



Fire resistance test report

Penetration systems tested in accordance with AS 1530.4:2014



Test sponsor: Allproof Industries NZ Limited

Products: Allproof ALLFC25Galv fire collar and Bostik Firecaulk sealant

Job number: FRT190057 Test number: FRT180434

Test date: 13 December 2018 Revision: R1.0

Amendment schedule

Version	Date	Information relating to report			
R1.0	19/03/2019	Description	Initial issue as an additional report for test number FRT180434.		
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Exova Warringtonfire rebranded to Warringtonfire on 1 December 2018. Apart from the change to our brand name, no other changes have occurred. The introduction of our new brand name does not affect the validity of any existing documents we have previously issued.

Executive summary

This report documents the findings of the fire resistance test of penetration systems undertaken on 13 December 2018 in accordance with section 2 and 10 of AS 1530.4:2014 as test number FRT180434. Warringtonfire Australia did the test at the request of Allproof Industries NZ Limited.

Table 1 Test sponsor details

Test Sponsor	Address
Allproof Industries NZ Limited	17 Bay Park Place Beach Haven 0626 Auckland New Zealand

The test specimen consisted of 90mm thick plasterboard wall system consisting of one layer of 13mm thick fire-rated plasterboard on either side of 64mm thick steel frame system penetrated by nine penetration systems, of which four are reported in this report. A summary of the penetration systems is provided in Table 2.

Table 2 Test summary

Penetration system	Service	Local fire-stopping protection		Aperture size (mm)	Fire resistance rating (FRR)
A	Ø28mm Polybute pipe	Allproof ALLFC25Galv fire-collar	Bostik Firecaulk sealant	Ø32mm	-/60/60
B	Ø22mm Polybute pipe			Ø25mm	-/60/45
F	Ø18mm Polybute pipe			Ø20mm	-/60/30
G	Ø15mm Polybute Pipe			Ø16mm	-/60/30

Contents

Amendment schedule	2
Executive summary	4
Contents	5
1. Introduction	6
2. Construction details	6
3. Schedule of components	7
4. Test procedure	11
5. Test measurements and results	12
6. Application of test results	13
6.1 Test limitations	13
6.2 Variations from the tested specimen	13
6.3 Uncertainty of measurements	13
Appendix A Drawings of test assembly	14
Appendix B Test observations	20
Appendix C Direct field of application	22
Appendix D Instrumentation locations	24
Appendix E Test data	26
Appendix F Photographs	32

1. Introduction

This report documents the findings of the fire resistance test of penetration systems undertaken on 13 December 2018 in accordance with section 2 and 10 of AS 1530.4:2014 as test number FRT180434. Warringtonfire Australia did the test at the request of Allproof Industries NZ Limited.

Table 3 Test sponsor details

Test Sponsor	Address
Allproof Industries NZ Limited	17 Bay Park Place Beach Haven 0626 Auckland New Zealand

2. Construction details

Table 4 provides details of the test assembly. Table 5 provides a summary of the test specimen. A full description of the specimen is provided in Appendix A and section 3. Table 6 shows the installation method and orientation of the test specimen.

Table 4 Test assembly

Item	Detail
Separating element	90mm thick plasterboard wall system consisting of one layer of 13mm thick fire-rated plasterboard on either side of 64mm thick steel frame system.
Nominal separating element size	Width (w): 1200mm Height (h): 1200mm Thickness (t): 90mm
Number of penetration systems	Nine penetration systems were tested and four penetration systems are reported.
Restraint conditions	Restrained on all edges.

Table 5 Test specimen

Penetration system	Service	Local fire-stopping protection		Aperture size (mm)
A	Ø28mm Polybute pipe	Allproof ALLFC25Galv fire-collar	Bostik Firecaulk sealant	Ø32mm
B	Ø22mm Polybute pipe			Ø25mm
F	Ø18mm Polybute pipe			Ø20mm
G	Ø15mm Polybute Pipe			Ø16mm

Table 6 Installation method and orientation

Item	Detail
Start date of separating element construction	11 December 2018
Start date of penetration systems installation	12 December 2018
Completion date of test specimen construction and installation	13 December 2018
Separating element constructed by	Representatives of Warringtonfire Melbourne.
Penetration system installed by	Representatives of Warringtonfire Melbourne.
Orientation	Asymmetrical, due to services being supported on the unexposed side only and the pipes being capped on the exposed side only.

3. Schedule of components

Table 7 lists the schedule of components for the test specimen which were surveyed by Warringtonfire Australia.

Table 7 Schedule of components

Item	Description		
Separating element			
1.	Item name	13mm fire-rated plasterboard	
	Product name	13mm CSR Fyrchek Plasterboard	
	Density	833 kg/m ³ (measured)	
	Size	3000mm wide × 1200mm high × 13mm thick	
2.	Item name	64mm steel frame	
	Product name	64mm × 0.5 BMT steel stud, 64mm × 0.7 BMT nogging track, and 64mm × 50mm × 0.5 BMT wall track	
	Size	1200mm wide × 1200mm high × 64mm thick	
SE	Size	1200mm wide × 1200mm high × 90mm thick	
	Specification	<p>One layer of 13mm fire-rated plasterboard (item 1) fixed onto both sides of the steel framing (item 2) to construct a nominal 1200mm wide × 1200mm high × 90 thick plasterboard wall system. The studs were located at nominal maximum 385mm centres.</p> <p>The plasterboard was secured to the steel frame with plasterboard screws (item 9) at nominal 300mm centres.</p> <p>Ø6mm × 60mm long masonry anchors (item 10) were used to secure the steel frame to the perimeter blockwork.</p> <p>Mineral wool was inserted in the studs and noggings of the steel frame to insulate the different segments.</p> <p>See Appendix A for more details.</p>	
Fire-stopping protections			
Sealant			
3.	Item name	Sealant	
	Product name	Bostik Firecaulk Fire and Acoustic-rated Acrylic Construction Sealant	
	Installation	The sealant was applied at the annular gaps between the services and the separating element as a smoke seal on both the exposed and unexposed sides.	
Fire collar			
4.	Item name	Fire collar	
	Product name	Allproof Industries ALLFC25GALV fire collar	
	Collar details	Outer diameter (OD)	45mm (measured)
		Inner diameter (ID)	32mm (measured)
		Height (h)	26mm (measured)
Outer shell thickness (t)		0.59mm thick galvanised steel (measured)	
Intumescent details	Number of layers	1	
	Width (w)	26mm	
	Thickness (t)	5.9mm	
	Density	1211kg/m ³	

Item	Description	
	Installation	The fire-collar was fixed to both the exposed and unexposed side of the separating element through two flanges with M5 × 9mm hollow wall anchor (item 11).
Services		
5.	Item name	Ø28mm Polybute pipe
	Product name	DUX28 PN 16 P.B. L1
	Size	Outer diameter (OD) 28mm (measured) Inner diameter (ID) 22mm (measured) Thickness (t) 2.94mm (measured)
6.	Item name	Ø22mm Polybute pipe
	Product name	DUX22 PN 16 P.B. L1
	Size	Outer diameter (OD) 22mm (measured) Inner diameter (ID) 18mm (measured) Thickness (t) 2.14mm (measured)
7.	Item name	Ø18mm Polybute pipe
	Product name	DUX18 PN 16 P.B. L1
	Size	Outer diameter (OD) 16mm (measured) Inner diameter (ID) 13mm (measured) Thickness (t) 1.64mm (measured)
8.	Item name	Ø15mm Polybute pipe
	Product name	DUX15 PN 16 P.B. L1
	Size	Outer diameter (OD) 13mm (measured) Inner diameter (ID) 10mm (measured) Thickness (t) 1.68mm (measured)
Fixings		
9.	Item name	Plasterboard screws
	Product name	6g × 32mm fine thread needle point screws
	Installation	To secure the plasterboard (item 1) to the steel framing (item 2) at nominal 300mm centres.
10.	Item name	Masonry anchors
	Description	Ø6mm × 60mm long masonry anchors
	Installation	To secure the steel framing (item 2) to the perimeter block work.
11.	Item name	Hollow wall anchors
	Product name	Ramset™ Hollow Wall Anchor M5×9mm zinc
	Installation	Used to secure the fire-collars (item 4) to the separating element.
Penetration system A		
A	Service	Ø28mm Polybute pipe (item 5)
	Service detail	Protruded nominally 530mm on the exposed side and 2000mm on the unexposed side of the separating element. The pipe was capped on the exposed side to a nominal depth of 30mm with ceramic fibre wool and sealant.

Item	Description	
	Service support	The service was supported on the unexposed side of the separating element at nominal 500mm and 1500mm centres from the unexposed face of the separating element.
	Aperture size	Ø32mm
	Local fire-stopping protection	
	Protection	<p>Sealant (item 3) was applied at the annular gap between the service and the separating element as a smoke seal on both the exposed and unexposed sides.</p> <p>Allproof Industries ALLFC25GALV fire-collar (item 4) was installed on both the exposed and unexposed side of the separating element through two flanges with M5 × 9mm hollow wall anchor (item 11).</p> <p>See Figure 1, Figure 2, and Figure 3 in Appendix A for more details.</p>
Penetration system B		
B	Service	Ø22mm Polybute pipe (item 6)
	Service detail	<p>Protruded nominally 530mm on the exposed side and 2000mm on the unexposed side of the separating element.</p> <p>The pipe was capped on the exposed side to a nominal depth of 30mm with ceramic fibre wool and sealant.</p>
	Service support	The service was supported on the unexposed side of the separating element at nominal 500mm and 1500mm centres from the unexposed face of the separating element.
	Aperture size	Ø25mm
	Local fire-stopping protection	
	Protection	<p>Sealant (item 3) was applied at the annular gap between the service and the separating element as a smoke seal on both the exposed and unexposed sides.</p> <p>Allproof Industries ALLFC25GALV fire-collar (item 4) was installed on both the exposed and unexposed side of the separating element through two flanges with M5 × 9mm hollow wall anchor (item 11).</p> <p>See Figure 1, Figure 2, and Figure 4 in Appendix A for more details.</p>
Penetration system F		
F	Service	Ø18mm Polybute pipe (item 7)
	Service detail	<p>Protruded nominally 530mm on the exposed side and 2000mm on the unexposed side of the separating element.</p> <p>The pipe was capped on the exposed side to a nominal depth of 30mm with ceramic fibre wool and sealant.</p>
	Service support	The service was supported on the unexposed side of the separating element at nominal 500mm and 1500mm centres from the unexposed face of the separating element.
	Aperture size	Ø20mm
	Local fire-stopping protection	
	Protection	<p>Sealant (item 3) was applied at the annular gap between the service and the separating element as a smoke seal on both the exposed and unexposed sides.</p> <p>Allproof Industries ALLFC25GALV fire-collar (item 4) was installed on both the exposed and unexposed side of the separating element through two flanges with M5 × 9mm hollow wall anchor (item 11).</p> <p>See Figure 1, Figure 2, and Figure 5 in Appendix A for more details.</p>
Penetration system G		
G	Service	Ø15mm Polybute pipe (item 8)

Item	Description	
	Service detail	Protruded nominally 530mm on the exposed side and 2000mm on the unexposed side of the separating element. The pipe was capped on the exposed side to a nominal depth of 30mm with ceramic fibre wool and sealant.
	Service support	The service was supported on the unexposed side of the separating element at nominal 500mm and 1500mm centres from the unexposed face of the separating element.
	Aperture size	Ø16mm
	Local fire-stopping protection	
	Protection	Sealant (item 3) was applied at the annular gap between the service and the separating element as a smoke seal on both the exposed and unexposed sides. Allproof Industries ALLFC25GALV fire-collar (item 4) was installed on both the exposed and unexposed side of the separating element through two flanges with M5 × 9mm hollow wall anchor (item 11). See Figure 1, Figure 2, and Figure 6 in Appendix A for more details.

4. Test procedure

Table 8 details the test procedure for this fire resistance test.

Table 8 Test procedure

Item	Detail	
Statement of compliance	The test was performed in accordance with the requirements of section 2 and 10 of AS 1530.4:2014 appropriate for service penetrations.	
Variations	<ul style="list-style-type: none"> None 	
Pre-test conditioning	The construction and installation of the test specimen was completed on 13 December 2018. 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	21°C
	Minimum temperature	21°C
	Maximum temperature	25°C
Test duration	66 minutes	
Instrumentation and equipment	<p>The instrumentation was provided in accordance with AS 1530.4:2014 as follow:</p> <ul style="list-style-type: none"> The furnace temperature was measured by four mineral insulated metal sheathed Type K thermocouples – with wire diameters not greater than 1mm, an overall diameter of 3mm, and the measuring junction insulated from the sheath. The thermocouples protruded a minimum of 25mm from steel supporting tubes. The non-fire side specimen temperatures were measured by Type K thermocouples with wire diameters less than 0.5mm soldered to 12mm diameter × 0.2mm thick copper discs covered by 30mm × 30mm × 2.0mm inorganic insulating pads. The thermocouple positions are shown in Table 11 and Figure 7 to Figure 10 in Appendix D. A roving thermocouple was available to measure temperatures at positions that appeared hotter than the positions monitored by the fixed thermocouples. The furnace pressure was measured at 300mm above mid-height of the lowest penetration and corrected to mid-height of the lowest penetration. Cotton pads were available during the test to assess the performance of the specimen under the criteria for integrity. 	

5. Test measurements and results

The measurements taken for the pressure and temperature of the furnace and test specimen are included in Appendix E. Table 10 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 9 summarises the results the specimen achieved against the performance criteria listed in sections 2 and 10 of AS 1530.4:2014.

Table 9 Test results

Penetration system	Criteria	Results	Fire resistance rating (FRR)
A	Structural adequacy	Not applicable	-/60/60
	Integrity	No failure at 66 minutes	
	Insulation	Failure at 60 minutes	
B	Structural adequacy	Not applicable	-/60/45
	Integrity	No failure at 66 minutes	
	Insulation	Failure at 57 minutes	
F	Structural adequacy	Not applicable	-/60/30
	Integrity	No failure at 66 minutes	
	Insulation	Failure at 44 minutes	
G	Structural adequacy	Not applicable	-/60/30
	Integrity	No failure at 66 minutes	
	Insulation	Failure at 39 minutes	

6. Application of test results

6.1 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 the construction under the particular conditions of the test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use, and they do not necessarily reflect the actual behaviour in fires.

6.2 Variations from the tested specimen

This report details methods of construction, the test conditions and the results obtained when the specific element of construction described herein was tested 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 Australia Pty Ltd or another registered testing authority.

6.3 Uncertainty of measurements

It is not possible to provide a stated degree of accuracy for the results, because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance.

Appendix A Drawings of test assembly

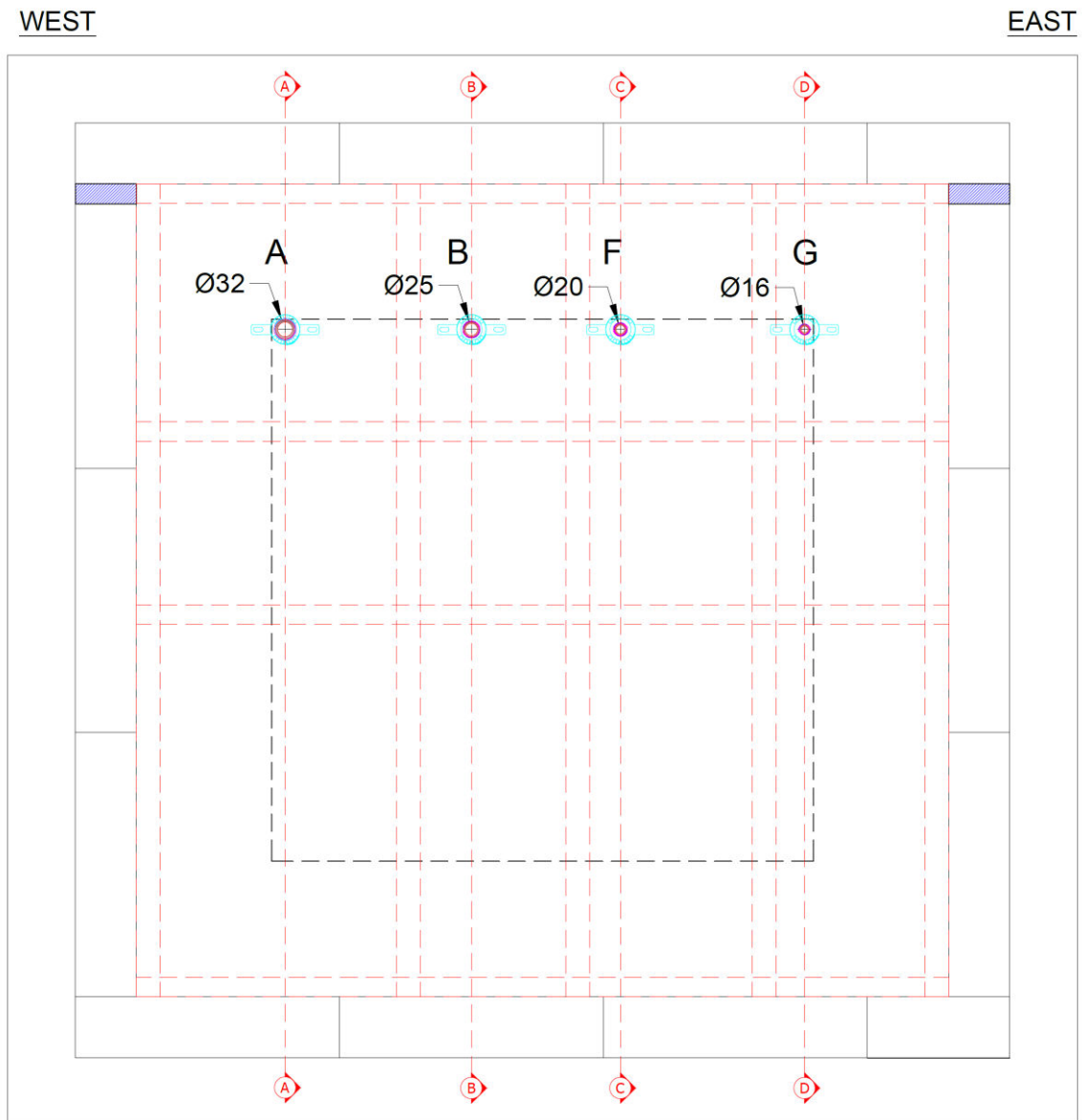


Figure 1 Elevation view of test specimen (unexposed side)

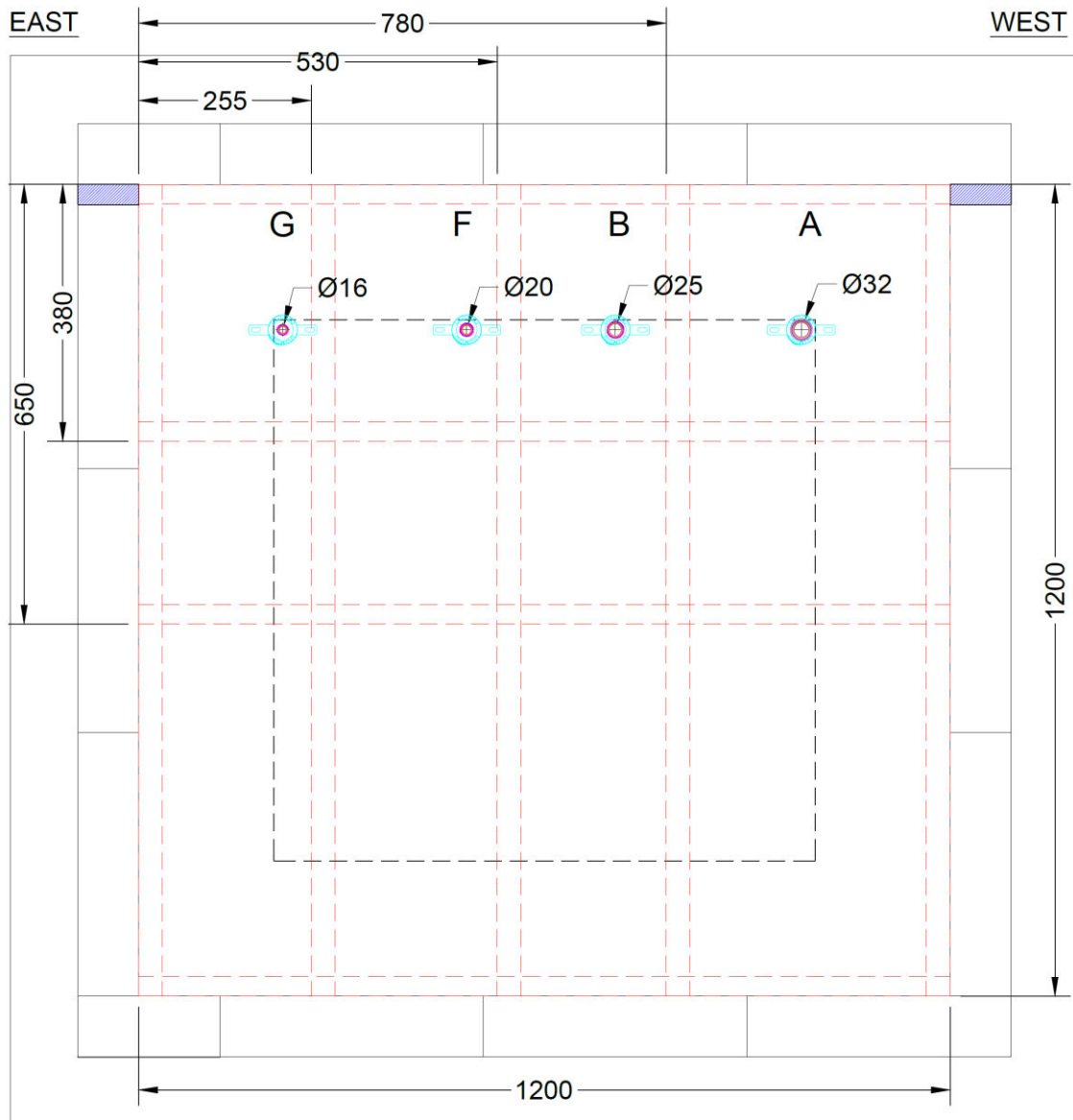


Figure 2 Elevation view of test specimen (exposed side)

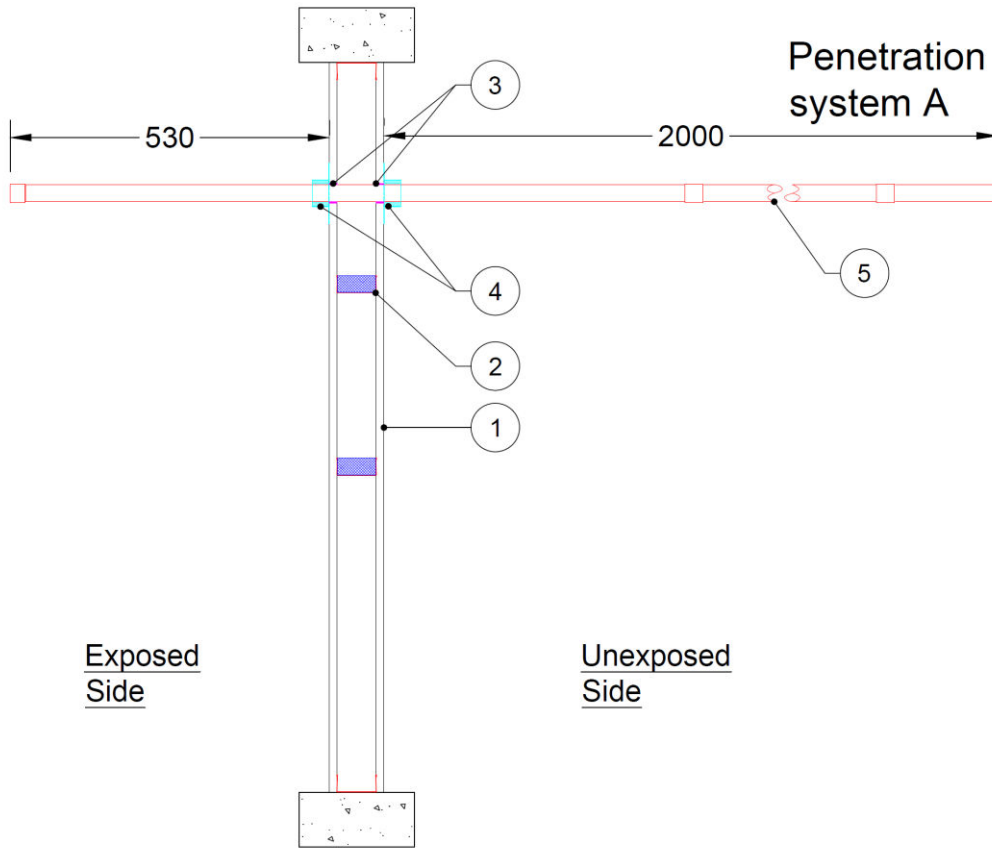


Figure 3 Cross-section A-A

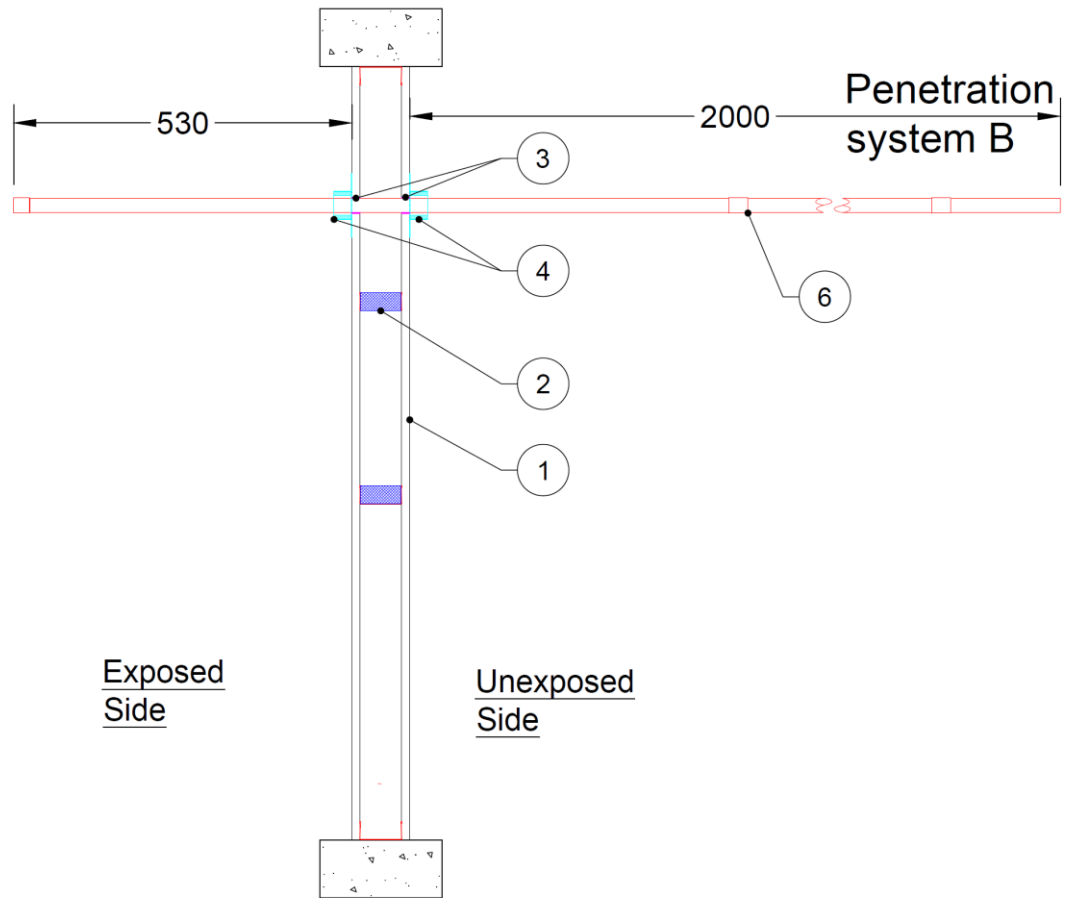


Figure 4 Cross-section B-B

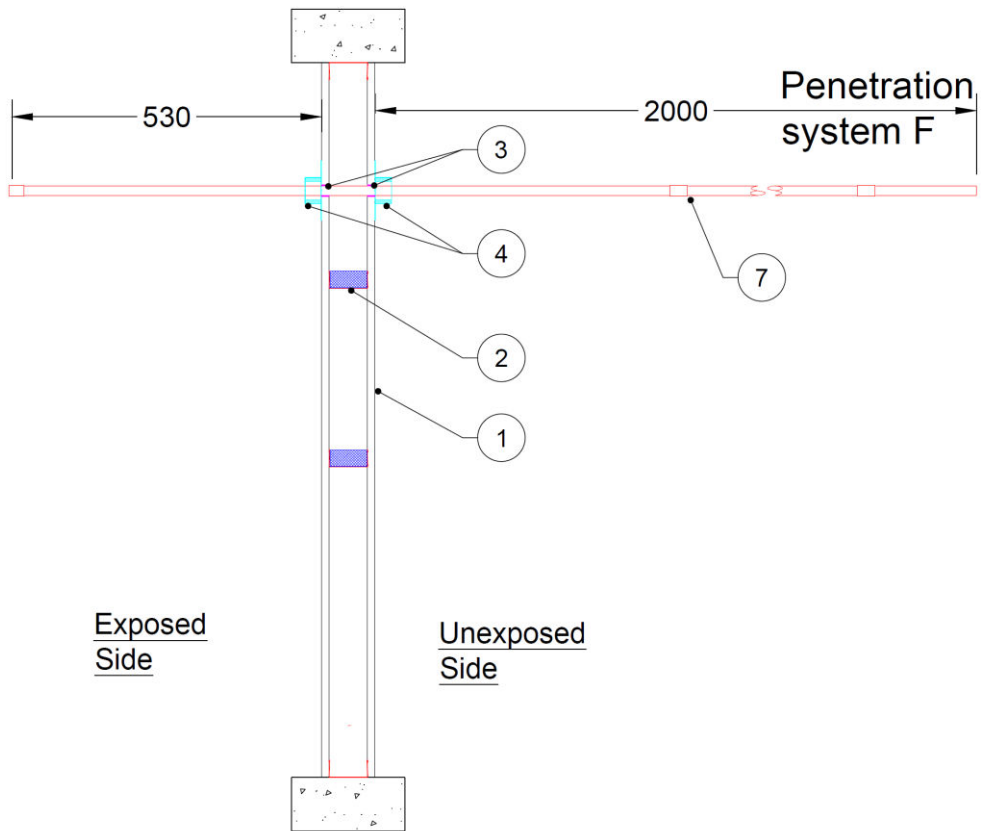


Figure 5 Cross-section C-C

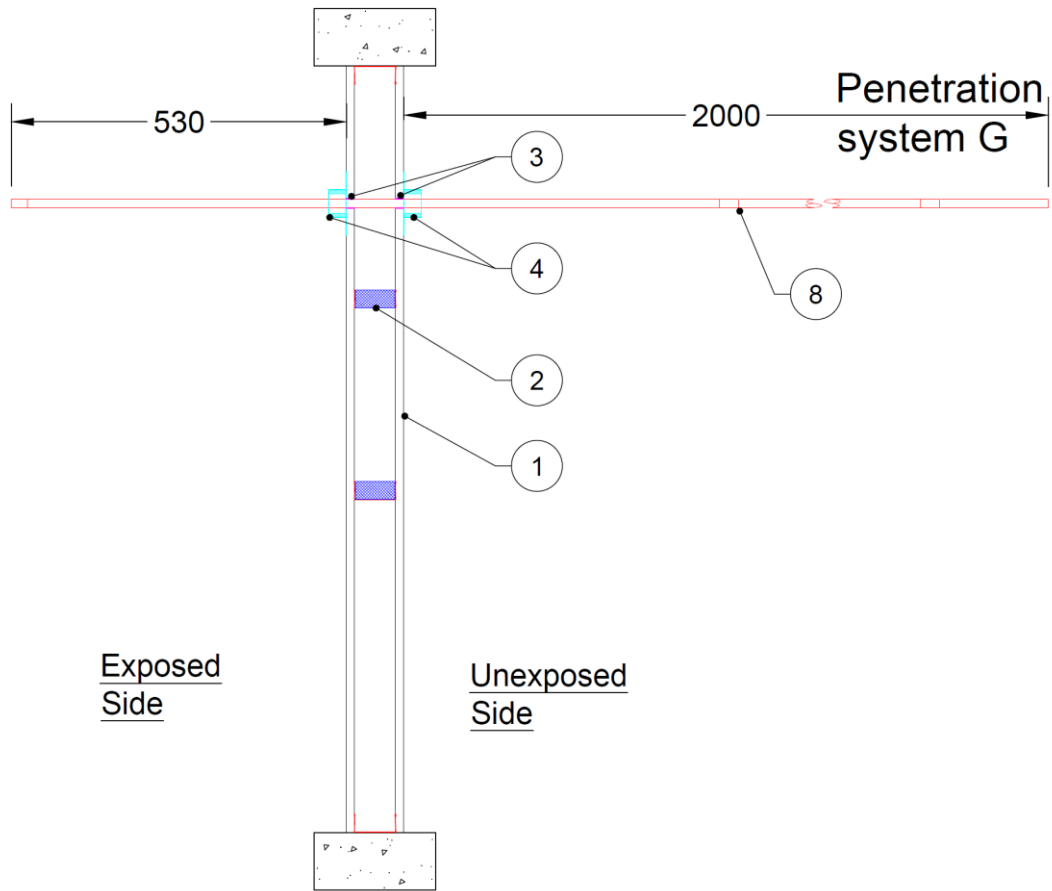


Figure 6 Cross-section D-D

Appendix B Test observations

Table 10 shows observations of any significant behaviour of the specimen during the test.

Table 10 Test observations

Time		Observation
Min	Sec	
Penetration system A		
00	00	Fire resistance test commenced, and the initial temperature of the specimen was approximately 22°C.
03	36	Smoke emitting from the fire collar.
30	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
50	42	Smoke emitting from the fire collar and aperture.
57	33	Plasterboard has discoloured below mid-height of the separating element.
60	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	50	TC 012 on the separating element, 25mm from the fire collar recorded a temperature of 202°C. Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 012 exceeded the initial temperature by more than 180K.
66	00	Test terminated at the request of the sponsor.
Penetration system B		
00	00	Fire resistance test commenced, and the initial temperature of the specimen was approximately 22°C.
30	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
50	42	Smoke emitting from the fire collar and aperture.
57	33	Plasterboard has discoloured below mid-height of the separating element.
57	50	TC 021 on the separating element, 25mm from the fire collar recorded a temperature of 202°C. Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 021 exceeded the initial temperature by more than 180K.
60	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
66	00	Test terminated at the request of the sponsor.
Penetration system F		
00	00	Fire resistance test commenced, and the initial temperature of the specimen was approximately 22°C.
30	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
38	09	Service has deformed near the fire collar.
44	55	TC 105 on the service, 25mm from the fire collar recorded a temperature of 202°C. Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 105 exceeded the initial temperature by more than 180K.
46	02	Service has further deformed near the fire collar.
50	42	Smoke emitting from the fire collar and aperture.

Time		Observation
Min	Sec	
57	33	Plasterboard has discoloured below mid-height of the separating element.
60	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
66	00	Test terminated at the request of the sponsor.
Penetration system G		
00	00	Fire resistance test commenced, and the initial temperature of the specimen was approximately 21°C.
03	36	Smoke emitting from the fire collar.
17	12	Smoke continues to emit from the fire collar.
30	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
38	09	Service has deformed near the fire collar.
39	10	TC 115 on the service, 25mm from the fire collar recorded a temperature of 202°C. Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 115 exceeded the initial temperature by more than 180K.
46	02	Service has further deformed near the fire collar.
50	42	Smoke emitting from the fire collar and aperture.
57	33	Plasterboard has discoloured below mid-height of the separating element.
60	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
66	00	Test terminated at the request of the sponsor.

Appendix C Direct field of application

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

C.1 General

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

C.2 Separating elements

Results obtained 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 $\pm 15\%$ 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 Plastic pipes

C.3.1 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.3.2 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.

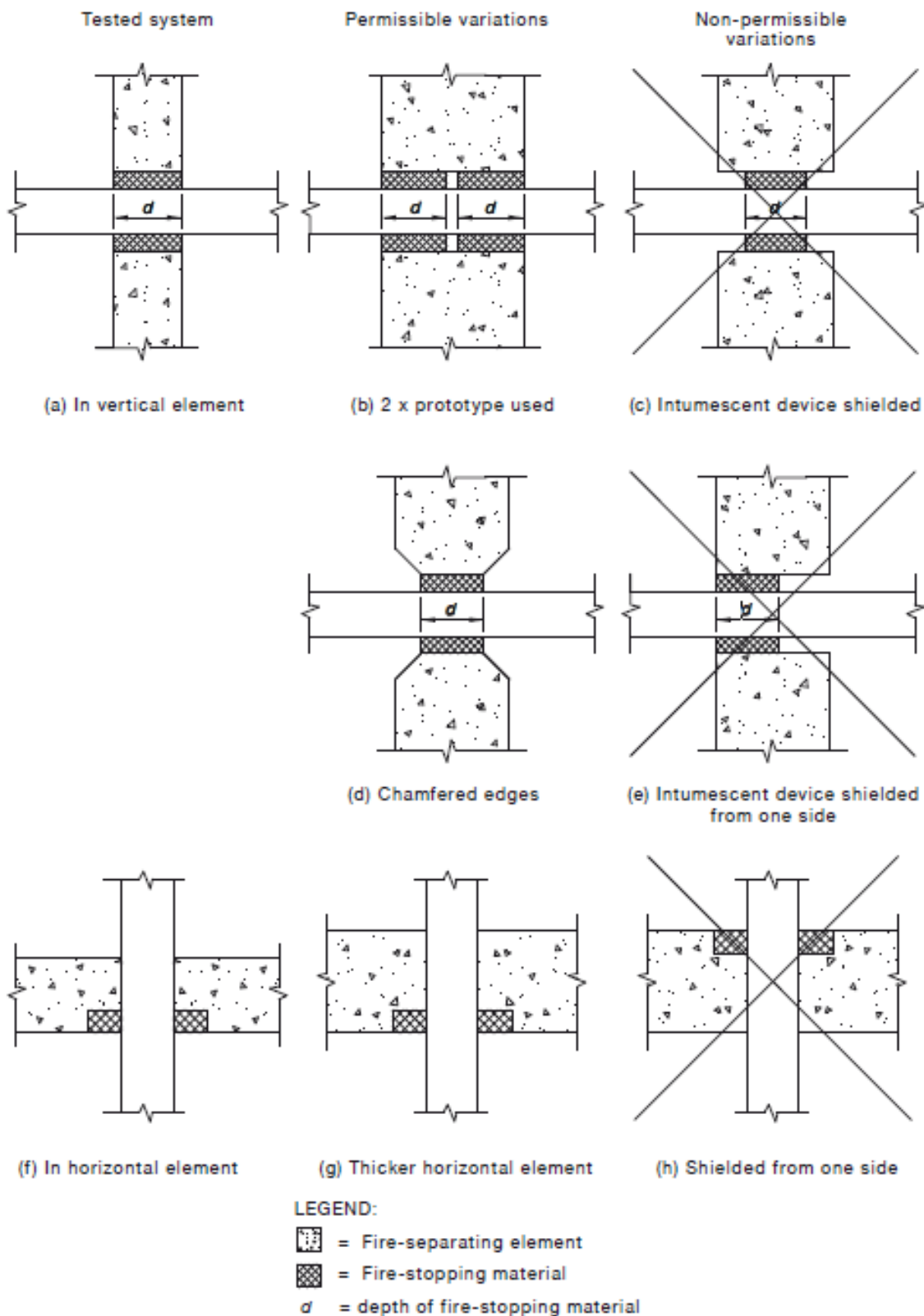


FIGURE 10.12.5.1 EQUIVALENT EXPOSURE OF UPVC PIPE FIRE-STOPPING SYSTEMS

Appendix D Instrumentation locations

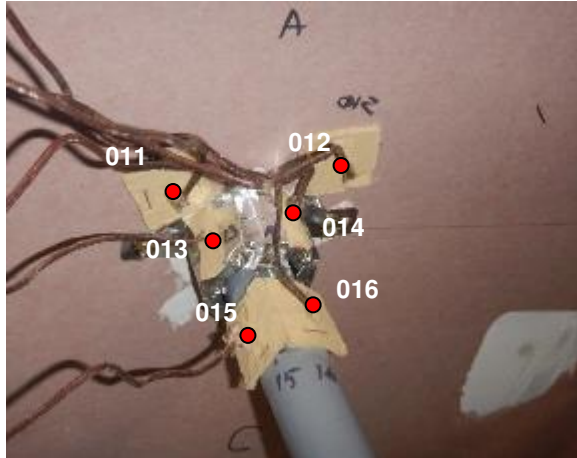


Figure 7 Penetration system A

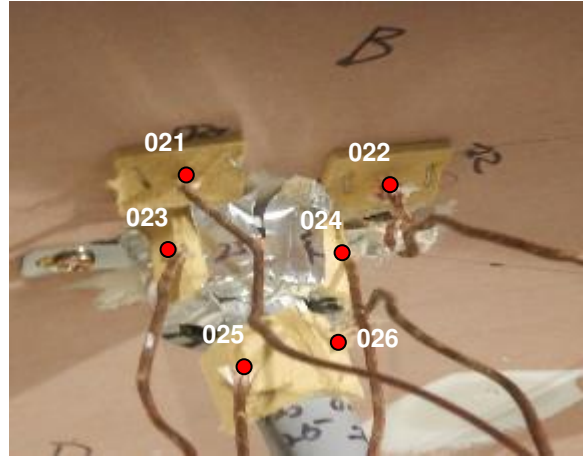


Figure 8 Penetration system B



Figure 9 Penetration system F

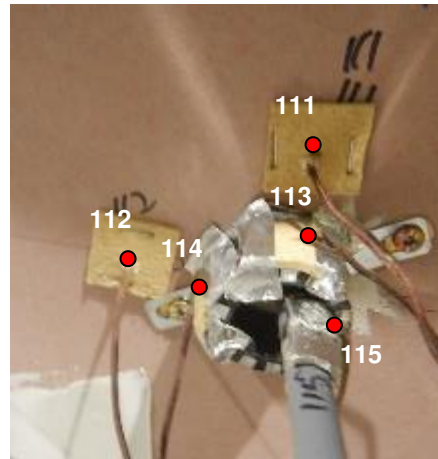


Figure 10 Penetration system G

Table 11 Thermocouple locations

Penetration system	T/C no.	Description
A	011	On the separating element, 25mm from the fire collar.
	012	On the separating element, 25mm from the fire collar.
	013	On the fire collar, 25mm from the separating element.
	014	On the fire collar, 25mm from the separating element.
	015	On the service, 25mm from the separating element.
	016	On the service, 25mm from the separating element.
B	021	On the separating element, 25mm from the fire collar.
	022	On the separating element, 25mm from the fire collar.
	023	On the fire collar, 25mm from the separating element.
	024	On the fire collar, 25mm from the separating element.
	025	On the service, 25mm from the separating element.
	026	On the service, 25mm from the separating element.
F	101	On the separating element, 25mm from the fire collar.
	102	On the separating element, 25mm from the fire collar.
	103	On the fire collar, 25mm from the separating element.
	104	On the fire collar, 25mm from the separating element.
	105	On the service, 25mm from the separating element.
G	111	On the separating element, 25mm from the fire collar.
	112	On the separating element, 25mm from the fire collar.
	113	On the fire collar, 25mm from the separating element.
	114	On the fire collar, 25mm from the separating element.
	115	On the service, 25mm from the separating element.

Appendix E Test data

E.1 Furnace temperature

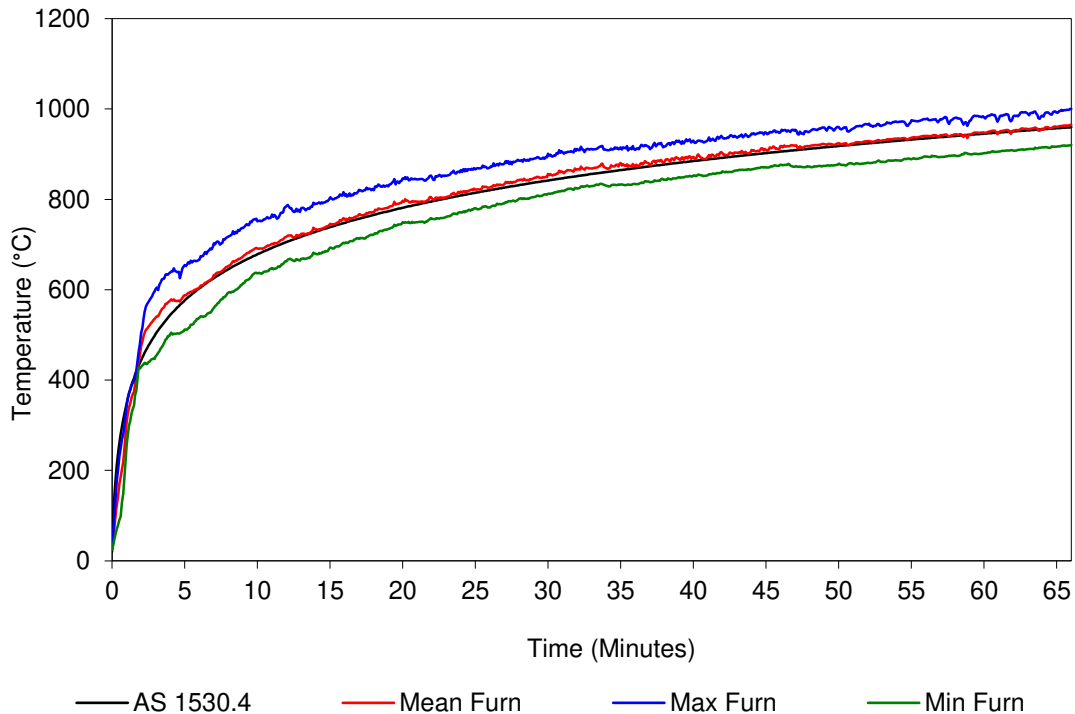


Figure 11 Furnace thermocouple temperature vs time

E.2 Furnace pressure

The furnace pressure was measured at 300mm above mid-height of the lowest penetration and corrected to mid-height of the lowest penetration.

Table 12 Furnace pressure

Time (minutes)	Pressure (Pa) average	Time (minutes)	Pressure (Pa) average	Time (minutes)	Pressure (Pa) average
5-10	17	25-30	15	45-50	14
10-15	13	30-35	13	50-55	14
15-20	15	35-40	14	55-60	14
20-25	15	40-45	16	60-65	14

E.3 Specimen temperatures

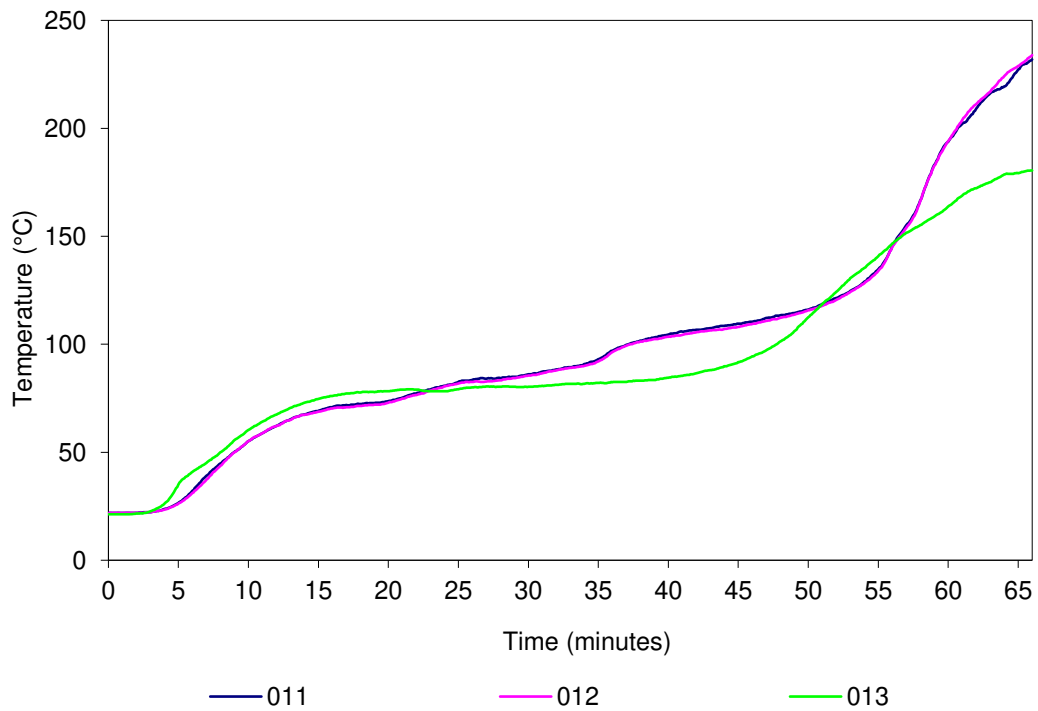


Figure 12 Penetration system A – temperature vs time

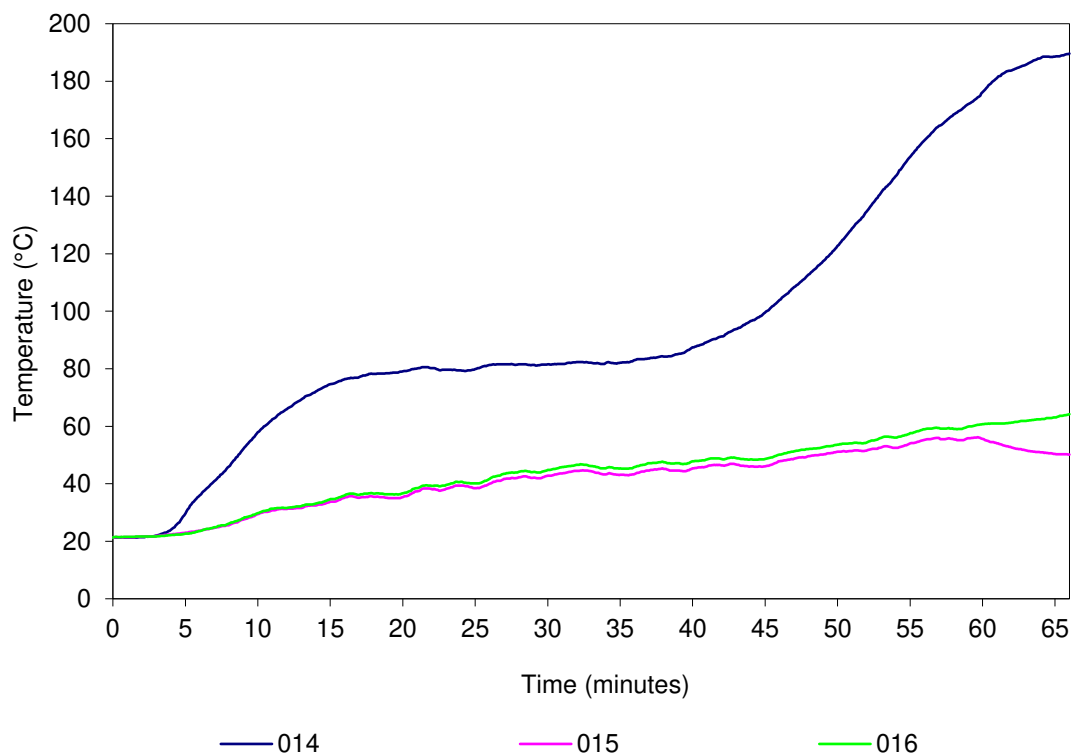


Figure 13 Penetration system A – temperature vs time

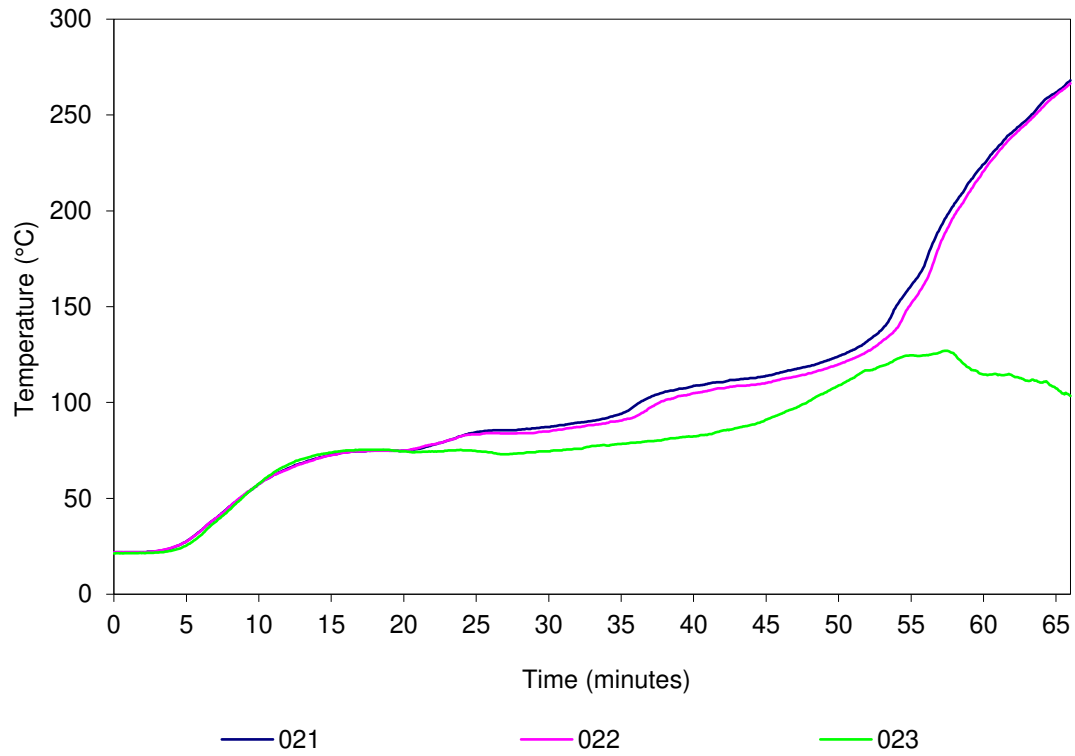


Figure 14 Penetration system B – temperature vs time

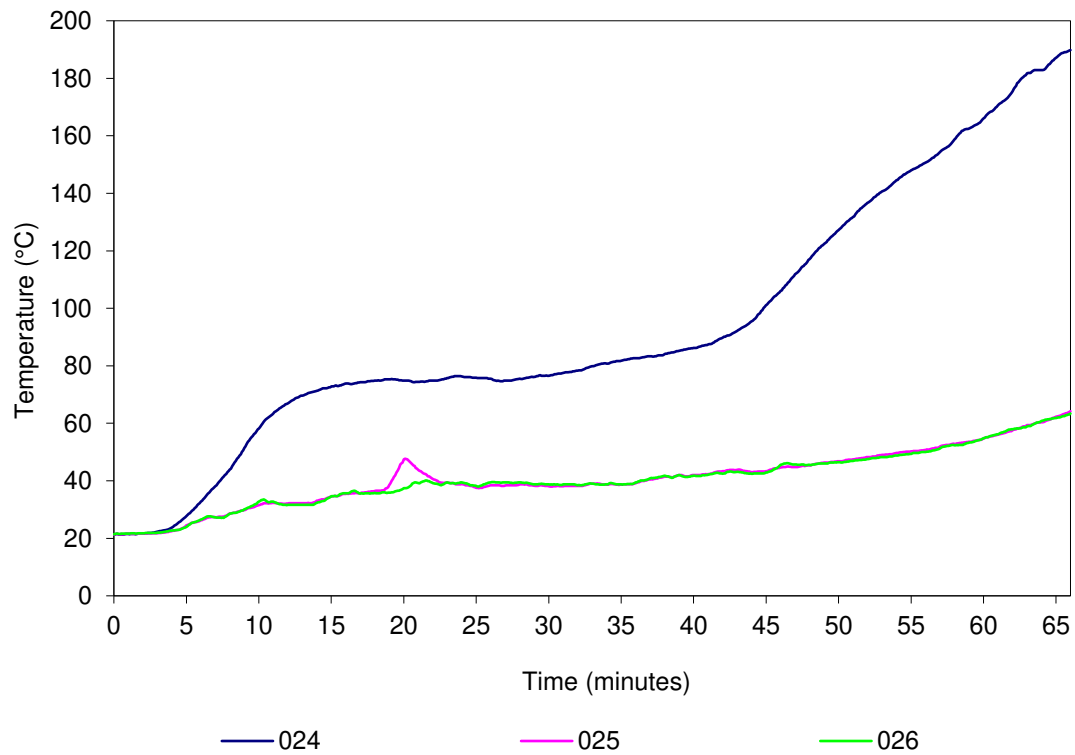


Figure 15 Penetration system B – temperature vs time

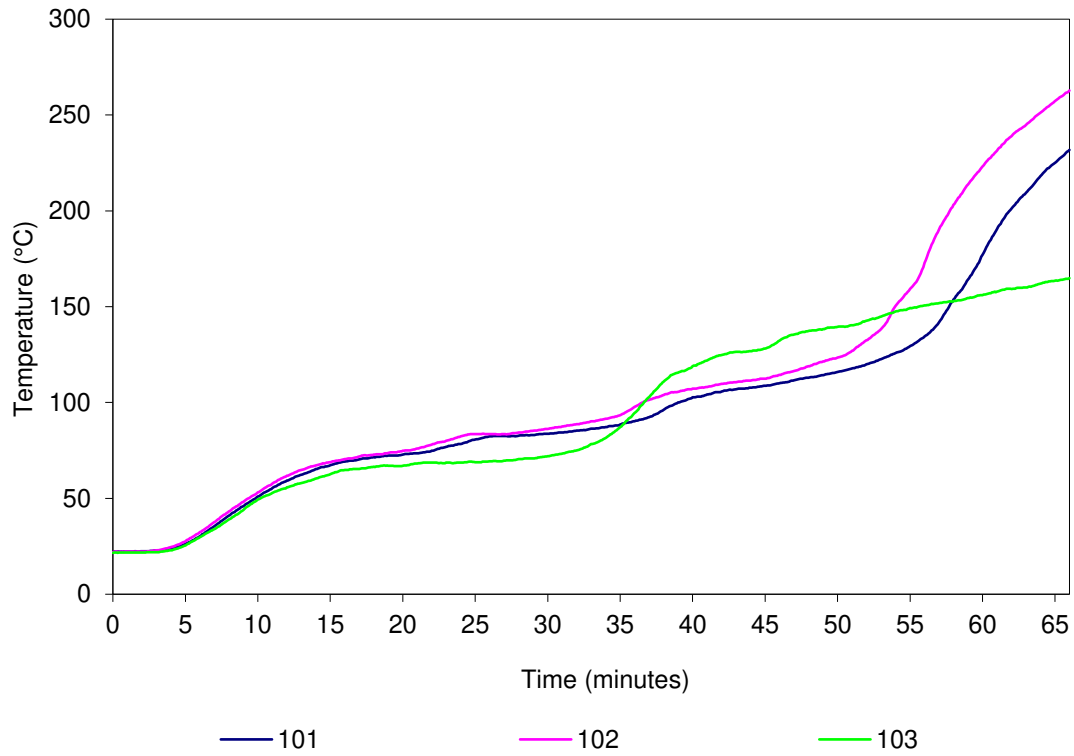


Figure 16 Penetration system F – temperature vs time

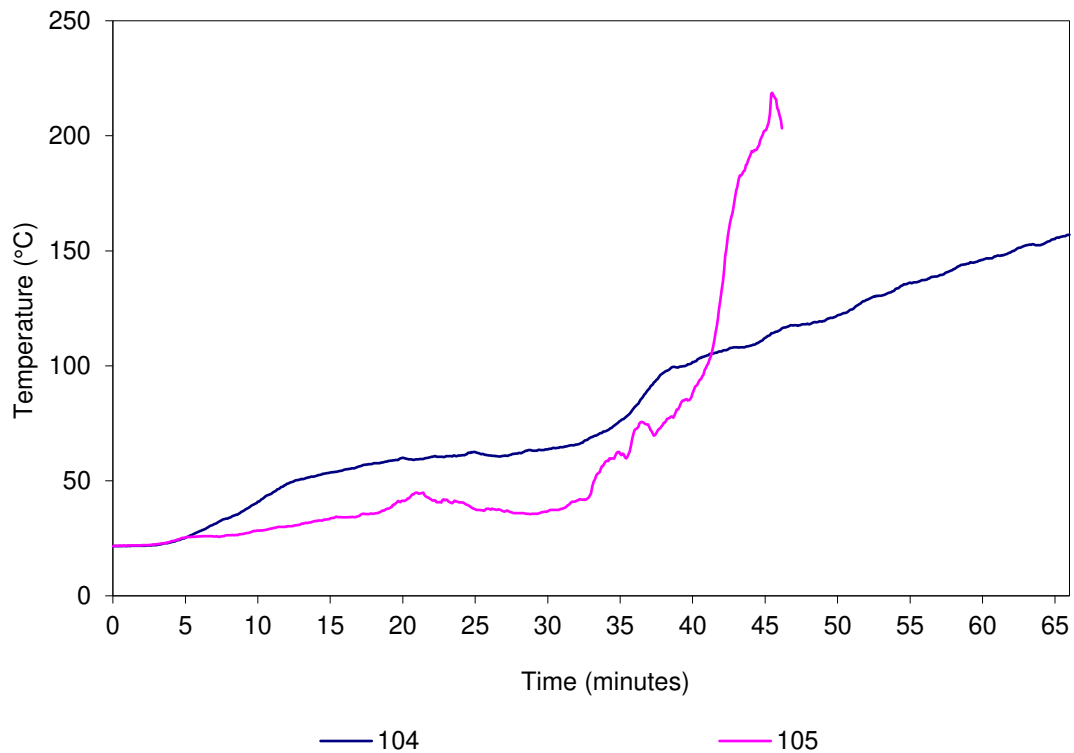


Figure 17 Penetration system F – temperature vs time (TC105 detached after the 46 minute period)

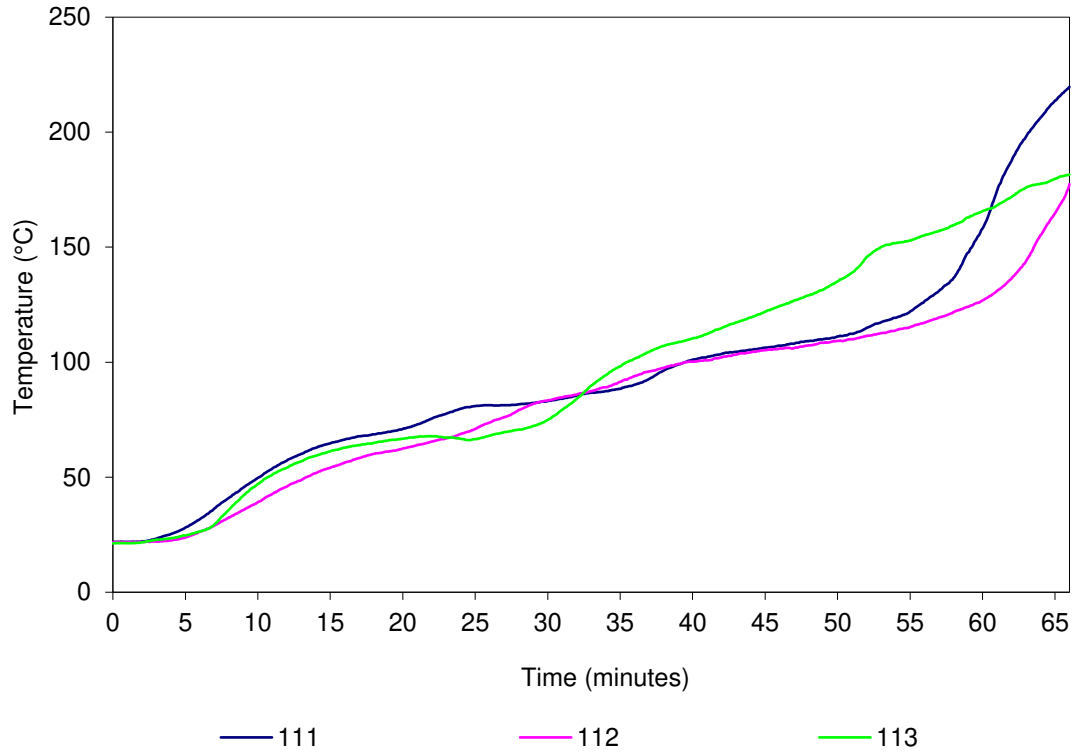


Figure 18 Penetration system G – temperature vs time

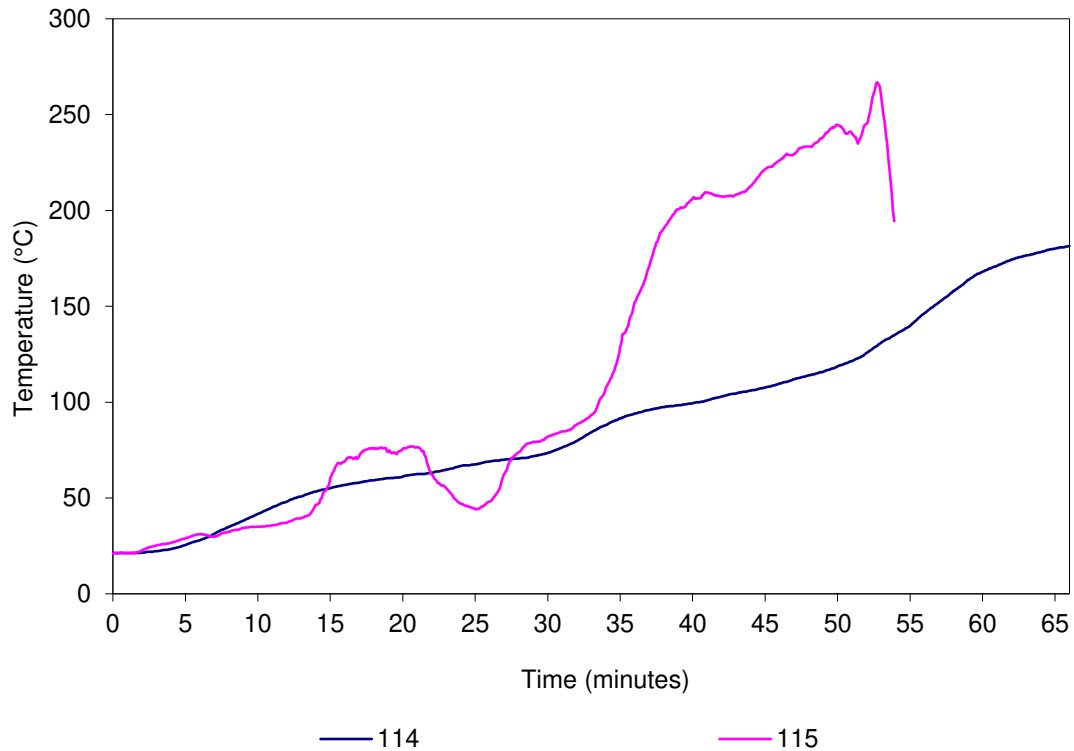


Figure 19 Penetration system G – temperature vs time (TC115 detached at the 54 minute period)

Table 13 Test specimen temperatures

Penetration system	T/C no.	Description ²	Temp (°C) at t (minutes)					Limit ¹ (minutes)
			t=0	t=15	t=30	t=60	t=66	
A	011	On the separating element.	22	70	87	194	231	60
	012	On the separating element.	22	69	86	194	233	60
	013	On the fire collar.	21	75	81	164	181	-
	014	On the fire collar.	21	75	82	176	189	-
	015	On the service.	21	34	43	56	50	-
	016	On the service.	21	35	45	61	64	-
B	021	On the separating element.	22	73	88	224	268	57
	022	On the separating element.	22	73	86	221	266	58
	023	On the fire collar.	21	74	75	115	104	-
	024	On the fire collar.	21	73	77	166	190	-
	025	On the service.	21	35	38	55	64	-
	026	On the service.	21	35	39	55	63	-
F	101	On the separating element.	22	68	84	177	231	62
	102	On the separating element.	22	70	87	223	262	57
	103	On the fire collar.	22	64	73	156	165	-
	104	On the fire collar.	22	54	64	146	157	-
	105	On the service.	22	34	37	#	#	44
G	111	On the separating element.	22	65	84	158	219	63
	112	On the separating element.	22	55	84	127	175	-
	113	On the fire collar.	21	62	77	166	181	-
	114	On the fire collar.	21	56	75	168	181	-
	115	On the service.	21	66	83	#	#	39

- Notes
- ¹ Limit time is the time to the nearest whole minute, rounded down to the nearest minute, at which the temperature recorded by the thermocouple does not rise by more than 180K above the initial temperature.
 - ² Refer to Appendix D for locations of thermocouples as only a generic description is included in the table.
 - ³ No insulation failure before thermocouple failure.
 - # Thermocouple failure.
 - * Integrity failure of the penetration system.
 - ⌋ 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

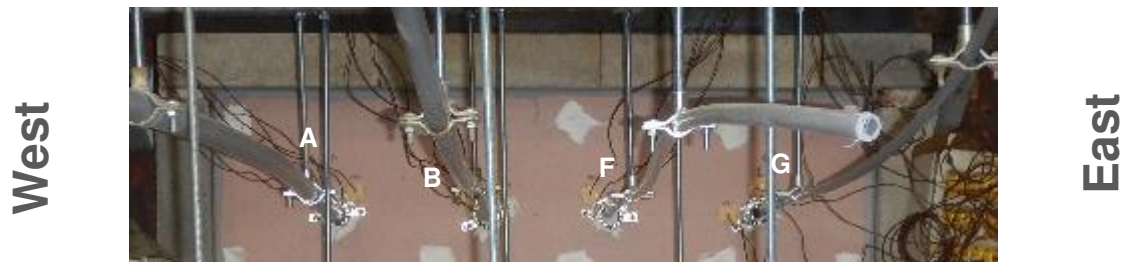


Figure 20 Unexposed face of specimen before the start of test

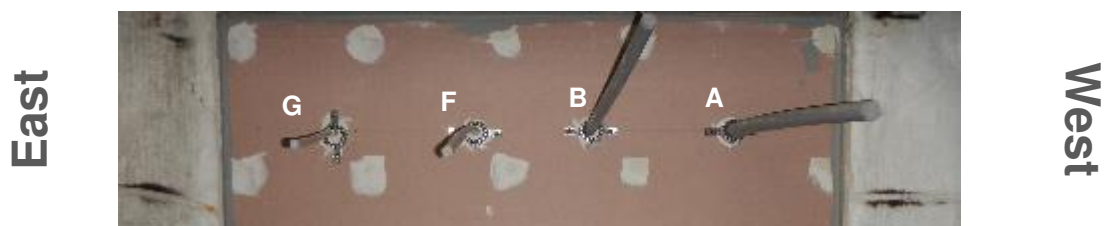


Figure 21 Exposed face of the specimen before the start of test

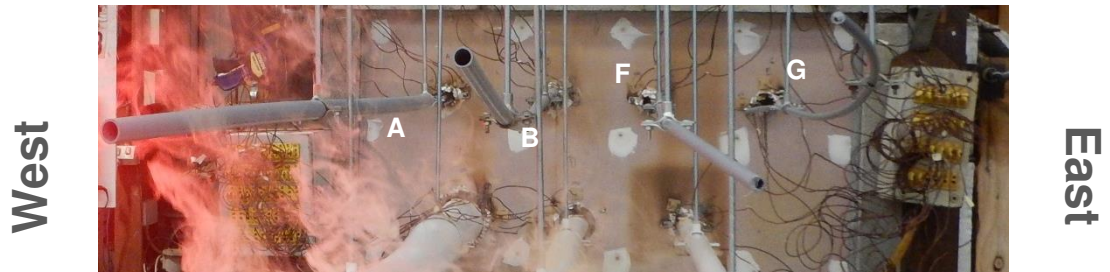


Figure 22 Unexposed face of specimen at the end of test

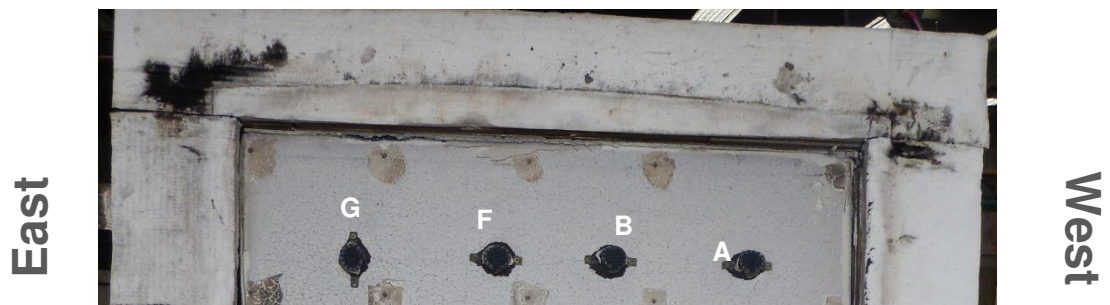


Figure 23 Exposed face of the specimen at the end of test