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Fire resistance test report

Test standard: Sections 2 and 10 of AS 1530.4:2014

Test sponsor: H B Fuller Aus Co P/L; USG Boral

Job number: 48763900

Test date: 31 May 2017 Revision: R1.1

Warringtonfire: accredited for compliance with ISO/IEC 17025 – Testing

ilac-MRA NATA Accreditation No. 3277

Quality management

Revision	Date	Information about the report			
R1.0	26 July 2017	Description	Initial issue		
			Prepared by		Reviewed by
		Name	Patrick Chan		Steven Halliday
R1.1	3 December 2021	Description	Amendment on the thickness of the separating element		
			Prepared by	Reviewed by	Authorised by
		Name	Mohammed Taher	Patrick Chan	Mandeep Kamal
		Signature			

Executive summary

This report documents the findings of the fire resistance test of penetration systems in accordance with sections 2 and 10 of AS 1530.4:2014. The testing was done on 31 May 2017.

Warringtonfire performed the test at the request of H B Fuller Aus Co P/L and USG Boral.

Table 1 provides details of the test assembly, and Table 2 provides a summary of the test specimen. A summary of the results is provided in Table 3.

Table 1 Test assembly

Item	Detail	
Separating element	Boral Firestop 13mm Plasterboard wall system	
Nominal separating element size	Width	1600 mm
	Height	1600 mm
	Thickness	116 mm
Number of penetration systems	Six	
Restraint conditions	Restrained on all edges	

Table 2 Test specimen

Penetration system / control joint	Service	Local fire-stopping protection	Local aperture size (mm)
A	2 × TPS cables	2 layers of 13mm Firestop plasterboard HB Fuller Firesound sealant	Ø20 mm
B	NB 25 mm Galvanised steel pipe	2 layers of 13mm Firestop plasterboard HB Fuller Firesound sealant	Ø40 mm
C	NB 32 mm Galvanised steel pipe	HB Fuller Firesound sealant 50mm × 50mm fillet cone	Ø50 mm
D	5 × TPS cables	HB Fuller Firesound sealant 50mm × 50mm fillet cone	Ø25 mm
E	Group A configuration cable tray	HB Fuller Firesound sealant 70mm × 50mm fillet cone	335 mm wide × 70 mm long
F	Group B configuration cable tray	HB Fuller Firesound sealant 70mm × 50mm fillet cone	181 mm wide × 130 mm long

Table 3 Test results

Penetration system/ control joint	Criteria	Results	Fire resistance level (FRL)
A	Structural adequacy	Not applicable	**-/180/180**
	Integrity	No failure at 180 minutes	
	Insulation	No failure at 180 minutes	
B	Structural adequacy	Not applicable	**-/180/180**
	Integrity	No failure at 180 minutes	
	Insulation	No failure at 180 minutes	
C	Structural adequacy	Not applicable	**-/180/120**
	Integrity	No failure at 180 minutes	
	Insulation	Failure at 153 minutes	
D	Structural adequacy	Not applicable	**-/180/120**
	Integrity	No failure at 180 minutes	
	Insulation	Failure at 125 minutes	
E	Structural adequacy	Not applicable	**-/180/45**
	Integrity	No failure at 180 minutes	
	Insulation	Failure at 58 minutes	
F	Structural adequacy	Not applicable	**-/180/120**
	Integrity	No failure at 180 minutes	
	Insulation	Failure at 122 minutes	

Contents

1. Introduction

This report documents the findings of the fire resistance test of penetration systems in accordance with sections 2 and 10 of AS 1530.4:2014. The testing was done on 31 May 2017.

Warringtonfire performed the test at the request of the test sponsor listed in Table 4.

Table 4 Test sponsor details

Test sponsor	Address
H B Fuller Aus Co P/L	16-22 Redgum Dr Dandenong South VIC 3175 Australia
USG Boral	251 Salmon Street Port Melbourne VIC 3207 Australia

2. Test specimen

2.1 Schedule of components

Table 5 describes the test specimen and lists the schedule of components. These were provided by the test sponsor and surveyed by Warringtonfire.

All measurements were done by Warringtonfire – unless indicated otherwise.

Detailed drawings of the test specimen are provided in Appendix A.

Table 5 Schedule of components

Item	Description		
Separating element (SE)			
1.	Item name	Plasterboard wall	
	Product name	Boral Firestop 13 mm Plasterboard wall system	
	Density	894 kg/m^3 (measured)	
2.	Item name	Steel frame	
	Product name	• 64 mm Rondo steel stud • 64 mm Rondo steel track	
	Size	Rondo steel stud	64 mm web × 33.5 mm flange × 0.55 mm BMT
		Rondo steel track	64°mm web × 29 mm flange × 0.5 mm BMT
SE	Overall size	1600 mm wide × 1600 mm long × 116 mm thick	
	Restraint conditions	Restrained on all four edges	
	Installation	The wall incorporated wall incorporated two layers of 13 mm thick plasterboard on both exposed and unexposed sides with 64 mm Rondo steel frame. The perimeter tracks and studs were secured to the concrete blockwork with 6 mm masonry anchors at 600 mm centres. The wall was divided into six 800 mm wide × 463 mm height compartments. The compartments were separated from each other by 13 mm thick plasterboard with stone wool inserted into the cavity of the steel stud and nogging.	
	Compartmentation	A	Extra two layers of 13 mm Firestop plasterboard were applied on the wall system as an extra protection system of the pipe on both the exposed and unexposed sides.

Item	Description		
			A rectangle hole which extended from the top edge of the wall system to the core hole was formed on the wall system to allow the bundle of cable inserted through the wall system. The protection board was 150 mm height × 550 mm wide and secured to the wall with 8-off S type screws. Part of the bottom of the protection plasterboard was cut out to allow the protection board to be installed through the bundle of cable.
		B	Extra two layers of 13 mm Firestop plasterboards were applied on the wall system as an extra protection of the pipe on both exposed and unexposed side. A rectangle hole which extended from the top edge of the wall system to the core hole was formed on the wall system to allow the bundle of cable inserted through the wall system. The protection board was 150 mm height × 550 mm wide and secured to the wall with 8-off S type screws. Part of the bottom of the protection plasterboard was cut out to allow the protection board to be installed through the pipe.
		C	No extra feature installed in the wall system
		D	No extra feature installed in the wall system
		E	No extra feature installed in the wall system
		F	No extra feature installed in the wall system
Fire-stopping protections			
Sealant			
3.	Item name	Sealant	
	Product name	H. B. Fuller Firesound sealant	
	Density	1496 kg/m³	
Services			
4.	Item name	NB 25 mm galvanised steel pipe	
	Material	Galvanised steel	
	Size	Outer diameter	Ø33.7 mm
		Wall thickness	3.1 mm
5.	Item name	NB 32 mm Galvanised steel pipe	
	Material	Galvanised steel	
	Size	Outer diameter	Ø42.4 mm
		Wall thickness	3.2 mm
6.	Item name	TPS cables	
	Manufacturer	Prysmian	
	Product name	2.5 mm² 2C+E TPS cable	
	Size	Width	12.2 mm
		Length	5.5 mm

Item	Description		
		Cross section area	2.5 mm^2 each core
7.	Item name	D1 power cable group	
	Product name	• CMI Electrical product 0.6/1kV × 90 1C630SQmm CU 2013 • Prysmian L electrical cable 0.6/1kV X-90 3C × 185 mm² + E 70 mm² • Advance cable 2017 V90 Electrical cable 450/750V 6 mm² 3C+E • WW VIPERCON electric cable 3C + E 16 XLPE / PVC 5V90 AS/NZS 5000.1 0.6/1kV 2019 1016 UA	
	Size	Cable cross section area	Outer diameter
		630 mm²	41 mm
		185 mm²	52 mm
		6 mm²	13 mm
		16 mm²	18 mm
	Number of cables	• 1 × 630 mm² cable • 1 × 185 mm² cable • 3 × 6 mm² cable • 8 × 16 mm² cable	
8.	Item name	300 mm cable tray	
	Product name	Burndy® LT3-300-3 ladder-tray	
	Size	Width Height Thickness	325 mm 47.0 mm 1.0 mm
	Material	Galvanised steel	
9.	Item name	D2 communication cable group	
	Product name	Prysmian DW Maxtel CAT 3 50 PR internal telephone 0.5 mm T50P I J/N 65048/C	
	Manufacturer	Prysmian	
	Size	18 mm × 11 mm	
	Number of cables	60 × CAT 3 cables	
10.	Item name	150 mm cable tray	
	Product name	Burndy® LT3-150-3 ladder tray	
	Size	Width Height Thickness	175 mm 50 mm 1.0 mm
Fixings			
11.	Item name	Screws	
	Product description	S type screws	
Penetration system A			
A	Service	Bundle of TPS cable (2-off cable)	

Item	Description	
	Service detail	The service was installed 60mm away from the top edge of the compartment. The service protruded 500 mm from the exposed and unexposed sides of the separating element.
	Service support	The service was supported at 200 mm and 450 mm away from the wall system with plastic cable ties on the threaded rods.
	Aperture size	Ø20 mm
	Main fire-stopping protection system	
	Protection	The service was protected by extra two layers of 550 mm × 150 mm × 13 mm plasterboard (item 1) on the exposed and unexposed side. The plasterboards were located 20 mm below the top edge of the wall system.
	Local fire-stopping protection	
	Protection	The sealant (Item 2) was applied: • On the interface between the galvanize pipe and the plasterboard on the exposed and unexposed side. • On the 20mm gap between the protection plasterboard and the concrete lintel • In the cut out of the wall system and the protection plasterboard board.
Penetration system B		
B	Service	NB 25 mm galvanize pipe (Item 3).
	Service detail	The service was installed 70mm away from the top edge of the compartment. The service protruded 500 mm from the exposed and unexposed side of the separating element.
	Service support	The service was supported at 200mm and 450mm away from the separating element with pipe clamp.
	Aperture size	Ø40 mm
	Local fire-stopping protection	
	Protection	The service was protected by extra two layers of 550 mm × 150 mm × 13 mm plasterboard (Item 1) on the exposed and unexposed side. The plasterboards were located 20 mm below the top edge of the wall system.
	Local fire-stopping protection	
	Protection	The sealant (Item 2) was applied: • On the interface between the galvanize pipe and the plasterboard on the exposed and unexposed side. • On the 20 mm gap between the protection plasterboard and the concrete lintel • In the cut out of the wall system and the protection plasterboard board.
Penetration system C		
C	Service	NB 32 mm Galvanised steel pipe. (item 5)
	Service detail	The service was installed 480 mm away from the west edge of the wall system and 735 mm from the sill. The service protruded 500 mm away from both the exposed and unexposed sides of the separating element and capped with wielded steel plate on the exposed side.
	Service support	The service was supported at 200mm and 450mm away from the separating element with pipe clamps.
	Aperture size	Ø50 mm
	Local fire-stopping protection	

Item	Description	
	Protection	The sealant (item 3) was applied on the annular gap between the separating element and the service and finished with 50 mm × 50 mm fillet cone on both exposed and unexposed sides.
Penetration system D		
D	Service	2 × bundle of cable (5 × TPS cables) (item 6).
	Service detail	The Ø50 mm core hole was located 1020 mm away from the west edge of the wall system and Ø25 mm core hole was located 1265 mm away from the west edge. Both holes were 735 mm above the sill. The service protruded 500 mm away from both the exposed and unexposed sides of the separating element.
	Service support	The service was supported at 200 mm and 450 mm away from the separating element with cable ties on the threaded rods.
	Aperture size	West: Ø50 mm East: Ø25 mm
	Local fire-stopping protection	
	Protection	A bundle of cable was inserted into each core holes. Sealant (item 3) was applied in the annual gap and finished with a 50 mm × 50 mm fillet cone on both the exposed and unexposed sides.
Penetration system E		
E	Service	D1 power cable group (item 7) with 300 mm cable tray
	Service detail	The service was installed at 300 mm away from the west edge of the wall system and 190 mm away from the sill. The service protruded 500 mm from both the exposed and unexposed sides.
	Service support	The service was supported at 200 mm and 450 mm away from the separating element on the Unistruts.
	Aperture size	335 mm wide × 70 mm long
	Local fire-stopping protection	
	Protection	Sealant (item 3) was applied into the spacing between the separating element and the service and finished off with a fillet cone on both the exposed and unexposed sides. The fillet cone was 70 mm × 50 mm on the top section of the cone and 50 mm × 50 mm on the bottom section.
Penetration system F		
F	Service	D2 communication cable group (item 9) with 150 mm cable tray (item 10)
	Service detail	The service was installed at 1035 mm away from the west edge of the wall system and 190 mm away from the sill. The service protruded 500 mm from both the exposed and unexposed side of the separating element.
	Service support	The service was supported at 200 mm and 450 mm away from the separating element on the Unistruts.
	Aperture size	181 mm wide × 130 mm long
	Local fire-stopping protection	
	Protection	Sealant (item 3) was applied into the spacing between the separating element and the service and finished off with a fillet cone on both the exposed and unexposed sides. The fillet cone was 70 mm × 50 mm on the top section of the cone and 50 mm × 50 mm on the bottom section.

2.2 Installation details

Table 6 lists the installation details for the test specimen.

Table 6 Installation details

Item	Detail
Start date for construction of separating element	17 May 2017
Start date for installation of fire-stopping protection for the penetration systems	21 May 2017
Completion date for constructing and installing the test specimen	18 May 2017
Separating element constructed by	Representatives of Warringtonfire
Fire-stopping protection for penetration systems installed by	Representatives of the test sponsor
Symmetry	Symmetrical

3. Test procedure

Table 7 details the test procedure for this fire resistance test.

Table 7 Test procedure

Item	Detail	
Statement of compliance	The test was performed in accordance with the requirements of sections 2 and 10 of AS 1530.4:2014 for penetration systems, subject to the variations below.	
Variations	The pressure for the 5–15-minute period was above the limits prescribed in AS1530.4-2014 by 8-39 Pa. This exceeded the pressure requirement of the standard and was therefore more severe than required by the standard. Based on the above the results of this test remain valid.	
Pre-test conditioning	The construction and installation of the test specimen was completed on 18 May 2017. The test specimen was subjected to normal laboratory temperatures and conditions between the completion of construction of the test specimen and the start of the test.	
Sampling / specimen selection	The laboratory was not involved in sampling or selecting the test specimen for the fire resistance test. The results obtained during the test only apply to the test samples as received and tested by Warringtonfire.	
Ambient laboratory temperature	Start of the test	13 °C
	Minimum temperature	13 °C
	Maximum temperature	19 °C
Test duration	180 minutes	
Instrumentation and equipment	The instrumentation was provided in accordance with AS 1530.4-2014 and as detailed below: • The furnace temperature was measured by 4-off mineral insulated metal sheathed Type K thermocouples with wire diameters not greater than 1 mm and overall diameter of 3 mm with the measuring junction insulated from the sheath. The thermocouples protruded a minimum of 25 mm from steel supporting tubes. • The unexposed side specimen temperatures were measured by Type K thermocouples with wire diameters less than 0.5 mm diameter soldered to 12 mm diameter × 0.2 mm thick copper discs covered by 30 mm × 30 mm × 2.0 mm inorganic insulating pads. The thermocouples positions are described in Table 10 and are shown on Figure 6 in Appendix D. • A roving thermocouple was available to measure temperatures at positions that appeared hotter than the positions monitored by the fixed thermocouples. • Cotton pads were available during the test to assess the performance under the criteria for integrity. • The furnace pressure was measured the centre of lowest penetration.	

4. Test measurements and results

Table 8 summarises the results the specimen achieved against the performance criteria listed in sections 2 and 10 of AS 1530.4:2014, subject to the variations listed in section 3.

Appendix E includes details of the measurements taken during the test.

Table 9 in Appendix B includes observations of any significant behaviour of the specimen and details of the occurrence of the various performance criteria specified in AS 1530.4:2014.

Photographs of the specimen are included in Appendix F.

Table 8 Test results

Penetration system/ control joint	Criteria	Results	Fire resistance level (FRL)
A	Structural adequacy	Not applicable	**-/180/180**
	Integrity	No failure at 180 minutes	
	Insulation	No failure at 180 minutes	
B	Structural adequacy	Not applicable	**-/180/180**
	Integrity	No failure at 180 minutes	
	Insulation	No failure at 180 minutes	
C	Structural adequacy	Not applicable	**-/180/120**
	Integrity	No failure at 180 minutes	
	Insulation	Failure at 153 minutes	
D	Structural adequacy	Not applicable	**-/180/120**
	Integrity	No failure at 180 minutes	
	Insulation	Failure at 125 minutes	
E	Structural adequacy	Not applicable	**-/180/30**
	Integrity	No failure at 180 minutes	
	Insulation	Failure at 58 minutes	
F	Structural adequacy	Not applicable	**-/180/120**
	Integrity	No failure at 180 minutes	
	Insulation	Failure at 122 minutes	

5. Application of test results

5.1 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 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.

5.2 Variations from the tested specimen

This report details methods of construction, the test conditions and the results obtained when the specific element of construction described herein was tested in accordance with the test method with AS1530.4. 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 C should be referred to the test sponsor in the first instance to obtain appropriate documentary evidence of compliance from Warringtonfire or another accredited testing authority.

5.3 Uncertainty of measurements

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 for the result.

Appendix A Drawings of test assembly

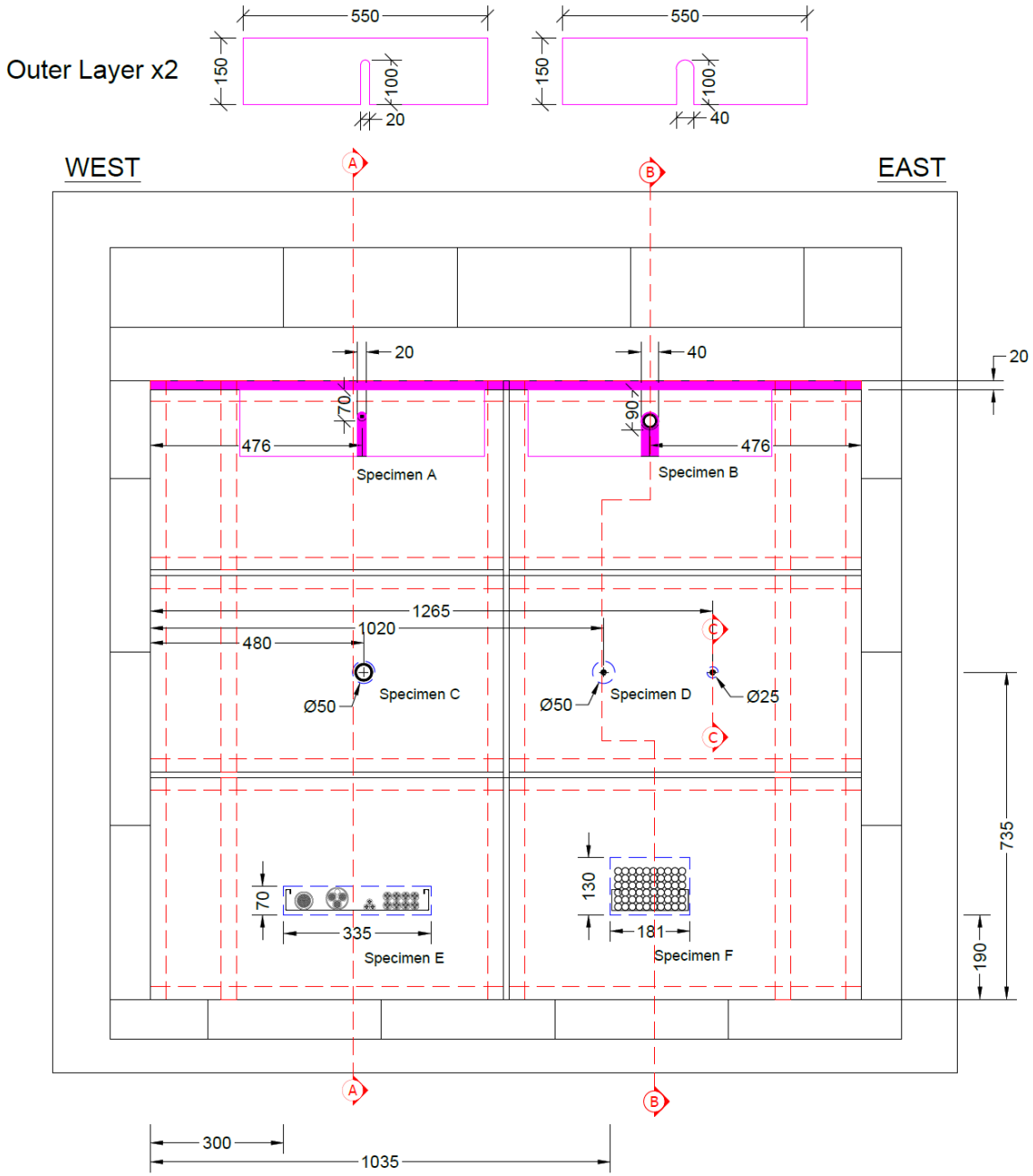


Figure 1 Elevation view of test specimen (unexposed side)

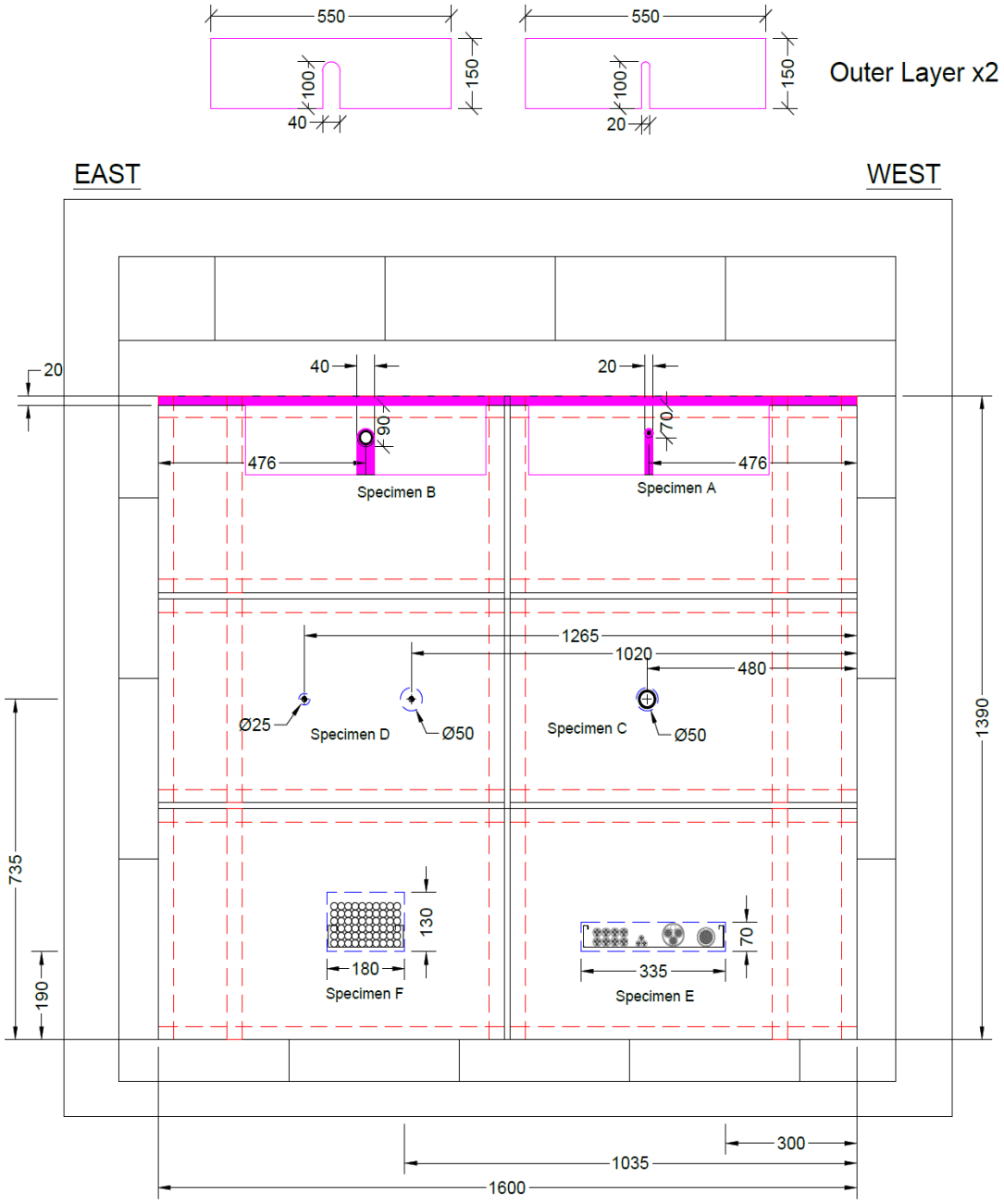


Figure 2 Elevation view of test specimen (exposed side)

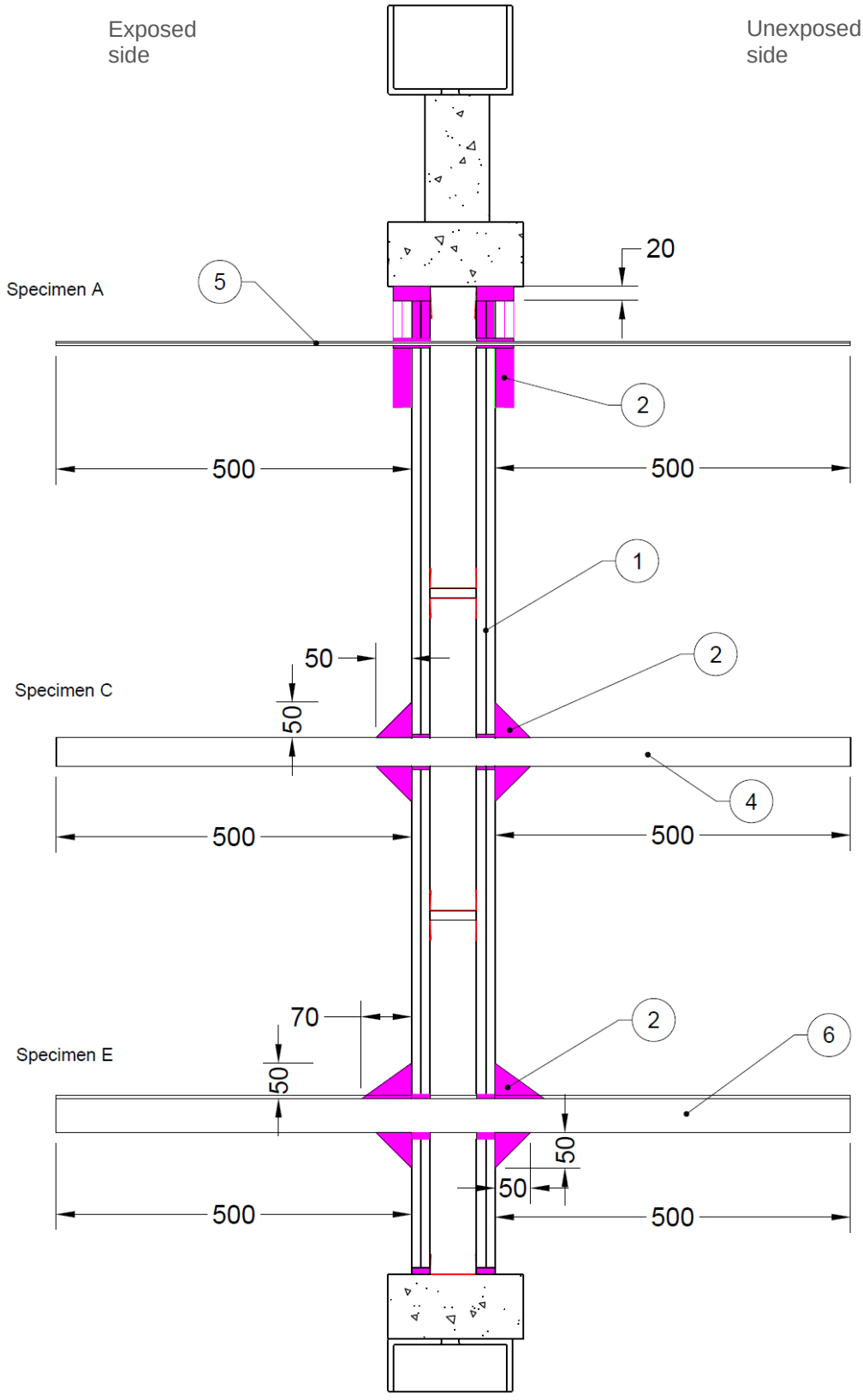


Figure 3 Cross section A-A

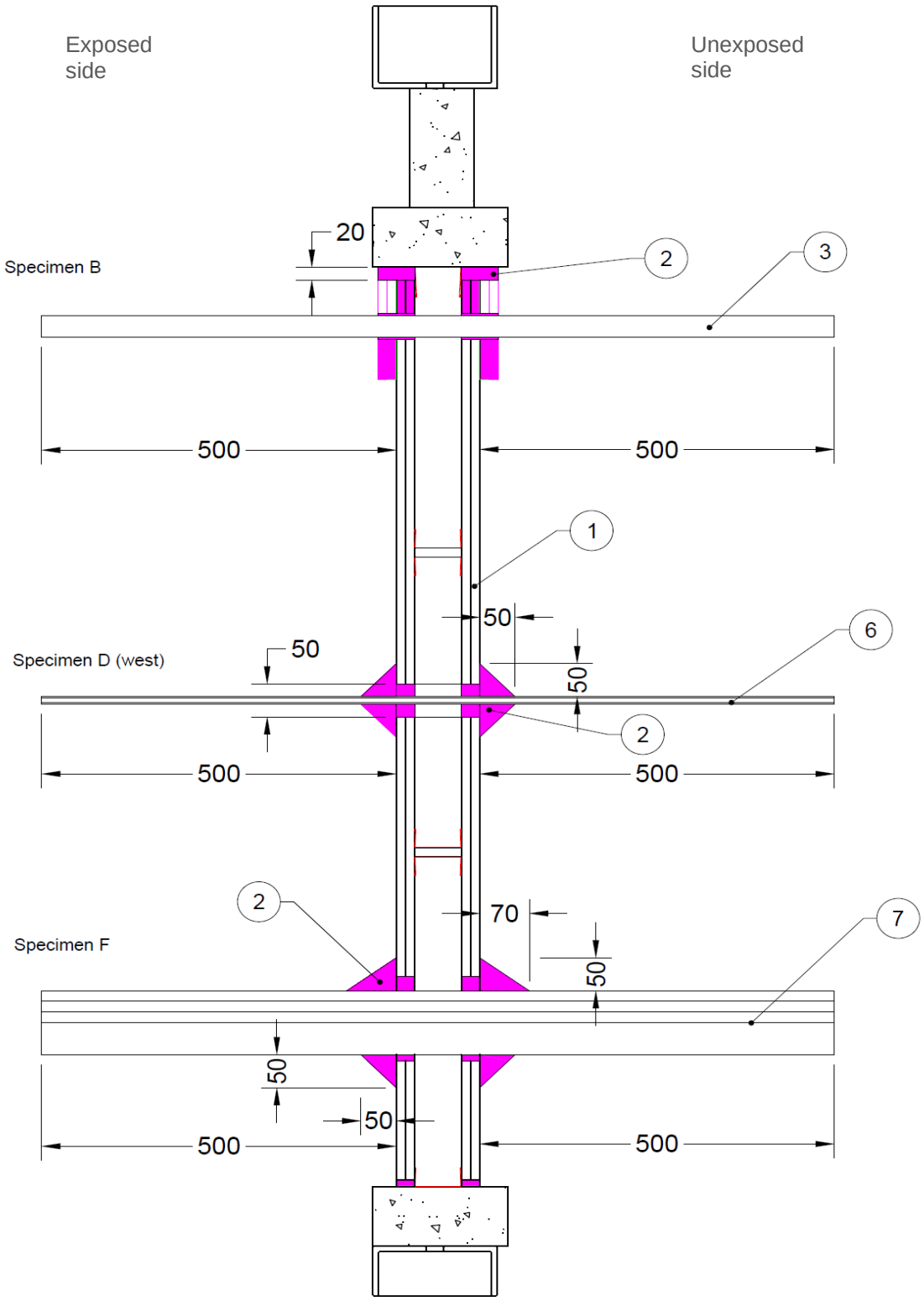


Figure 4 Cross section B-B

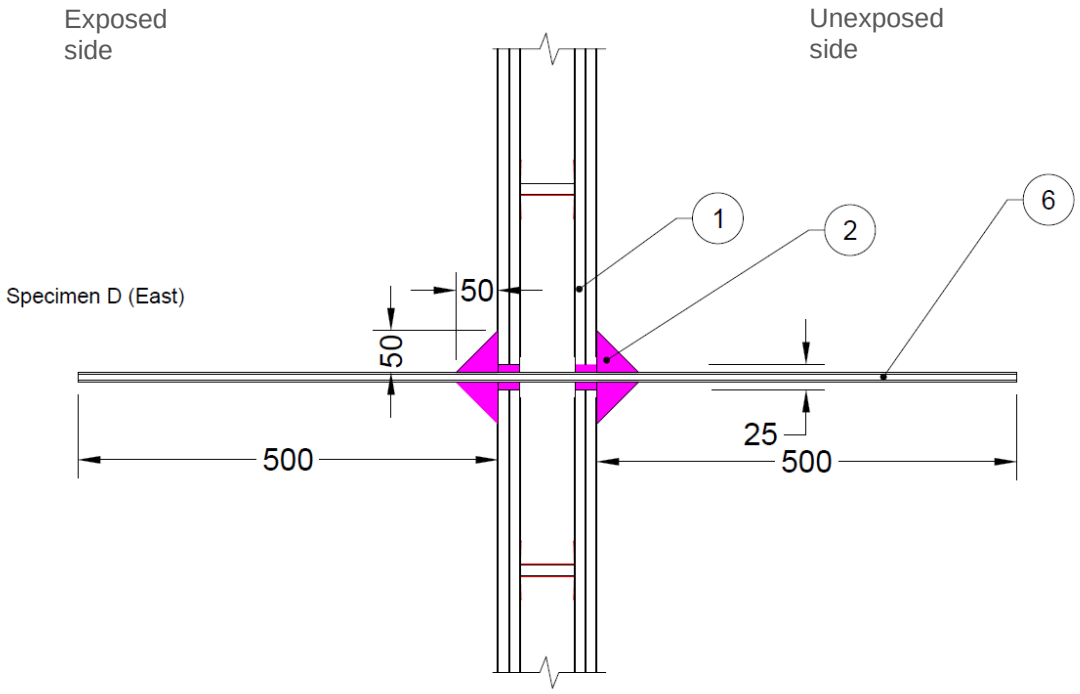


Figure 5 Cross section C-C

Appendix B Test observations

Table 9 shows the observations of any significant behaviour of the specimen during the test.

Table 9 Test observations

Time		Observation
Min	Sec	
Penetration system A		
00	00	Fire resistance test commenced, and the ambient temperature was approximately 13°C.
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
60	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
90	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
111	00	The sealant cone had expanded.
120	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
180	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
180	00	Test stopped at the request of the sponsor
Penetration system B		
00	00	Fire resistance test commenced, and the ambient temperature was approximately 13°C.
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
60	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
80	44	The sealant cone had expanded
90	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
120	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
180	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
180	00	Test stopped at the request of the sponsor
Penetration system C		
00	00	Fire resistance test commenced, and the ambient temperature was approximately 13°C.
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
42	18	Part of the sealant cone had liquefied and dripping to the specimen F
60	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
72	30	The sealant cone had expanded
90	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.

Time		Observation
Min	Sec	
120	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
153	**50**	**TC 031 on the metal pipe, 25mm away from sealant recorded a temperature of 193°C. Failure of insulation in accordance with AS 1530.4-2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 031 exceeded the initial temperature by more than 180°C.**
180	00	The specimen had continued to maintain integrity in accordance with AS 1530.4-2014.
180	00	Test stopped at the request of the sponsor.
Penetration system D		
00	00	Fire resistance test commenced, and the ambient temperature was approximately 13°C.
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
60	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
72	30	The sealant cone had expanded
90	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
120	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014.
125	**15**	**TC 051 on the bundle of TPS cable on the east side hole, 25mm away from sealant recorded a temperature of 193°C. Failure of insulation in accordance with AS 1530.4-2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 051 exceeded the initial temperature by more than 180°C.**
137	**40**	**TC 041 on the bundle of TPS cable on the west side hole, 25mm away from sealant recorded a temperature of 193°C. Failure of insulation in accordance with AS 1530.4-2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 041 exceeded the initial temperature by more than 180°C.**
180	00	The specimen had continued to maintain integrity in accordance with AS 1530.4-2014.
180	00	Test stopped at the request of the sponsor.
Penetration system E		
00	00	Fire resistance test commenced, and the ambient temperature was approximately 13°C.
01	00	Smoke emission appeared from the cable tray gap
24	30	Amount of smoke emission had increased.
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
48	18	Part of the sealant cone had liquefied, and bubbling appeared.
58	**55**	**TC 104 on the 630mm2 single core cable, 25mm away from sealant recorded a temperature of 193°C. Failure of insulation in accordance with AS 1530.4-2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 104 exceeded the initial temperature by more than 180°C.**
60	00	The specimen had continued to maintain integrity in accordance with AS 1530.4-2014.
72	30	The sealant cone had expanded

Time		Observation
Min	Sec	
80	44	Smoke emission on the 185mm2 cable had increased. Discolouration appeared on the 16mm2 cables
82	45	The sheath of the 185mm2 and 630mm2 cable had melted
90	00	The specimen had continued to maintain integrity in accordance with AS 1530.4-2014
120	00	The specimen had continued to maintain integrity in accordance with AS 1530.4-2014
170	00	The molten sheath of the cables was dripping off from the cable tray.
180	00	The specimen had continued to maintain integrity in accordance with AS 1530.4-2014
180	00	Test stopped at the request of the sponsor.
Penetration system F		
00	00	Fire resistance test commenced, and the ambient temperature was approximately 13°C.
01	00	Smoke emission appeared from the cable tray gap
24	30	Amount of smoke emission had increased.
24	30	Discoloration appeared on the cables
30	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
48	18	Part of the sealant cone had liquefied, and bubbling appeared.
60	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
72	30	The sealant cone had expanded
90	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
120	00	The specimen had continued to maintain integrity and insulation in accordance with AS 1530.4-2014
122	**75**	**TC 127 on the bottom of the cable tray, 25mm away from sealant recorded a temperature of 193°C.** **Failure of insulation in accordance with AS 1530.4-2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 127 exceeded the initial temperature by more than 180°C.**
170	00	The molten sheath of the cables was dripping off from the cable tray.
180	00	The specimen had continued to maintain integrity in accordance with AS 1530.4-2014
180	00	Test stopped at the request of the sponsor.

Appendix C Direct field of application

The text, figures and tables in this appendix have been taken from section 10 of AS 1530.4:2014.

C.1 General

The results of the fire test contained in the test report are directly applicable without reference to the testing authority to similar constructions where one or more of the changes set out in clauses 10.12.2 to 10.12.6 of AS 1530.4:2014 have been made.

C.2 Separating elements

- Results obtained from framed wall systems may be applied to the performance of a system in concrete, masonry or solid gypsum blocks of greater or equal thickness to that of the tested prototype. The reverse does not apply.
- Results obtained from framed wall systems may be applied to similar walls having studs of the same material with sizes greater than the tested prototype.
- Results obtained from a prototype test may be applied to framed wall systems of similar construction but having thicker facings of the same material applied to the stud.

C.3 Metal pipes

C.3.1 Sealing systems tested using standard configurations

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 10.12.3.1 of AS 1530.4:2014, provided 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.

Note: For information on standard configurations, see Appendix F of AS 1530.4:2014.

TABLE 10.12.3.1

METAL PIPE DEEMED TO HAVE EQUIVALENT FIRE RESISTANCE LEVELS

Nominal size mm	Actual OD (outside diameter) 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

C.3.2 Sealing systems tested not using standard configurations

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.

Note: For information on standard configurations for metal pipes, see Appendix F of AS 1530.4:2014.

C.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.

C.3.4 Insulated – lagged – metal pipes

Where fire test data on the insulation system is not available, penetration sealing systems that have been subjected to the standard test with uninsulated metal pipes may be used, provided the appropriate requirements of clause 10.12.3.2 of AS 1530.4:2014 are satisfied and the following procedures are followed:

- 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.
- If the insulation is combustible, it shall be cut away for 1000 mm either side of the separating element (provided 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.

C.3.5 Alternative pipe materials

If an element is penetrated by —

- a pipe other than brass, copper or ferrous alloys
- a pipe of cross-section other than circular
- a pipe outside the field of application specified in this Standard for the standard test configuration, then the results obtained from a single tested system may be applied to these pipes provided the —
  - melting point of the material is equal to or greater than the tested specimen
  - surface area to mass ratio of a cross-section of the pipe is equal to or less than the tested specimen
  - thermal conductivity is equal to or less than the tested specimen diffusivity of the material.

Appendix D Instrumentation locations

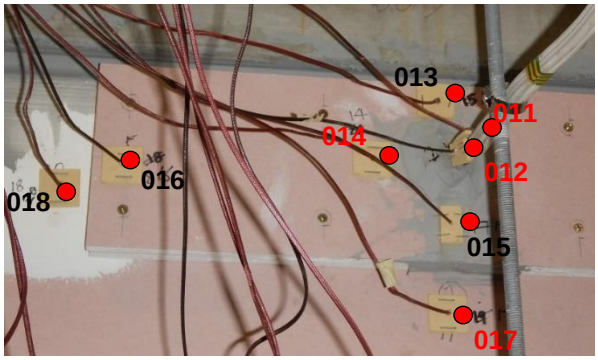


Figure 6 Penetration system A

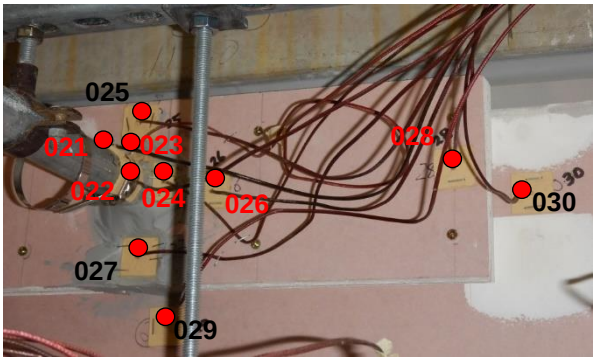


Figure 7 Penetration system B

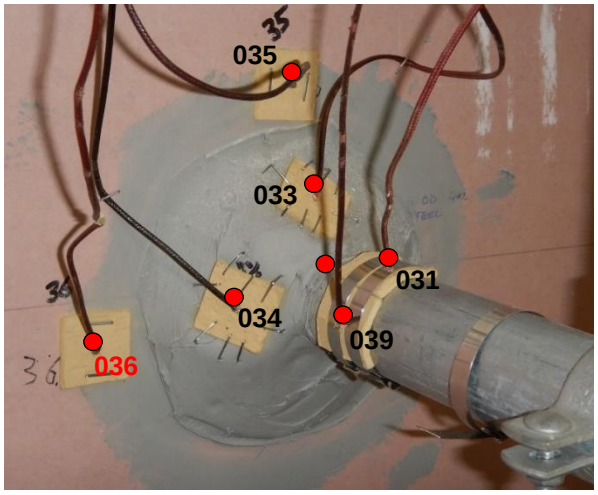


Figure 8 Penetration system C

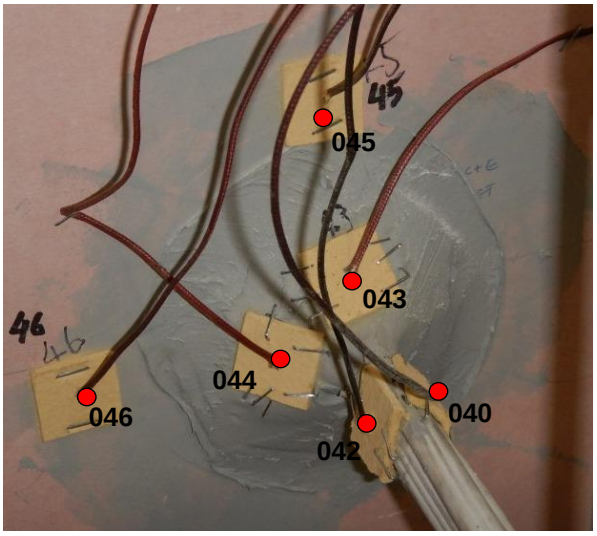


Figure 9 Penetration system D west

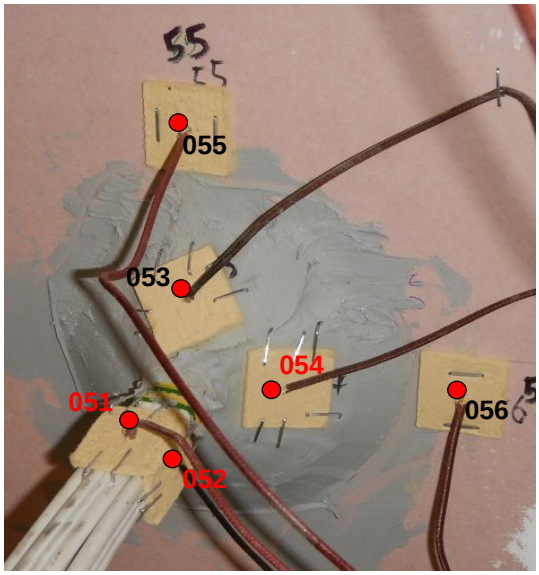


Figure 10 Penetration system D east

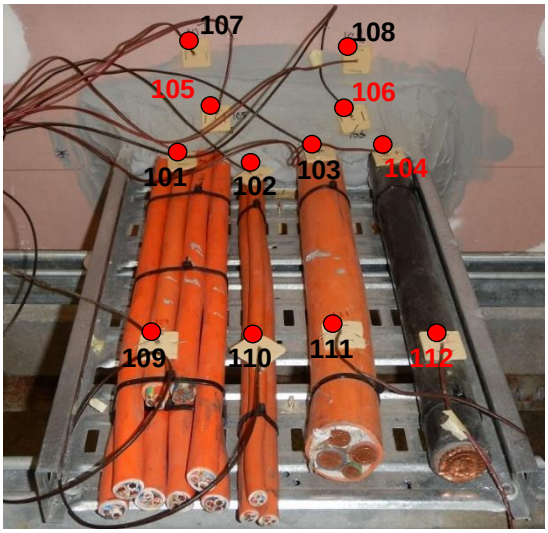


Figure 11 Penetration system D top

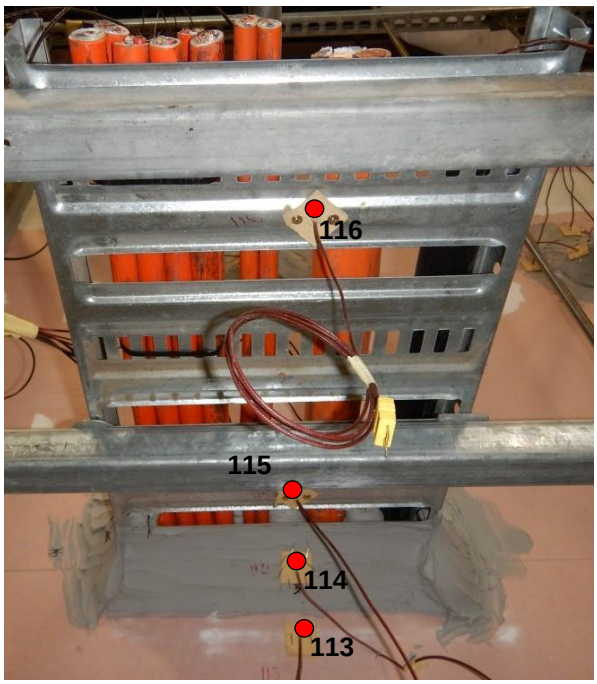


Figure 12 Penetration system E bottom

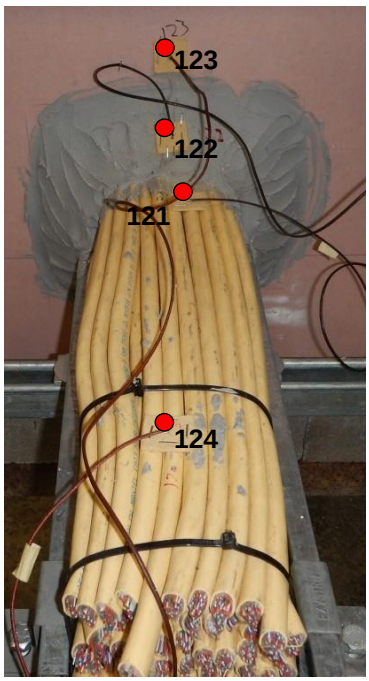


Figure 13 Penetration system F top

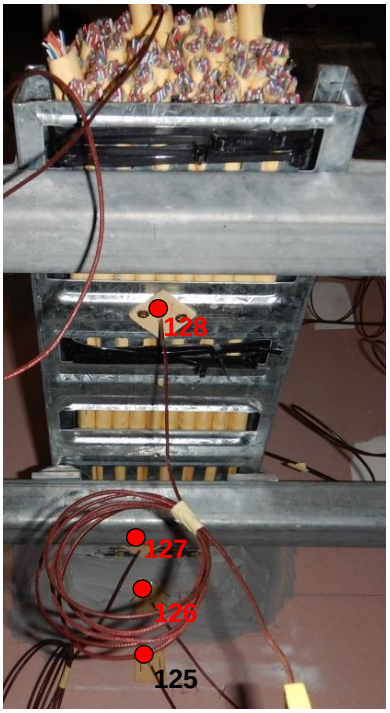


Figure 14 Penetration system F bottom

Table 10 Thermocouple locations

Penetration system	T/C #	Description
A	011	On the top of the bundle of TPS cables, 25mm away from the sealant
	012	On the side of the bundle of TPS cables, 25mm away from the sealant
	013	On the extra protection plasterboard, 25mm away from the sealant
	014	On the extra protection plasterboard, 25mm away from the sealant
	015	On the sealant in the extra protection plasterboard channel, 25mm away from the sealant fillet cone
	016	On the extra protection plasterboard, 25mm away from the wall system below the extra protection plasterboard channel.
	017	On the wall system, 25mm away from the extra protection plasterboard
	018	On the wall system, 25mm away from the extra protection plasterboard
B	021	On the top of the 25mm galvanised steel pipe, 25mm away from the sealant
	022	On the side of the 25mm galvanised steel pipe, 25mm away from the sealant
	023	On the top of the sealant cone, 25mm away from the pipe.
	024	On the side of the sealant cone, 25mm away from the pipe.
	025	On the extra protection plasterboard, 25mm away from the sealant
	026	On the extra protection plasterboard, 25mm away from the sealant
	027	On the sealant in the extra protection plasterboard channel, 25mm away from the sealant fillet cone
	028	On the extra protection plasterboard, 25mm away from the wall system below the extra protection plasterboard channel.
	029	On the wall system, 25mm away from the extra protection plasterboard
	030	On the wall system, 25mm away from the extra protection plasterboard
C	031	On the top of 32mm galvanised steel pipe, 25mm away from the sealant
	032	On the side of 32mm galvanised steel pipe, 25mm away from the sealant
	033	On the top of the sealant cone, 25mm away from the galvanised steel pipe
	034	On the side of the sealant cone, 25mm away from the galvanised steel pipe
	035	On the wall system, 25mm away from the top of the sealant cone
	036	On the wall system, 25mm away from the side of the sealant cone
D (west)	041	On the top of the bundle of TPS cables, 25mm away from the sealant
	042	On the side of the bundle of TPS cables, 25mm away from the sealant
	043	On the top of the sealant cone, 25mm away from the bundle of TPS cable
	044	On the side of the sealant cone, 25mm away from the bundle of TPS cable
	045	On the wall system, 25mm away from the top of the sealant cone
	046	On the wall system, 25mm away from the side of the sealant cone
D (East)	051	On the top of the bundle of TPS cables, 25mm away from the sealant
	052	On the side of the bundle of TPS cables, 25mm away from the sealant
	053	On the top of the sealant cone, 25mm away from the bundle of TPS cable
	054	On the side of the sealant cone, 25mm away from the bundle of TPS cable
	055	On the wall system, 25mm away from the top of the sealant cone
	056	On the wall system, 25mm away from the side of the sealant cone

Penetration system	T/C #	Description
E	101	On the 16mm2 cables, 25mm away from the sealant cone
	102	On the 6mm2 cable, 25mm away from the sealant cone
	103	On the 185mm2 cable, 25mm away from the sealant cone
	104	On the 630mm2 cable, 25mm away from the sealant cone
	105	On the sealant cone, 25mm away from the 16mm2 cables
	106	On the sealant cone, 25mm away from the 630mm2 cable
	107	On the wall system, 25mm away from the top of sealant cone.
	108	On the wall system, 25mm away from the top of sealant cone.
	109	On the 16mm2 cable, 400mm away from the wall system
	110	On the 6mm2 cable, 400mm away from the sealant cone
	111	On the 185mm2 cable, 400mm away from the sealant cone
	112	On the 630mm2 cable, 400mm away from the sealant cone
	113	On the wall system, 25mm away from the bottom of sealant cone.
	114	On the sealant cone, 25mm away from the bottom of cable tray
	115	On the bottom of cable tray, 25mm away from the sealant
	116	On the bottom of cable tray, 400mm away from the wall system
F	121	On the communication cables, 25mm away from the sealant cone
	122	On the sealant cone, 25mm away from the communication cables
	123	On the wall system, 25mm away from the top of sealant cone
	124	On the communication cables, 400mm away from the wall
	125	On the wall system, 25mm away from the bottom of sealant cone
	126	On the sealant cone, 25mm away from the bottom of communication cables.
	127	On the bottom of cable tray, 25mm away from the bottom of sealant cone
	128	On the bottom of cable tray, 400mm away from the wall system

Appendix E Test data

E.1 Furnace temperature and severity

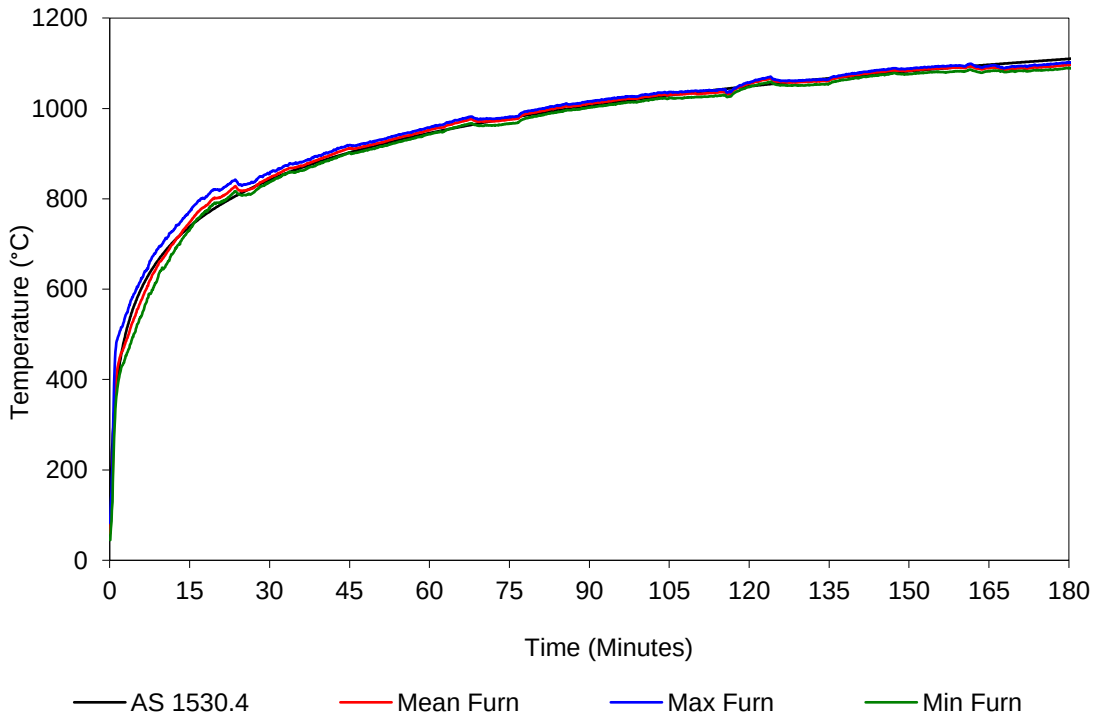


Figure 7: Furnace thermocouple temperature vs time

E.2 Furnace pressure

The furnace pressure was set to 15Pa at the centre of the lowest penetration.

Table 11 Furnace pressure

Time (minutes)	Average pressure (Pa)	Time (minutes)	Average pressure (Pa)	Time (minutes)	Average pressure (Pa)
5-10	54	65-70	17	125-130	15
10-15	23	70-75	15	130-135	16
15-20	16	75-80	16	135-140	16
20-25	16	80-85	17	140-145	17
25-30	16	85-90	17	145-150	15
30-35	18	90-95	17	150-155	18
35-40	17	95-100	16	155-160	15
40-45	16	100-105	16	160-165	18
45-50	17	105-110	15	165-170	16
50-55	17	110-115	15	170-175	15
55-60	18	115-120	17	175-180	16
60-65	19	120-125	17		

E.3 Specimen Temperatures

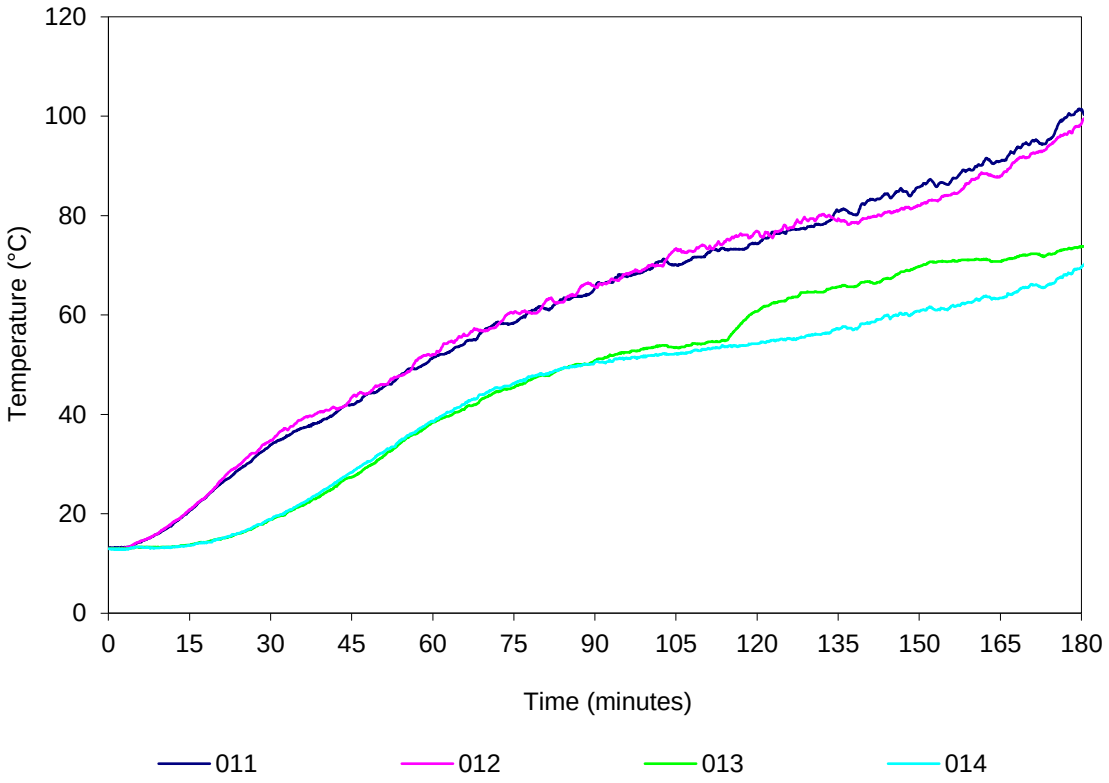


Figure 15 Penetration system A (around the bundle of cable) – temperature vs time

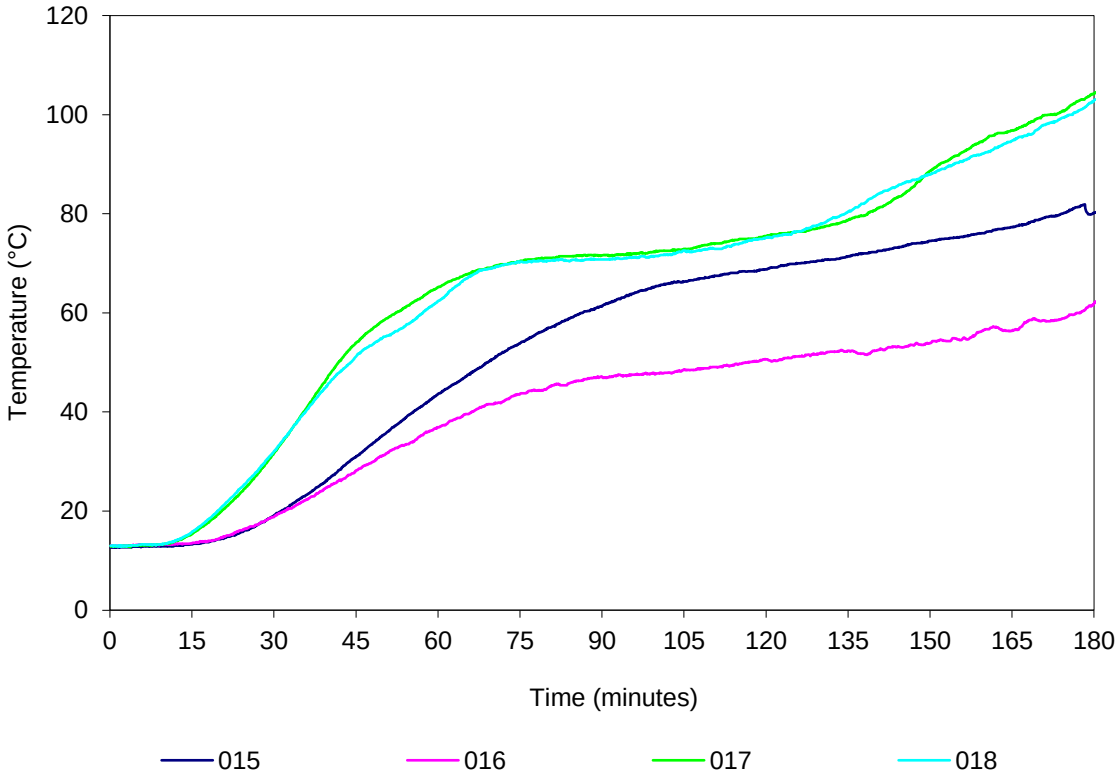


Figure 16 Penetration system A (on the extra protection board and wall system) – temperature vs time

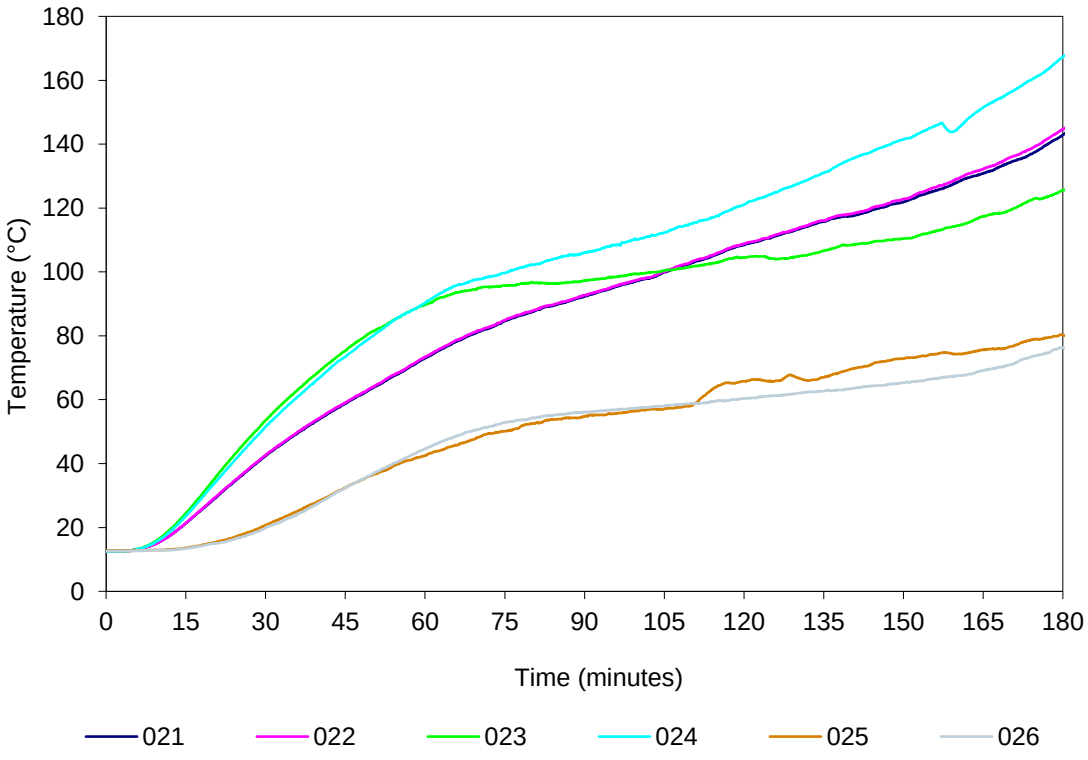


Figure 17 Penetration system B (near the galvanised steel pipe) – temperature vs time

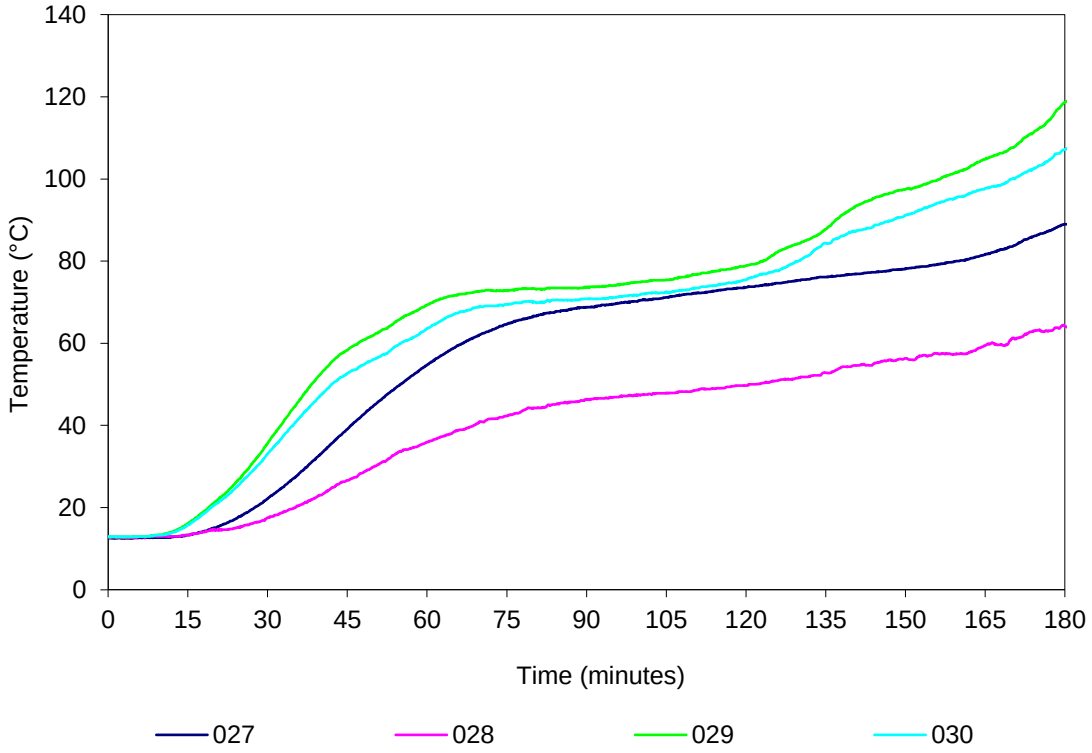


Figure 18 Penetration system B (on the extra protection board and wall system) – temperature vs time

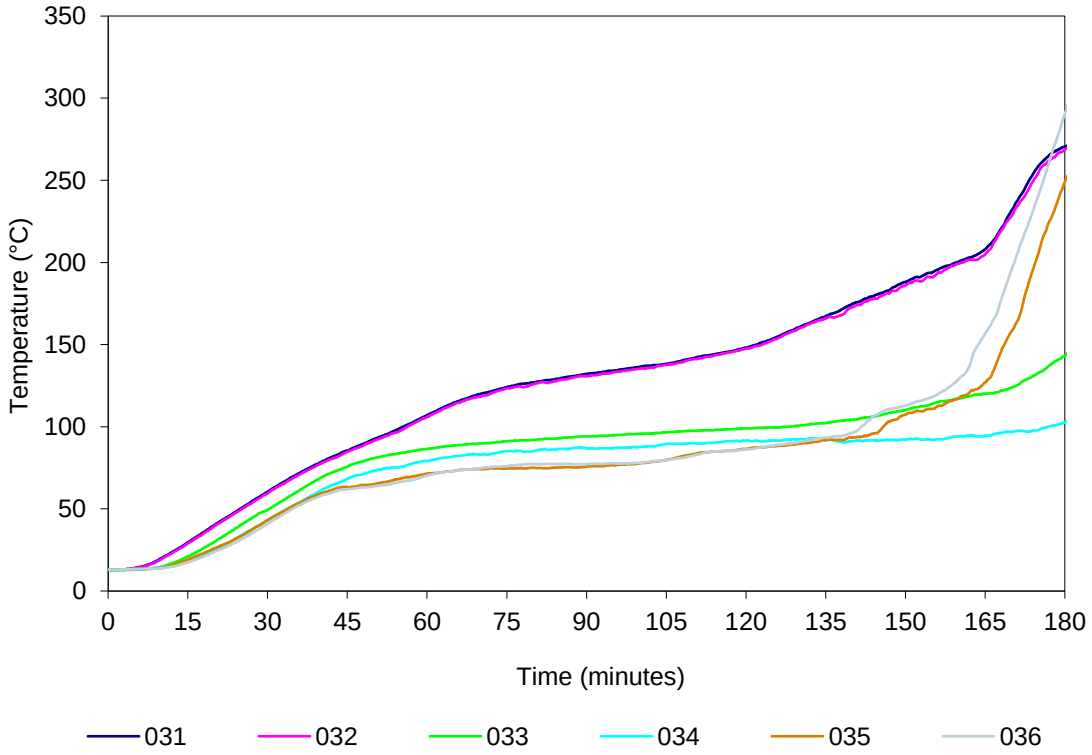


Figure 19 Penetration system C – temperature vs time

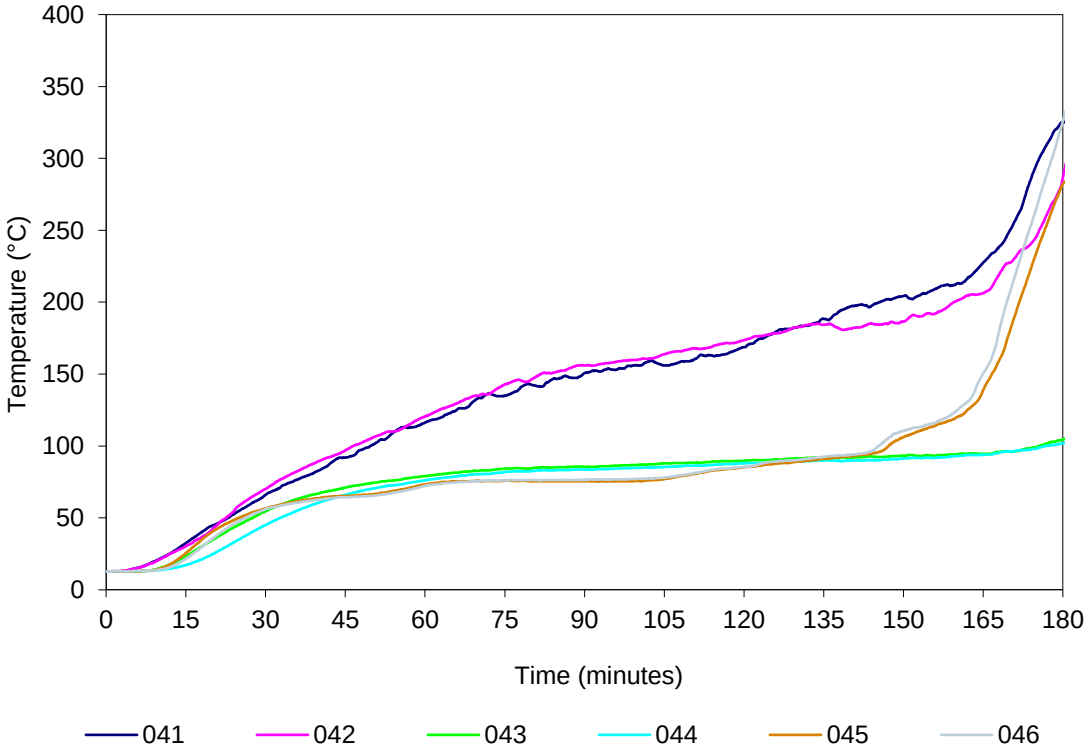


Figure 20 Penetration system D (on the west penetration) – temperature vs time

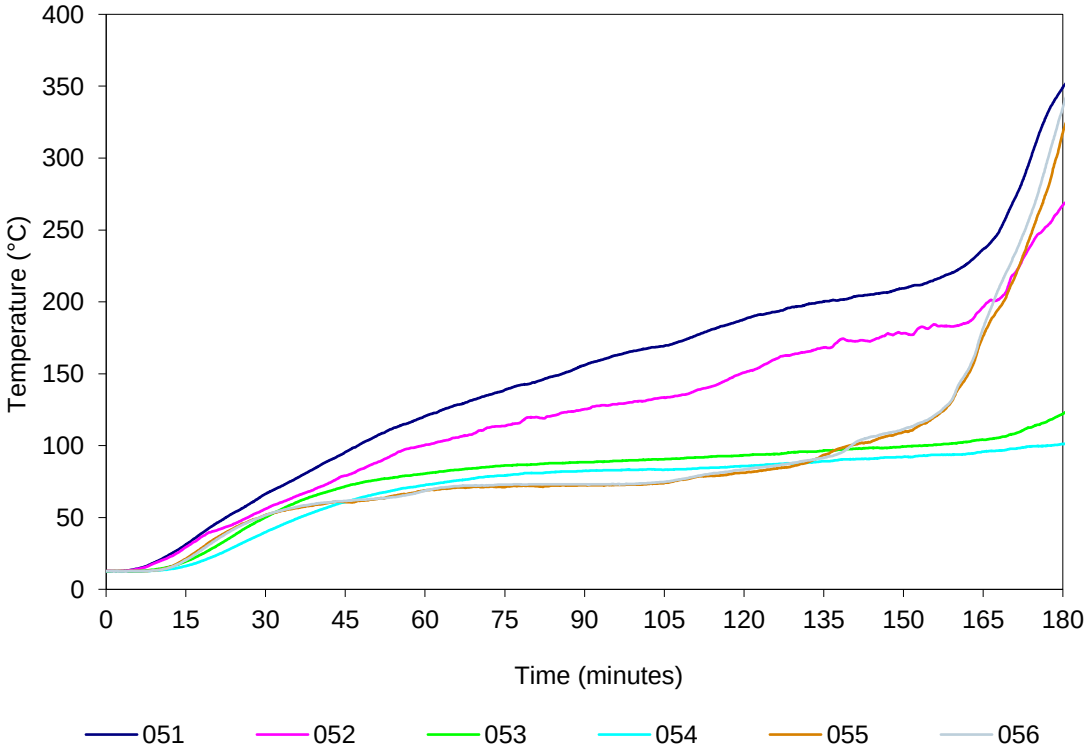


Figure 21 Penetration system D (on the east penetration) – temperature vs time

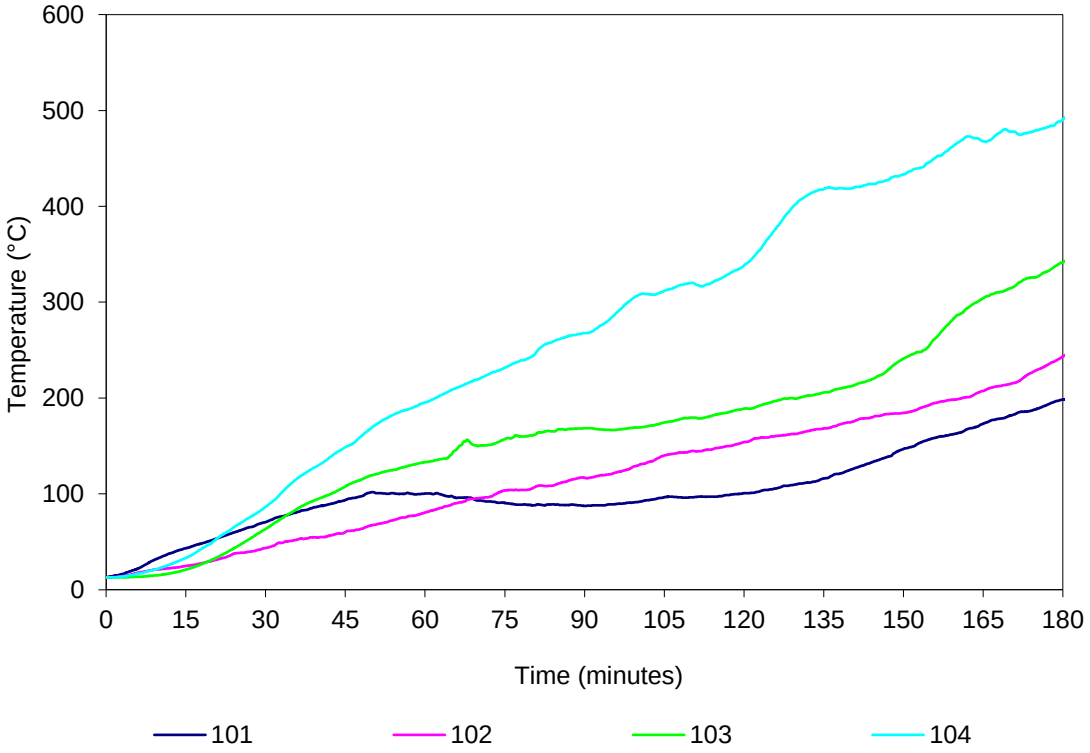


Figure 22 **Penetration system E (on the cables, 25 mm away from sealant) – temperature vs time**

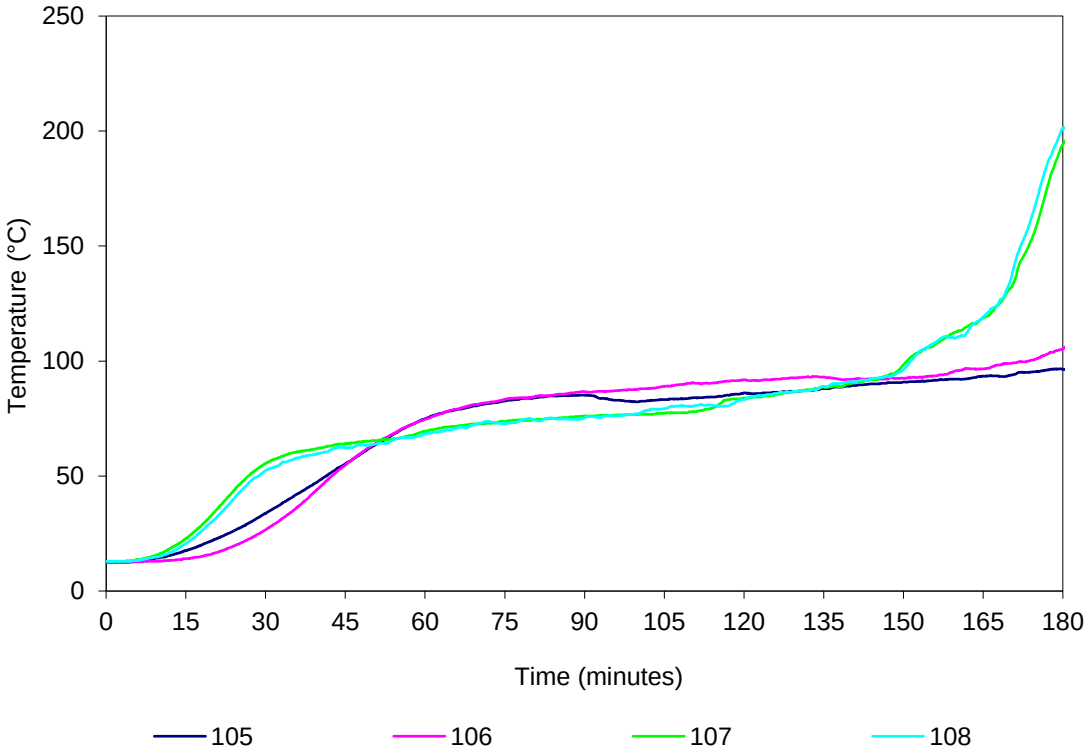


Figure 23 **Penetration system E (on the sealant and 25 mm away from sealant) – temperature vs time**

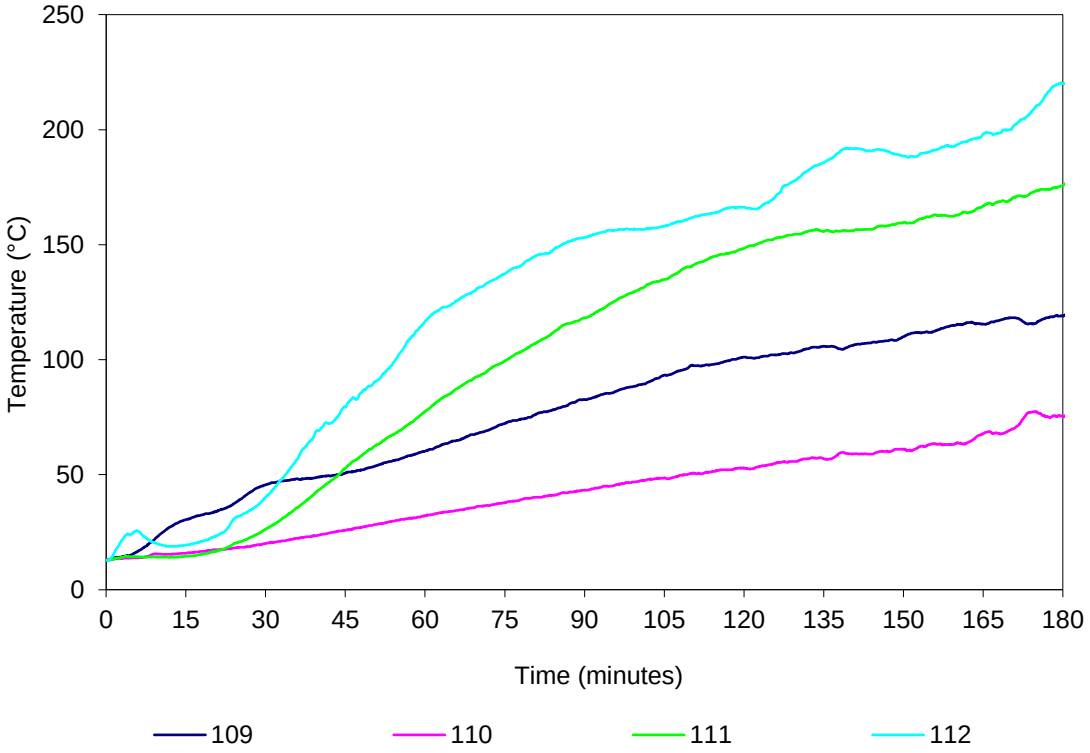


Figure 24 Penetration system E (on the cables, 400 mm away from wall system)– temperature vs time

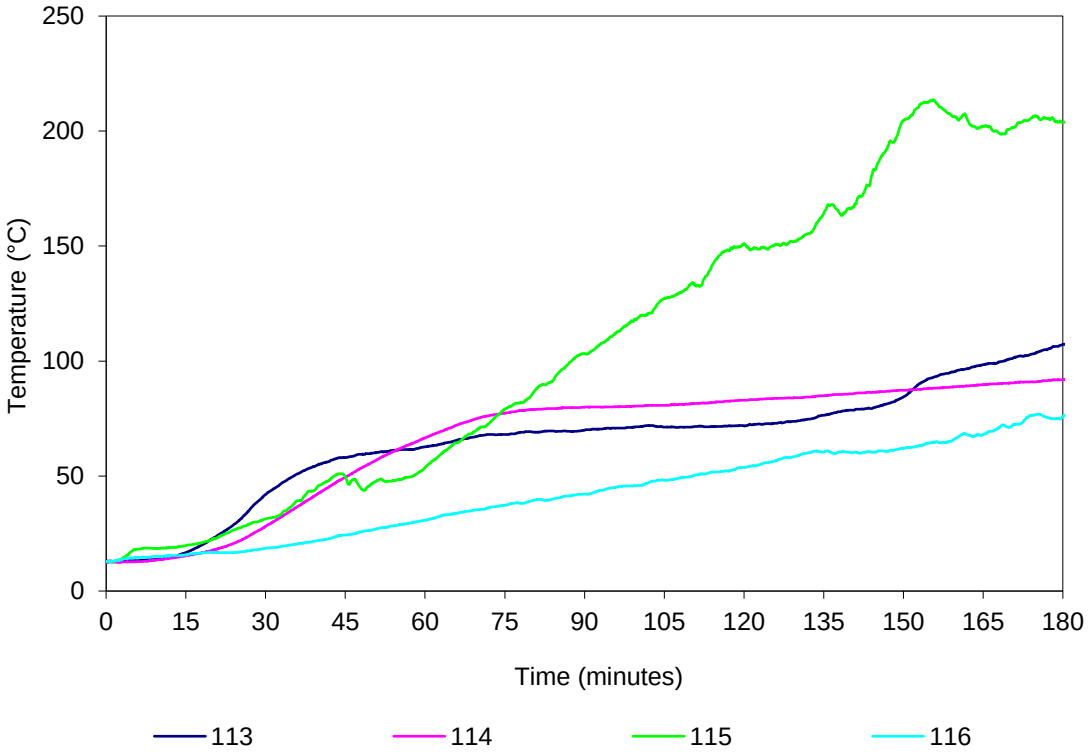


Figure 25 Penetration system E (TC on the bottom side of the specimen) – temperature vs time

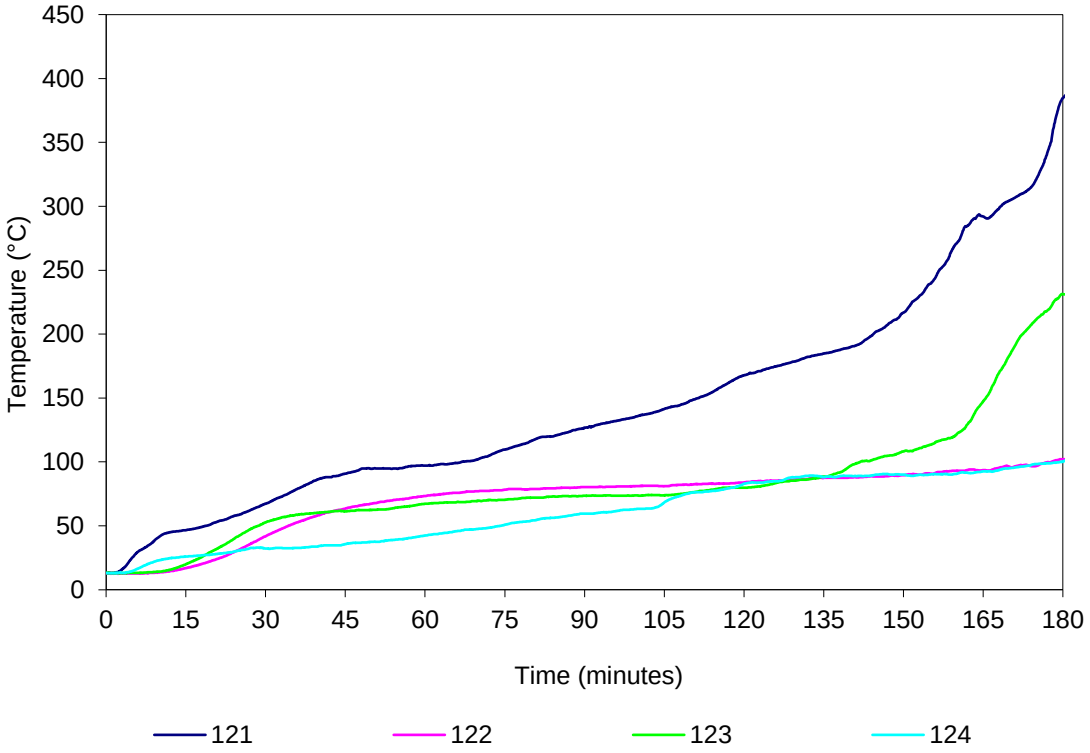


Figure 26 Penetration system F (on the top side) – temperature vs time

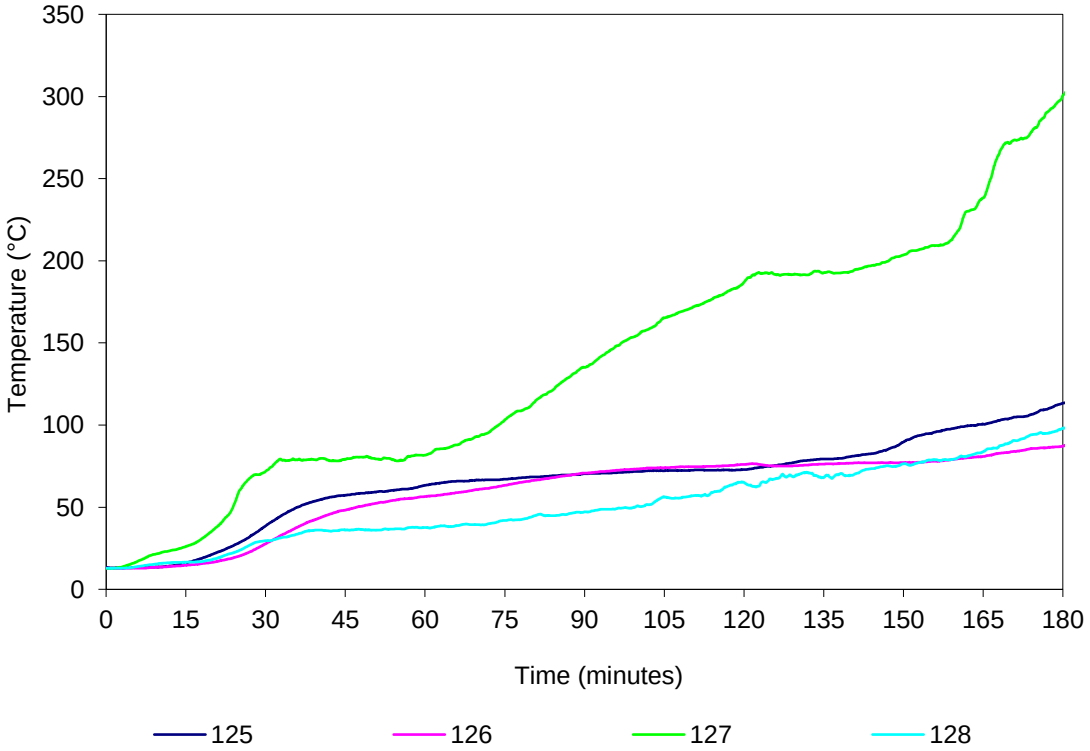


Figure 27 Penetration system F (on the bottom side) – temperature vs time

Table 12 Test specimen temperatures

Penetration system	T/C #	Description[1]	Temp (°C) at t (minutes)					Limit[2] (minutes)
			t=0	t=60	t=90	t=120	t=180	
A	011	On the service	13	52	65	75	101	-
	012	On the service	13	52	66	76	98	-
	013	On the extra protection plasterboard	13	39	51	61	74	-
	014	On the extra protection plasterboard	13	39	50	54	69	-
	015	On the sealant	13	44	61	69	80	-
	016	On the extra protection plasterboard	13	37	47	50	62	-
	017	On the separating element	13	65	72	76	104	-
	018	On the separating element	13	63	71	75	103	-
B	021	On the service	13	74	92	109	143	-
	022	On the service	13	74	93	109	144	--
	023	On the sealant cone	13	90	97	105	125	-
	024	On the sealant cone	13	91	106	122	167	-
	025	On the extra protection plasterboard	13	43	55	66	80	-
	026	On the extra protection plasterboard	13	45	56	60	76	-
	027	On the sealant	13	55	69	74	89	-
	028	On the extra protection plasterboard	13	36	46	50	64	-
	029	On the separating element	13	70	74	79	119	-
	030	On the separating element	13	64	71	76	107	-
C	031	On the service	13	108	132	148	270	153
	032	On the service	13	107	131	148	268	155
	033	On the sealant cone	13	87	94	99	143	-
	034	On the sealant cone	13	79	87	92	102	-
	035	On the separating element	13	72	76	87	247	173
	036	On the separating element	13	71	77	86	288	169
D (west)	041	On the service	13	117	150	169	325	137
	042	On the service	13	121	156	174	282	156
	043	On the sealant cone	13	79	85	90	104	-
	044	On the sealant cone	13	76	84	88	102	-
	045	On the separating element	13	74	75	85	280	171
	046	On the separating element	13	73	76	85	323	168
D (east)	051	On the service	13	121	156	188	348	125
	052	On the service	13	101	125	151	266	164
	053	On the sealant cone	13	81	88	93	122	-
	054	On the sealant cone	12	73	83	86	101	-

Penetration system	T/C #	Description[1]	Temp (°C) at t (minutes)					Limit[2] (minutes)
			t=0	t=60	t=90	t=120	t=180	
	055	On the separating element	13	69	73	81	314	167
	056	On the separating element	13	69	73	84	332	166
E	101	On the 16 mm² cable	13	100	88	101	198	177
	102	On the 6 mm² cable	13	81	117	154	242	155
	103	On the 185 mm² cable	13	133	168	189	341	123
	104	On the 630 mm² cable	13	196	268	340	489	58
	105	On the sealant cone	13	75	85	86	97	-
	106	On the sealant cone	13	75	87	92	105	-
	107	On the separating element	13	70	76	84	193	179
	108	On the separating element	13	69	75	84	200	178
	109	On the 16 mm² cable	13	60	83	101	119	-
	110	On the 6 mm² cable	13	32	43	53	76	-
	111	On the 185 mm² cable	13	78	118	149	176	-
	112	On the 630 mm² cable	13	118	153	166	220	157
	113	On the separating element	13	63	70	72	107	-
	114	On the sealant cone	13	67	80	83	92	-
	115	On the bottom of cable tray	13	55	103	150	204	146
	116	On the bottom of cable tray	13	31	42	54	75	-
F	121	On the communication cable	13	97	127	168	383	142
	122	On the sealant cone	13	74	80	84	102	-
	123	On the separating element	13	67	74	80	231	171
	124	On the communication cable	13	43	60	83	100	-
	125	On the separating element	13	64	70	73	113	-
	126	On the sealant cone	13	57	71	76	87	-
	127	On the bottom of cable tray	13	82	135	189	299	122
	128	On the bottom of cable tray	13	38	47	64	98	-

Note:

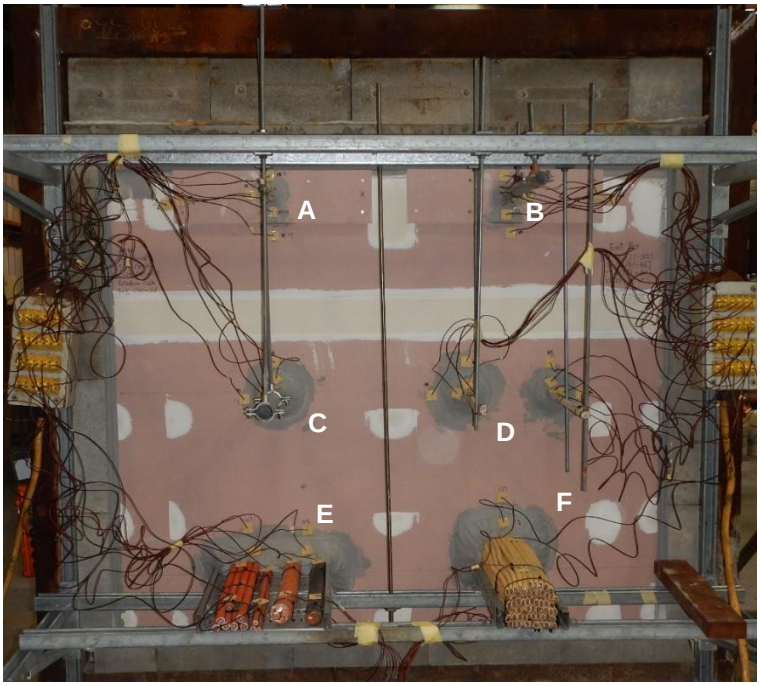
1 Refer to Table 10 for the locations of thermocouples as only a generic description is included in the table.

2 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.

'-' 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.

Appendix F Photographs

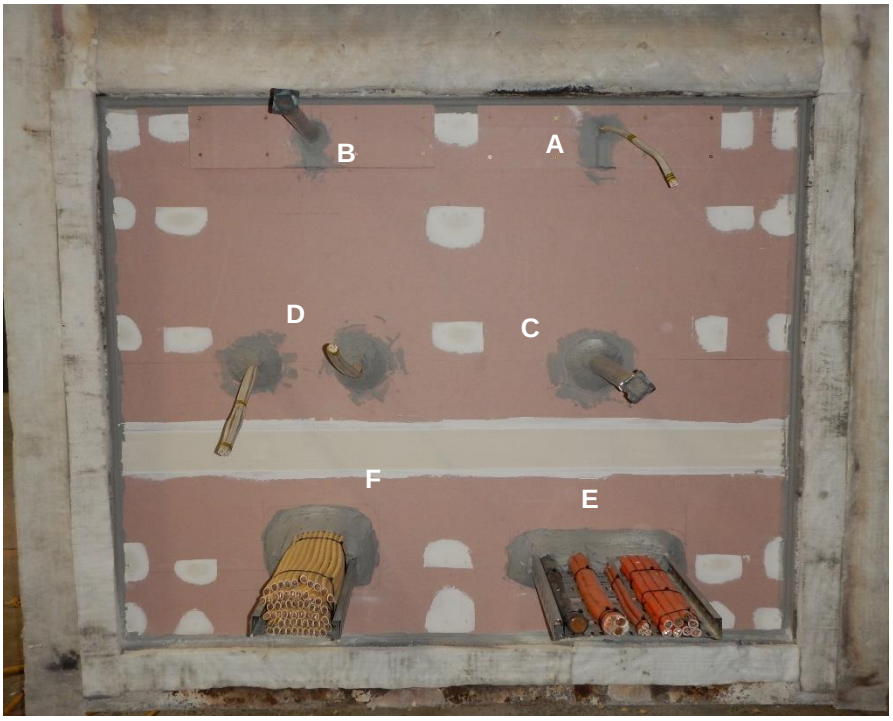
West



East

Figure 28 Unexposed face of the specimen before the start of the test

East



West

Figure 29 Exposed face of the specimen before the start of the test

West

East

Figure 30 Unexposed face of the specimen at the end of the test

East

West

Figure 31 Exposed face of the specimen at the end of the test

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