Fire-resistance test on sealing systems protecting service penetrations and control joints in concrete walls

Test Report

Author: Chris Wojcik
Report number: FSP 1839
Date: 20 July 2017

Client: Sika Australia Pty Ltd

NATA Accredited Laboratory
Number: 165
Corporate Site No 3625
Accredited for compliance with ISO/IEC 17025 - Testing

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AUTHOR	REVIEWED BY	AUTHORISED BY
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20 July 2017	20 July 2017	20 July 2017

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Fire-resistance test on sealing systems protecting service penetrations and control joints in concrete walls

Sponsored Investigation No. FSP 1839

1 Introduction

1.1 Identification of specimen

The sponsor identified the test specimen as Sikaflex 400 fire sealant protecting a control joint, copper pipe and a cable tray penetrations in concrete walls.

1.2 Sponsor

Sika Australia Pty Ltd
55 Elizabeth Street
Wetherill Park NSW

1.3 Manufacturers

Sika Ltd
1-1 Nagatoro, Hiratsuka-shi
Kanagawa 254-0021
Japan

1.4 Test standards

Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4 – 2014, Fire-resistance tests of elements of construction.

Section 10: Service penetrations and control joints.

1.5 Reference standard

Australian Standard 4072, Components for the protection of openings in fire-resistant separating elements, Part 1 - 2005, Service penetrations and control joints.

1.6 Test number

CSIRO Reference test number FS4598/3974

1.7 Test date

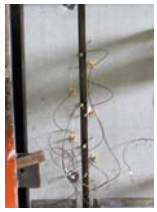
The fire-resistance test was conducted on 8 August 2016.

2 Description of specimen

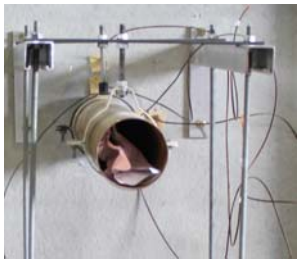
2.1 General

The specimen comprised one 1000-mm exposed length control joint, one copper pipe and one cable tray formed in and penetrating a 150-mm thick concrete wall. The joint and penetrations were protected with Sikaflex 400 fire sealant.

Specimen 1 – 30-mm wide control joint protected by Sikaflex 400 Fire sealant applied from the fire exposed side

SEPERATING ELEMENT		
150-mm thick concrete wall, with an established FRL of -/240/240.		
SIZE OF OPENING		
30-mm wide x 1000-mm exposed length.		
FIRE STOPPING SYSTEM		
Trade name	Sikaflex 400 fire sealant	
Manufacturer	Sika Australia Pty Ltd	
Size	30-mm wide x 15-mm deep x 1000-mm long	
Description	One component moisture curing, elastic joint sealant	
Installation	The 30-mm wide joint was protected with Sikaflex 400 Fire sealant installed from the exposed side of the wall. The sealant was applied to a depth of 15-mm controlled by two side by side 25-mm x 25-mm polyurethane foam backing rods, and finished flush with the exposed face of the wall.	
Photographs	 fire exposed face	 unexposed face
Drawings	Drawing numbered 1, dated 30 June 2016, by Sika Australia Pty Ltd.	

Specimen 2 – Nominal 100-mm OD copper pipe penetration protected by Sikaflex 400 Fire sealant applied from both sides

SEPERATING ELEMENT		
150-mm thick concrete wall, with an established FRL of -/240/240.		
SIZE OF OPENING		
150-mm diameter hole		
PENETRATING SERVICE		
Description	Copper pipe	
Size	102-mm OD, with 1-mm wall thickness, pipe extended minimum 500-mm from each side of the wall	
End conditions	Capped on the exposed end using copper end cap	
Supports	Approximately 200-mm on the exposed side and 100-mm and 400-mm away from the wall on the unexposed face	
FIRE STOPPING SYSTEM		
Trade name	Sikaflex 400 fire sealant	
Manufacturer	Sika Australia Pty Ltd	
Size	25-mm wide annular gap x 15-mm deep	
Description	One component moisture curing, elastic joint sealant	
Installation	The 25-mm wide annular was protected with Sikaflex 400 Fire sealant installed from both sides of the wall. The sealant was applied to a depth of 15-mm controlled by two side by side 25-mm x 25-mm polyurethane foam backing rods, and finished flush with both faces of the wall.	
Photographs	 fire exposed face	 unexposed face
Drawings	Drawing numbered 1, dated 30 June 2016, by Sika Australia Pty Ltd.	

Specimen 3 – Nominal 155-mm wide cable tray penetration protected by Sikaflex 400 Fire sealant applied from both sides

SEPERATING ELEMENT	
150-mm thick concrete wall, with an established FRL of -/240/240.	
SIZE OF OPENING	
170-mm x 50-mm	
PENETRATING SERVICE	
Description	Cable tray
Size	155-mm wide x 20-mm high cable tray, supporting ten 20-mm diameter electrical cables, cable tray extended minimum 500-mm from each side of the wall
End conditions	Not applicable
Supports	Approximately 200-mm on the exposed side and 100-mm and 400-mm away from the wall on the unexposed face
FIRE STOPPING SYSTEM	
Trade name	Sikaflex 400 fire sealant
Manufacturer	Sika Australia Pty Ltd
Size	Resulting annular gap x 10-mm deep
Description	One component moisture curing, elastic joint sealant
Installation	The resulting annular gap between the tray, cables and the wall opening was protected with Sikaflex 400 Fire sealant installed from both sides of the wall. The sealant was applied to a depth of 10-mm controlled by one 25-mm x 25-mm polyurethane foam backing rod, and finished flush with both faces of the wall.
Photographs	 fire exposed face  unexposed face
Drawings	Drawing numbered 1, dated 30 June 2016, by Sika Australia Pty Ltd.

2.2 Orientation

The control joint was tested with the sealant applied to the fire exposed face of the wall.

2.3 Dimensions

The overall exposed length of the control joint specimen was 1000-mm, to suit the opening in the specimen containing frame.

2.4 Restraints

The concrete slab was restrained along all four sides.

2.5 Conditioning

The specimen installation was finalised on 30 June 2016 and the specimen was stored under laboratory conditions until the day of the test.

2.6 Selection, construction and installation of the specimen and the supporting construction

The construction was organised by the sponsor. CSIRO was not involved in the selection of the materials.

3 Documentation

The following documents were supplied or referenced by the sponsor as a complete description of the specimen and should be read in conjunction with this report:

- Drawing numbered 1, dated 30 June 2016, by Sika Australia Pty Ltd.

Confidential information about the test specimen has been submitted and is retained at CSIRO Infrastructure Technologies.

4 Equipment

4.1 Furnace

The furnace had a nominal opening of 1000-mm x 1000-mm for attachment of vertical or horizontal specimens.

The furnace was lined with refractory bricks and materials with the thermal properties as specified in AS 1530.4-2014 and was heated by combustion of a mixture of natural gas and air.

4.2 Temperature

The temperature in the furnace chamber was measured by four type K, 3-mm diameter, and 310 stainless steel Mineral Insulated Metal Sheathed (MIMS) thermocouples. Each thermocouple was housed in high-nickel steel tubes opened at the exposed end.

The temperatures of the specimen were measured by glass-fibre insulated and sheathed K-type thermocouples with a wire diameter of 0.5-mm.

Locations of the thermocouples on the unexposed face of the specimen are described in Appendix A.

4.3 Measurement system

The primary measurement system comprised multiple-channel data loggers, scanning at one minute intervals during the test.

5 Ambient temperature

The temperature of the test area was 15°C at the commencement of the test.

6 Departure from standard

There were no departures from the requirements of AS 1530.4-2014.

7 Termination of the test

The test was terminated at 241 minutes by the agreement with the sponsor.

8 Test results

8.1 Critical observations

The following observations were made during the fire-resistance test:

5 minutes -	Smoke is emitted from around the cables of Specimen 3.
10 minutes -	Insulation failure of Specimen 2 – maximum temperature rise of 180 deg C is exceeded on the unexposed face of the pipe.
17 minutes -	Smoke emitted from around the cables of Specimen 3 is increasing. Sealant around the pipe of Specimen 2 is starting to discolour.
22 minutes -	Glow is visible inside the joint of Specimen 1, at approximately ¾ height.
28 minutes -	Insulation failure of Specimen 1 – maximum temperature rise of 180 deg C is exceeded on the unexposed face of the backing rod.
38 minutes -	Some sealant from around the pipe of Specimen 2 is starting to fall off.
58 minutes -	Cotton pad test applied over the glow noted at 22 minutes – no ignition of cotton noted.
113 minutes -	Sealant around the pipe of Specimen 2 is starting to discolour/char, pipe has subsided within the penetration opening.
134 minutes -	End cap from the pipe of Specimen 2 has melted.
140 minutes -	Integrity failure of Specimen 2 - copper pipe has started to melt at the base of penetration, ceramic fibre plug is inserted into the pipe
145 minutes -	Insulation failure of Specimen 3 – maximum temperature rise of 180 deg C is exceeded on the unexposed face of the cables.
180 minutes -	No apparent change to specimens.
241 minutes -	Test terminated.

8.2 Furnace temperature

Figure 1 shows the standard curves of temperature versus time for heating the furnace chamber and the actual curves of average and maximum temperature versus time recorded during the heating period.

8.3 Furnace severity

Figure 2 shows the curve of furnace severity versus time during the heating period.

8.4 Specimen temperature

Figure 3 shows curves of temperature versus time recorded on the unexposed face of Specimen 1.

Figure 4 shows curves of temperature versus time recorded on the unexposed face of Specimen 2.

Figure 5 shows curves of temperature versus time recorded on the unexposed face of Specimen 3.

8.5 Performance

Performance observed in respect of the following AS 1530.4-2014 criteria:

Specimen 1 – 30-mm wide control joint protected by Sikaflex 400 Fire sealant applied from the fire exposed side

Structural adequacy	-	not applicable
Integrity	-	no failure at 241 minutes
Insulation	-	28 minutes

Specimen 2 – Nominal 100-mm OD copper pipe penetration protected by Sikaflex 400 Fire sealant applied from both sides

Structural adequacy	-	not applicable
Integrity	-	140 minutes
Insulation	-	10 minutes

Specimen 3 – Nominal 155-mm wide cable tray penetration protected by Sikaflex 400 Fire sealant applied from both sides

Structural adequacy	-	not applicable
Integrity	-	no failure at 241 minutes
Insulation	-	145 minutes

This report details methods of construction, the test conditions and the results obtained when specific element of construction described herein was tested following the procedure outlined in this standard. Any significant variation with respect to size, constructional details, loads, stresses, edge or end conditions, other than those allowed under the field of direct application in the relevant test method, is not covered by this report.

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.

9 Fire-Resistance Level (FRL)

For the purpose of building regulations in Australia, the FRLs of the test specimens were as follows:

Specimen 1: -/240/0,

Specimen 2: -/120/0; and

Specimen 3: -/240/120

The fire-resistance levels of the Specimen 1 are applicable when the system is exposed to fire from the direction as tested.

The fire-resistance levels of the Specimens 2 and 3 are applicable when the systems are exposed to fire from either direction.

For the purposes of AS 1530.4-2014 the results of these fire tests may be used to directly assess fire hazard, but it should be noted that a single test method will not provide a full assessment of fire hazard under all fire conditions.

10 Field of direct application of test results

The results of the fire test contained in this test report are directly applicable, without reference to the testing authority, to similar constructions where one or more changes listed in Clause 10.12 of AS1530.4-2014, have been made provided no individual component is removed or reduced.

11 Tested by

Chris Wojcik
Testing Officer

Appendices

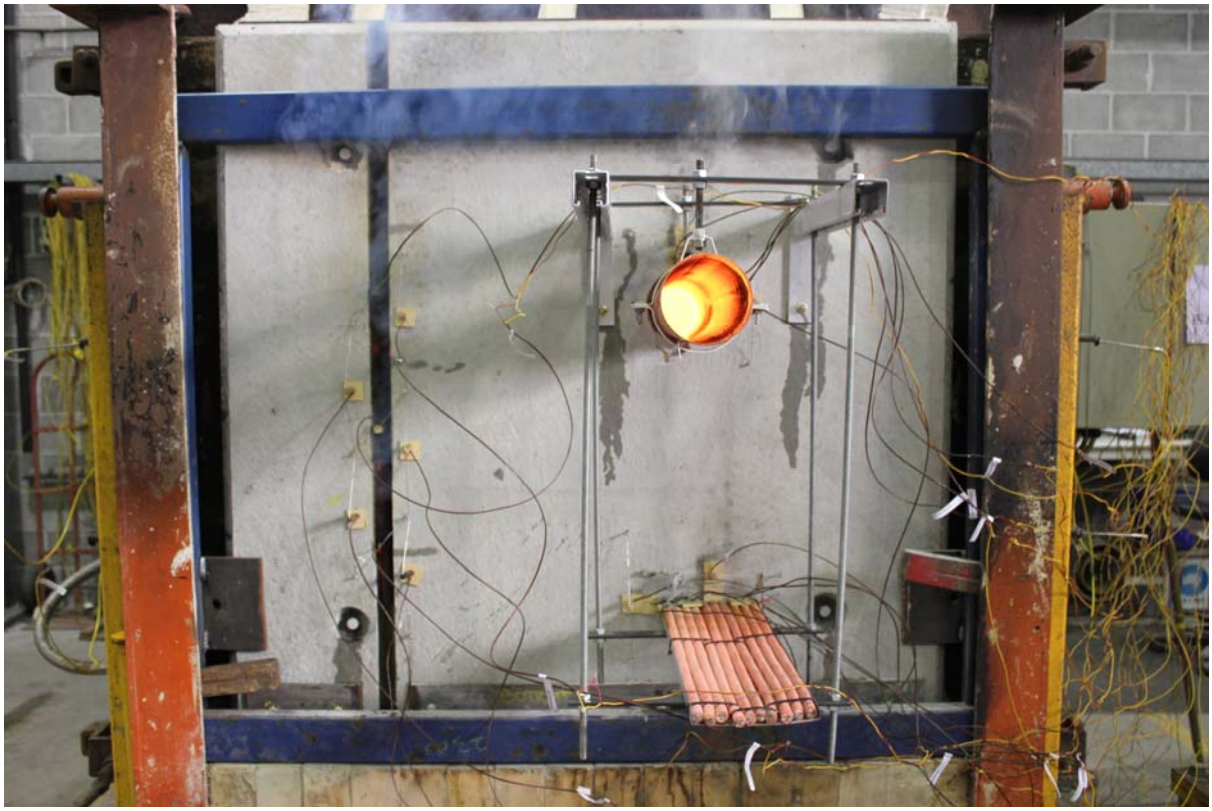
Appendix A – Measurement location

Measurement Location		
Group location	**T/C Position**	**T/C designation**
Specimen		
Specimen 1 – 30-mm wide control joint protected by Sikaflex 400 Fire sealant applied from the fire exposed side	On the backing rod inside the joint, ¾ height	S1
	On the backing rod inside the joint, ½ height	S2
	On the backing rod inside the joint, ¼ height	S3
	On the wall 25-mm from the joint – left side 2/3 height	S4
	On the wall 25-mm from the joint – left side 1/3 height	S5
	On the wall 25-mm from the joint – right side ¾ height	S6
	On the wall 25-mm from the joint – right side ½ height	S7
	On the wall 25-mm from the joint – right side ¼ height	S8
Specimen 2 – Nominal 100-mm OD copper pipe penetration protected by Sikaflex 400 Fire sealant applied from both sides	On the wall – 25-mm above sealant	S9
	On the wall – 25-mm beside the sealant	S10
	On the sealant – above the pipe	S11
	On the sealant – beside the pipe	S12
	On the pipe – 25-mm from the sealant	S13
	On the pipe – 25-mm from the sealant	S14
Specimen 3 – Nominal 155-mm wide cable tray penetration protected by Sikaflex 400 Fire sealant applied from both sides	On the wall – 25-mm above sealant	S15
	On the wall – 25-mm beside the sealant	S16
	On the sealant – above the tray	S17
	On the sealant – beside the tray	S18
	On the tray – 25-mm from the sealant – left side	S19
	On the tray – 25-mm from the sealant – right side	S20
	On the cables – 25-mm from the sealant	S21
	On the cables – 25-mm from the sealant	S22
Rover		
Ambient		

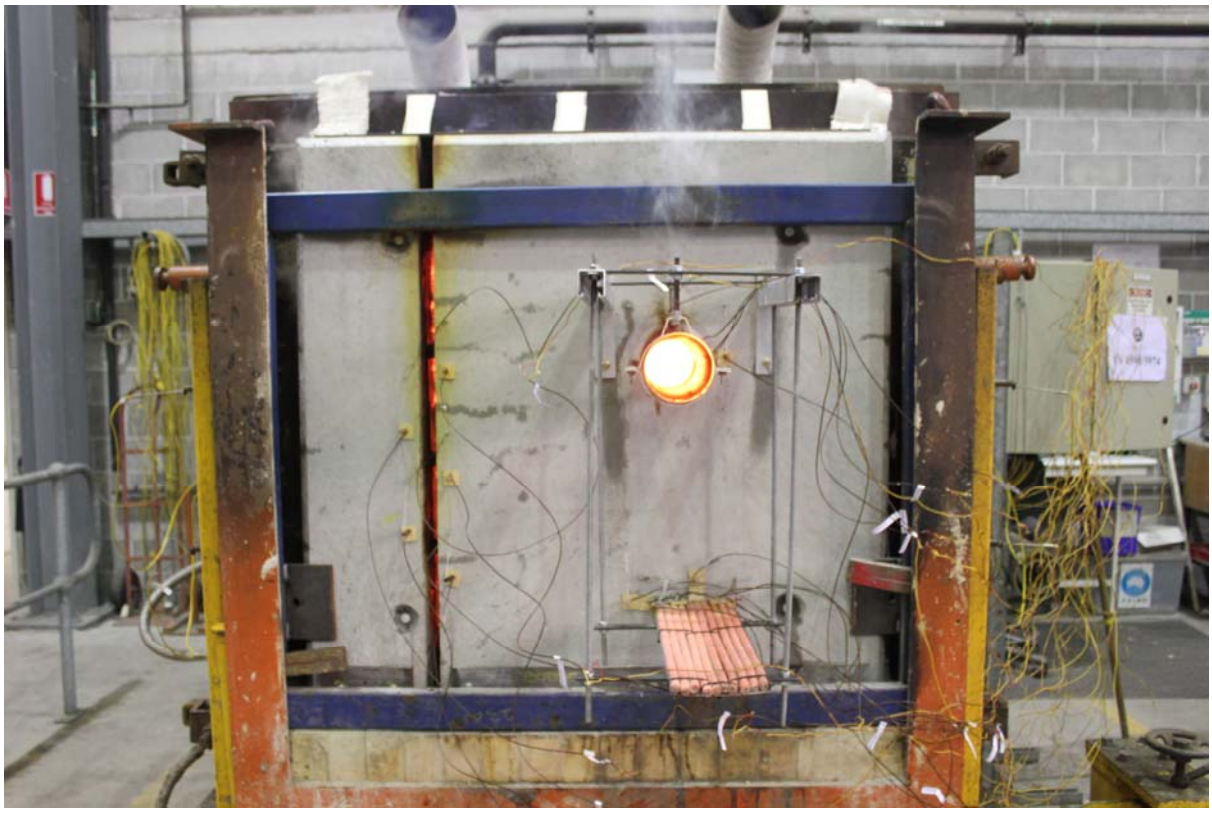
Appendix B – Test photographs

PHOTOGRAPH 1 – EXPOSED FACE OF THE SPECIMENS PRIOR TO TEST

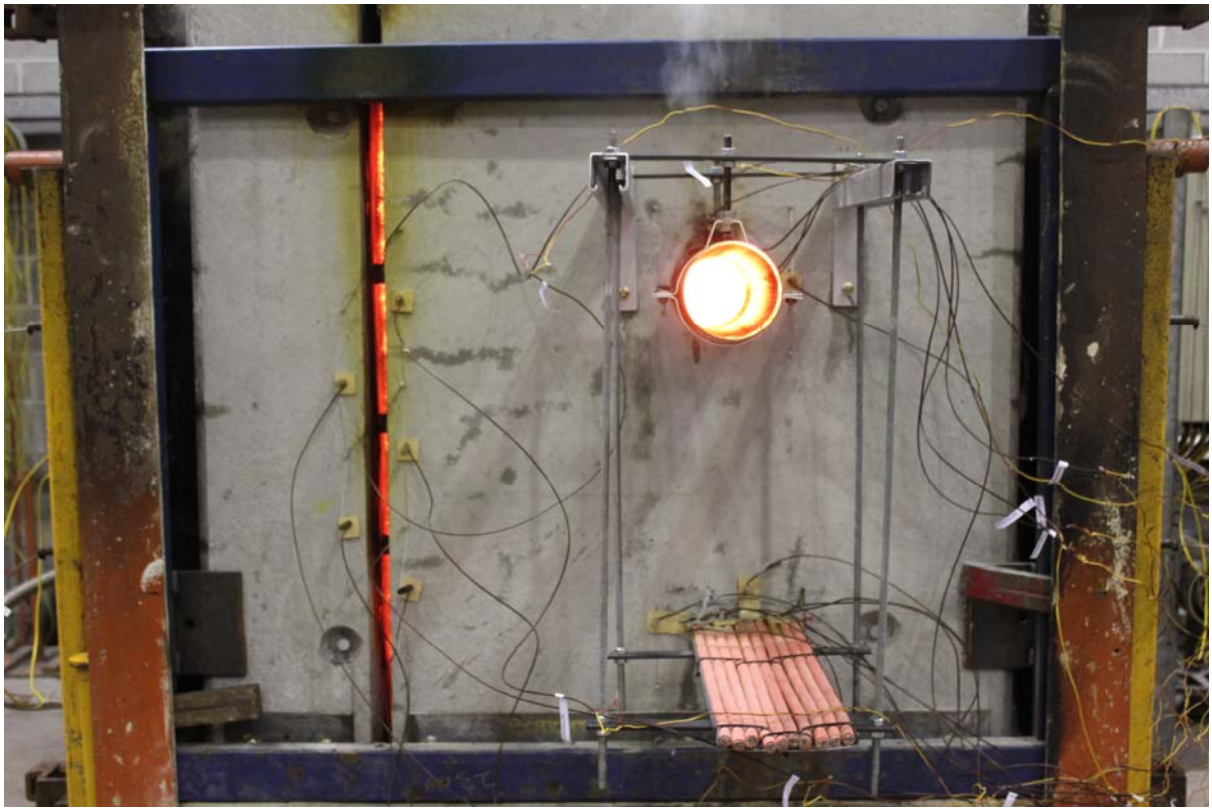
PHOTOGRAPH 2 – UNEXPOSED FACE OF THE SPECIMENS PRIOR TO TESTING



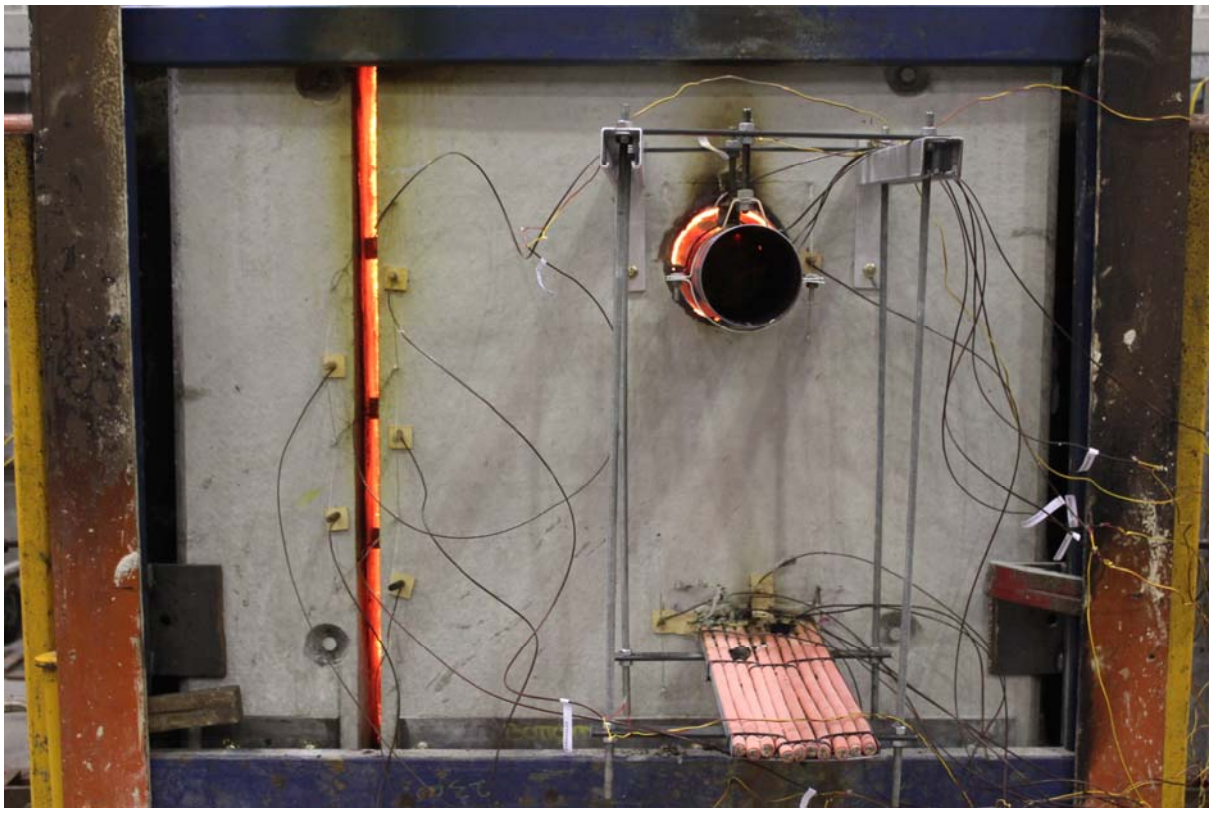
PHOTOGRAPH 3 – SPECIMENS AT 30 MINUTES INTO THE TEST



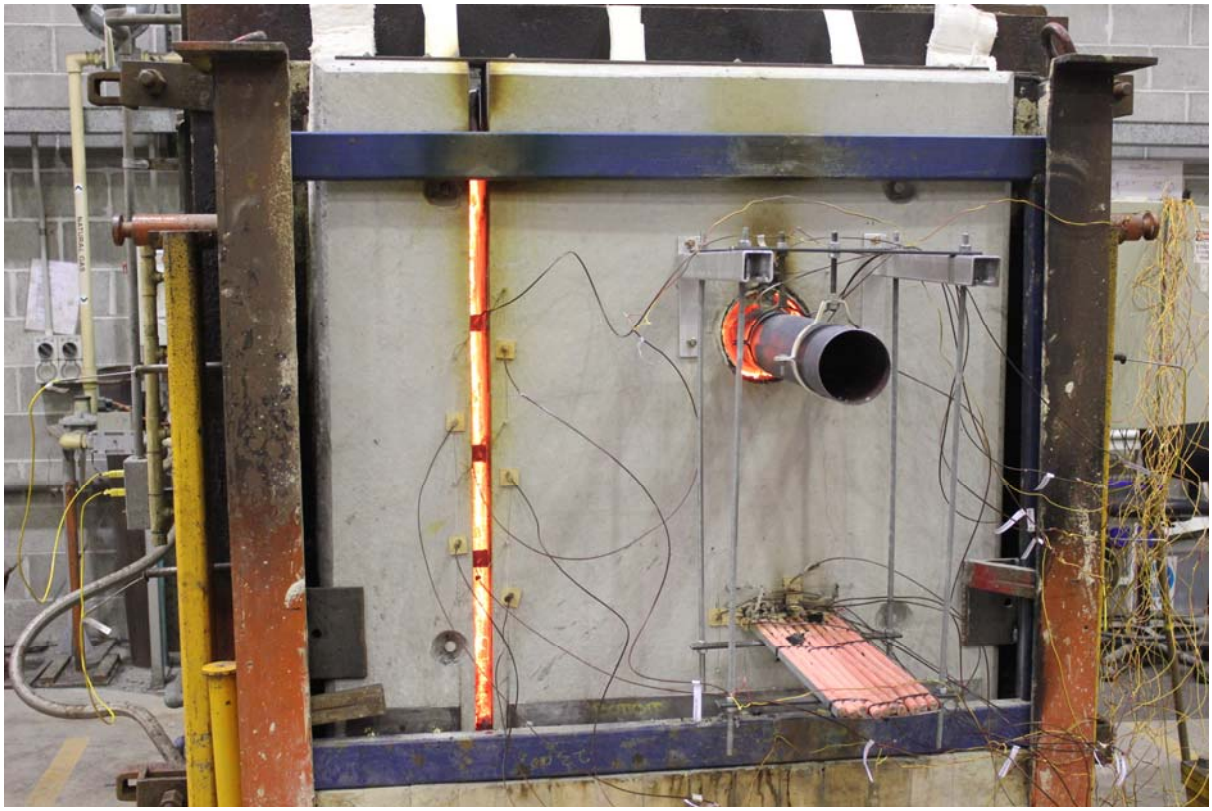
PHOTOGRAPH 4 – SPECIMENS AT 60 MINUTES INTO THE TEST



PHOTOGRAPH 5 – SPECIMENS AT 120 MINUTES INTO THE TEST



PHOTOGRAPH 6 – SPECIMENS AT 180 MINUTES INTO THE TEST



PHOTOGRAPH 7 – SPECIMENS AT THE CONCLUSION OF TESTING

PHOTOGRAPH 8 – EXPOSED FACE OF THE SPECIMEN AFTER THE CONCLUSION OF TESTING

Appendix C – Test data charts

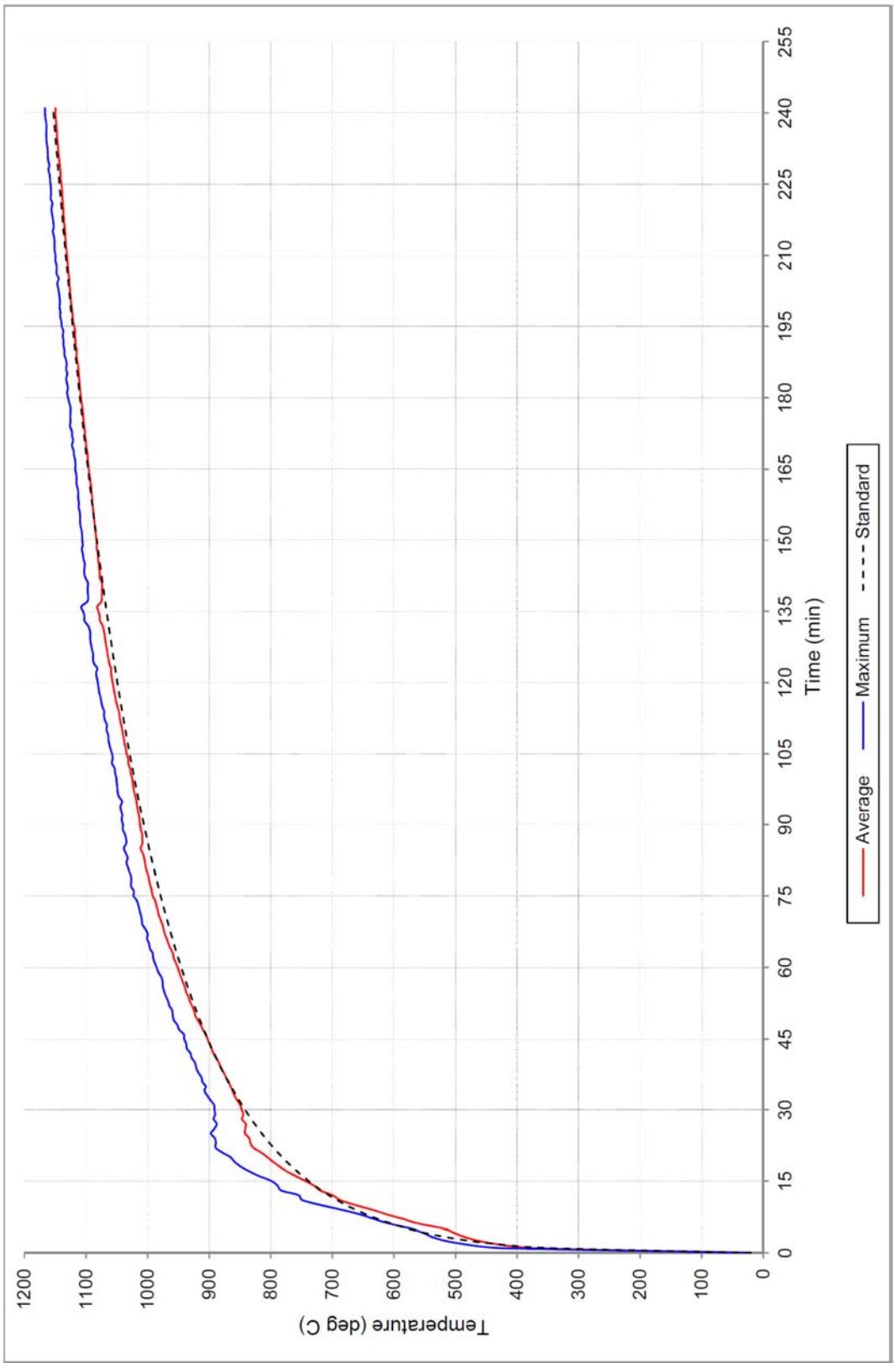


FIGURE 1 – FURNACE TEMPERATURE

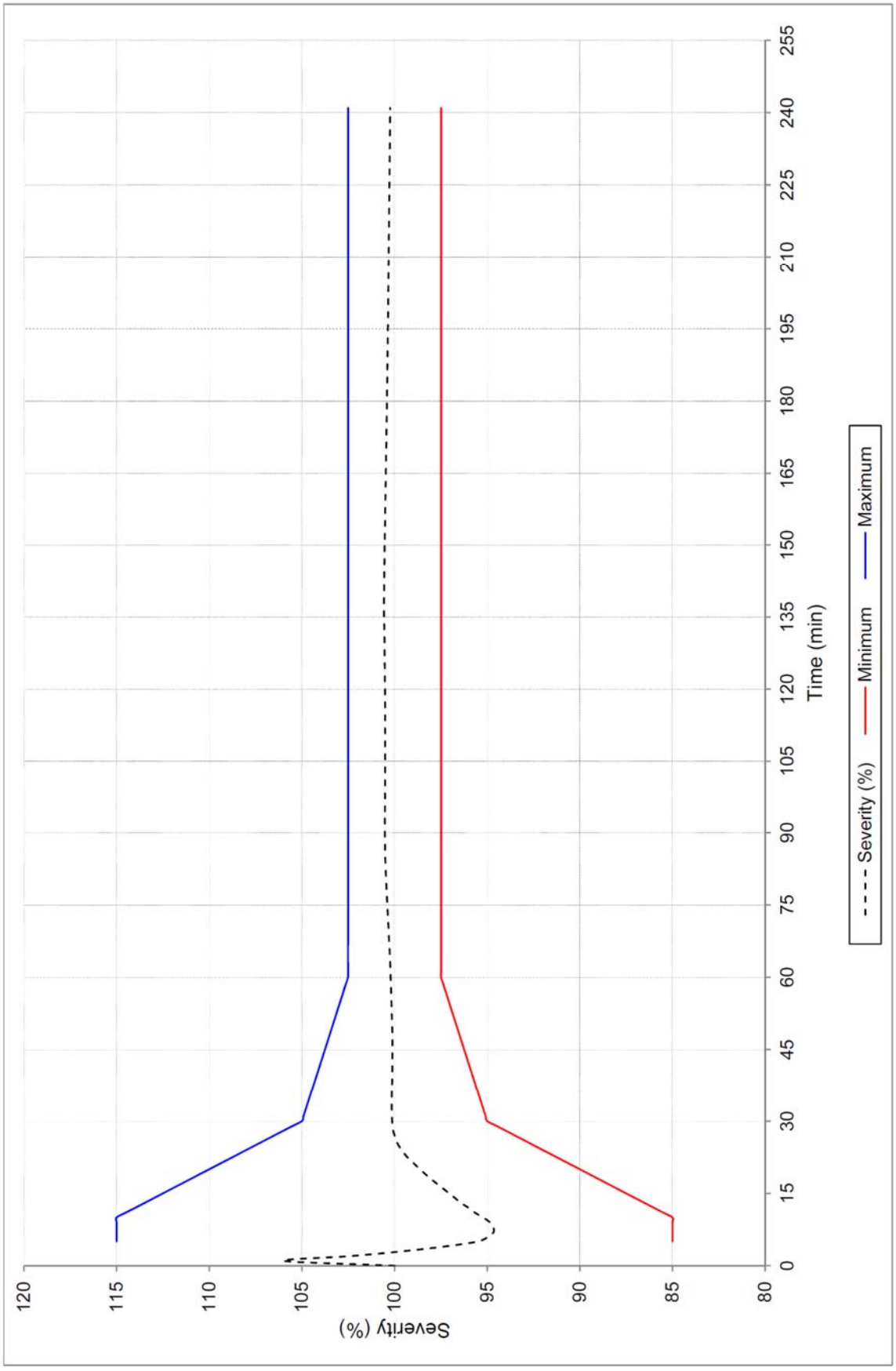


FIGURE 2 – FURNACE SEVERITY

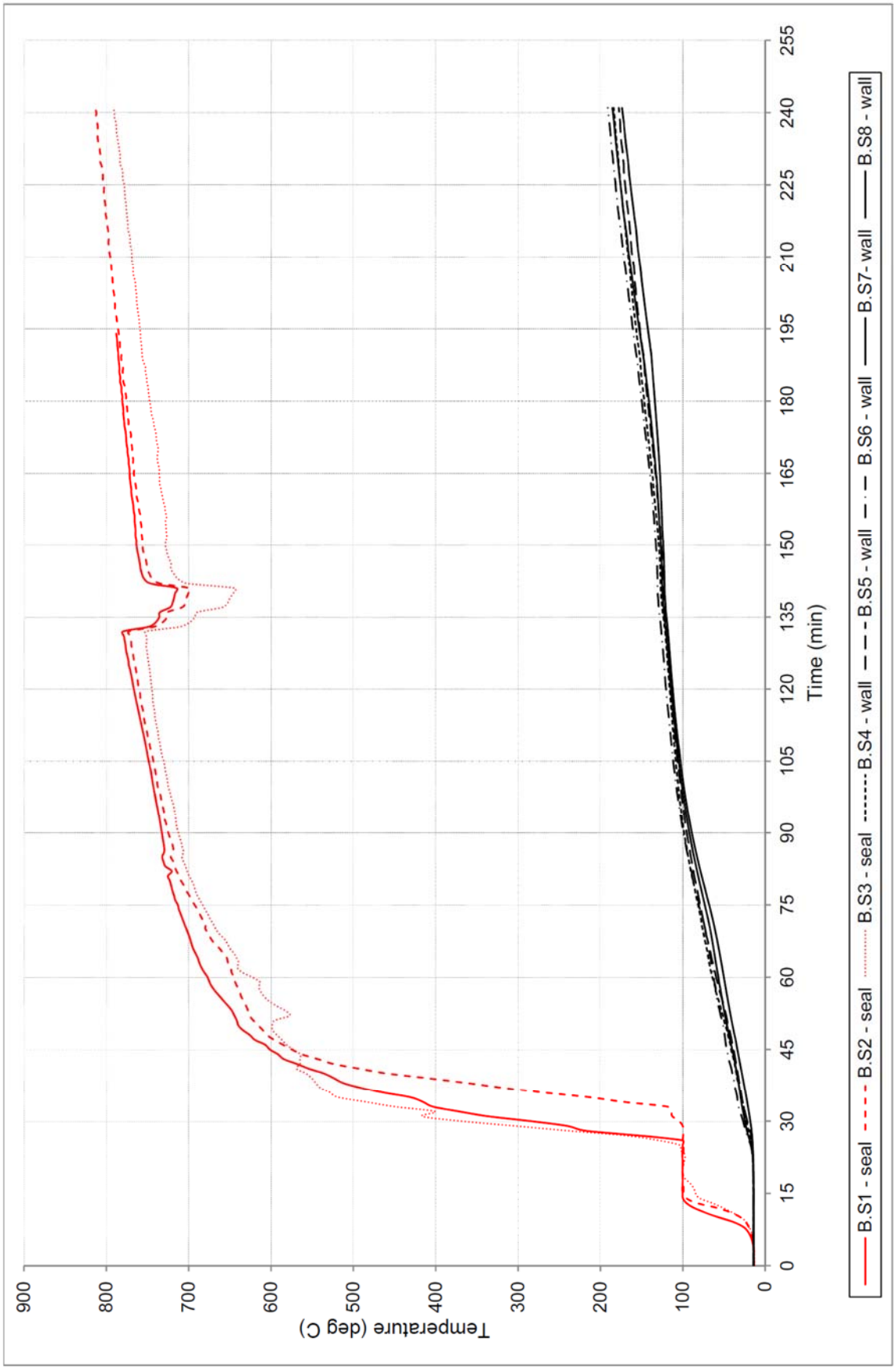


FIGURE 3 – SPECIMEN TEMPERATURE – UNEXPOSED FACE OF SPECIMEN 1

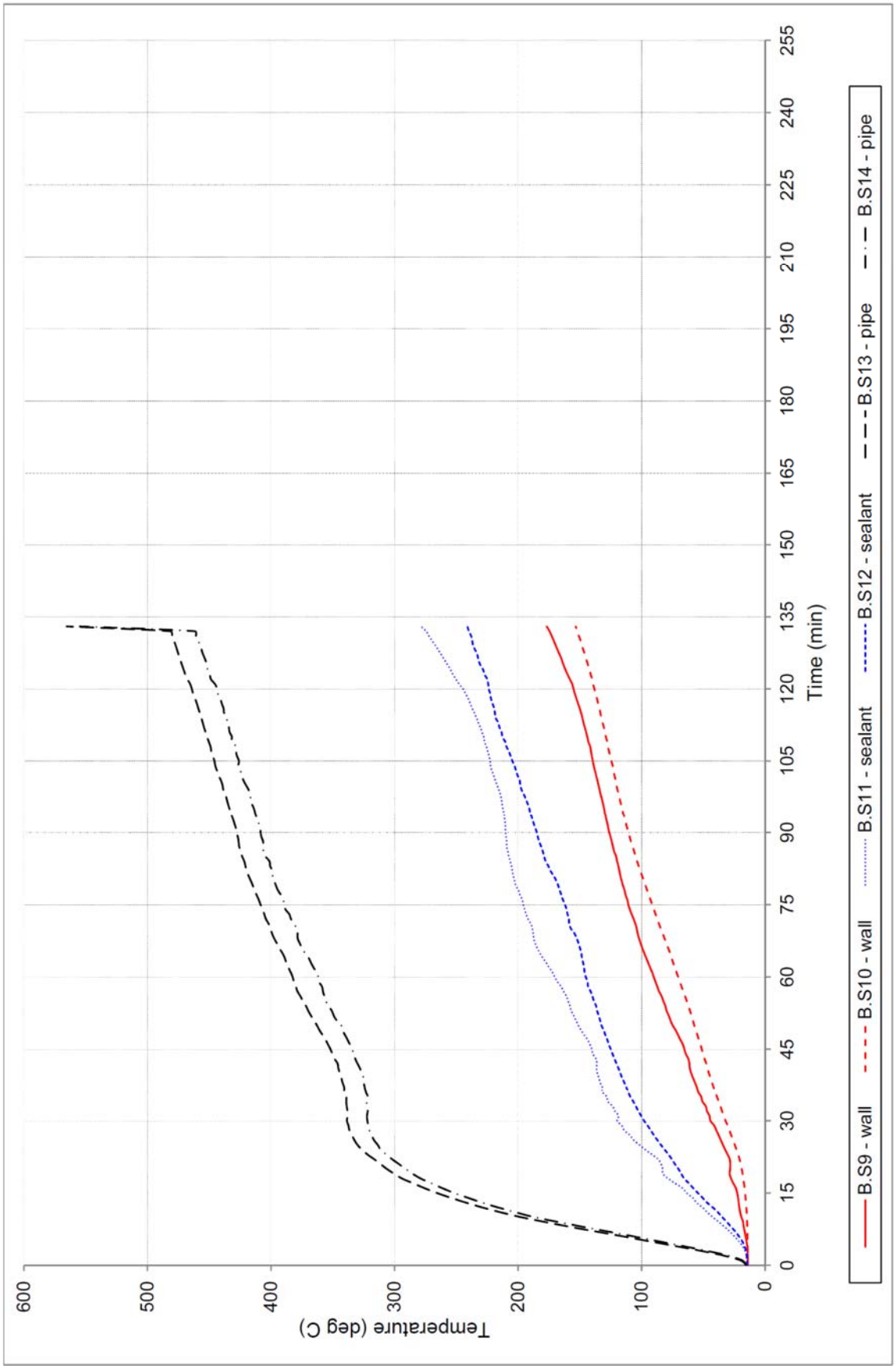


FIGURE 4 – SPECIMEN TEMPERATURE – UNEXPOSED FACE OF SPECIMEN 2

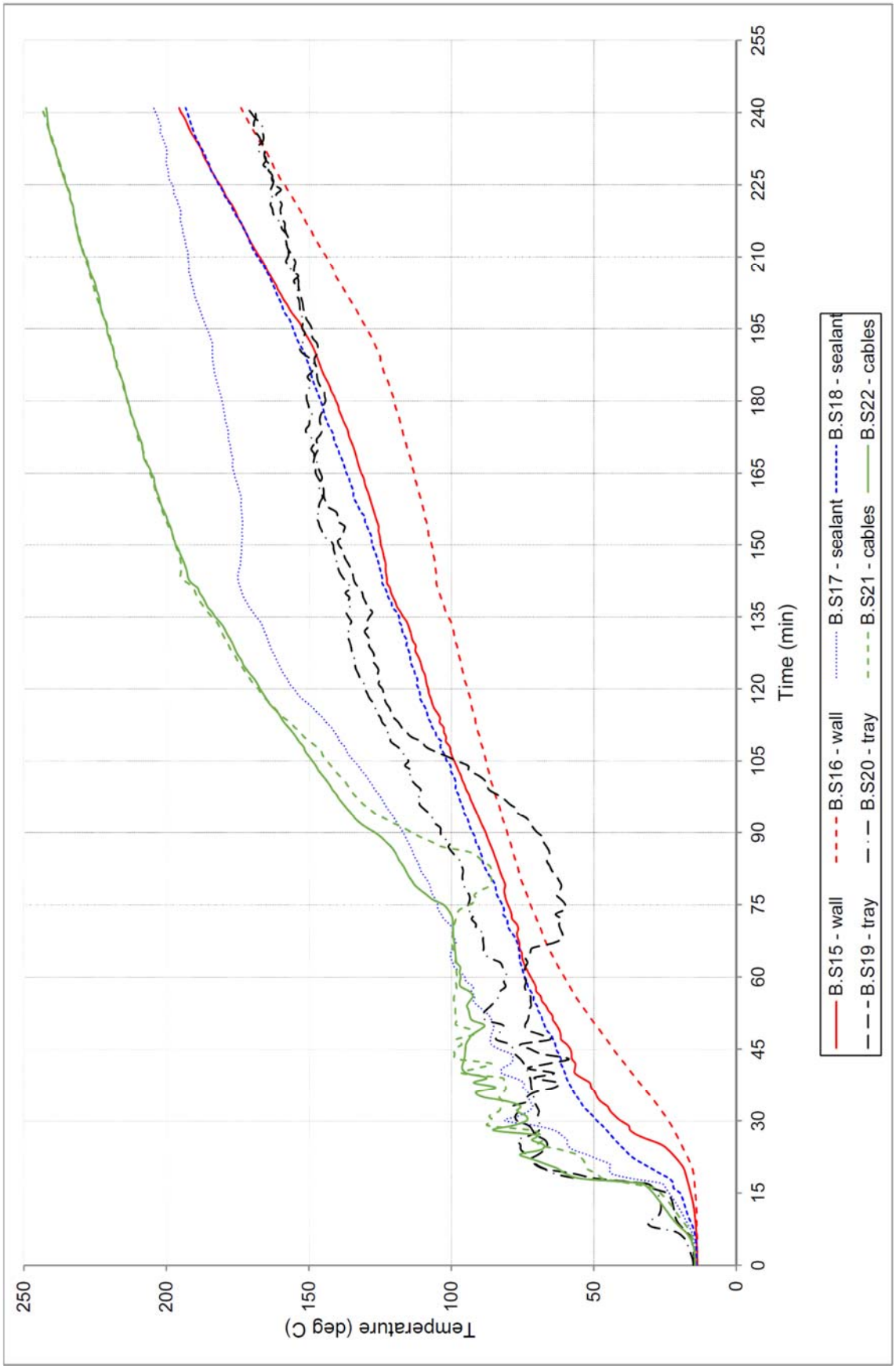
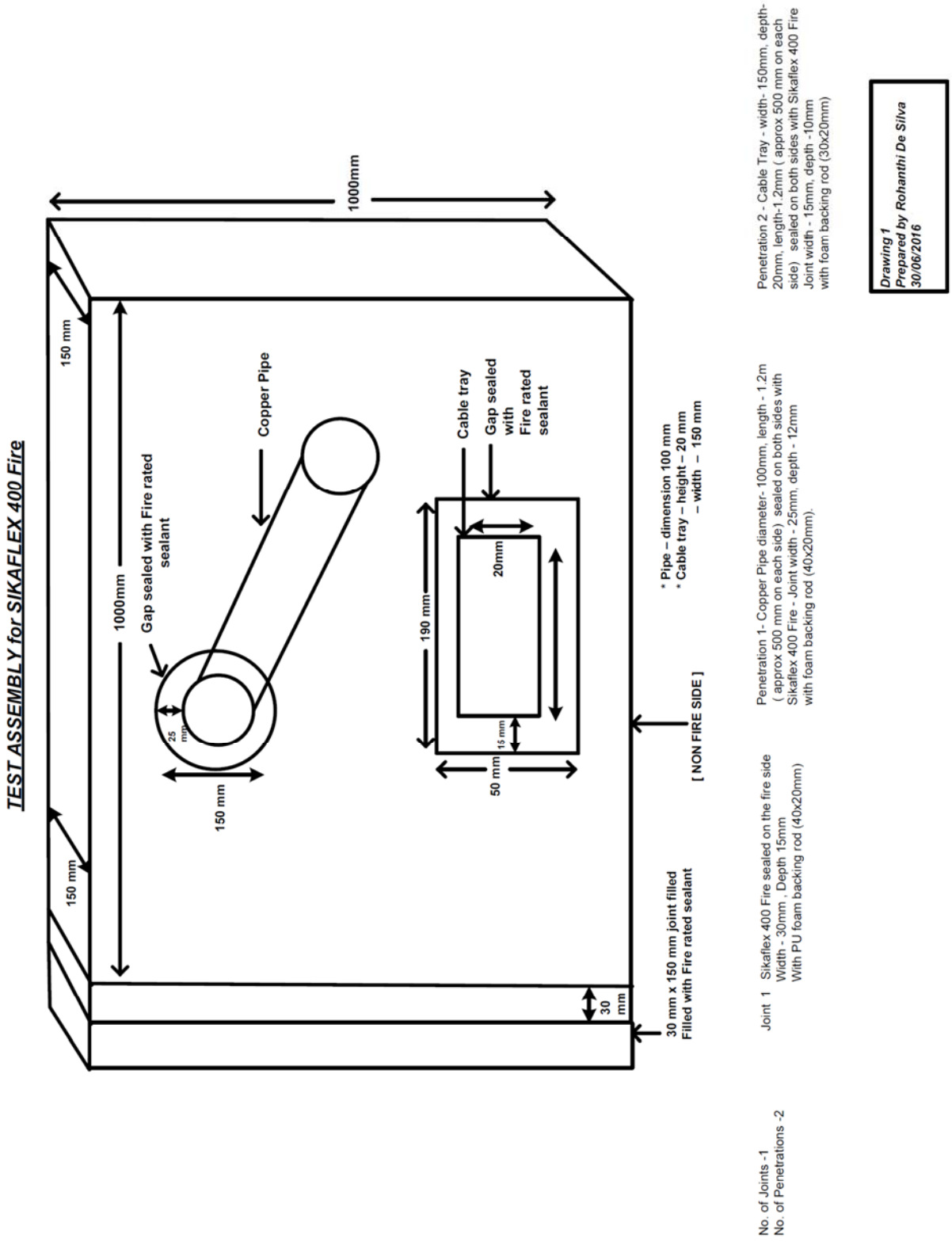


FIGURE 5 – SPECIMEN TEMPERATURE – UNEXPOSED FACE OF SPECIMEN 3

Appendix D – Specimen drawings



DRAWING NUMBERED 1, DATED 30 JUNE 2016, BY SIKA AUSTRALIA PTY LTD

Appendix E – Certificate(s) of Test

INFRASTRUCTURE TECHNOLOGIES
www.csiro.au
14 Julius Avenue, North Ryde NSW 2113
PO Box 310, North Ryde NSW 1670, Australia
T (02) 9490 5444 • ABN 41 687 119 230

Certificate of Test

No. 2980

This is to certify that the element of construction described below was tested by the CSIRO Infrastructure Technologies in accordance with Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4 – 2014, Fire-resistance tests of elements of construction on behalf of:

Sika Australia Pty Ltd
55 Elizabeth Street
Wetherill Park NSW

A full description of test specimen and complete test results are detailed in the Division's report numbered FSP 1839.

Product Name: Specimen 1 – 30-mm wide control joint protected by Sikaflex 400 Fire sealant applied from the fire exposed side

Description: The specimen comprised one 1000-mm exposed length control joint penetrating a 150-mm thick concrete wall with an established FRL of -/240/240. The size of the opening measured 30-mm wide x 1000-mm exposed length. The 30-mm wide joint was protected with Sikaflex 400 Fire sealant installed from the exposed side of the wall. The sealant was applied to a depth of 15-mm controlled by two side by side 25-mm x 25-mm polyurethane foam backing rods, and finished flush with the exposed face of the wall. The fire stopping system is described as a one component moisture curing, elastic joint sealant. For a complete description of the specimen, refer to Drawing numbered 1, dated 30 June 2016, by Sika Australia Pty Ltd.

The element of construction described above satisfied the following criteria for fire-resistance for the period stated.

Structural adequacy	-	not applicable
Integrity	-	no failure at 241 minutes
Insulation	-	28 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of -/240/0.

The fire-resistance level of the specimen is applicable when the system is exposed to fire from the direction as tested. For the purposes of AS 1530.4-2014 the results of these fire tests may be used to directly assess fire hazard, but it should be recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions. This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Chris Wojcik Date of Test: 8 August 2016

Issued on the 20th day of July 2017 without alterations or additions.

Brett Roddy
Manager, Fire Testing and Assessments

NATA Accredited Laboratory
Number: 165
Corporate Site No 3625
Accredited for compliance with ISO/IEC 17025 - Testing

CERTIFICATE OF TEST NO. 2980

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Certificate of Test

No. 2981

This is to certify that the element of construction described below was tested by the CSIRO Infrastructure Technologies in accordance with Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4 – 2014, Fire-resistance tests of elements of construction on behalf of:

Sika Australia Pty Ltd
55 Elizabeth Street
Wetherill Park NSW

A full description of test specimen and complete test results are detailed in the Division's report numbered FSP 1839.

Product Name: Specimen 2 – Nominal 100-mm OD copper pipe penetration protected by Sikaflex 400 Fire sealant applied from both sides

Description: The specimen comprised a copper pipe penetrating a 150-mm diameter hole through a 150-mm thick concrete wall with an established FRL of -/240/240. The copper pipe measured 102-mm OD, with 1-mm wall thickness and extended minimum 500-mm from each side of the wall. The pipe was capped on the exposed end using copper end cap. The pipe was supported approximately 200-mm on the exposed side and 100-mm and 400-mm away from the wall on the unexposed face. The pipe penetration, 25-mm wide annular was protected with Sikaflex 400 Fire sealant installed from both sides of the wall. The sealant was applied to a depth of 15-mm controlled by two side by side 25-mm x 25-mm polyurethane foam backing rods, and finished flush with both faces of the wall. The fire stopping system is described as a one component moisture curing, elastic joint sealant. For a complete description of the specimen, refer to Drawing numbered 1, dated 30 June 2016, by Sika Australia Pty Ltd.

The element of construction described above satisfied the following criteria for fire-resistance for the period stated.

Structural adequacy	-	not applicable
Integrity	-	140 minutes
Insulation	-	10 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of -/120/0.

The fire-resistance level of the specimen is applicable when the systems is exposed to fire from either direction. For the purposes of AS 1530.4-2014 the results of these fire tests may be used to directly assess fire hazard, but it should be recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions. This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Chris Wojcik Date of Test: 8 August 2016

Issued on the 20th day of July 2017 without alterations or additions.

B. Roddy

Brett Roddy
Manager, Fire Testing and Assessments

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T (02) 9490 5444 • ABN 41 687 119 230

Certificate of Test

No. 2982

This is to certify that the element of construction described below was tested by the CSIRO Infrastructure Technologies in accordance with Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4 – 2014, Fire-resistance tests of elements of construction on behalf of:

Sika Australia Pty Ltd
55 Elizabeth Street
Wetherill Park NSW

A full description of test specimen and complete test results are detailed in the Division's report numbered FSP 1839.

Product Name: Specimen 3 – Nominal 155-mm wide cable tray penetration protected by Sikaflex 400 Fire sealant applied from both sides

Description: The specimen comprised a cable tray with size opening 170-mm x 50-mm penetrating a 150-mm thick concrete wall with an established FRL of -/240/240. The cable tray measured 155-mm wide x 20-mm high cable tray, supporting ten 20-mm diameter electrical cables, cable tray extended minimum 500-mm from each side of the wall. The cable tray was supported approximately 200-mm on the exposed side and 100-mm and 400-mm away from the wall on the unexposed face. The resulting annular gap between the tray, cables and the wall opening was protected with Sikaflex 400 Fire sealant installed from both sides of the wall. The sealant was applied to a depth of 10-mm controlled by one 25-mm x 25-mm polyurethane foam backing rod, and finished flush with both faces of the wall. The fire stopping system is described as a one component moisture curing, elastic joint sealant. For a complete description of the specimen, refer to Drawing numbered 1, dated 30 June 2016, by Sika Australia Pty Ltd.

The element of construction described above satisfied the following criteria for fire-resistance for the period stated.

Structural adequacy	-	not applicable
Integrity	-	No failure at 241 minutes
Insulation	-	145 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of -/240/120.

The fire-resistance level of the specimen is applicable when the systems is exposed to fire from either direction. For the purposes of AS 1530.4-2014 the results of these fire tests may be used to directly assess fire hazard, but it should be recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions. This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Chris Wojcik Date of Test: 8 August 2016

Issued on the 20th day of July 2017 without alterations or additions.

B. Roddy

Brett Roddy
Manager, Fire Testing and Assessments

NATA Accredited Laboratory
Number: 165
Corporate Site No 3625
Accredited for compliance with ISO/IEC 17025 - Testing

CERTIFICATE OF TEST NO. 2982

References

The following informative documents are referred to in this Report:

AS 1530.4-2014	Methods for fire tests on building materials, components and structures - Part 4: Fire-resistance tests of elements of building construction.
AS 4072.1-2005	Components for the protection of openings in fire-resistant separating elements, Part 1: Service penetrations and control joints.

END OF REPORT

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