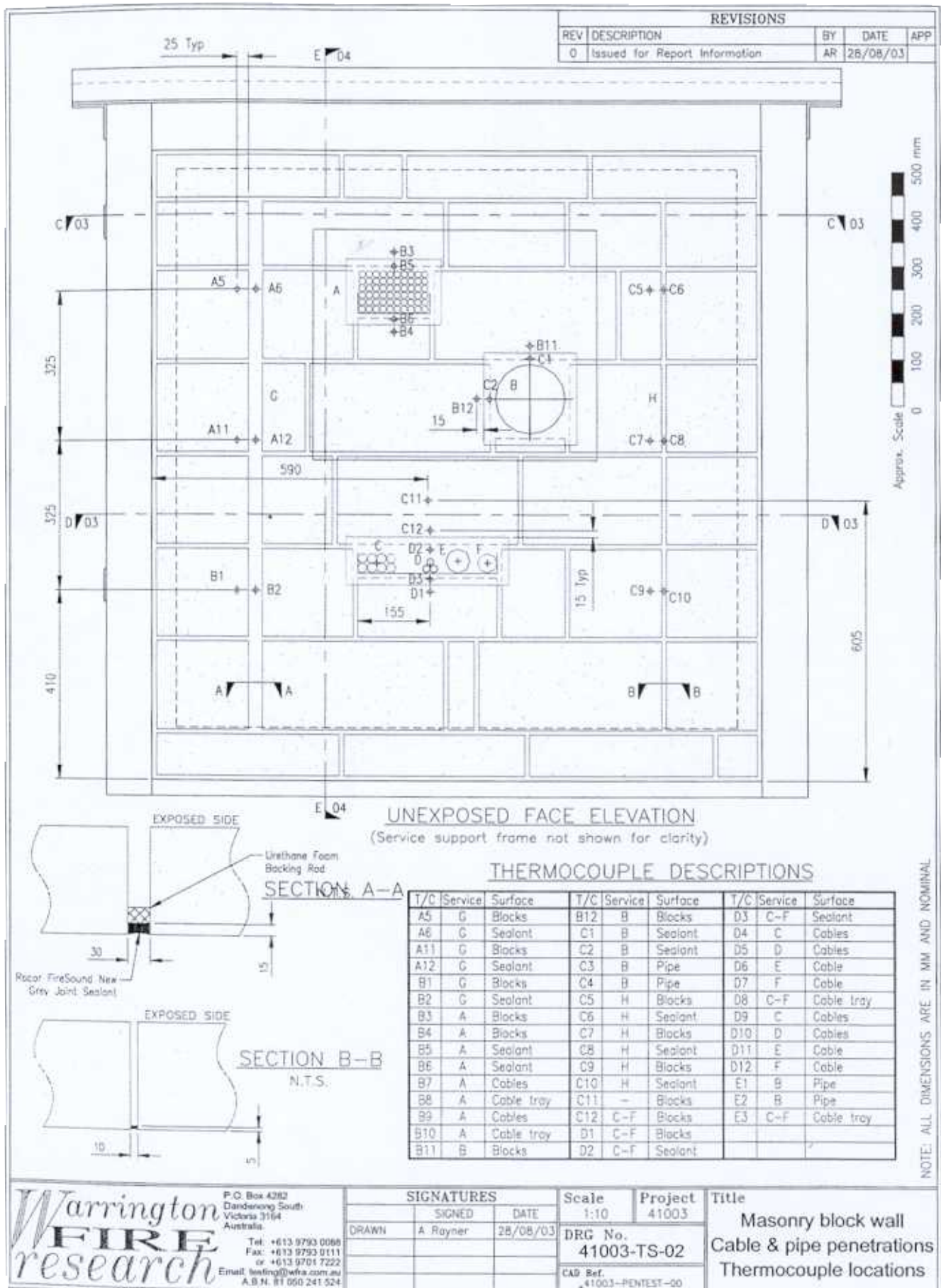
- A1.5.3.1 140mm thick x 190mm high x 390mm long concrete hollow core blocks for wall
- A1.5.3.2 190mm thick x 90mm high x 390mm long solid concrete blocks for the sill

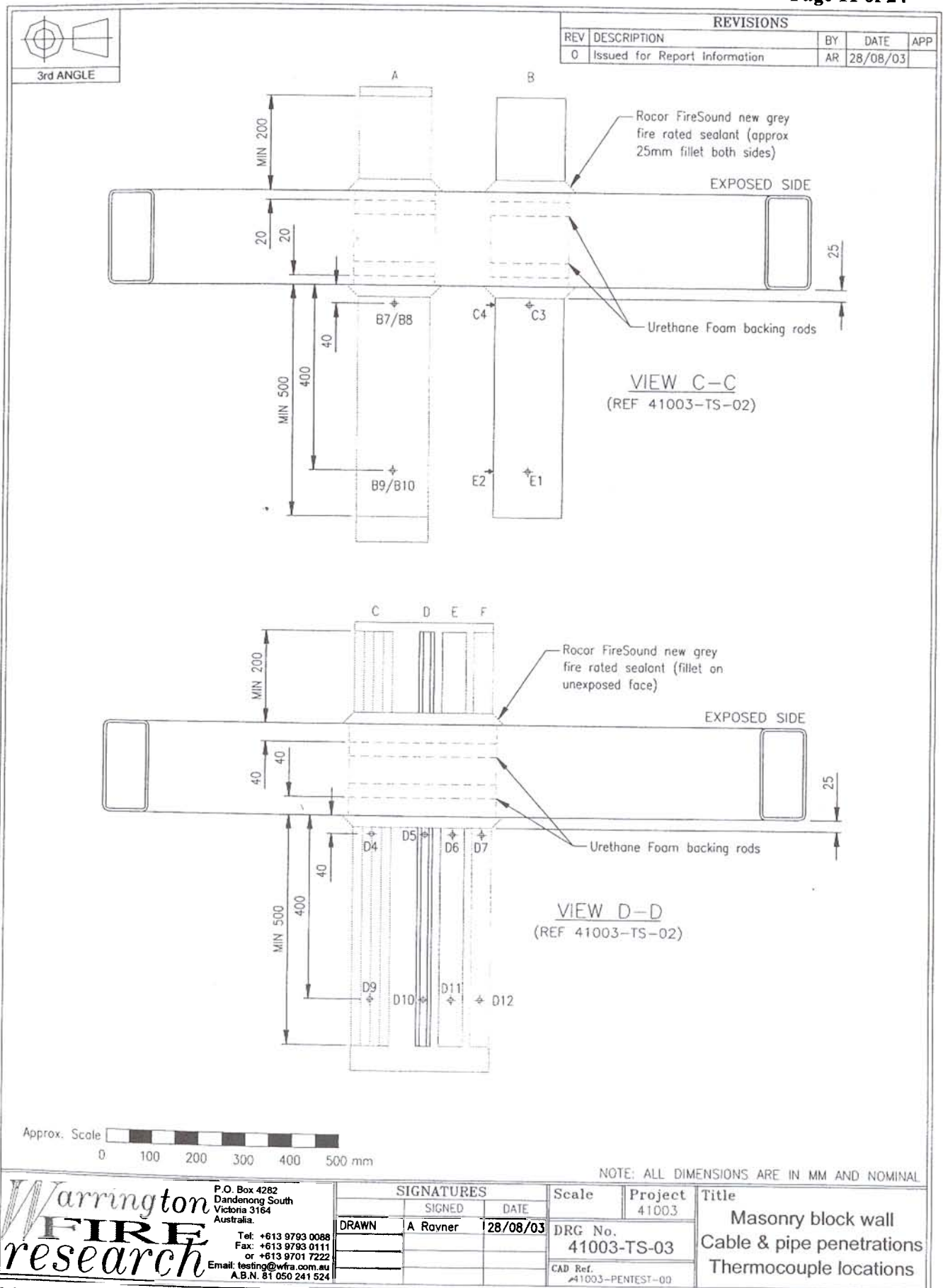
A1.5.4 Services support

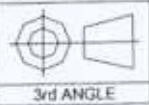
- A1.5.4. Galvanized slotted cable trays

A1.6 DRAWINGS OF SPECIMEN

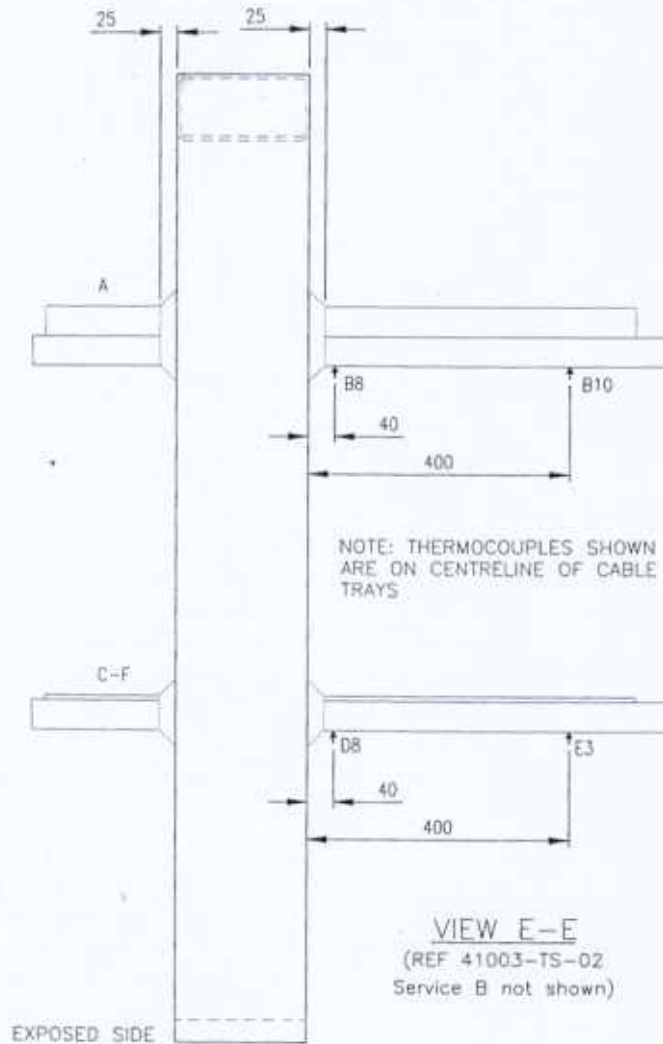
Drawing Designation	Description
41003-TS-01	Test specimen construction
41003-TS-02	Thermocouple locations – Unexposed Face Elevation view
41003-TS-03	Thermocouple locations – Plan views
41003-TS-04	Thermocouple locations – Side view







REVISIONS				
REV	DESCRIPTION	BY	DATE	APP
0	Issued for Report Information	AR	28/08/03	



Approx. Scale 0 100 200 300 400 500 mm

NOTE: ALL DIMENSIONS ARE IN MM AND NOMINAL

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SIGNATURES		
DRAWN	SIGNED	DATE
	A. Rayner	28/08/03

Scale	Project
	41003
DRG No.	CAD Ref.
41003-TS-04	41003-PENTEST-00

Title
Masonry block wall Cable & pipe penetrations Thermocouple locations

APPENDIX 2

TEST DATA AND OBSERVATIONS

Table A2.1: Specimen Temperatures

Service	T/C No.	Surface	Description	Temp (°C) at t (minutes)					Limit* (minutes)
				t=0	t=30	t=60	t=120	t=180	
Comm. cables tray (Service A)	B3	Wall	15mm from the edge of the sealant	14	45	84	105	320	146
	B4	Wall	15mm from the edge of the sealant	14	54	91	116	266	139
	B5	Sealant	Midpoint of fillet	17	66	88	127	305	147
	B6	Sealant	Midpoint of fillet	16	69	105	178	267	130
	B7	Cables	15mm from the edge of the sealant	18	67	94	#	#	#
	B8	Cable tray	15mm from the edge of the sealant	18	67	109	200	299	116
	B9	Cables	400mm from the wall	19	27	43	85	98	-
	B10	Cable tray	400mm from the wall	16	22	38	77	123	-
Copper pipe (Service B)	B11	Wall	15mm from the edge of the sealant	15	73	114	262	348	93
	B12	Wall	15mm from the edge of the sealant	15	57	96	213	313	112
	C1	Sealant	Midpoint of fillet	18	140	207	274	313	53
	C2	Sealant	Midpoint of fillet	18	99	140	205	240	114
	C3	Pipe	15mm from the edge of the sealant	19	288	368	442	465	14
	C4	Pipe	15mm from the edge of the sealant	19	273	350	422	446	15
	E1	Pipe	400mm from the wall	19	113	147	177	190	-
	E2	Pipe	400mm from the wall	19	109	141	170	182	-

- Notes:
- * Limit time is the time to the nearest whole minute, rounded down to the nearest minute, at which the temperature recorded by the thermocouple does not rise by more than 180 K above the initial temperature.
 - '-' indicates the temperature limit was not exceeded during the test period.
 - '#' indicates a thermocouple fault or possible over range conditions.

Table A2.1: Specimen Temperatures (continued...)

Service	T/C No.	Surface	Description	Temp (°C) at t (minutes)					Limit* (minutes)
				t=0	t=30	t=60	t=120	t=180	
Electrical cables cable tray (Services C-F)	C12	Wall	15mm from the edge of the sealant	14	41	79	163	219	167
	D1	Wall	15mm from the edge of the sealant	13	48	81	106	276	162
	D2	Sealant	Midpoint of fillet	15	26	54	58	107	-
	D3	Sealant	Midpoint of fillet	14	32	75	90	134	-
	D4	Cables	15mm from the edge of the sealant	17	78	134	149	223	156
	D5	Cables	15mm from the edge of the sealant	16	55	98	137	193	-
	D6	Cable	15mm from the edge of the sealant	16	73	115	154	332	139
	D7	Cable	15mm from the edge of the sealant	16	88	151	203	227	118
	D8	Cable tray	15mm from the edge of the sealant	15	86	87	105	178	-
	D9	Cables	400mm from the wall	17	27	49	83	122	-
	D10	Cables	400mm from the wall	17	22	34	49	76	-
	D11	Cable	400mm from the wall	17	30	69	108	160	-
	D12	Cable	400mm from the wall	16	38	97	158	153	-
	E3	Cable tray	400mm from the wall	15	21	27	35	50	-
Vertical Control joint 30mm wide x 5mm deep (Service G)	A5	Blocks	25mm from edge of sealant	15	80	109	250	337	92
	A6	Sealant	Midpoint of sealant	15	100	120	217	274	101
	A11	Blocks	25mm from edge of sealant	15	76	99	240	328	98
	A12	Sealant	Midpoint of sealant	15	96	111	203	256	114
	B1	Blocks	25mm from edge of sealant	15	100	119	282	368	80
	B2	Sealant	Midpoint of sealant	15	106	160	259	324	75
Vertical Control joint 30mm wide x 5mm deep (Service H)	C5	Blocks	25mm from edge of sealant	15	58	91	157	249	141
	C6	Sealant	Midpoint of sealant	15	53	88	110	184	-
	C7	Blocks	25mm from edge of sealant	15	59	97	101	207	170
	C8	Sealant	Midpoint of sealant	15	51	81	99	181	-
	C9	Blocks	25mm from edge of sealant	14	54	97	101	220	162
	C10	Sealant	Midpoint of sealant	14	50	84	141	241	148

- Notes:
- * Limit time is the time to the nearest whole minute, rounded down to the nearest minute, at which the temperature recorded by the thermocouple does not rise by more than 180 K above the initial temperature.
 - ‘-’ indicates the temperature limit was not exceeded during the test period.
 - ‘#’ indicates a thermocouple fault or possible over range conditions.

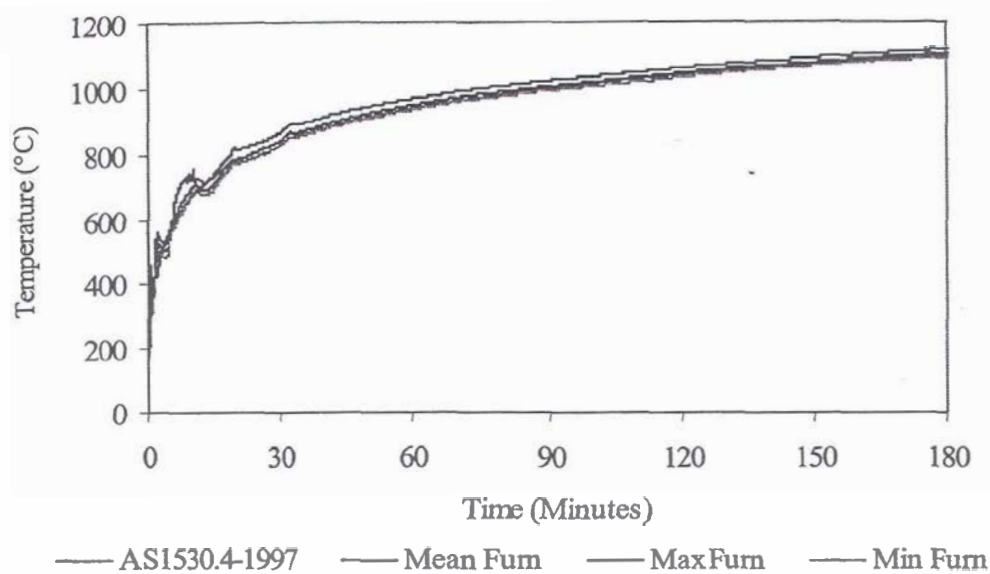


Figure A2.1: Furnace Temperatures versus Time

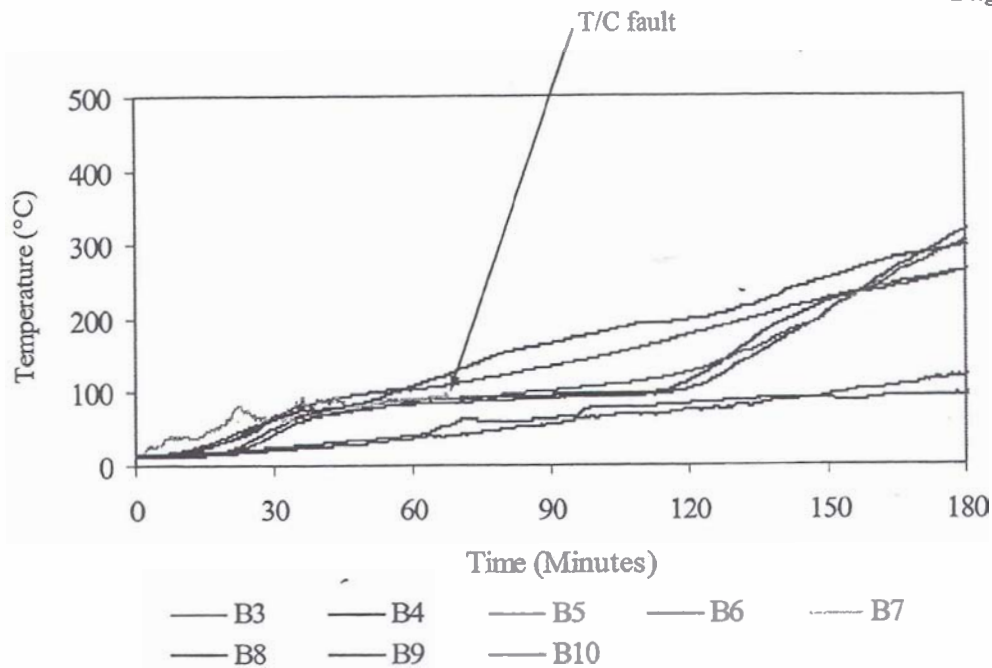


Figure A2.2: Service penetration A (Telecommunication cable tray) Temperatures versus Time

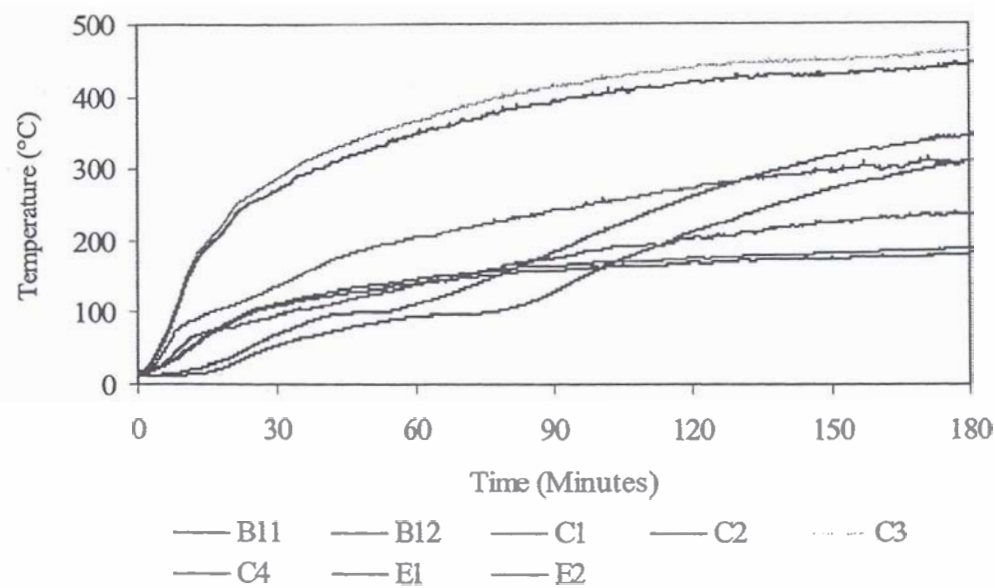


Figure A2.3: Service Penetration B (Copper pipe) Temperatures versus Time

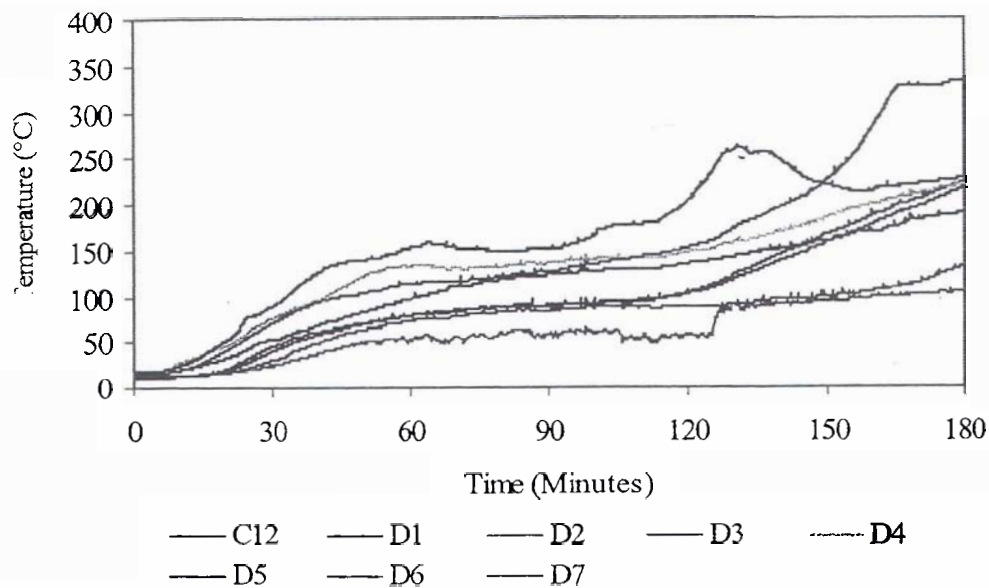


Figure A2.4: Service penetration C-F (Electrical power cables configuration on cable tray)
Temperatures versus Time (400mm temperatures below)

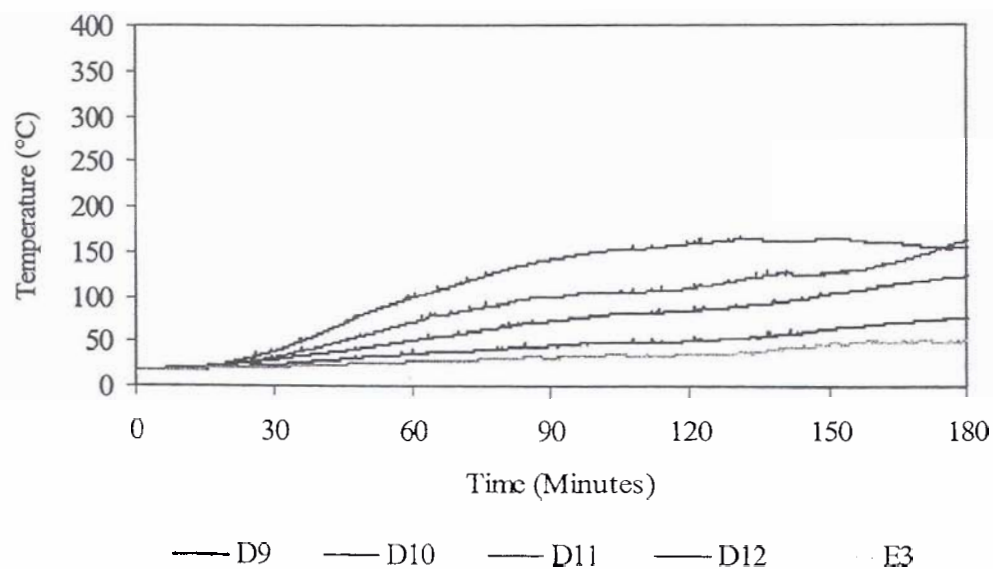
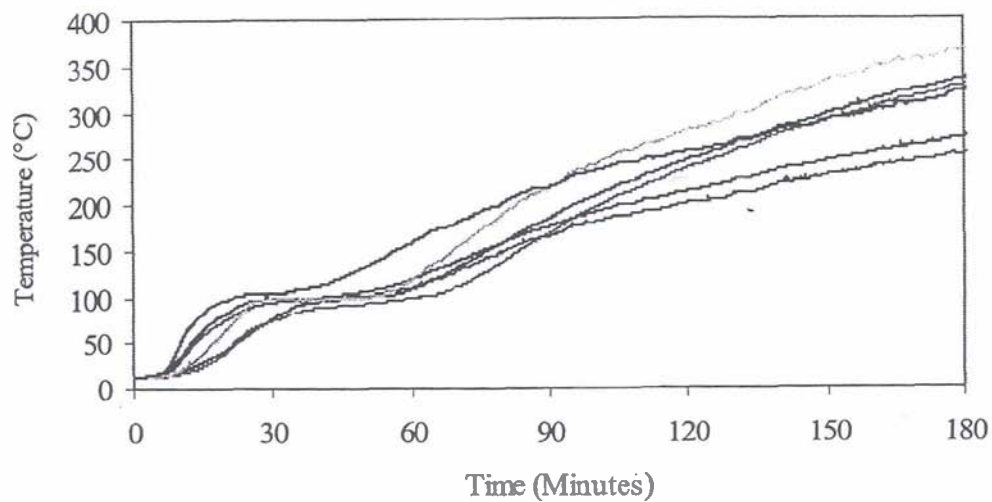
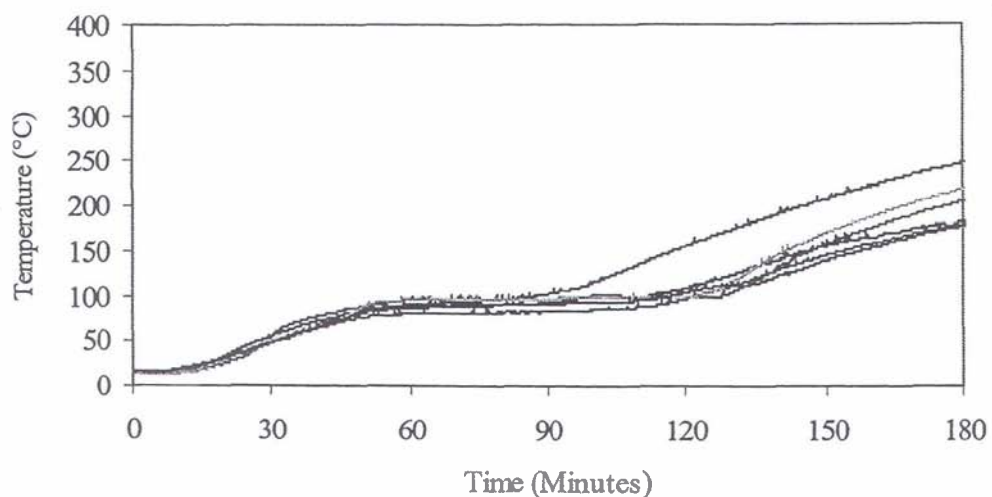


Figure A2.5: Service penetration C-F Temperatures at 400mm from face of wall versus Time



— A5 — A6 — A11 — A12 — B1 — B2
Figure A2.6: Service penetration G (Vertical Control joint – 30mm wide x 15mm deep)
Temperatures versus Time



— C5 — C6 — C7 — C8 — C9 — C10
Figure A2.7: Service penetration H (Vertical Control joint – 10mm wide x 5mm deep)
Temperatures versus Time

Table A2.2: Test Observations

Time		Test Observations 41003
Min	Sec	
0	00	Commencement of the fire-resistance test.
2	05	Smoke had emitted from around Service penetration A at the wall.
3	22	Smoke had emitted from around Service penetration C to F at the wall.
9	45	Smoke from around all service penetrations had stopped.
15	10	No further smoke had become evident from around the service penetrations on the non-fire side.
22	00	A small opening that had formed below Service penetration B in the block-work was sealed.
27	00	A small amount of smoke had become evident from around service penetrations A and C.
		Moisture had begun to form on some joints in the block-work.
30	00	Thermocouple B7 had detached from position, and was refitted.
31	00	Service penetrations continued to maintain integrity in accordance with AS1530.4-1997.
45	00	No change to the specimen had become evident.
46	50	Gaps that had formed in the block-work (away from penetrations) were sealed with intumescent sealant.
60	00	No change to the specimen had become evident.
61	00	Service penetrations continued to maintain integrity in accordance with AS1530.4-1997.
68	00	Thermocouple B7 had become loose.
70	00	A weight was placed on top of thermocouple B7 to keep in place.
75	00	No change to the specimen had become evident.
80	00	The replacement of thermocouple B7 proved ineffective as temperature readings could not be verified on measuring device, therefore was removed.
81	00	Charring had become evident around sealant of service penetration B.
90	25	No through gaps had become evident in any service penetration.
97	00	Specimen C in service penetration C to F had split approximately 150mm from the wall which allowed the passage of smoke. No through gaps had become evident in any service penetration.
105	00	All service penetrations appear stable and no through gaps had become evident.
117	00	All service penetrations appear stable and no through gaps had become evident.
121	00	Service penetrations continued to maintain integrity in accordance with AS1530.4-1997.
124	00	Fire resistance test was continued at the request of the client.
129	00	Both vertical expansion joints had blackened on the edges of the bottom half.
135	00	All service penetrations appear stable and no through gaps had become evident.
137	00	There had been an increase in smoke from service penetration A.
145	00	There had been a further increase in smoke from service penetration A and cable tray C to F.
150	00	All service penetrations appear stable and no through gaps had become evident.

Note: All observations were taken from the unexposed side of specimen.

Table A2.2: Test Observations (continued...)

Time		Test Observations 41003
Min	Sec	
155	00	The vertical expansion joint service G had blackened for the full height on the edges, but no gaps had become evident.
165	00	All service penetrations appear stable and no through gaps had become evident.
173	50	There had been an increase in smoke emission from service penetrations A and C-F but no through gaps had become evident.
181	00	Fire resistance test was terminated at the request of the test sponsor.

Note: All observations were taken from the unexposed side of specimen.

APPENDIX 3
PHOTOGRAPHS

- PLATE 1: Exposed face, service penetrations A, B & C sealed with HB Fuller's 'FireSound'.
- PLATE 2: Non-Exposed face, service penetrations A, B & C sealed with HB Fuller's 'FireSound'.
- PLATE 3: Exposed face prior to commencement of the fire-resistance test.
- PLATE 4: Unexposed face prior to commencement of the fire-resistance test
- PLATE 5: Unexposed face after completion of the fire-resistance test.
- PLATE 6: Exposed face after completion of the fire-resistance test.

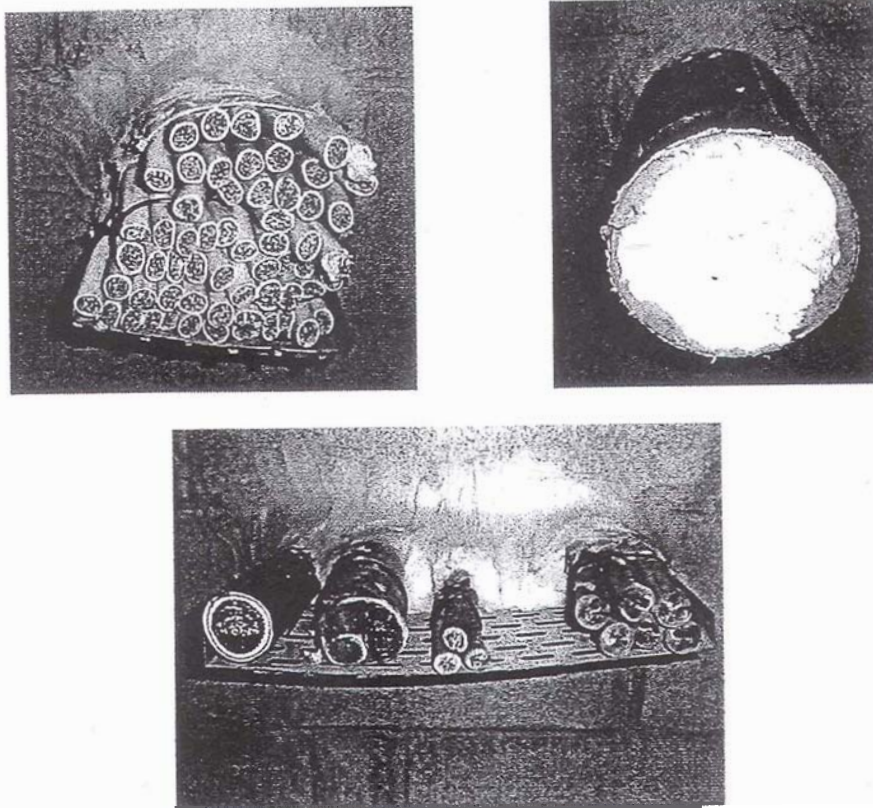


Plate 1: Exposed face, service penetrations A, B & C sealed with HB Fuller's 'FireSound'.

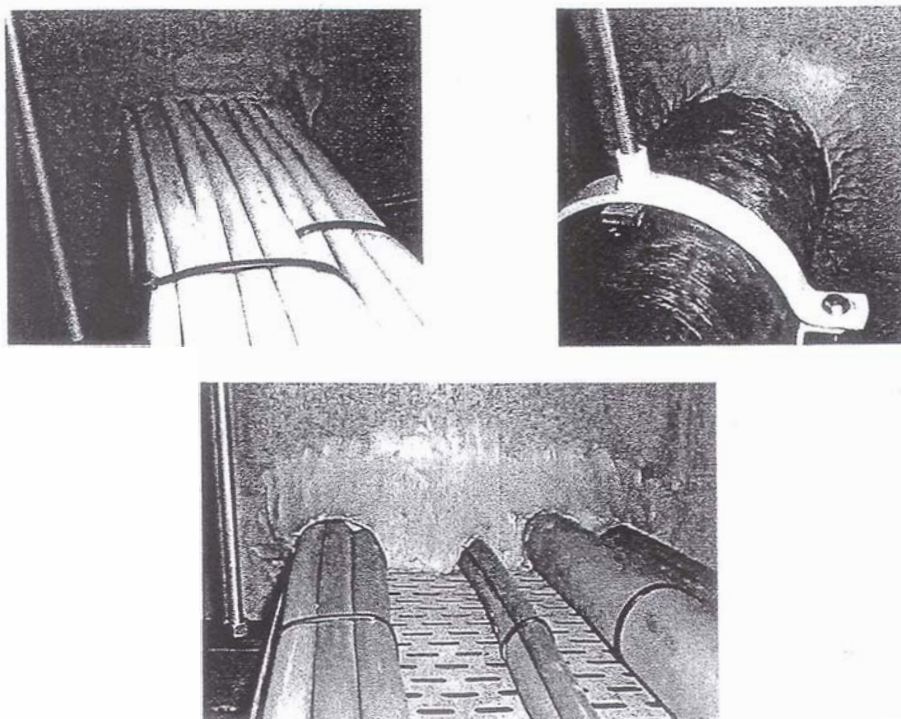


Plate 2: Non-Exposed face, service penetrations A, B & C sealed with HB Fuller's 'FireSound'.

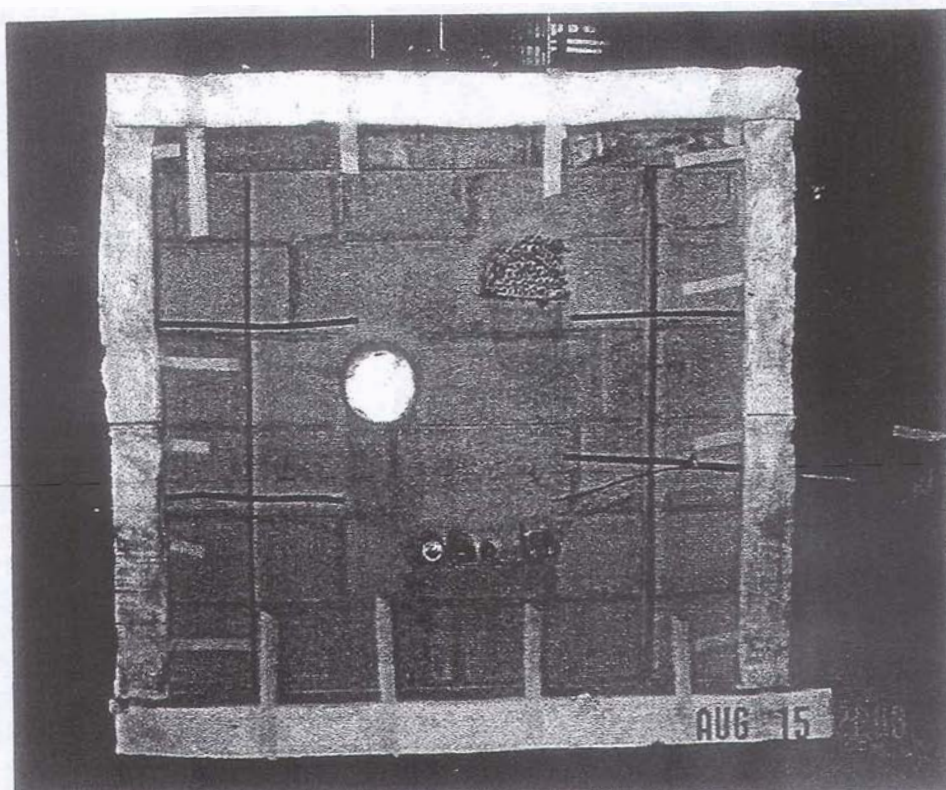


Plate 3: Exposed face prior to commencement of the fire-resistance test.

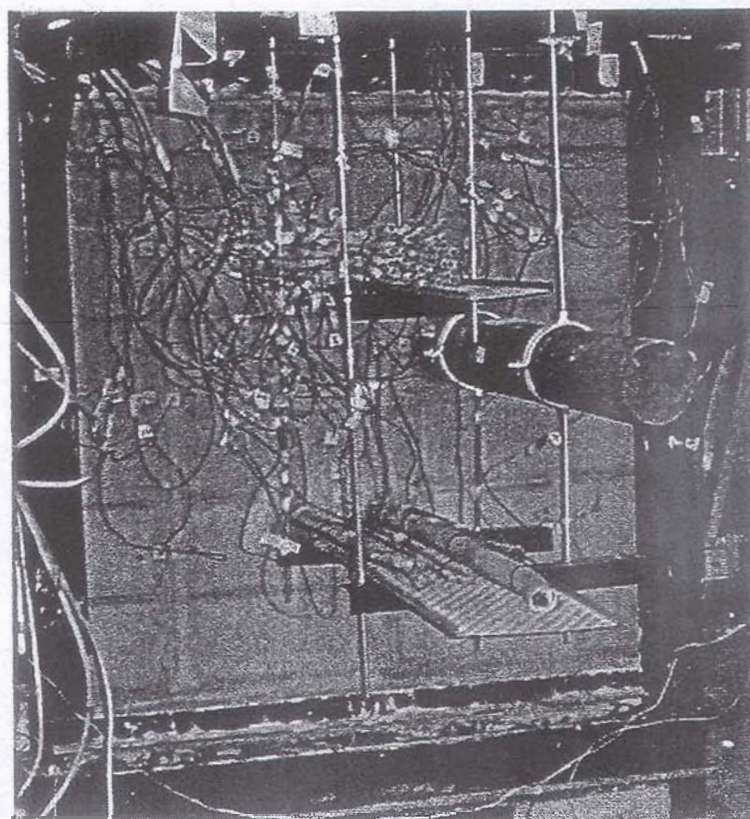


Plate 4: Unexposed face prior to commencement of the fire-resistance test.

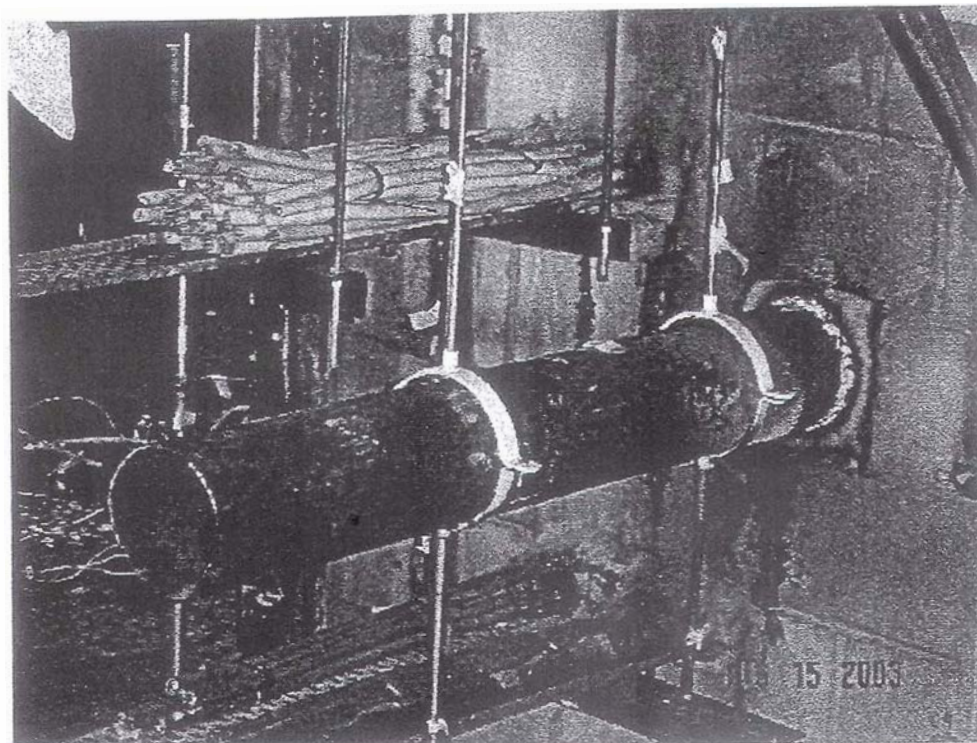


Plate 5: Unexposed face after completion of the fire-resistance test.

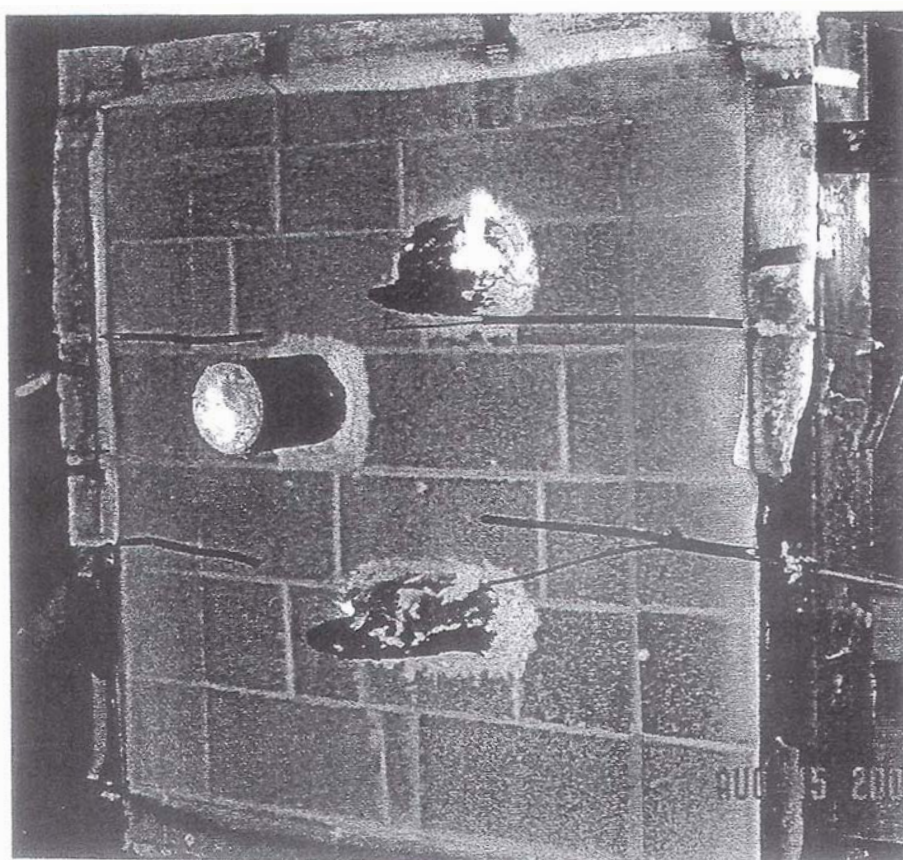


Plate 6: Exposed face after completion of the fire-resistance test.