H B FULLER AUSTRALIA PTY LTD

FIRE RESISTANCE TEST REPORT

Test standard: Sections 2 and 10 of AS 1530.4:2014
Reference Standard: AS 4072.1-2005 AMDT 1 (Rec:2016)
Test sponsor**:** H B Fuller Australia Pty Ltd
Products: H B Fuller Firesound Original Grey
Job number**:** FRT200220
Revision: R1.1 Test date: 23 November 2020

Accredited for compliance with ISO/IEC 17025 – Testing

JENSEN HUGHES

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ilac-MRA NATA Accreditation No. 3277

Quality management

Revision	Date	Revision description		
R1.0	30/11/2020	Initial issue.		
		Prepared	**Reviewed**	**Authorised**
		Pius Jerome	Mandeep Kamal	Mandeep Kamal
R1.1	20/06/2025	Report rebranding and reference to AS 4072.1-2005.		
		Prepared	**Reviewed**	**Authorised**
		Patrick Chan	Mandeep Kamal	Mandeep Kamal
				

Jensen Hughes Fire Testing Pty Ltd
ABN 81 050 241 524
Formerly Warringtonfire Australia Pty Ltd[1]

[1] Warringtonfire Australia Pty Ltd was acquired by Jensen Hughes in December 2023. Jensen Hughes Fire Testing Pty Ltd is not affiliated, associated, authorised, or endorsed by Warringtonfire Australia Pty Ltd, Warringtonfire Testing and Certification Limited or its "Warringtonfire" or "Certifire" brands.

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 with reference to AS 4072.1–2005 AMDT 1 (Rec:2016). The testing was done on 23 November 2020.

Warringtonfire performed the test at the request of H B Fuller Australia Pty Ltd.

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	Floor system	
Nominal separating element size	Width	1760 mm
	Height	1200 mm
	Thickness	150 mm
Number of penetration systems	Seven	
Restraint conditions	Simple supported along all four edges	

Table 2 Test specimen

Penetration system	Service	Local fire-stopping protection	Local aperture size (mm)
A	D1 power cable group and 300 mm cable tray	H B Fuller Firesound Original Grey	350 mm long × 90 mm wide
B	DN 32 type D copper pipe	H B Fuller Firesound Original Grey	Ø50 mm
C	DN 100 type A copper pipe	H B Fuller Firesound Original Grey	Ø150 mm
D	DN 100 type A copper pipe	Tombo rock wrap and	Ø150 mm
E	DN 200 type B copper pipe	H B Fuller Firesound Original Grey	Ø250 mm
F	DN 25 type B copper pipe	H B Fuller Firesound Original Grey	Ø40 mm
G	DN 100 brass pipe	H B Fuller Firesound Original Grey	Ø150 mm

Table 3 Test results

Penetration system	Criteria	Results	Fire resistance level (FRL)
A	Structural adequacy	Not applicable	**-/240/60**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 60 minutes	
B	Structural adequacy	Not applicable	**-/240/120**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 127 minutes	

Penetration system	Criteria	Results	Fire resistance level (FRL)
C	Structural adequacy	Not applicable	**-/240/15**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 24 minutes	
D	Structural adequacy	Not applicable	**-/240/60**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 70 minutes	
E	Structural adequacy	Not applicable	**-/180/15**
	Integrity	Failure at 228 minutes	
	Insulation	Failure at 17 minutes	
F	Structural adequacy	Not applicable	**-/240/90**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 100 minutes	
G	Structural adequacy	Not applicable	**-/240/30**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 37 minutes	

NOTE: The FRLs for the specimens are only applicable to (or - only apply to) the tested orientation. As the FRL was only determined for one direction, an FRL cannot be assigned for the other direction.

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1.0 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 with reference to AS 4072.1–2005 AMDT 1 (Rec:2016). The testing was done on 23 November 2020.

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 Australia Pty Ltd	16-22 Redgum Drive Dandenong South VIC 3175 Australia

2.0 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 name	150 mm thick concrete
	Description	40 MPa normal weight concrete
SE	Size	1760 mm long × 1200 mm wide × 150 mm thick
	Restraint conditions	Not restrained at all
	Installation	The concrete slab was precast and kept at Warringtonfire. Coring was done at Warringtonfire to accommodate the varying services.
Fire-stopping protections		
Sealant		
2.	Item name	Firesound sealant
	Product name	H B Fuller Firesound Original Grey
	Density	1485 kg/m^3
Backing rod		
3.	Item name	Open cell backing rod
	Material	Polyurethane
	Size	30 mm wide × 20 mm deep
Wrap		
4.	Item name	Wrap
	Product name	Tombo rock
	Overall density	80 kg/m^3 (provided by test sponsor)
	Overall thickness	25 mm (provided by test sponsor)
	Description	25 mm thick mineral fibre blanket with 0.27 mm thick aluminium foil on one face.
Services		
5.	Item name	D1 power cable group
	Product name	+ 1 × CMI electrical product 0.6/1kV × 90 1C × 630 sqm Cu + 1 × Prysmian L Electrical cable 0.6/1kV X-90 3C × 185 mm2 + E 70 mm2

Item	Description			
		+ 3 × Advance cables 2017 V90 Electrical cable 450/750V 6 mm2 3C+E + 8 × WW VIPERCON Electric cable 3C + E 16 mm2 Cu / XLPE X-90 /PVC 5V-90 AS/NZS 5000.1 0.6/1kV 2020 1016 UA EESS		
	Product name	Outer diameter	630 mm^2	41 mm
			185 mm^2	52 mm
			6 mm^2	13 mm
			16 mm^2	18 mm
6.	Item name	DN 32 type D copper pipe		
	Manufacturer	Kembla		
	Product name	DN 32 type D copper pipe		
	Size	Outer diameter	31.75 mm (as per AS 1432)	
		Thickness	0.91 mm (as per AS 1432)	
7.	Item name	DN 100 type A copper pipe		
	Manufacturer	Kembla		
	Product name	DN 100 type A copper pipe		
	Size	Outer diameter	101.6 mm (as per AS 1432)	
		Thickness	2.03 mm (as per AS 1432)	
8.	Item name	DN 200 type B copper pipe		
	Manufacturer	Kembla		
	Product name	DN 200 type B copper pipe		
	Overall size	Outer diameter	203.2 mm (as per AS 1432)	
		Thickness	2.03 mm (as per AS 1432)	
9.	Item name	DN 25 type B copper pipe		
	Manufacturer	Kembla		
	Product name	DN 25 type B copper pipe		
	Size	Outer diameter	25.4 mm (as per AS 1432)	
		Thickness	1.22 mm (as per AS 1432)	
10.	Item name	DN 100 brass pipe		
	Product name	DN 100 brass pipe		
	Size	Outer diameter	101.6 mm	
		Thickness	2.02 mm	
11.	Item name	300 mm cable tray		
	Product name	Ezystrut ET3 steel cable tray – ET3 300G		
	Material	Galvanised steel		
	Size	Width	325 mm	
		Height	50 mm	
		Thickness	0.7 mm thick	

Item	Description		
Fixings			
12.	Item name	Foil tape	
	Product description	Pressure sensitive aluminium foil tape	
	Overall size	Width	72 mm
13.	Item name	Cable ties	
	Overall size	4.6 mm stainless steel cable ties	
Penetration system A			
A	Service	D1 power cable group (item 5) 300 mm cable tray (item 11)	
	Service detail	The D1 power cable group was secured to the cable tray with steel cable ties. The services extended a nominal 500 mm on both the exposed and unexposed sides from the separating element.	
	Service support	The cable tray was supported on the unexposed side at a nominal 230 mm and 470 mm from the separating element, using screws fixed to the channel.	
	Aperture size	350 mm long × 90 mm wide	
	Local fire-stopping protection		
	Protection	A backing rod (item 2) was installed into the annular gap between the service and the separating element at a depth of 10 mm from the separating element on both the unexposed and exposed sides. The Firesound sealant (item 3) was then applied to the depth of the backing rod – that is, to 10 mm. A 50 mm × 50 mm fillet of sealant was also applied around the service on both the exposed and unexposed sides of the separating element.	
Penetration system B			
B	Service	DN 32 type D copper pipe (item 6)	
	Service detail	The pipe protruded nominally 500 mm on both the exposed and unexposed sides from the separating element. The pipe was capped with a copper end cap on the exposed side.	
	Service support	The pipe was supported on the unexposed side at a nominal 230 mm and 470 mm from the separating element, using pipe clamps fixed to the channel.	
	Aperture size	Ø50 mm	
	Local fire-stopping protection		
	Protection	A backing rod (item 2) was installed into the annular gap between the service and the separating element at a depth of 10 mm from the separating element on both the unexposed and exposed sides. The Firesound sealant (item 3) was then applied to the depth of the backing rod – that is, to 10 mm. A 50 mm × 50 mm fillet of sealant was also applied around the service on both the exposed and unexposed sides of the separating element.	
Penetration system C			
C	Service	DN 100 type A copper pipe (item 7)	
	Service detail	The pipe protruded nominally 500 mm on both the exposed and unexposed sides from the separating element. The pipe was capped with a copper end cap on the exposed side.	

Item	Description	
	Service support	The pipe was supported on the unexposed side at a nominal 375 mm and 480 mm from the separating element, using pipe clamps fixed to the channel.
	Aperture size	Ø150 mm
	Local fire-stopping protection	
	Protection	A backing rod (item 2) was installed into the annular gap between the service and the separating element at a depth of 10 mm from the separating element on both the unexposed and exposed sides. The Firesound sealant (item 3) was then applied to the depth of the backing rod – that is, to 10 mm. A 50 mm × 50 mm fillet of sealant was also applied around the service on both the exposed and unexposed sides of the separating element.
Penetration system D		
D	Service	DN 100 type A copper pipe (item 7)
	Service detail	The pipe protruded nominally 500 mm on both the exposed and unexposed sides from the separating element. The pipe was capped with a copper end cap on the exposed side.
	Service support	The pipe was supported on the unexposed side at a nominal 375 mm and 480 mm from the separating element, using pipe clamps fixed to the channel.
	Aperture size	Ø150 mm
	Local fire-stopping protection	
	Protection	A backing rod (item 2) was installed into the annular gap between the service and the separating element at a depth of 10 mm from the separating element on both the unexposed and exposed sides. The Firesound sealant (item 3) was then applied to the depth of the backing rod – that is, to 10 mm. A 25 mm × 25 mm fillet of sealant was then applied around the service on both the exposed and unexposed sides of the separating element. One layer of 300 mm high Tombo rock (item 4) was wrapped around the service on both the exposed and unexposed side from the separating element. The wrap consisted of a 75 mm vertical overlap. It was secured with cable ties (item 13) in the centre and at a nominal 50 mm from the top and bottom edges. Foil tape (item 12) of 72 mm wide was used at the overlap to secure the wrap overlap joint. A 50 mm × 50 mm fillet of sealant was then applied around the wrap on both the exposed and unexposed sides of the separating element.
Penetration system E		
E	Service	DN 200 type B copper pipe (item 8)
	Service detail	The pipe protruded nominally 500 mm on both the exposed and unexposed sides from the separating element. The pipe was capped with a copper end cap on the exposed side.
	Service support	The pipe was supported on the unexposed side at a nominal 375 mm and 480 mm from the separating element, using pipe clamps fixed to the channel.
	Aperture size	Ø250 mm
	Local fire-stopping protection	
	Protection	A backing rod (item 2) was installed into the annular gap between the service and the separating element at a depth of 20 mm from the separating element on both the unexposed and exposed sides.

Item	Description	
		The Firesound sealant (item 3) was then applied to the depth of the backing rod – that is, to 20 mm. A 50 mm × 50 mm fillet of sealant was also applied around the service on both the exposed and unexposed sides of the separating element.
Penetration system F		
F	Service	DN 25 type B copper pipe (item 9)
	Service detail	The pipe protruded nominally 500 mm on both the exposed and unexposed sides from the separating element. The pipe was capped with a copper end cap on the exposed side.
	Service support	The pipe was supported on the unexposed side at a nominal 375 mm and 480 mm from the separating element, using pipe clamps fixed to the channel.
	Aperture size	Ø40 mm
	Local fire-stopping protection	
	Protection	A backing rod (item 2) was installed into the annular gap between the service and the separating element at a depth of 20 mm from the separating element on both the unexposed and exposed sides. The Firesound sealant (item 3) was then applied to the depth of the backing rod – that is, to 20 mm. A 50 mm × 50 mm fillet of sealant was also applied around the service on both the exposed and unexposed sides of the separating element.
Penetration system G		
G	Service	DN 100 brass pipe (item 10)
	Service detail	The pipe protruded nominally 500 mm on both the exposed and unexposed sides from the separating element. The pipe was capped with a copper end cap on the exposed side.
	Service support	The pipe was supported on the unexposed side at a nominal 375 mm and 480 mm from the separating element, using pipe clamps fixed to the channel.
	Aperture size	Ø150 mm
	Local fire-stopping protection	
	Protection	A backing rod (item 2) was installed into the annular gap between the service and the separating element at a depth of 20 mm from the separating element on both the unexposed and exposed sides. The Firesound sealant (item 3) was then applied to the depth of the backing rod – that is, to 20 mm. A 50 mm × 50 mm fillet of sealant was also applied around the service on both the exposed and unexposed sides of the separating element.

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	1 October 2020
Start date for installation of fire-stopping protection for the penetration systems	5 October 2020
Completion date for constructing and installing the test specimen	12 October 2020
Separating element constructed by	Representatives of Warringtonfire
Fire-stopping protection for penetration systems installed by	Representatives of the test sponsor
Symmetry	Symmetrical

3.0 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/control joints.	
Variations	+ The 2005 revision of AS 4072.1 has all testing requirements removed from it and placed in AS 1530.4-2005 however the reference in the construction code was not updated to reflect this and still erroneously calls for testing to be in accordance with AS 4072.1. To accommodate this oversight, reference is made to AS 4072.1-2005 AMDT 1 (Rec:2016). + The pressure was up to 1 Pa below the limits prescribed in the standard during the 225-230 minute period. 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 this time period, 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 12 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. 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	20 °C
	Minimum temperature	20 °C
	Maximum temperature	24 °C
Test duration	240 minutes	
Instrumentation and equipment	+ 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 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 of the specimen under the criteria of integrity. + The furnace pressure was measured at approximately 100 mm below the underside of the separating element. It was monitored using a differential pressure transmitter. + All electronic data was sampled at 5 second intervals.	

4.0 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.

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.

Appendix D includes instrumentation details of the specimen.

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	**-/240/60**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 60 minutes	
B	Structural adequacy	Not applicable	**-/240/120**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 127 minutes	
C	Structural adequacy	Not applicable	**-/240/15**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 24 minutes	
D	Structural adequacy	Not applicable	**-/240/60**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 70 minutes	
E	Structural adequacy	Not applicable	**-/180/15**
	Integrity	Failure at 228 minutes	
	Insulation	Failure at 17 minutes	
F	Structural adequacy	Not applicable	**-/240/90**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 100 minutes	
G	Structural adequacy	Not applicable	**-/240/30**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 37 minutes	

NOTE: The FRLs for the specimens are only applicable to (or - only apply to) the tested orientation. As the FRL was only determined for one direction, an FRL cannot be assigned for the other direction.

5.0 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 Jensen Hughes Fire Testing 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

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

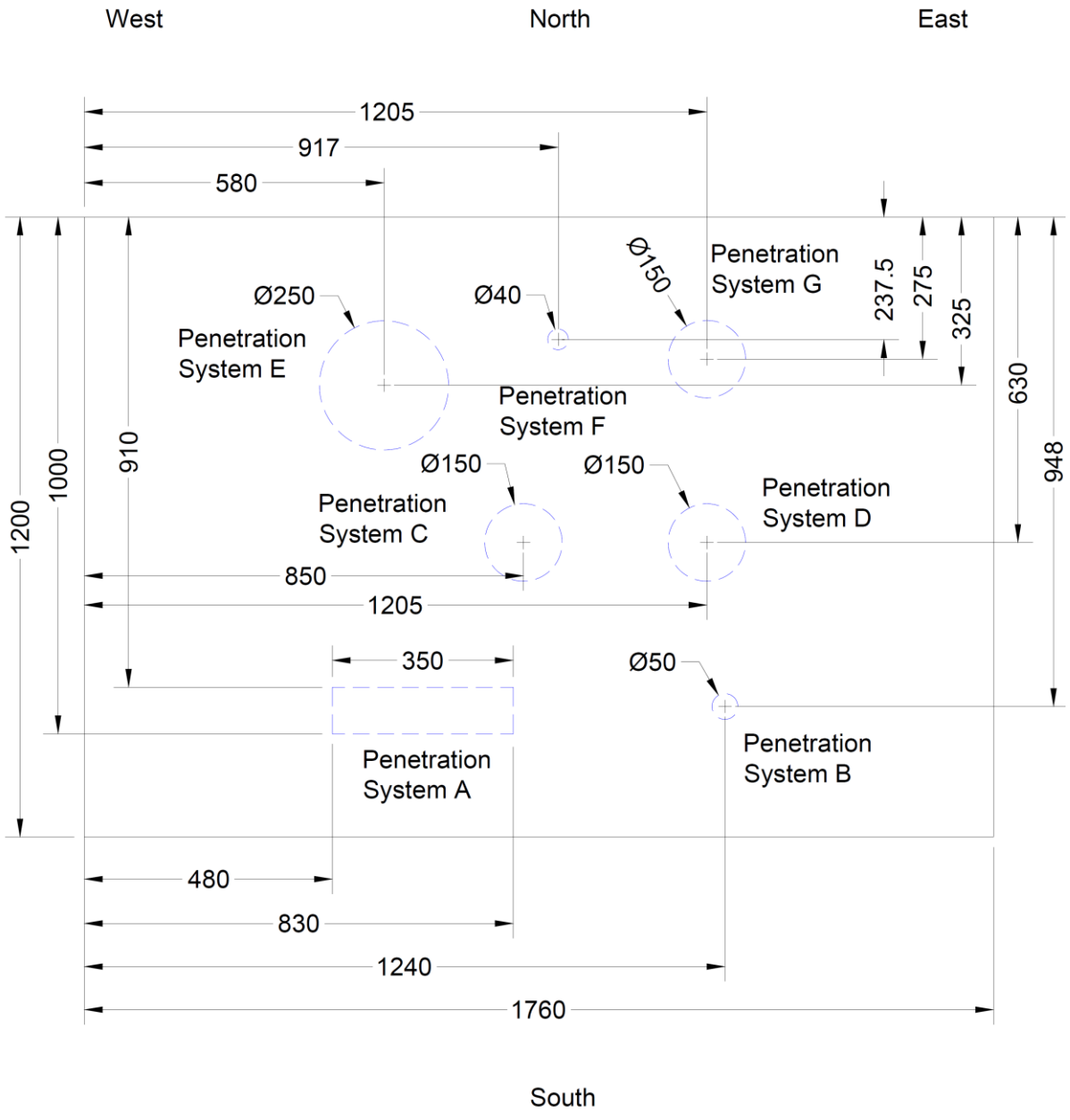


Figure 1 Plan view of core hole locations of test specimen (unexposed side)

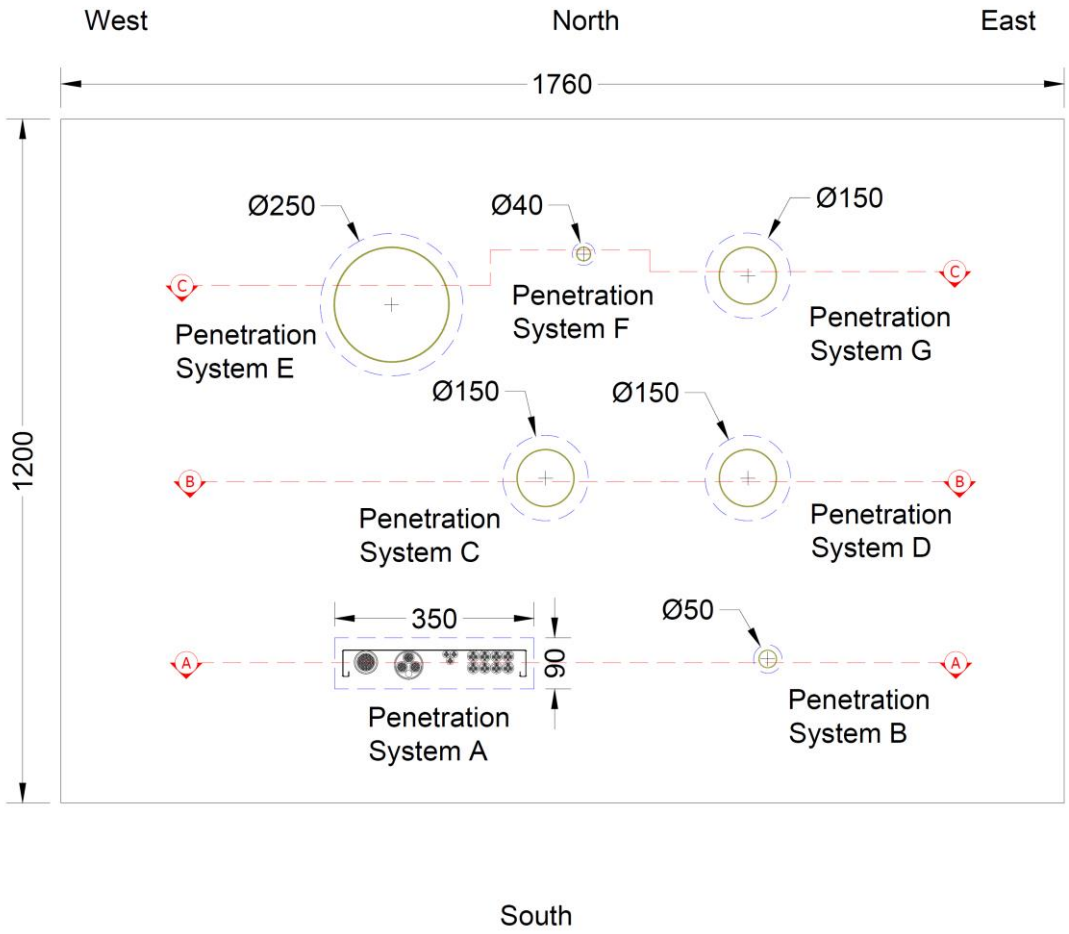


Figure 2 Plan view of test specimen (unexposed side)

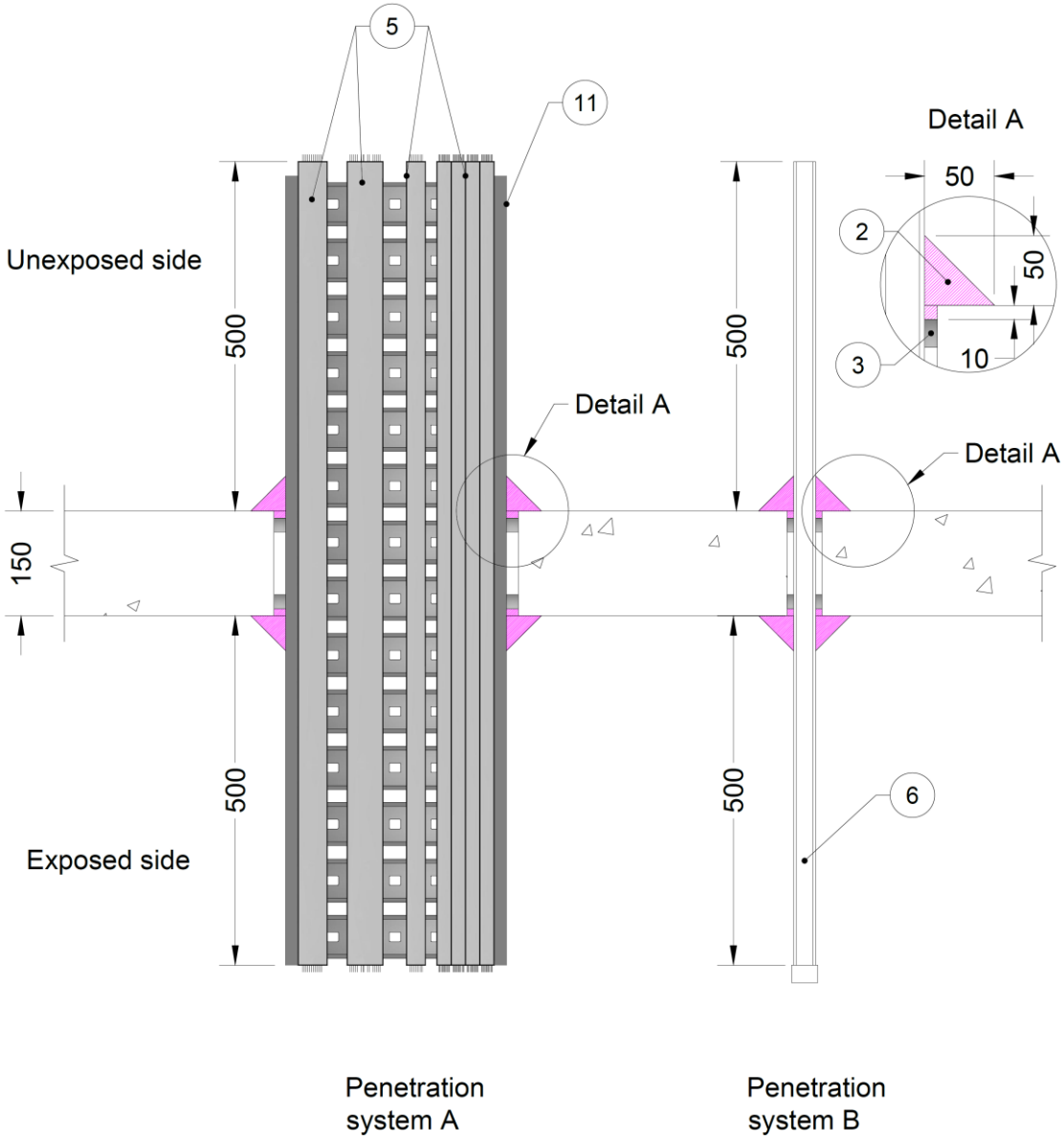


Figure 3 Cross-section A-A

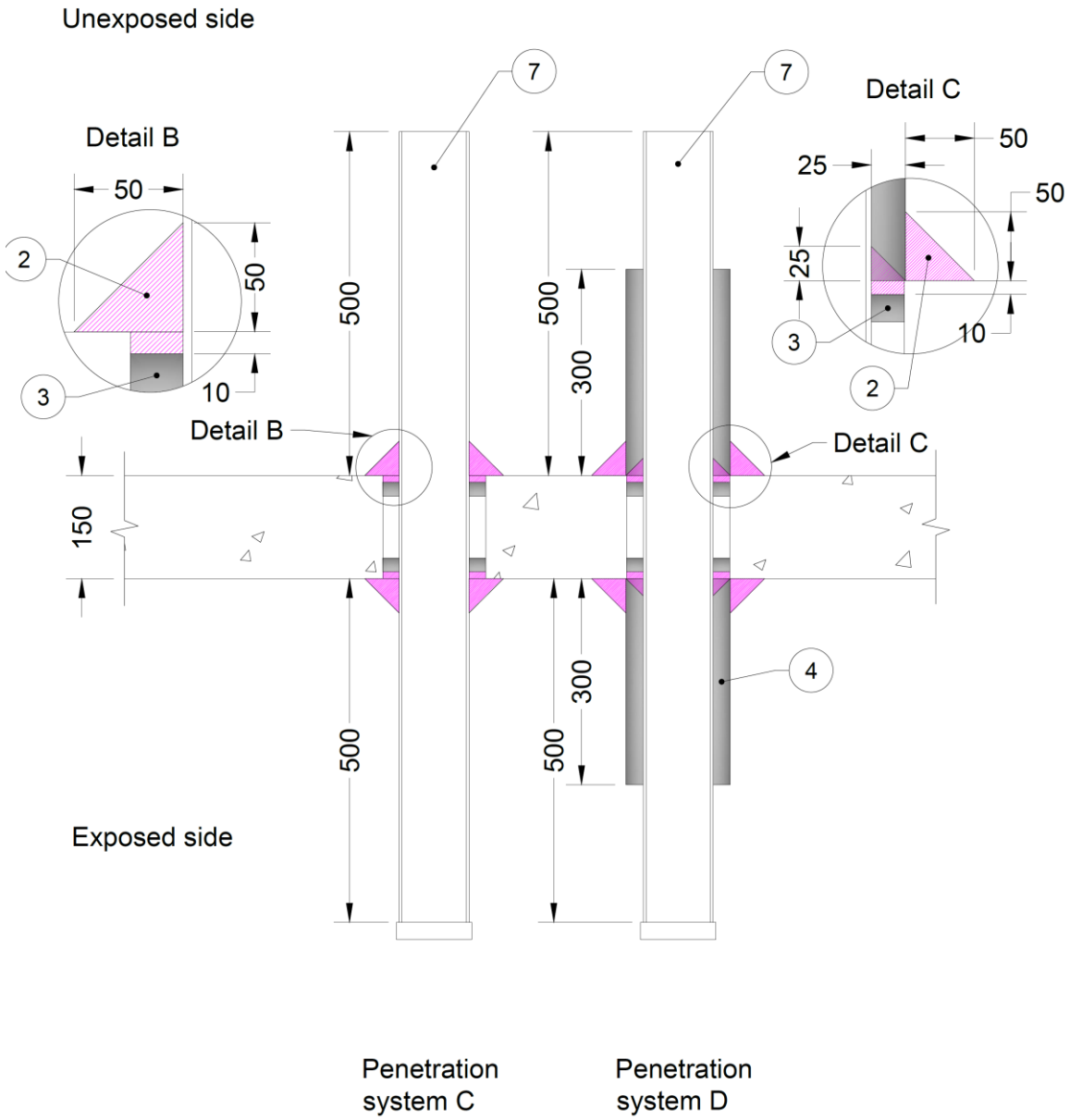


Figure 4 Cross-section B-B

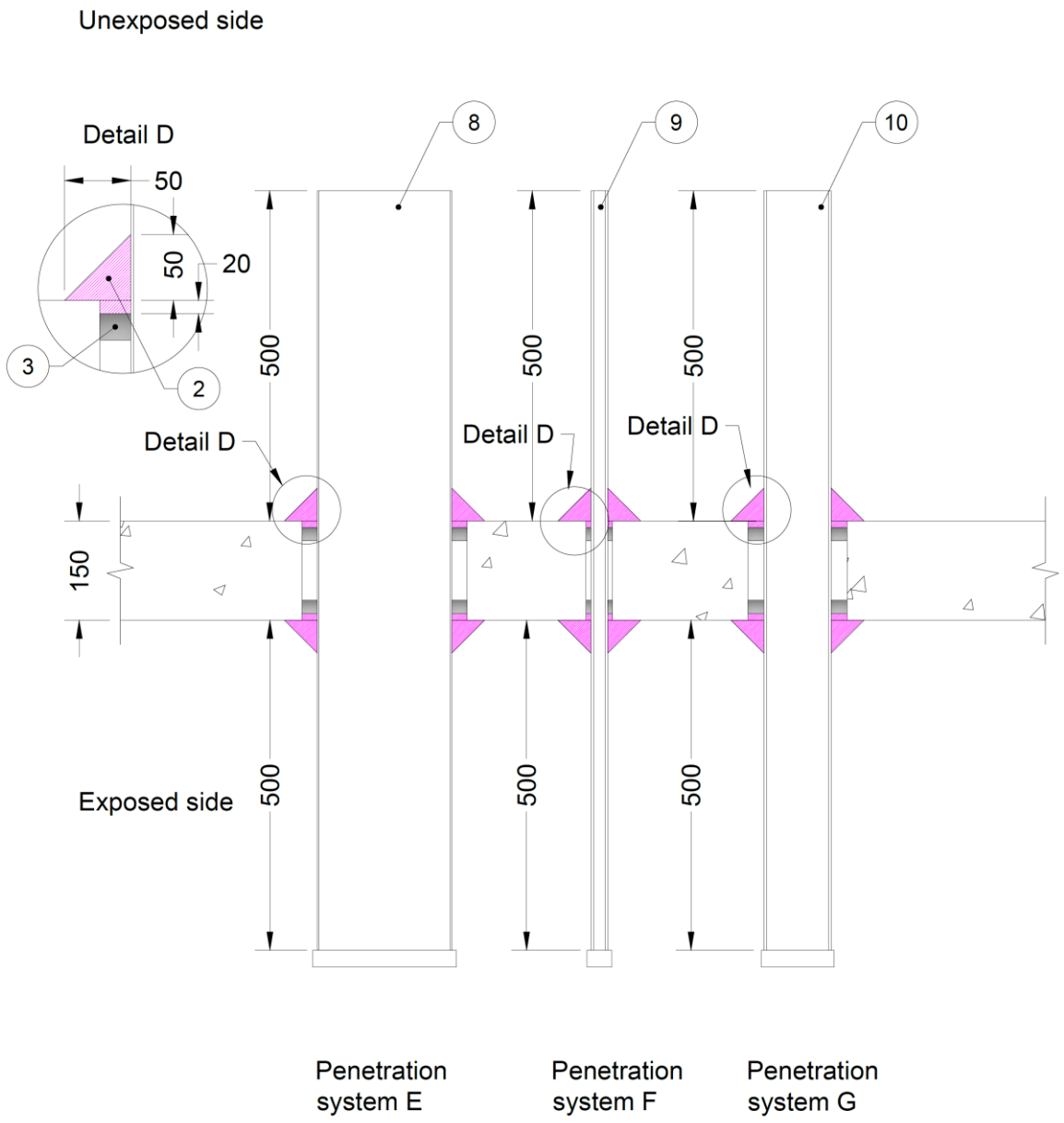


Figure 5 Cross-section C-C

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	The fire resistance test started. The initial temperature of the test specimen was approximately 20 °C.
01	20	Smoke emitting from between the cables.
03	10	Volume of smoke emitting from between the cables had increased.
11	56	Volume of smoke emitting from between the cables had decreased.
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.
31	10	Volume of smoke emitting from between the cables had increased.
40	10	Sealant appeared expanded and bulged between the cables.
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.
60	**55**	**TC007, on 16 mm^2 cables, 25 mm from the sealant recorded a temperature of 201 °C.** **Failure of insulation in accordance with clause 2.13.3(b) of AS 1530.4:2014, where the maximum temperature of thermocouple TC007 exceeded the initial temperature by more than 180 K.**
63	25	All the cables deformed inside the cable tray.
90	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
120	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
180	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
240	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Test stopped.
Penetration system B		
00	00	The fire resistance test started. The initial temperature of the test specimen was approximately 21 °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.
45	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
55	00	Sealant appeared expanded and bulged.

Time		Observation
Min	Sec	
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.
127	**30**	**TC028, on service, 25 mm from the sealant recorded a temperature of 207 °C.** **Failure of insulation in accordance with clause 2.13.3(b) of AS 1530.4:2014, where the maximum temperature of thermocouple TC028 exceeded the initial temperature by more than 180 K.**
130	00	Smoke emitting from the surface of the sealant.
180	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
240	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Test stopped.
Penetration system C		
00	00	The fire resistance test started. The initial temperature of the test specimen was approximately 21 °C.
04	00	Smoke emitting from the end of service.
11	56	Volume of smoke emitting from the end of service had decreased.
15	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
24	**45**	**TC036, on service, 25 mm from the sealant recorded a temperature of 201 °C.** **Failure of insulation in accordance with clause 2.13.3(b) of AS 1530.4:2014, where the maximum temperature of thermocouple TC036 exceeded the initial temperature by more than 180 K.**
30	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
30	10	Sealant appeared expanded and bulged.
45	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
60	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
90	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
120	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
180	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
240	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Test stopped.
Penetration system D		
00	00	The fire resistance test started. The initial temperature of the test specimen was approximately 21 °C.
15	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.

Time		Observation
Min	Sec	
30	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
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.
71	**40**	**TC047, on service, 25 mm from the wrap recorded a temperature of 201 °C.** **Failure of insulation in accordance with clause 2.13.3(b) of AS 1530.4:2014, where the maximum temperature of thermocouple TC047 exceeded the initial temperature by more than 180 K.**
85	09	Sealant appeared expanded and bulged.
90	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
110	00	More sealant appeared expanded and bulged.
120	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
180	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
182	00	Smoke emitting from the wrap joints.
240	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Test stopped.
Penetration system E		
00	00	The fire resistance test started. The initial temperature of the test specimen was approximately 21 °C.
01	20	Smoke emitting from the end of service.
11	56	Volume of smoke emitting from the end of service had decreased.
15	00	The penetration system continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
17	**55**	**TC054, on service, 25 mm from the sealant recorded a temperature of 202 °C.** **Failure of insulation in accordance with clause 2.13.3(b) of AS 1530.4:2014, where the maximum temperature of thermocouple TC054 exceeded the initial temperature by more than 180 K.**
18	50	Smoke emitting from the interface of sealant to service.
15	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
30	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
40	00	Sealant appeared expanded and bulged and black discolouration at the interface of sealant to service.
45	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
60	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
90	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
120	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
180	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.

Time		Observation
Min	Sec	
225	40	Glowing appeared at the interface of sealant to service, A 30 second cotton pad test was carried out at interface of sealant to service, in accordance with clause 2.13.2.2 of AS 1530.4:2014. There was no ignition of the cotton pad, no failure.
228	**30**	**A 30 second cotton pad test was carried out at the interface of sealant to service, resulting in the ignition of the cotton pad at 228 minutes and 30 seconds.** **Failure of integrity of the specimen in accordance with clause 2.13.2.2 of AS 1530.4:2014, where ignition of the cotton pad has occurred.**
241	00	Test stopped.
Penetration system F		
00	00	The fire resistance test started. The initial temperature of the test specimen was approximately 21 °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.
30	10	Sealant appeared expanded and bulged.
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.
100	**55**	**TC061, on service, 25 mm from the sealant recorded a temperature of 201 °C.** **Failure of insulation in accordance with clause 2.13.3(b) of AS 1530.4:2014, where the maximum temperature of thermocouple TC061 exceeded the initial temperature by more than 180 K.**
120	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
180	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
240	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Test stopped.
Penetration system G		
00	00	The fire resistance test started. The initial temperature of the test specimen was approximately 21 °C.
04	00	Smoke emitting from the end of service.
11	56	Volume of smoke emitting from the end of service had decreased.
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.
30	10	Sealant appeared expanded and bulged.
37	**35**	**TC068, on service, 25 mm from the sealant recorded a temperature of 201 °C.**

Time		Observation
Min	Sec	
		Failure of insulation in accordance with clause 2.13.3(b) of AS 1530.4:2014, where the maximum temperature of thermocouple TC068 exceeded the initial temperature by more than 180 K.
45	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
60	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
90	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
120	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
180	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
240	00	The penetration system continued to maintain integrity in accordance with AS 1530.4:2014.
241	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 10.12.5.1. 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.

Appendix D Instrumentation locations

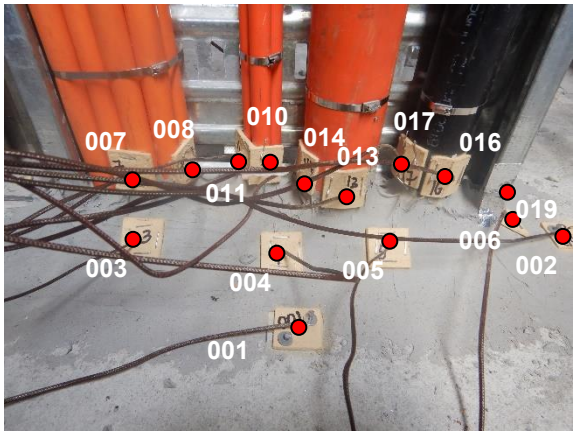


Figure 6 Penetration system A

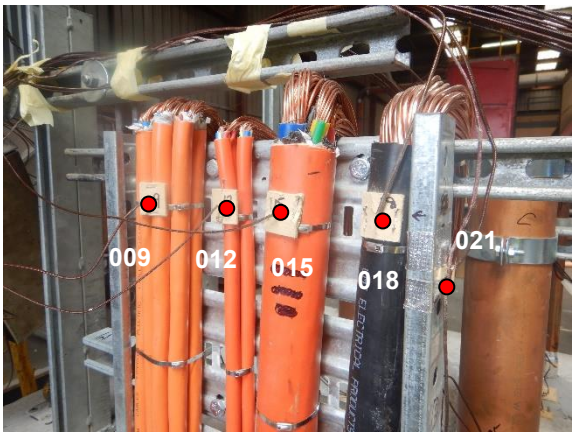


Figure 7 Penetration system A

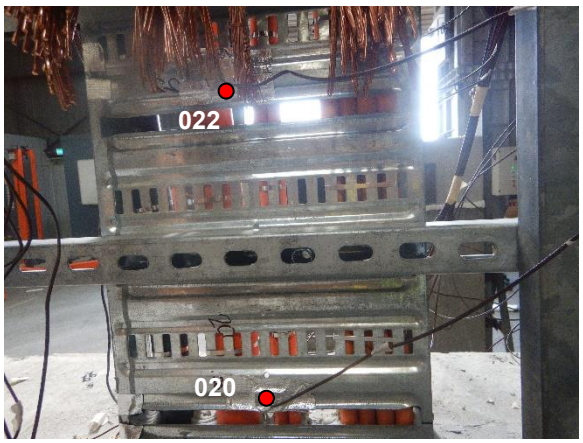


Figure 8 Penetration system A

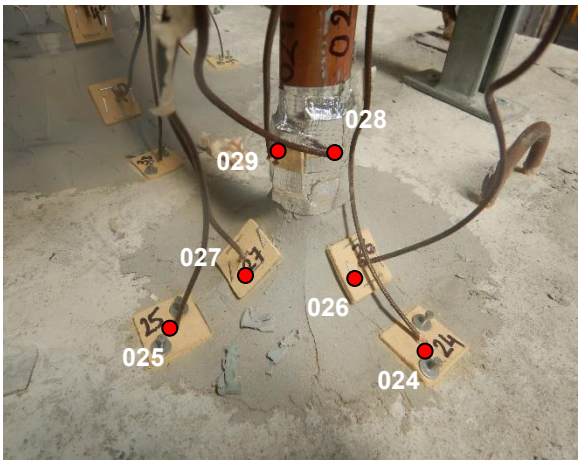


Figure 9 Penetration system B

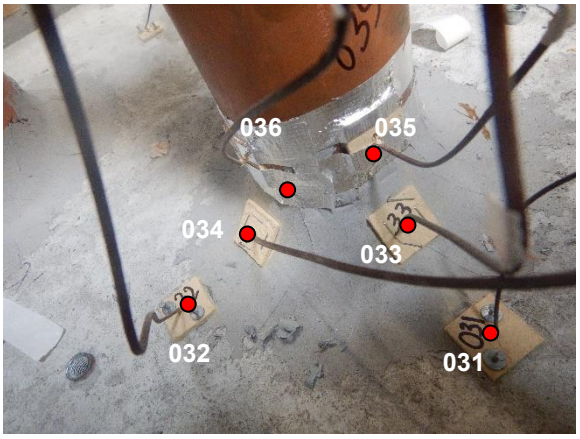


Figure 10 Penetration system C

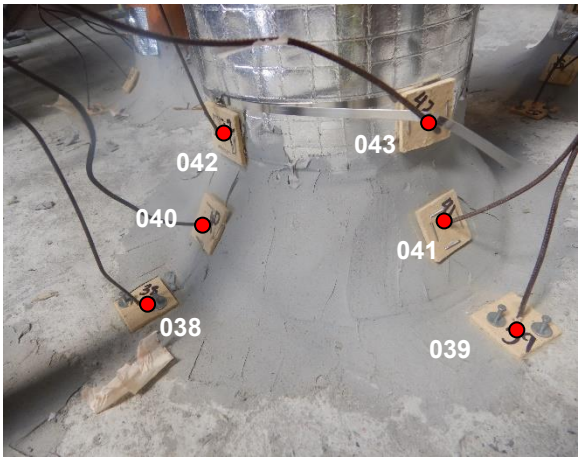


Figure 11 Penetration system D

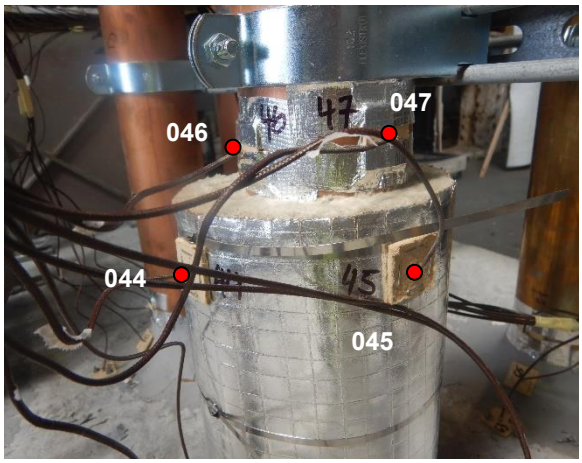


Figure 12 Penetration system D

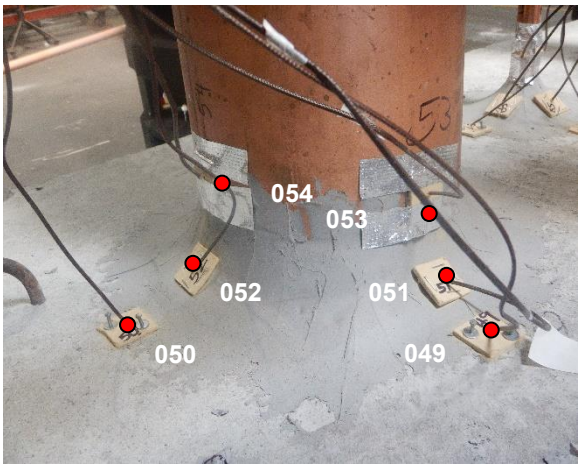


Figure 13 Penetration system E

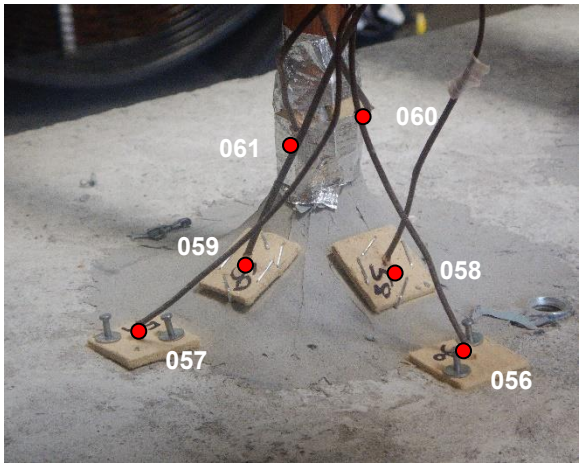


Figure 14 Penetration system B

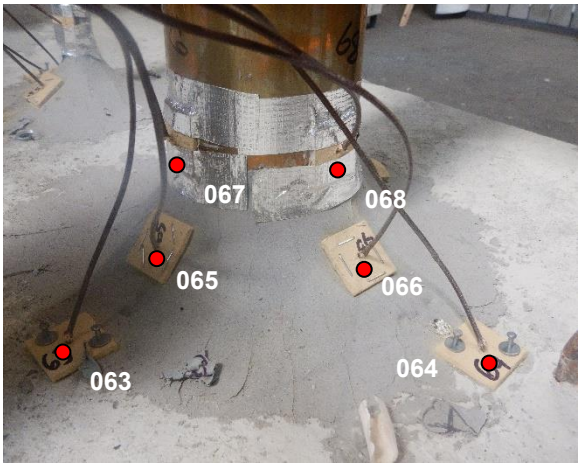


Figure 15 Penetration system C

Table 10 Thermocouple locations

Penetration system	TC No.	Description
A	001	On the separating element, 25 mm from the sealant
	002	On the separating element, 25 mm from the sealant
	003	On the centre of sealant, near eight 16 mm^2 cables.
	004	On the centre of sealant, in-between the three 6 mm^2 cables and the 185 mm^2 cable.
	005	On the centre of sealant, in-between the 185 mm^2 cables and the 630 mm^2 cable.
	006	On the centre of sealant, near the cable tray (east side)
	007	On the eight 16 mm^2 cables, 25 mm from the sealant.
	008	On the eight 16 mm^2 cables, 25 mm from the sealant.
	009	On the eight 16 mm^2 cables, 400 mm from the sealant.
	010	On the three 6 mm^2 cables, 25 mm from the sealant.
	011	On the three 6 mm^2 cables, 25 mm from the sealant.
	012	On the three 6 mm^2 cables, 400 mm from the sealant.
	013	On the 185 mm^2 cable, 25 mm from the sealant.
	014	On the 185 mm^2 cables, 25 mm from the sealant.
	015	On the 185 mm^2 cables, 400 mm from the sealant.
	016	On the 630 mm^2 cable, 25 mm from the sealant.
	017	On the 630 mm^2 cables, 25 mm from the sealant.
	018	On the 630 mm^2 cables, 400 mm from the sealant.
	019	On the cable tray, 25 mm from the sealant.
	020	On the cable tray, 25 mm from the sealant.
	021	On the cable tray, 400 mm from the sealant.
	022	On the cable tray, 400 mm from the sealant.
B	024	On the separating element, 25 mm from the sealant.
	025	On the separating element, 25 mm from the sealant.
	026	On the centre of sealant.
	027	On the centre of sealant.
	028	On the service, 25 mm from the sealant.
	029	On the service, 25 mm from the sealant.
C	031	On the separating element, 25 mm from the sealant.
	032	On the separating element, 25 mm from the sealant.
	033	On the centre of sealant.
	034	On the centre of sealant.
	035	On the service, 25 mm from the sealant.
	036	On the service, 25 mm from the sealant.
D	038	On the separating element, 25 mm from the sealant.
	039	On the separating element, 25 mm from the sealant.

Penetration system	TC No.	Description
	040	On the centre of sealant.
	041	On the centre of sealant.
	042	On the wrap, 25 mm from the sealant.
	043	On the wrap, 25 mm from the sealant.
	044	On the wrap, 25 mm from the service.
	045	On the wrap, 25 mm from the service.
	046	On the service, 25 mm from the wrap.
	047	On the service, 25 mm from the wrap.
E	049	On the separating element, 25 mm from the sealant.
	050	On the separating element, 25 mm from the sealant.
	051	On the centre of sealant.
	052	On the centre of sealant.
	053	On the service, 25 mm from the sealant.
	054	On the service, 25 mm from the sealant.
F	056	On the separating element, 25 mm from the sealant.
	057	On the separating element, 25 mm from the sealant.
	058	On the centre of sealant.
	059	On the centre of sealant.
	060	On the service, 25 mm from the sealant.
	061	On the service, 25 mm from the sealant.
G	063	On the separating element, 25 mm from the sealant.
	064	On the separating element, 25 mm from the sealant.
	065	On the centre of sealant.
	066	On the centre of sealant.
	067	On the service, 25 mm from the sealant.
	068	On the service, 25 mm from the sealant.

Appendix E Test data

E.1 Furnace temperature and severity

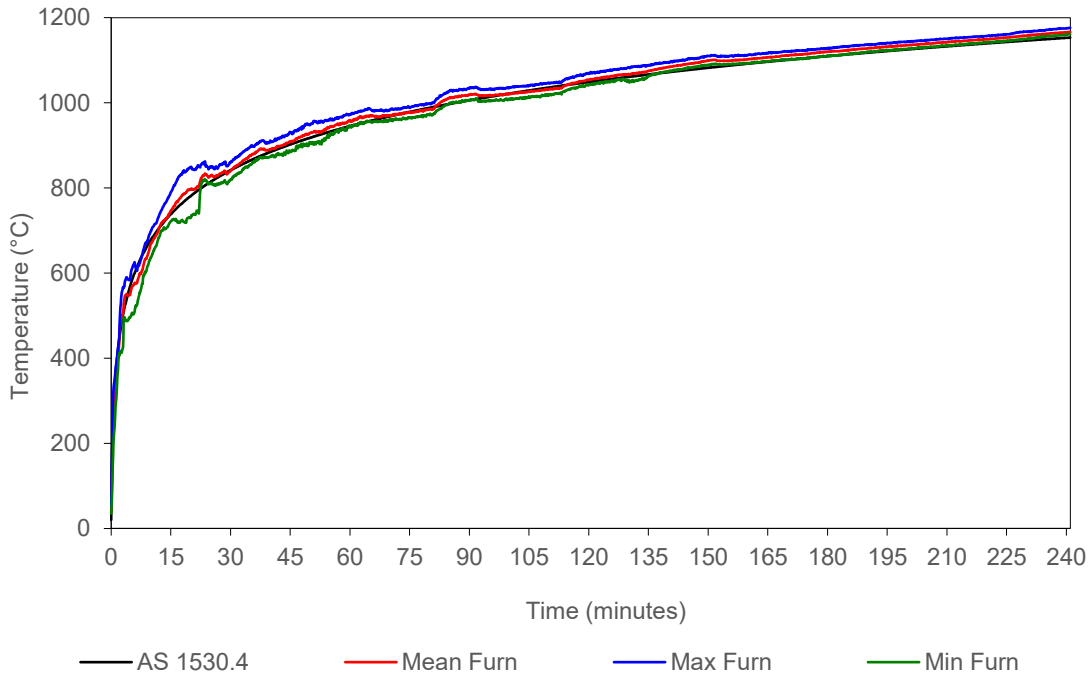


Figure 16 Furnace thermocouple temperature vs time

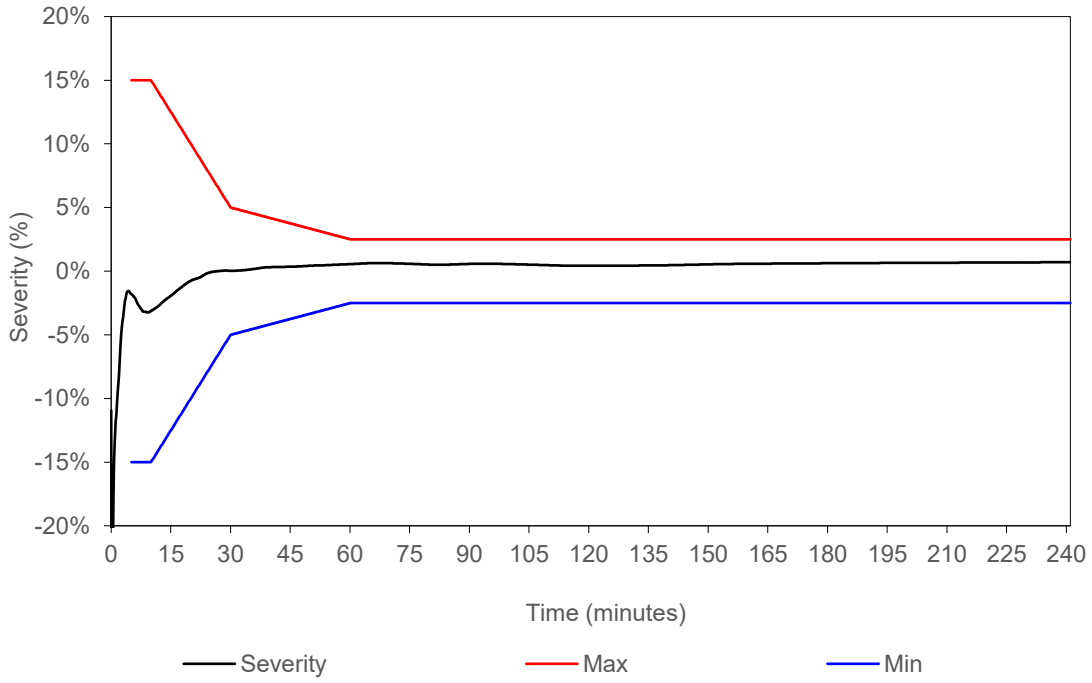


Figure 17 Percentage deviation of exposure severity vs time

E.2 Furnace pressure

The furnace pressure was measured 100 mm below the underside of the floor system.

Table 11 Furnace pressure

Time (minutes)	Average pressure (Pa)	Time (minutes)	Average pressure (Pa)	Time (minutes)	Average pressure (Pa)
5-10	21	85-90	20	165-170	19
10-15	21	90-95	20	170-175	21
15-20	20	95-100	19	175-180	20
20-25	20	100-105	19	180-185	20
25-30	19	105-110	21	185-190	19
30-35	20	110-115	21	190-195	21
35-40	21	115-120	20	195-200	20
40-45	21	120-125	20	200-205	20
45-50	21	125-130	19	205-210	20
50-55	20	130-135	19	210-215	20
55-60	20	135-140	20	215-220	20
60-65	19	140-145	20	220-225	20
65-70	20	145-150	19	225-230	16
70-75	20	150-155	19	230-235	18
75-80	20	155-160	20	235-240	19
80-85	20	160-165	19		

E.3 Specimen temperatures

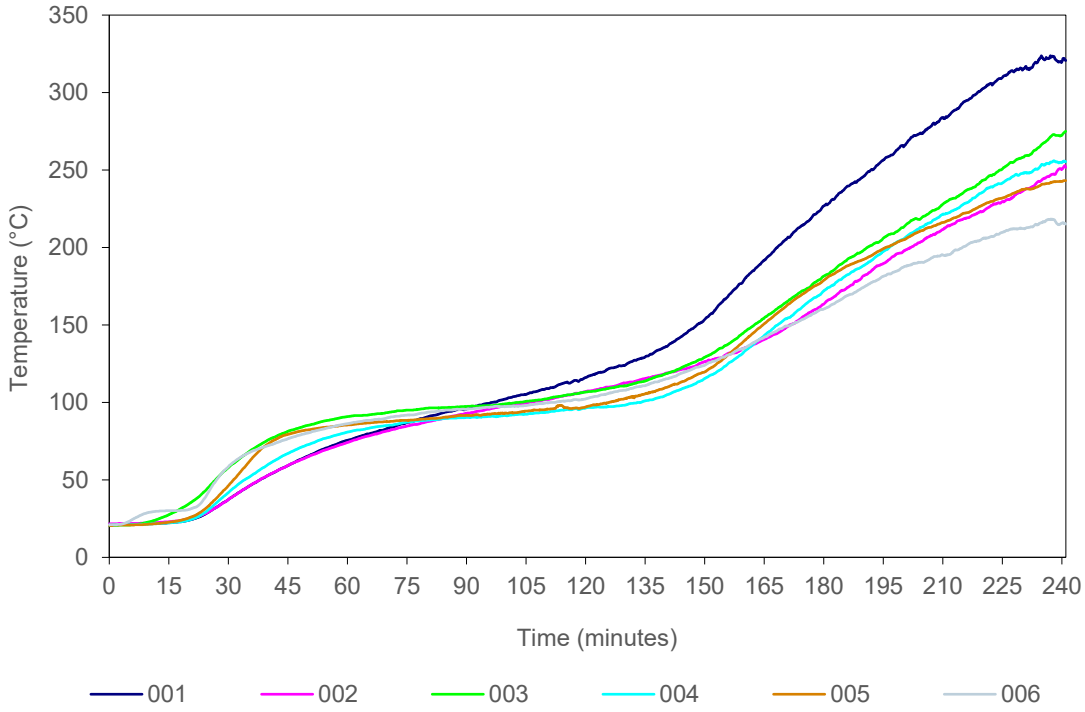


Figure 18 Penetration system A – temperature vs time

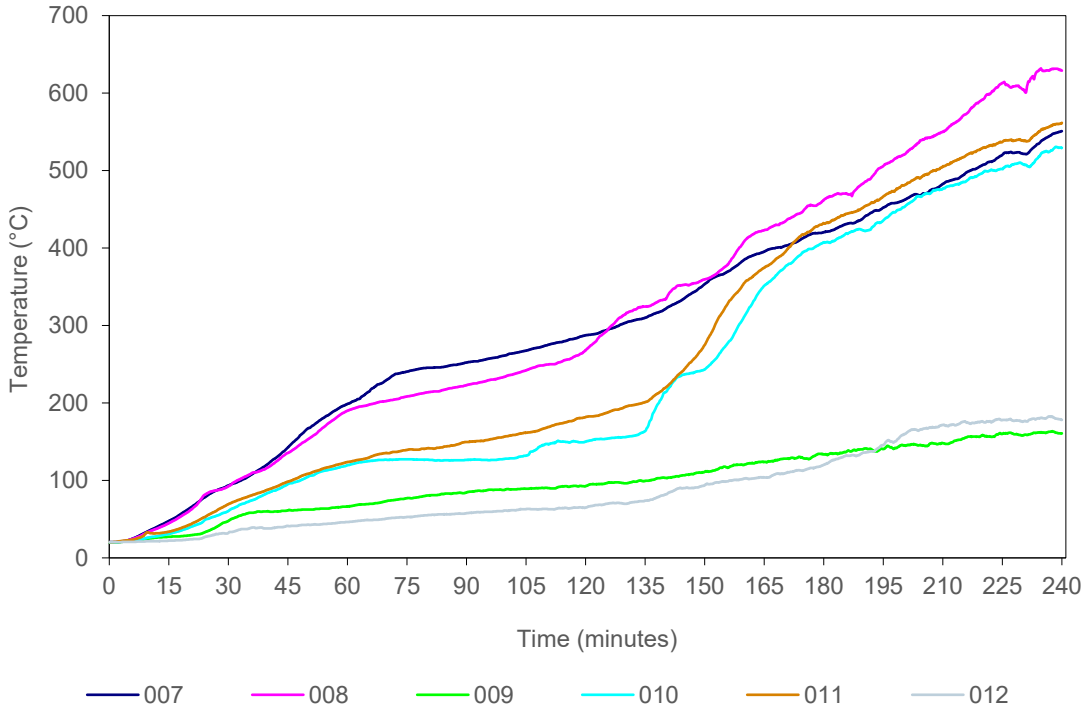


Figure 19 Penetration system A– temperature vs time

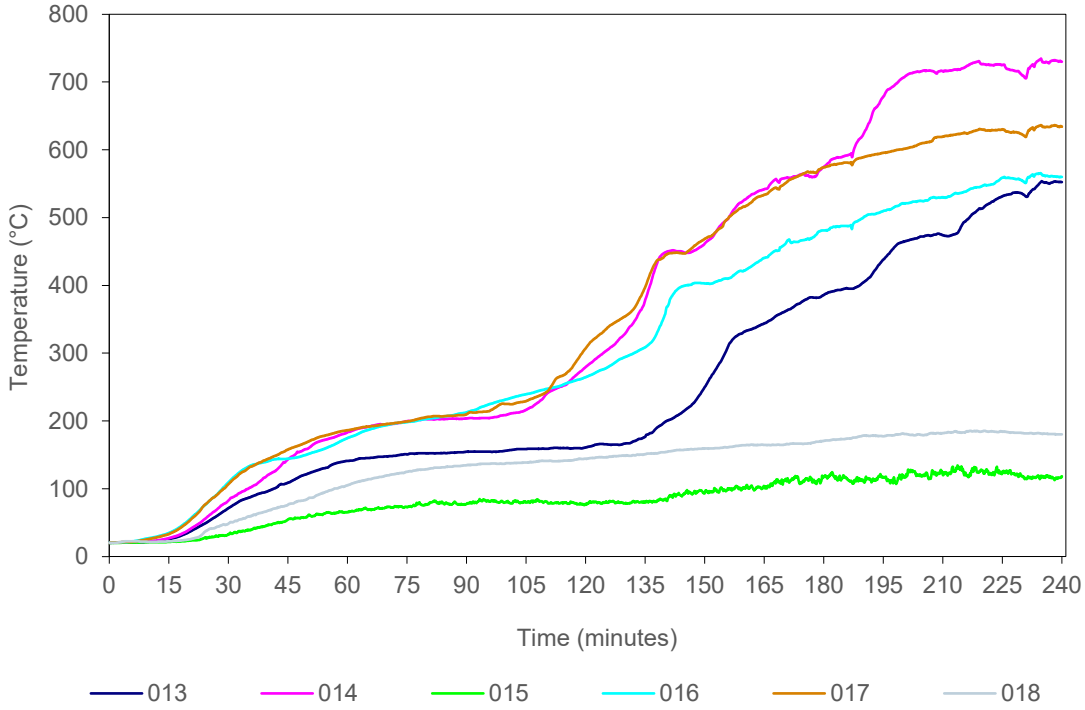


Figure 20 Penetration system A– temperature vs time

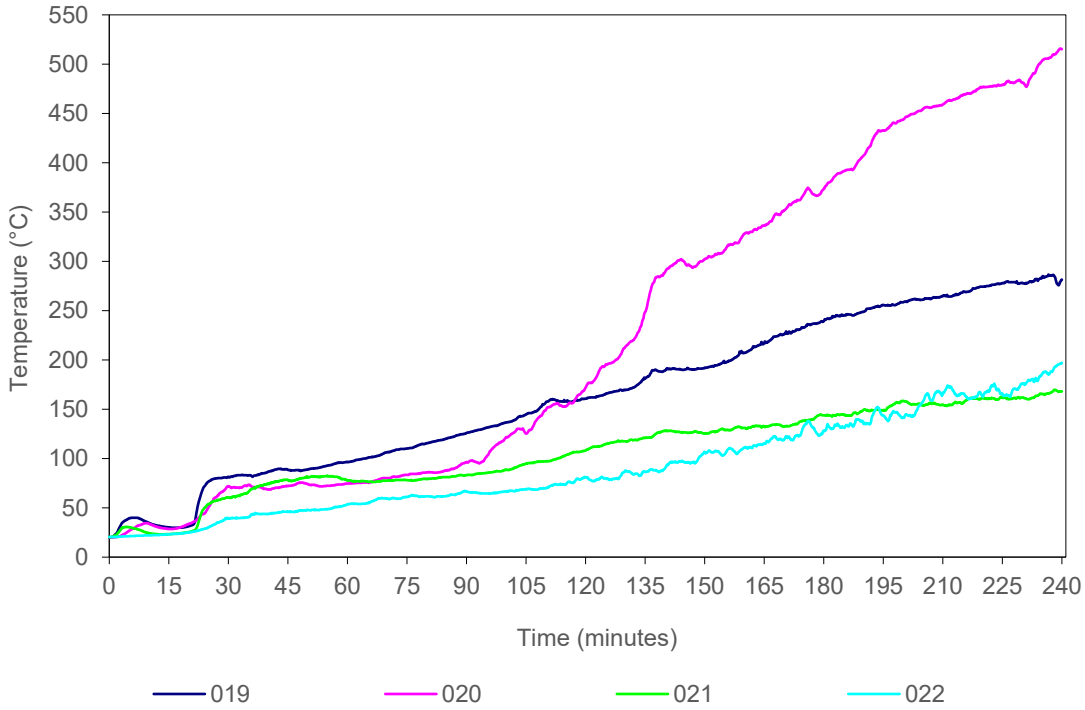


Figure 21 Penetration system A– temperature vs time

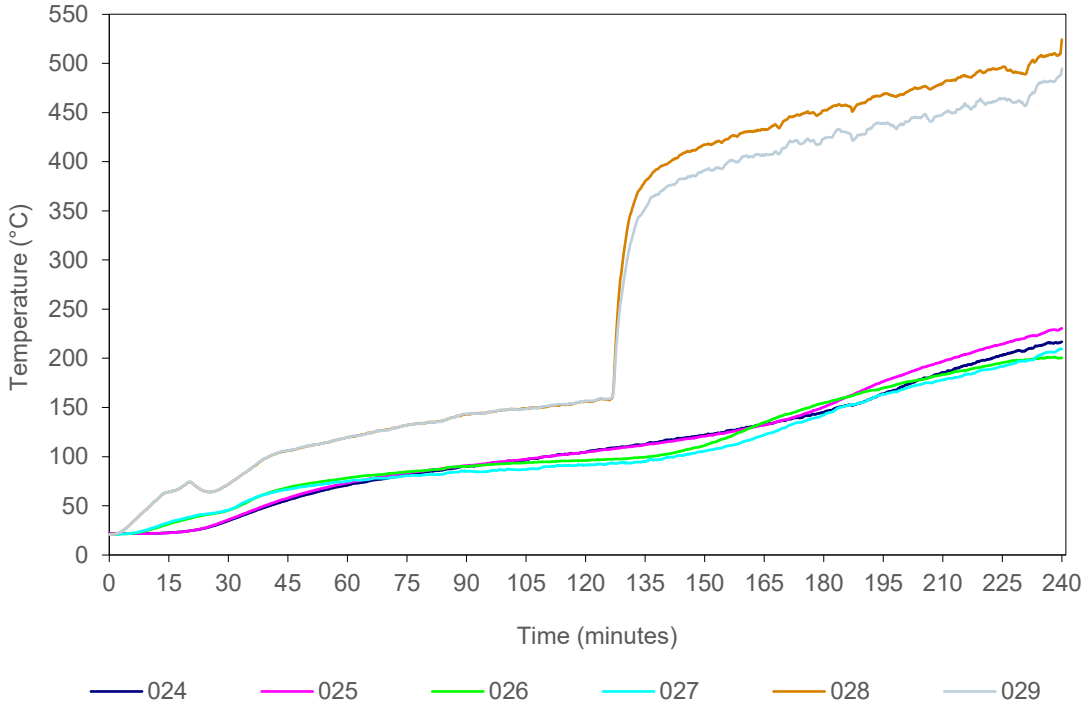


Figure 22 Penetration system B– temperature vs time

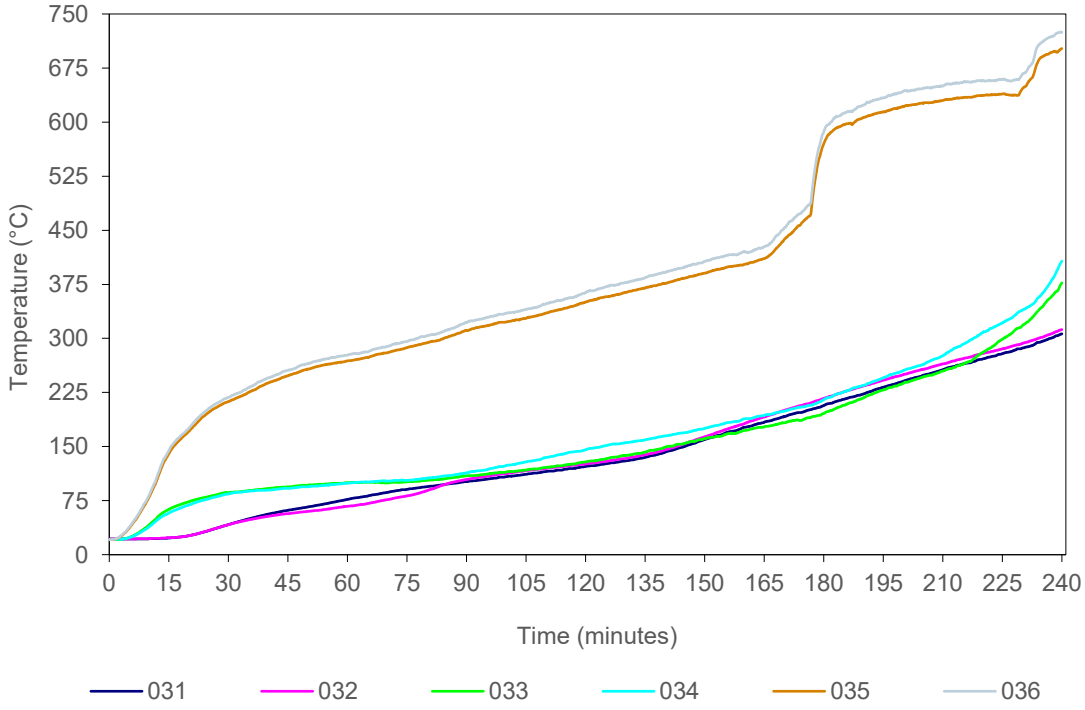


Figure 23 Penetration system C– temperature vs time

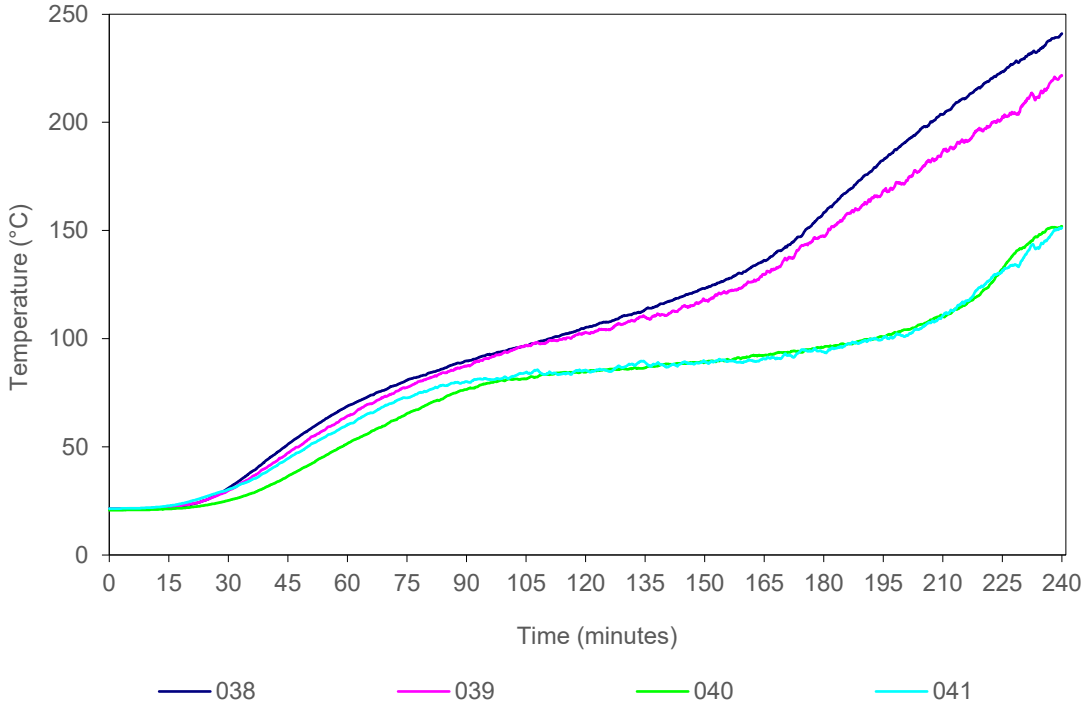


Figure 24 Penetration system D – temperature vs time

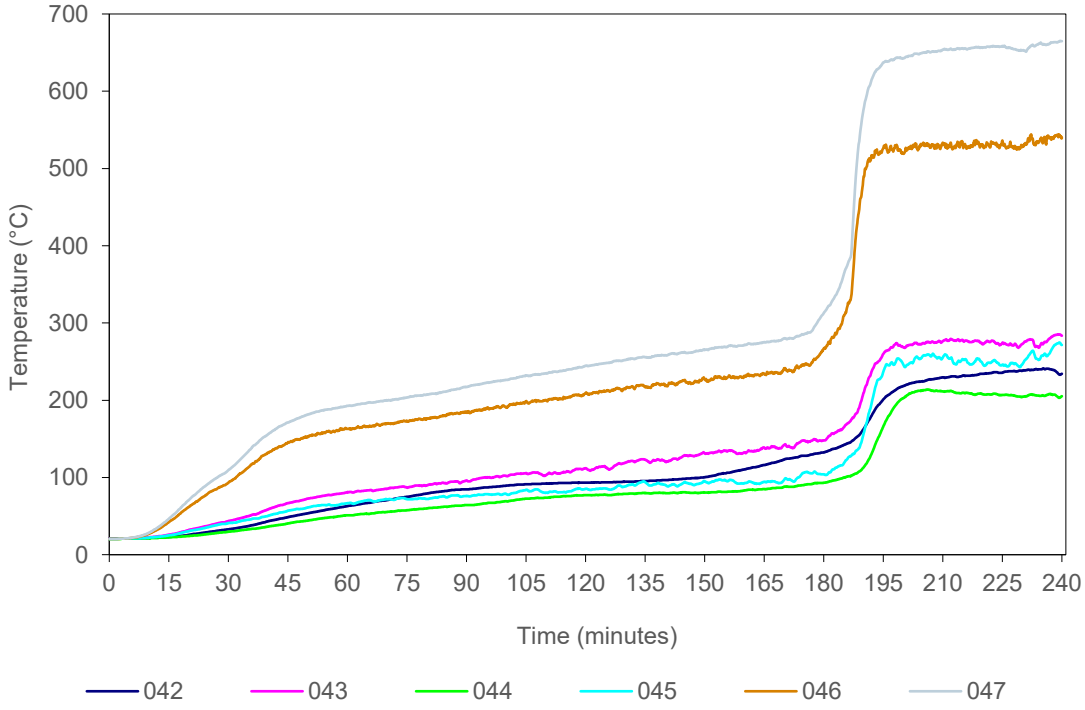


Figure 25 Penetration system B – temperature vs time

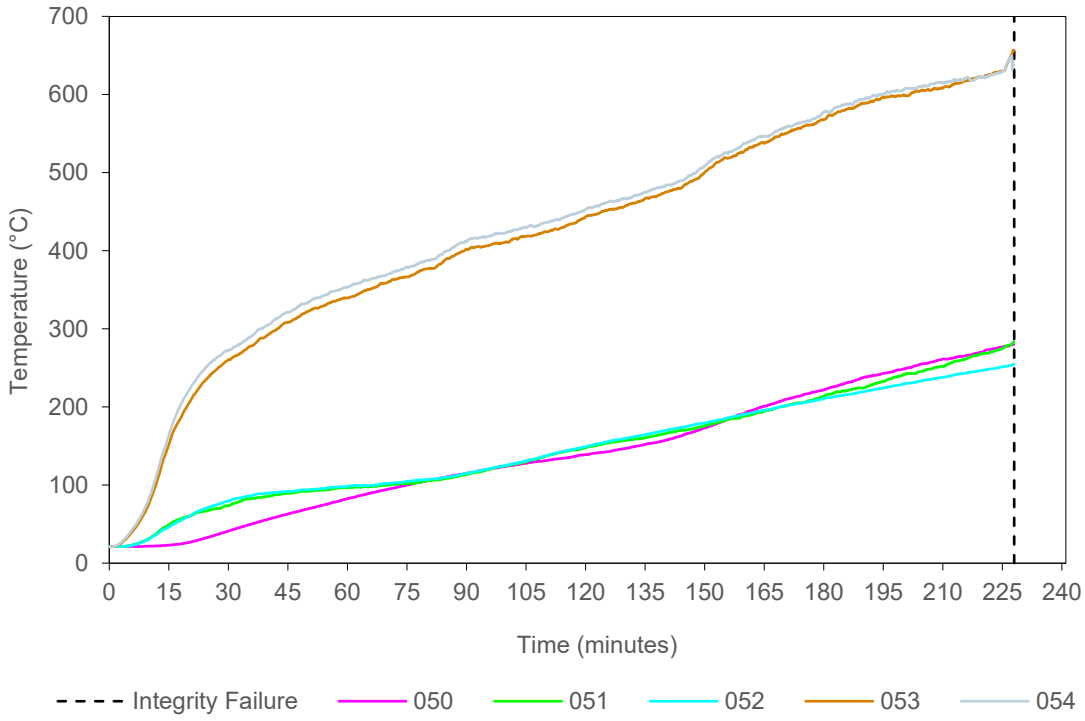


Figure 26 Penetration system E– temperature vs time

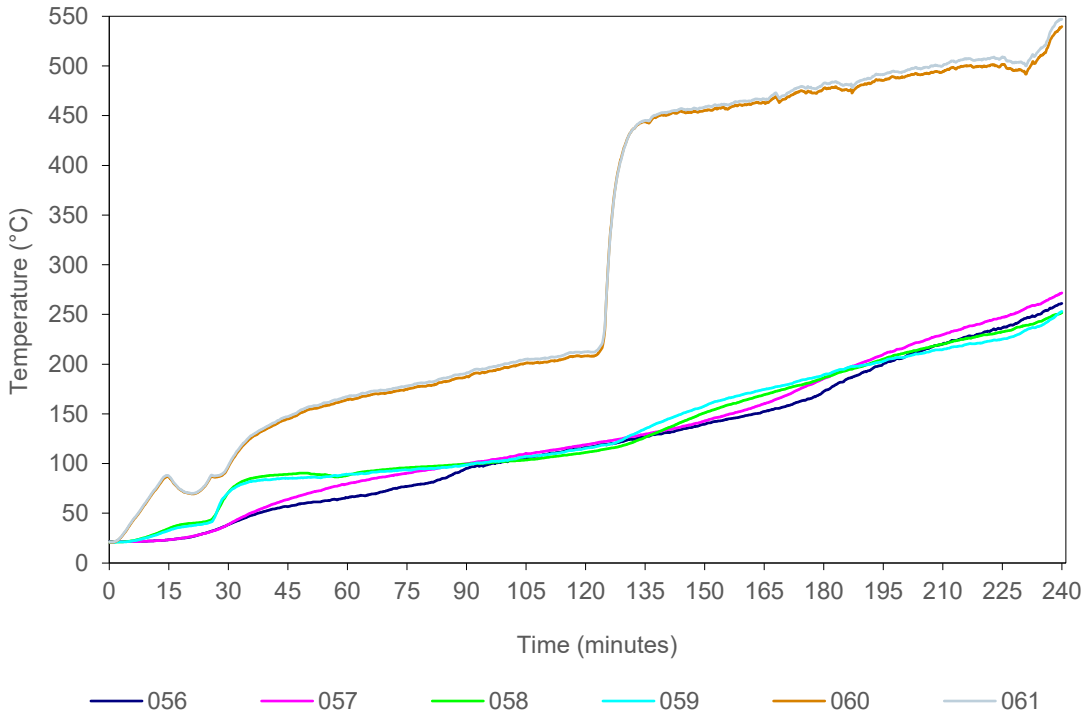


Figure 27 Penetration system C – temperature vs time

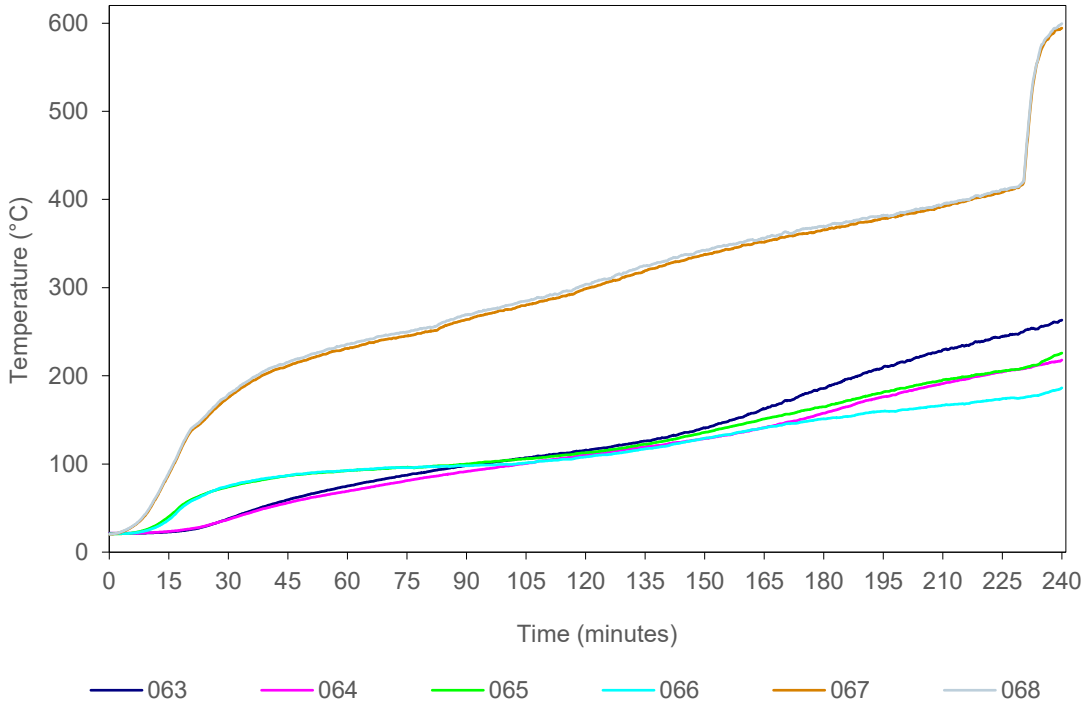


Figure 28 Penetration system D – temperature vs time

Table 12 Test specimen temperatures

Penetration system	TC No.	Description[1]	Temp (°C) at t (minutes)					Limit[2] (minutes)
			t=0	t=60	t=120	t=180	t=240	
A	001	On the separating element.	21	76	116	227	320	168
	002	On the separating element.	22	74	107	164	251	202
	003	On the centre of sealant.	21	91	107	181	272	191
	004	On the centre of sealant.	21	81	96	172	255	196
	005	On the centre of sealant.	21	86	97	179	243	196
	006	On the centre of sealant.	21	86	102	160	216	215
	007	On the eight 16 mm^2 cables.	20	199	287	420	551	60
	008	On the eight 16 mm^2 cables.	20	190	268	462	629	67
	009	On the eight 16 mm^2 cables.	20	66	93	134	161	-
	010	On the three 6 mm^2 cables.	20	120	150	407	529	138
	011	On the three 6 mm^2 cables.	20	124	182	432	562	134
	012	On the three 6 mm^2 cables.	20	46	65	120	178	-
	013	On the 185 mm^2 cable.	20	141	161	386	552	140
	014	On the 185 mm^2 cable.	20	183	279	575	730	76
	015	On the 185 mm^2 cable.	20	66	78	118	118	-
	016	On the 630 mm^2 cable.	21	175	265	481	560	77

Penetration system	TC No.	Description[1]	Temp (°C) at t (minutes)					Limit[2] (minutes)
			t=0	t=60	t=120	t=180	t=240	
	017	On the 630 mm^2 cable.	20	187	307	574	634	76
	018	On the 630 mm^2 cable.	20	105	144	171	180	-
	019	On the cable tray.	20	97	161	239	281	157
	020	On the cable tray.	20	75	172	374	515	127
	021	On the cable tray.	21	78	108	144	168	-
	022	On the cable tray.	20	54	81	128	197	-
B	024	On the separating element.	22	71	105	145	217	223
	025	On the separating element.	22	73	105	150	231	213
	026	On the centre of sealant.	21	78	96	155	201	238
	027	On the centre of sealant.	21	75	91	142	210	233
	028	On the service.	21	120	156	452	524	127
	029	On the service.	21	119	157	423	495	127
C	031	On the separating element.	22	77	122	207	306	176
	032	On the separating element.	22	67	126	217	312	170
	033	On the centre of sealant.	21	100	129	196	377	182
	034	On the centre of sealant.	21	99	146	215	407	171
	035	On the service.	21	269	351	570	702	26
	036	On the service.	21	277	364	586	725	24
D	038	On the separating element.	21	69	105	158	241	207
	039	On the separating element.	21	64	103	147	222	223
	040	On the centre of sealant.	21	52	85	96	152	-
	041	On the centre of sealant.	21	60	86	94	151	-
	042	On the wrap.	21	63	93	132	234	195
	043	On the wrap.	21	81	112	148	283	189
	044	On the wrap.	20	51	77	93	205	199
	045	On the wrap.	20	67	85	104	271	192
	046	On the service.	20	163	210	267	540	110
	047	On the service.	20	193	245	313	665	71
E	049	On the separating element.	21	81	129	218	*	170
	050	On the separating element.	21	83	139	222	*	165
	051	On the centre of sealant.	21	97	148	214	*	170
	052	On the centre of sealant.	21	98	149	211	*	170
	053	On the service.	21	340	444	568	*	19
	054	On the service.	21	353	453	577	*	17
F	056	On the separating element.	22	66	116	172	261	195
	057	On the separating element.	21	80	119	186	272	189
	058	On the centre of sealant.	21	88	111	186	252	192

Penetration system	TC No.	Description[1]	Temp (°C) at t (minutes)					Limit[2] (minutes)
			t=0	t=60	t=120	t=180	t=240	
	059	On the centre of sealant.	21	89	115	189	253	193
	060	On the service.	21	165	208	478	540	105
	061	On the service.	21	167	213	483	547	100
G	063	On the separating element.	21	75	116	186	263	189
	064	On the separating element.	22	69	110	158	218	220
	065	On the centre of sealant.	21	93	113	165	226	218
	066	On the centre of sealant.	21	93	108	151	187	-
	067	On the service.	21	231	299	366	595	38
	068	On the service.	21	236	304	370	600	37

Note:

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

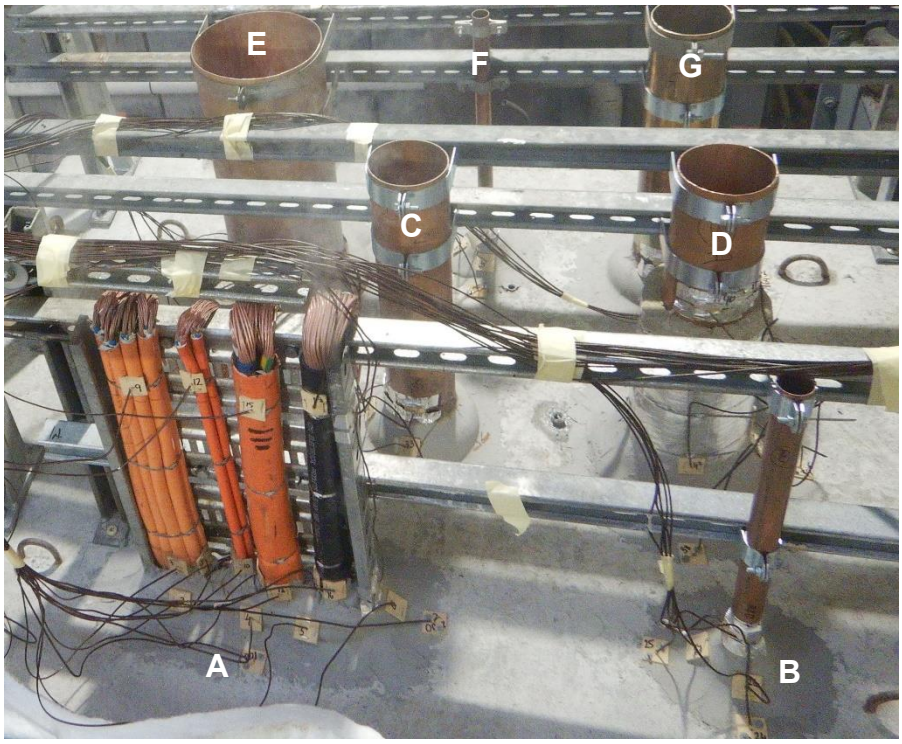
2 Limit time is the time to the nearest whole minute, rounded down to the nearest minute, at which the temperature recorded by the thermocouple does not rise by more than 180 K above the initial temperature.

3 No insulation failure before thermocouple malfunction.

* Integrity failure of the penetration systems

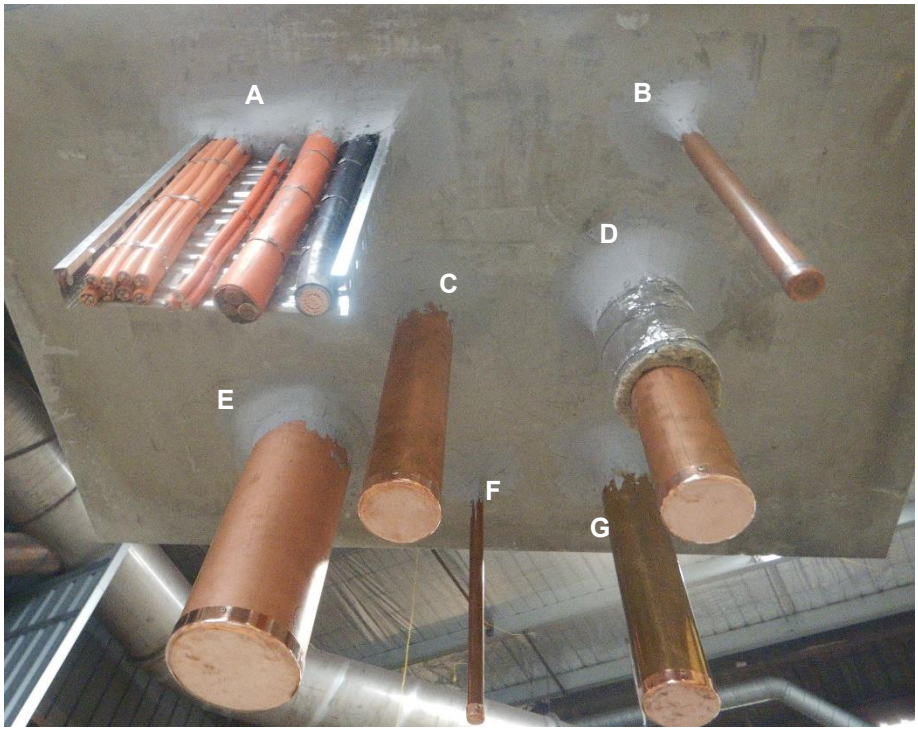
‘ – ’ Under limit column indicates the temperature limit was not exceeded during the test period or up until the time of integrity failure if a failure occurred.

Appendix F Photographs



West East

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



West East

Figure 30 Exposed face of the specimen before the start of the test

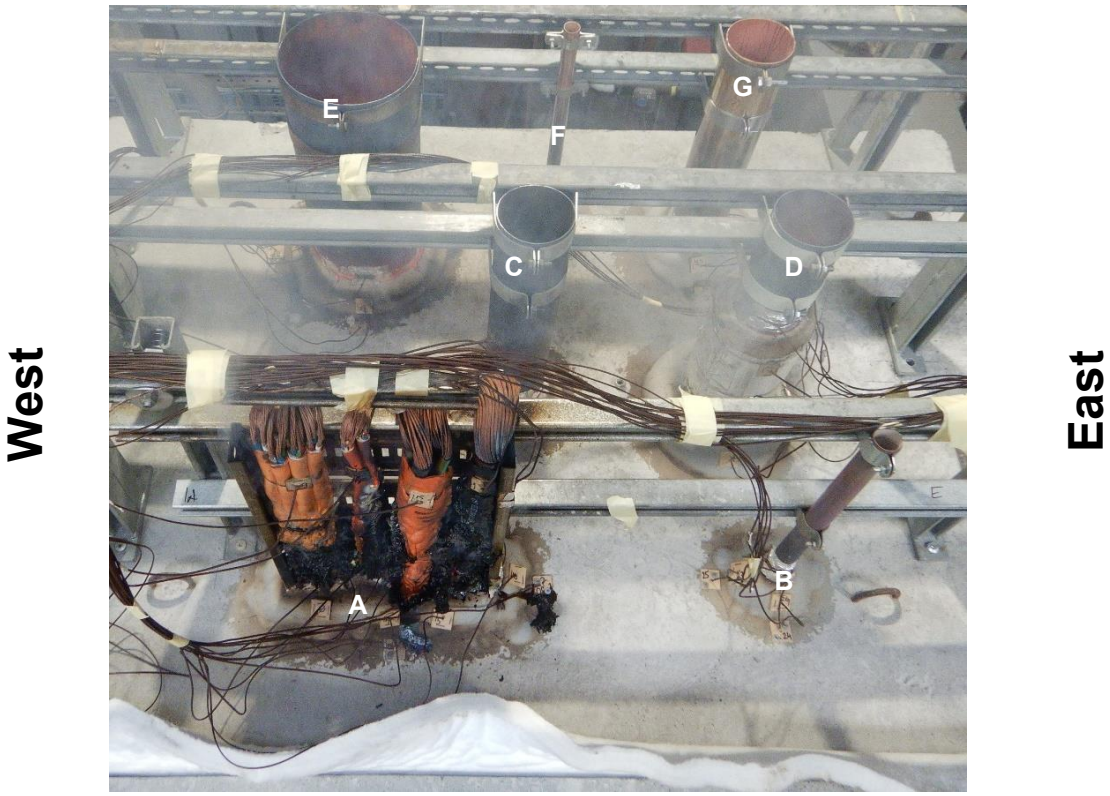


Figure 31 Unexposed face of the specimen at the end of the test

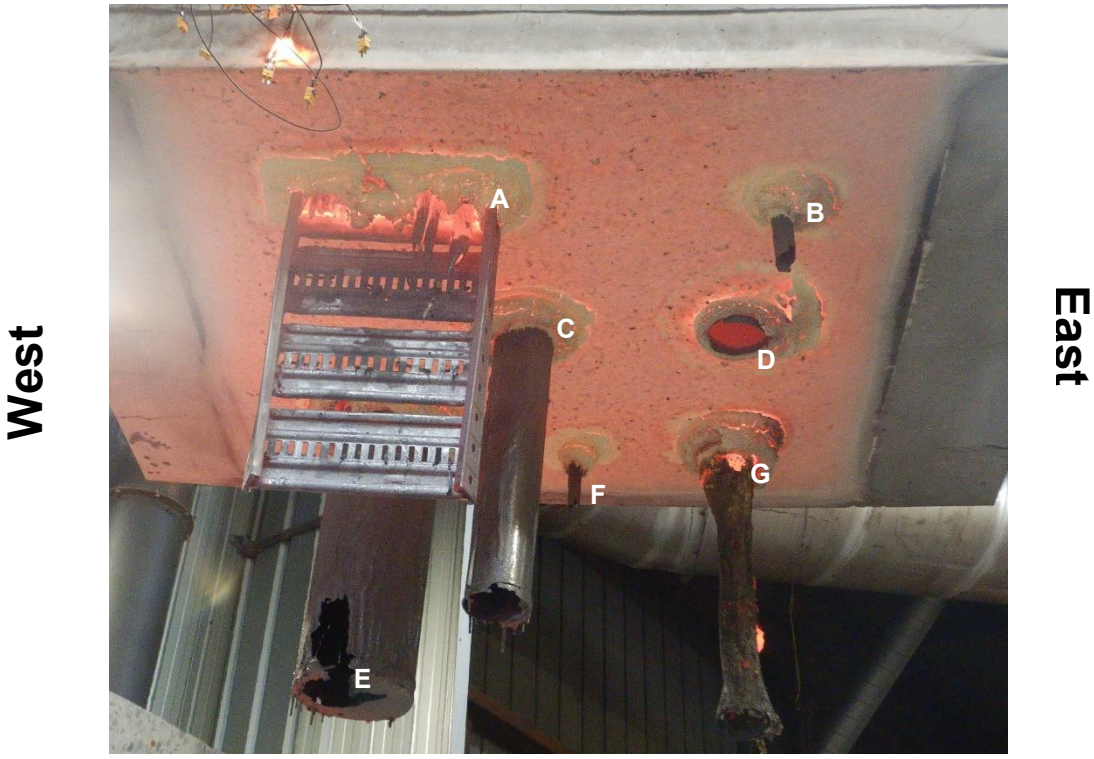


Figure 32 Exposed face of the specimen at the end of the test

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