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

Test Report

Author: Peter Gordon
Report number: FSP 1949
Date: 7 December 2018

Client: IG6 Pty Ltd as trustee for the IG6 IP Trust

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Report Authorization:

AUTHOR	REVIEWED BY	AUTHORISED BY
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7 December 2018	7 December 2018	7 December 2018

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Contents

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

Sponsored Investigation No. FSP 1949

1 Introduction

1.1 Identification of specimen

The sponsor identified the specimen as two (2) cast-in fire collars protecting a 120-mm thick concrete floor slab penetrated by two (2) stack pipes.

1.2 Sponsor

IG6 Pty Ltd as trustee for the IG6 IP Trust
3 Skirmish Court
Victoria Point Qld 4165

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.

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: FS 4809/4283

1.7 Test date

The fire-resistance test was conducted on 8 October 2018.

2 Description of specimen

2.1 General

The specimen comprised an 1150-mm x 1150-mm x 120-mm thick reinforced concrete slab penetrated by two PVC stack pipes protected by cast in fire collars.

The penetrated slab comprised a 120-mm thick concrete slab reinforced with a single layer of steel reinforcement.

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

- ASTM D1785 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- AS /NZS 1254 PVC-U pipes and fittings for stormwater and surface water applications

For the purpose of the test, the specimens were referenced as Specimen 1and 2.

Specimen 1 – 200C Cast-in fire collar protecting a nominal 200 (outer) and 100 (inner) Polyvinyl Chloride (PVC) stack pipes.

The SNAP 200C cast-in fire collar comprised a 3-mm ABS Haircell cover attached to a 0.75-mm thick steel casing with a 250-mm inner diameter and a 362-mm diameter base flange. The 120-mm high casing incorporated a 760-mm x 112-mm x 6-mm thick Intumesh intumescent material. The closing mechanism comprised five stainless steel springs, nylon fuse links and a 834-mm x 107-mm stainless steel mesh, as shown in drawing number 200C, titled “SNAP 200 Cast-In”, received 9 November 2018 , by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 200-mm (outer) and 115-mm (inner) PVC stack pipes, with a wall thicknesses of 8-mm and 7-mm respectively. The two pipes (placed one inside the other) were secured together with four sets of casting spacers at approximately 400-mm below the slab and 400-mm, 800-mm, 1350-mm and 1600-mm above the slab. Three 9-mm threaded rods were also secured through both pipes for additional support at approximately 450-mm, 1200-mm and 1800-mm above the slab. (See photograph 1). The pipes projected vertically 2000-mm above the concrete and 500-mm into the furnace chamber. The pipe was supported at 500-mm and 1250-mm from the unexposed face of the concrete slab as shown in Drawing titled “Specimen #1, 200 IPEX PVC Outer Pipe 115 IPEX PVC Inner Pipe and 200C”, dated October 2018, provided by Snap Fire Systems Pty Ltd. The exposed end of both pipes were plugged with Superwool ceramic fibre.

Specimen 2 – 200C cast-in fire collar protecting a nominal 175 Polyvinyl Chloride (PVC) stack pipe.

The SNAP 200C cast-in fire collar comprised a 3-mm ABS Haircell cover attached to a 0.75-mm thick steel casing with a 250-mm inner diameter and a 362-mm diameter base flange. The 120-mm high casing incorporated a 760-mm x 112-mm x 6-mm thick Intumesh intumescent material. The closing mechanism comprised five stainless steel springs, nylon fuse links and a 834-mm x 107-mm stainless steel mesh, as shown in drawing number 200C, titled "SNAP 200 Cast-In", received 9 November 2018 , by Snap Fire Systems Pty Ltd.

The penetrating service comprised a 200-mm PVC stack pipe, with a wall thickness of 4.5-mm. 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 "Specimen #2, 175 MARLEY PVC-U Stack and 200C", dated October 2018, provided by Snap Fire Systems Pty Ltd. On the exposed end, the pipe was plugged with Superwool ceramic fibre.

2.2 Dimensions

The overall dimension of the concrete slab was 1150-mm wide x 1150-mm long x 120-mm thick, 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 number 200C, titled "SNAP 200 Cast-In", received 9 November 2018, by Snap Fire Systems Pty Ltd.

Drawing titled "Test Slab S-18-I Layout", dated 16 August 2018, by Snap Fire Systems Pty Ltd.

Drawing titled "Specimen #1, 200 IPEX PVC Outer Pipe 115 IPEX PVC Inner Pipe and 200C", dated October 2018, provided by Snap Fire Systems Pty Ltd.

Drawing titled "Specimen #2, 175 MARLEY PVC-U Stack and 200C", dated October 2018, provided 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 20°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 furnace flues.
3 minutes -	Heavy smoke is being emitted from furnace flues.
4 minutes -	Smoke is being emitted from Specimen 1.
4.30 minutes -	Smoke is being emitted from Specimens 1 and 2.
5 minutes -	Heavy smoke emitted from both Specimen 1 and 2.
6 minutes -	The smoke fluing from Specimen 2 has started to reduce, whilst Specimen 2 continues to emit heavy smoke.
7 minutes -	Smoke is being emitted from Specimen 1, changing from heavy to light smoke.
8 minutes -	The smoke fluing from Specimen 2 has further diminished.
9 minutes -	The smoke fluing from Specimen 1 has started to reduce.
11 minutes -	The smoke from Specimen 1 has almost ceased.
12 minutes -	Whilst the fluing from specimens has almost ceased, there is still smoke from the furnace flues.
21 minutes -	Smoke from furnace flue has reduced substantially.
26 minutes -	Water pooling on slab between Specimens 1 and 2.
30 minutes -	Very light smoke fluing from the pipes of Specimens 1 and 2.
60 minutes -	No visible change from both specimens.
81 minutes -	Light smoke emitted from the base of Specimen 2 on grout near TC#8.
88 minutes -	A yellow liquid has condensed at the base of pipe of Specimen 2 near TC#8
119 minutes -	Light smoke continues to be emitted from the base of Specimen 2 on grout near TC#8.
130 minutes -	The smoke level fluing from both Specimens 1 and 2 has increased.
147 minutes -	Smoke emitted from the base of Specimen 2 near TC#8 has ceased.
195 minutes -	Insulation Failure Specimen 1 – maximum temperature rise of 180K is exceeded on the hob.
203 minutes -	Smoke level fluing from Specimen 1 continues to increase.
218 minutes -	The base of pipe of Specimen 2 near TC#8 has darkened and is emitting smoke.
224 minutes -	Mastic at the base of pipe of Specimen 1 has started to swell
227 minutes -	Insulation Failure Specimen 2 – maximum temperature rise of 180K is exceeded on the concrete slab 25-mm from hob.
232 minutes -	Cotton wool pad applied to base of Specimen 1 near where a red glow is visible through pipe. No ignition noted.
235 minutes -	Cotton wool pad applied to base of Specimen 1 near where a red glow is visible through pipe. No ignition noted.

236 minutes -	Integrity failure of Specimen 1 - Cotton wool pad applied to base of Specimen 1 near where a red glow is visible through pipe. Ignition of cotton pad noted at this time.
237 minutes -	Heavy smoke fluing from Specimen 1.
238 minutes -	Sustained flaming at the base of Specimen 1.
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 temperature versus time associated with Specimen 1.

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

8.5 Performance

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

Specimen 1 – 200C Cast-in fire collar protecting a nominal 200 (outer) and 100 (inner) Polyvinyl Chloride (PVC) stack pipes.

Structural adequacy	-	not applicable
Integrity	-	236 minutes
Insulation	-	195 minutes

Specimen 2 – 200C Cast-in fire collar protecting a nominal 175 Polyvinyl Chloride (PVC) stack pipe.

Structural adequacy	-	not applicable
Integrity	-	No failure at 241 minutes
Insulation	-	227 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:

Specimen 1 -/180/180

Specimen 2 -/240/180

The fire-resistance level of the specimen is applicable when the system is exposed to fire from the same 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 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 AS 1530.4-2014, have been made provided no individual component is removed or reduced.

11 Tested by

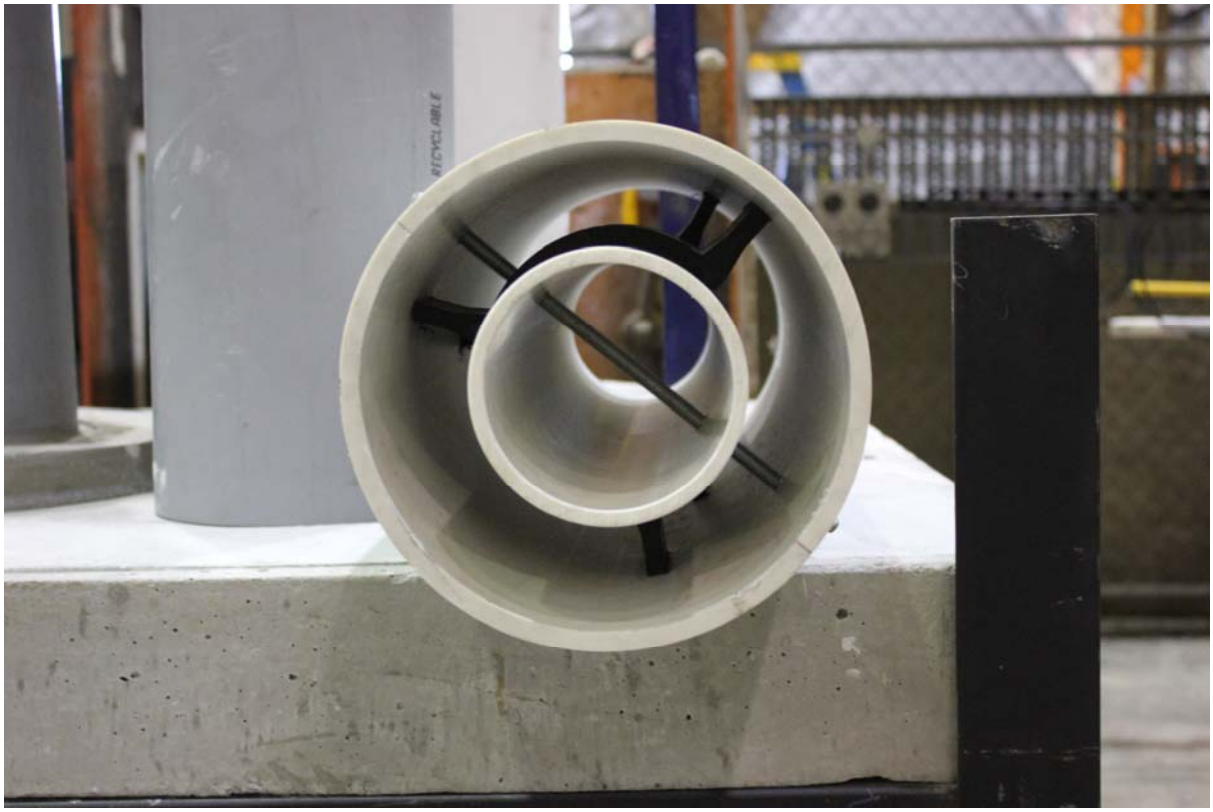
Peter Gordon
Testing Officer

Appendices

Appendix A – Measurement location

Measurement Location		Data Logger Channel Information
Specimen	**T/C Position**	**T/C designation**
Specimen 1 – IPEX PVC inner and Outer with 200C collar	On the slab – 25-mm from Hob East	S1
	On the slab – 25-mm from Hob West	S2
	On the Hob – 25-mm from the pipe East	S3
	On the Hob – 25-mm from the pipe West	S4
	On the Pipe – 25-mm from the Hob	S5
	On the Pipe – 25-mm from the Hob	S6
Specimen 2 – Marley grey PVC 200-mm OD 4.5 mm thickness 200 C Collar	On the slab – 25-mm from Hob East	S7
	On the slab – 25-mm from Hob West	S8
	On the Hob – 25-mm from the pipe East	S9
	On the Hob – 25-mm from the pipe West	S10
	On the Pipe – 25-mm from the Hob	S11
	On the Pipe – 25-mm from the Hob	S12
Rover		S13
Ambient		S14

Appendix B – Photographs



PHOTOGRAPH 1 – SPACERS AND THREADED STEEL ROD IN SPECIMEN 1

PHOTOGRAPH 2 – EXPOSED FACE OF SPECIMENS PRIOR TO TESTING

PHOTOGRAPH 3 – UNEXPOSED FACE OF SPECIMENS PRIOR TO TESTING

PHOTOGRAPH 4 – SPECIMENS AFTER 88 MINUTES OF TESTING

PHOTOGRAPH 5 – BASE OF SPECIMEN 2 AFTER 122 MINUTES OF TESTING

PHOTOGRAPH 6 – SPECIMENS AFTER 121 MINUTES OF TESTING

PHOTOGRAPH 7 – SPECIMENS AFTER 180 MINUTES OF TESTING

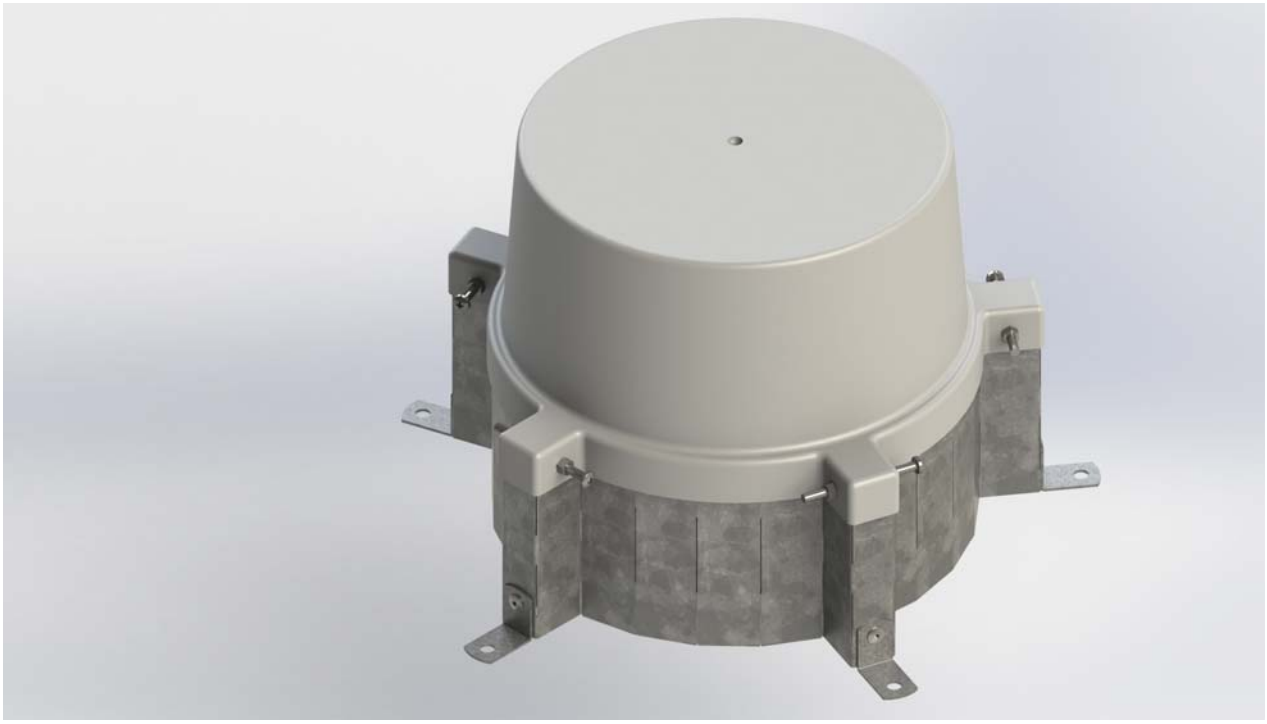
PHOTOGRAPH 8 – SPECIMEN 1 AFTER 222 MINUTES OF TESTING

PHOTOGRAPH 9 – SPECIMEN 1 AFTER 232 MINUTES OF TESTING

PHOTOGRAPH 10 – SPECIMEN 1 AFTER 238 MINUTES OF TESTING

PHOTOGRAPH 11 – UNEXPOSED FACE OF SPECIMEN AT CONCLUSION OF TESTING

PHOTOGRAPH 12 – EXPOSED FACE OF SPECIMENS AT CONCLUSION OF TESTING



PHOTOGRAPH 13 – SNAP 200C CAST-IN COLLAR

Appendix C – Furnace Temperature

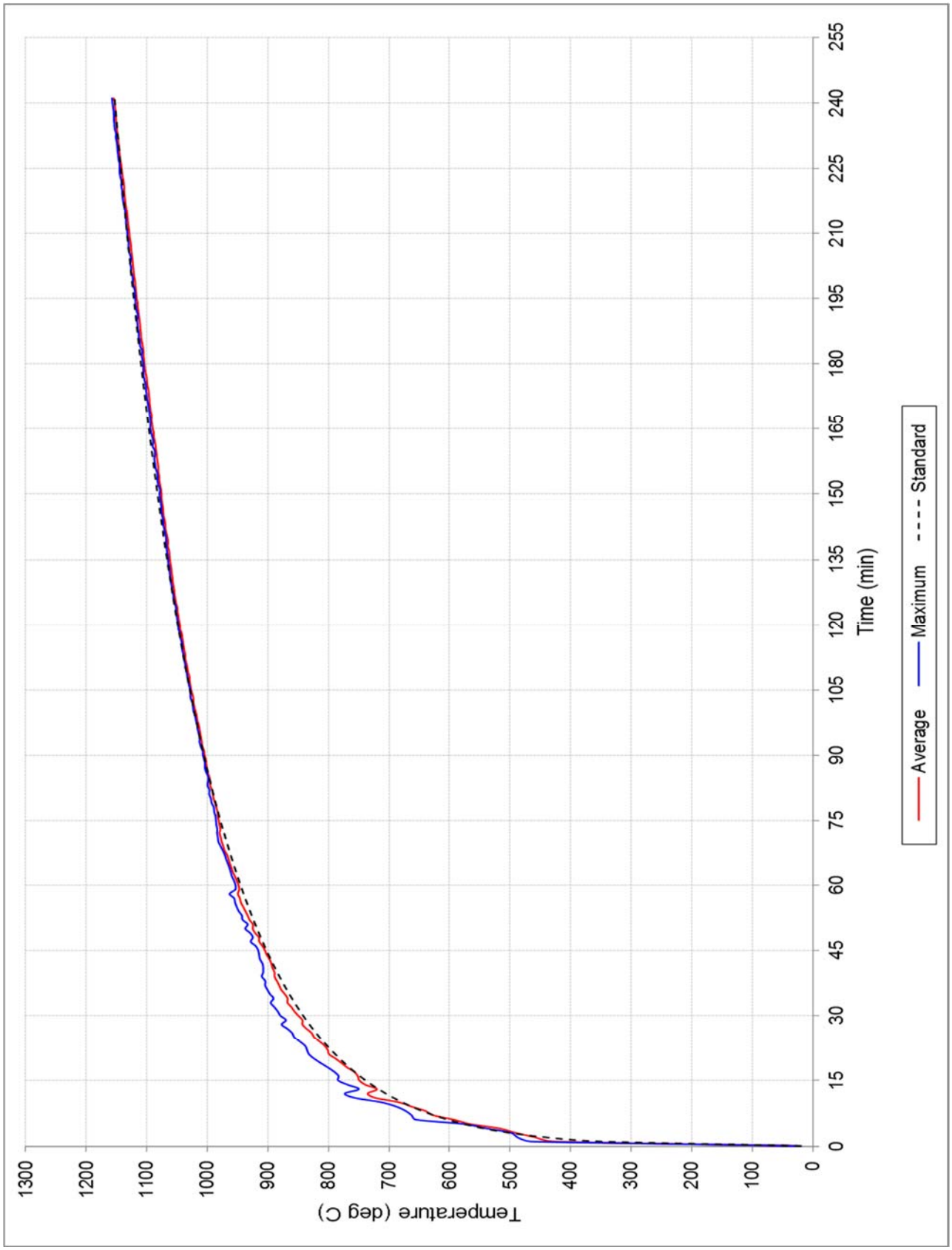


FIGURE 1 – FURNACE TEMPERATURE

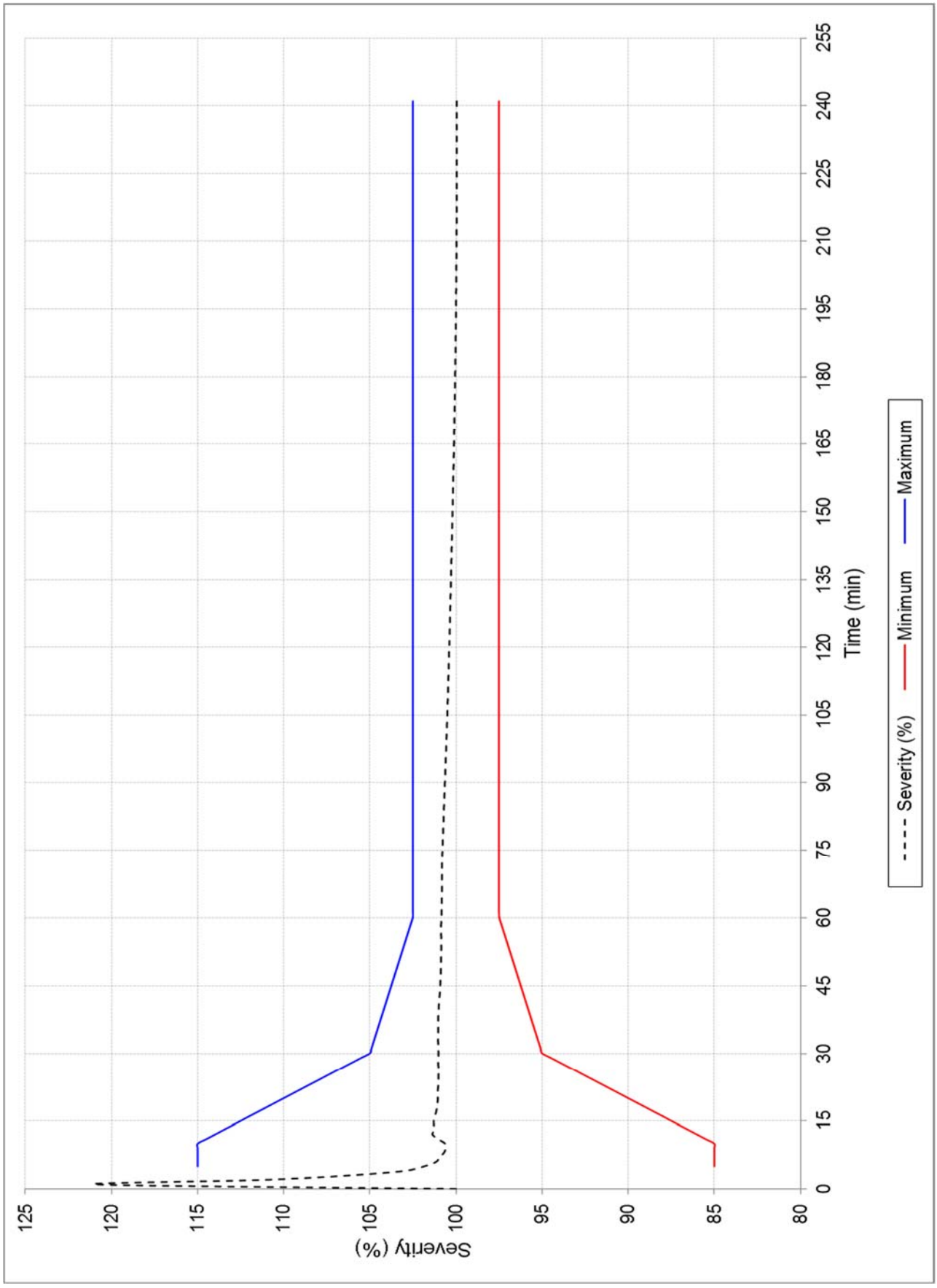


FIGURE 2 – FURNACE SEVERITY

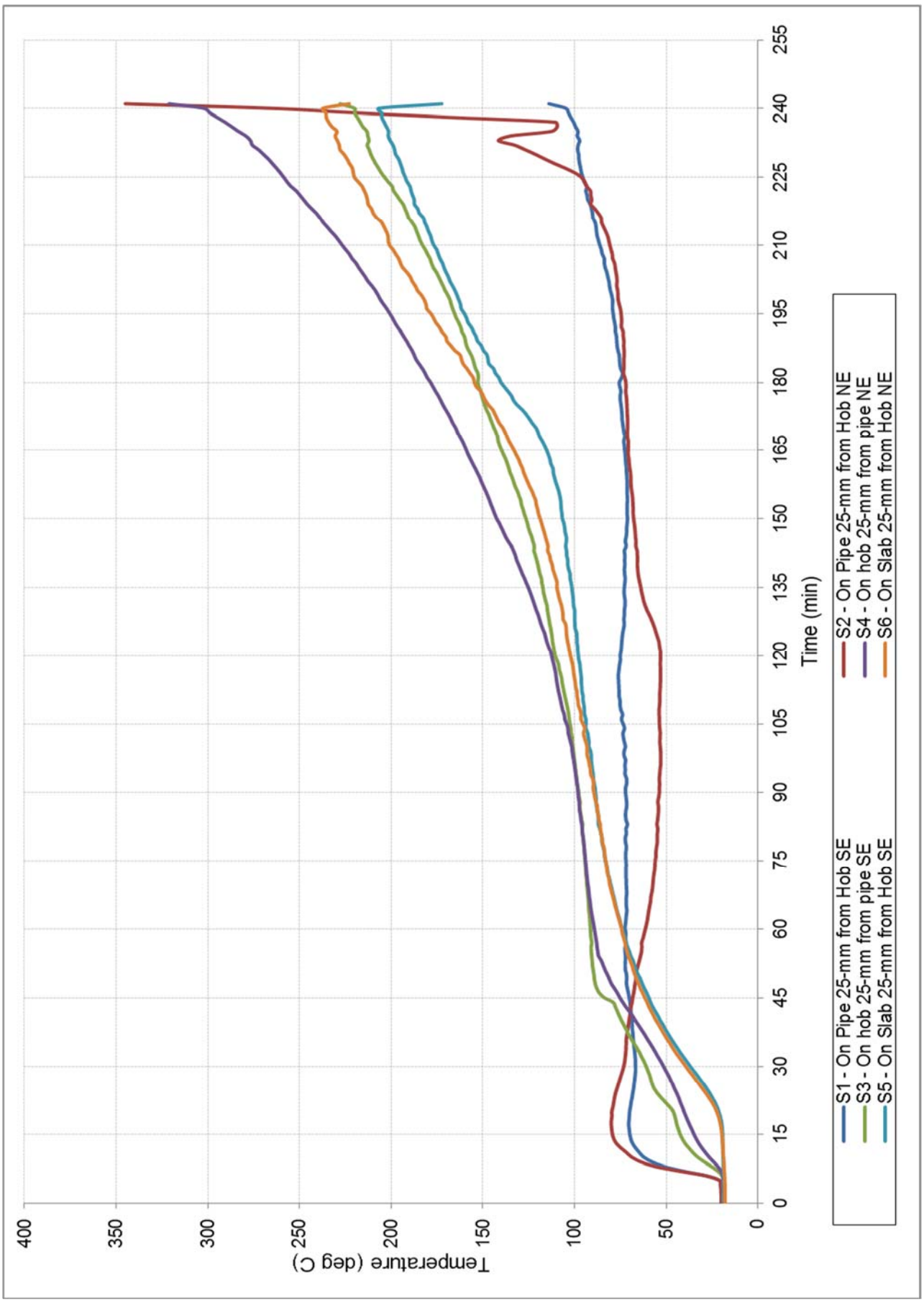


FIGURE 3 – SPECIMEN TEMPERATURE – ASSOCIATED WITH SPECIMEN # 1

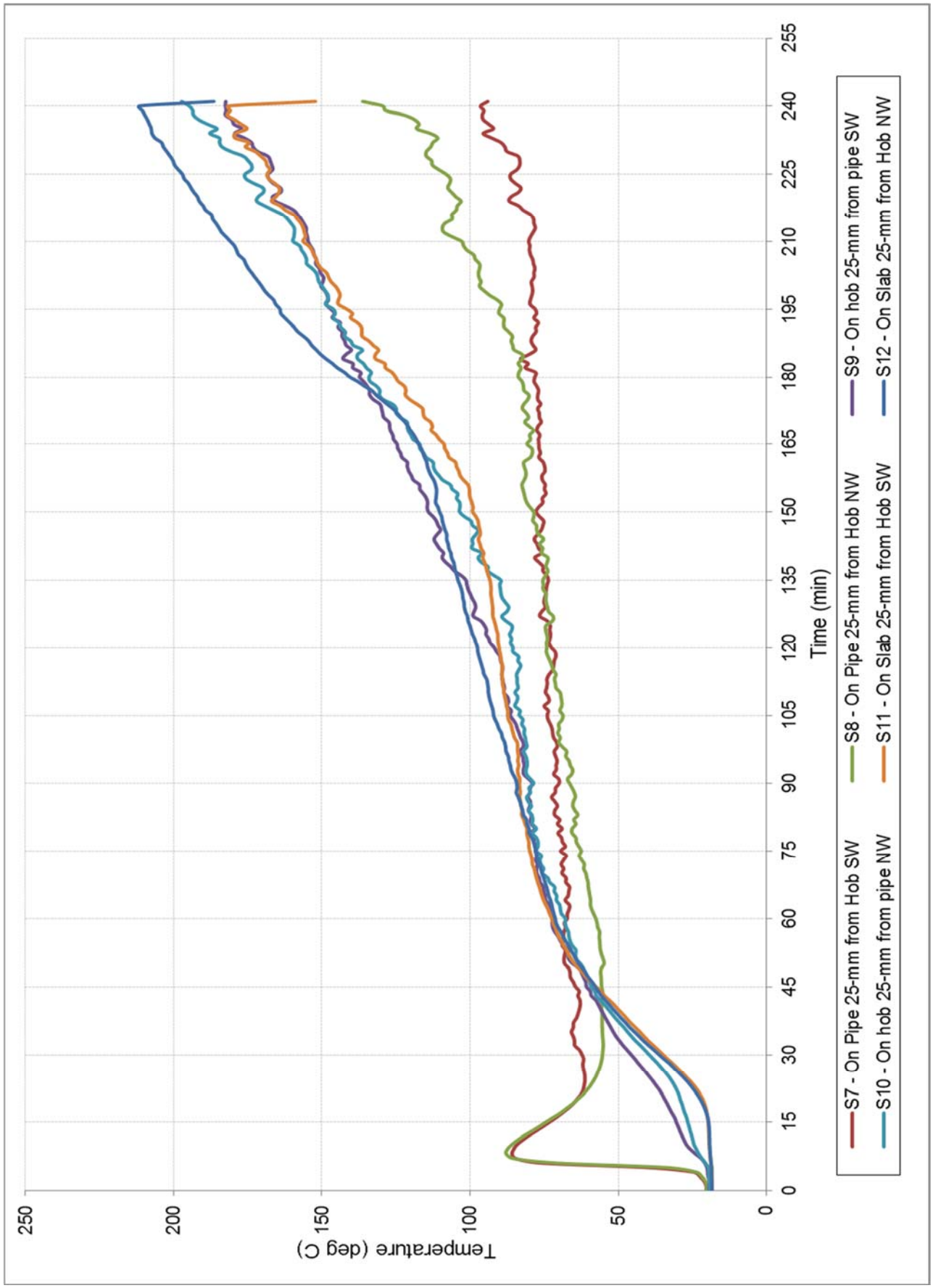
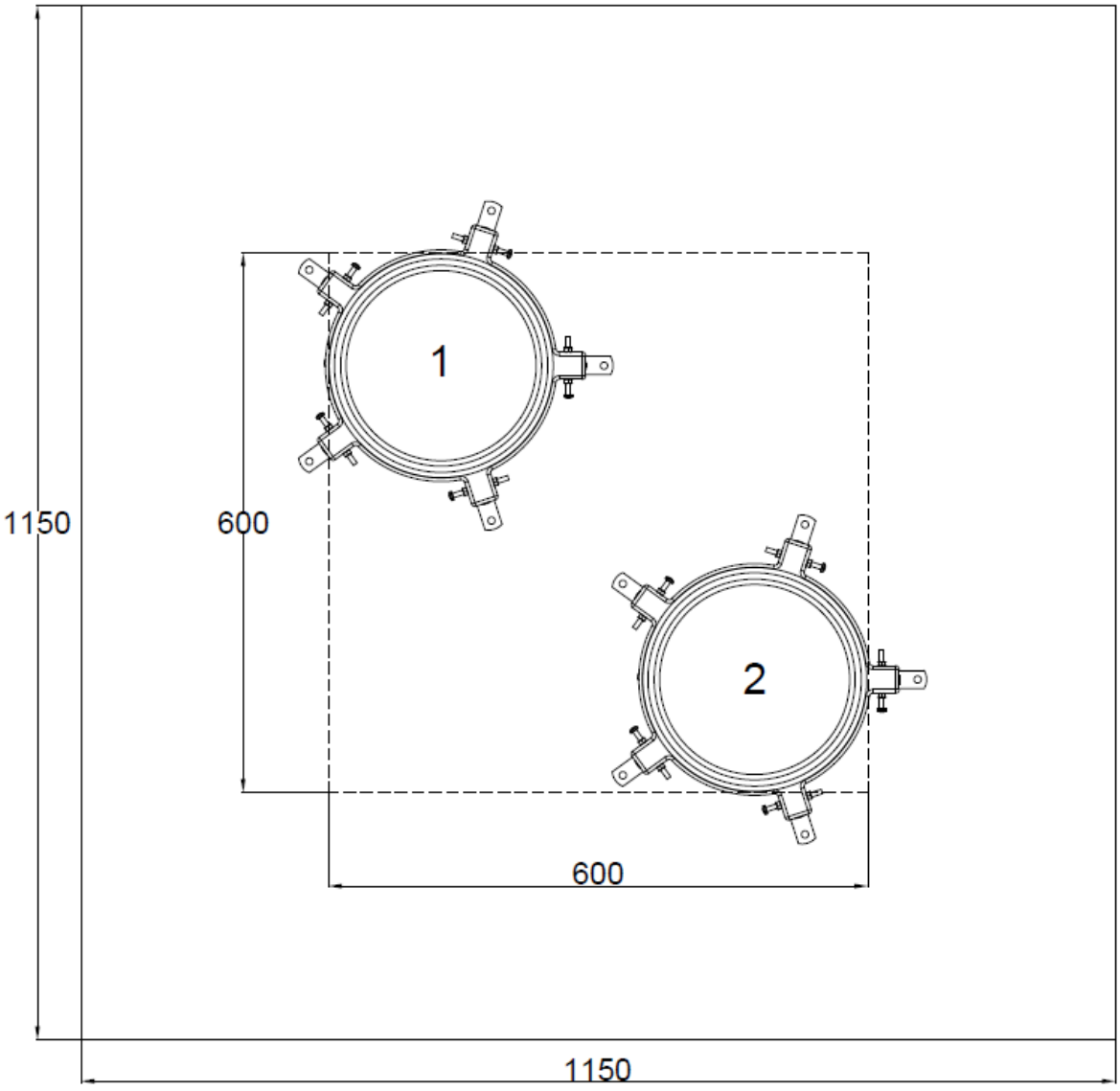


FIGURE 4 – SPECIMEN TEMPERATURE – ASSOCIATED WITH SPECIMEN # 2

Appendix D – Installation drawings

Snap Fire Systems Pty Ltd
Test Slab S-18-I Layout
Date: 16 AUG 2018



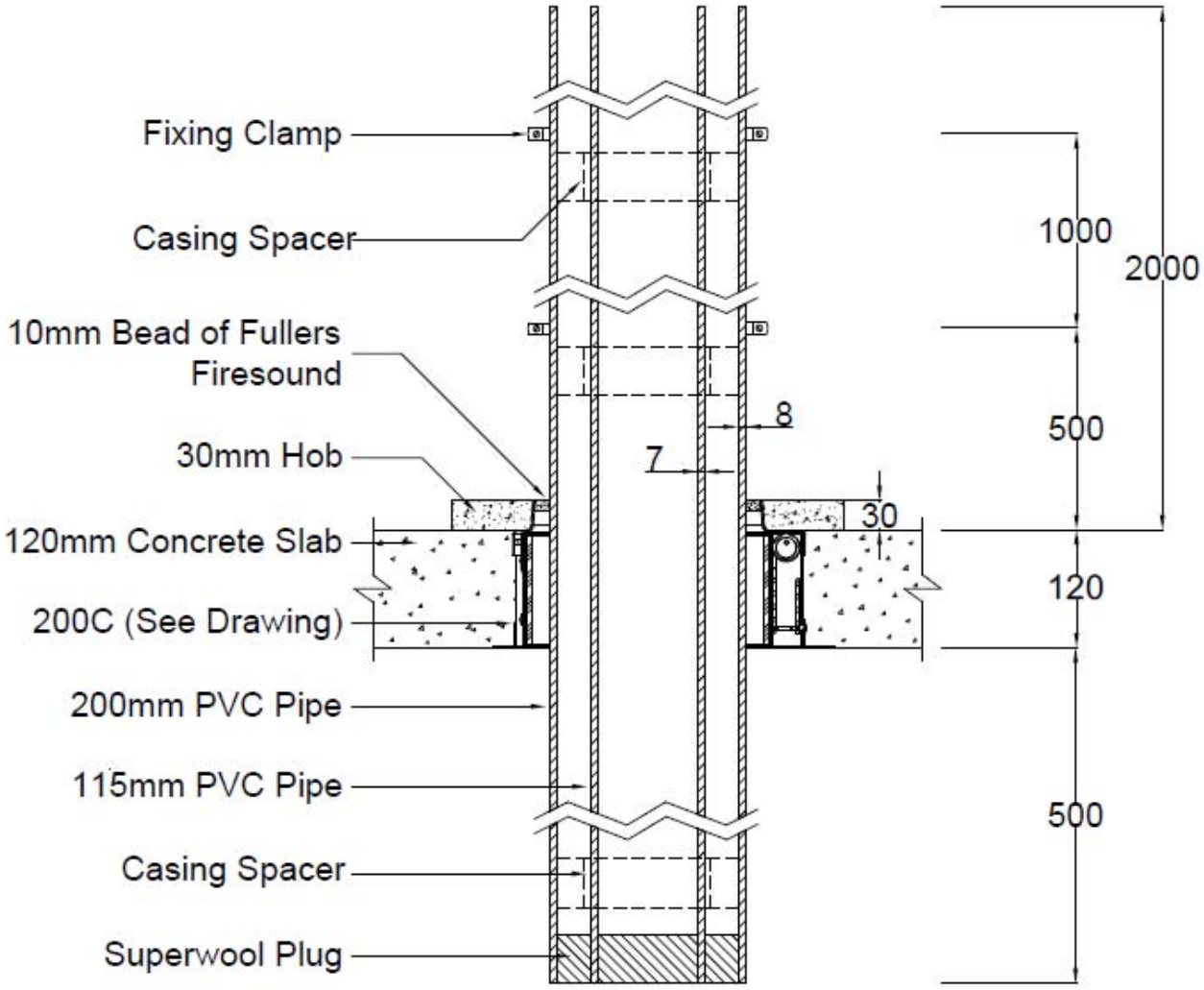
1: 200C

2: 200C

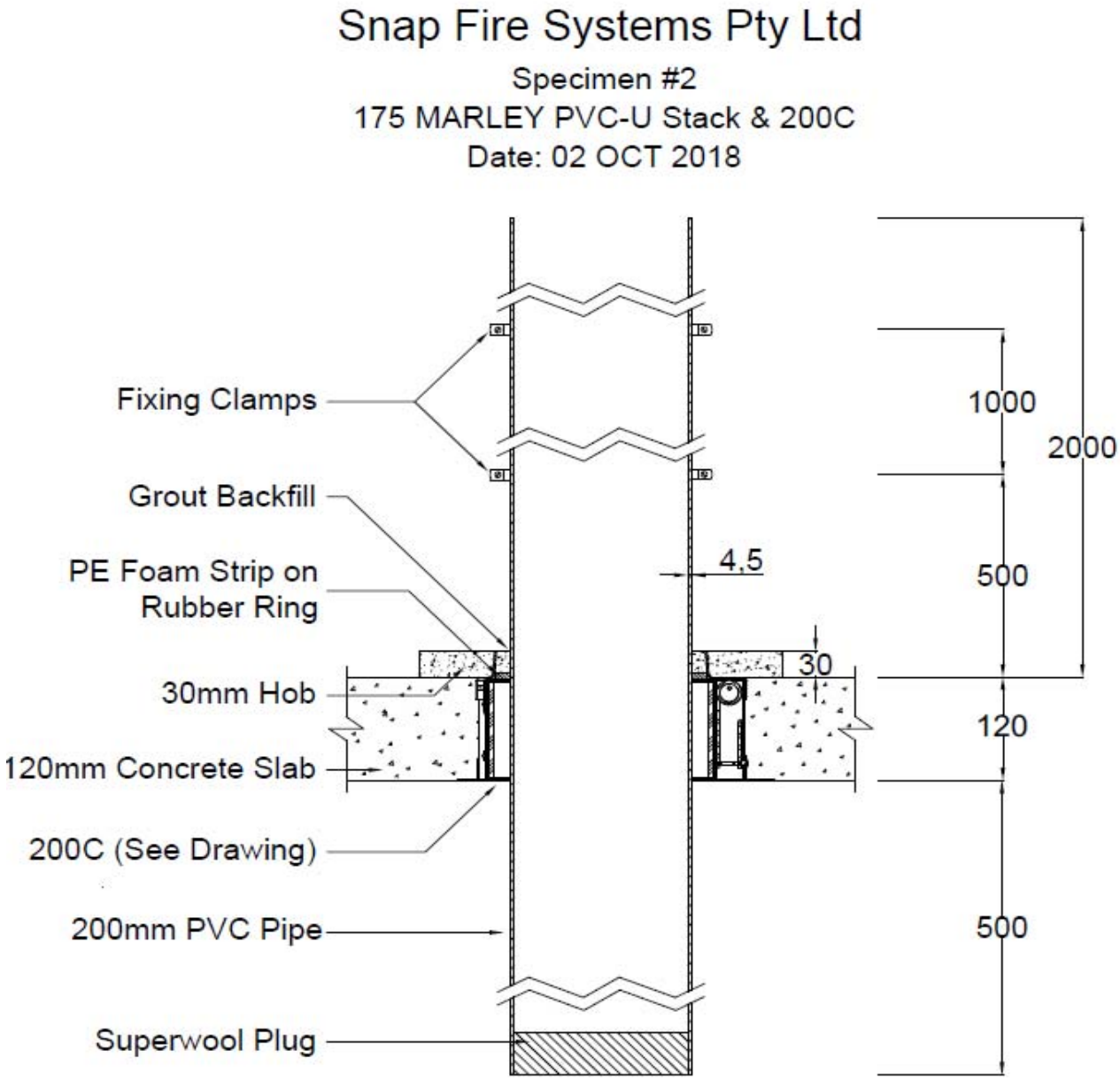
DRAWING TITLED "TEST SLAB S-18-I LAYOUT", DATED 16 AUGUST 2018, BY SNAP FIRE SYSTEMS PTY LTD.

Snap Fire Systems Pty Ltd

Specimen #1
200 IPEX PVC Outer Pipe
115 IPEX PVC Inner Pipe & 200C
Date: 02 OCT 2018

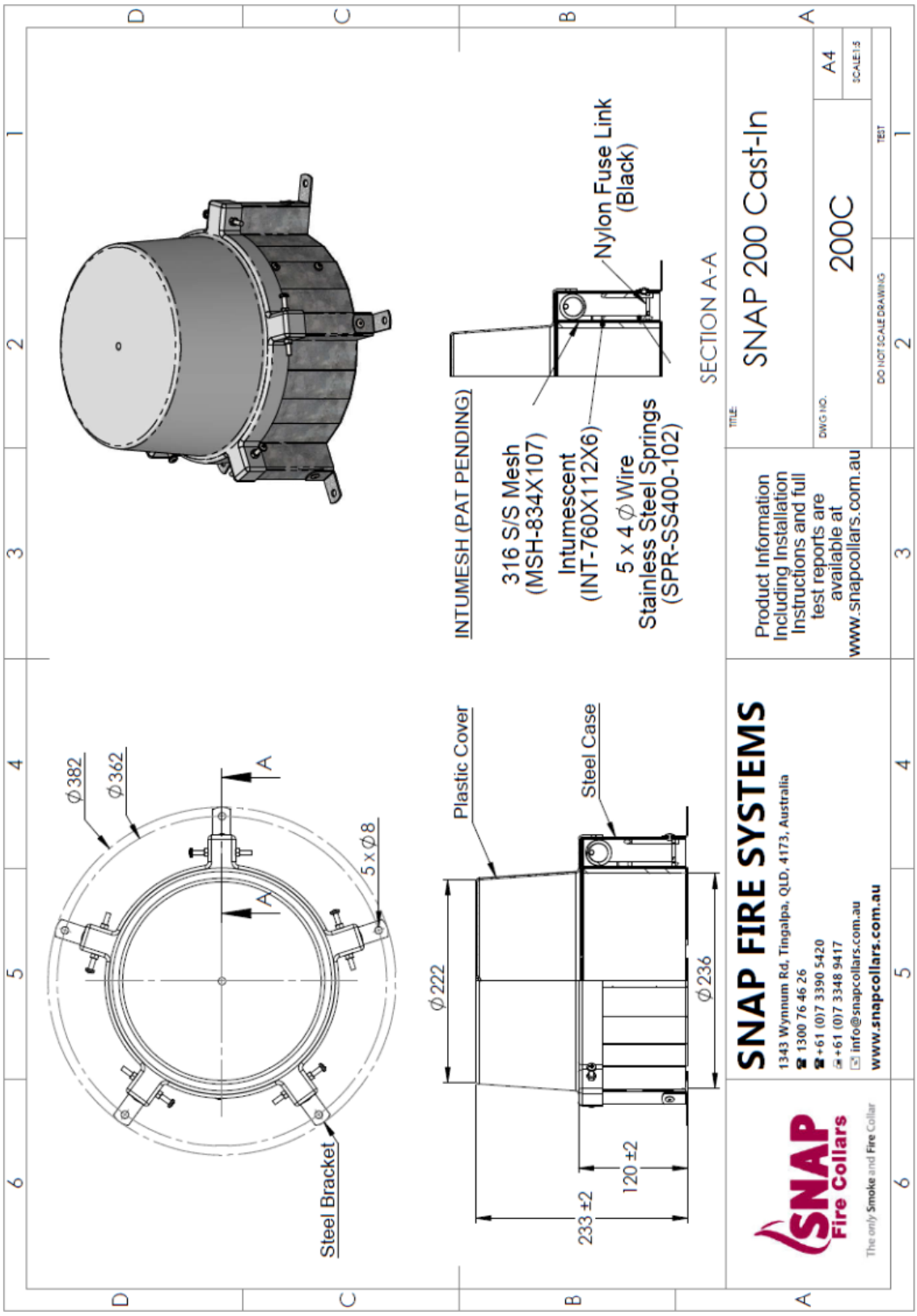


DRAWING TITLED "SPECIMEN #1, 200 IPEX PVC OUTER PIPE 115 IPEX PVC INNER PIPE AND 200C", DATED OCTOBER 2018, PROVIDED BY SNAP FIRE SYSTEMS PTY LTD.



DRAWING TITLED "SPECIMEN #2, 100-MM PVC FLOORWASTE & H100FWS-RR", DATED 28 FEBRUARY 2018, PROVIDED BY SNAP FIRE SYSTEMS PTY LTD.

Appendix E – Specimen Drawings



DRAWING NUMBERED 200C, TITLE "SNAP 200 CAST-IN" RECEIVED 9 NOVEMBER 2018, BY SNAP FIRE SYSTEMS PTY LTD

Appendix F – Certificate(s) of Test

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PO Box 52, North Ryde NSW 1670, Australia
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Certificate of Test

No. 3186

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 (Section 10, Service penetrations and control joints), on behalf of:

IG6 Pty Ltd as trustee for the IG6 IP Trust
3 Skirmish Court
Victoria Point Qld 4165

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSP 1949.

Product Name: 200C Cast-in fire collar protecting a nominal 200 (outer) and 100 (inner) Polyvinyl Chloride (PVC) stack pipes.

Description: The specimen comprised an 1150-mm x 1150-mm x 120-mm thick reinforced concrete slab penetrated by a PVC stack pipe protected by a cast in fire collar. The SNAP 200C cast-in fire collar comprised a 3-mm ABS Haircell cover attached to a 0.75-mm thick steel casing with a 250 mm inner diameter and a 362-mm diameter base flange. The 120-mm high casing incorporated a 760 mm x 112-mm x 6-mm thick Intumesh intumescent material. The closing mechanism comprised five stainless steel springs, nylon fuse links and a 834-mm x 107-mm stainless steel mesh, as shown in drawing number 200C, titled "SNAP 200 Cast-In", received 9 November 2018 , by Snap Fire Systems Pty Ltd. The penetrating service comprised a 200-mm (outer) and 115-mm (inner) PVC stack pipes, with a wall thicknesses of 8 mm and 7-mm respectively. The two pipes (placed one inside the other) were secured together with four sets of casting spacers at approximately 400-mm below the slab and 400-mm, 800-mm, 1350-mm and 1600-mm above the slab. Three 9-mm threaded rods were also secured through both pipes for additional support at approximately 450-mm, 1200-mm and 1800 mm above the slab. The pipes projected vertically 2000-mm above the concrete and 500 mm into the furnace chamber. The pipe was supported at 500-mm and 1250 mm from the unexposed face of the concrete slab as shown in Drawing titled "Specimen #1, 200 IPEX PVC Outer Pipe 115 IPEX PVC Inner Pipe and 200C", dated October 2018, provided by Snap Fire Systems Pty Ltd. The exposed end of both pipes were plugged with Superwool ceramic fibre.

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

Structural Adequacy	not applicable
Integrity	236 minutes
Insulation	195 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of -/180/180.

The fire-resistance level of the specimen is applicable when the system is exposed to fire from the same 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: Peter Gordon Date of Test: 8 October 2018

Issued on the 13th day of December 2018 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. 3186

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Certificate of Test

No. 3187

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 (Section 10, Service penetrations and control joints), on behalf of:

IG6 Pty Ltd as trustee for the IG6 IP Trust
3 Skirmish Court
Victoria Point Qld 4165

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSP 1949.

Product Name: 200C cast-in fire collar protecting a nominal 175 Polyvinyl Chloride (PVC) stack pipe.

Description: The specimen comprised an 1150-mm x 1150-mm x 120-mm thick reinforced concrete slab penetrated by a PVC stack pipe protected by a cast in fire collar. The SNAP 200C cast-in fire collar comprised a 3-mm ABS Haircell cover attached to a 0.75-mm thick steel casing with a 250 mm inner diameter and a 362-mm diameter base flange. The 120-mm high casing incorporated a 760 mm x 112-mm x 6-mm thick Intumesh intumescent material. The closing mechanism comprised five stainless steel springs, nylon fuse links and a 834-mm x 107-mm stainless steel mesh, as shown in drawing number 200C, titled "SNAP 200 Cast-in", received 9 November 2018 , by Snap Fire Systems Pty Ltd. The penetrating service comprised a 200-mm PVC stack pipe, with a wall thickness of 4.5 mm. 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 "Specimen #2, 175 MARLEY PVC-U Stack and 200C", dated October 2018, provided by Snap Fire Systems Pty Ltd. On the exposed end, the pipe was plugged with Superwool ceramic fibre.

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

Structural Adequacy	not applicable
Integrity	no failure at 241 minutes
Insulation	227 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 specimen is applicable when the system is exposed to fire from the same 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: Peter Gordon Date of Test: 8 October 2018

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B. Roddy

Brett Roddy
Manager, Fire Testing and Assessments

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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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