Fire-resistance test on fire collars protecting a concrete slab penetrated by services

Test Report

Author: Chris Wojcik
Report number: FSP 1781
Date: 23 December 2016

Client: Snap Fire Systems Pty Ltd

Commercial-in-confidence

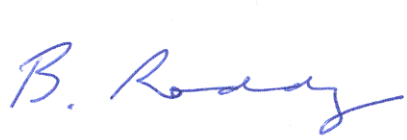
Inquiries should be address to:

Fire Testing and Assessments	Author	The Client
NATA Registered Laboratory 14 Julius Avenue North Ryde, NSW 2113 Telephone +61 2 9490 5444	Infrastructure Technologies 14 Julius Avenue North Ryde, NSW 2113 Telephone +61 2 9490 5500	Snap Fire Systems Pty Ltd Building A, 1343 Wynnum Road Tingalpa QLD 4173 Telephone +61 7 3390 5420

Report Status and Revision History:

VERSION	STATUS	DATE	DISTRIBUTION	ISSUE NUMBER
Revision A	Draft for review	01/12/2016	CSIRO/SNAP	FSP 1781
Revision B	Final for issue	23/12/2016	CSIRO/SNAP	FSP 1781

Report Authorization:

AUTHOR	REVIEWED BY	AUTHORISED BY
Chris Wojcik	Brett Roddy	Brett Roddy
		
23 December 2016	23 December 2016	23 December 2016

Use of this Report

Use of Reports – Testing

This report is subject to binding obligations under which it was prepared. In particular, the Report must not be used:

- *as a means of endorsement; or*
- *in a company prospectus or notification to a Stock Exchange document for capital raising, without the prior written consent of CSIRO.*

The Report may be published verbatim and in full, provided that a statement is included on the publication that it is a copy of the Report issued by CSIRO.

Excerpts of the Report may not be published.

Use of Reports – Consultancy

This report is subject to binding obligations under which it was prepared. In particular, the Report may only be used for the following purposes:

- *the information in the Report may be used by the party that commissioned the Report for its internal business operations (but not licensing to third parties);*
- *the report may be copied for distribution within the organisation that commissioned the Report;*
- *copies of the Report (or extracts of the Report) may be distributed to contractors and agents of the organisation that commissioned the Report who have a need for the Report for its internal business operations. Any extracts of the Report distributed for this purpose must clearly note that the extract is part of a larger Report held by the organisation that commissioned the Report and which has been prepared by CSIRO.*

The name, trade mark or logo of the CSIRO must not be used without the prior written consent of CSIRO.

The Report must not be used as a means of endorsement without the prior written consent of CSIRO.

Copyright and disclaimer

Important disclaimer

Contents

Fire-resistance test on fire collars protecting a concrete slab penetrated by services

Sponsored Investigation No. FSP 1781

1 Introduction

1.1 Identification of specimen

The sponsor identified the specimen as Snap Retrofit Fire Collars protecting a 150-mm thick concrete slab penetrated by two (2) floor wastes and four (4) stack pipes.

1.2 Sponsor

Snap Fire Systems Pty Ltd
Building A, 1343 Wynnum Road
Tingalpa QLD 4173

1.3 Manufacturer

Snap Fire Systems Pty Ltd
Building A, 1343 Wynnum Road
Tingalpa QLD 4173

1.4 Test standard

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

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: FS 4608/4007

1.7 Test date

The fire-resistance test was conducted on 26 September 2016.

2 Description of specimen

2.1 General

The specimen comprised an 1150-mm x 1150-mm x 150-mm thick reinforced concrete slab penetrated by two (2) floor wastes and four (4) stack pipes protected by Retrofit Snap Fire System fire collars.

The pipes used in the test are stated to be manufactured in accordance with:

- AS/NZS 2053:2001 'Conduits and fittings for electrical installations'
- AS/NZS 1260:2009 'PVC-U pipes and fittings for drain, waste and vent application'

For the purpose of the test, the specimens were referenced as Penetrations 1, 2, 3, 4, 5 and 6. Documents containing a complete description of each specimen were supplied by the sponsor and are retained on file.

Penetration 1 – LP100R-D Retrofit collar protecting a nominal 80-mm diameter Polyvinyl Chloride (PVC) Pipe and Floorwaste

The SNAP Retrofit LP100R-D collar comprised a 0.95-mm thick steel casing with a 122-mm inner diameter and a 260-mm base flange. The 65-mm high collar casing incorporated a layer of 418-mm x 59-mm x 5-mm thick Intumescent material. The closing mechanism comprised 4 x 304 stainless steel spring bound with a black nylon fuse link and a 316 stainless steel mesh measuring 415 x 120-mm as shown in drawing numbered LP100R-D-T dated 2 November 2016, by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 82-mm PVC pipe, with a wall thickness of 3-mm fitted through the LP100R-D Snap fire collar. The floor waste system was fitted with a trench grate. On the exposed side of the slab an 80-mm PVC P-Trap was fitted to the pipe within the collar, supported by a M10 HKD clamp 80-mm nut clip fixed to the concrete slab. On the exposed face, the penetration was capped using an 80-mm PVC end cap.

The floor waste gully was charged with water to the level shown in drawing titled "Test Slab S-16-G Penetration 1, 80-mm PVC Pipe – Floor Waste – LP100R-D, dated 26 October 2016, by Snap Fire Systems Pty Ltd.

Penetration 2 – 32R Retrofit collar protecting a 20-mm diameter Polyvinyl Chloride (PVC) Conduit

The SNAP Retrofit 32R fire collar comprised a 0.75-mm steel casing with a 40-mm inner diameter fitted with three fixing tabs. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 20-mm PVC Conduit, with a wall thickness of 1.8-mm fitted through the collar's sleeve. The pipe projected vertically 2000-mm above the concrete and 500-mm into the furnace chamber. The pipe was supported at 500-mm and 1500-mm from the unexposed face of the concrete slab as shown in drawing titled "Test Slab S-16-G Penetration 2, 20-mm PVC Conduit – 32R Collar" dated 26 October 2016, by Snap Fire Systems Pty Ltd. On the exposed end, the pipe was capped with a Superwool Plug.

Penetration 3 – 32R Retrofit collar protecting a 25-mm diameter Polyvinyl Chloride (PVC) Conduit

The SNAP Retrofit 32R fire collar comprised a 0.75-mm steel casing with a 40-mm inner diameter fitted with three fixing tabs. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 25-mm PVC Conduit, with a wall thickness of 2-mm fitted through the collar's sleeve. The pipe projected vertically 2000-mm above the concrete and 500-mm into the furnace chamber. The pipe was supported at 500-mm and 1500-mm from the unexposed face of the concrete slab as shown in drawing titled "Test Slab S-16-G Penetration 3, 25-mm PVC Conduit – 32R Collar" dated 26 October 2016, by Snap Fire Systems Pty Ltd. On the exposed end, the pipe was capped with a Superwool Plug.

Penetration 4 – HP150R Retrofit collar protecting a nominal 150-mm diameter Polyvinyl Chloride (PVC-SC) Pipe – Steel Grate and steel formwork

The SNAP retrofitted HP150R collar comprised a 0.95-mm steel casing with a 175-mm inner diameter and a 326-mm base flange. The 117-mm high collar casing incorporated a strip of 570-mm x 112-mm x 8-mm thick Intumesh intumescent material. The closing mechanism comprised four 304 stainless steel springs, with nylon fuse links, and a 596-mm x 112-mm stainless steel mesh as shown in drawing numbered HP 150R-T dated 2 October 2015, by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 160-mm PVC-SC pipe, with a wall thickness of 4-mm fitted through the HP150R Snap fire collar. The floor waste system was fitted with a steel grate. On the exposed side of the slab an 150-mm PVC 90°C Elbow was fitted to the pipe within the collar, supported by a M10 HKD clamp 150-mm nut clip fixed to the concrete slab. The collar was attached to a section of Condek steel formwork incorporated to the underside of the slab. Gaps formed between the collar and the corrugations of the steel formwork were filled with Bostik Fireban 1 as shown in drawing titled "Test Slab S-16-G Penetration 4, 150-mm PVC-SC Pipe – Steel Grate – Fitting inside HP150R Collar, dated 26 October 2016, by Snap Fire Systems Pty Ltd.

On the exposed face, the penetration was capped using an 150-mm PVC-SC end cap.

The floor waste gully was charged with water to the level shown in drawing titled "Test Slab S-16-G Penetration 4, 150-mm PVC-SC Pipe – Steel Grate – Fitting inside HP150R Collar, dated 26 October 2016, by Snap Fire Systems Pty Ltd.

Penetration 5 – 32R Retrofit collar protecting a 20-mm diameter Polyvinyl Chloride (PVC) Conduit – 3-Core cable

The SNAP Retrofit 32R fire collar comprised a 0.75-mm steel casing with a 40-mm inner diameter fitted with three fixing tabs. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 20-mm PVC Conduit with a 3-Core cable inside, with a wall thickness of 1.8-mm fitted through the collar's sleeve. The pipe projected vertically 2000-mm above the concrete and 500-mm into the furnace chamber. The pipe was supported at 500-mm and 1500-mm from the unexposed face of the concrete slab as shown in drawing titled "Test Slab S-16-G Penetration 5, 20-mm PVC Conduit – 3-Core Cable – 32R" dated 26 October 2016, by Snap Fire Systems Pty Ltd. On the exposed end, the pipe was capped with a Superwool Plug.

Penetration 6 – 32R Retrofit collar protecting a 25-mm diameter Polyvinyl Chloride (PVC) Conduit – 3-Core cable

The SNAP Retrofit 32R fire collar comprised a 0.75-mm steel casing with a 40-mm inner diameter fitted with three fixing tabs. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 25-mm PVC Conduit with 3 x 3-Core cable inside, with a wall thickness of 2-mm fitted through the collar's sleeve. The pipe projected vertically 2000-mm above the concrete and 500-mm into the furnace chamber. The pipe was supported at 500-mm and 1500-mm from the unexposed face of the concrete slab as shown in drawing titled "Test Slab S-16-G Penetration 6, 25-mm PVC Conduit – 3-Core Cable – 32R Collar" dated 26 October 2016, by Snap Fire Systems Pty Ltd. On the exposed end, the pipe was capped with a Superwool Plug.

2.2 Dimensions

The overall dimension of the concrete slab was 1150-mm wide x 1150-mm long, to suit the opening in the specimen containing frame.

2.3 Orientation

The reinforced concrete slab was placed horizontally on top of the furnace chamber, and subjected to fire exposure from the underside.

2.4 Conditioning

The concrete slab was left to cure for a period longer than 30 days.

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 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd.

Drawing numbered HP 150R-T dated 2 October 2015, by Snap Fire Systems Pty Ltd.

Drawing numbered LP100R-D dated 2 November 2016, by Snap Fire Systems Pty Ltd.

Drawing titled "Test Slab S-16-G Penetration 1, 80-mm PVC Pipe – Floor Waste – LP100R-D, dated 26 October 2016, by Snap Fire Systems Pty Ltd.

Drawing titled "Test Slab S-16-G Penetration 2, 20-mm PVC Conduit – 32R Collar" dated 26 October 2016, by Snap Fire Systems Pty Ltd.

Drawing titled "Test Slab S-16-G Penetration 3, 25-mm PVC Conduit – 32R Collar" dated 26 October 2016, by Snap Fire Systems Pty Ltd.

Drawing titled "Test Slab S-16-G Penetration 4, 150-mm PVC-SC Pipe – Steel Grate – Fitting inside HP150R Collar, dated 26 October 2016, by Snap Fire Systems Pty Ltd.

Drawing titled “Test Slab S-16-G Penetration 5, 20-mm PVC Conduit – 3-Core Cable – 32R” dated 26 October 2016, by Snap Fire Systems Pty Ltd.

Drawing titled “Test Slab S-16-G Penetration 6, 25-mm PVC Conduit – 3-Core Cable – 32R Collar” dated 26 October 2016, by Snap Fire Systems Pty Ltd.

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.

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

4.3 Measurement system

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

5 Ambient temperature

The temperature of the test area was 17°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 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:

Time	Observation
1 minutes -	Smoke is being emitted from the grate of Penetration 1.
2 minutes -	Smoke is being emitted from the end of Penetration 2, 3 and 4.
5 minutes -	Cotton Wool Pad test applied over Penetration 4. No ignition.
6 minutes -	Cotton Wool Pad test applied over Penetration 4. No ignition.
10 minutes -	Smoke is no longer fluing from Penetration 2 and 3. Amount of smoke being emitted from Penetration 1 and 4 has subsided.
30 minutes -	Light smoke/steam is being emitted from around the pipes on Penetration 2 and 3. Moisture is starting to form on the top of the slab.
60 minutes -	No apparent change.
120 minutes -	Smoke some is visible from Penetration 1 and 4.
230 minutes -	Cotton Wool Pad test applied over Penetration 4. No ignition.
238 minutes -	Insulation failure - Penetration 4. Temperature rise exceeding 180 K recorded on the grate. Cotton Wool Pad test applied over Penetration 4. No ignition.
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 the curve of maximum temperature versus time associated with Penetration 1.

Figure 4 shows the curve of maximum temperature versus time associated with Penetration 2.

Figure 5 shows the curve of maximum temperature versus time associated with Penetration 3.

Figure 6 shows the curve of maximum temperature versus time associated with Penetration 4.

Figure 7 shows the curve of maximum temperature versus time associated with Penetration 5.

Figure 8 shows the curve of maximum temperature versus time associated with Penetration 6.

8.5 Performance

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

Penetration 1 – LP100R-D Retrofit collar protecting a 80-mm diameter Polyvinyl Chloride (PVC) Pipe and Floorwaste

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

Penetration 2 – 32R Retrofit collar protecting a 20-mm diameter Polyvinyl Chloride (PVC) Conduit

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

Penetration 3 – 32R Retrofit collar protecting a 25-mm diameter Polyvinyl Chloride (PVC) Conduit

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

Penetration 4 – HP150R Retrofit collar protecting a 150-mm diameter Polyvinyl Chloride (PVC-SC) Pipe – Steel Grate

Structural adequacy	-	not applicable
Integrity	-	No failure 241 minutes
Insulation	-	238 minutes

Penetration 5 – 32R Retrofit collar protecting a 20-mm diameter Polyvinyl Chloride (PVC) Conduit – 3-Core cable

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

Penetration 6 – 32R Retrofit collar protecting a 25-mm diameter Polyvinyl Chloride (PVC) Conduit – 3-Core cable

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

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 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 FRL's of the test specimens were as follows:

Penetration 1	-	-/240/240	Penetration 4	-	-/240/180
Penetration 2	-	-/240/240	Penetration 5	-	-/240/240
Penetration 3	-	-/240/240	Penetration 6	-	-/240/240

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 10.11 of AS 1530.4-2014, have been made provided no individual component is removed or reduced.

11 Tested by

Russell Collins
Testing Officer

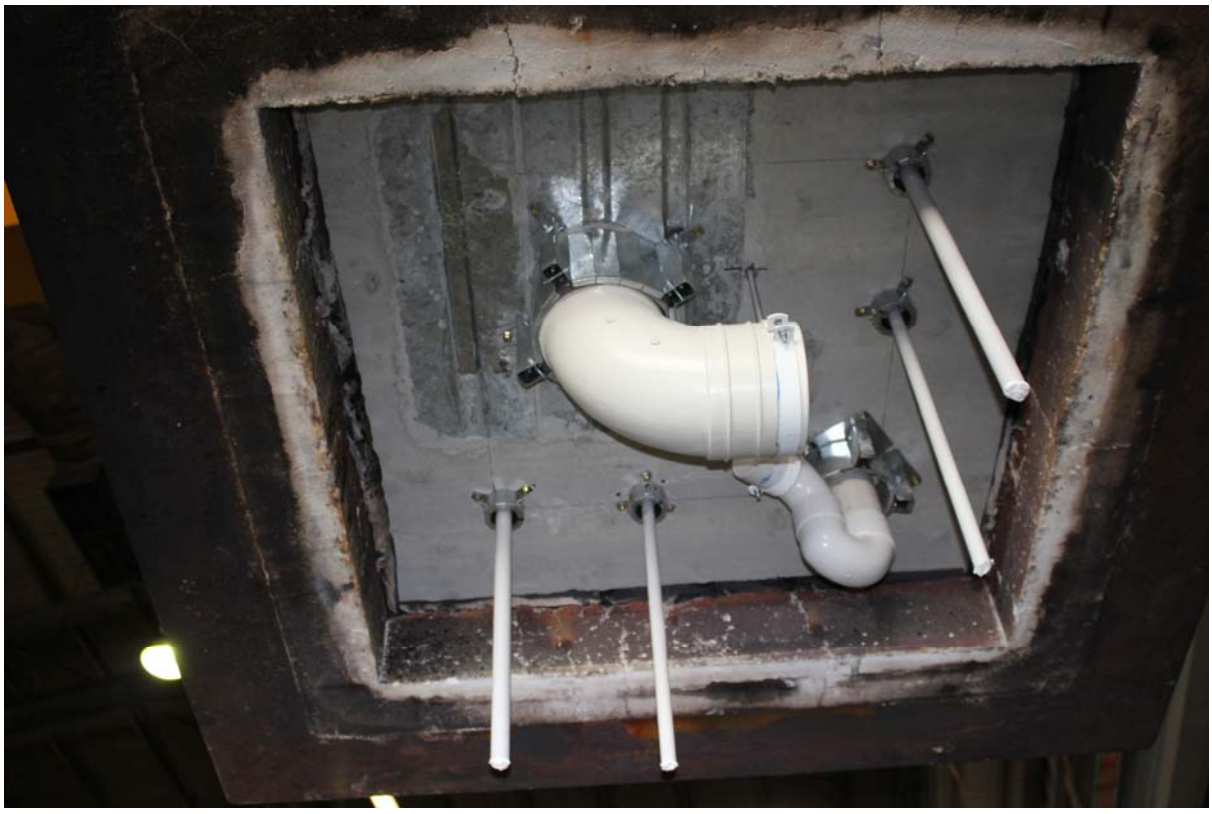
Appendices

Appendix A – Measurement location

Measurement Location		Data Logger Channel Information
Group location / **Specimen**	**T/C Position**	**T/C designation**
Penetration 1	On concrete, 25-mm from the opening	S1
	On concrete, 25-mm from the opening	S2
	On top of the grate	S3
	The grate drain housing	S4
	The grate drain housing	S5
Penetration 2	On concrete, 25-mm from the pipe	S6
	On concrete, 25-mm from the pipe	S7
	On pipe – 25-mm up from the concrete slab	S8
	On pipe – 25-mm up from the concrete slab	S9
Penetration 3	On concrete, 25-mm from the pipe	S10
	On concrete, 25-mm from the pipe	S11
	On pipe – 25-mm up from the concrete slab	S12
	On pipe – 25-mm up from the concrete slab	S13
Penetration 4	On concrete, 25-mm from the grate	S14
	On concrete, 25-mm from the grate	S15
	On the grate – centre	S16
	On the grate – off centre	S17
Penetration 5	On concrete, 25-mm from the pipe	S18
	On concrete, 25-mm from the pipe	S19
	On pipe – 25-mm up from the concrete slab	S20
	On pipe – 25-mm up from the concrete slab	S21
Penetration 6	On concrete, 25-mm from the pipe	S22
	On concrete, 25-mm from the pipe	S23
	On pipe – 25-mm up from the concrete slab	S24
	On pipe – 25-mm up from the concrete slab	S25

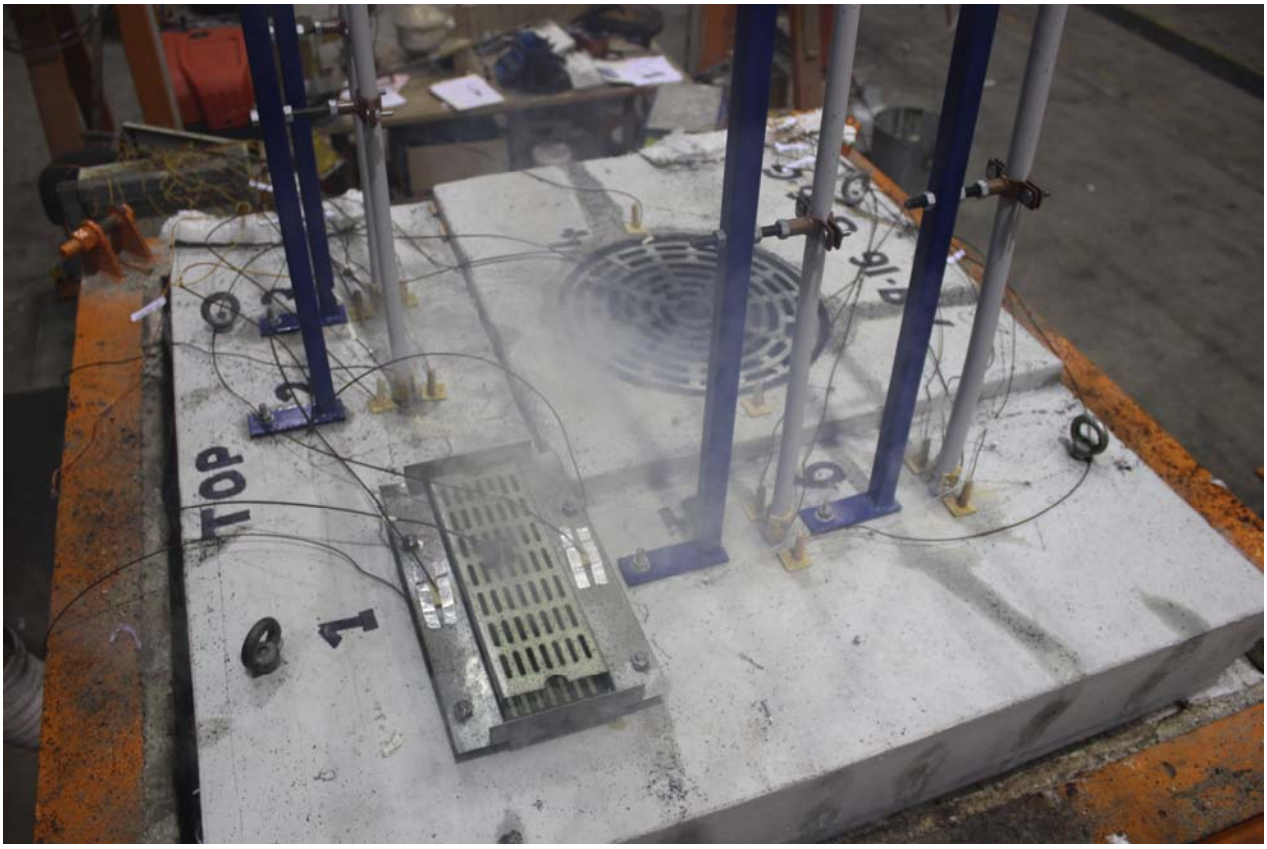
Appendix B – Photographs

PHOTOGRAPH 1 – UNEXPOSED FACE OF SPECIMENS PRIOR TO TESTING



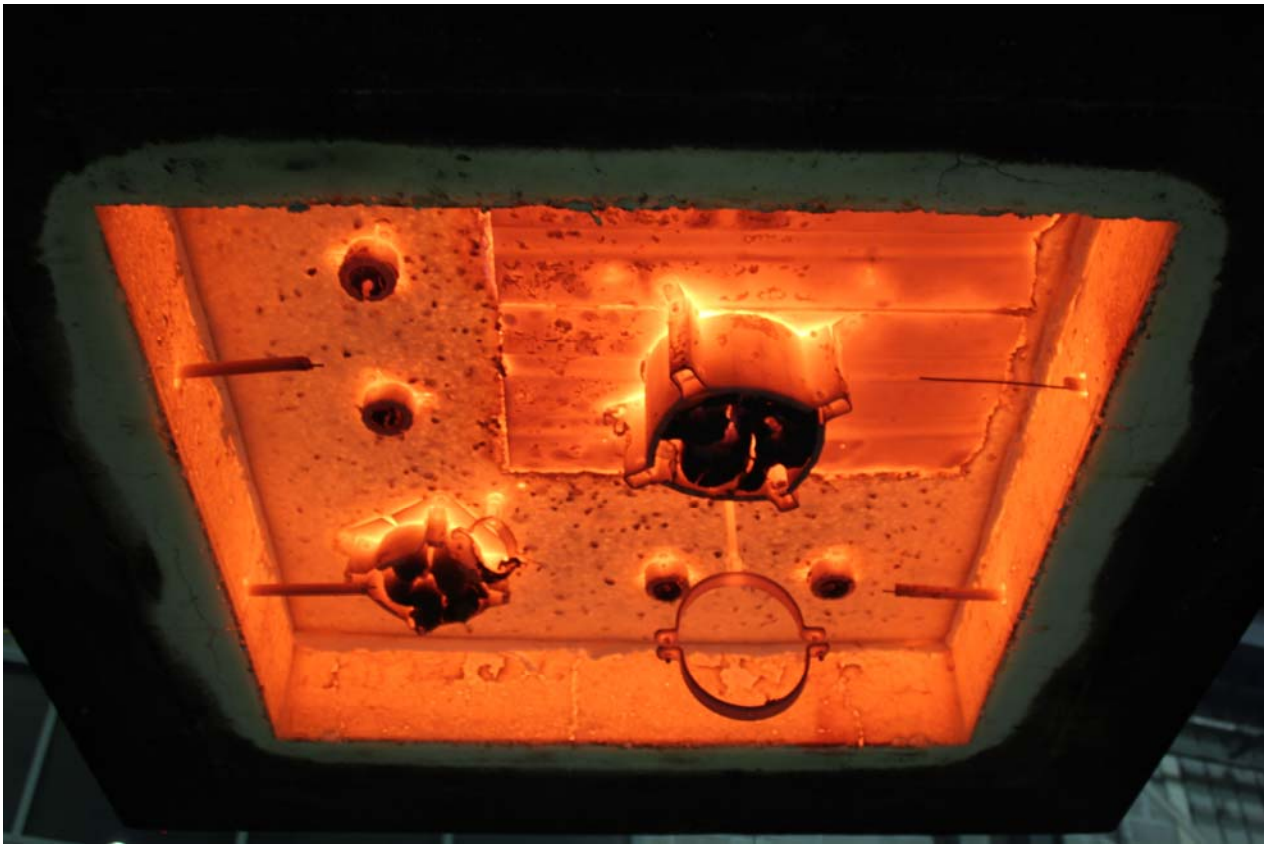
PHOTOGRAPH 2 – EXPOSED FACE OF SPECIMEN PRIOR TO TESTING

PHOTOGRAPH 3 – SPECIMENS AFTER 60 MINUTES OF TESTING



PHOTOGRAPH 4 – SPECIMENS AFTER 120 MINUTES OF TESTING

PHOTOGRAPH 5 – SPECIMENS AFTER 180 MINUTES OF TESTING



PHOTOGRAPH 6 – EXPOSED FACE OF SPECIMENS AT CONCLUSION OF TESTING

Appendix C – Furnace Temperature

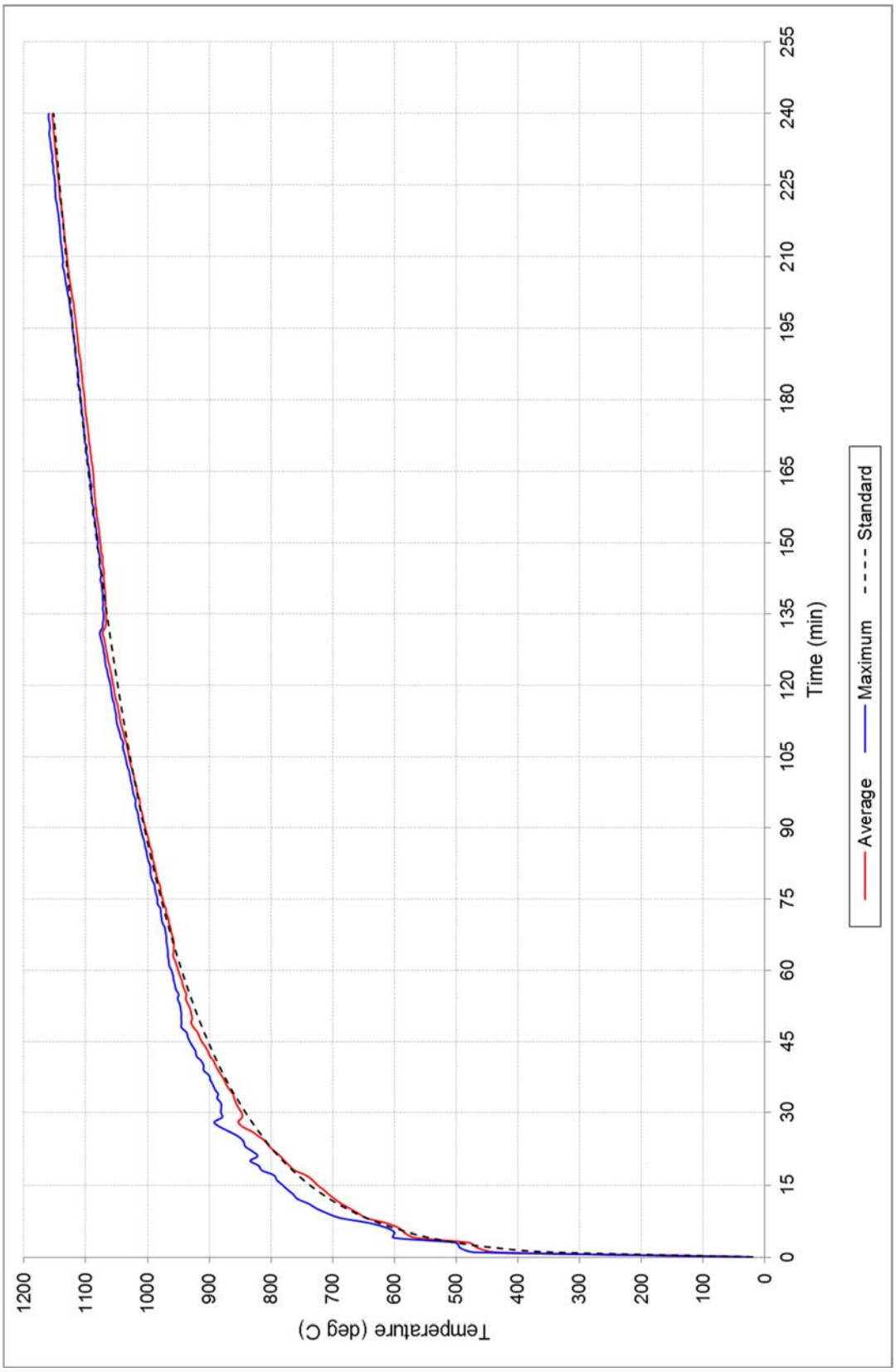


FIGURE 1 – FURNACE TEMPERATURE

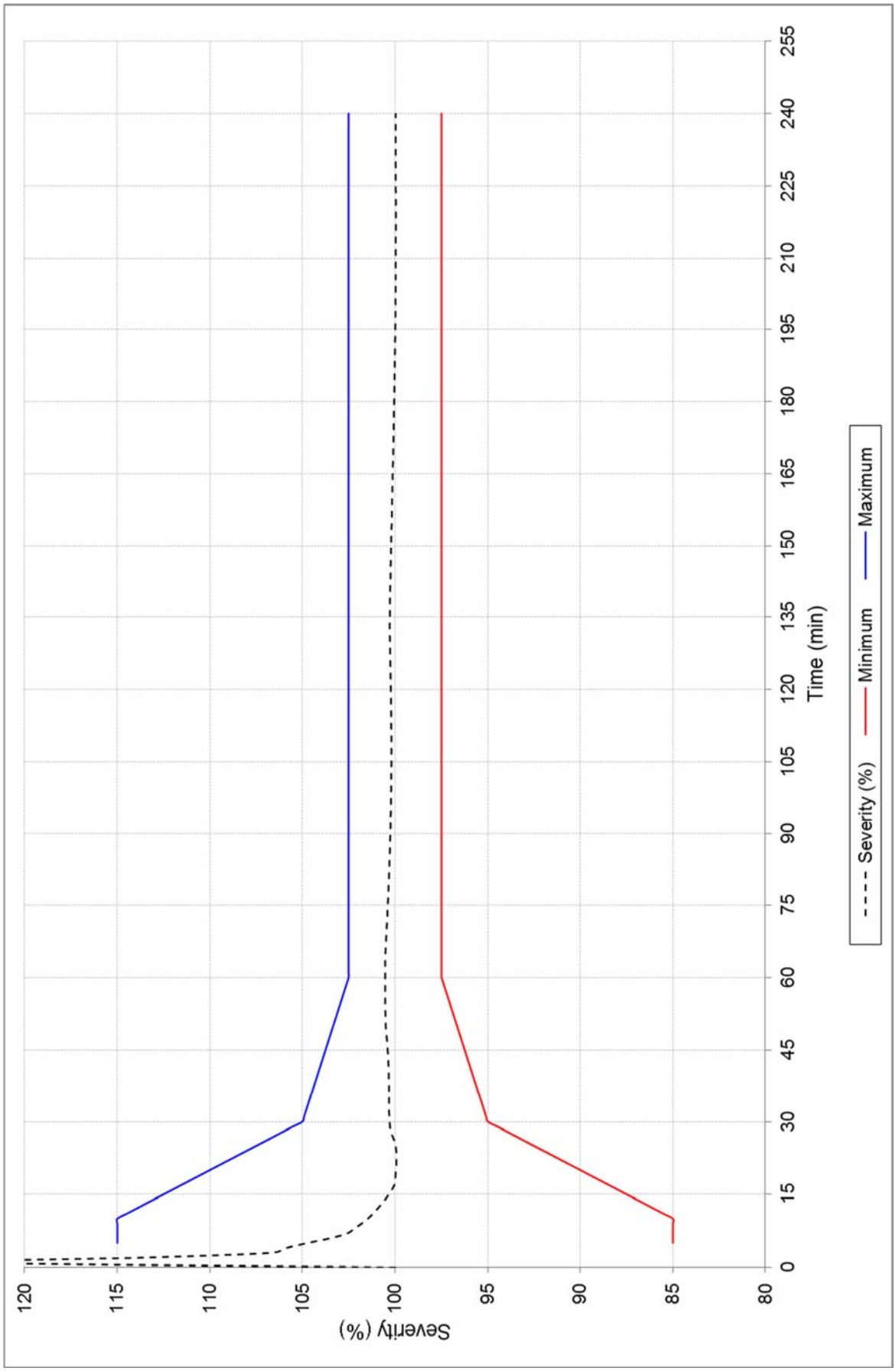


FIGURE 2 – FURNACE SEVERITY

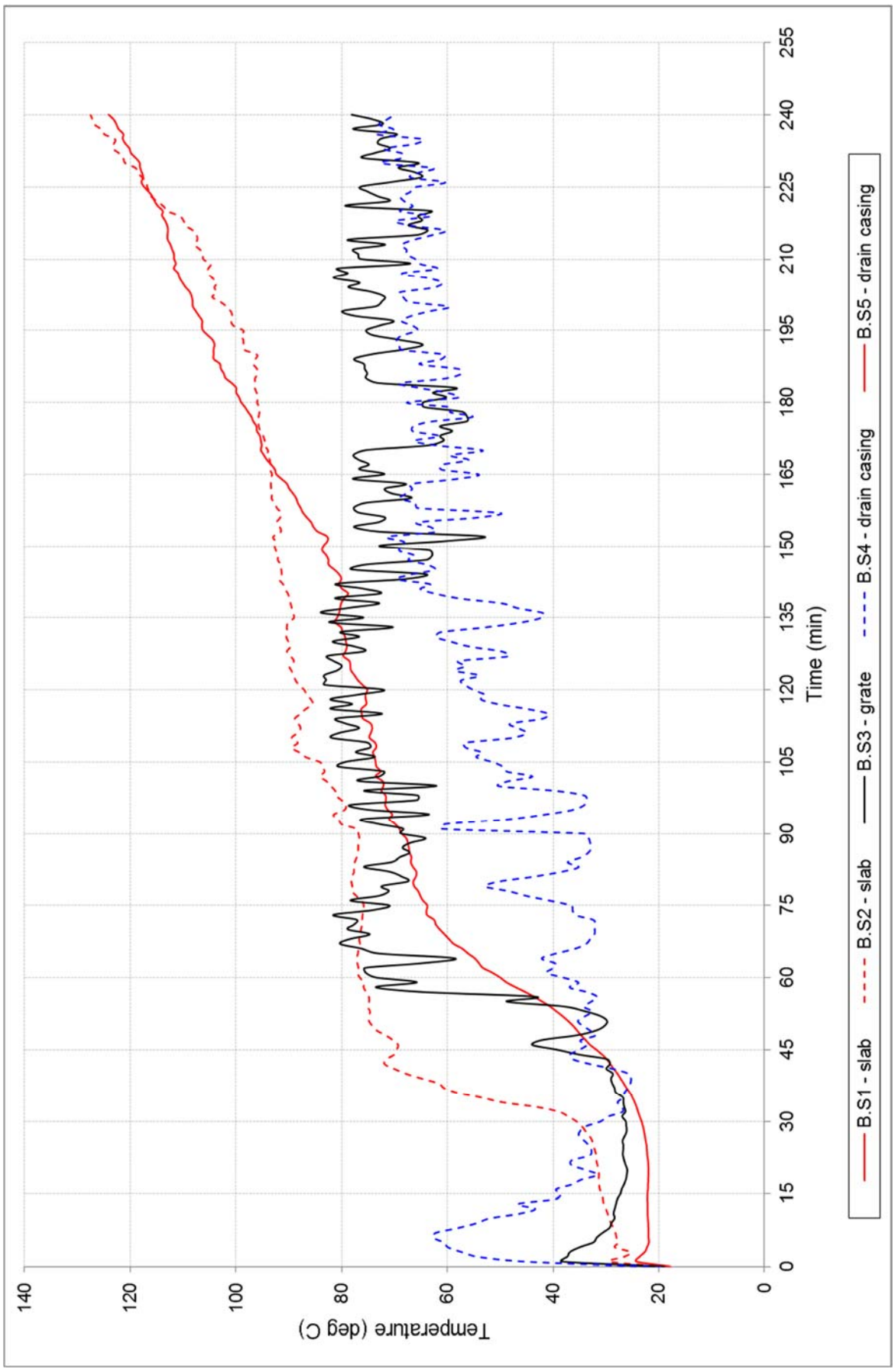


FIGURE 3 – SPECIMEN TEMPERATURE – ASSOCIATED WITH PENETRATION 1

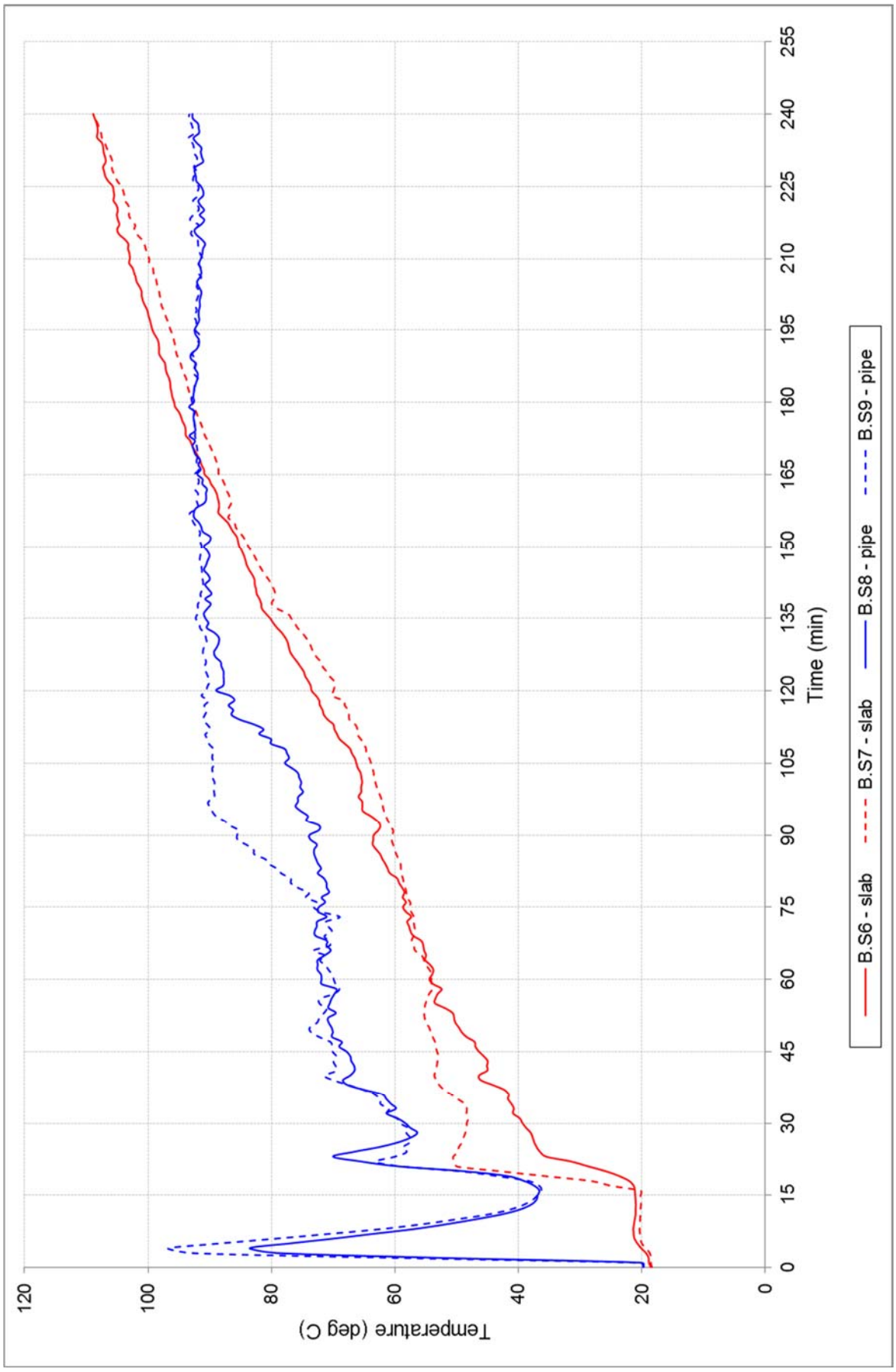


FIGURE 4 – SPECIMEN TEMPERATURE – ASSOCIATED WITH PENETRATION 2

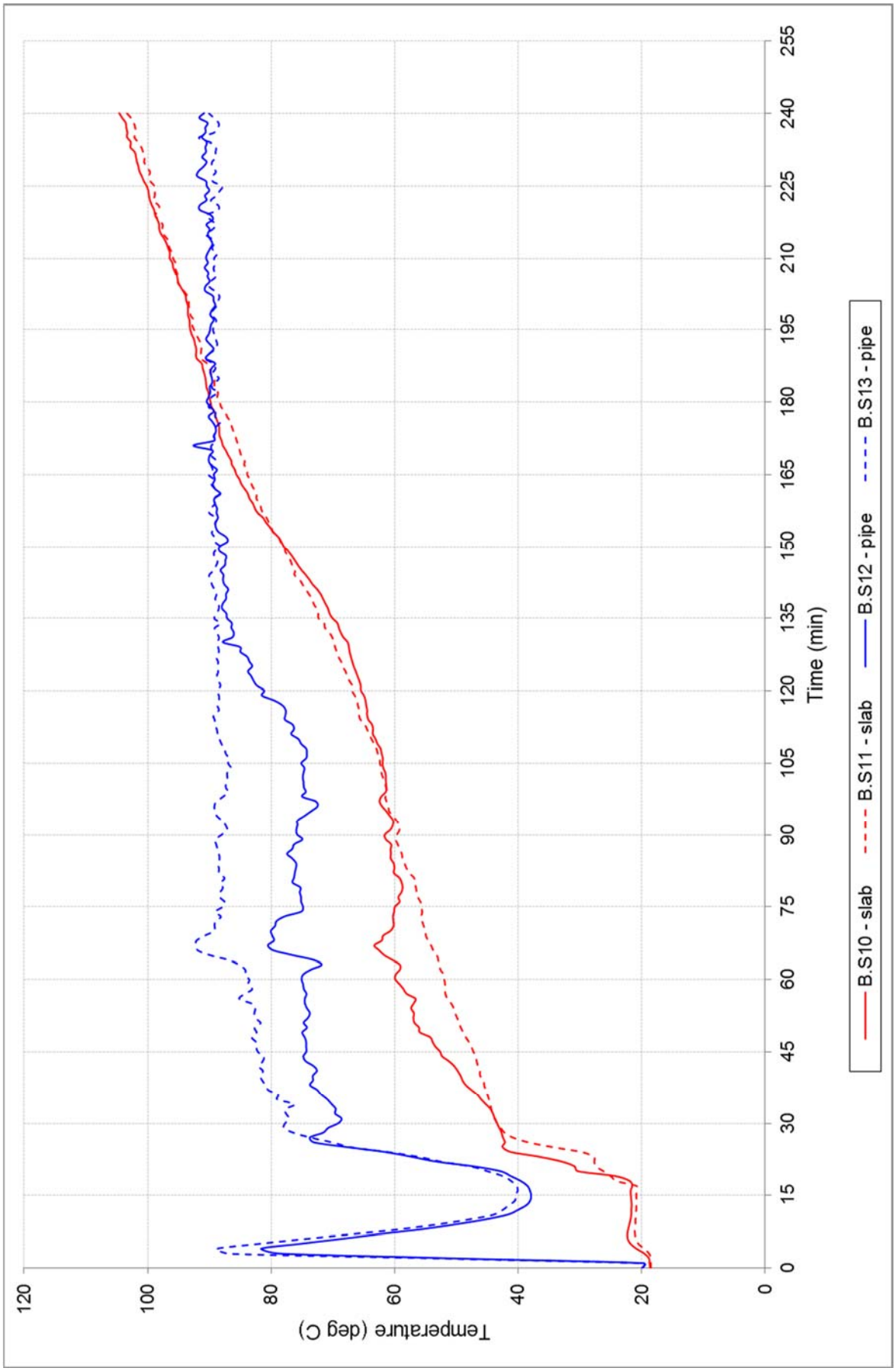


FIGURE 5 – SPECIMEN TEMPERATURE – ASSOCIATED WITH PENETRATION 3

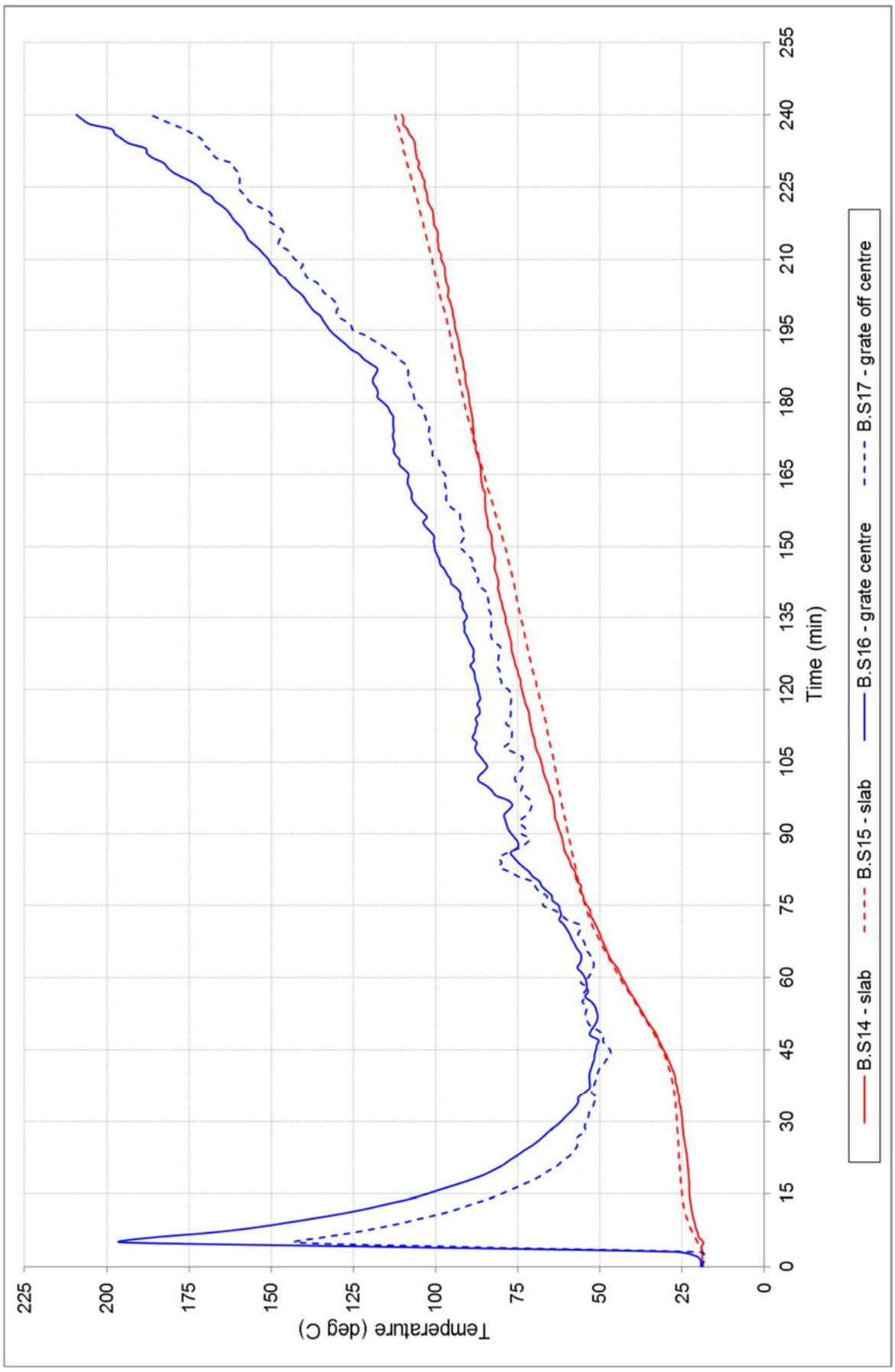


FIGURE 6 – SPECIMEN TEMPERATURE – ASSOCIATED WITH PENETRATION 4

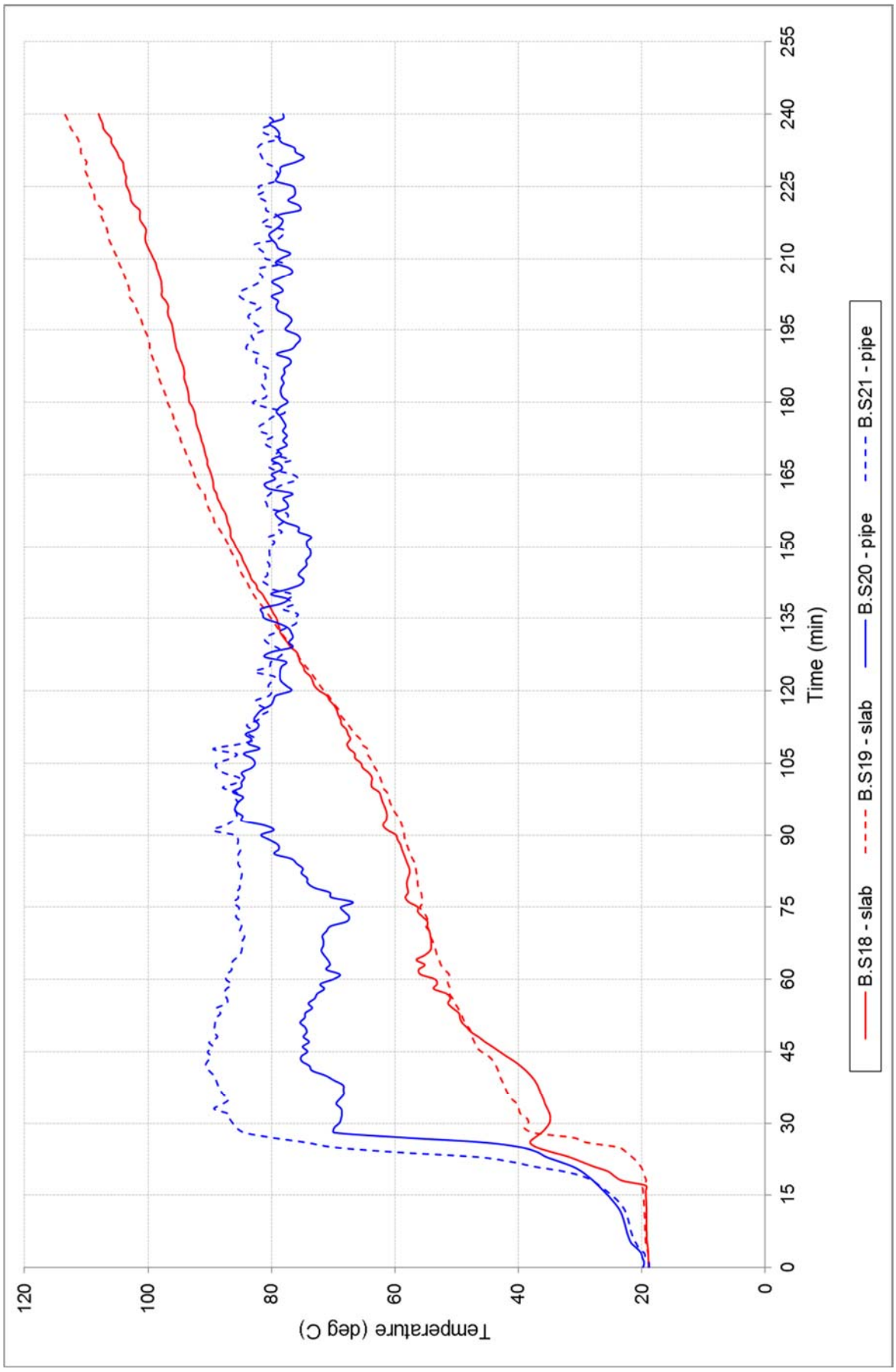


FIGURE 7 – SPECIMEN TEMPERATURE – ASSOCIATED WITH PENETRATION 5

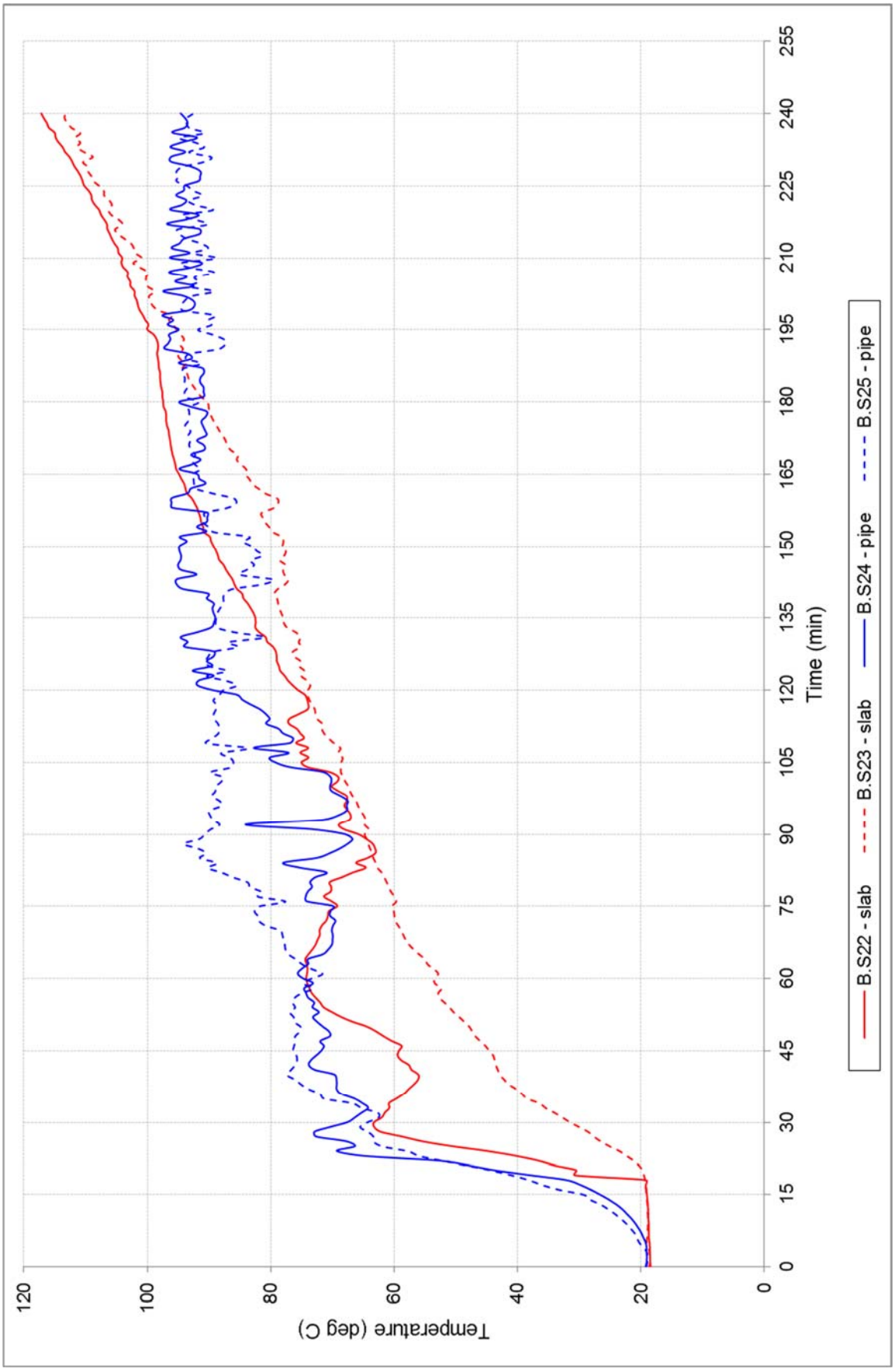
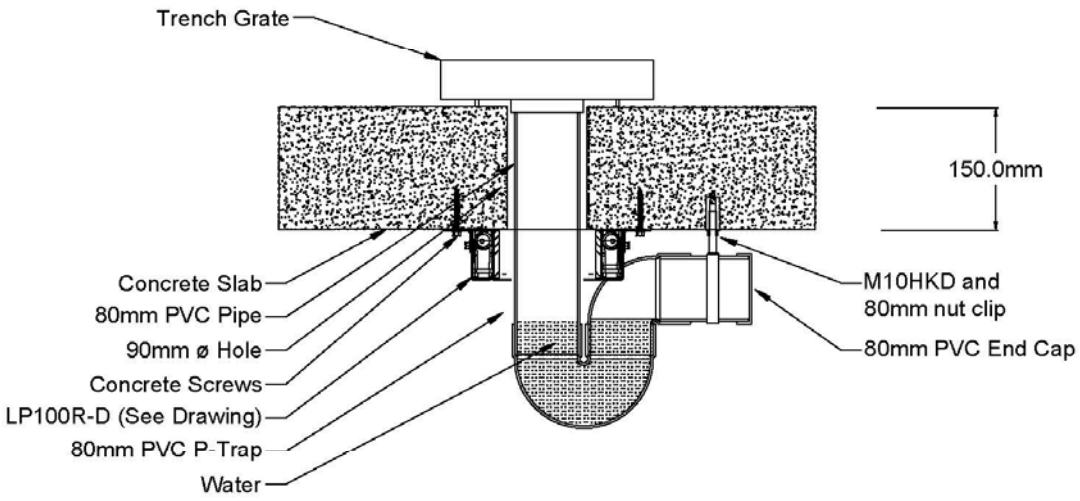


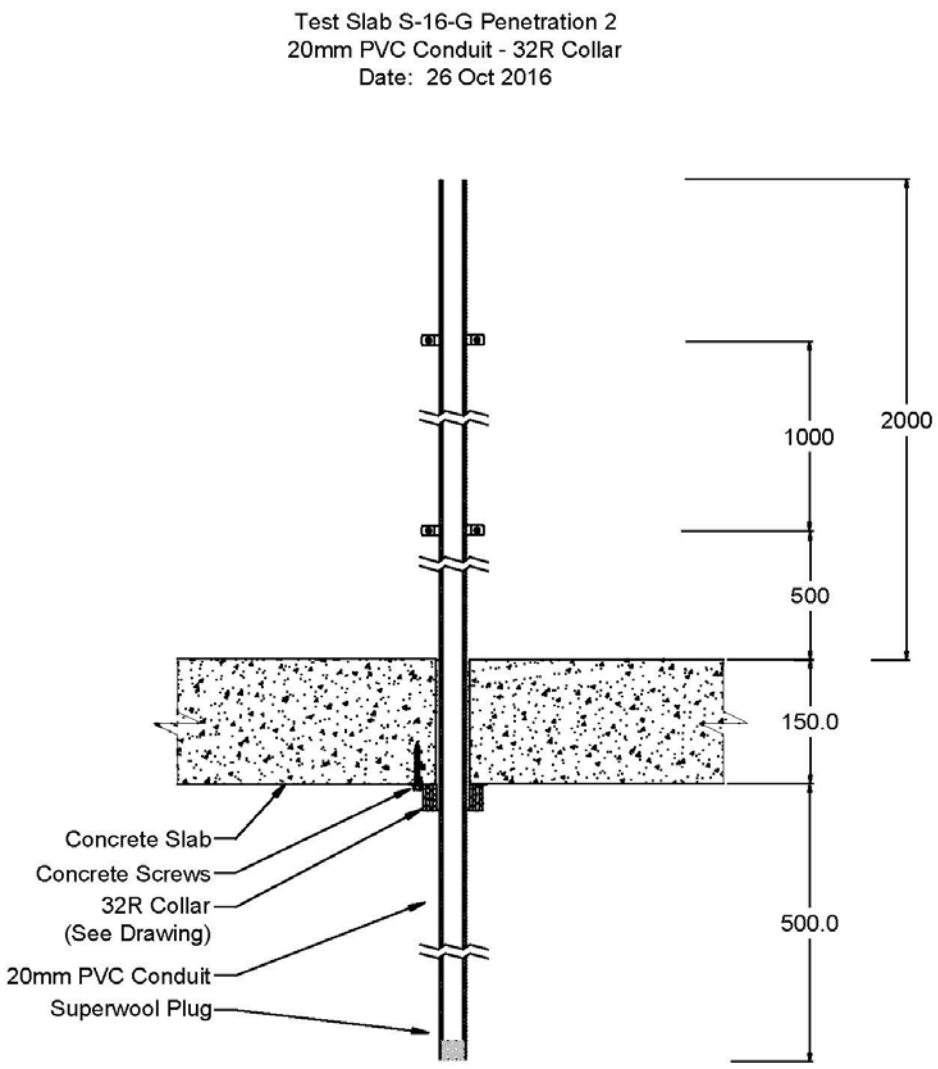
FIGURE 8 – SPECIMEN TEMPERATURE – ASSOCIATED WITH PENETRATION 6

Appendix D – Installation drawings

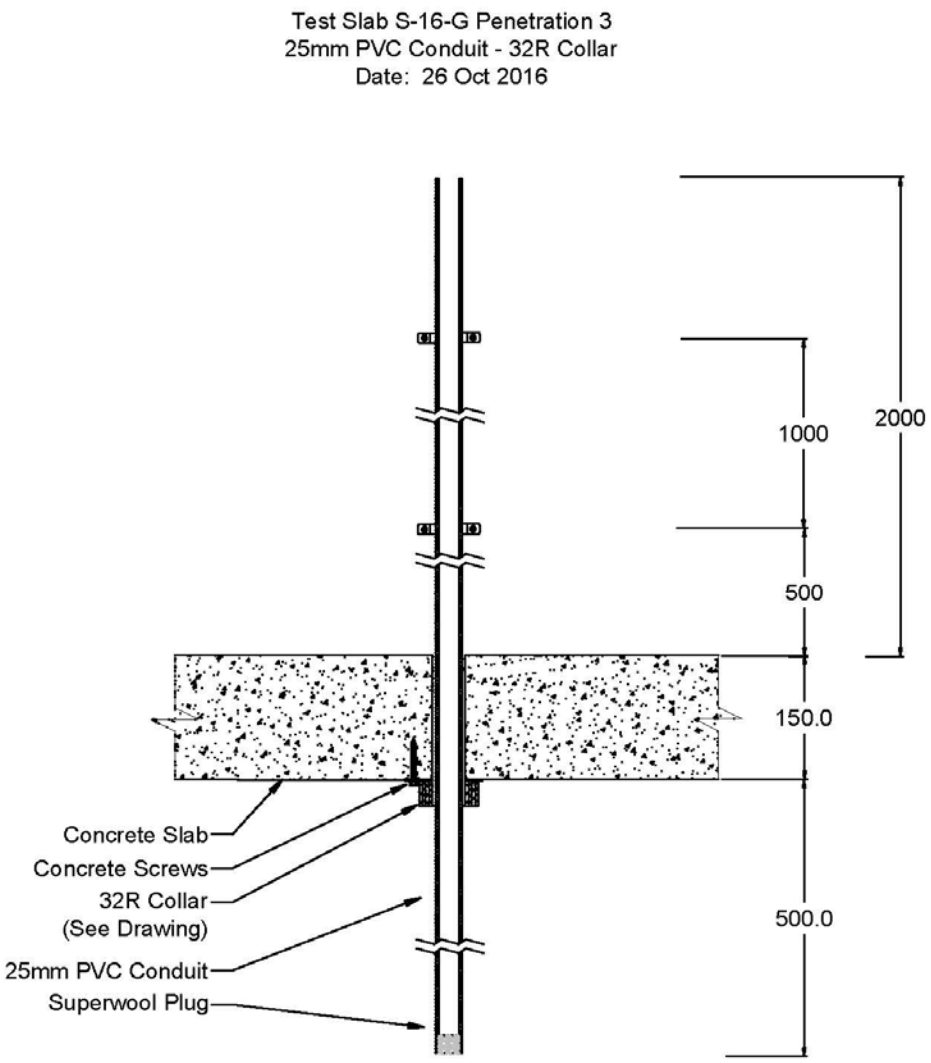
Test Slab S-16-G Penetration 1
80mm PVC Pipe - Floor Waste – LP100R-D
Date: 26 Oct 2016



DRAWING TITLED "TEST SLAB S-16-G PENETRATION 1, 80-MM PVC PIPE – FLOOR WASTE – LP100R-D, DATED 26 OCTOBER 2016, BY SNAP FIRE SYSTEMS PTY LTD.

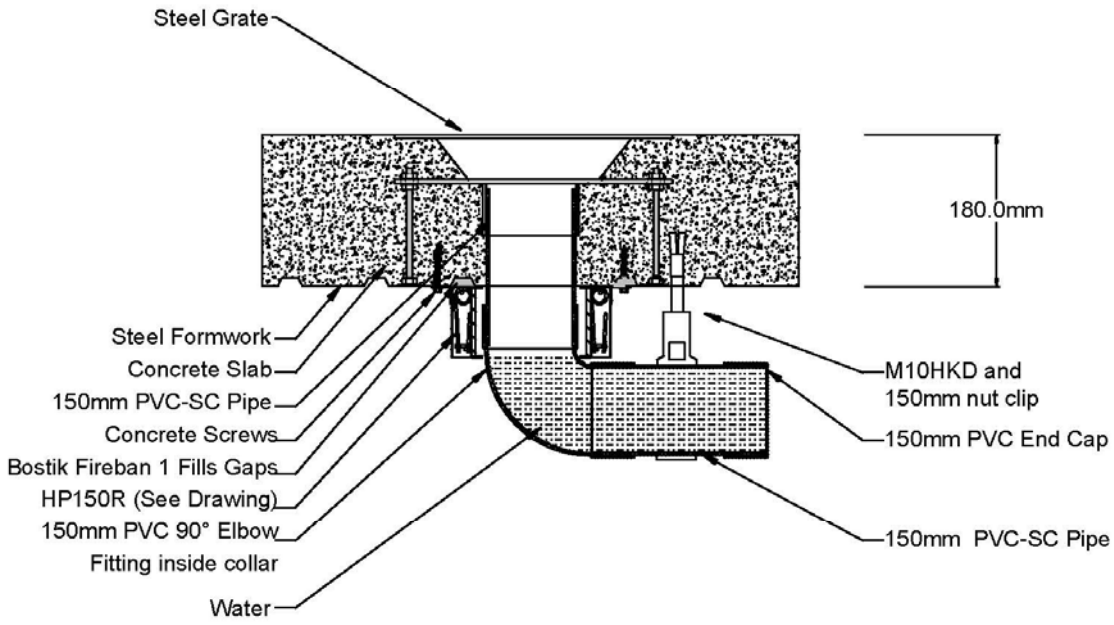


DRAWING TITLED "TEST SLAB S-16-G PENETRATION 2, 20-MM PVC CONDUIT – 32R COLLAR" DATED 26 OCTOBER 2016, BY SNAP FIRE SYSTEMS PTY LTD.

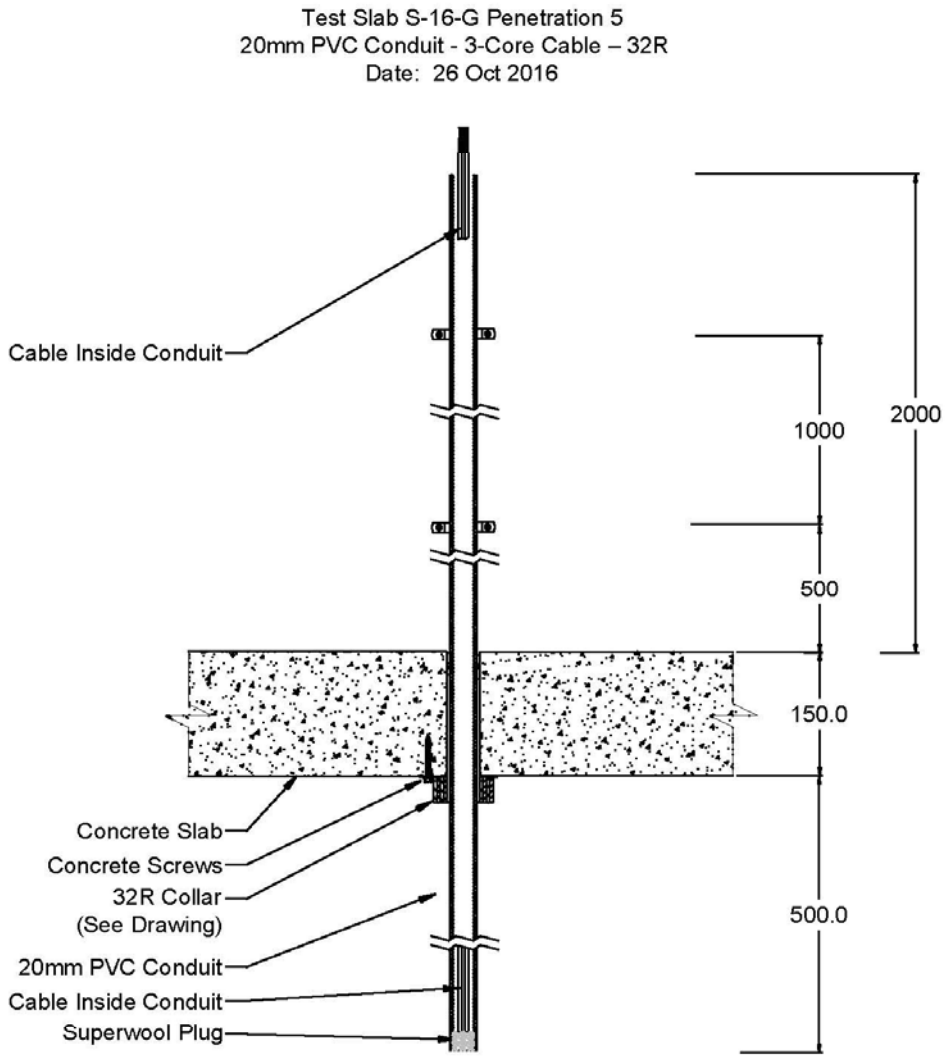


DRAWING TITLED "TEST SLAB S-16-G PENETRATION 3, 25-MM PVC CONDUIT – 32R COLLAR" DATED 26 OCTOBER 2016, BY SNAP FIRE SYSTEMS PTY LTD.

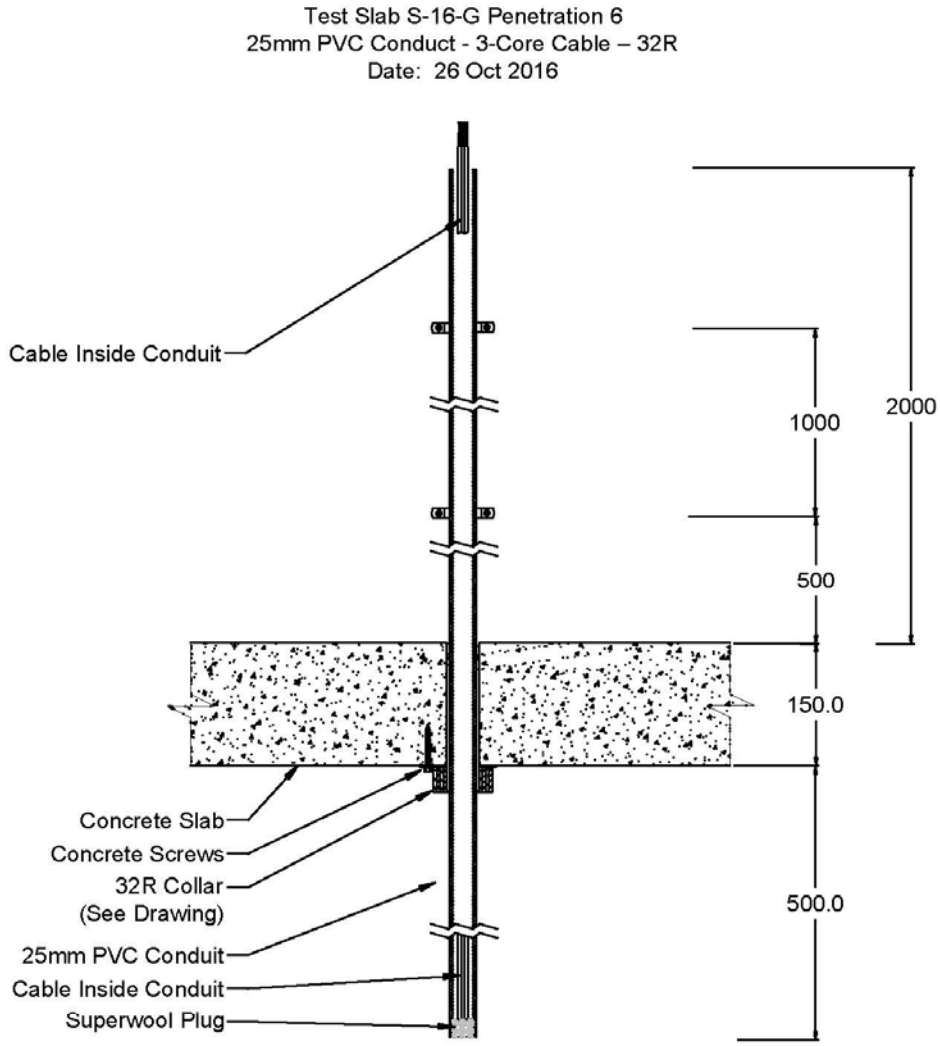
Test Slab S-16-G Penetration 4
150mm PVC-SC Pipe - Steel Grate - Fitting Inside HP150R Collar
Date: 26 Oct 2016



DRAWING TITLED "TEST SLAB S-16-G PENETRATION 4, 150-MM PVC-SC PIPE – STEEL GRATE – FITTING INSIDE HP150R COLLAR, DATED 26 OCTOBER 2016, BY SNAP FIRE SYSTEMS PTY LTD.

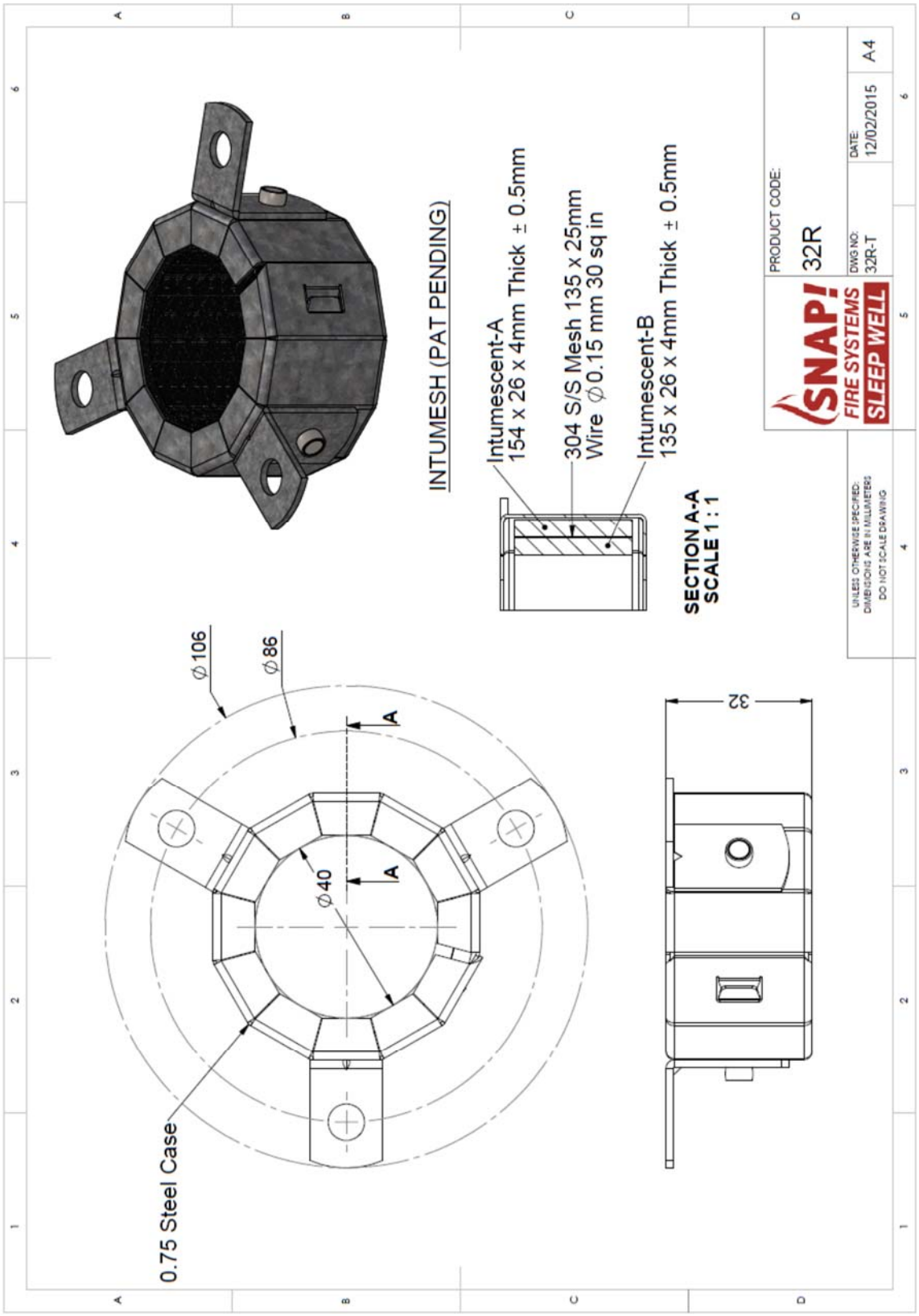


DRAWING TITLED "TEST SLAB S-16-G PENETRATION 5, 20-MM PVC CONDUIT – 3-CORE CABLE – 32R" DATED 26 OCTOBER 2016, BY SNAP FIRE SYSTEMS PTY LTD.

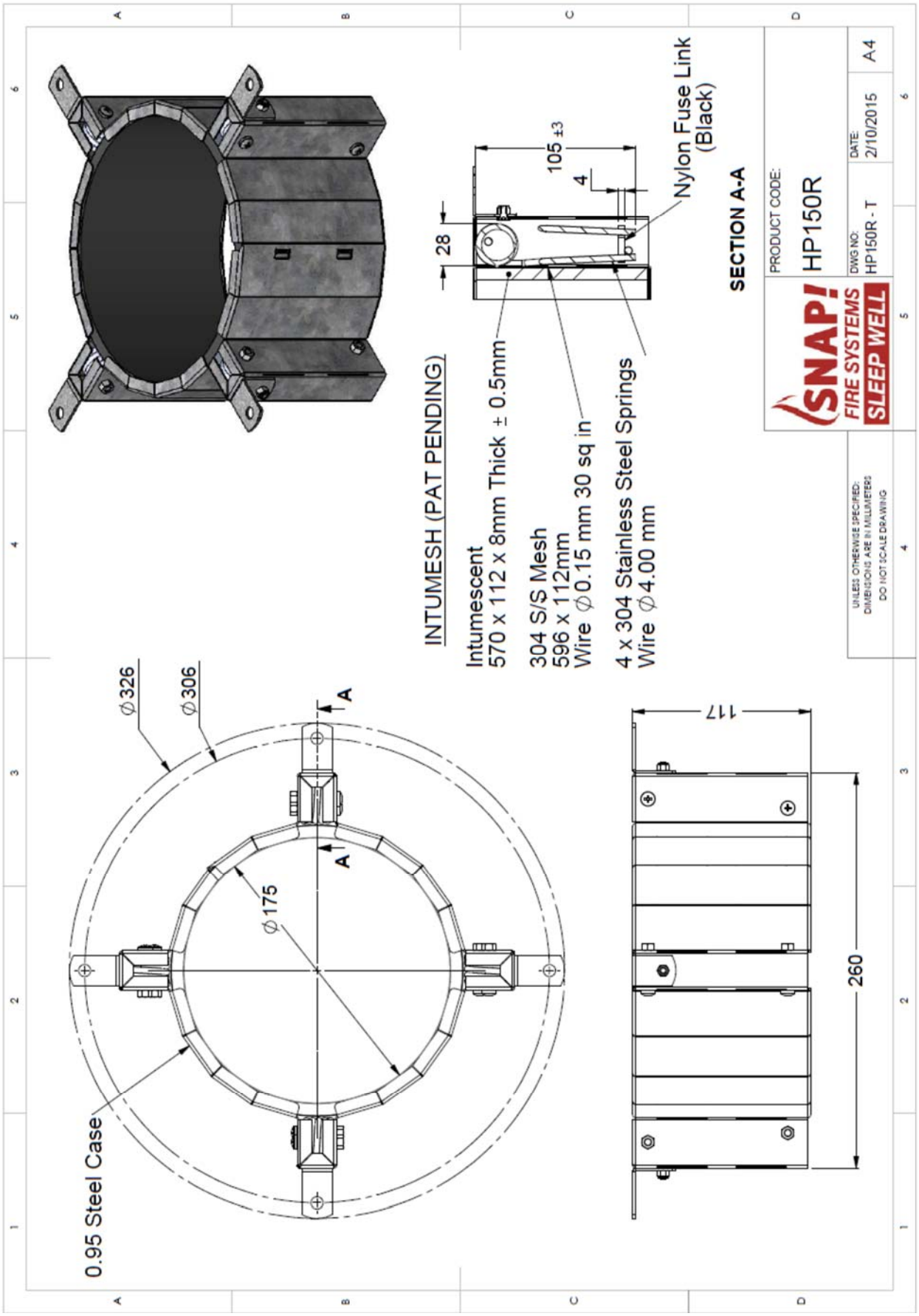


DRAWING TITLED "TEST SLAB S-16-G PENETRATION 6, 25-MM PVC CONDUIT – 3-CORE CABLE – 32R COLLAR" DATED 26 OCTOBER 2016, BY SNAP FIRE SYSTEMS PTY LTD.

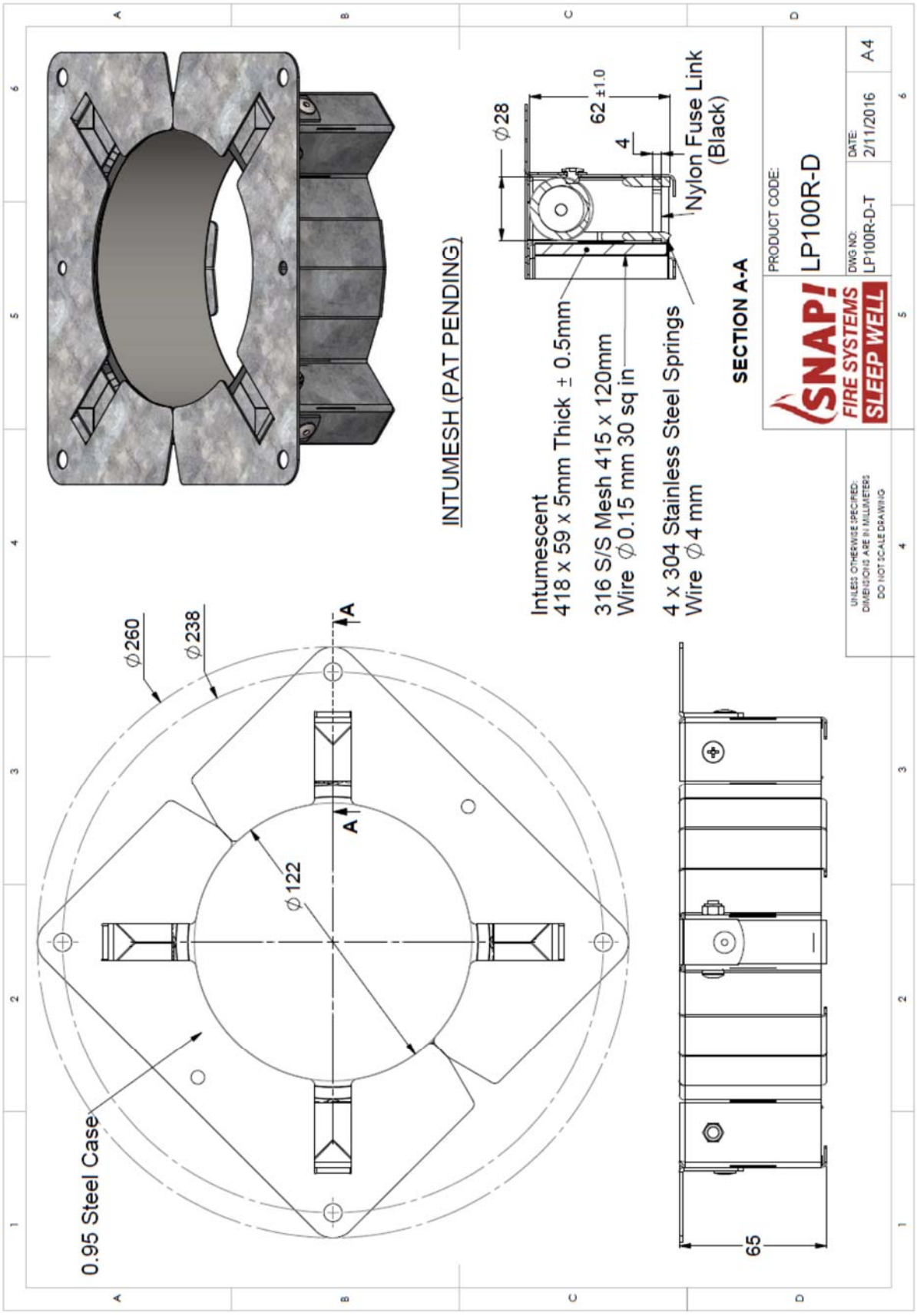
Appendix E – Specimen Drawings



DRAWING NUMBERED 32R-T DATED 12 FEBRUARY 2015, BY SNAP FIRE SYSTEMS PTY LTD.



DRAWING NUMBERED HP 150R-T DATED 2 OCTOBER 2015, BY SNAP FIRE SYSTEMS PTY LTD.



DRAWING NUMBERED LP100R-D-T DATED 2 NOVEMBER 2016, BY SNAP FIRE SYSTEMS PTY LTD.

Appendix F – Certificates

INFRASTRUCTURE TECHNOLOGIES
www.csiro.au

14 Julius Avenue, North Ryde NSW 2113
PO Box 52, North Ryde NSW 1670, Australia
T (02) 9490 5444 • **ABN** 41 687 119 230

Certificate of Test

No. 2896

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

Snap Fire Systems Pty Ltd
Building A, 1343 Wynnum Road
Tingalpa QLD 4173

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSP 1781.

Product Name: Penetration 1 – LP100R-D Retrofit collar protecting a nominal 80-mm diameter Polyvinyl Chloride (PVC) Pipe and Floorwaste

Description: The SNAP Retrofit LP100R-D collar comprised a 0.95-mm thick steel casing with a 122-mm inner diameter and a 260-mm base flange. The 65-mm high collar casing incorporated a layer of 418-mm x 59-mm x 5-mm thick Intumescent material. The closing mechanism comprised 4 x 304 stainless steel spring bound with a black nylon fuse link and a 316 stainless steel mesh measuring 415 x 120-mm as shown in drawing numbered LP100R-D-T dated 2 November 2016, by Snap Fire Systems Pty Ltd. The penetrating service comprised a 82-mm PVC pipe, with a wall thickness of 3-mm fitted through the LP100R-D Snap fire collar. The floor waste system was fitted with a trench grate. On the exposed side of the slab an 80-mm PVC P-Trap was fitted to the pipe within the collar, supported by a M10 HKD clamp 80-mm nut clip fixed to the concrete slab. On the exposed face, the penetration was capped using an 80-mm PVC end cap. The floor waste gully was charged with water to the level shown in drawing titled "Test Slab S-16-G Penetration 1, 80-mm PVC Pipe – Floor Waste – LP100R-D, dated 26 October 2016, by Snap Fire Systems Pty Ltd.

Structural Adequacy	not applicable
Integrity	no failure at 241 minutes
Insulation	no failure at 241 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of -/240/240. The fire-resistance level of the wall system is applicable when the system is exposed to fire from either direction. The fire-resistance level (FRL) are limited to that of the separating element. This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Russell Collins Date of Test: 26 September 2016

Issued on the 23rd day of December 2016 without alterations or additions.

B. Roddy

Brett Roddy
Manager, Fire Testing and Assessments

This document is issued in accordance with NATA's accreditation requirements.
Accreditation No. 165 – Corporate Site No. 3625
Accredited for compliance with ISO/IEC 17025 - Testing

COPY OF CERTIFICATE OF TEST – NO. 2896

INFRASTRUCTURE TECHNOLOGIES
www.csiro.au

14 Julius Avenue, North Ryde NSW 2113
PO Box 52, North Ryde NSW 1670, Australia
T (02) 9490 5444 • **ABN** 41 687 119 230

Certificate of Test

No. 2897

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

Snap Fire Systems Pty Ltd
Building A, 1343 Wynnum Road
Tingalpa QLD 4173

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSP 1781.

Product Name: Penetration 2 – 32R Retrofit collar protecting a 20-mm diameter Polyvinyl Chloride (PVC) Conduit

Description: The SNAP Retrofit 32R fire collar comprised a 0.75-mm steel casing with a 40-mm inner diameter fitted with three fixing tabs. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd. The penetrating service comprised a 20-mm PVC Conduit, with a wall thickness of 1.8-mm fitted through the collar's sleeve. The pipe projected vertically 2000-mm above the concrete and 500-mm into the furnace chamber. The pipe was supported at 500-mm and 1500-mm from the unexposed face of the concrete slab as shown in drawing titled "Test Slab S-16-G Penetration 2, 20-mm PVC Conduit – 32R Collar" dated 26 October 2016, by Snap Fire Systems Pty Ltd. On the exposed end, the pipe was capped with a Superwool Plug.

Structural Adequacy	not applicable
Integrity	no failure at 241 minutes
Insulation	no failure at 241 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of -/240/240. The fire-resistance level of the wall system is applicable when the system is exposed to fire from either direction. The fire-resistance level (FRL) are limited to that of the separating element. This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Russell Collins Date of Test: 26 September 2016

Issued on the 23rd day of December 2016 without alterations or additions.

B. Roddy

Brett Roddy
Manager, Fire Testing and Assessments

This document is issued in accordance with NATA's accreditation requirements.
Accreditation No. 165 – Corporate Site No. 3625
Accredited for compliance with ISO/IEC 17025 - Testing

COPY OF CERTIFICATE OF TEST – NO. 2897

INFRASTRUCTURE TECHNOLOGIES
www.csiro.au

14 Julius Avenue, North Ryde NSW 2113
PO Box 52, North Ryde NSW 1670, Australia
T (02) 9490 5444 • **ABN** 41 687 119 230

Certificate of Test

No. 2898

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

Snap Fire Systems Pty Ltd
Building A, 1343 Wynnum Road
Tingalpa QLD 4173

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSP 1781.

Product Name: Penetration 3 – 32R Retrofit collar protecting a 25-mm diameter Polyvinyl Chloride (PVC) Conduit

Description: The SNAP Retrofit 32R fire collar comprised a 0.75-mm steel casing with a 40 mm inner diameter fitted with three fixing tabs. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd. The penetrating service comprised a 25-mm PVC Conduit, with a wall thickness of 2 mm fitted through the collar's sleeve. The pipe projected vertically 2000-mm above the concrete and 500 mm into the furnace chamber. The pipe was supported at 500-mm and 1500 mm from the unexposed face of the concrete slab as shown in drawing titled "Test Slab S-16-G Penetration 3, 25-mm PVC Conduit – 32R Collar" dated 26 October 2016, by Snap Fire Systems Pty Ltd. On the exposed end, the pipe was capped with a Superwool Plug.

Structural Adequacy	not applicable
Integrity	no failure at 241 minutes
Insulation	no failure at 241 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of -/240/240. The fire-resistance level of the wall system is applicable when the system is exposed to fire from either direction. The fire-resistance level (FRL) are limited to that of the separating element. This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Russell Collins Date of Test: 26 September 2016

Issued on the 23rd day of December 2016 without alterations or additions.

B. Roddy

Brett Roddy
Manager, Fire Testing and Assessments

This document is issued in accordance with NATA's accreditation requirements.
Accreditation No. 165 – Corporate Site No. 3625
Accredited for compliance with ISO/IEC 17025 - Testing

COPY OF CERTIFICATE OF TEST – NO. 2898

INFRASTRUCTURE TECHNOLOGIES
www.csiro.au

14 Julius Avenue, North Ryde NSW 2113
PO Box 52, North Ryde NSW 1670, Australia
T (02) 9490 5444 • **ABN** 41 687 119 230

Certificate of Test

No. 2899

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

Snap Fire Systems Pty Ltd
Building A, 1343 Wynnum Road
Tingalpa QLD 4173

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSP 1781.

Product Name: Penetration 4 – HP150R Retrofit collar protecting a nominal 150-mm diameter Polyvinyl Chloride (PVC-SC) Pipe – Steel Grate and steel formwork

Description: The SNAP retrofitted HP150R collar comprised a 0.95-mm steel casing with a 175-mm inner diameter and a 326-mm base flange. The 117-mm high collar casing incorporated a strip of 570-mm x 112-mm x 8-mm thick Intumesh intumescent material. The closing mechanism comprised four 304 stainless steel springs, with nylon fuse links, and a 596-mm x 112-mm stainless steel mesh as shown in drawing numbered HP 150R-T dated 2 October 2015, by Snap Fire Systems Pty Ltd. The penetrating service comprised a 160-mm PVC-SC pipe, with a wall thickness of 4-mm fitted through the HP150R Snap fire collar. The floor waste system was fitted with a steel grate. On the exposed side of the slab an 150-mm PVC 90°C Elbow was fitted to the pipe within the collar, supported by a M10 HKD clamp 150-mm nut clip fixed to the concrete slab. The collar was attached to a section of Condek steel formwork incorporated to the underside of the slab. Gaps formed between the collar and the corrugations of the steel formwork were filled with Bostik Fireban 1 as shown in drawing titled "Test Slab S-16-G Penetration 4, 150-mm PVC-SC Pipe – Steel Grate – Fitting inside HP150R Collar, dated 26 October 2016, by Snap Fire Systems Pty Ltd. On the exposed face, the penetration was capped using an 150-mm PVC-SC end cap. The floor waste gully was charged with water to the level shown in drawing titled "Test Slab S-16-G Penetration 4, 150-mm PVC-SC Pipe – Steel Grate – Fitting inside HP150R Collar, dated 26 October 2016, by Snap Fire Systems Pty Ltd.

Structural Adequacy	not applicable
Integrity	no failure at 241 minutes
Insulation	238 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of -/240/180. The fire-resistance level of the wall system is applicable when the system is exposed to fire from either direction. The fire-resistance level (FRL) are limited to that of the separating element. This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Russell Collins Date of Test: 26 September 2016

Issued on the 23rd day of December 2016 without alterations or additions.

B. Roddy

Brett Roddy
Manager, Fire Testing and Assessments

This document is issued in accordance with NATA's accreditation requirements.
Accreditation No. 165 – Corporate Site No. 3625
Accredited for compliance with ISO/IEC 17025 - Testing

COPY OF CERTIFICATE OF TEST – NO. 2899

INFRASTRUCTURE TECHNOLOGIES
www.csiro.au

14 Julius Avenue, North Ryde NSW 2113
PO Box 52, North Ryde NSW 1670, Australia
T (02) 9490 5444 • **ABN** 41 687 119 230

Certificate of Test

No. 2900

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

Snap Fire Systems Pty Ltd
Building A, 1343 Wynnum Road
Tingalpa QLD 4173

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSP 1781.

Product Name: Penetration 5 – 32R Retrofit collar protecting a 20-mm diameter Polyvinyl Chloride (PVC) Conduit – 3-Core cable

Description: The SNAP Retrofit 32R fire collar comprised a 0.75-mm steel casing with a 40-mm inner diameter fitted with three fixing tabs. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd. The penetrating service comprised a 20-mm PVC Conduit with a 3-Core cable inside, with a wall thickness of 1.8-mm fitted through the collar's sleeve. The pipe projected vertically 2000-mm above the concrete and 500-mm into the furnace chamber. The pipe was supported at 500-mm and 1500-mm from the unexposed face of the concrete slab as shown in drawing titled "Test Slab S-16-G Penetration 5, 20-mm PVC Conduit – 3-Core Cable – 32R" dated 26 October 2016, by Snap Fire Systems Pty Ltd. On the exposed end, the pipe was capped with a Superwool Plug.

Structural Adequacy	not applicable
Integrity	no failure at 241 minutes
Insulation	no failure at 241 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of -/240/240. The fire-resistance level of the wall system is applicable when the system is exposed to fire from either direction. The fire-resistance level (FRL) are limited to that of the separating element. This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Russell Collins Date of Test: 26 September 2016

Issued on the 23rd day of December 2016 without alterations or additions.

B. Roddy

Brett Roddy
Manager, Fire Testing and Assessments

This document is issued in accordance with NATA's accreditation requirements.
Accreditation No. 165 – Corporate Site No. 3625
Accredited for compliance with ISO/IEC 17025 - Testing

COPY OF CERTIFICATE OF TEST – NO. 2900

INFRASTRUCTURE TECHNOLOGIES
www.csiro.au

14 Julius Avenue, North Ryde NSW 2113
PO Box 52, North Ryde NSW 1670, Australia
T (02) 9490 5444 • **ABN** 41 687 119 230

Certificate of Test

No. 2901

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

Snap Fire Systems Pty Ltd
Building A, 1343 Wynnum Road
Tingalpa QLD 4173

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSP 1781.

Product Name: Penetration 6 – 32R Retrofit collar protecting a 25-mm diameter Polyvinyl Chloride (PVC) Conduit – 3-Core cable

Description: The SNAP Retrofit 32R fire collar comprised a 0.75-mm steel casing with a 40-mm inner diameter fitted with three fixing tabs. The 32-mm high collar casing incorporated a closing mechanism that was comprised of two soft Intumesh intumescent strips lined within the internal circumference of the collar. The inner and outer strips were 4-mm thick x 26-mm wide x 135-mm long, and 4-mm thick x 26-mm wide x 154-mm long, respectively. Between the strips was a layer of 304 stainless steel mesh 135 mm long x 25-mm wide with wire mesh diameter of 0.15-mm, as shown in drawing numbered 32R-T dated 12 February 2015, by Snap Fire Systems Pty Ltd. The penetrating service comprised a 25-mm PVC Conduit with 3 x 3-Core cable inside, with a wall thickness of 2-mm fitted through the collar's sleeve. The pipe projected vertically 2000-mm above the concrete and 500-mm into the furnace chamber. The pipe was supported at 500-mm and 1500-mm from the unexposed face of the concrete slab as shown in drawing titled "Test Slab S-16-G Penetration 6, 25-mm PVC Conduit – 3-Core Cable – 32R Collar" dated 26 October 2016, by Snap Fire Systems Pty Ltd. On the exposed end, the pipe was capped with a Superwool Plug.

Structural Adequacy	not applicable
Integrity	no failure at 241 minutes
Insulation	no failure at 241 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of -/240/240. The fire-resistance level of the wall system is applicable when the system is exposed to fire from either direction. The fire-resistance level (FRL) are limited to that of the separating element. This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Russell Collins Date of Test: 26 September 2016

Issued on the 23rd day of December 2016 without alterations or additions.

B. Roddy

Brett Roddy
Manager, Fire Testing and Assessments

This document is issued in accordance with NATA's accreditation requirements.
Accreditation No. 165 – Corporate Site No. 3625
Accredited for compliance with ISO/IEC 17025 - Testing

COPY OF CERTIFICATE OF TEST – NO. 2901

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----**

CONTACT US

t 1300 363 400
+61 3 9545 2176
e enquiries@csiro.au
w www.csiro.au

YOUR CSIRO

Australia is founding its future on science and innovation. Its national science agency, CSIRO, is a powerhouse of ideas, technologies and skills for building prosperity, growth, health and sustainability. It serves governments, industries, business and communities across the nation.

FOR FURTHER INFORMATION

Infrastructure Technologies
Brett Roddy
Team Leader, Fire Testing and Assessments
t +61 2 94905449
e brett.roddy@csiro.au
w www.csiro.au/Organisation-Structure/Divisions/CMSE/Infrastructure-Technologies/Fire-safety.aspx