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TEST REPORT

A fire resistance test of six control joints in concrete wall in accordance with AS 1530.4:2014

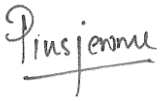
Test sponsor: HB Fuller Aust Co P/L

Address: 16-22 Redgum Drive
Dandenong South, Victoria, 3175
Australia

Job number: FRT180400 Author: Pius Jerome

Test Date: 14 February 2019 Revision: R1.0

Amendment schedule

Version	Date	Information relating to report			
R1.0	22/02/2019	Description			
			Prepared by	Reviewed by	Reviewed by
		Name	Pius Jerome	Kai Loh	Mandeep Kamal
		Signature			
		Description			
			Prepared by	Reviewed by	Approved by
		Name			
		Signature			

Contact information

Warringtonfire Australia Pty Ltd – ABN 81 050 241 524

Melbourne – NATA registered laboratory
Unit 2, 409-411 Hammond Road
Dandenong South, VIC 3175
Australia

T: +61 3 9767 1000

Brisbane
Suite 6, Level 12
133 Mary Street
Brisbane, QLD 4000
Australia

T: +61 7 3238 1700

Perth
Unit 22, 22 Railway Road
Subiaco, WA 6008
Australia

T: +61 8 9382 3844

Sydney
Suite 802, Level 8
383 Kent Street
Sydney, NSW 2000
Australia

T: +61 2 9211 4333

Canberra
Unit 2, 11 Murray Crescent
Griffith, ACT 2603
Australia

T: +61 2 6260 8488

General conditions of use

Executive summary

Objective

To evaluate the fire resistance of a concrete wall system with six varying control joints subjected to a test in accordance with AS 1530.4:2014 Section 2 & 10.

Sponsor

HB Fuller Aust Co P/L , 16-22 Redgum Drive, Dandenong South, Victoria, 3175, Australia

Summary of tested specimen

The test specimen consisted of a 120mm thick concrete wall system incorporating six varying control joints. A summary of the control joints is listed in Table 1 below.

Control joint	Service	Local fire-stopping protection	Aperture size (mm)	Sealant depth (mm)
A	Control joint	HB Fuller – Fulacaulk FR	30 × 1000	20 on the exposed side
B	Control joint	HB Fuller – Fulacaulk FR	20 ×1000	15 on the exposed side
C	Control joint	HB Fuller – Fulacaulk FR	10 × 1000	10 on the exposed side
D	Control joint	HB Fuller – Fulacaulk FR	30 × 1000	30 on the unexposed side
E	Control joint	HB Fuller – Fulacaulk FR	20 × 1000	20 on the unexposed side
F	Control joint	HB Fuller – Fulacaulk FR	10 × 1000	10 on the unexposed side

Table 1 Test assembly

The specimen was tested against the performance criteria for control joints specified in AS 1530.4:2014 Section 2 & 10.

Test results

The control joints satisfied the performance requirements specified in AS 1530.4:2014 for the periods stated below:

- Control joint A
  - FRL (Fire Resistance Level): -/240/30
- Control joint B
  - FRL (Fire Resistance Level): -/240/0
- Control joint C
  - FRL (Fire Resistance Level): -/240/120
- Control joint D
  - FRL (Fire Resistance Level): -/240/90
- Control joint E
  - FRL (Fire Resistance Level): -/240/90
- Control joint F
  - FRL (Fire Resistance Level): -/240/120

Date of test

14 February 2019

Contents

1. Construction details

1.1 Test assembly

The test assembly consisted of a nominal 1520mm wide × 1900mm high × 120mm thick concrete wall system with six varying control joints.

The wall was restrained at all edges.

1.2 Test specimen

The wall system consisted of a 1900mm long × 200mm wide × 120mm thick concrete wall strips supported at the ends using parallel flange channel (PFC) to form six control joints of various widths. Masonry anchors were used to fix the concrete strips to PFC giving the floor overall width of 1520mm. The control joints were protected by HB Fuller – Fulacaulk FR sealant. The test assembly is summarised in Table 2 below.

A full description of the specimen is provided in Appendix A and Section 2.

Control joint	Service	Local fire-stopping protection	Aperture size (mm)	Sealant depth (mm)
A	Control joint	HB Fuller – Fulacaulk FR	30 × 1000	20 on the exposed side
B	Control joint	HB Fuller – Fulacaulk FR	20 × 1000	15 on the exposed side
C	Control joint	HB Fuller – Fulacaulk FR	10 × 1000	10 on the exposed side
D	Control joint	HB Fuller – Fulacaulk FR	30 × 1000	30 on the unexposed side
E	Control joint	HB Fuller – Fulacaulk FR	20 × 1000	20 on the unexposed side
F	Control joint	HB Fuller – Fulacaulk FR	10 × 1000	10 on the unexposed side

Table 2 Test assembly

1.3 Assembly and installation methods

The services and fire-stopping protections were installed on 15 January 2019 and completed on 16 January 2019 by the test sponsor.

1.4 Orientation

The wall system was asymmetrical.

2. Schedule of components

Item		Description
Separating element		
1.	Item name	Concrete wall strips
	Product name	120mm thick concrete
	Density	2400 kg/m^3 (measured)
	Installation	The concrete strips were precast and stored at Warringtonfire Australia (WFA). The concrete strips were aligned as per the varying control joint sizes. The concrete strips were supported at both the edges by PFC. Masonry anchors were used to fix the concrete strips to the PFCs.
Fire-stopping protections		
Sealant		
2.	Product name	HB Fuller – Fulacaulk FR
	Density	1606 kg/m^3 (measured)
	Installation	The sealant was installed in the control joints as detailed in various control joint descriptions below.
Backing Rod		
3.	Item name	Open cell backing rod
	Material	Polyethylene
	Size	Various sizes as per the control joints.
	Installation	The backing rod of varying sizes were installed at all the control joints as detailed in various control joint descriptions below.
Control joint A		
A	Control joint detail	Control joint – nominally 1000mm long × 30mm wide; 20mm deep. Sealant applied on exposed side only.
	Aperture size	30mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 32mm × 29mm, was installed into the control joint at a depth of 20mm from the exposed face of the wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finished flush with the face of wall. The backing rod & sealant is applied only on the exposed side. See Figure 1, Figure 2 and Figure 3 in Appendix A for more details.
Control joint B		
B	Control joint detail	Control joint – nominally 1000mm long × 20mm wide; 15mm deep. Sealant applied on exposed side only.
	Aperture size	20mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 29mm × 20mm, was installed into the control joint at a depth of 15mm from the exposed face of the wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finished flush with the face of wall. The backing rod & sealant is applied only on the exposed side. See Figure 1, Figure 2 and Figure 3 in Appendix A for more details.

Item		Description
Control joint C		
C	Control joint detail	Control joint – nominally 1000mm long × 10mm wide; 10mm deep. Sealant applied on exposed side only.
	Aperture size	10mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 21mm × 18mm, was installed into the control joint at a depth of 10mm from the exposed face of the wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finished flush with the face of wall. The backing rod & sealant is applied only on the exposed side. See Figure 1, Figure 2 and Figure 3 in Appendix A for more details.
Control joint D		
D	Control joint detail	Control joint – nominally 1000mm long × 30mm wide; 30mm deep. Sealant applied on unexposed side only.
	Aperture size	30mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 32mm × 29mm, was installed into the control joint at a depth of 30mm from the unexposed face of the wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finished flush with the face of wall. The backing rod & sealant is applied only on the unexposed side. See Figure 1, Figure 2 and Figure 3 in Appendix A for more details.
Control joint E		
E	Control joint detail	Control joint – nominally 1000mm long x 20mm wide; 20mm deep. Sealant applied on unexposed side only.
	Aperture size	20mm x 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 29mm x 20mm, was installed into the control joint at a depth of 20mm from the unexposed face of the wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finished flush with the face of wall. The backing rod & sealant is applied only on the unexposed side. See Figure 1, Figure 2 and Figure 3 in Appendix A for more details.
Control joint F		
F	Control joint detail	Control joint – nominally 1000mm long × 10mm wide; 10mm deep. Sealant applied on unexposed side only.
	Aperture size	10mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 21mm × 18mm, was installed into the control joint at a depth of 10mm from the unexposed face of the wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finished flush with the face of wall. The backing rod & sealant is applied only on the unexposed side. See Figure 1, Figure 2 and Figure 3 in Appendix A for more details.

Table 3 Schedule of components

3. Test procedure

3.1 Statement of compliance

The test was performed in accordance with the requirements of AS 1530.4:2014 Sections 2 & 10 appropriate for control joints subject to the variations below.

3.2 Variations to test method

The pressure was 2Pa above the limits prescribed in the standard during the 144-150-minute period. The pressure and temperature were within the limits for rest of the test duration. This overpressure resulted in more onerous test conditions, thus would not have invalidated the test result.

3.3 Pre-test conditioning

The construction of the test specimen was completed on 16 January 2019. The test specimen was subjected to normal laboratory temperatures and conditions during this period.

3.4 Sampling/specimen selection

The laboratory was not involved in sampling or selecting the test specimen for the fire resistance test.

3.5 Ambient temperature

The ambient temperature of the laboratory at the start of the test was 18°C and varied between 18°C and 28°C during the test.

3.6 Test duration

The test duration was 241 minutes.

3.7 Instrumentation and equipment

The instrumentation was provided in accordance with AS 1530.4:2014 as detailed below:

- 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 × 2.0 mm inorganic insulating pads. The thermocouple positions are shown in Table 6 and Figure 4 to Figure 9 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 mid-height of the control joint.
- Cotton pads were available during the test to assess the performance under the criteria for integrity.

4. Test measurements

4.1 Furnace temperature and pressure measurements

The furnace temperature and pressure data are provided in Figure 10 and Table 7 in Appendix E.

4.2 Specimen temperatures

The specimen temperature data is provided in Figure 11 to Figure 22 and Table 8 in Appendix E.

4.3 Observations

Table 5 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.

5. Performance criteria and test results

Table 4 shows the results the specimen achieved against the performance criteria listed in AS 1530.4:2014 Sections 2 & 10 subject to the variations listed in Section 3.

System	Criteria	Results
A	Structural adequacy	Not applicable
	Integrity	No failure at 241 minutes
	Insulation	Failure at 40 minutes
	FRL	-/240/30
B	Structural adequacy	Not applicable
	Integrity	No failure at 241 minutes
	Insulation	Failure at 22 minutes
	FRL	-/240/0
C	Structural adequacy	Not applicable
	Integrity	No failure at 241 minutes
	Insulation	Failure at 164 minutes
	FRL	-/240/120
D	Structural adequacy	Not applicable
	Integrity	No failure at 241 minutes
	Insulation	Failure at 109 minutes
	FRL	-/240/90
E	Structural adequacy	Not applicable
	Integrity	No failure at 241 minutes
	Insulation	Failure at 106 minutes
	FRL	-/240/90
F	Structural adequacy	Not applicable
	Integrity	No failure at 241 minutes
	Insulation	Failure at 135 minutes
	FRL	-/240/120

Table 4 Test results

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

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.

7. Conclusions

A test specimen consisting of a concrete wall system with varying control joints subjected to a fire resistance test in accordance with AS 1530.4:2014 Section 2 & 10.

The specimen satisfied the performance requirements specified in AS 1530.4:2014 for the periods stated below:

- Control joint A
  - FRL (Fire Resistance Level): -/240/30
- Control joint B
  - FRL (Fire Resistance Level): -/240/0
- Control joint C
  - FRL (Fire Resistance Level): -/240/120
- Control joint D
  - FRL (Fire Resistance Level): -/240/90
- Control joint E
  - FRL (Fire Resistance Level): -/240/90
- Control joint F
  - FRL (Fire Resistance Level): -/240/120

Appendix A Drawings of test assembly

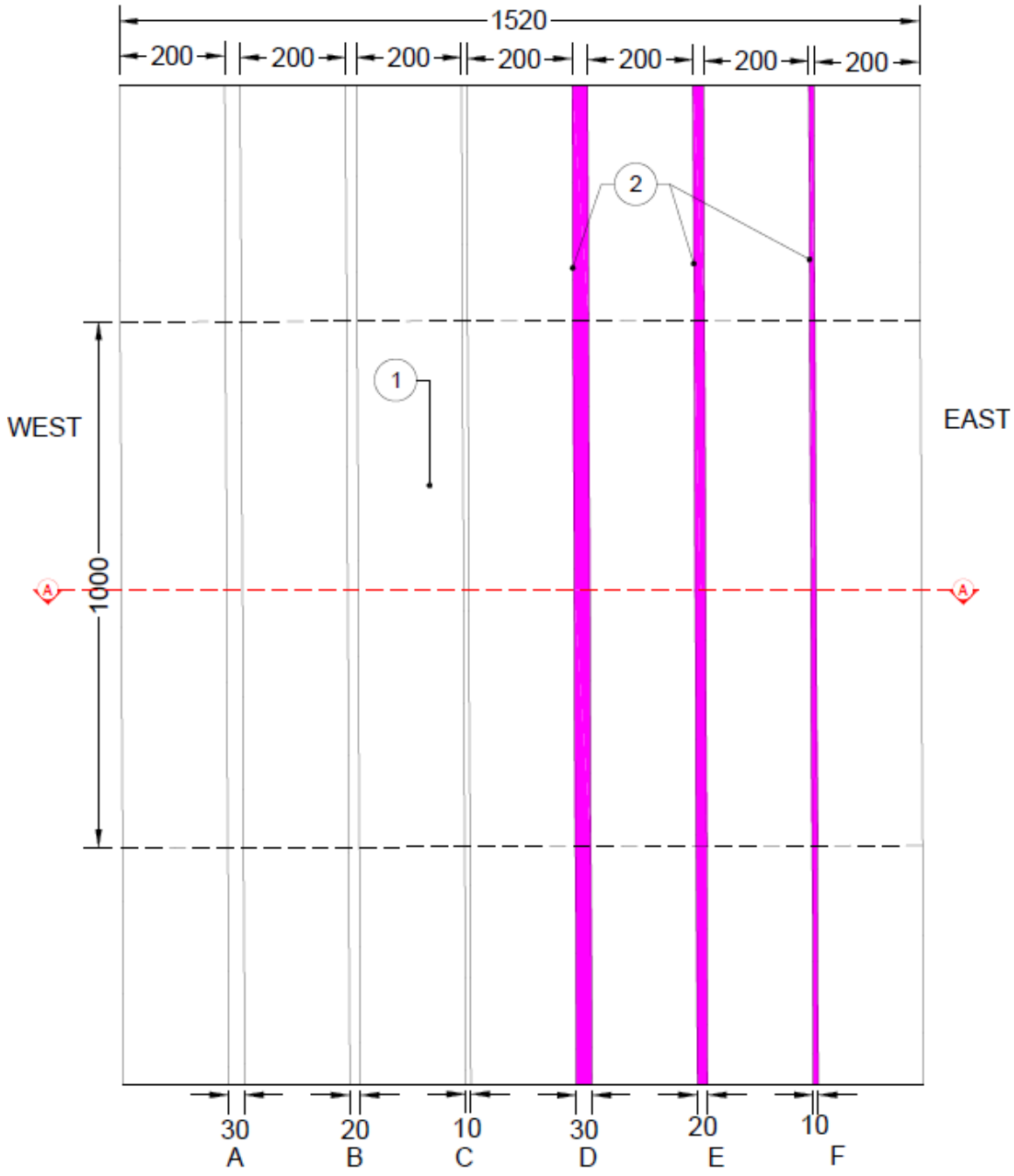


Figure 1 Elevation view of test specimen (unexposed side)

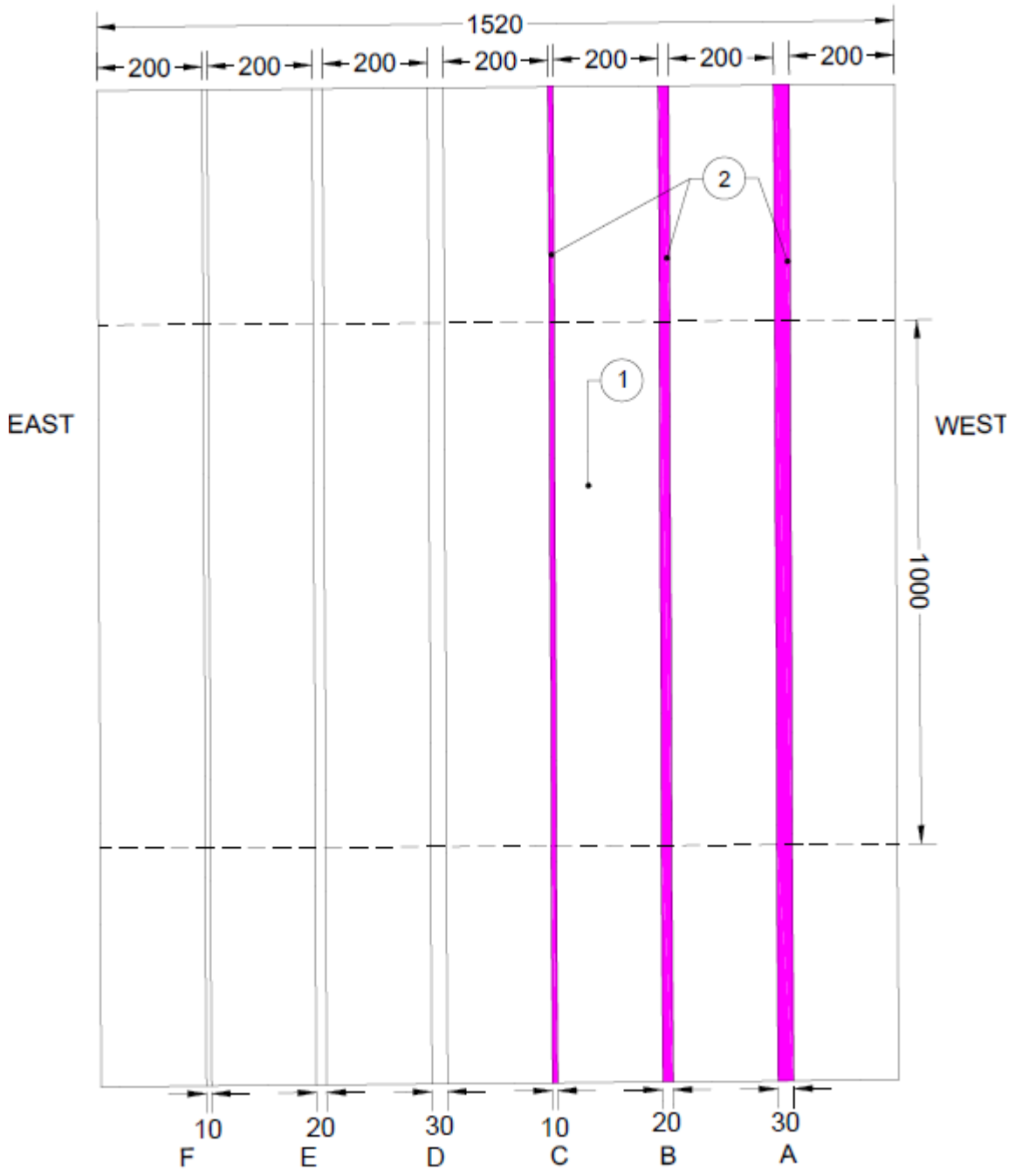


Figure 2 Elevation view of test specimen (exposed side)

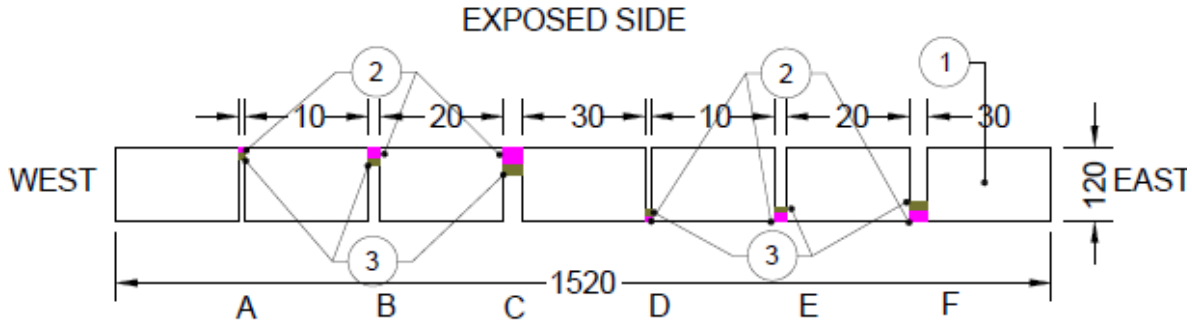


Figure 3 Section A-A

Appendix B Test observations

Table 5 shows observations of any significant behaviour of the specimen during the test.

Time		Observation
Min	Sec	
Control joint A		
00	00	Fire resistance test commenced, and the average initial temperature of the specimen was approximately 18°C.
24	00	Slight smoke emitting from the top of control joint.
30	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
40	**45**	**TC 013, on the control joint, 250mm down from the centre recorded a temperature of 201°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 013 exceeded the initial temperature by more than 180K.**
43	15	The colour of the backing rod on control joints started turning to dark grey.
60	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
90	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
120	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
180	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
240	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Fire resistance test terminated.
Control joint B		
00	00	Fire resistance test commenced, and the average initial temperature of the specimen was approximately 19°C.
12	30	Slight smoke emitting from the top of control joint.
22	**50**	**TC 023, on the control joint, 250mm down from the centre recorded a temperature of 199°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 023 exceeded the initial temperature by more than 180K.**
30	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
43	15	The colour of the backing rod on control joints started turning to dark grey
60	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
90	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
120	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
180	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
192	00	Glowing can be seen on the control joint.
240	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Fire resistance test terminated.
Control joint C		
00	00	Fire resistance test commenced, and the average initial temperature of the specimen was approximately 19°C.

Time		Observation
Min	Sec	
10	00	Slight smoke emitting from the top of control joint.
28	00	Moisture seen on concrete at mid-height adjacent to control joint.
30	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
90	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
120	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
164	**35**	**TC 034, 25mm from the control joint, 250mm up from the centre recorded a temperature of 199°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 034 exceeded the initial temperature by more than 180K.**
180	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
191	00	Glowing can be seen on the control joint.
240	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Fire resistance test terminated.
Control joint D		
00	00	Fire resistance test commenced, and the average initial temperature of the specimen was approximately 18°C.
30	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	21	The sealant seems bulged on the unexposed side.
68	12	Crack appeared on the sealant at the concrete to sealant interface near to TC 041, TC 045.
90	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
109	**45**	**TC 046, 25mm from the control joint, 375mm up from the centre recorded a temperature of 198°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 046 exceeded the initial temperature by more than 180K.**
119	35	The colour of the sealant on control joints started turning to light grey.
120	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
180	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
240	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Fire resistance test terminated.
Control joint E		
00	00	Fire resistance test commenced, and the average initial temperature of the specimen was approximately 18°C.
30	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	21	The sealant seems bulged on the unexposed side.
90	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.

Time		Observation
Min	Sec	
106	**50**	**TC 054, 25mm from the control joint, 125mm up from the centre recorded a temperature of 199°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 054 exceeded the initial temperature by more than 180K.**
119	35	The colour of the sealant on control joints started turning to light grey.
120	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
180	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
240	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Fire resistance test terminated.
Control joint F		
00	00	Fire resistance test commenced, and the average initial temperature of the specimen was approximately 19°C.
30	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
90	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
92	10	The sealant seems bulged on the unexposed side.
120	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
135	**00**	**TC 101, 25mm from the control joint, 250mm up from the centre recorded a temperature of 199°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 101 exceeded the initial temperature by more than 180K.**
180	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
240	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Fire resistance test terminated.

Table 5 Test observations

Appendix C Direct field of application

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 have been made.

C.2 Separating Elements

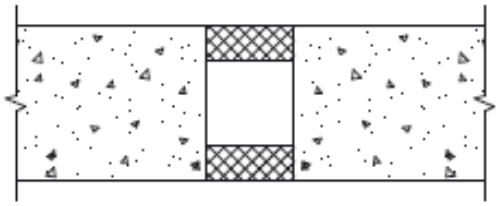
Results obtained for sealing systems in various types of masonry and concrete construction may be applied as follows:

- 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.

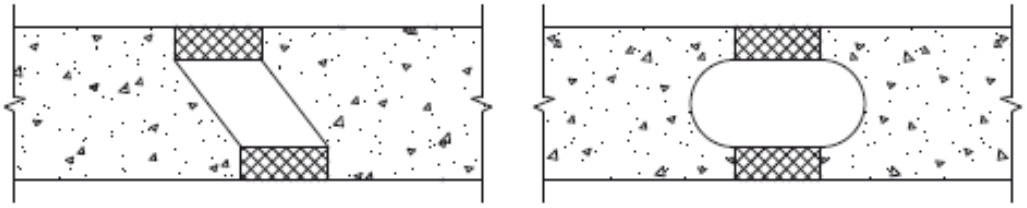
C.3 Control Joints

The following variations are permitted:

- Results obtained from single test on a butt joints may be applied to contoured joints, provided the joints have —
  - equal width and equal or greater depth of sealant; and
  - equal or greater thickness of fire-separating element.
  - NOTE: Examples of butt and contoured control joints are shown in Figure 10.12.6.
- Facings may be applied to the surface of the fire-stopping system.



(a) Butt joint



(b) Contoured joints

LEGEND:

= Fire-separating element

= Fire-stopping material

FIGURE 10.12.6 CONTOURED CONTROL JOINTS

Appendix D Instrumentation positions

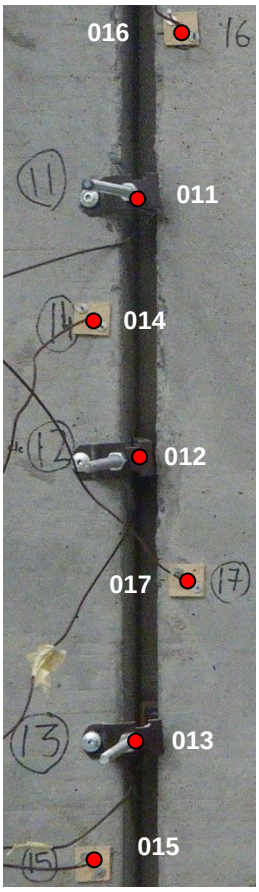


Figure 4 Penetration system A

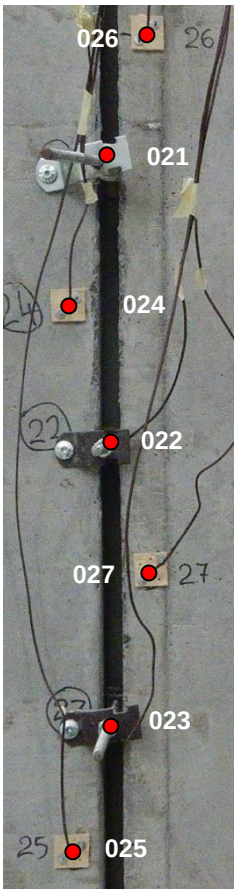


Figure 5 Penetration system B

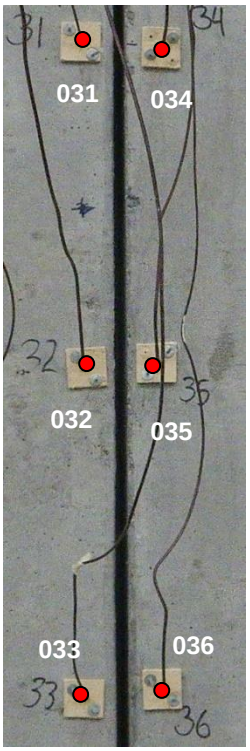


Figure 6 Penetration system C

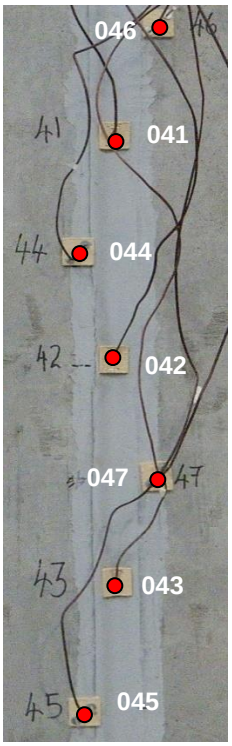


Figure 7 Penetration system D

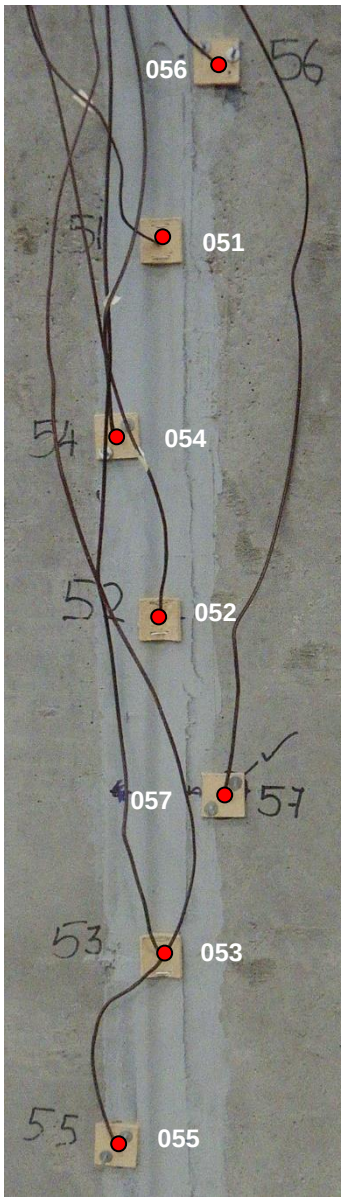


Figure 8 Penetration system E

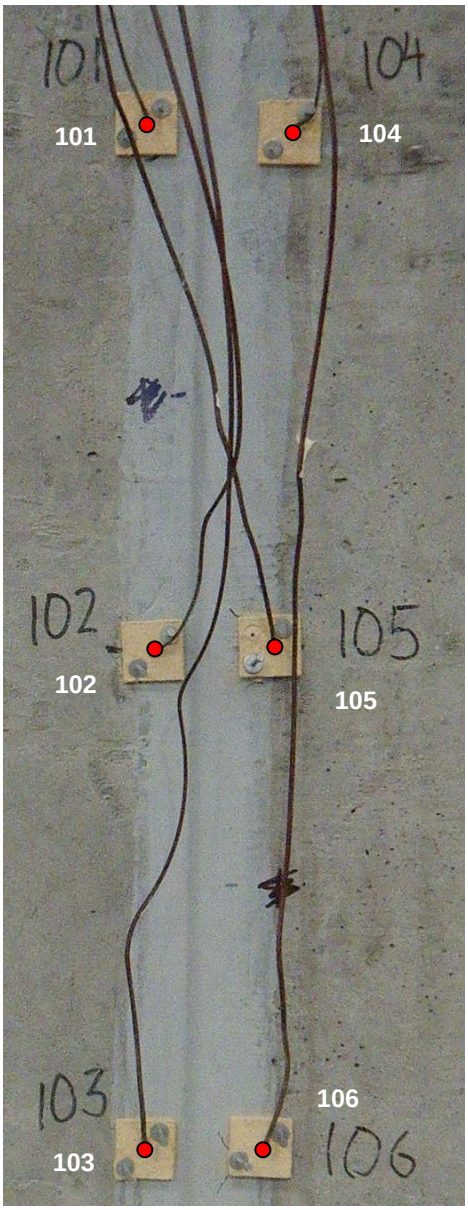


Figure 9 Penetration system F

System	T/C No.	Description
A	011	On control joint, 250mm up from the centre.
	012	On control joint, at the centre.
	013	On control joint, 250mm down from the centre.
	014	25mm from control joint, 125mm up from the centre.
	015	25mm from control joint, 375mm down from the centre.
	016	25mm from control joint, 375mm up from the centre.
	017	25mm from control joint, 125mm down from the centre.
B	021	On control joint, 250mm up from the centre.
	022	On control joint, at the centre.
	023	On control joint, 250mm down from the centre.
	024	25mm from control joint, 125mm up from the centre.
	025	25mm from control joint, 375mm down from the centre.
	026	25mm from control joint, 375mm up from the centre.
	027	25mm from control joint, 125mm down from the centre.
C	031	25mm from control joint, 250mm up from the centre.
	032	25mm from control joint, at the centre.
	033	25mm from control joint, 250mm down from the centre.
	034	25mm from control joint, 250mm up from the centre.
	035	25mm from control joint, at the centre.
	036	25mm from control joint, 250mm down from the centre.
D	041	On control joint, 250mm up from the centre.
	042	On control joint, at the centre.
	043	On control joint, 250mm down from the centre.
	044	25mm from control joint, 125mm up from the centre.
	045	25mm from control joint, 375mm down from the centre.
	046	25mm from control joint, 375mm up from the centre.
	047	25mm from control joint, 125mm down from the centre.
E	051	On control joint, 250mm up from the centre.
	052	On control joint, at the centre.
	053	On control joint, 250mm down from the centre.
	054	25mm from control joint, 125mm up from the centre.
	055	25mm from control joint, 375mm down from the centre.
	056	25mm from control joint, 375mm up from the centre.
	057	25mm from control joint, 125mm down from the centre.
F	101	25mm from control joint, 250mm up from the centre.
	102	25mm from control joint, at the centre.
	103	25mm from control joint, 250mm down from the centre.
	104	25mm from control joint, 250mm up from the centre.
	105	25mm from control joint, at the centre.
	106	25mm from control joint, 250mm down from the centre.

Table 6 Thermocouple locations

Appendix E Test data

E.1 Furnace temperature

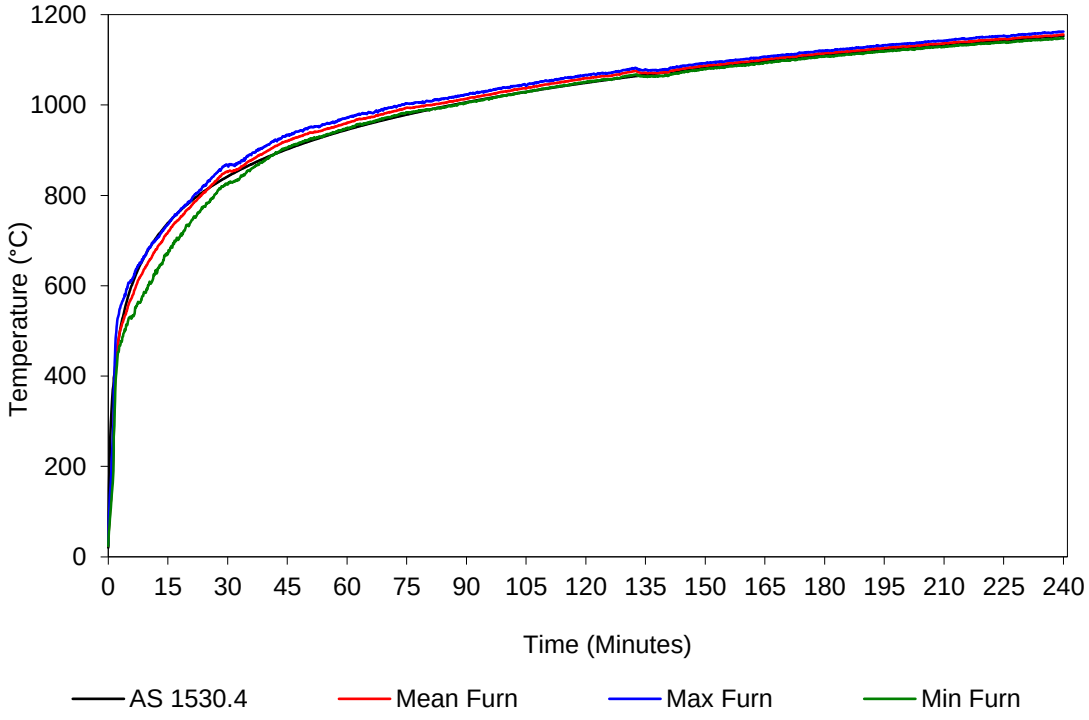


Figure 10 Furnace thermocouple temperature vs time

E.2 Furnace pressure

The furnace pressure was measured at mid-height of the control joint.

Time (minutes)	Pressure (Pa) average	Time (minutes)	Pressure (Pa) average	Time (minutes)	Pressure (Pa) average
5-10	17	85-90	15	165-170	15
10-15	16	90-95	14	170-175	15
15-20	18	95-100	14	175-180	17
20-25	17	100-105	16	180-185	14
25-30	14	105-110	15	185-190	15
30-35	14	110-115	16	190-195	18
35-40	15	115-120	16	195-200	18
40-45	15	120-125	15	200-205	13
45-50	14	125-130	13	205-210	17
50-55	13	130-135	18	210-215	16
55-60	14	135-140	13	215-220	14
60-65	15	140-145	17	220-225	14
65-70	16	145-150	20	225-230	17
70-75	16	150-155	15	230-235	14
75-80	16	155-160	14	235-240	15
80-85	17	160-165	12		

Table 7 Furnace pressure

E.3 Specimen temperatures

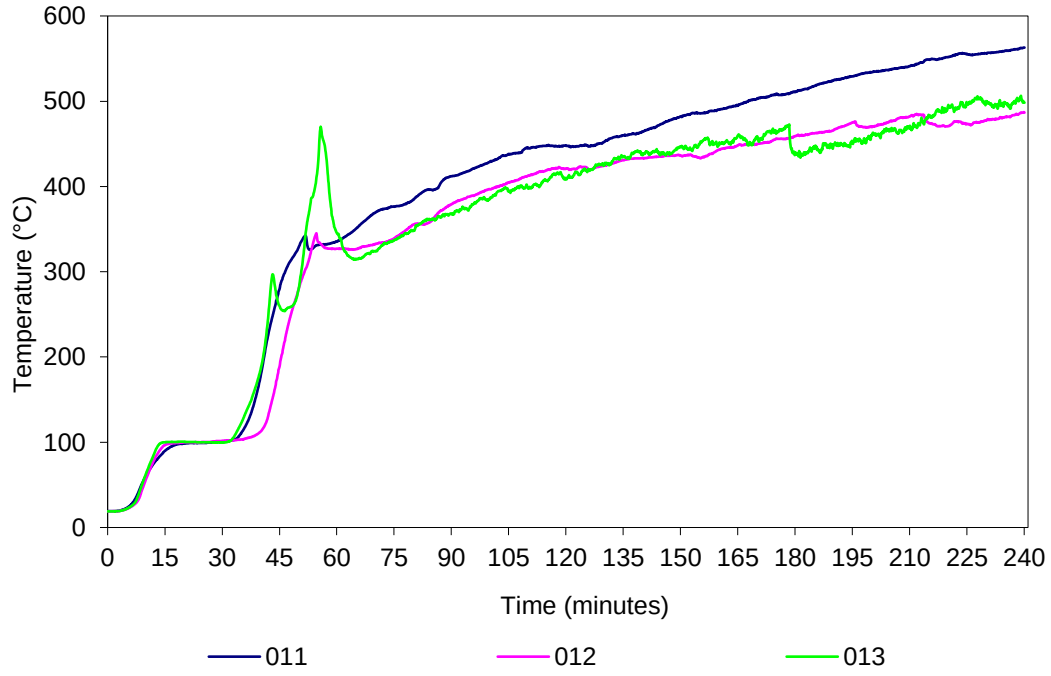


Figure 11 **Penetration system A – temperature vs time**

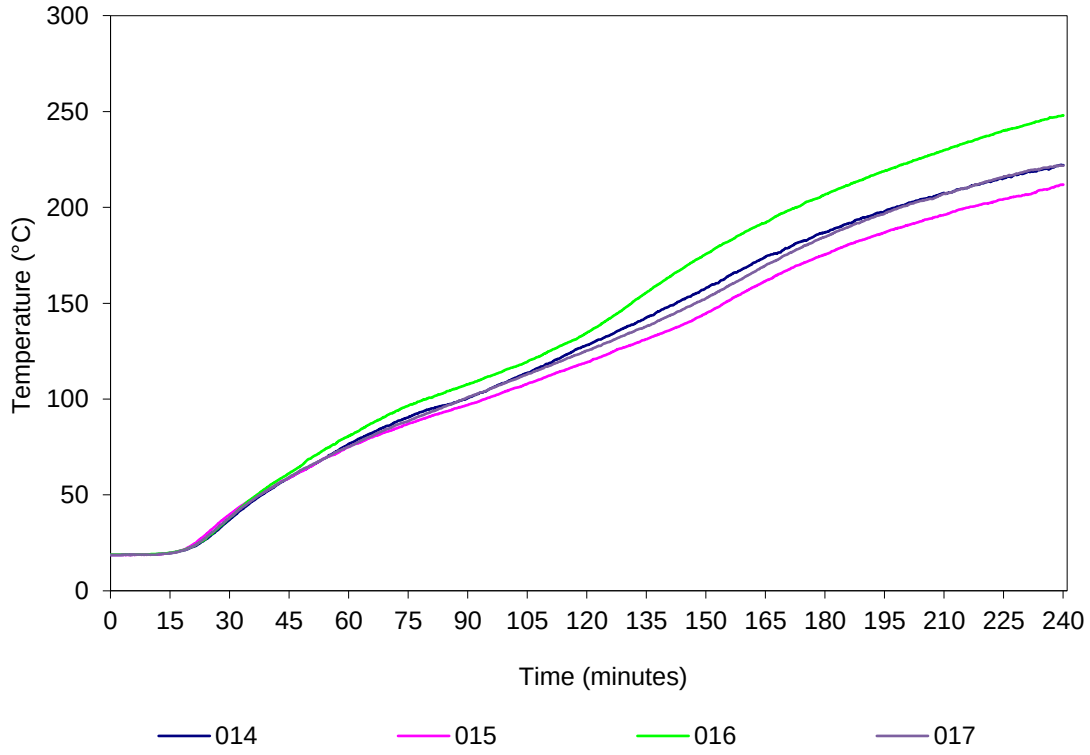


Figure 12 **Penetration system A – temperature vs time**

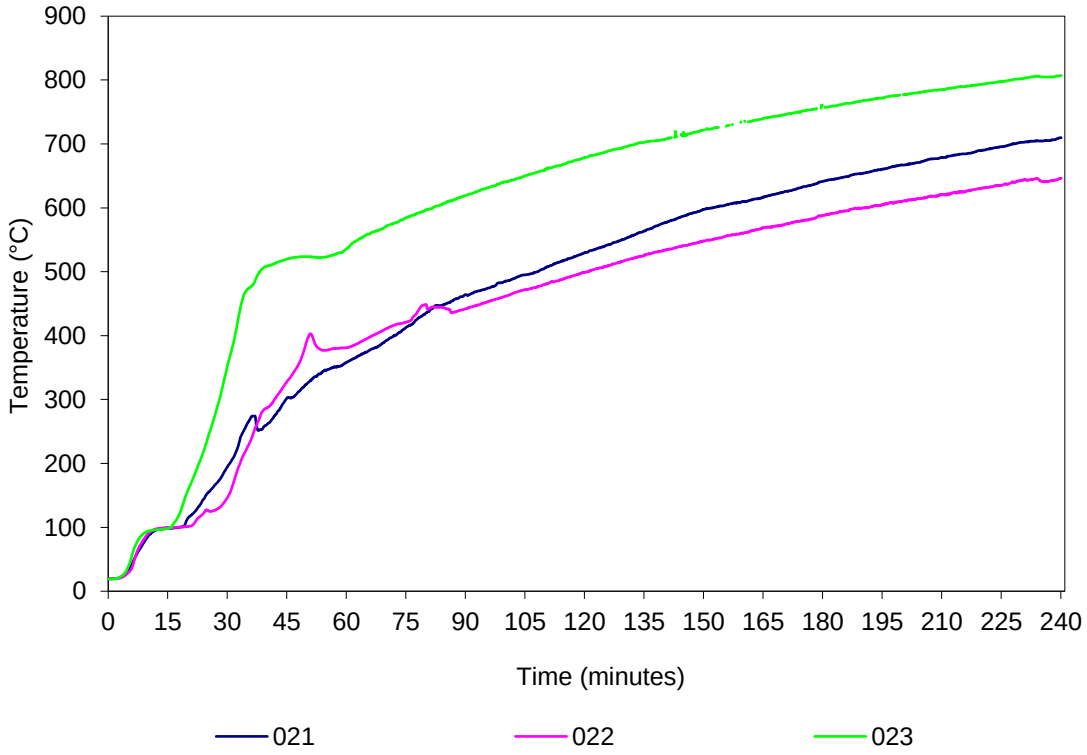


Figure 13 **Penetration system B – temperature vs time**

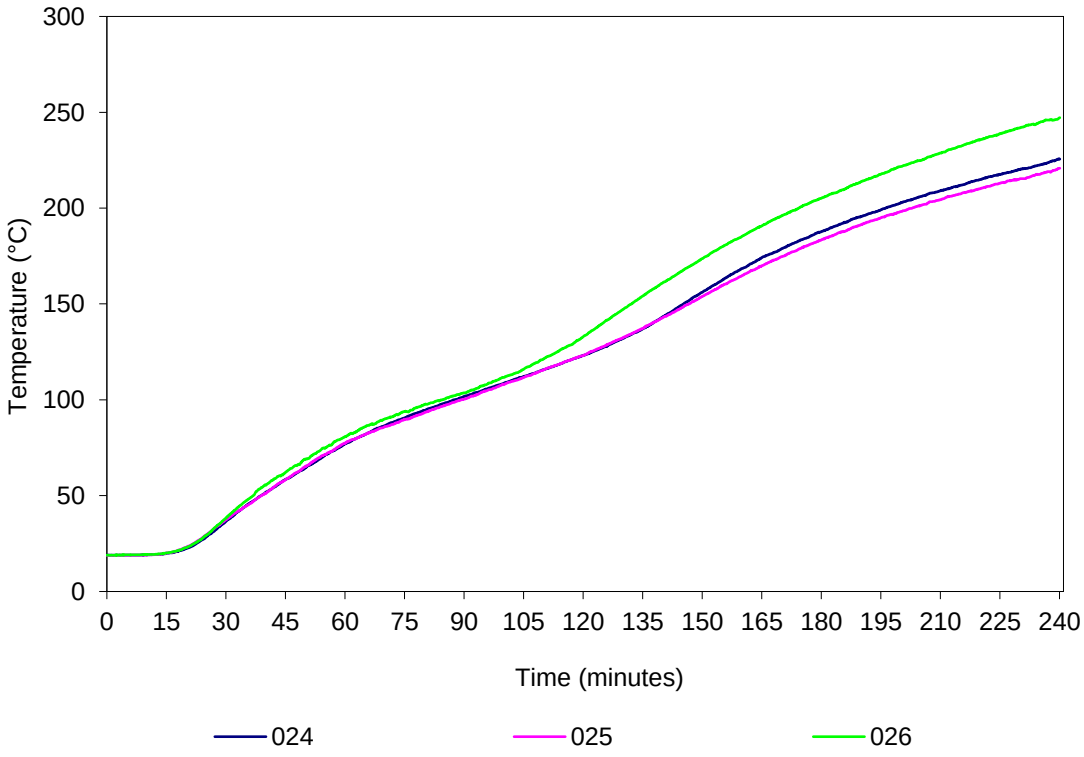


Figure 14 **Penetration system B – temperature vs time**

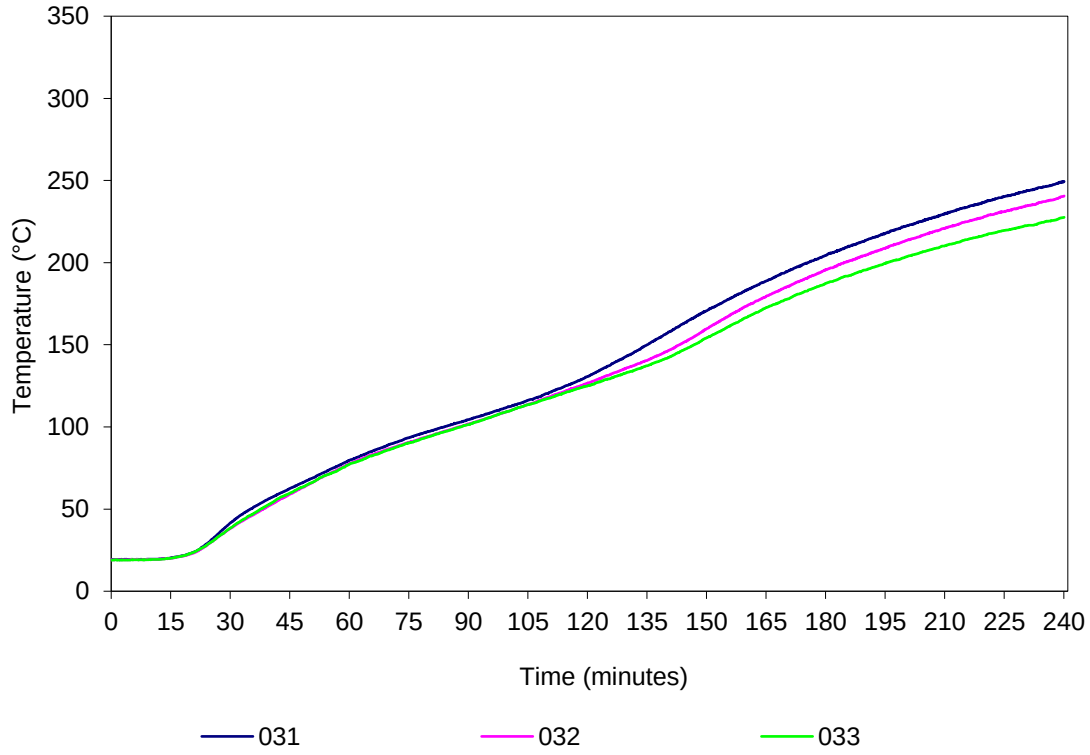


Figure 15 **Penetration system C – temperature vs time**

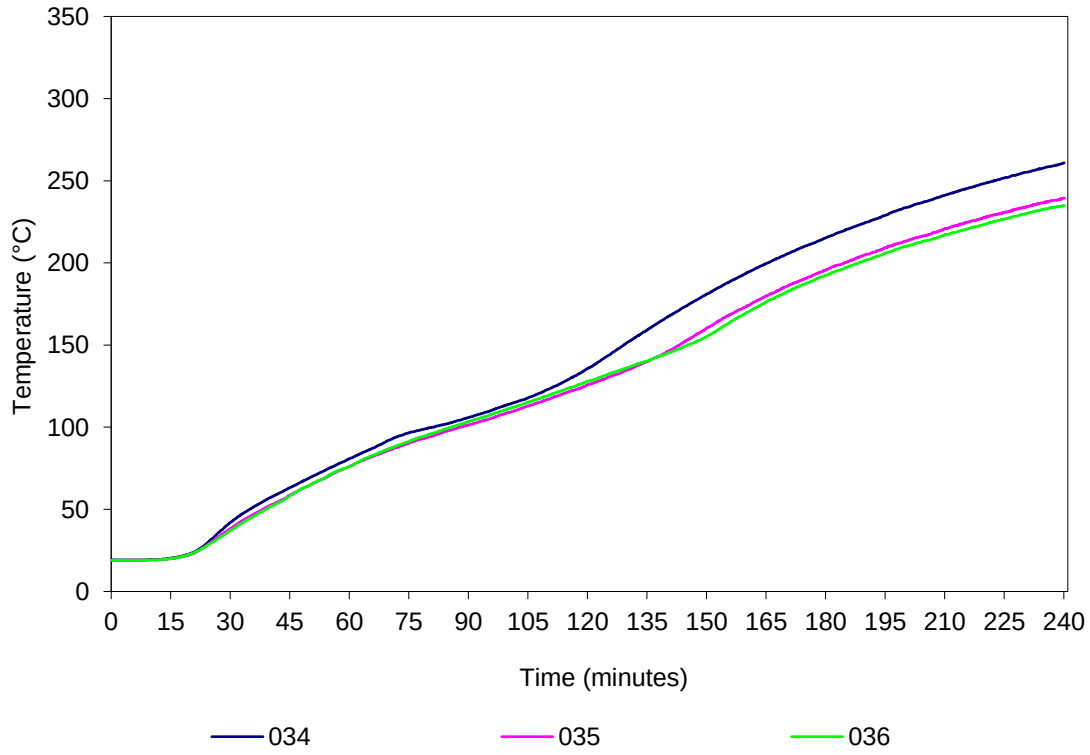


Figure 16 **Penetration system C – temperature vs time**

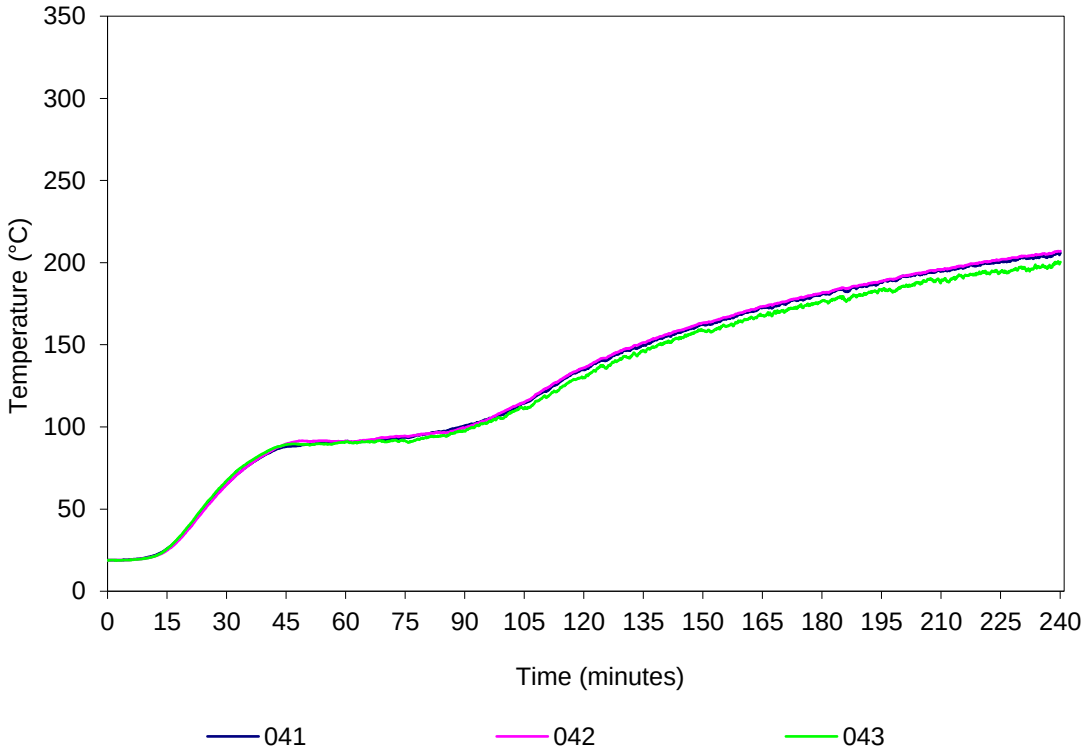


Figure 17 **Penetration system D – temperature vs time**

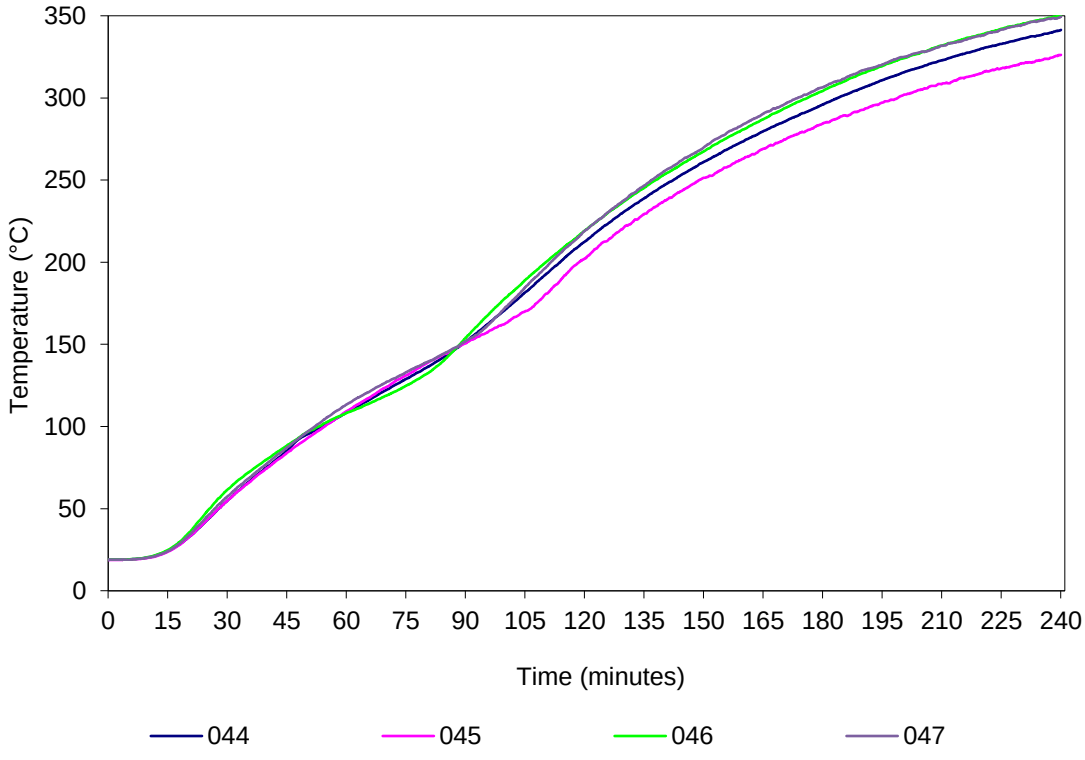


Figure 18 **Penetration system D – temperature vs time**

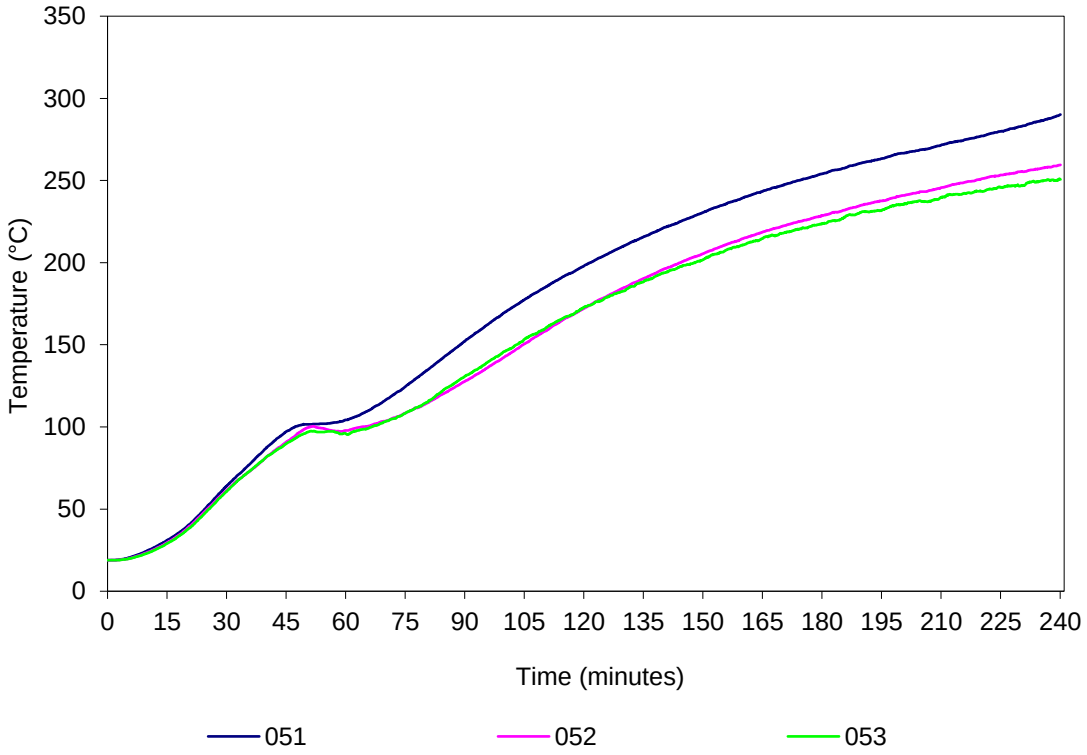


Figure 19 **Penetration system E – temperature vs time**

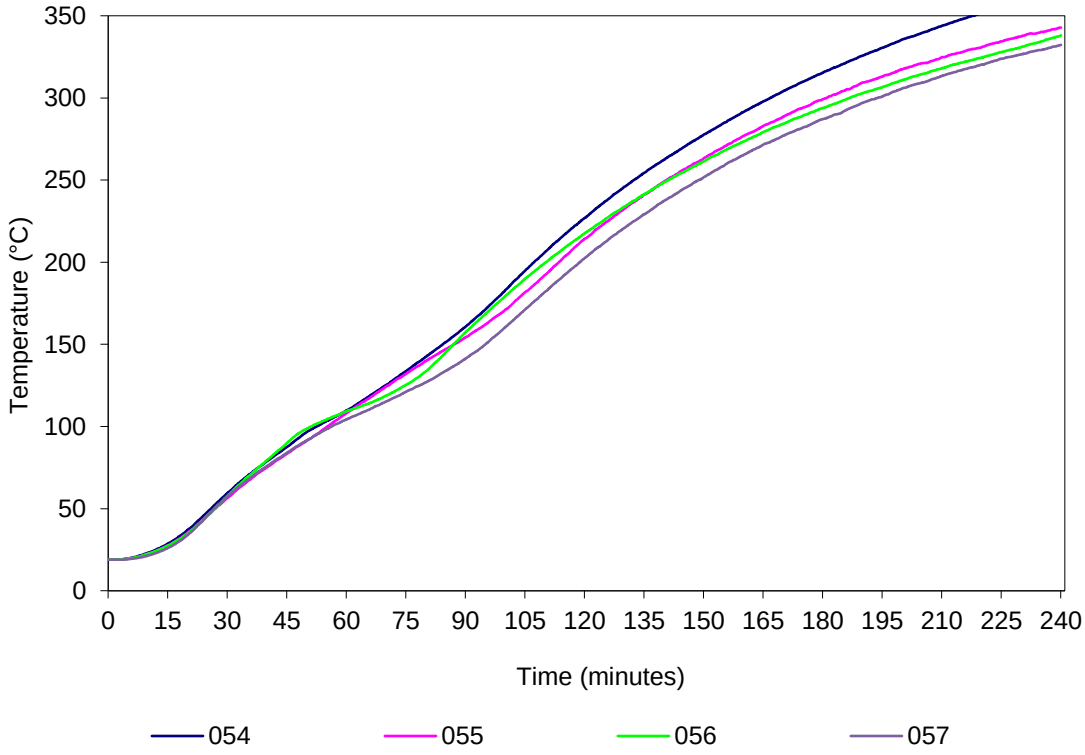


Figure 20 **Penetration system E – temperature vs time**

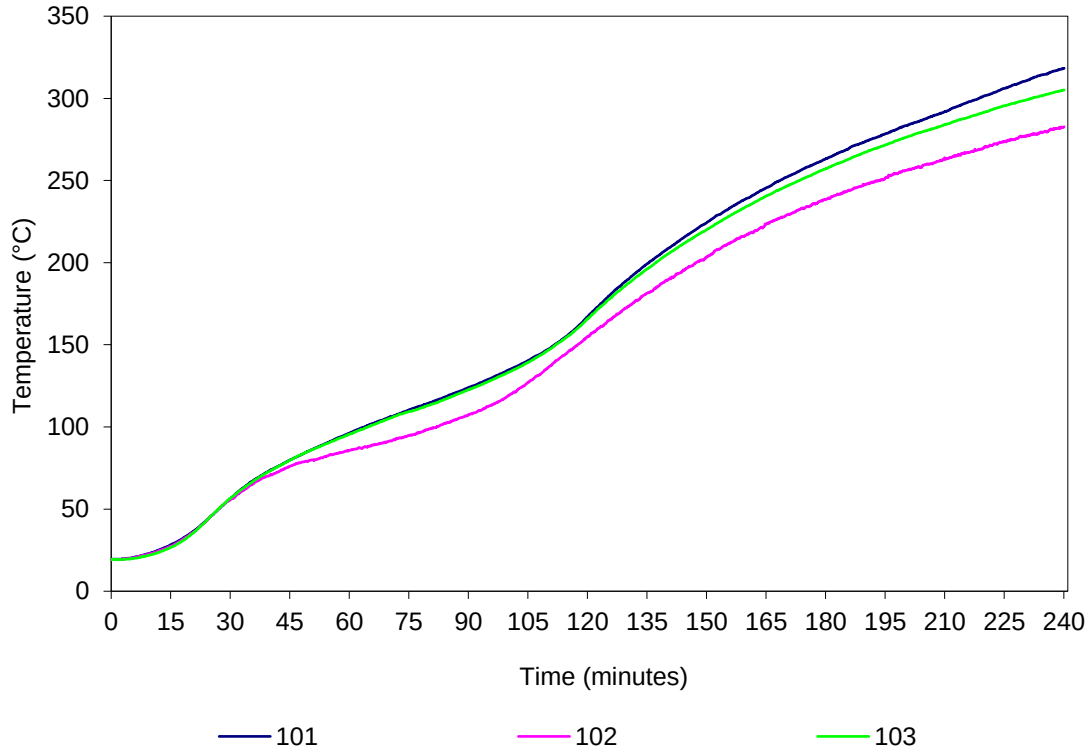


Figure 21 **Penetration system F – temperature vs time**

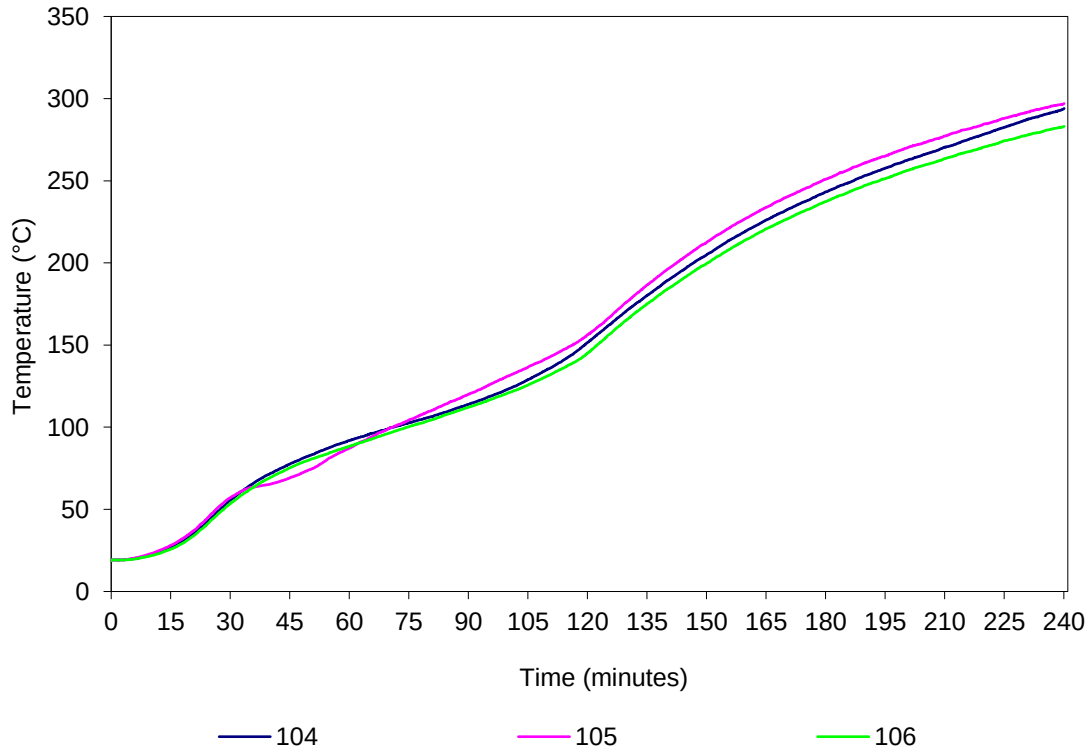


Figure 22 **Penetration system F – temperature vs time**

System	T/C No.	Description[2]	Temp (°C) at t (minutes)					Limit[1] (minutes)
			t=0	t=60	t=120	t=180	t=240	
A	011	On control joint	19	335	448	511	563	40
	012	On control joint	19	327	421	459	487	45
	013	On control joint	19	349	409	440	499	40
	014	25mm from control joint	19	76	128	187	222	195
	015	25mm from control joint	19	75	119	175	212	213
	016	25mm from control joint	19	80	135	207	248	171
	017	25mm from control joint	19	75	125	185	222	197
B	021	On control joint	20	357	530	641	710	30
	022	On control joint	19	381	499	588	646	33
	023	On control joint	19	534	679	753	807	22
	024	25mm from control joint	19	77	123	188	226	195
	025	25mm from control joint	19	77	123	183	221	201
	026	25mm from control joint	19	81	133	205	247	173
	027	25mm from control joint	#	#	#	#	#	#
C	031	25mm from control joint	19	79	131	204	249	174
	032	25mm from control joint	19	77	127	196	240	183
	033	25mm from control joint	19	77	125	187	228	194
	034	25mm from control joint	19	81	136	215	261	164
	035	25mm from control joint	19	76	126	196	240	183
	036	25mm from control joint	19	76	128	193	235	187
D	041	On control joint	19	91	135	181	206	217
	042	On control joint	19	91	136	182	207	217
	043	On control joint	19	91	130	177	200	238
	044	25mm from control joint	19	108	213	296	341	113
	045	25mm from control joint	19	109	202	284	326	118
	046	25mm from control joint	19	108	219	304	350	109
	047	25mm from control joint	19	113	219	306	349	111
E	051	On control joint	19	104	198	254	290	120
	052	On control joint	19	98	172	228	259	143
	053	On control joint	19	96	173	224	251	146
	054	25mm from control joint	19	109	227	315	365	106
	055	25mm from control joint	19	108	214	299	343	113
	056	25mm from control joint	19	109	218	294	338	109
	057	25mm from control joint	19	104	203	287	332	118
F	101	25mm from control joint	19	96	167	263	318	135
	102	25mm from control joint	19	86	155	238	283	146
	103	25mm from control joint	19	95	166	257	305	136
	104	25mm from control joint	19	92	152	243	294	146
	105	25mm from control joint	19	87	156	251	297	141

System	T/C No.	Description[2]	Temp (°C) at t (minutes)					Limit[1] (minutes)
			t=0	t=60	t=120	t=180	t=240	
	106	25mm from control joint	19	88	145	237	283	149

Table 8 Test specimen temperatures

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 prior to thermocouple failure.

Thermocouple failure.

'–' 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

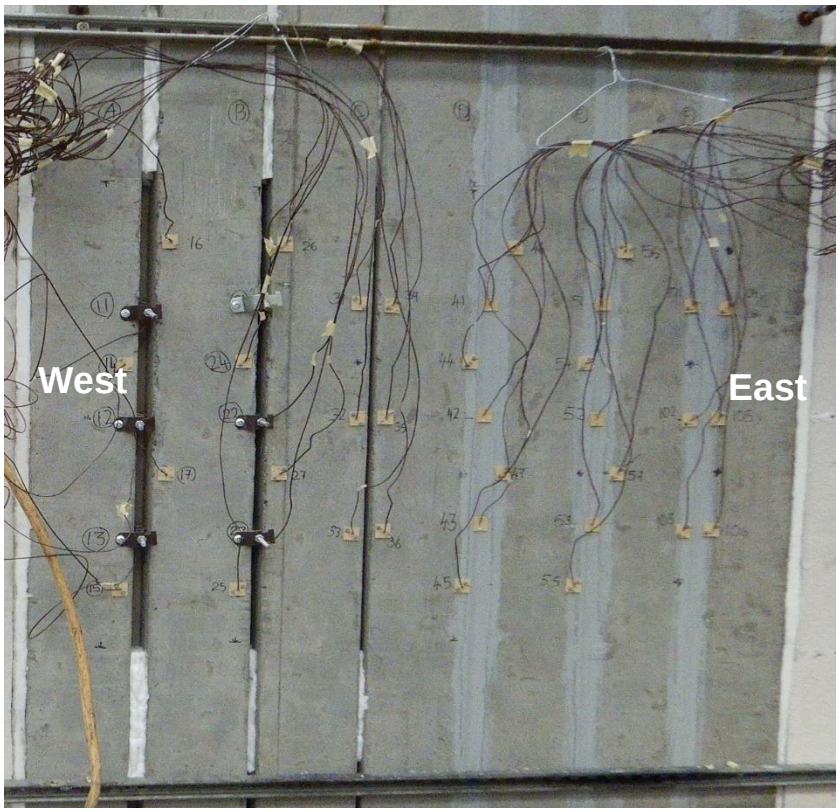


Figure 23 Unexposed face of specimen before the start of the fire-resistance test

Figure 24 Exposed face of the specimen before the start of the fire-resistance test

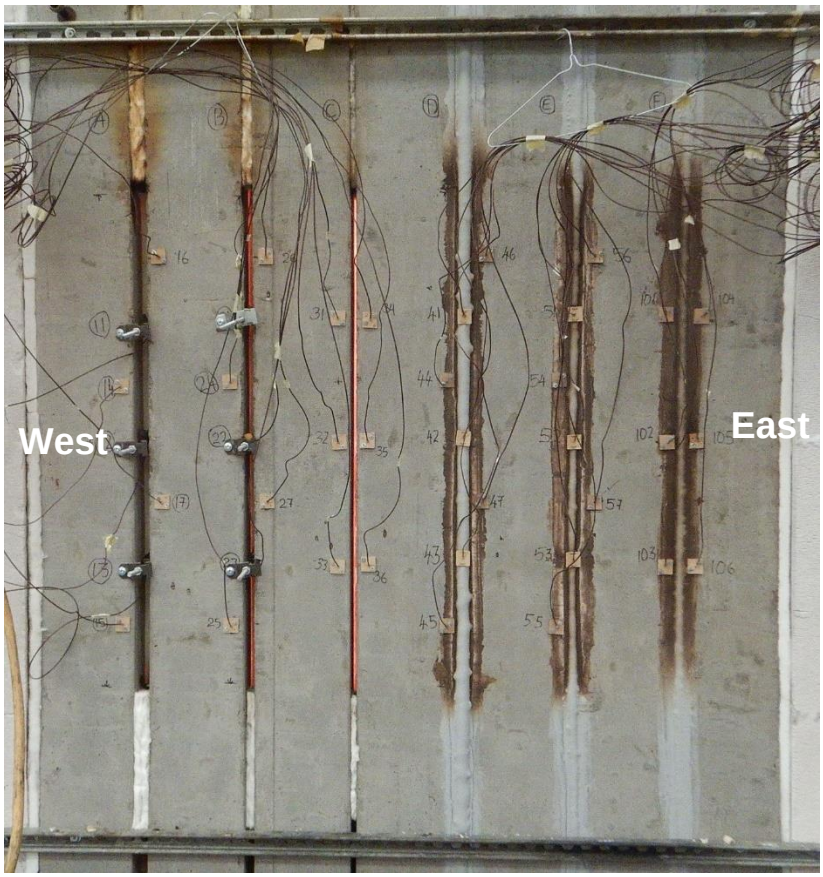


Figure 25 Unexposed face of specimen at the end of the fire-resistance test

Figure 26 Exposed face of the specimen at the end of the fire-resistance test