Warrington FIRE research
CONSULTANCY • TESTING

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Test Report

TEST DESCRIPTION

FIRE RESISTANCE TEST IN ACCORDANCE WITH AS 1530.4-2005 AND AS 4072.1-2005 AS APPROPRIATE ON A 150mm THICK CSR HEBEL POWERPANEL™ WALL SYSTEM PENETRATED BY PVC COATED CABLES, VARIOUS METAL PIPES AND A CONTROL JOINT, PROTECTED BY PROMASEAL® PILLOWS AND HB-FULLER FIRESOUND SEALANT.

TEST APPLICANT

H.B. Fuller
16-22 Red Gum Avenue,
Dandenong South,
Vic, 3175.

TEST DATE
11th October 2006

Unit 2, 409 - 411 Hammond Road, Dandenong, Victoria 3175, P.O. Box 4282, Dandenong South, Victoria 3164, Australia.
Tel: Int+61 (0)3 9767 1066 Fax: Int+61 (0)3 9767 1001 or (0)3 9767 1051 Email: testing@wfra.com.au,
Home Page: www.wfra.com.au A.B.N. 81 050 241 524

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Prepared by:

C. M. McLean

Reviewed by:

K. G. Nicholls

On behalf of Warrington Fire Research (Aust) Pty Ltd

GENERAL CONDITIONS OF USE

CONTENTS

1 CONSTRUCTION DETAILS

TEST ASSEMBLY

The test assembly comprised a nominal 1300mm wide × 1250mm × 150mm thick steel reinforced CSR Hebel Powerpanel™ wall system penetrated by the standard cable configurations for the evaluation of electrical (×'s 2) and telecommunications cables, various sized metal pipes and a control joint, protected by PROMASEAL® Pillows and HB Fuller Firesound.

TEST SPECIMENS

The Services were designated as Services A - H and a Control Joint, for the purposes of this report. The services penetrating the slab were: The standard cable configuration for the evaluation of PVC insulated power cables incorporating (a) 1-off 1C PVC insulated/sheathed cable with a core size of 630mm^2 (b) 1-off 3C+E PVC insulated/sheathed cable, each with a core size of 185mm^2 (c) 3-off 3C+E PVC insulated/sheathed cable with each core size 6mm^2 (d) 8-off 3C+E PVC insulated/sheathed cables with each core size 16mm^2, protected by PROMASEAL® Pillows and HB Fuller Firesound Sealant (Service A), The standard cable configuration for the evaluation of large bundles of telecommunications cables, incorporating a pack of 60, 50 pair telecommunications cables protected by HB Fuller Firesound Sealant (Service B), a single 50 pair telecommunications cable protected by HB Fuller Firesound Sealant (Service C), 1-off 22mm (ID) steel sprinkler pipe protected by HB Fuller Firesound Sealant (Service D), 1-off 35mm (ID) steel sprinkler pipe protected by HB Fuller Firesound Sealant (Service E), 1-off 100mm (ID) copper pipe protected by HB Fuller Firesound Sealant (Service F) 1-off 80mm (ID) steel sprinkler pipe protected by HB Fuller Firesound Sealant (Service G), The standard cable configuration for the evaluation of PVC insulated power cables incorporating (a) 1-off 1C PVC insulated/sheathed cable with a core size of 630mm^2 (b) 1-off 3C+E PVC insulated/sheathed cable, each with a core size of 185mm^2 (c) 3-off 3C+E PVC insulated/sheathed cable with each core size 6mm^2 (d) 8-off 3C+E PVC insulated/sheathed cables with each core size 16mm^2, protected by HB Fuller Firesound Sealant (Service H). The control joint was 20mm thick and was filled to a depth of 10mm with HB Fuller Firesound Sealant. Further details are provided in Figures A1.1 to A1.2 and the 'Schedule of Components' in Section 2.

ASSEMBLY AND INSTALLATION METHODS

The services were installed by the test applicant into a CSR Hebel Powerpanel™ wall system at WFRA Melbourne on the 13th & 14th of June 2006, under the supervision of a WFRA representative. The CSR Hebel Powerpanel™ was supplied and cored by WFRA.

ORIENTATION

The assembly was tested in the vertical orientation on a pilot furnace with a nominal opening of 1200 mm x 1200 mm.

2 SCHEDULE OF COMPONENTS

ITEM	DESCRIPTION
	Service A
Cables	(a) One single-core PVC insulated, PVC sheathed for 0.6/1 kV copper conductors complying with AS 5000.1 - 630mm^2 (127 × 2.52 mm conductors, insulation 2.4mm thick, OD 41.4mm). (b) One three-core plus earth PVC insulated, PVC sheathed for 0.6/1 kV copper conductors complying with AS 5000.1 - 185mm^2 (32 × 2.52mm conductors, OD 53.8mm). (c) Three three-core plus earth PVC insulated, PVC sheathed for 0.6/1 kV copper conductors complying with AS 5000.1 - 6mm^2 (7 × 1.04mm conductors OD 16mm). (d) Eight three-core plus earth PVC insulated, PVC sheathed for 0.6/1 kV copper conductors complying with AS 5000.1 - 16mm^2 (7 × 1.7mm conductors, OD 20.4mm).
Tray	The cables were installed onto a LT3-300-3 Burndy® Ladder-tray. Measured dimensions of the tray were; 325mm wide × 47mm high with an 18mm wide top lip, and a drop down lip 12mm long. The tray was made from 1mm thick steel.
Fixing	The cables were fixed to the cable tray with plastic cable ties and steel wire.
Pillows	Three types of PROMASEAL® Pillows were used to fill the gaps around the cable tray system the width of the separating element. The Pillows are compressive fire-stopping pillows made from quality cloth envelopes, enclosing a high temperature fire resistant granulated material. Details are as follows:- a) Small sample - 90mm wide × 230mm long × 40mm thick having a nominal weight of 0.24kg with a density prior to compaction of 290kg/m^3. b) Medium sample - 180mm wide × 230mm long × 40mm thick having a nominal weight of 0.64kg with a density prior to compaction of 390kg/m^3. c) Large sample - 290mm wide × 270mm long × 25mm thick having a nominal weight of 0.84kg with a density prior to compaction of 430kg/m^3.
Primer	Express 290 D primer was painted on the inside of the opening and up to 30mm around the opening on both faces prior to sealing.
Sealant	HB Fuller FIRESOUND – Fire Rated Acoustic Sealant, Grey. Batch No. 3660503440. The sealant was used on both exposed and non-exposed sides to cover and fill gaps in the pillows. Directly around the penetration, the sealant was applied in a fillet style 50mm × 50mm.
Hole size	400mm wide × 200mm high.
Support of Services	Service projection from the exposed face was 530mm, and from the unexposed face 550mm. The service tray was supported at 150mm and 600mm from the un-exposed face.

ITEM	DESCRIPTION
	Service B
Cables	A pack of 60, 50 pair telecommunication cables, with each of the 100 wires in each cable having an outside diameter of 0.5mm.
Tray	The cables were installed onto a LT3-150-3 Burndy® Ladder-tray. Measured dimensions of the tray were; 175mm wide × 50mm high with a 19mm wide top lip, and a drop down lip 10mm long. The tray was made from 1mm thick steel.
Fixing	The cables were fixed to the cable tray with plastic cable ties and steel wire.
Backing rod	"Open cell" foam backing rod 30mm × 20mm, with a density of approximately 20kg/m^3, was positioned in the annular gap a nominal 10mm back from both sides of the wall face
Primer	Express 290 D primer was painted on the inside of the opening and up to 30mm around the opening on both faces prior to sealing.
Sealant	HB Fuller FIRESOUND – Fire Rated Acoustic Sealant, Grey. Batch No. 3660503440. The sealant was used on both exposed and non-exposed sides and was applied around the annular gap to the backing rod in a fillet style 50mm × 50mm.
Hole size	200mm wide × 160mm high.
Support of Services	Service projection from the exposed face was 550mm, and from the unexposed face 550mm. The service was supported at 150mm and 600mm from the un-exposed face.
	Service C
Cable	A single 50 pair telecommunications cable, with each of the 100 wires in the cable having an outside diameter of 0.5mm.
Backing rod	"Open cell" foam backing rod 30mm × 20mm, with a density of approximately 20kg/m^3, was positioned nominal 10mm back from both sides of the wall face.
Primer	Express 290 D primer was painted on the inside of the holes and up to 30mm around the hole on both faces prior to sealing.
Sealant	HB Fuller FIRESOUND – Fire Rated Acoustic Sealant, Grey. Batch No. 3660503440. The sealant was used on both exposed and non-exposed sides and was applied around the annular gap to the backing rod in a fillet style 30mm × 30mm.
Hole diameter	40mm
Support of Services	Service projection from the exposed face was 550mm, and from the unexposed face 550mm. The service was supported at 500mm from the exposed and un-exposed faces.

ITEM	DESCRIPTION
	Service D
Pipe	A 22mm (ID-measured) steel sprinkler pipe with a wall thickness of 3mm (measured).
Backing rod	"Open cell" foam backing rod 30mm × 20mm, with a density of approximately 20kg/m^3, was positioned nominal 10mm back from both sides of the wall face.
Primer	Express 290 D primer was painted on the inside of the hole and up to 30mm around the hole on both faces prior to sealing.
Sealant	HB Fuller FIRESOUND – Fire Rated Acoustic Sealant, Grey. Batch No. 3660503440. The sealant was used on both exposed and non-exposed sides and was applied around the annular gap to the backing rod in a fillet style 30mm × 30mm.
Hole diameter	40mm
Support of Services	Service projection from the exposed face was 510mm, and from the unexposed face 600mm. The service was supported at 150mm and 600mm from the un-exposed face and was capped on the exposed side with ceramic fibre wool.
	Service E
Pipe	A 32mm (ID-measured) steel sprinkler pipe with a wall thickness of 3mm (measured).
Backing rod	"Open cell" foam backing rod 30mm × 20mm, with a density of approximately 20kg/m^3, was positioned nominal 10mm back from both sides of the wall face.
Primer	Express 290 D primer was painted on the inside of the hole and up to 30mm around the hole on both faces prior to sealing.
Sealant	HB Fuller FIRESOUND – Fire Rated Acoustic Sealant, Grey. Batch No. 3660503440. The sealant was used on both exposed and non-exposed sides and was applied around the annular gap to the backing rod in a fillet style 50mm × 50mm.
Hole diameter	40mm
Support of Services	Service projection from the exposed face was 510mm, and from the unexposed face 600mm. The service was supported at 150mm and 600mm from the un-exposed face and was capped on the exposed side with ceramic fibre wool.
	Service F
Pipe	A 100mm (ID-measured) copper pipe with a wall thickness of 2mm (measured)
Backing rod	"Open cell" foam backing rod 30mm × 20mm, with a density of approximately 20kg/m^3, was positioned nominal 10mm back from both sides of the wall face.

ITEM	**DESCRIPTION**
Primer	Express 290 D primer was painted on the inside of the hole and up to 30mm around the hole on both faces prior to sealing.
Sealant	HB Fuller FIRESOUND – Fire Rated Acoustic Sealant, Grey. Batch No. 3660503440. The sealant was used on both exposed and non-exposed sides and was applied around the annular gap to the backing rod in a fillet style 50mm × 50mm.
Hole	150mm diameter
Support of Services	Service projection from the exposed face was 530mm, and from the unexposed face 600mm. The service was supported at 150mm and 600mm from the un-exposed face and was capped on the exposed side with ceramic fibre wool.

Service G

Pipe	An 80mm (ID-measured) steel sprinkler pipe with a wall thickness of 4mm (measured)
Backing rod	"Open cell" foam backing rod 30mm × 20mm, with a density of approximately 20kg/m^3, was positioned nominal 10mm back from both sides of the wall face.
Primer	Express 290 D primer was painted on the inside of the hole and up to 30mm around the hole on both faces prior to sealing.
Sealant	HB Fuller FIRESOUND – Fire Rated Acoustic Sealant, Grey. Batch No. 3660503440. The sealant was used on both exposed and non-exposed sides and was applied around the annular gap to the backing rod in a fillet style 50mm × 50mm.
Hole diameter	100mm
Service Installation	Service projection from the exposed face was 510mm, and from the unexposed face 600mm. The service was supported at 150mm and 600mm from the un-exposed face and was capped on the exposed side with ceramic fibre wool.

Service H

Cables	(a) One single-core PVC insulated, PVC sheathed for 0.6/1 kV copper conductors complying with AS 5000.1 - 630mm^2 (127 × 2.52mm conductors, insulation 2.4mm thick, OD 41.4mm). (b) One three-core plus earth PVC insulated, PVC sheathed for 0.6/1 kV copper conductors complying with AS 5000.1 - 185mm^2 (32 × 2.52mm conductors, OD 53.8mm). (c) Three three-core plus earth PVC insulated, PVC sheathed for 0.6/1 kV copper conductors complying with AS 5000.1 - 6mm^2 (7 × 1.04mm conductors OD 16mm). (d) Eight three-core plus earth PVC insulated, PVC sheathed for 0.6/1 kV copper conductors complying with AS 5000.1 - 16mm^2 (7 × 1.7mm conductors, OD 20.4mm).

ITEM	DESCRIPTION
Tray	LT3-300-3 Burndy® Ladder-tray. Measured dimensions of the tray were; 325mm wide × 47mm high with an 18mm wide top lip, and a drop down lip 12mm long. The tray was made from 1mm thick steel.
Fixing	The cables were fixed to the cable tray with plastic cable ties and steel wire.
Backing rod	"Open cell" foam backing rod 30mm × 20mm, with a density of approximately 20kg/m^3, was positioned nominal 10mm back from both sides of the wall face
Primer	Express 290 D primer was painted on the inside of the opening and up to 30mm around the opening on both faces prior to sealing.
Sealant	HB Fuller FIRESOUND – Fire Rated Acoustic Sealant, Grey. Batch No. 3660503440. The sealant was used on both exposed and non-exposed sides and was applied around the annular gap to the backing rod in a fillet style 50mm × 50mm.
Hole size	350mm wide × 90mm high.

Control Joint

Backing rod	"Open cell" foam backing rod 30mm × 20mm, with a density of approximately 20kg/m^3, was positioned nominal 10mm back from both sides of the wall face
Primer	Express 290 D primer was painted on the inside of the opening and up to 30mm around the opening on both faces prior to sealing.
Sealant	HB Fuller FIRESOUND – Fire Rated Acoustic Sealant, Grey. Batch No. 3660503440. The sealant was used on both exposed and non-exposed sides and was applied to the backing the entire width of the join to a depth of 10mm.
Hole size	20mm high × 1300mm long.

Separating Element

Panel	Two layers of 75mm thick steel reinforced CSR Hebel Powerpanel™ was used to form a separating element 150mm thick. The panel was manufactured from CSR Hebel AAC. AAC is manufactured from sand, lime and cement to which a gas-forming agent is added.
Adhesive	CSR Hebel Thin Bed Adhesive was used to bond the two 75mm thick panels together to form the 150mm thick separating element.
Location	The separating element was formed using two horizontal panel sections, each 600mm high × 1300 wide, with a 20mm horizontal gap between them.

ITEM	DESCRIPTION
Fixing	Both the upper and lower panels were fixed using 10mm diameter × 75mm long masonry anchors through four fixed plates to the steel restraint frame. These points were located nominal 100mm from the top/bottom, and 50mm from the sides of the panels. The upper panel was also supported on the bottom at the two sides, with two 50mm × 50mm angles.

Specimen Seal

Seal	The specimen was sealed around the entire perimeter edge with 25mm thick Ceramic Fibre Wool.

3 TEST PROCEDURE

STATEMENT OF COMPLIANCE

The test was performed in accordance with the requirements of AS 1530.4-2005 Sections 2 & 10 and AS 4072.1-2005.

VARIATIONS TO TEST METHOD

The average pressure over a 5 minute period at various times during the test exceeded the maximum variation of ±3Pa, the running average of pressure at all times during the test remained within the specified limits of variance. This variation is considered slightly more onerous than that required by the test standard and not considered to significantly affect the results of the test.

Upon commencement of the fire resistance test it had become evident that some thermocouples had become faulty, causing some services not to comply with the thermocouple locations specified in AS 1530.4-2005. The remaining thermocouples did however cover at least one point of the thermocouple locations specified in AS 1530.4-2005. Roving thermocouple readings were taken where possible. This variation is not considered to significantly affect the results of the test.

PRE-TEST CONDITIONING

The sealant around the services was allowed to cure in the test laboratory after construction for a period of 4 months prior to testing. During this period the average temperature and relative humidity of the laboratory was 15℃ and 54% respectively.

SAMPLING / SPECIMEN SELECTION

The laboratory was not involved in the selection of the test specimen for the fire resistance test.

AMBIENT TEMPERATURE

The ambient temperature at the start of the test was 30°C and decreased to 26°C by the end of the test.

TEST DURATION

The test was terminated after 181 minutes 40 seconds after agreement between the test laboratory and applicant.

INSTRUMENTATION AND EQUIPMENT

The instrumentation was provided in accordance with AS 1530.4-2005 as detailed below:

The furnace temperature was measured by 4-off mineral insulated metal sheathed Type K thermocouples with wire diameters not greater than 1mm and overall diameter of 3mm with the measuring junction insulated from the sheath. The thermocouples protruded a minimum of 25mm from steel supporting tubes.

The non fire side specimen temperatures were measured by Type K thermocouples with wire diameters less than 0.5mm diameter soldered to 12mm diameter × 0.2mm thick copper discs covered by a 30mm × 30mm × 2.0 mm inorganic insulating pads.

The thermocouples positions are described in Table A4.1, and are shown in Figure A4.1 in Appendix 4. A roving thermocouple was available to measure temperatures at positions that appear hotter than the positions monitored by fixed thermocouples.

The furnace pressure was measured level with the lowest penetration, nominal 300mm from the base of the wall.

4 TEST MEASUREMENTS

FURNACE TEMPERATURE AND PRESSURE MEASUREMENTS

Furnace temperature and pressure data are provided in A5.1 and A5.2 in Appendix 5.

SPECIMEN TEMPERATURES

Specimen temperature data is provided in A5.3 and Table A5.1 in Appendix 5.

OBSERVATIONS

A table that includes observations of the significant behaviour of the specimen and details of the occurrence of the various performance criteria specified in AS 1530.4-2005 is provided in Appendix 2. Photographs of the specimen are included in Appendix 6.

5 TEST RESULTS

The specimen achieved the following performance when tested in accordance with AS 1530.4-2005, Section 2 & 10 and AS 4072.1-2005.

Service	Criteria	Result
A	**Structural Adequacy**	Not applicable
	Integrity	No failure at 181 minutes
	Insulation	49 minutes
	FRL	**-/180/30**
B	**Structural Adequacy**	Not applicable
	Integrity	No failure at 181 minutes
	Insulation	149 minutes
	FRL	**-/180/120**
C	**Structural Adequacy**	Not applicable
	Integrity	No failure at 181 minutes
	Insulation	No failure at 181 minutes
	FRL	**-/180/180**
D	**Structural Adequacy**	Not applicable
	Integrity	No failure at 181 minutes
	Insulation	No failure at 181 minutes
	FRL	**-/180/180**
E	**Structural Adequacy**	Not applicable
	Integrity	No failure at 181 minutes
	Insulation	No failure at 181 minutes
	FRL	**-/180/180**
F	**Structural Adequacy**	Not applicable
	Integrity	No failure at 181 minutes
	Insulation	14 minutes
	FRL	**-/180/-**
G	**Structural Adequacy**	Not applicable
	Integrity	No failure at 181 minutes
	Insulation	41 minutes
	FRL	**-/180/30**
H	**Structural Adequacy**	Not applicable
	Integrity	No failure at 181 minutes
	Insulation	100 minutes
	FRL	**-/180/90**

Control Joint	**Structural Adequacy**	Not applicable
	Integrity	No failure at 181 minutes
	Insulation	No failure at 181 minutes
	FRL	**-/180/180**

6 APPLICATION OF TEST RESULTS

TEST LIMITATIONS

The results of this fire test may be used to directly assess fire hazard, but it should be recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions. The results only relate to the behaviour of the specimen of the element of the construction under the particular conditions of the test; they are not intended to be the sole criteria for assessing the potential fire performance of the element in use nor do they necessarily reflect the actual behaviour in fires**.**

VARIATIONS FROM THE TESTED SPECIMENS

This report details the methods of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in AS 1530.4. Any significant variation with respect to size, constructional details, loads, stresses, edge or end conditions, other than those allowed under the field of direct application in the relevant test method, is not addressed by this report. It is recommended that any proposed variation to the tested configuration other than as permitted under the field of direct application specified in Appendix 3 should be referred to the test sponsor in the first instance to obtain appropriate documentary evidence of compliance from Warrington Fire Research or another Registered Testing Authority.

UNCERTAINTY OF MEASUREMENT

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

APPENDIX 1 DRAWINGS OF TEST ASSEMBLY

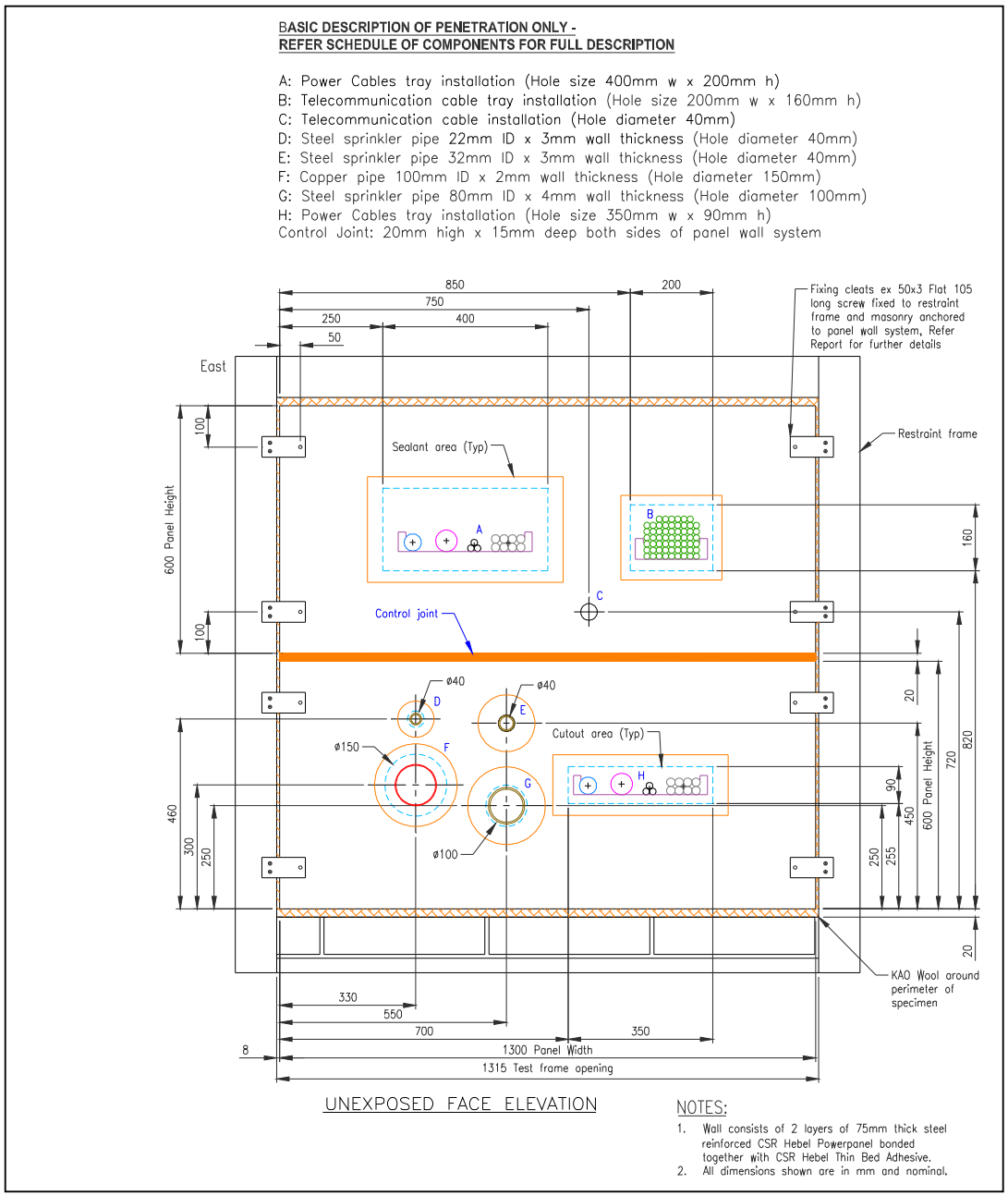
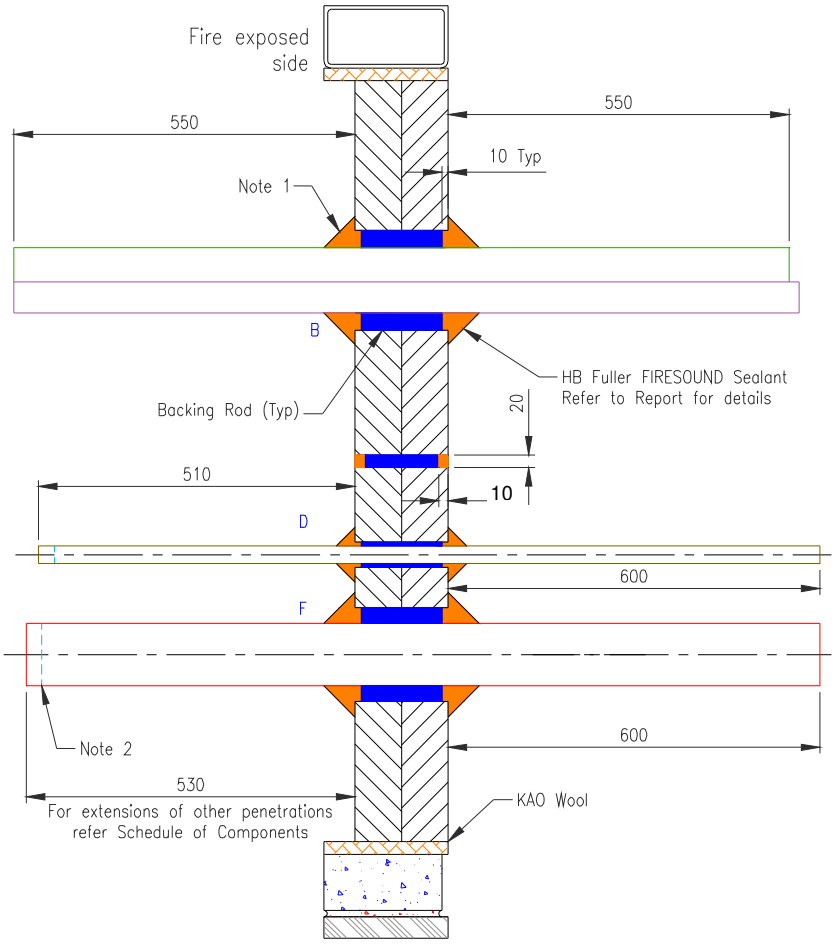


Figure A1.1: Elevation of Test Specimen



SECTIONAL ELEVATION THROUGH SERVICES B, D & F
(Supports not shown)
1:10

NOTES:

1. Pipe penetration to wall interface sealed with Firesound Sealant on both sides (nominal 50mm fillet).
2. Pipe ends plugged with KAO wool sealed in with Firesound Sealant.
3. All dimensions shown are in mm and nominal.

Figure A1.2: Cross Sections through Test Specimen

APPENDIX 2 TEST OBSERVATIONS

Time Min	Time Sec	Observation
Service A		
0	00	Fire Resistance Test was commenced and ambient air temperature was approximately 30°C.
4	00	Smoke emissions had become evident from the pipe/wall interface.
10	30	Minimal smoke emissions evident from this service.
26	00	Minimal smoke emissions evident from this service.
30	00	Minimal smoke emissions evident from this service.
49	**00**	**Failure on insulation in accordance with AS 1530.4-2005, where the temperature of thermocouple B3 that was located 25mm from the sealant on the single core PVC insulated cable, exceeded the initial temperature by more than 180°C.**
53	41	Smoke had begun to emit from the ends of the large cables.
60	00	Smoke had continued to emit from the ends of the large cables. Service continues to maintain integrity in accordance with AS 1530.4-2005.
80	00	Smoke had become evident emitting from between the two large cables.
86	40	An increase in smoke emissions had become evident above the 3C + E cable. Darkening of the seal on the top side of the service had become evident also.
94	00	A 30 second cotton pad test was carried out at the top section of sealant. No glowing or flaming had become evident.
99	00	An increase in smoke emissions had become evident above the large cables.
108	15	Melted PVC had begun to drip from the large single core cable.
120	00	Smoke had continued to emit from the sealant/cables interface.
138	00	Melted PVC had continued to drip from the large single core cable.
181	40	Service continued to maintain integrity in accordance with AS 1530.4-2005. Test Stopped at the request of the sponsor.
Service B		
0	00	Fire Resistance Test was commenced and ambient air temperature was approximately 30°C.
4	00	Smoke emissions had become evident from the pipe/wall interface.
7	20	Smoke had become evident emitting through the cable cores.
15	00	Smoke had continued to emit through the cable cores.
26	00	Minimal smoke emissions evident from this service.
30	00	Minimal smoke emissions evident from this service.

Time		Observation
Min	**Sec**	
60	00	Blackening of the cable insulation had become evident. Service continues to maintain integrity in accordance with AS 1530.4-2005.
120	00	Smoke had continued to emit from the sealant/cables interface.
145	00	An increase in smoke emissions from the cable/seal interface had become evident.
149	**00**	**Failure on insulation in accordance with AS 1530.4-2005, where the temperature of thermocouple C2 that was located 25mm from the sealant on the cables, exceeded the initial temperature by more than 180°C.**
160	00	A greater increase in smoke emissions from the cable/seal interface had become evident. Material had also become evident dripping from the service.
181	40	Service continued to maintain integrity in accordance with AS 1530.4-2005. Test Stopped at the request of the sponsor.
Service C		
0	00	Fire Resistance Test was commenced and ambient air temperature was approximately 30°C.
1	15	Smoke evident emitting around the base of the service.
60	00	Minimal smoke emissions evident from this service. Service had continued to maintain integrity in accordance with AS 1530.4-2005.
120	00	Minimal smoke emissions evident from this service. Service continues to maintain integrity in accordance with AS 1530.4-2005.
140	00	Minimal smoke emissions evident from this service.
172	00	No smoke emissions evident from the service.
181	40	Service had continued to maintain integrity and insulation in accordance with AS 1530.4-2005. Test Stopped at the request of the sponsor.
Service D		
0	00	Fire Resistance Test was commenced and ambient air temperature was approximately 30°C.
10	30	Minimal smoke emissions evident from this service.
26	00	Minimal smoke emissions evident from this service.
30	00	Minimal smoke emissions evident from this service.
60	00	Minimal smoke emissions evident from this service. Service continues to maintain integrity in accordance with AS 1530.4-2005.
120	00	Minimal smoke emissions evident from this service. Service continues to maintain integrity in accordance with AS 1530.4-2005.
140	00	Minimal smoke emissions evident from this service.

Time Min	Time Sec	Observation
172	00	No smoke emissions evident from the service.
181	40	Service had continued to maintain integrity and insulation in accordance with AS 1530.4-2005. Test Stopped at the request of the sponsor.
Service E		
0	00	Fire Resistance Test was commenced and ambient air temperature was approximately 30°C.
10	30	Minimal smoke emissions evident from this service.
26	00	Minimal smoke emissions evident from this service.
30	00	Minimal smoke emissions evident from this service.
48	00	Smoke emissions from the end of the pipe had become evident.
60	00	Minimal smoke emissions evident from this service. Service continues to maintain integrity in accordance with AS 1530.4-2005.
120	00	Minimal smoke emissions evident from this service. Service continues to maintain integrity in accordance with AS 1530.4-2005.
140	00	Minimal smoke emissions evident from this service.
172	00	No smoke emissions evident from the service.
181	40	Service had continued to maintain integrity and insulation in accordance with AS 1530.4-2005. Test Stopped at the request of the sponsor.
Service F		
0	00	Fire Resistance Test was commenced and ambient air temperature was approximately 30°C.
4	00	Smoke emissions had become evident from the pipe/wall interface and from the end of the pipe.
10	30	Minimal smoke emissions evident from this service.
12	50	Darkening of the sealant had become evident at the top due to smoke emissions from the pipe/sealant interface.
14	**00**	**Failure on insulation in accordance with AS 1530.4-2005, where the temperature of thermocouple E8 that was located 25mm from the sealant on the pipe, exceeded the initial temperature by more than 180°C.**
17	44	Smoke had continued to emit from the pipe/seal interface.
27	10	The seal around the pipe had begun to swell, with smoke emissions from the seal/pipe interface.
29	00	The sealant around the pipe has continued to get darker, and the separation between the edge of the sealant and the pipe had begun to increase.
30	00	The seal around the pipe had continued to swell, with an increase in smoke emissions from the seal/pipe interface.
58	14	A 30 second cotton pad test was carried out at the top of the penetration at the wall. No glowing or flaming had become evident.

Time		Observation
Min	**Sec**	
60	00	Smoke was evident emitting from the top of the seal. Service continues to maintain integrity in accordance with AS 1530.4-2005.
72	00	An increase in smoke emissions had become evident from the pipe/seal interface.
103	00	Smoke had become evident emitting from the end of the pipe.
113	00	Red smoke due to furnace gases (because end seal had fallen out), had become evident emitting from the end of the pipe.
115	50	Furnace gases continuing to emit through the pipe. Smoke evident emitting from between the seal/wall interface.
116	45	The end of the pipe was plugged with ceramic fibre wool.
120	00	Smoke had continued to emit from the sealant/pipe interface.
181	40	Service continued to maintain integrity in accordance with AS 1530.4-2005. Test Stopped at the request of the sponsor.
Service G		
0	00	Fire Resistance Test was commenced and ambient air temperature was approximately 30°C.
4	00	Smoke emissions had become evident from the pipe/wall interface and from the end of the pipe.
10	30	Minimal smoke emissions evident from this service.
26	00	Minimal smoke emissions evident from this service.
30	00	Minimal smoke emissions evident from this service.
41	**00**	**Failure on insulation in accordance with AS 1530.4-2005, where the temperature of thermocouple E11 that was located 25mm from the sealant on the pipe, exceeded the initial temperature by more than 180°C.**
49	20	Swelling of the seal had become evident.
60	00	Minimal smoke emissions evident from this service. Service continues to maintain integrity in accordance with AS 1530.4-2005.
65	00	The sealant around the pipe had continued to swell.
120	00	Minimal smoke emissions evident from this service. Service continues to maintain integrity in accordance with AS 1530.4-2005.
181	40	Service had continued to maintain integrity in accordance with AS 1530.4-2005. Test Stopped at the request of the sponsor.
Service H		
0	00	Fire Resistance Test was commenced and ambient air temperature was approximately 30°C.
4	00	Smoke emissions had become evident from the pipe/wall interface.
10	30	Minimal smoke emissions evident from this service.

Time		Observation
Min	**Sec**	
26	00	Minimal smoke emissions evident from this service.
30	00	Minimal smoke emissions evident from this service.
51	15	Smoke had become evident emitting from between the large single core cable and the tray.
60	00	Smoke was evident emitting from the internal west edge of the tray. Service continues to maintain integrity in accordance with AS 1530.4-2005.
72	00	An increase in smoke emissions had become evident from the tray/cable interface.
80	00	Smoke emissions had continued from the tray/cable interface.
84	00	Darkening of the seal had become evident on the west edge of the tray.
100	**00**	**Failure on insulation in accordance with AS 1530.4-2005, where the temperature of thermocouple F8 that was located 25mm from the sealant on the single core cable, exceeded the initial temperature by more than 180°C.**
105	50	Melted PVC had begun to drip from large single core cable.
111	00	An increase in smoke emissions had become evident from the west edge of the tray/seal interface.
120	00	Smoke had continued to emit from the sealant/cables interface.
176	00	Melted PVC had continued to drip from large single core cable.
181	40	Service had continued to maintain integrity in accordance with AS 1530.4-2005. Test Stopped at the request of the sponsor.
Control Joint		
0	00	Fire Resistance Test was commenced and ambient air temperature was approximately 30°C.
60	00	Service continues to maintain integrity in accordance with AS 1530.4-2005.
120	00	Service continues to maintain integrity in accordance with AS 1530.4-2005.
126	35	A roving thermocouple was applied at a position adjacent to thermocouple D7 (centre of seal) for 90 seconds, resulting in a temperature of 86°C.
154	35	A roving thermocouple was applied at a position adjacent to thermocouple D7 (centre of seal) for 90 seconds, resulting in a temperature of 91°C.
177	48	A roving thermocouple was applied at a position adjacent to thermocouple D7 (centre of seal) for 90 seconds, resulting in a temperature of 101°C.
181	40	Service had continued to maintain integrity and insulation in accordance with AS 1530.4-2005. Test Stopped at the request of the sponsor.

The above observations include observations of the significant behaviour of the specimen

APPENDIX 3 DIRECT FIELD OF APPLICATION

A 3.1 GENERAL

AS 1530.4-2005 indicates that the results of a fire resistance test contained in this report are directly applicable without reference to the testing authority to similar constructions where one or more of the following changes are made:

A 3.2 SEPARATING ELEMENTS

Results obtained for sealing systems in various types of masonry and concrete construction may be applied as follows:

(a) For elements manufactured from similar types of concrete or masonry, the results of the prototype test may be applied to materials of density within ±15% of the tested specimen. For greater variations, the opinion of a registered testing authority shall be obtained.

A 3.3 METAL PIPES

A 3.3.1 *Sealing systems not tested in accordance with A 3.3.6*

Results obtained with a penetration sealing system protecting the opening around copper or brass pipes may be applied to pipes of the same material and to ferrous metal pipes having outside diameters not greater than the tested diameter, and wall thicknesses not less than the tested thickness.

A 3.3.2 *Sealing systems tested in accordance with A 3.3.6.*

The results may be applied to brass pipes of the same composition up to maximum outside diameter of 101.6 mm (normally 70/30 arsenical brass) and to copper and ferrous metal pipes having wall thicknesses greater than or equal to those listed in Table 3.1.

Provided that the same penetration sealing system was used for the above penetrations in the same type of separating element and all the specimens achieved the required FRL.

TABLE A3- METAL PIPE DEEMED TO HAVE EQUIVALENT FIRE RESISTANCE LEVELS

Nominal size (mm)	Actual OD (mm)	Actual wall thickness (mm)
32	**31.75**	**0.91**
40	**38.10**	**0.91**
50	**50.80**	**0.91**
65	**63.50**	**0.91**
80	**76.20**	**1.22**
90	**88.90**	**1.22**
100	**101.60**	**1.22**
125	**127.00**	**1.42**
150	**152.40**	**1.63**

A 3.3.3 *Shape and size of openings for penetration seals*

For mineral-fibre, cast and gun-applied mastic seals, results obtained in openings with a smooth surface texture may be applied to openings having a rough surface texture. Except for multiple penetration sealing systems, the penetration seal should be tested in a circular opening having a smooth surface texture and parallel sides that run perpendicular to the plane of the separating element. Where this is not the case, the registered testing authority shall include a statement in the report giving reasons for variations from this practice and specifying any limitations on the application of the results.

A 3.3.4 *Insulated (lagged) metal pipes*

Where fire test data on the insulation system are not available, penetration sealing systems that have been subjected to the standard test with un-insulated metal pipes may be used provided that the appropriate requirements of Clause A 3.2 are satisfied and the following procedures are followed:

(a) If the insulation is non-combustible or is manufactured solely from mineral fibre, it shall be cut away where the service penetrates the separating element and the opening shall be fire-stopped in accordance with the tested method.

(b) If the insulation is combustible, it shall be cut away for 1000 mm either side of the separating element (provided that the pipe did not vent hot gases during the fire resistance test) and the pipe shall be fire-stopped in accordance with the tested method. A non-combustible lagging may be placed over the bare pipe. If venting occurs during the fire-resistance test at a time less than the required FRL, a fire test shall be carried out to evaluate the insulated pipe system.

A 3.3.5 *Alternative pipe materials*

If an element is penetrated by—

(a) a pipe other than brass, copper or ferrous alloys;

(b) a pipe of cross-section other than circular;

(c) a pipe outside the field of application specified in AS 1530.4-2005 for the standard test configuration, the results obtained from a single test may be applied to these pipes provided that the—

  (i) melting point of the material is equal or greater than the tested specimen;

  (ii) surface area to mass ratio of a cross-section of the pipe is equal to or less than the tested specimen; and

  (iii) thermal conductivity is equal to or less than the tested specimen diffusivity of the material.

A 3.3.6 *APPENDIX E AS 1530.4-2005 - TEST PROGRAM FOR SEALING SYSTEMS PROTECTING METAL PIPE PENETRATIONS. (Informative).*

The following test program is recommended for use for sealing systems protecting metal pipe penetrations of various materials wall thickness and outside diameter (OD):

(a) Service A Copper pipe, nominal diameter 150 mm, actual OD 152.4 mm and wall thickness 1.63 mm, or nominal diameter 200 mm, actual OD 203.2 mm and wall thickness 2.03 mm.

(b) Service B Brass pipe, nominal diameter 100 mm, actual OD 101.65 mm, wall thickness 1.22 mm.

(c) Service C Brass pipe, nominal diameter 32 mm, actual OD 31.75 mm, wall thickness 0.91 mm.
(d) Service D Copper pipe, nominal diameter 32 mm, actual OD 31.75 mm, wall thickness 0.91 mm (only required if the insulation criterion has not been waived).

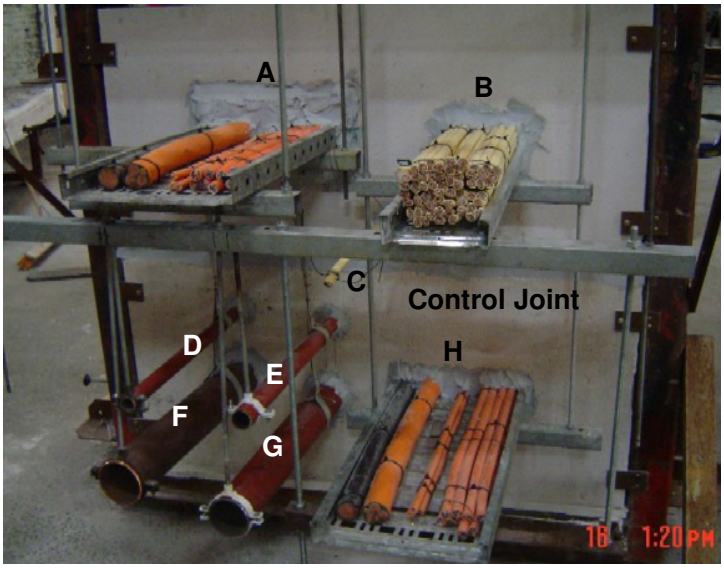
A 3.4 ELECTRICAL AND COMMUNICATIONS CABLES

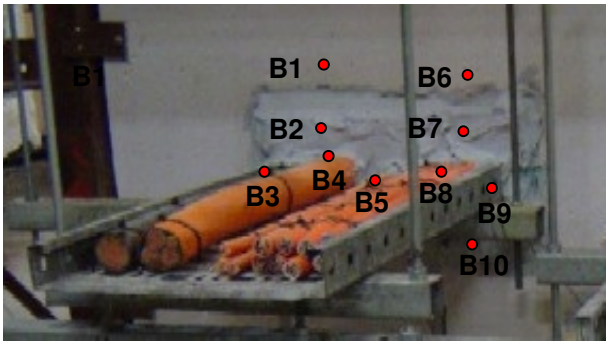
A 3.4.1 The test results on the standard configurations specified in AS 1530.4-2005 Appendix D may be applied to all PVC-insulated and sheathed power and communications cables with copper conductors.

A 3.5 CONTROL JOINTS

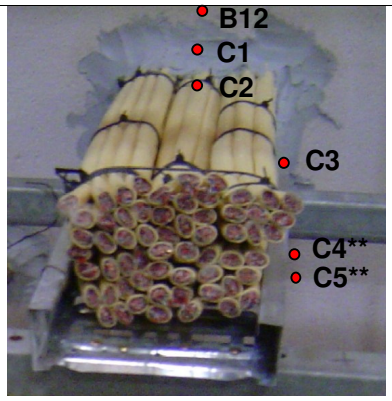
A 3.5.1 The following variations are permitted:
(a) Results obtained with butt-joints may be applied to contoured joints (see Figure 10.11.6 in AS 1530.4-2005) provided that, if only one specimen has been tested, the results may be applied to joints of the same configuration having—
(i) equal width and equal or greater depth of sealant; and
(ii) equal or greater thickness of fire-separating element.
(b) Facings may be applied to the surface of the fire-stopping system.

APPENDIX 4 INSTRUMENTATION POSITIONS



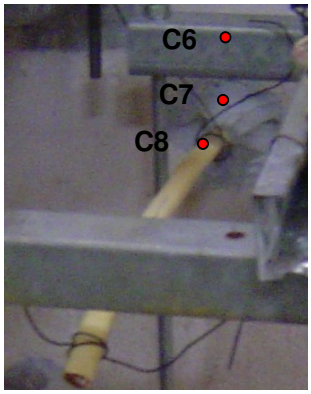


Service A

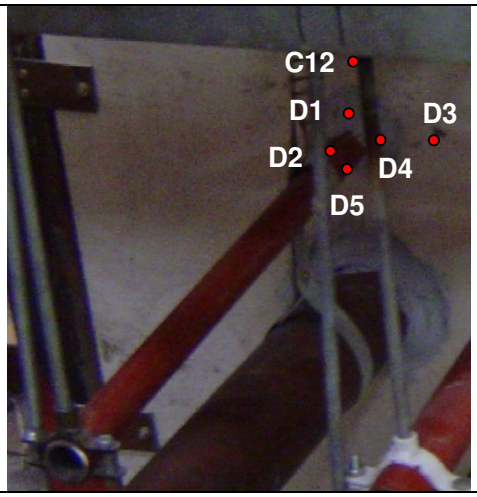


Service B

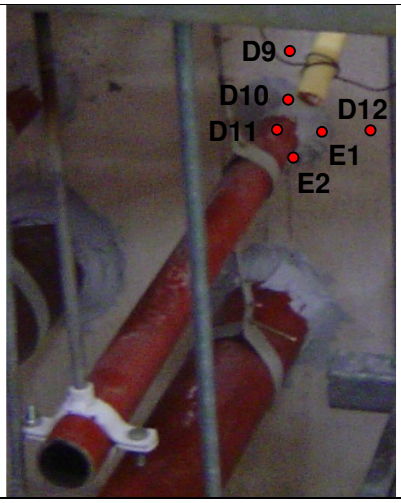
**Thermocouples located underneath. See Table 4.1 for details.



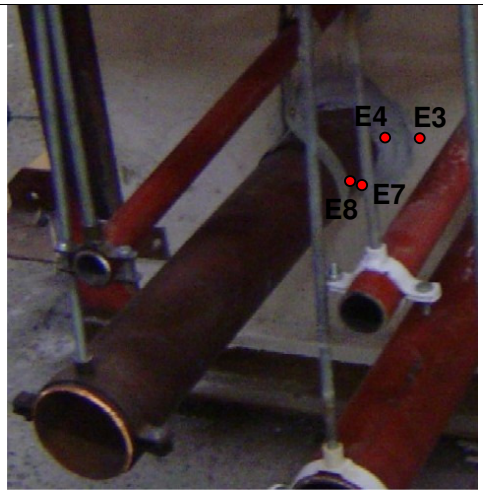
Service C



Service D

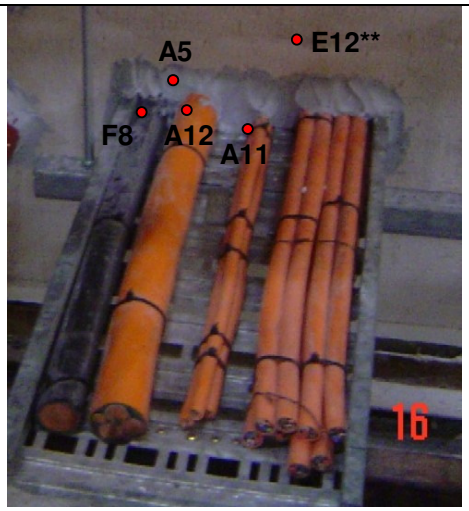


Service E



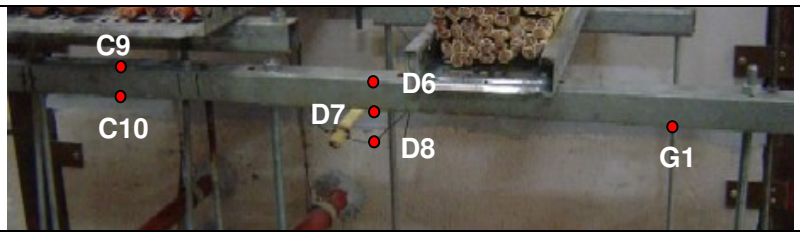
Service F

Service G



Service H

**Thermocouple located underneath. See Table 4.1 for details.



Control Joint

Note: Thermocouple locations show positions they were fixed, to and around the joint on the separating element and seal.

Figure A4.1: Thermocouple Locations on Un-exposed Face

Table A 4.1 Thermocouple Locations

SERVICE	T/C	DESCRIPTION
A	B 1	25mm from sealant on panel
	B 2	Centre of sealant fillet
	B 3	25mm from sealant on cable
	B 4	25mm from sealant on cable
	B 5	25mm from sealant on cable
	B 6	25mm from sealant on panel
	B 7	Centre of sealant fillet
	B 8	25mm from sealant on cable
	B 9	25mm from sealant on tray
	B 10	Centre of sealant fillet
B	B 12	25mm from sealant on panel
	C 1	Centre of sealant fillet
	C 2	25mm from sealant on cables
	C 3	25mm from sealant on tray
	C 4	Centre of sealant fillet
	C 5	25mm from sealant on panel
C	C 6	25mm from sealant on panel
	C 7	Centre of sealant fillet
	C 8	25mm from sealant on cable
D	C 12	25mm from sealant on panel
	D 3	25mm from sealant on panel
	D 1	Centre of sealant fillet
	D 4	Centre of sealant fillet
	D 2	25mm from sealant on pipe
	D 5	25mm from sealant on pipe
E	D 9	25mm from sealant on panel
	D 12	25mm from sealant on panel
	D 10	Centre of sealant fillet
	E 1	Centre of sealant fillet
	D 11	25mm from sealant on pipe
	E 2	25mm from sealant on pipe
F	E 3	25mm from sealant on panel
	E 4	Centre of sealant fillet
	E 7	Centre of sealant fillet
	E 8	25mm from sealant on pipe
G	E 9	25mm from sealant on panel
	E 12	25mm from sealant on panel
	E 10	Centre of sealant fillet
	F 1	Centre of sealant fillet
	E 11	25mm from sealant on pipe
H	A 5	Centre of sealant fillet
	F 8	25mm from sealant on cable
	A 12	25mm from sealant on cable
	A 11	25mm from sealant on cable
	E 5	Centre of sealant fillet

Table A 4.1 Thermocouple Locations (Continued…)

SERVICE	T/C	DESCRIPTION
CONTROL JOINT	C 9	Top west edge of join
	D 6	Top centre edge of join
	D 8	Bottom centre edge of join
	C 10	West end of seal
	D7	Centre of seal
	G 1	East end of seal

APPENDIX 5 TEST DATA

A 5.1 FURNACE TEMPERATURE

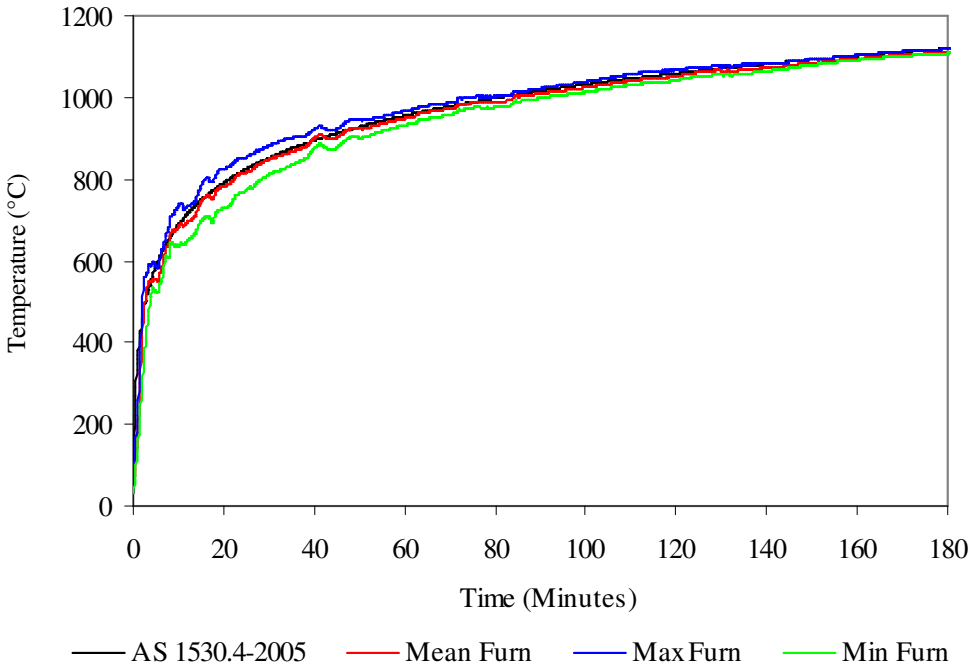


Figure A5.1: Furnace Temperatures vs. Time.

A 5.2 FURNACE PRESSURE

Time (minutes)	Pressure (Pa)	Time (minutes)	Pressure (Pa)
	Avg		Avg
5-10	13	125-130	14
10-15	16	130-135	12
15-20	22	135-140	14
20-25	12	140-145	14
25-30	14	145-150	14
30-35	15	150-155	15
35-40	15	155-160	15
40-45	20	160-165	15
45-50	14	165-170	14
50-55	16	170-175	13
55-60	14	175-180	13
60-65	18		
65-70	14		
70-75	14		
75-80	14		
80-85	15		
85-90	19		
90-95	15		
95-100	14		
100-105	12		
105-110	15		
110-115	14		
115-120	13		
120-125	11		

A 5.3 SPECIMEN TEMPERATURES

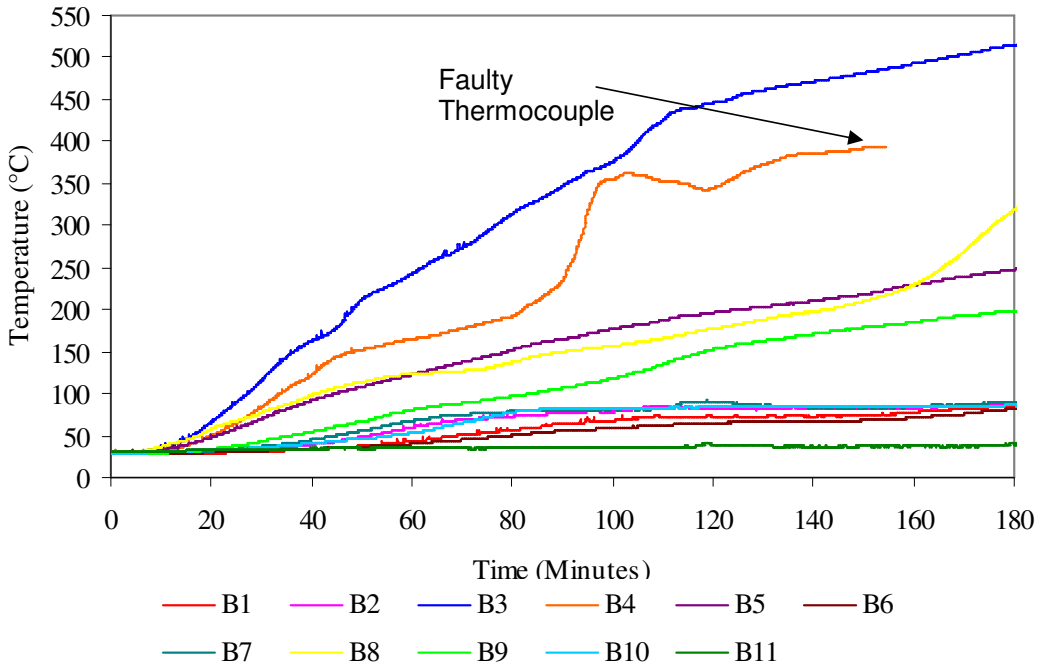


Figure A5.2: Service A. Temperatures vs. Time

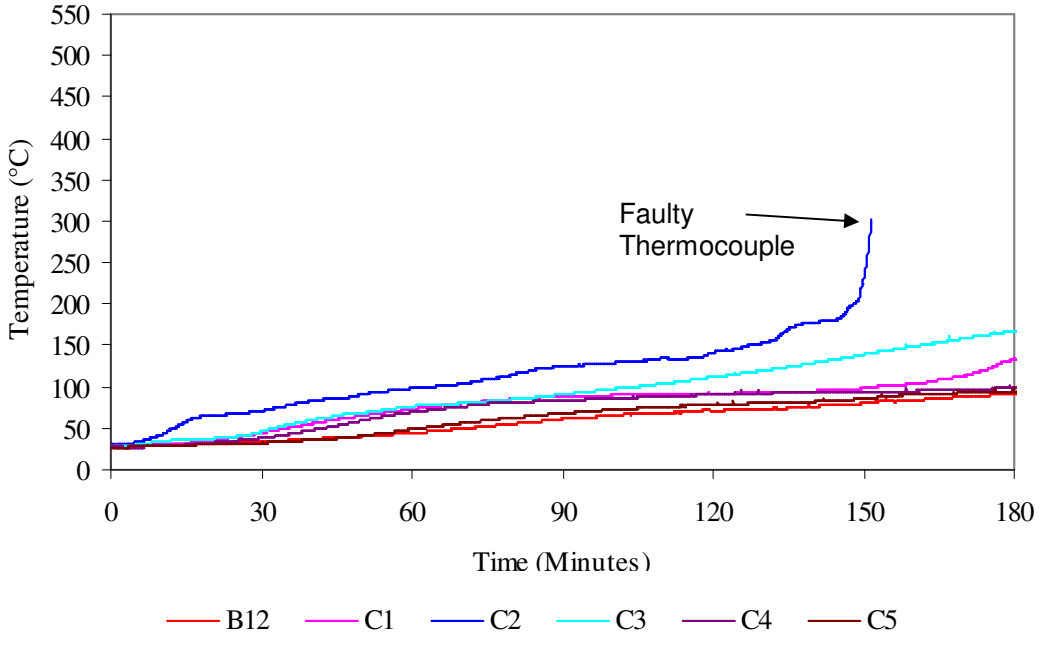


Figure A5.3: Service B. Temperatures vs. Time

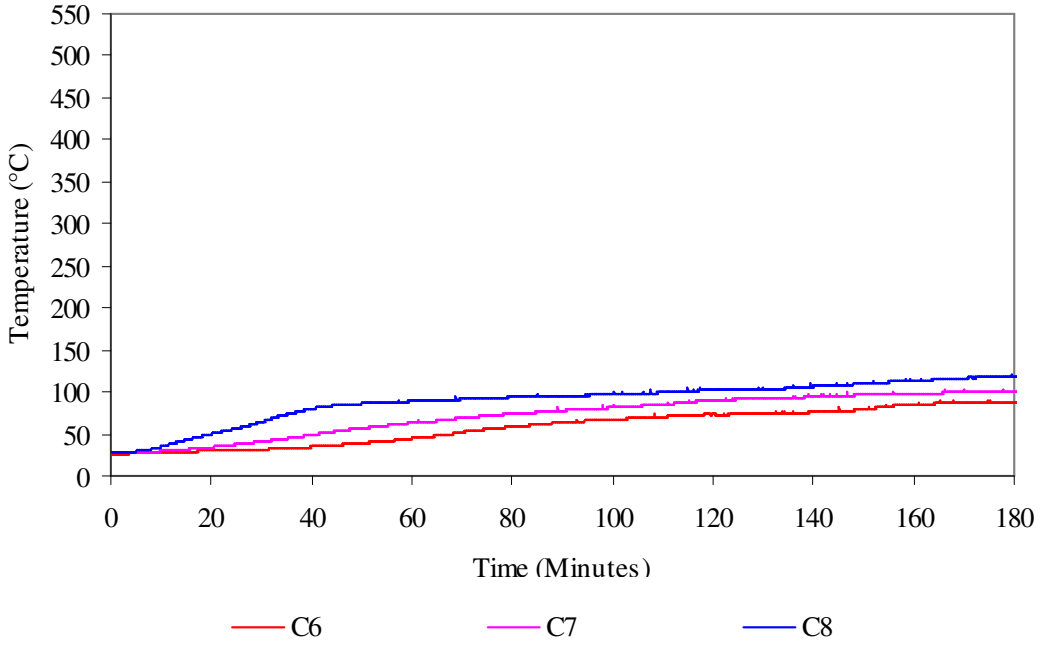


Figure A5.4: Service C. Temperatures vs. Time

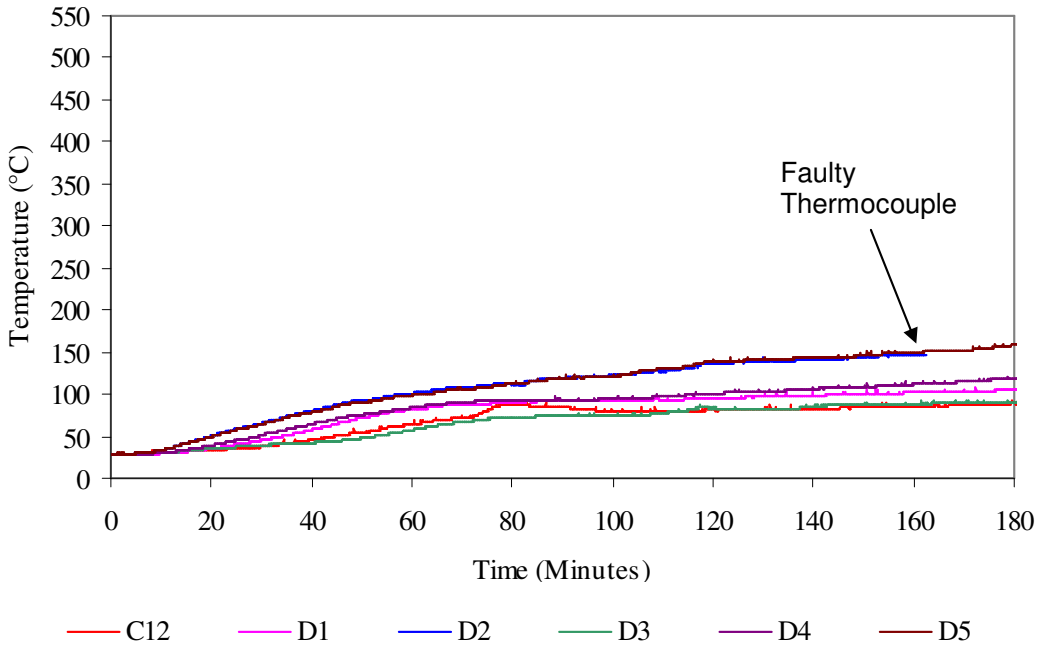


Figure A5.5: Service D. Temperatures vs. Time

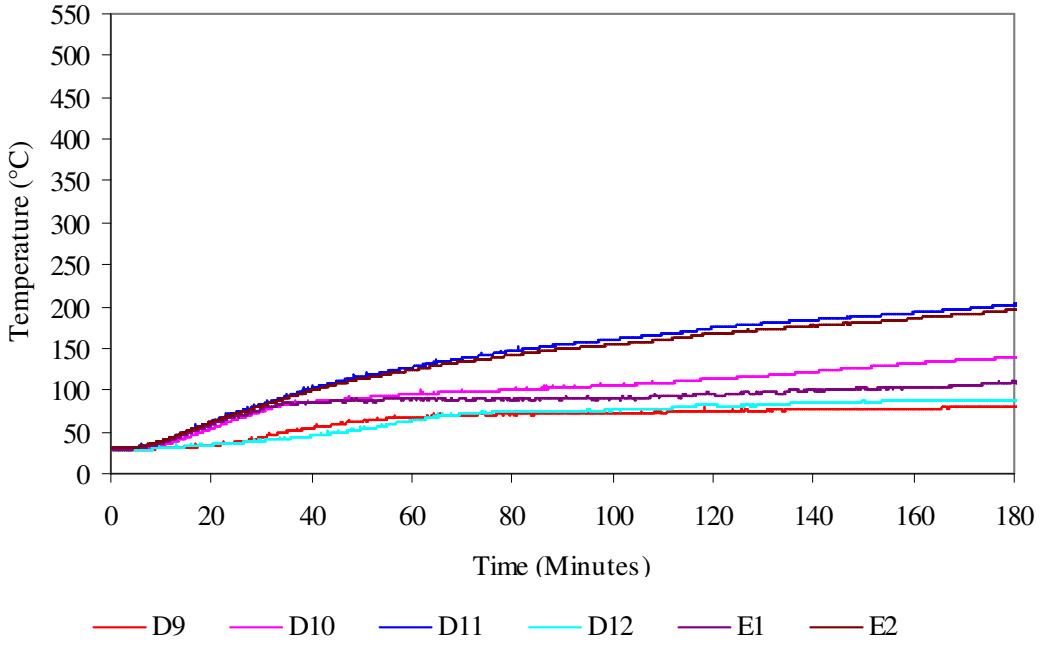


Figure A5.6: Service E. Temperatures vs. Time

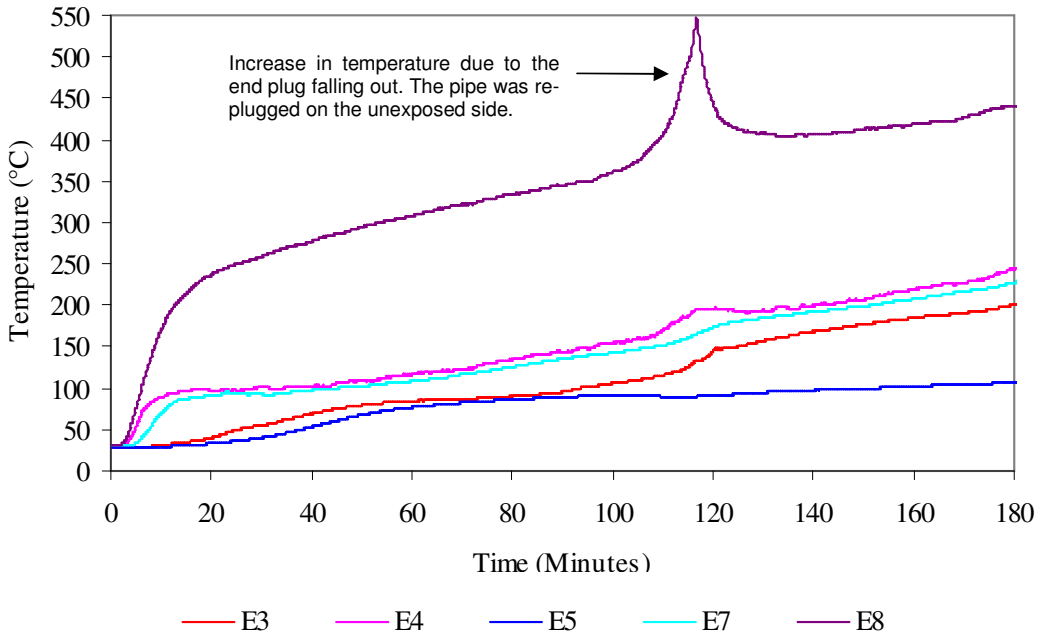


Figure A5.7: Service F. Temperatures vs. Time

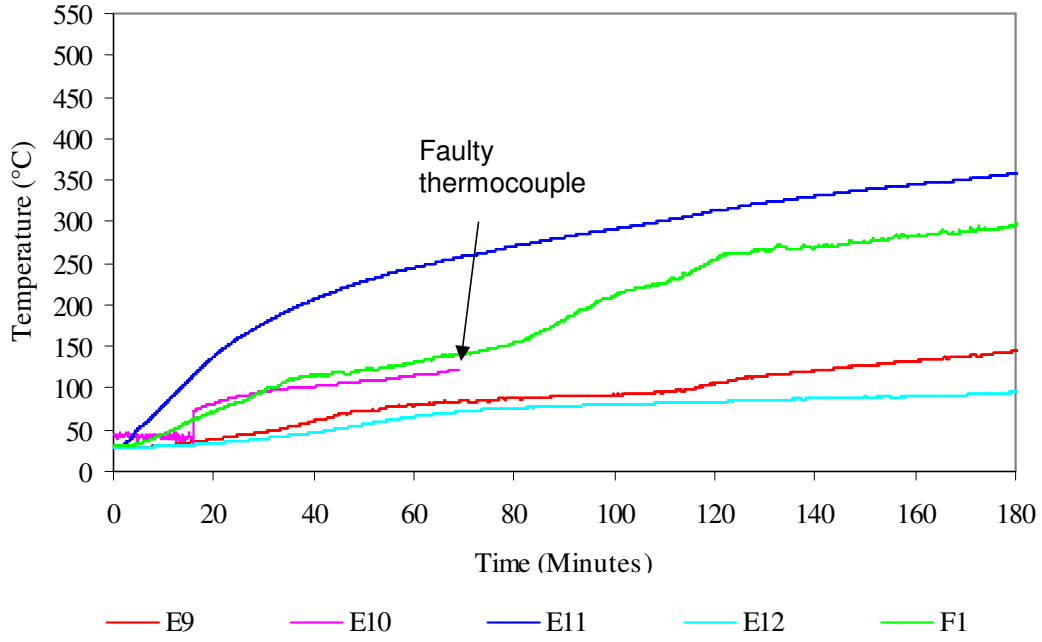


Figure A5.9: Service G. Temperatures vs. Time

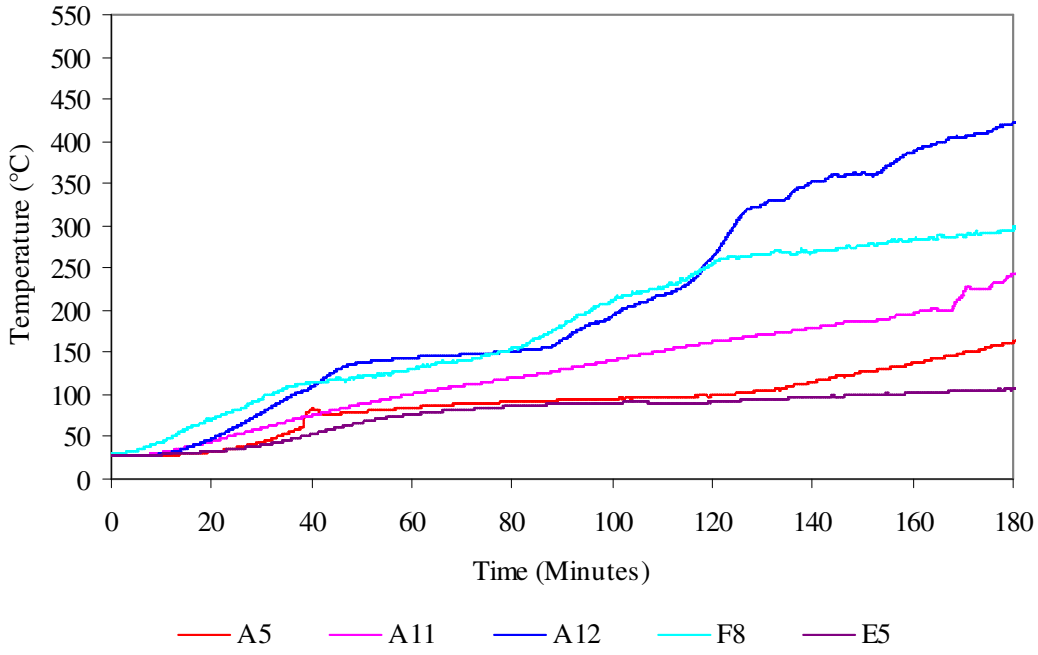


Figure A5.9: Service H. Temperatures vs. Time

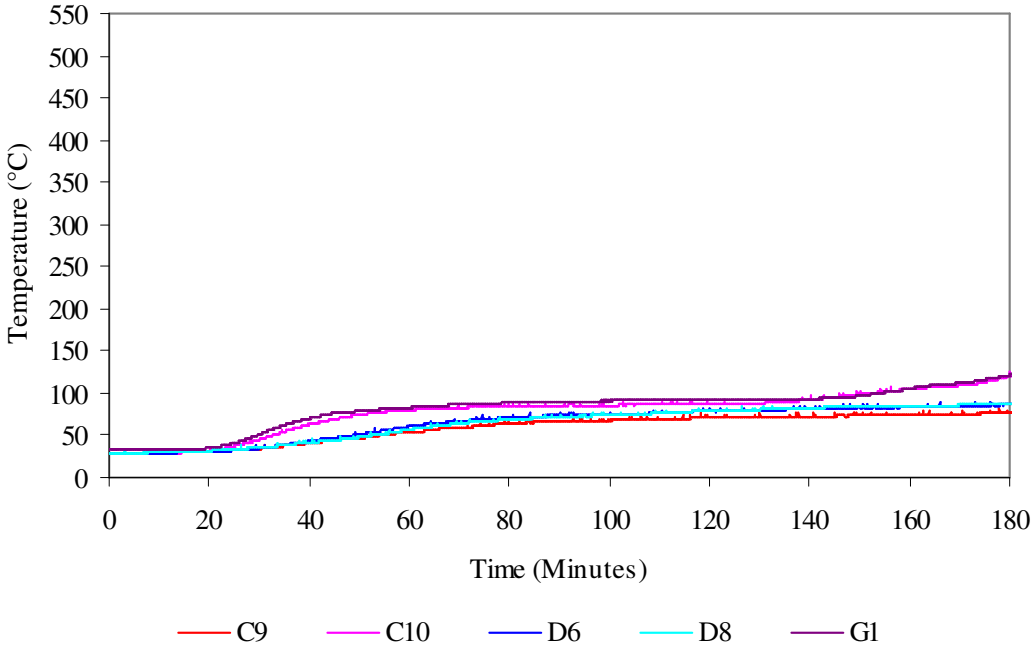


Figure A5.10: Control Joint. Temperatures vs. Time

TABLE A5.1: TEST SPECIMEN TEMPERATURES

T/C No.	Description[2]	Temp (°C) at t (minutes)					Limit[1] (Mins)
		t=0	t=30	t=60	t=120	t=180	
Service A							
B1	25mm from sealant on panel	29	32	44	74	86	-
B2	Centre of sealant fillet	30	35	61	84	88	-
B3	25mm from sealant on cable	30	117	243	446	515	49
B4	25mm from sealant on cable	30	85	166	345	394[3]	84
B5	25mm from sealant on cable	30	71	123	197	250	138
B6	25mm from sealant on panel	29	32	41	66	83	-
B7	Centre of sealant fillet	30	38	69	92	91	-
B8	25mm from sealant on cable	30	78	124	179	326	149
B9	25mm from sealant on tray	30	44	82	154	201	-
B10	Centre of sealant fillet	29	35	53	84	85	-
Service B							
B12	25mm from sealant on panel	30	33	44	71	92	-
C1	Centre of sealant fillet	29	44	73	92	133	-
C2	25mm from sealant on cables	30	71	98	142	392[4]	149
C3	25mm from sealant on tray	29	46	76	111	167	-
C4	Centre of sealant fillet	27	38	69	91	98	-
C5	25mm from sealant on panel	27	31	48	77	93	-
Service C							
C6	25mm from sealant on panel	28	31	44	73	87	-
C7	Centre of sealant fillet	28	40	63	90	99	-
C8	25mm from sealant on cable	29	63	88	102	118	-
Service D							
C12	25mm from sealant on panel	28	36	63	80	88	-
D3	25mm from sealant on panel	28	39	56	82	90	-
D1	Centre of sealant fillet	28	47	83	95	105	-
D4	Centre of sealant fillet	28	54	85	101	118	-
D2	25mm from sealant on pipe	29	68	102	137	147[5]	-
D5	25mm from sealant on pipe	29	67	100	138	158	-
Service E							
D9	25mm from sealant on panel	28	46	67	74	80	-
D12	25mm from sealant on panel	28	40	65	81	88	-
D10	Centre of sealant fillet	29	78	95	114	139	-
E1	Centre of sealant fillet	30	77	90	94	110	-
D11	25mm from sealant on pipe	29	86	129	175	202	-
E2	25mm from sealant on pipe	30	81	124	167	196	-

Notes

[1] 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 180K above the initial temperature.

[2] Refer to Appendix 4 for locations of thermocouples as only a generic description is included in the table.

[3] Last reading of thermocouple prior to removal at 154 minutes.

[4] Last reading of thermocouple prior to removal at 156 minutes.

[5] Last reading of thermocouple prior to removal at 161 minutes.

'-' Under limit column indicates the temperature limit was not exceeded during the test period or up until the time of integrity failure if a failure occurred.

# Indicates thermocouple fault.

TABLE A5.1: TEST SPECIMEN TEMPERATURES (CONTINUED…)

T/C No.	Description[2]	Temp (°C) at t (minutes)					Limit[1] (Mins)
		t=0	t=30	t=60	t=120	t=180	
Service F							
E3	25mm from sealant on panel	28	55	84	145	201	-
E4	Centre of sealant fillet	31	101	116	197	244	152
E7	Centre of sealant fillet	30	93	108	174	227	163
E8	25mm from sealant on pipe	31	257	308	442	441	14
Service G							
E9	25mm from sealant on panel	29	47	80	105	144	-
E12	25mm from sealant on panel	29	40	66	84	95	-
E10	Centre of sealant fillet	72[3]	96	115	121[3]	#	-
F1	Centre of sealant fillet	31	96	131	255	299	100
E11	25mm from sealant on pipe	30	178	245	314	358	41
Service H							
A5	Centre of sealant fillet	28	44	84	98	162	-
F8	25mm from sealant on cable	32	95	131	255	299	100
A12	25mm from sealant on cable	29	80	145	265	422	104
A11	25mm from sealant on cable	28	61	102	163	243	168
E5	Centre of sealant fillet	29	40	77	91	106	-
Control joint							
C9	Top west edge of join	28	34	53	71	76	-
D6	Top centre edge of join	28	36	62	78	85	-
D8	Bottom centre edge of join	29	35	58	78	86	-
C10	West end of seal	28	45	79	87	120	-
G1	East end of seal	32	51	83	92	122	-

Thermocouple D7 that was in the centre of the sealant on the control join was found to be faulty during the test. Three measurements were taken at 90 seconds each with a roving thermocouple at 126 minutes 35 seconds, 154 minutes 35 seconds and 177 minutes 48 seconds with respective resultant temperatures of 86°C, 91°C and 101°C.

Notes

[1] 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 180K above the initial temperature.

[2] Refer to Appendix 4 for locations of thermocouples as only a generic description is included in the table.

[3] Last reading of thermocouple prior to removal at 68 minutes.

'-' Under limit column indicates the temperature limit was not exceeded during the test period or up until the time of integrity failure if a failure occurred.

# Indicates thermocouple fault.

APPENDIX 6 PHOTOGRAPHS

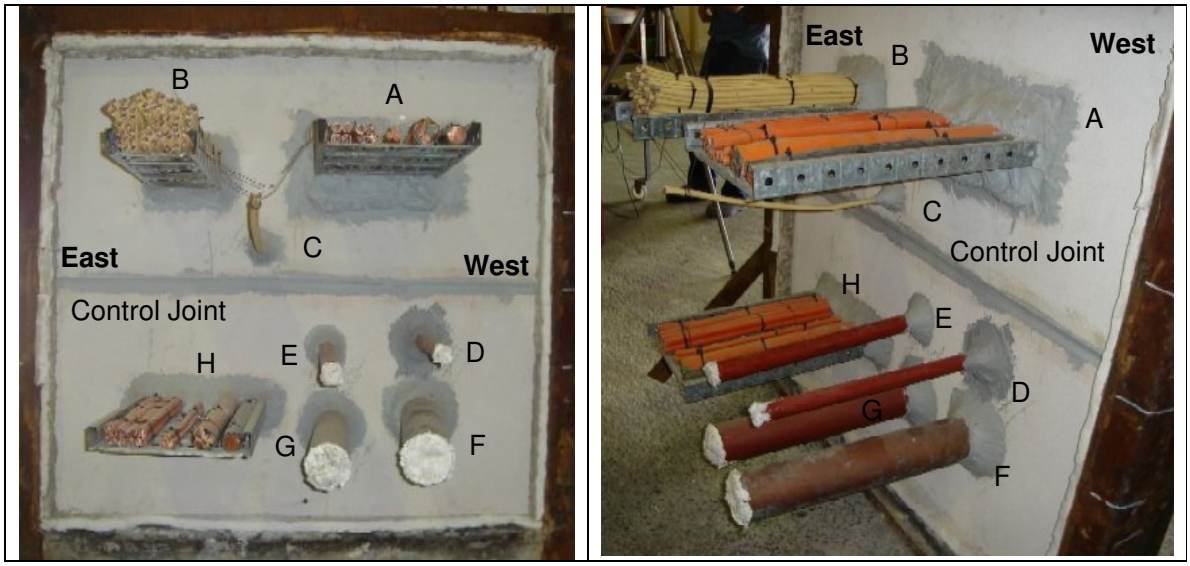


Figure A6.1. Exposed face of test specimen prior to commencement of the test.

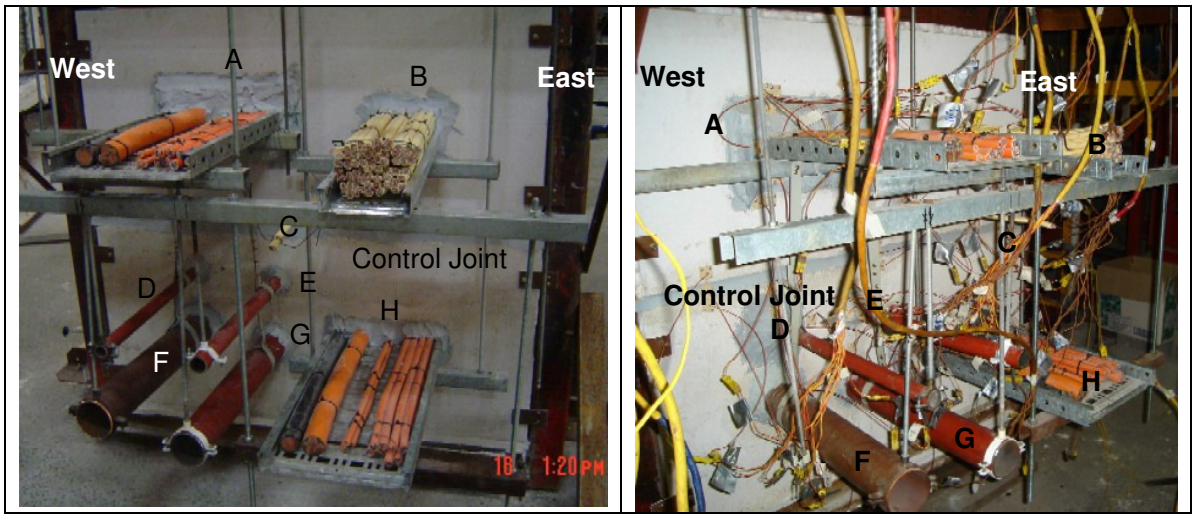


Figure A6.2: Unexposed face of test specimen prior to commencement of the test.

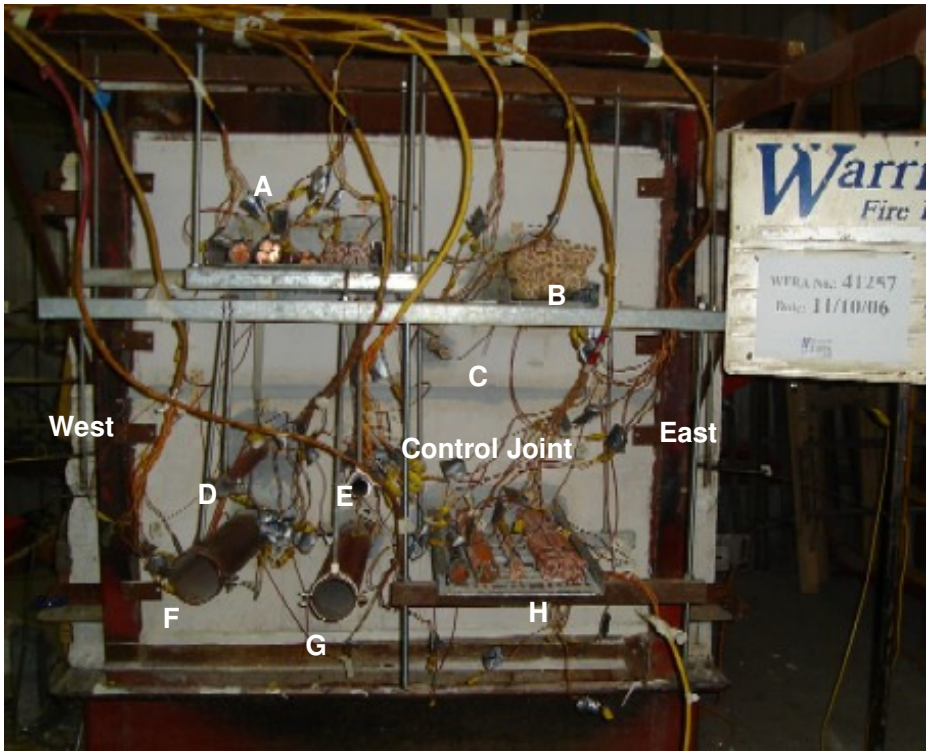


Figure A6.3: Unexposed face of test specimen prior to commencement of the test.

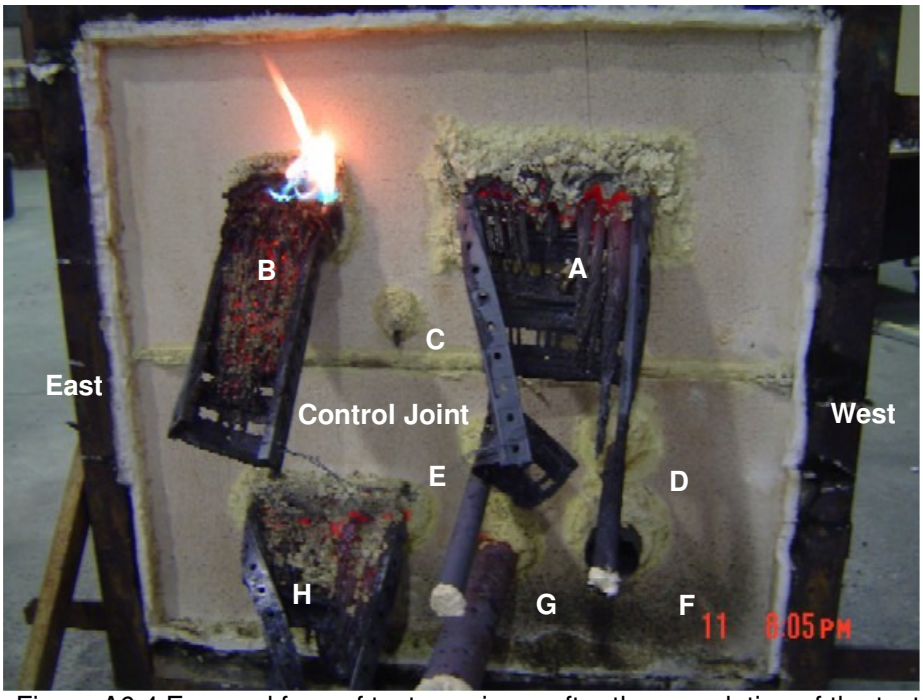


Figure A6.4 Exposed face of test specimen after the completion of the test.

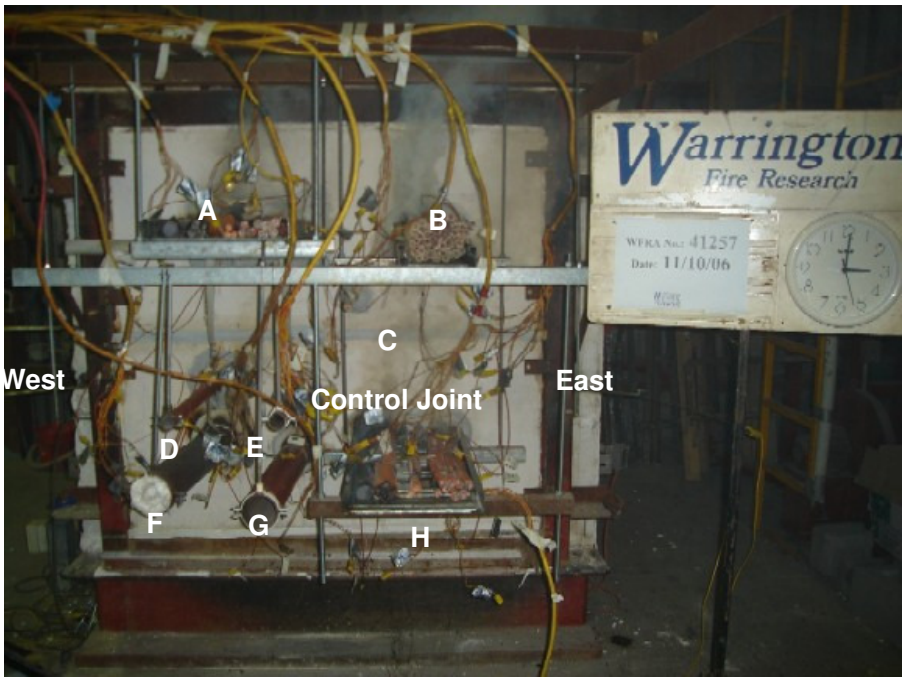


Figure A6.5: Unexposed face of test specimen after the completion of the test.