warringtonfire
Proud to be part of element

Fire resistance test report

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

Test sponsor: Trafalgar Group

Job number: FRT200257

Test date: 2 October 2020 Revision: R1.0

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	20 October 2020	Description	Initial issue		
			Prepared by	Reviewed by	Authorised by
		Name	Kai Loh	Mandeep Kamal	Mandeep Kamal
		Signature			

Executive summary

This report documents the findings of the fire resistance test of penetration systems undertaken on 2 October 2020 in accordance with sections 2 and 10 of AS 1530.4:2014.

Warringtonfire did the test at the request of the Trafalgar Group.

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	120 mm concrete floor slab	
Nominal separating element size	Width	1760 mm
	Length	1200 mm
	Thickness	120 mm
Number of penetration systems	Three	
Restraint conditions	Not restrained at all	

Table 2 Test specimen

Penetration system		Service	Local fire-stopping protection	Main fire-stopping protection	Local aperture size (mm)	Main aperture size (mm)
A	1	1 × Ø25 mm PE-Xa/Al/PE	-	• Trafalgar FyreSet™ FR mortar • Trafalgar FyreBOX™ cast-in 350 × 125 • Trafalgar TWrap • Trafalgar FyreFlex™ sealant	-	600 × 300
	2	1 × Ø25 mm PE-Xa				
	3	8 × 16 mm² 3C+E power cables				
	4	• 1 × 3/8 + 3/4 FR pair coil w/ 13 mm insulation • 1 × 1/4 + 3/8 FR pair coil w/ 13 mm insulation				
B	1	1 × DN 50 type B copper pipe	• Trafalgar TWrap • Trafalgar FyreFlex™ sealant	• Trafalgar FyrePlug™ pillows • Trafalgar FyreFlex sealant	-	300 × 300
	2	1 × DN 100 type B copper pipe	• Trafalgar TWrap • Trafalgar FyreFlex™ sealant			
C		1 × DN 150 type B copper pipe	• Trafalgar Insulguard • Trafalgar FyreFlex™ sealant	-	Ø170	-

Table 3 Test results

Penetration system		Criteria	Results	Fire resistance level (FRL)
A		Structural adequacy	Not applicable	**-/120/120**
		Integrity	Failure at 137 minutes	
		Insulation	Failure at 137 minutes	
B	Main fire-stopping protection	Structural adequacy	Not applicable	**-/180/120**
		Integrity	No failure at 181 minutes	
		Insulation	Failure at 162 minutes	
	1	Structural adequacy	Not applicable	
		Integrity	No failure at 181 minutes	
		Insulation	Failure at 152 minutes	
	2	Structural adequacy	Not applicable	
		Integrity	No failure at 181 minutes	
		Insulation	Failure at 156 minutes	
C		Structural adequacy	Not applicable	**-/180/120**
		Integrity	No failure at 181 minutes	
		Insulation	Failure at 126 minutes	

Note: The FRLs for the specimens are only applicable to the tested orientation. As the FRL was only determined for one direction, an FRL cannot be assigned for the other direction.

Contents

1. Introduction

This report documents the findings of the fire resistance test of penetration systems undertaken on 2 October 2020 in accordance with sections 2 and 10 of AS 1530.4:2014.

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

Table 4 Test sponsor details

Test sponsor	Address
Trafalgar Group	26a Ferndell Street South Granville NSW 2142 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	Concrete floor slab	
	Product description	120 mm thick concrete slab	
	Material	40 MPa, 14 mm aggregate concrete	
SE	Size	1760 mm wide × 1200 mm long × 120 mm thick	
	Restraint conditions	Not restrained at all	
	Installation	The concrete floor slab was pre-cast off site and stored at Warringtonfire's Dandenong facility. An aperture of 600 mm wide × 300 mm long, an aperture of 300 mm wide × 300 mm long, and an aperture of Ø170 mm was cut to allow for three penetration systems.	
Fire-stopping protections			
Sealant			
2.	Item name	Sealant	
	Product name	Trafalgar FyreFlex™ sealant	
	Density	1600 kg/m^3 (provided by test sponsor)	
Fire box			
3.	Item name	Fire box	
	Product name	Trafalgar FyreBOX™ cast-in 350 × 125	
	Fire box details	Internal box width	350 mm
		Internal box length	125 mm
		External box width	368 mm
		External box length	144 mm

Item	Description		
		Overall box width (including flange)	450 mm
		Overall box length (including flange)	225 mm
		Overall box height	380 mm
		Outer shell thickness	1.1 mm thick mild steel
	Intumescent details	Number of layers	One layer made from four nominal 1.8 mm thick layers on all four internal sides
		Width	340 mm
		Height	100 mm
		Overall thickness	7.3 mm
		Density	1201 kg/m^3
	Intumescent foam details	Number of layers	1
		Overall width	355 mm
		Overall height	130 mm
		Thickness	43 mm
		Density	69 kg/m^3
	Product name	External casing key flange	
	Flange profile	20 mm × 30 mm × 10 mm ‘z’ profile	
	Overall size	Overall width	320 mm
		Overall height	30 mm
		Length	33 mm
		Outer shell thickness	1 mm thick galvanised mild steel
	Description	The fire box was constructed from four nominal 1.1 mm thick mild steel plates, folded at the bottom and extending a nominal 50 mm outwards to form the flanges. The nominal 20 mm ends of the steel plates were folded to a 45° angle and were riveted to each other with 4 mm mild steel rivets at nominal 50 mm centres along the full height of the fire box. This formed an internal box size of 350 mm wide × 125 mm long and an external box size of 368 mm wide × 144 mm long. The overall box size – including the folded flanges at the bottom – was 450 mm wide × 225 mm long × 380 mm high. Four layers of 1.8 mm thick intumescent strips, forming an overall thickness of 7.3 mm, were placed into the internal aperture of the fire box along the bottom edge. The intumescent strips were held in place by ‘z’ profile galvanised mild steel sections on each side of the fire box – along the top and bottom of the intumescent strips. The ‘z’ profile was 10 mm × 15 mm × 10 mm and fixed in place with 4 mm steel rivets to the fire box 10 mm from each end of the ‘z’ profile. Additional fixing was used in the centre of each of the longer ‘z’ profiles. Nominal 43 mm thick impregnated intumescent foam was fitted at the top end of the fire box and cut to size around the services. The external casing key flange was installed on the northern and southern side of the fire box at a nominal 100 mm from the bottom of the fire box, with 4 mm steel rivets 10 mm from each end of the external casing key flange and the centre.	

Item	Description	
Wrap		
4.	Item name	T wrap
	Product name	Trafalgar TWrap
	Ceramic mineral fibre wool density	132 kg/m^3
	Description	25 mm thick ceramic mineral fibre blanket faced with aluminium foil, supplied in a 300 mm wide roll.
Cage		
5.	Item name	Insulguard
	Product name	Trafalgar Insulguard
	Size	690 mm wide × 600 mm high × 0.6 mm thick
	Description	The insulguard is a sheet metal guard that wraps around the service that forms an air gap around. The insulguard is made from 0.5 mm steel and had slots and tabs punched to allow it to be hand rolled into a cylinder with the tabs folding into slots to allow it to remain in shape. Metal tabs were also included at the base in three locations with an Ø8 mm hole for fixing into the substrate. At the top end, thin metal strips were installed at 55 mm spacings and once installed around the pipe, are folded in and down to centre the insulguard around the pipe. The insulguard was punched with holes throughout in in a grid at 55 mm width centres, and 100 mm vertical centres.
Mortar		
6.	Item name	Mortar
	Product name	Trafalgar FyreSet™ FR mortar
	Material	Lightweight cement mortar
	Density	850 kg/m^3
Fire pillow		
7.	Item name	Fire pillow
	Product name	Trafalgar FyrePlug™ pillows
	Description	Fire retardant fabric stitched into a bag, filled with granulated mineral fibre.
	Size	100 mm × 250 mm × 30 mm
	Mass	0.15 kg
	Packing density	600 pillows per square metre
Backing rod		
8.	Item name	Backing rod
	Size	Ø10 mm × 100 m (cut to size)
	Description	Closed cell backing rod
Services		
9.	Item name	Ø25 mm PE-Xa
	Manufacturer	Rehau
	Product name	REHAU RAUTITAN platinum 25x3.5 1132320DN/OD 25 PN 20 SDR 7.4 PE-Xa 80 for Potable Water Supply AS/NZS 2492 LN 1413 Z05b0420160714
	Material	PE-Xa

Item	Description		
	Size	Outer diameter	25 mm
		Wall thickness	4 mm
10.	Item name	Ø25 mm PE-Xa/Al/PE	
	Manufacturer	Rehau	
	Product name	REHAU RAUTITAN gas stabil PE-Xa/Al/PE 25x3.7 T3031920180529 for NG and LPG MOP 70kPa AS4176.8 Class 500 PE-Al-PEX	
	Material	PE-Xa/Al/PE	
	Size	Outer diameter	25 mm
		Wall thickness	4 mm
11.	Item name	16 mm^2 3C+E power cable	
	Manufacturer	WW cables	
	Product name	WW VIPERCON Electric cable 3C + E 16 XLPE / PVC 5V90 AS/NZS 5000.1 0.6/1kV 2019 1016 UA	
	Size	Outer diameter	18 mm
12.	Item name	3/8 + 3/4 FR pair coil with 13 mm insulation	
	Manufacturer	Ardent	
	Product name	Ardent Superpair FR 13 mm 9.52 × 0.81 + 19.05 × 1.14	
	Overall size	Copper pipe outer diameter	9.49 mm + 19.21 mm
		Copper pipe wall thickness	0.8 mm + 1.14 mm
		Insulation thickness	13 mm
13.	Item name	1/4 + 3/8 FR pair coil with 13 mm insulation	
	Manufacturer	Ardent	
	Product name	Ardent Superpair FR 13 mm 6.35 × 0.81 + 9.52 × 0.81	
	Overall size	Copper pipe outer diameter	6.31 mm + 9.54 mm
		Copper pipe wall thickness	0.81 mm + 0.81 mm
		Insulation thickness	13 mm
14.	Item name	DN 50 type B copper pipe	
	Manufacturer	Kembla	
	Product name	DN 50 type B copper pipe	
	Size	Outer diameter	50.8 mm (as per AS 1432)
		Inner diameter	48.36 mm (as per AS 1432)
		Thickness	1.22 mm (as per AS 1432)
15.	Item name	DN 100 type B copper pipe	
	Manufacturer	Kembla	
	Product name	DN 100 type B copper pipe	
	Size	Outer diameter	101.6 mm (as per AS 1432)
		Inner diameter	98.34 mm (as per AS 1432)
		Thickness	1.63 mm (as per AS 1432)
16.	Item name	DN 150 type B copper pipe	
	Manufacturer	Kembla	
	Product name	DN 150 type B copper pipe	

Item	Description		
	Size	Outer diameter	152.4 mm (as per AS 1432)
		Inner diameter	148.34 mm (as per AS 1432)
		Thickness	2.03 mm (as per AS 1432)
Fixings			
17.	Item name	Masonry anchors	
	Product description	Ø6 mm × 40 mm long masonry anchors	
18.	Item name	Z angles	
	Size	50 × 50 × 90 mm × 1 mm thick	
	Material	Galvanised steel	
19.	Item name	Cable ties	
	Product description	4.6 mm stainless steel cable ties	
20.	Item name	Foil tape	
	Product description	Aluminium reinforced foil tape	
Penetration system A			
A	Service	A1	1 × Ø25 mm PE-Xa/Al/PE (item 10)
		A2	1 × Ø25 mm PE-Xa (item 9)
		A3	8 × 16 mm^2 3C+E power cables (item 11)
		A4	1 × 3/8 + 3/4 FR pair coil w/ 13 mm insulation (item 12) 1 × 1/4 + 3/8 FR pair coil w/ 13 mm insulation (item 13)
	Service details	A1	The service was installed at a nominal 61 mm centre from the western edge of the main fire-stopping protection. The service extended 530 mm from the exposed side and 2000 mm from the unexposed side of the separating element.
		A2	The service was installed at a nominal 35 mm centre from service A1. The service extended 530 mm from the exposed side and 2000 mm from the unexposed side of the separating element.
		A3	The services were bundled together and installed at a nominal 76 mm centre from service A2. The service extended 500 mm from the exposed side and 650 mm from the unexposed side of the separating element.
		A4	The services were bundled together and installed at a nominal 118 mm centre from service A3. The service extended 530 mm from the exposed side and 650 mm from the unexposed side of the separating element.
	Service support	A1, A2	The services were supported at 620 mm and 1500 mm centres from the separating element with pipe clamps onto channels. The services were capped on the exposed side with ceramic mineral wool and sealant.
		A3	The services were supported at 620 mm centres from the separating element with pipe clamps onto channels.

Item	Description		
		A4	The services were supported at 620 mm centres from the separating element with pipe clamps onto channels. The services were capped on the exposed side by crimping the copper pipes.
	Aperture size	600 mm wide × 300 mm long	
	Main fire-stopping protection		
	Protection	Formwork was installed on the exposed side of the separating element and secured to the separating element with masonry anchors (item 17). The fire box (item 3) was then installed in the centre of the aperture, sitting on top of the formwork for the mortar (item 6) and secured with fixings. Four Z angles (item 18) were installed on the perimeter at mid-length and mid-width – one on each edge – and secured to the separating element with masonry anchors. Mortar was then poured on 2 September 2020 to cover the full height of the aperture around the fire box. Once the mortar had cured, the formwork on the exposed side was removed. The services were then installed through the fire box with the intumescent foam installed on the top side (unexposed side) of the fire box. It was cut down the centre line with a profile matching the services cut into the foam. The foam was friction fitted around the services so that no light could be seen between the services and the intumescent foam. Small gaps were plugged with offcuts of the intumescent foam. A 25 mm × 25 mm fillet of sealant (item 2) was applied at the interface between the fire box and the mortar. A single layer of 300 mm T wrap (item 4) and a single layer of 150 mm wide T wrap was wrapped on three sides of the services on the unexposed side, with a total height of 450 mm from the main fire-stopping protection. The aluminium foil along the edges of the wrap was cut open and joined together with foil tape (item 20) to form the 450 mm high wrap. The wrap consisted of a 50 mm vertical overlap. It was secured with cable ties (item 19) in the centre and at a nominal 50 mm from the top and bottom edges. An additional cable tie was used just after the fire box to fit the wrap more tightly around the services.	
Penetration system B			
B	Service	B1	1 × DN 50 type B copper pipe (item 14)
		B2	1 × DN 100 type B copper pipe (item 15)
	Service detail	B1	The service was installed at a 226 mm centre from the western edge of the main aperture and a 230 mm centre from the southern edge of the main aperture. The service extended 500 mm from the exposed side and 690 mm from the unexposed side of the separating element. The service was capped on the exposed side with copper pipe capping.
		B2	The service was installed at a 100 mm centre from the western edge of the main aperture and a 84 mm centre from the southern edge of the main aperture. The service extended 500 mm from the exposed side and 1040 mm from the unexposed side of the separating element. The service was capped on the exposed side with copper pipe capping.
	Service support	B1	The service was supported at 650 mm above the separating element with pipe clamps onto channels.
		B2	The service was supported at 730 mm above the separating element with pipe clamps onto channels.
	Main aperture size	300 mm wide × 300 mm long	
	Main fire-stopping protection		

Item	Description		
	Protection	The services were installed and supported into the aperture. The pillows (item 7) were then friction fitted into the aperture between the separating element and the services. The pillows were tightly packed with no light seen between – as per the manufacturer's instructions. Small beads of sealant (item 2) were applied in the gaps between the pillow and the separating element.	
	Local fire-stopping protection		
	Protection	B1	Sealant (item 2) was applied between the service and the main fire-stopping protection to a nominal depth of 50 mm from the unexposed side. It finished on the unexposed side of the main fire-stopping protection with a 50 mm × 50 mm fillet. A single layer of 300 mm wide T wrap (item 4) and a single layer of 150 mm wide T wrap was wrapped around the services on the unexposed side, with a total height of 450 mm from the main fire-stopping protection. The aluminium foil along the edges of the wrap was cut open and joined together with foil tape (item 20) to form the 450 mm high wrap. The wrap consisted of a 50 mm vertical overlap. It was secured with cable ties (item 19) in the centre and at a nominal 50 mm from the top and bottom edges.
		B2	Sealant was applied between the service and the main fire-stopping protection to a nominal depth of 50 mm from the unexposed side. It finished on the unexposed side of the main fire-stopping protection with a 50 mm × 50 mm fillet. Two single layers of 300 mm wide T wrap and a single layer of 150 mm wide T wrap were wrapped around the services on the unexposed side, with a total height of 600 mm from the main fire-stopping protection. The aluminium foil along the edges of the wrap was cut open and joined together with foil tape to form the 600 mm high wrap. The wrap consisted of a 50 mm vertical overlap. It was secured with cable ties in the centre and at a nominal 50 mm from the top and bottom edges.
Penetration system C			
C	Service	1 × DN 150 type B copper pipe (item 16)	
	Service detail	The service was installed through the aperture, extending 530 mm on the exposed side and 800 mm on the unexposed side of the separating element. The service was capped on the exposed side with PVC capping.	
	Service support	The service was supported at 680 mm from the unexposed side of the separating element with pipe clamps onto channels.	
	Aperture size	Ø170 mm	
	Local fire-stopping protection		
	Protection	Sealant (item 2) was applied into the aperture between the service and the separating element to a nominal depth of 50 mm from the unexposed side. It was applied onto a backing rod (item 8) and finished on the unexposed side of the main fire-stopping protection with a 30 mm × 30 mm fillet. Insulguard (item 5) was then installed around the service up to 600 mm above the separating element and at a nominal 30 mm from the service.	

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	13 August 2020
Start date of installation of fire-stopping protection for the penetration systems	13 August 2020
Completion date for constructing and installing the test specimen	1 October 2020
Separating element constructed by	Representatives of Warringtonfire
Fire-stopping protection for penetration systems installed by	Representatives of Warringtonfire
Symmetry	Asymmetrical – • The wrap, sealant and intumescent foam for the cast-in firebox for penetration system A was installed on the unexposed side only. • The intumescent strips for the cast-in firebox for penetration system A was installed on the exposed side only. • The local fire-stopping protection for penetration system B and C was installed on the unexposed side only. • The pipes were capped on the exposed side only.

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 appropriate for penetration systems, subject to the variations below.	
Variations	The pressure was up to 2 Pa below the limits prescribed in the standard during the 135-140 and 150-155 minute periods. The pressure and temperature were within the limits for the rest of the test. Due to the nature of the specimen and the fact that no significant events occurred during these time periods, this under pressure is unlikely to have invalidated the test result.	
Pre-test conditioning	The construction and installation of the test specimen was completed on 1 October 2020. 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.	
Ambient laboratory temperature	Start of the test Minimum temperature Maximum temperature	23 °C 23 °C 28 °C
Test duration	181 minutes	

Item	Detail
Instrumentation and equipment	The instrumentation was provided in accordance with AS 1530.4:2014 as follows: • The furnace temperature was measured by four mineral insulated metal sheathed (MIMS) Type K thermocouples – with wire diameters not greater than 1 mm, an overall diameter of 3 mm, and 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 soldered to 12 mm diameter × 0.2 mm thick copper discs covered by 30 mm × 30 mm × 2.0 mm thick inorganic insulating pads. • The thermocouple positions are shown in Table 10 and in Figure 8 to Figure 14 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 of the specimen under the criteria of integrity. • The furnace pressure was measured at approximately 100 mm below the underside of the slab.

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		Criteria	Results	Fire resistance level (FRL)
A		Structural adequacy	Not applicable	**-/120/120**
		Integrity	Failure at 137 minutes	
		Insulation	Failure at 137 minutes	
B	Main fire-stopping protection	Structural adequacy	Not applicable	**-/180/120**
		Integrity	No failure at 181 minutes	
		Insulation	Failure at 162 minutes	
	1	Structural adequacy	Not applicable	
		Integrity	No failure at 181 minutes	
		Insulation	Failure at 152 minutes	
	2	Structural adequacy	Not applicable	
		Integrity	No failure at 181 minutes	
		Insulation	Failure at 156 minutes	
C		Structural adequacy	Not applicable	**-/180/120**
		Integrity	No failure at 181 minutes	
		Insulation	Failure at 126 minutes	

Note: The FRLs for the specimens are only applicable to the tested orientation. As the FRL was only determined for one direction, an FRL cannot be assigned for the other direction.

5. Application of test results

5.1 Test limitations

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

These results only relate to the behaviour of the specimen of the element of 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, and they do not 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 here was tested following the procedure outlined in AS 1530.4:2014. Any significant variation with respect to size, construction details, loads, stresses, edge or end conditions, other than that allowed under the field of direct application in the relevant test method, is not covered 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. They should then 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 of the result.

Appendix A Drawings of test assembly

The drawings of the test assembly in Figure 1 to Figure 7 were provided by the test sponsor and marked up by Warringtonfire. These mark ups to the drawings were:

- a minor adjustment to the service positioning
- adjustments to the service lengths.

The leaders in the drawings represent the items listed in section 2.1. All measurements – unless indicated – are in millimetres.

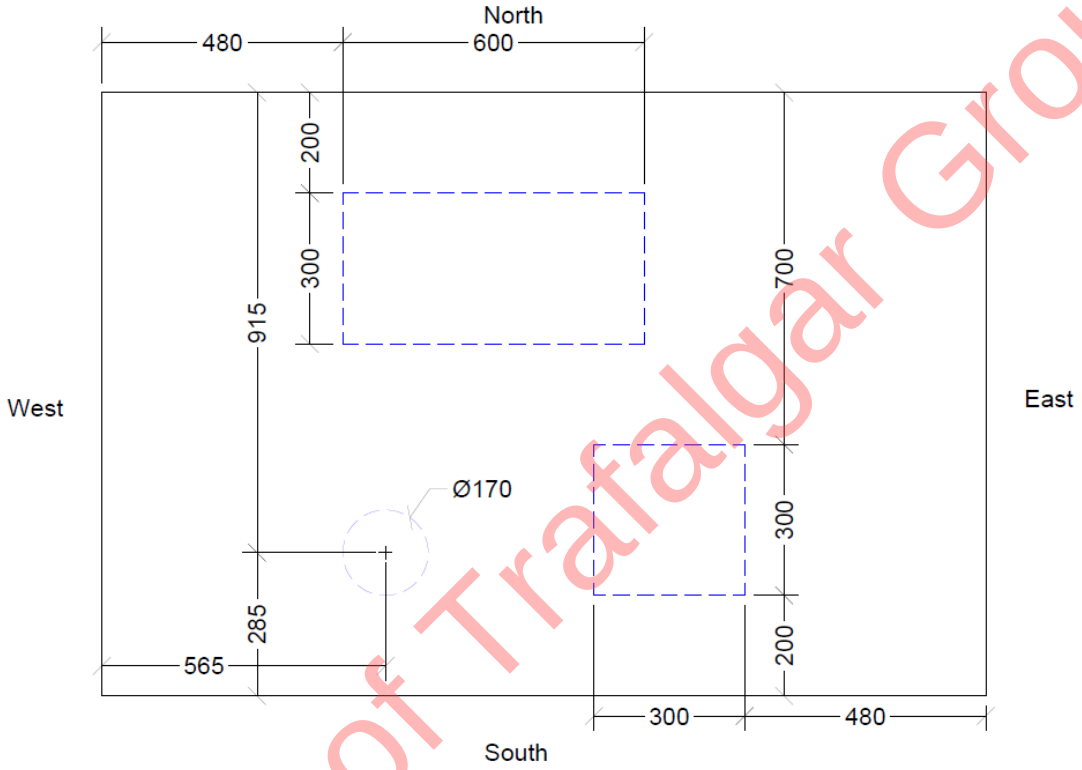

Figure 1 Plan view of aperture location (unexposed side)

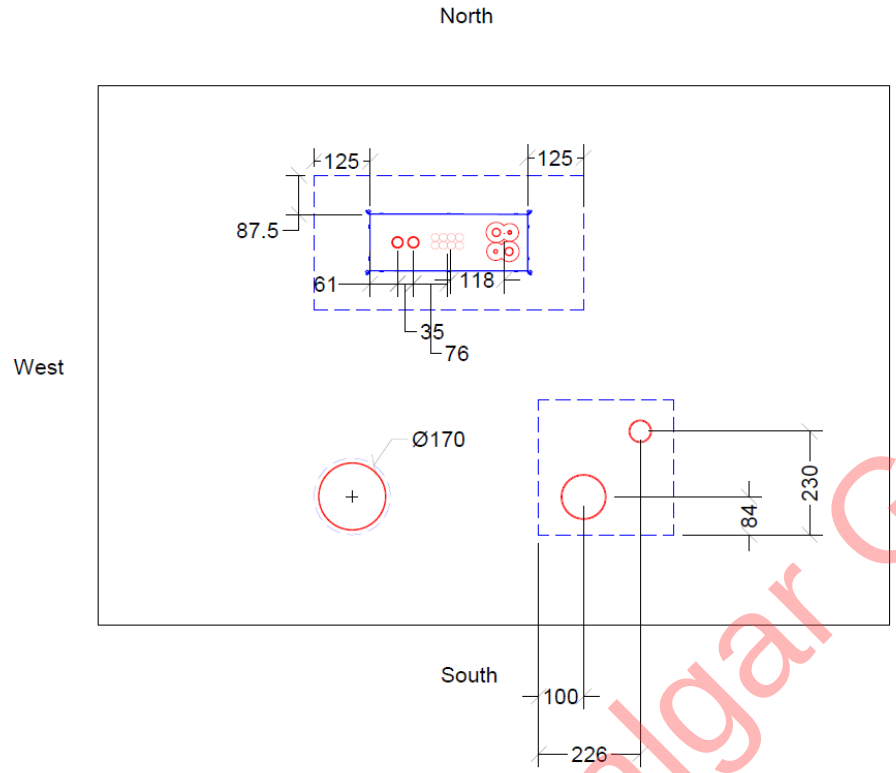

Figure 2 Plan view of service location (unexposed side)

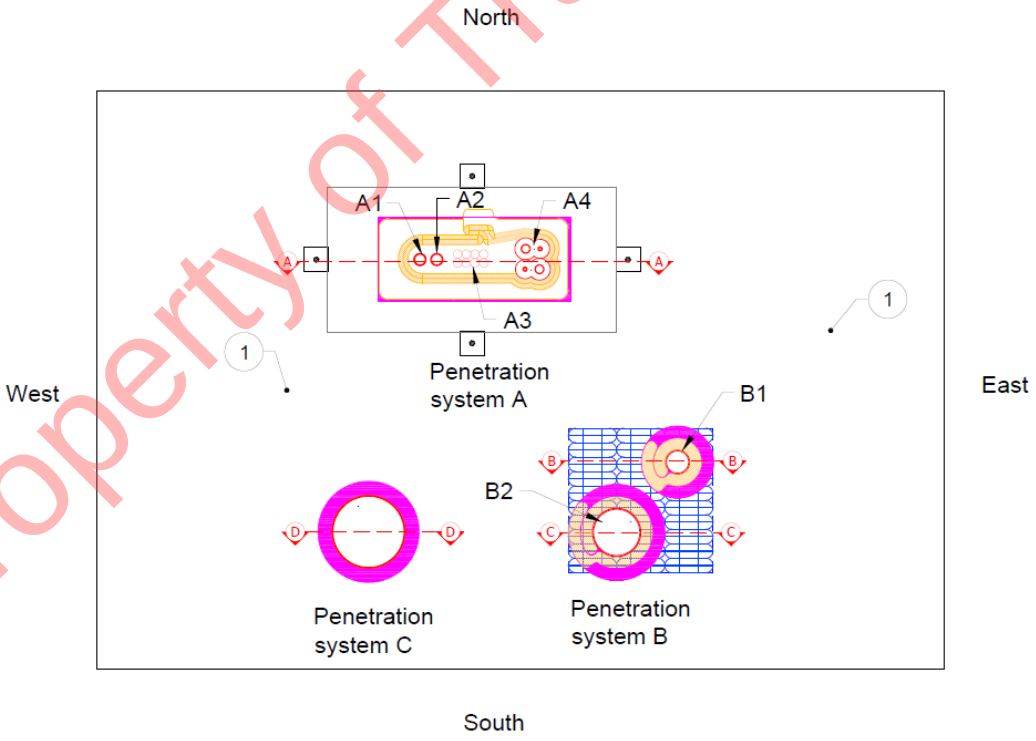

Figure 3 Plan view of test specimen (unexposed side)

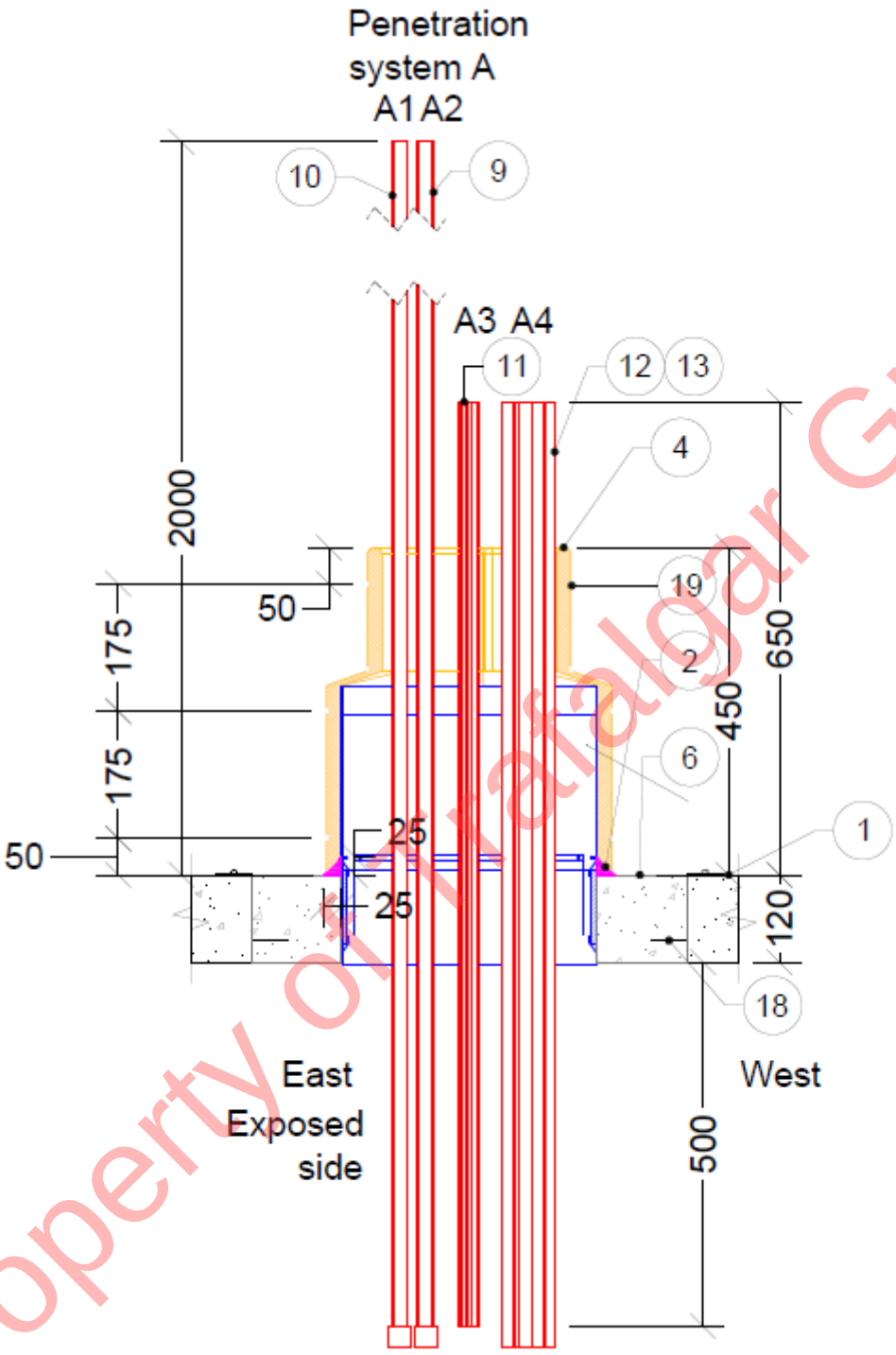

Figure 4 Cross-section A-A

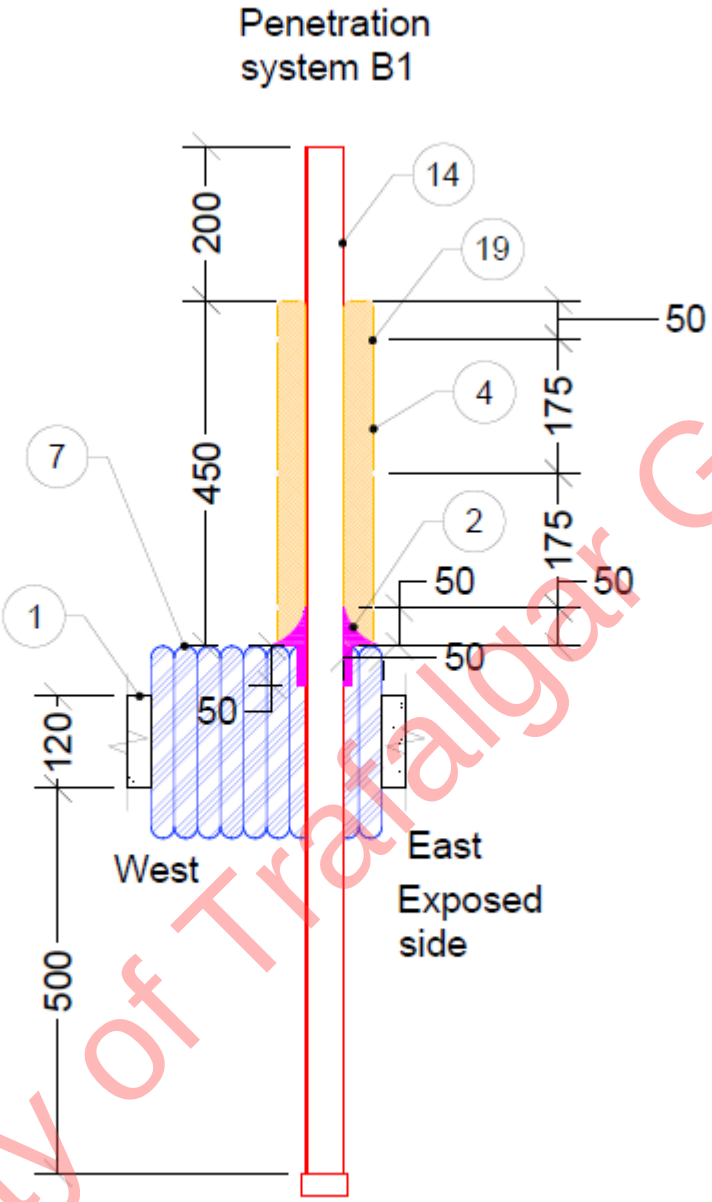

Figure 5 Cross-section B-B

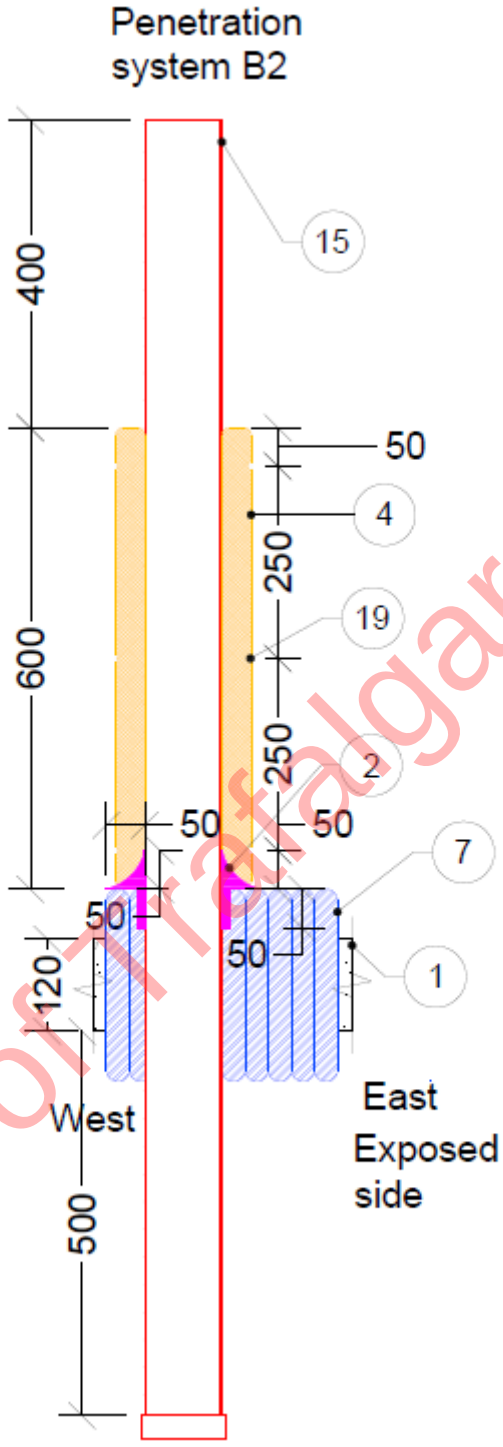

Figure 6 Cross-section C-C

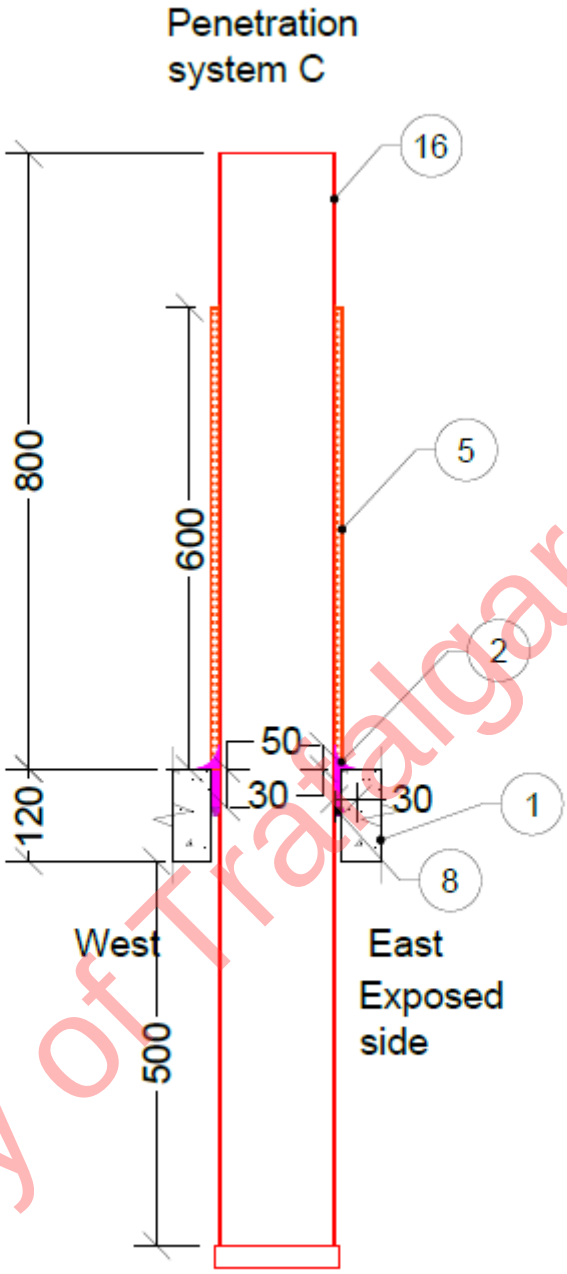

Figure 7 Cross-section D-D

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		
0	00	The fire resistance test started. The initial temperature of the test specimen was approximately 23 °C.
1	17	Smoke emitting from between the services.
4	00	Volume of smoke emitting from between service A3 and A4 had increased.
5	50	Smoke emitting from the end of service A2.
6	11	Volume of smoke emitting from between the services had increased.
6	58	Intumescent had started venting from between the services.
7	22	Smoke emitting from the end of service A1.
8	12	Service A2 had deformed just above the wrap.
9	14	Smoke had started to emit intermittently from the end of service A1.
10	28	Smoke emitting from the end of service A1 had stopped.
11	45	Smoke emitting from the end of service A1 had restarted.
15	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
16	27	Volume of smoke emitting from between the services had decreased.
30	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
30	00	Volume of smoke emitting from the end of service A1 and A2 had decreased.
35	31	Smoke emitting from the end of service A2 had stopped.
45	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
90	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
120	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
137	**39**	**Flaming for longer than 10 seconds just above the wrap in between the services.** **Failure of integrity in accordance with clause 2.13.2.4 of AS 1530.4:2014, where flaming occurred for more than 10 seconds on the unexposed side.**
181	00	Test stopped.
Penetration system B		
0	00	The fire resistance test started. The initial temperature of the test specimen was approximately 23 °C.
15	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
30	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.

Time		Observation
Min	Sec	
42	36	The sealant in service B3 had started to expand.
45	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
90	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
120	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
152	**10**	**TC038, on service B1, 25 mm from the wrap recorded a temperature of 203 °C.** **Failure of insulation in accordance with clause 2.13.3(b) of AS 1530.4:2014, where the maximum temperature of thermocouple TC038 exceeded the initial temperature by more than 180 K.**
156	20	TC044, on service B2, on the wrap, 25 mm from the sealant recorded a temperature of 203 °C. Failure of insulation in accordance with clause 2.13.3(b) of AS 1530.4:2014, where the maximum temperature of thermocouple TC044 exceeded the initial temperature by more than 180 K.
162	20	TC025, on separating element 25 mm from the fire pillow recorded a temperature of 203 °C. Failure of insulation in accordance with clause 2.13.3(b) of AS 1530.4:2014, where the maximum temperature of thermocouple TC025 exceeded the initial temperature by more than 180 K.
168	00	Furnace flames had started venting from service B1.
174	00	Furnace flames had started venting from service B2.
180	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
181	00	Test stopped.
Penetration system C		
0	00	The fire resistance test started. The initial temperature of the test specimen was approximately 23 °C.
15	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
30	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
42	36	Smoke emitting from between the insulguard and the service.
45	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
90	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
116	00	Smoke emitting from the end of the service.
120	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.

Time		Observation
Min	Sec	
126	**00**	**TC051, on separating element 25 mm from the insulguard recorded a temperature of 203 °C.** **Failure of insulation in accordance with clause 2.13.3(b) of AS 1530.4:2014, where the maximum temperature of thermocouple TC051 exceeded the initial temperature by more than 180 K.**
180	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
181	00	Test stopped.

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

- 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.
- Test results obtained in conjunction with hollow concrete blocks may be used in a solid concrete element of the same overall thickness. The reverse does not apply.
- 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 studs.

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.

C.4 Electrical and communication cables

Where standard configurations are used for electrical and communication cables, the results of tests may be applied to all PVC and XLPE insulated and PVC sheathed power and communication cables with copper conductors, provided the results are for the same penetration sealing system in the same separating element and all of the specimens achieved the designated FRL or greater.

Note: For information on recommended standard configurations for electrical and communication cables, see appendix D.

C.5 Plastic pipes

C.5.1 General

In addition to the requirements of clause 10.12.2 of AS 1530.4:2014, test results may be directly applied to masonry and concrete elements thicker than the tested prototype when installed in accordance with figure 10.12.5.1 of AS 1530.4:2014.

Results obtained from a particular test shall not be applied to plastics pipes of different diameters, wall thicknesses or material types.

Results obtained from tests on penetrations through vertical separating elements shall not be used to assess performance in horizontal elements, and vice versa.

As penetration seals for plastic pipes are dependent for activation upon exposure to fire conditions, they shall always be installed with the same orientation and fire exposure as was established in the fire resistance test.

C.5.2 Services not perpendicular to the fire separation

Penetrations not perpendicular to the plane of the element are acceptable, provided the fire-stopping system has similar exposure and dimensions to the tested prototype.

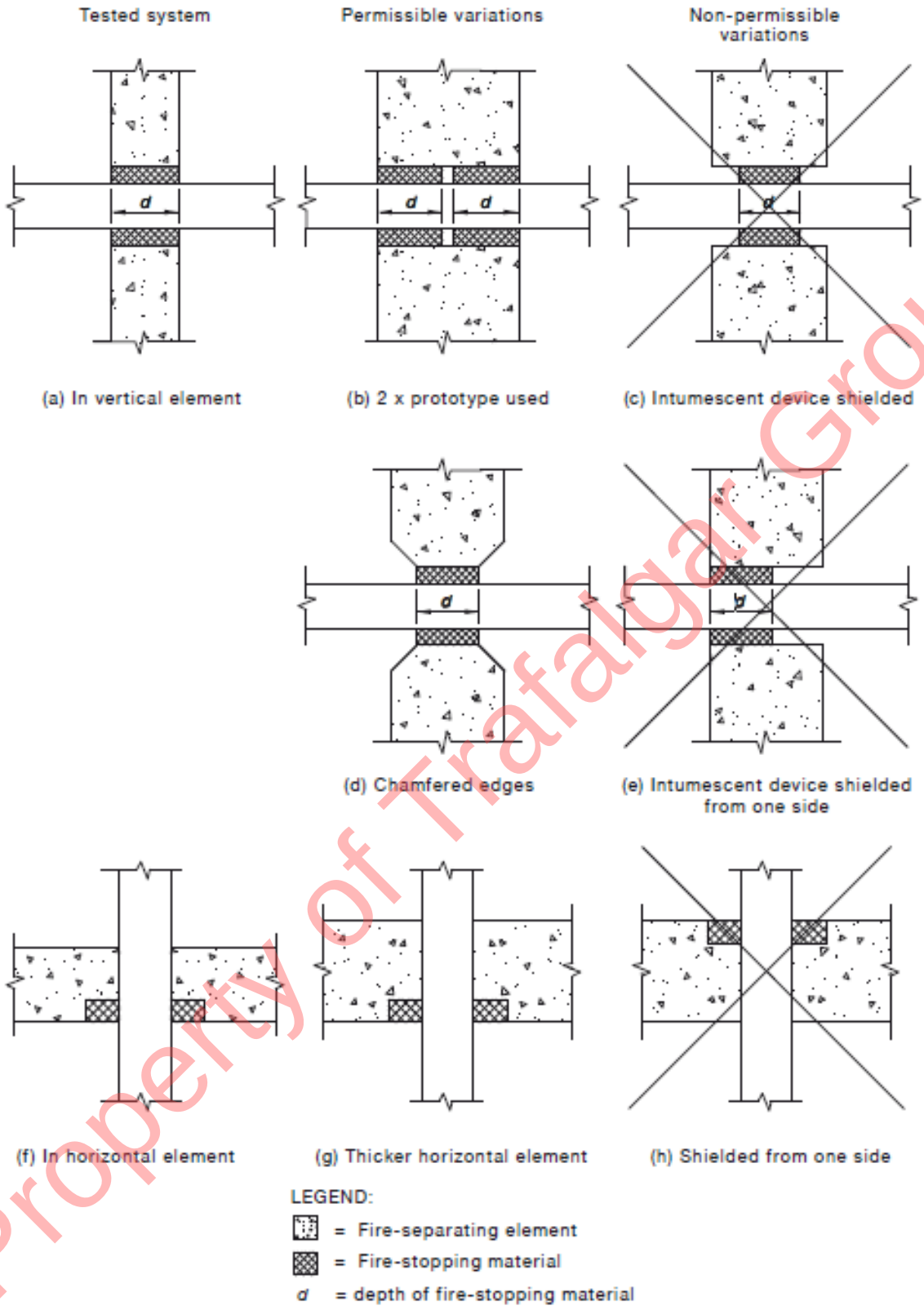

FIGURE 10.12.5.1 EQUIVALENT EXPOSURE OF UPVC PIPE FIRE-STOPPING SYSTEMS

Appendix D Instrumentation locations

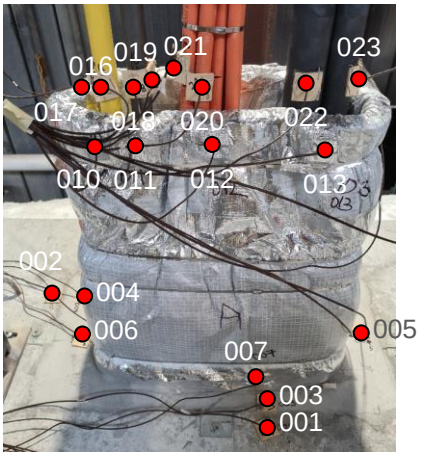

Figure 8 Penetration system A

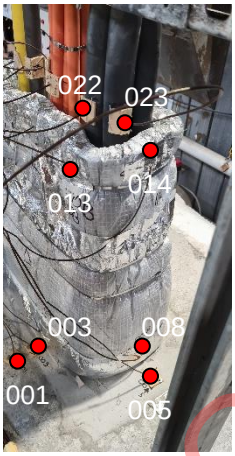

Figure 9 Penetration system A

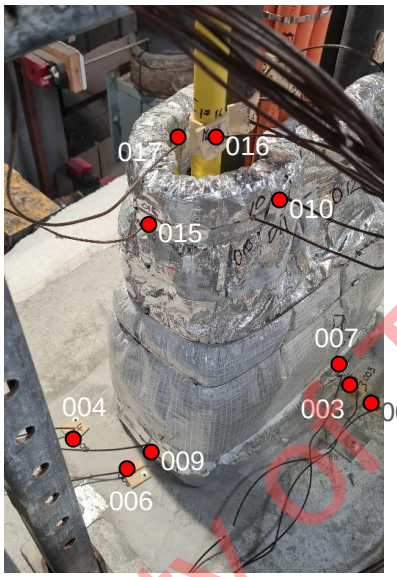

Figure 10 Penetration system A

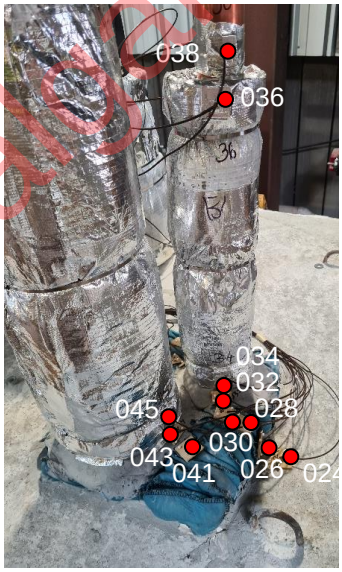

Figure 11 Penetration system B

Note: TC046-049 are not shown in these figures.

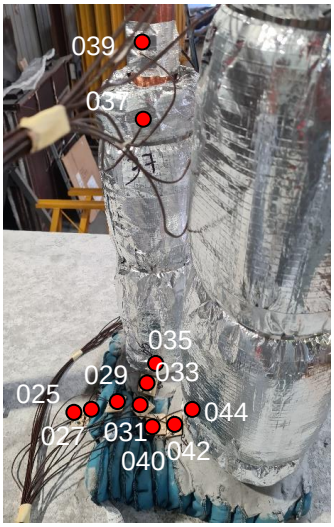

Figure 12 Penetration system B

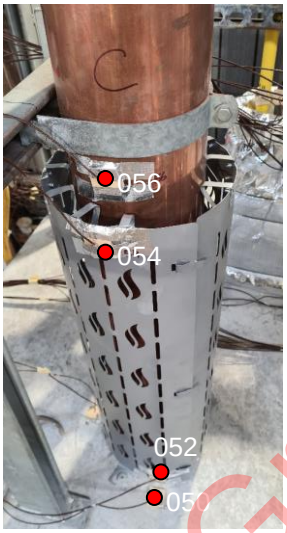

Figure 13 Penetration system C

Note: TC046-049 are not shown in these figures.

Figure 14 Penetration system C

Table 10 Thermocouple locations

Penetration system	T/C #	Description
A	001	On the separating element, 25 mm from the mortar. (south)
	002	On the separating element, 25 mm from the mortar. (west)
	003	On the mortar, 25 mm from the separating element. (south)
	004	On the mortar, 25 mm from the separating element. (west)

Penetration system		T/C #	Description
		005	On the mortar, 25 mm from the wrap. (east)
		006	On the mortar, 25 mm from the wrap. (west)
		007	On the wrap, 25 mm from the mortar. (south)
		008	On the wrap, 25 mm from the mortar. (east)
		009	On the wrap, 25 mm from the mortar. (west)
		010	On the wrap, 25 mm from the PE-Xa/AL/PE pipe. (south)
		011	On the wrap, 25 mm from the PE-Xa pipe. (south)
		012	On the wrap, 25 mm from the 16 mm^2 cable bundle. (south)
		013	On the wrap, 25 mm from the pair coil. (south)
		014	On the wrap, 25 mm from the pair coil. (east)
		015	On the wrap, 25 mm from the PE-Xa/AL/PE pipe. (west)
		016	On the PE-Xa/AL/PE pipe, 25 mm from the wrap. (south)
		017	On the PE-Xa/AL/PE pipe, 25 mm from the wrap. (west)
		018	On the PE-Xa pipe, 25 mm from the wrap. (south)
		019	On the PE-Xa pipe, 25 mm from the wrap. (east)
		020	On the 16 mm^2 cable bundle, 25 mm from the wrap. (south)
		021	On the 16 mm^2 cable bundle, 25 mm from the wrap. (west)
		022	On the larger pair coil, 25 mm from the wrap. (south)
		023	On the smaller pair coil, 25 mm from the wrap. (east)
B	Main fire-stopping protection	024	On the separating element, 25 mm from the fire pillows. (east)
		025	On the separating element, 25 mm from the fire pillows. (north)
		026	On the fire pillows, 25 mm from the separating element. (east)
		027	On the fire pillows, 25 mm from the separating element. (north)
		028	On the fire pillows, 25 mm from the top edge of the fire pillow. (east)
		029	On the fire pillows, 25 mm from the top edge of the fire pillow. (north)
	1	030	On the fire pillows, 25 mm from the sealant. (south)
		031	On the fire pillows, 25 mm from the sealant. (west)
		032	On the sealant, 25 mm from the fire pillows. (south)
		033	On the sealant, 25 mm from the fire pillows. (west)
		034	On the wrap, 25 mm from the sealant. (south)
		035	On the wrap, 25 mm from the sealant. (west)
		036	On the wrap, 25 mm from the service. (south)
		037	On the wrap, 25 mm from the service. (west)
		038	On the service, 25 mm from the wrap. (south)
		039	On the service, 25 mm from the wrap. (west)
	2	040	On the fire pillows, 25 mm from the sealant. (north)
		041	On the fire pillows, 25 mm from the sealant. (east)
		042	On the sealant, 25 mm from the fire pillows. (north)
		043	On the sealant, 25 mm from the fire pillows. (east)

Penetration system		T/C #	Description
		044	On the wrap, 25 mm from the sealant. (north)
		045	On the wrap, 25 mm from the sealant. (east)
		046	On the wrap, 25 mm from the service. (north)
		047	On the wrap, 25 mm from the service. (east)
		048	On the service, 25 mm from the wrap. (north)
		049	On the service, 25 mm from the wrap. (east)
C		050	On the separating element, 25 mm from the insulguard. (south)
		051	On the separating element, 25 mm from the insulguard. (west)
		052	On the insulguard, 25 mm from the separating element. (south)
		053	On the insulguard, 25 mm from the separating element. (west)
		054	On the insulguard, 25 mm from the service. (south)
		055	On the insulguard, 25 mm from the service. (west)
		056	On the service, 25 mm from the insulguard. (south)
		057	On the service, 25 mm from the insulguard. (west)

Appendix E Test data

E.1 Furnace temperature and severity

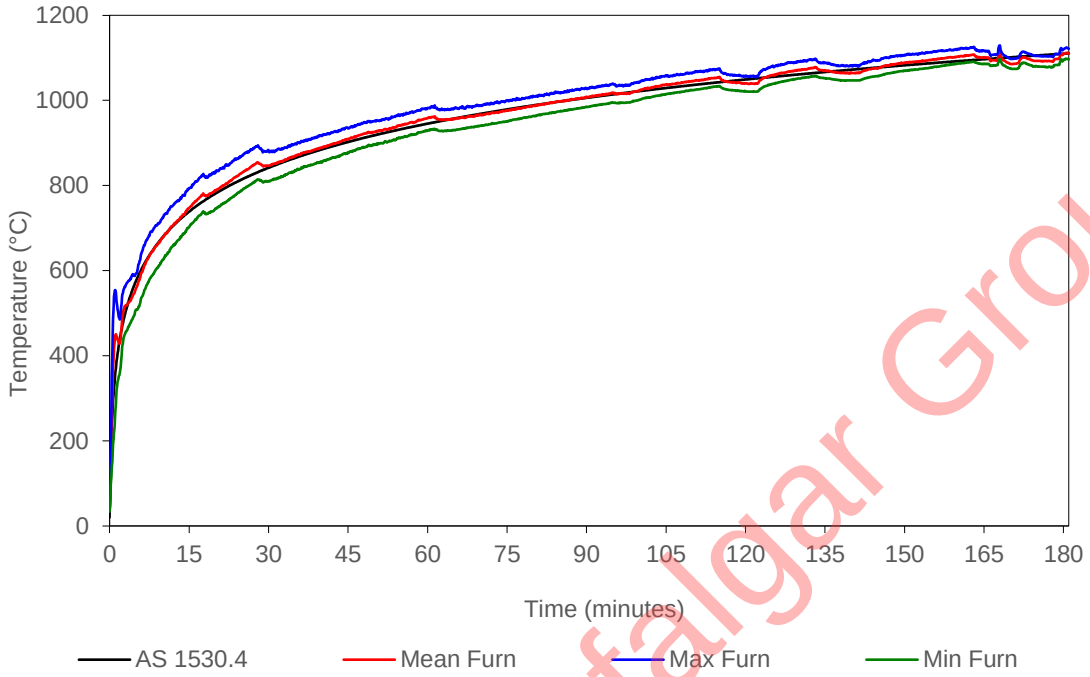

Figure 15 Furnace thermocouple temperature vs time

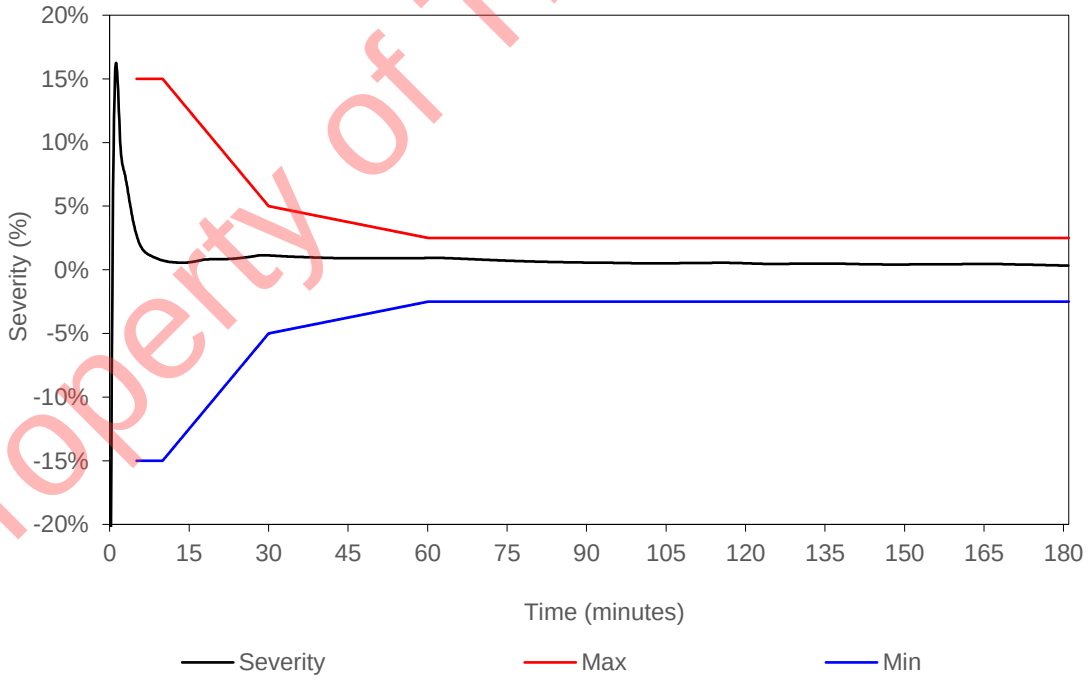

Figure 16 Percentage deviation of exposure severity vs time

E.2 Furnace pressure

The furnace pressure was measured at approximately 100 mm below the underside of the slab.

Table 11 Furnace pressure

Time (minutes)	Average pressure (Pa)	Time (minutes)	Average pressure (Pa)	Time (minutes)	Average pressure (Pa)
5-10	20	65-70	21	125-130	22
10-15	21	70-75	20	130-135	19
15-20	20	75-80	20	135-140	16
20-25	21	80-85	21	140-145	18
25-30	22	85-90	20	145-150	22
30-35	22	90-95	20	150-155	15
35-40	21	95-100	19	155-160	23
40-45	21	100-105	23	160-165	22
45-50	22	105-110	19	165-170	17
50-55	21	110-115	19	170-175	18
55-60	23	115-120	20	175-180	20
60-65	21	120-125	20		

E.3 Specimen temperatures

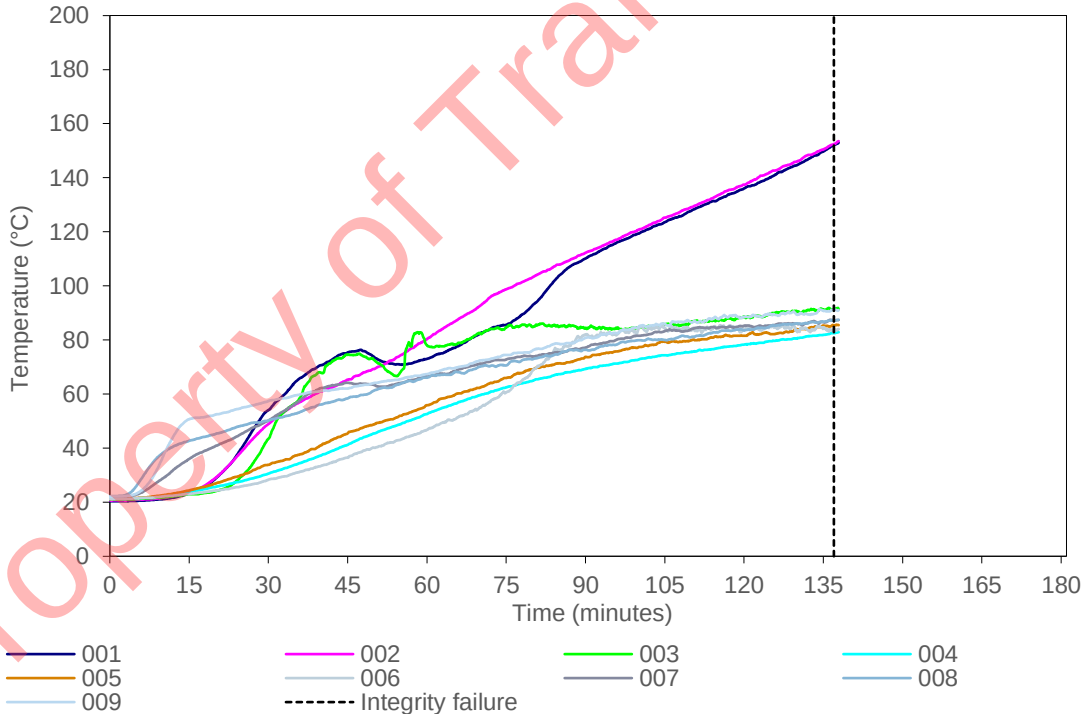

Figure 17 Penetration system A – temperature vs time

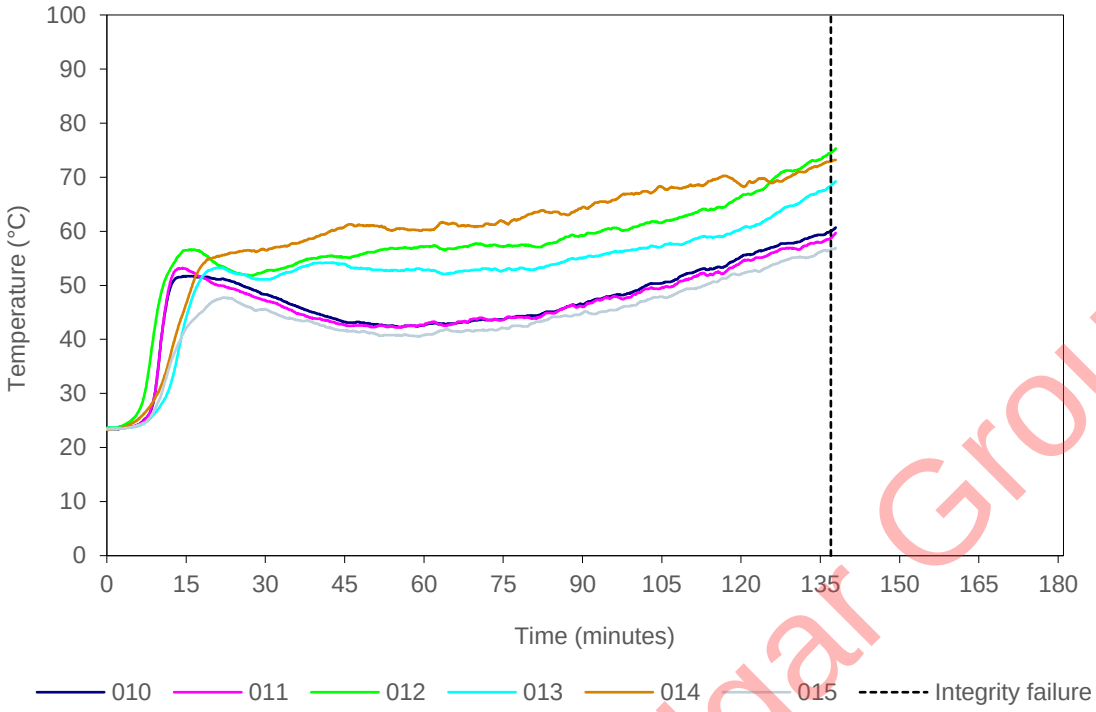

Figure 18 Penetration system A – temperature vs time

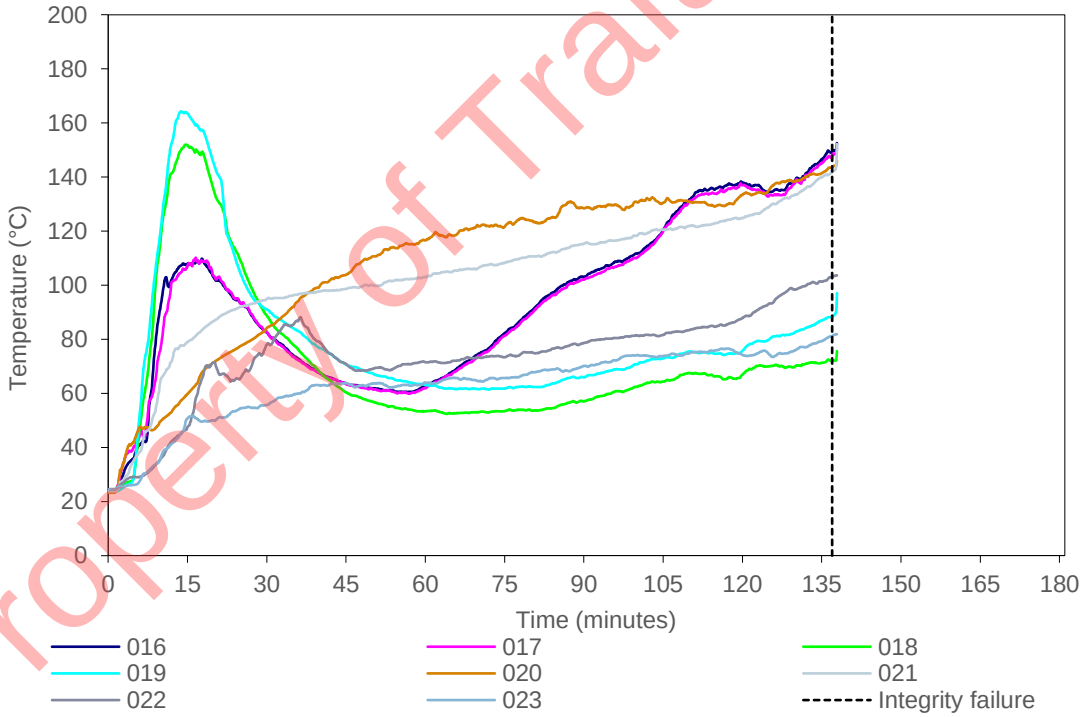

Figure 19 Penetration system A – temperature vs time

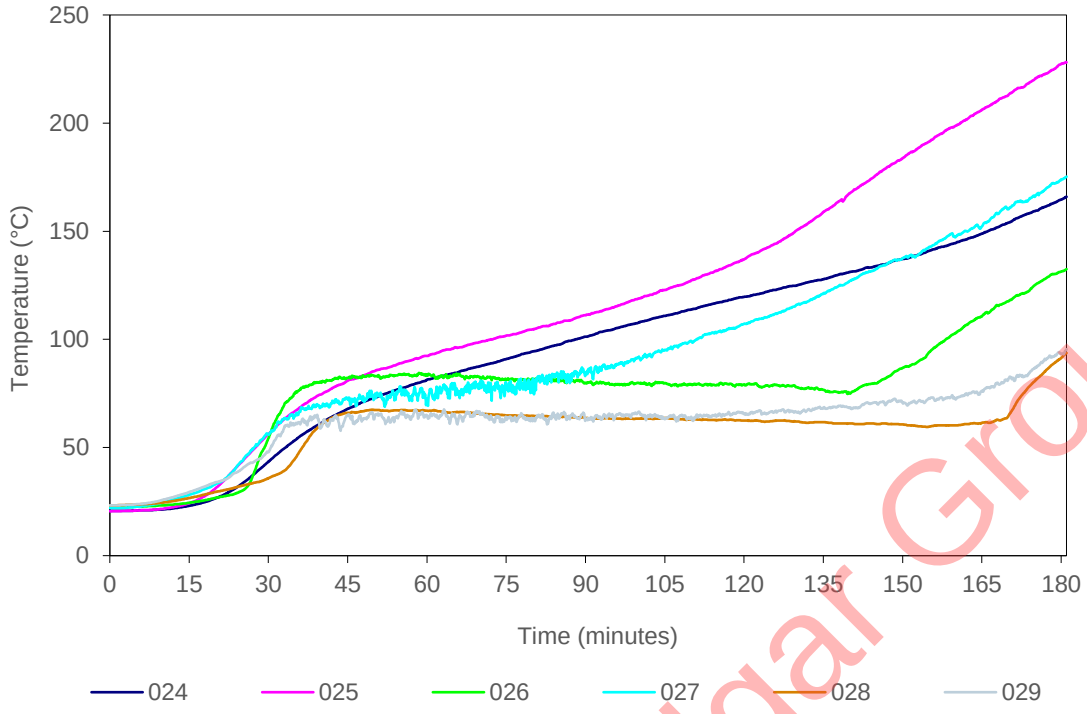

Figure 20 Penetration system B, main fire-stopping protection – temperature vs time

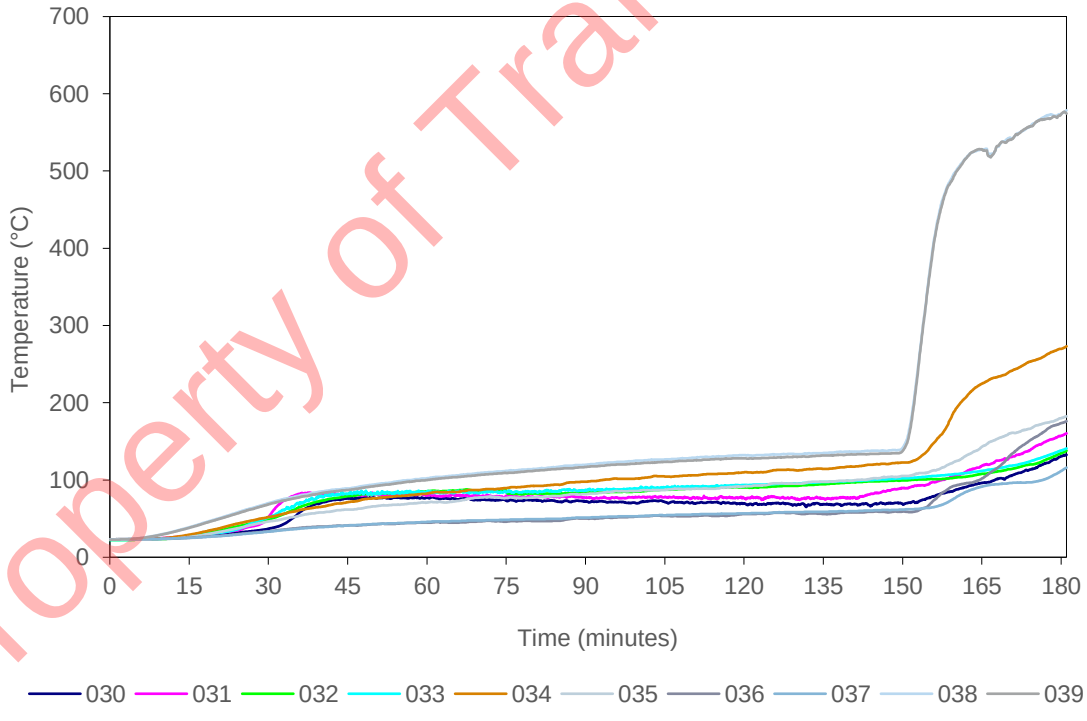

Figure 21 Penetration system B, service B1 – temperature vs time

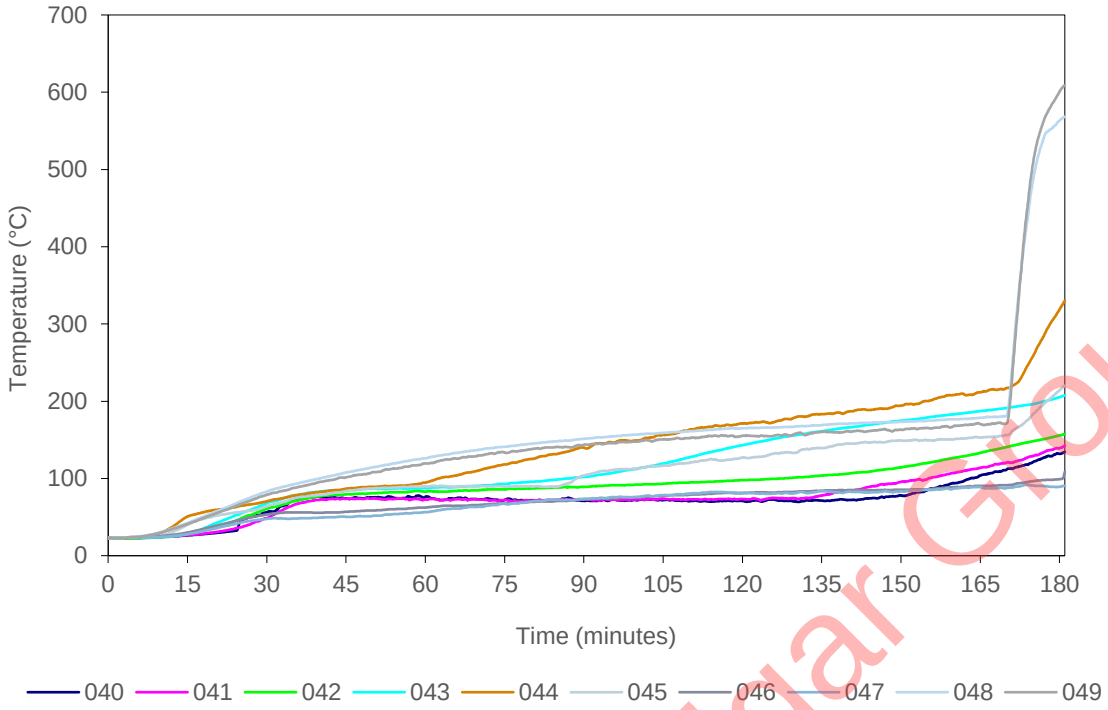

Figure 22 Penetration system B, service B2 – temperature vs time

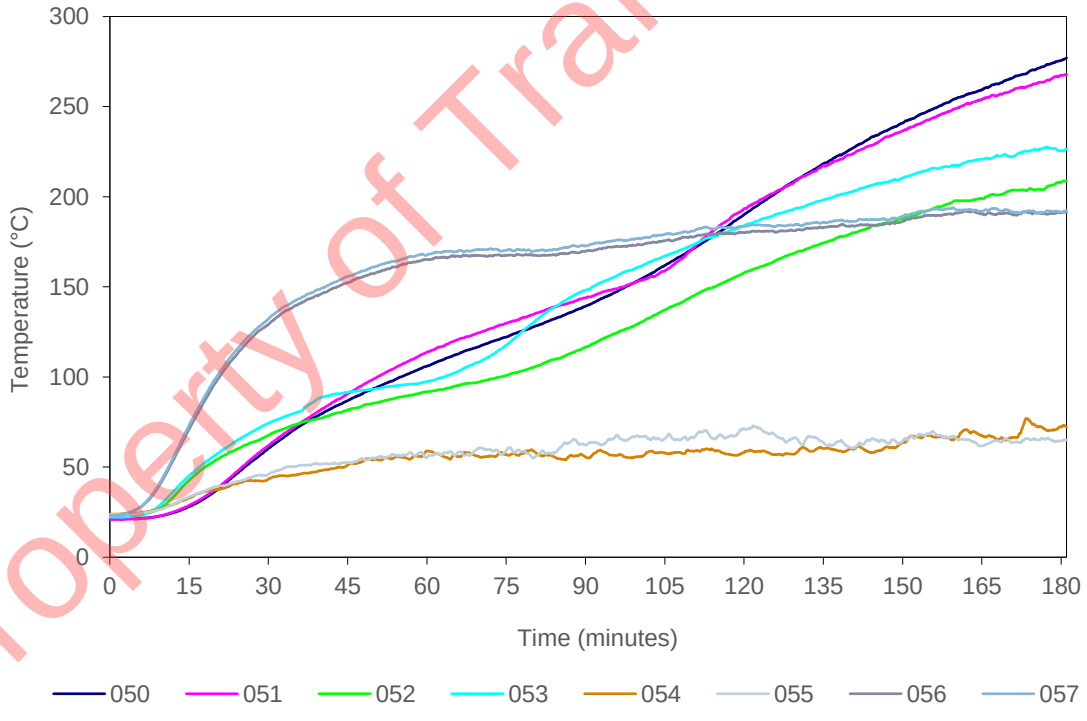

Figure 23 Penetration system C – temperature vs time

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		001	On the separating element.	20	73	110	136	*	-
		002	On the separating element.	21	81	112	138	*	-
		003	On the mortar.	21	78	84	89	*	-
		004	On the mortar.	21	53	69	78	*	-
		005	On the mortar.	21	56	74	82	*	-
		006	On the mortar.	21	47	82	84	*	-
		007	On the wrap.	22	67	77	85	*	-
		008	On the wrap.	22	66	76	84	*	-
		009	On the wrap.	22	67	81	89	*	-
		010	On the wrap.	23	43	47	55	*	-
		011	On the wrap.	23	43	46	54	*	-
		012	On the wrap.	24	57	59	67	*	-
		013	On the wrap.	24	53	55	61	*	-
		014	On the wrap.	23	60	65	68	*	-
		015	On the wrap.	23	41	45	52	*	-
		016	On the PE-Xa/AL/PE pipe	24	63	103	138	*	-
		017	On the PE-Xa/AL/PE pipe.	24	62	102	137	*	-
		018	On the PE-Xa pipe.	24	53	57	67	*	-
		019	On the PE-Xa pipe.	24	63	66	76	*	-
		020	On the 16 mm^2 cable bundle.	23	117	128	134	*	-
		021	On the 16 mm^2 cable bundle.	24	103	115	125	*	-
		022	On the larger pair coil.	25	72	79	88	*	-
		023	On the smaller pair coil.	24	64	70	74	*	-
B	Main fire-stopping protection	024	On the separating element.	21	81	101	120	165	-
		025	On the separating element.	21	92	111	137	228	162
		026	On the fire pillows.	23	83	80	79	132	-
		027	On the fire pillows.	22	70	85	107	174	-
		028	On the fire pillows.	23	67	64	63	92	-
		029	On the fire pillows.	23	64	63	65	93	-
	1	030	On the fire pillows.	23	77	72	69	131	-
		031	On the fire pillows.	23	81	77	76	157	-
		032	On the sealant.	22	86	84	90	135	-
		033	On the sealant.	22	86	86	94	138	-
		034	On the wrap.	23	83	98	110	270	161
		035	On the wrap.	23	71	82	92	180	-
		036	On the wrap.	23	45	50	56	174	-
		037	On the wrap.	23	46	51	57	112	-

Penetration system		T/C #	Description[1]	Temp (°C) at t (minutes)					Limit[2] (minutes)
				t=0	t=60	t=90	t=120	t=180	
		038	On the service.	23	102	120	132	574	152
		039	On the service.	23	100	117	128	574	152
	2	040	On the fire pillows.	22	77	71	71	132	-
		041	On the fire pillows.	24	73	73	74	139	-
		042	On the sealant.	22	83	89	98	156	-
		043	On the sealant.	23	88	102	143	205	178
		044	On the wrap.	23	95	140	171	320	156
		045	On the wrap.	23	90	104	127	215	178
		046	On the wrap.	23	62	73	81	99	-
		047	On the wrap.	23	57	74	81	89	-
		048	On the service.	23	126	152	165	564	170
		049	On the service.	23	119	144	155	602	170
C		050	On the separating element.	21	106	139	190	276	126
		051	On the separating element.	21	114	144	193	267	126
		052	On the insulguard.	23	92	117	158	208	169
		053	On the insulguard.	22	98	148	184	226	140
		054	On the insulguard.	24	59	56	58	72	-
		055	On the insulguard.	24	56	62	71	64	-
		056	On the service.	23	165	170	180	191	-
		057	On the service.	23	168	173	184	191	-

Note:

1 Refer to Table 10 for 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.

Thermocouple malfunction.

* Integrity failure of the penetration systems.

'–' 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

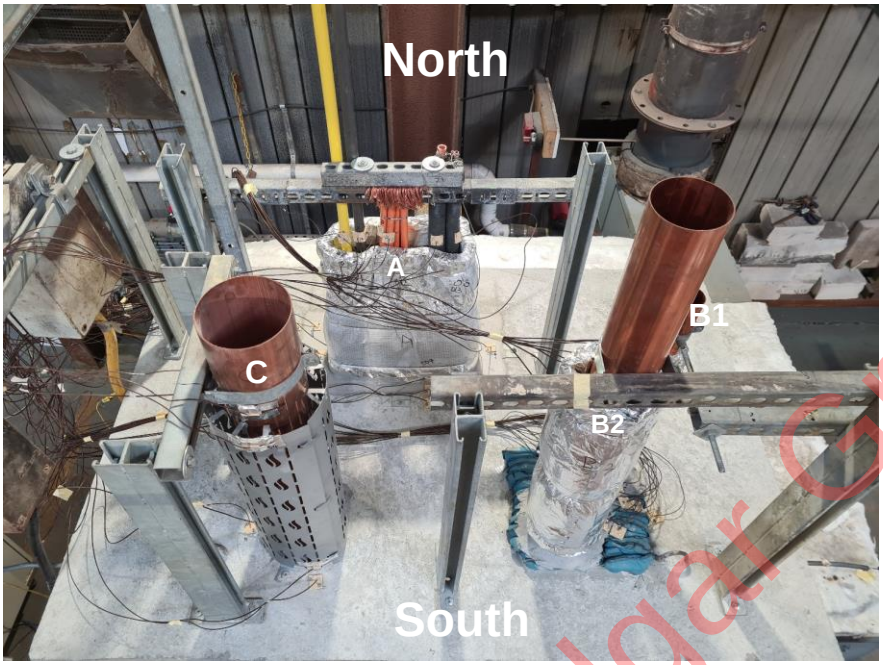

Figure 24 Unexposed face of the specimen before the start of the test

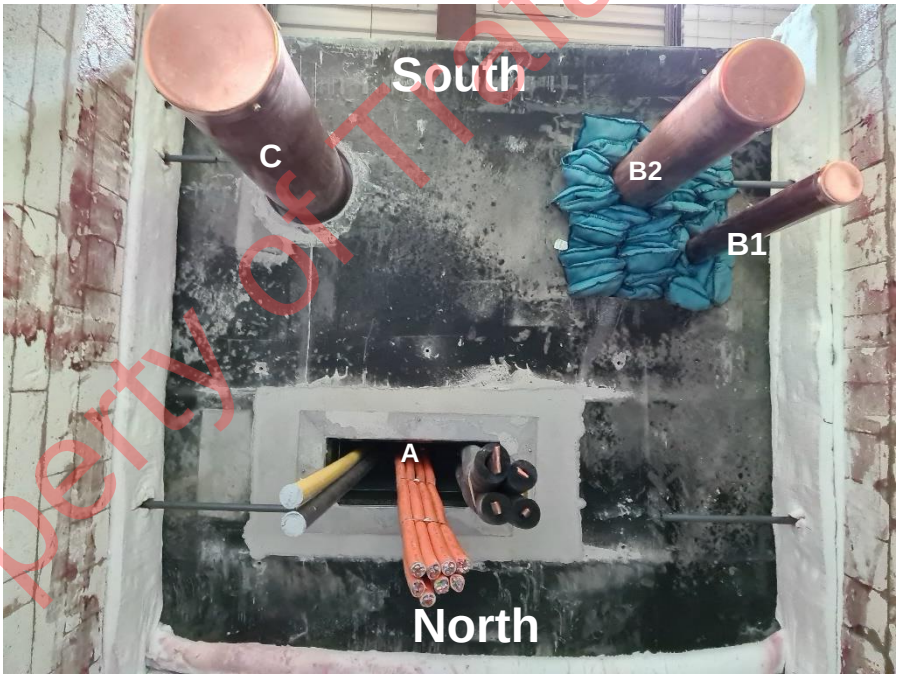

Figure 25 Exposed face of the specimen before the start of the test

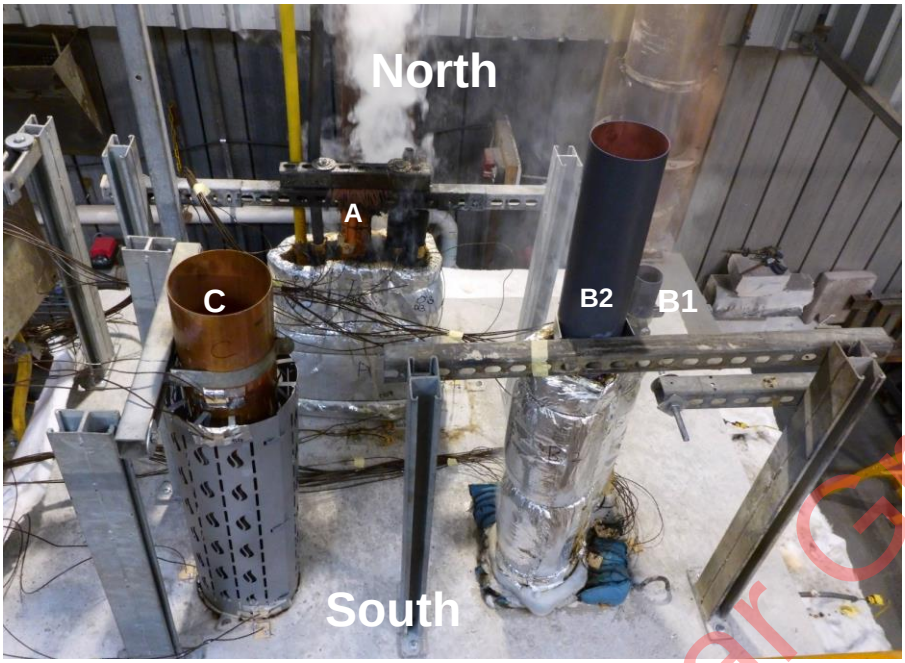

Figure 26 Unexposed face of the specimen at the end of the test

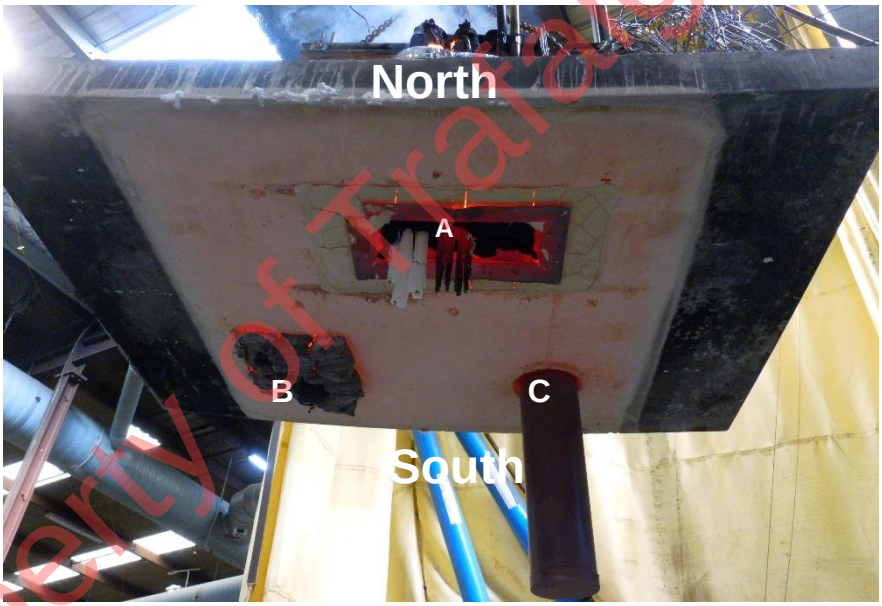

Figure 27 Exposed face of the specimen at the end of the test

warringtonfire

Proud to be part of element

Warringtonfire Australia Pty Ltd
ABN 81 050 241 524

Perth

Unit 22, 22 Railway Road
Subiaco WA 6008
Australia
T: +61 8 9382 3844

Canberra

Unit 10, 71 Leichhardt Street
Kingston ACT 2604
Australia
T: +61 2 6260 8488

Sydney

Suite 802, Level 8, 383 Kent Street
Sydney NSW 2000
Australia
T: +61 2 9211 4333

Brisbane

Suite 6, Level 12, 133 Mary Street
Brisbane QLD 4000
Australia
T: +61 7 3238 1700

Melbourne – NATA accredited laboratory

409-411 Hammond Road
Dandenong South VIC 3175
Australia
T: +61 3 9767 1000