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

Test Report

Author: Mario Lara-Ledermann
Report number: FSP 1715
Date: 29 October 2015

Client: Snap Fire Systems Pty Ltd

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Report Status and Revision History:

VERSION	STATUS	DATE	DISTRIBUTION	ISSUE NUMBER
Revision A	Final for issue	13/11/2015	CSIRO/SNAP	FSP 1715

Report Authorization:

AUTHOR	REVIEWED BY	AUTHORISED BY
Mario Lara-Ledermann	Brett Roddy	Brett Roddy
		
13 November 2015	13 November 2015	13 November 2015

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Important disclaimer

Contents

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

Sponsored Investigation No. FSP 1715

1 Introduction

1.1 Identification of specimen

The sponsor identified the specimen as Snap Cast-in Fire Collars protecting a concrete beam and slab penetrated by one (1) Floorwaste and one (1) Stack pipe.

1.2 Sponsor

Snap Fire Systems Pty Ltd
Unit 2/160 Redland Bay Road
CAPALABA QLD

1.3 Manufacturer

Snap Fire Systems Pty Ltd
Unit 2/160 Redland Bay Road
CAPALABA QLD

1.4 Test standard

Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4-2005, 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 4505/3884

1.7 Test date

The fire-resistance test was conducted on 29 July 2015.

2 Purpose of the test

The purpose of the test is to evaluate the effect of a plastic pipe penetration though a concrete slab in conjunction with a concrete beam.

3 Description of specimen

3.1 General

The specimen comprised a 1200-mm x 1200-mm x 420-mm thick concrete beam and slab penetrated by one (1) Vinidex Floorwaste and one (1) Vinidex Stack pipe protected by cast-in Snap Fire System fire collars.

The pipes used in the test are stated to be manufactured in accordance with AS/NZS 1260 - PVC-U pipes and fittings for drain, waste and vent application.

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

Penetration 1 – H100 S-RR cast-in fire collar protecting a 110-mm diameter Stack pipe

The SNAP Cast-in H100 S-RR fire collar comprised a 1.6-mm thick polypropylene casing with an 119-mm inner diameter and a 213-mm diameter base flange. The 250-mm high collar casing incorporated a 412-mm x 85-mm x 4-mm thick Intumesh intumescent material and a rubber ring seal. The closing mechanism comprised three galvanised steel springs bound with a nylon fuse link (natural) and a 460-mm x 85-mm stainless steel mesh as shown in drawing numbered H100S-RR-T dated 29 September 2015, by SNAP Fire Systems Pty Ltd. The collar was cast in the concrete beam horizontally as shown in Photograph # 1.

The penetrating service comprised a 110-mm Vinidex Stack pipe, with a wall thickness of 3.4-mm fitted through the collar's sleeve. The pipe projected vertically 2000-mm above the concrete and 300-mm horizontally into the furnace chamber as shown in drawing titled "Penetration #1 - PVC-SC (110-mm Ø) Stack", dated 12 August 2015, by Snap Fire Systems Pty Ltd. The pipe was supported at 500-mm and 1000-mm from the unexposed face of the concrete slab.

On the exposed side of the slab, a 110-mm PVC 90° elbow was connected to the penetrating pipe within the concrete beam and slab. The elbow was supported by an M10 HKD clamp fixed to the concrete slab as shown in drawing titled "Penetration #1 - PVC-SC (110-mm Ø) Stack", dated 12 August 2015, by Snap Fire Systems Pty Ltd. On the exposed end, the pipe was capped with a PVC End Cap.

Penetration 2 – L100FWS cast-in fire collar protecting a 110-mm diameter PVC-SC Floor waste

The SNAP Cast-in L100FWS fire collar comprised a 1.6-mm thick polypropylene casing with an 110-mm inner diameter and a 213-mm diameter base flange. The 105-mm high collar casing incorporated a 412-mm x 85-mm x 4-mm thick Intumesh intumescent material and a rubber ring seal. The closing mechanism comprised three stainless steel springs bound with nylon fuse link (black) and a 460-mm x 85-mm stainless steel mesh as shown in drawing numbered L100FWS-T dated 29 September 2015, by SNAP Fire Systems Pty Ltd. The collar was cast in the concrete beam horizontally as shown in Photograph # 1.

The penetrating service comprised a 110-mm Vinidex pipe, with a wall thickness of 3.4-mm fitted through the collar's sleeve. The floor waste system was fitted on the unexposed face with a Chrome brass floor waste grate. On the exposed side of the slab, a Vinidex 110-mm PVC Teap was connected to the penetrating pipe within the concrete beam and slab. The elbow was supported by a M10 HKD clamp fixed to the concrete slab as shown in drawing titled "Penetration #2 – PVC-SC (110-mm Ø) Floorwaste" dated 12 August 2015, by Snap Fire Systems Pty Ltd.

The trap was filled with water before the start of the test to the level shown in drawing titled "Penetration #2 – PVC-SC (110-mm Ø) Floorwaste" dated 12 August 2015, by Snap Fire Systems Pty Ltd.

3.2 Dimensions

The overall dimension of the concrete beam and slab was 1200-mm wide x 1200-mm long x 420-mm thick, to suit the opening in the specimen containing frame.

3.3 Orientation

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

3.4 Conditioning

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

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

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

4 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 titled "Penetration #1 - PVC-SC (110-mm Ø) Stack", dated 12 August 2015, by Snap Fire Systems Pty Ltd.

Drawing titled "Penetration #2 – PVC-SC (110-mm Ø) Floorwaste", dated 12 August 2015, by Snap Fire Systems Pty Ltd.

Drawing numbered L100FWS-T, dated 29 September 2015, by Snap Fire Systems Pty Ltd.

Drawing numbered H100S-RR-T, dated 29 September 2015, by Snap Fire Systems Pty Ltd.

5 Equipment

5.1 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 1530.4-2005 and was heated by combustion of a mixture of natural gas and air.

5.2 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.

5.3 Measurement system

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

6 Ambient temperature

The temperature of the test area was 21°C at the commencement of the test.

7 Departure from standard

The projection of the services into the furnace was 300-mm. This differs from the minimum requirement of 500-mm projection of service into the furnace as required by clause 10.4.2 of AS 1530.4-2005. It is considered that this deviation did not affect the test outcome.

The severity of the furnace was below the low limit stated in clause 2.10.2.2 of AS 1530.4-2005, between 0 and 139 minutes. Given the temperature dependency in the activation of the penetration sealing systems, it is considered that a lower temperature exposure will delay the activation of the intumescent and springs of the fire collar and therefore test conditions are more severe for the tested type of sealing system.

8 Termination of test

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

9 Test results

9.1 Critical observations

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

Time	Observation
2 minutes -	Smoke is fluing from the end of Penetration # 1.
7 minutes -	Spalling sounds can be heard coming from the specimen.
9 minutes -	The base of Penetration # 1 is derforming. The pipe has separated from its extension so leakage is evident and fluing from the end continues, therefore stack effect has not been altered.
11 minutes -	The smoke fluing from Penetration # 1 has decreased.
30 minutes -	Spalling sounds from specimen noted at 7 minutes are no longer audible.
60 minutes -	Moisture is visible on the unexposed face of the slab. Steam is emitted from the specimen.
80 minutes -	Smoke is fluing from the end of Penetration # 1.
107 minutes -	Smoke is being emitted from the end of Penetration # 2.
241 minutes -	Test terminated

9.2 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.

9.3 Furnace severity

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

9.4 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.

9.5 Performance

Performance observed in respect of the following AS 1530.4-2005 criteria:

Penetration 1 – L100 S cast-in fire collar protecting a 110-mm diameter Stack pipe

Structural adequacy	-	Not applicable
Integrity	-	No failure at 241 minutes
Insulation	-	No failure at 241 minutes

Penetration 2 – L100FWS cast-in fire collar protecting a 110-mm diameter PVC-SC Floor waste

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

10 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; and
Penetration 2	-	-/240/240;

For the purposes of AS 1530.4-2005 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.

11 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 1530.4-2005, have been made provided no individual component is removed or reduced.

12 Tested by

Mario Lara-Ledermann
Testing Officer

Appendices

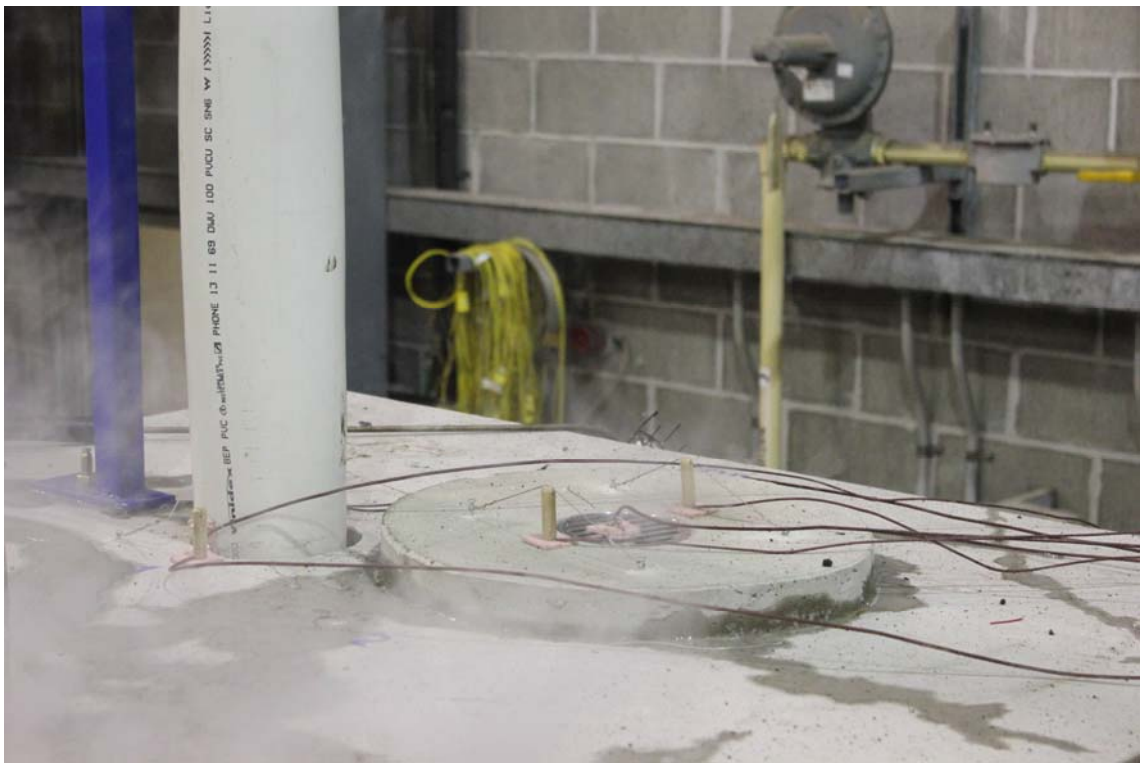
Appendix A – Measurement location

Measurement Location		
Group location	**T/C Position**	**T/C designation**
Specimen		
Penetration 1	On slab 25-mm from pipe.	S1
	On slab 25-mm from pipe.	S2
	On pipe 25-mm from slab.	S3
	On pipe 25-mm from slab.	S4
Penetration 2	On grate.	S7
	On step 25-mm from grate.	S6
	On step 25-mm from grate.	S5

Appendix B – Photographs

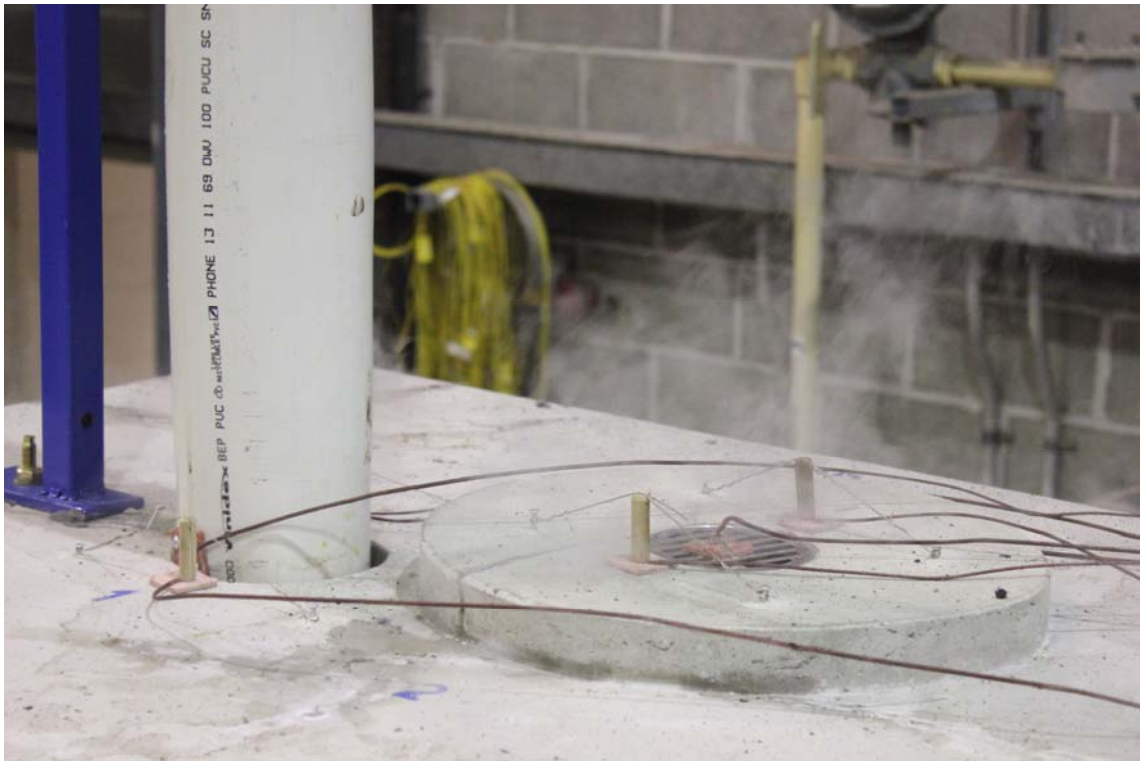
PHOTOGRAPH 1 – EXPOSED FACE OF SPECIMENS PRIOR TO TESTING

PHOTOGRAPH 2 – UNEXPOSED FACE OF SPECIMENS PRIOR TO TESTING

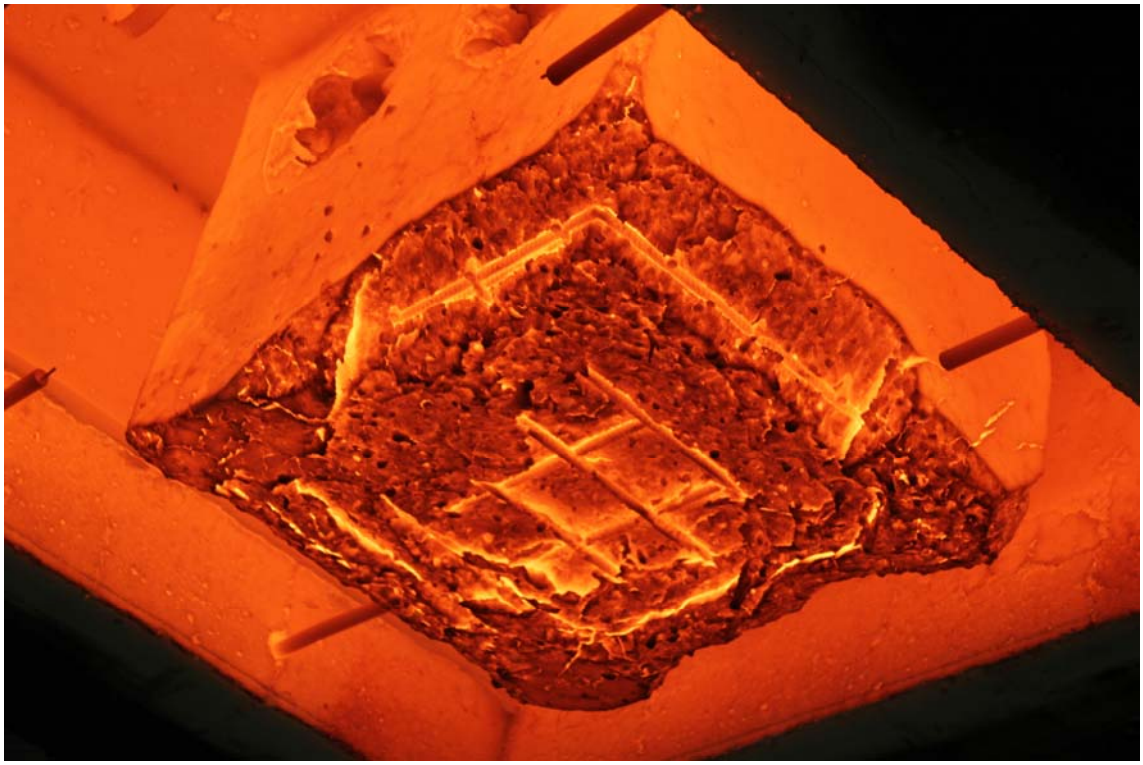


PHOTOGRAPH 3 – SPECIMENS AFTER 60 MINUTES OF TESTING

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

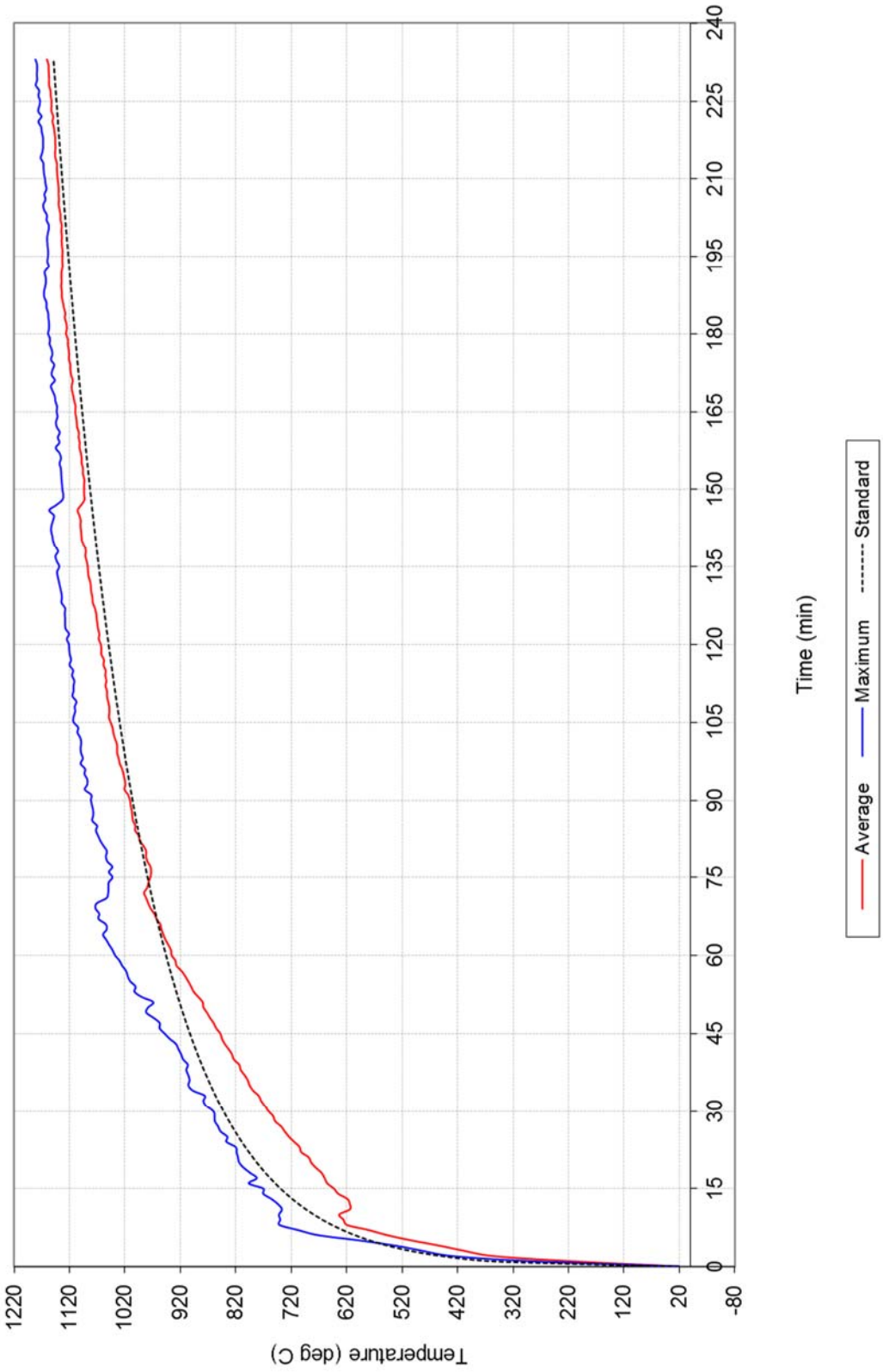


FIGURE 1 – FURNACE TEMPERATURE

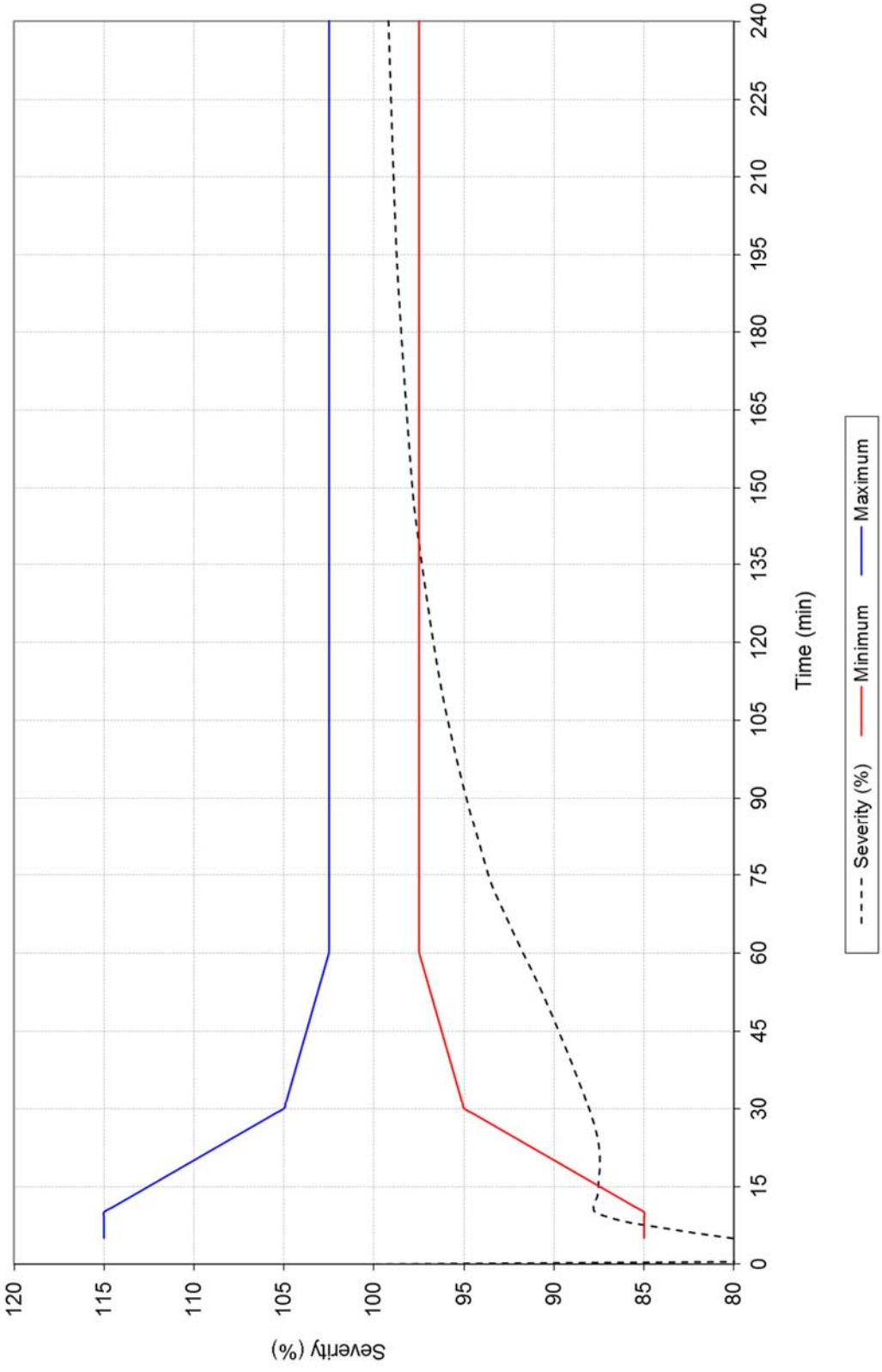


FIGURE 2 – FURNACE SEVERITY

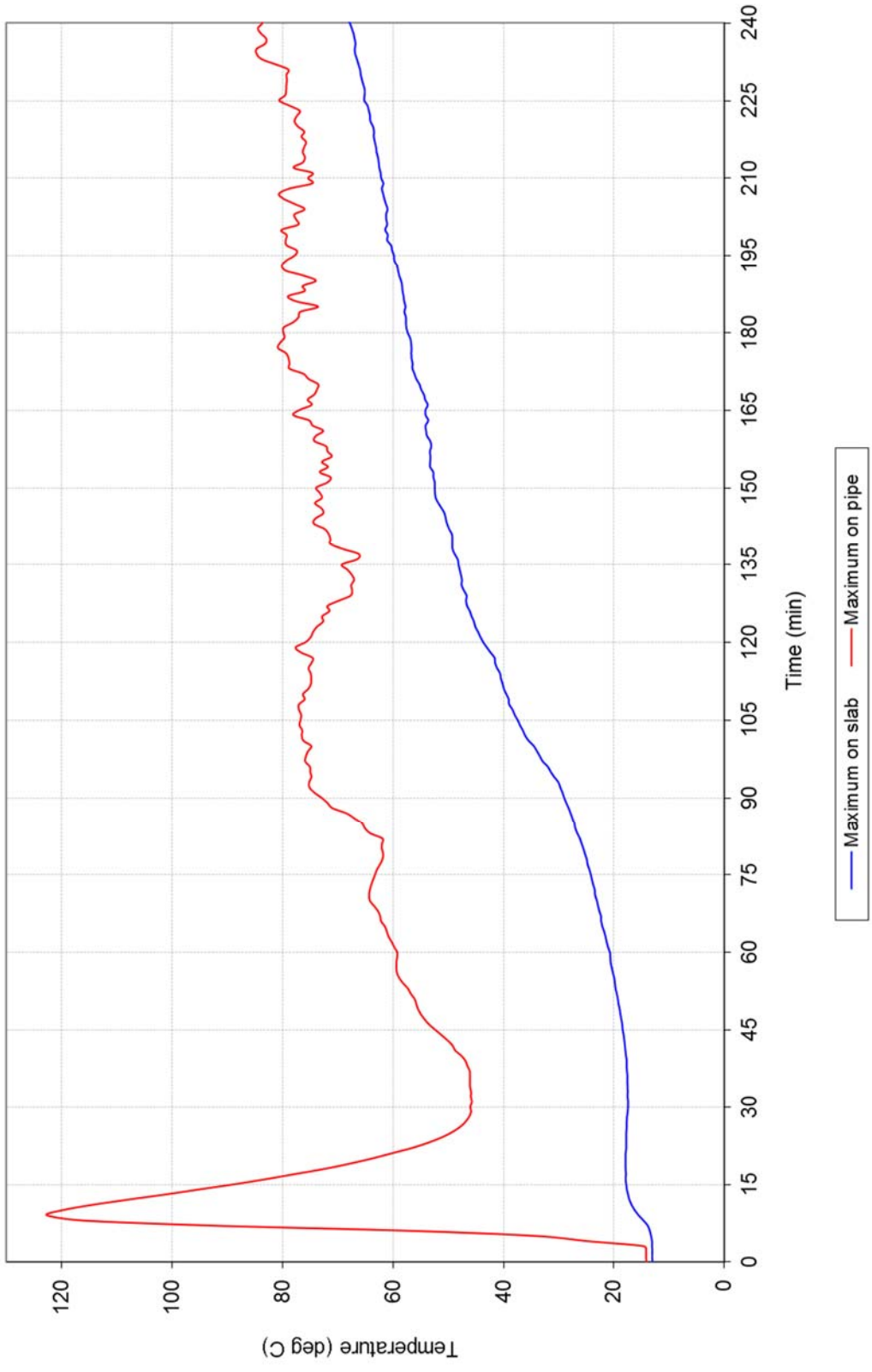


FIGURE 3 – SPECIMEN TEMPERATURE – ASSOCIATED WITH PENETRATION 1

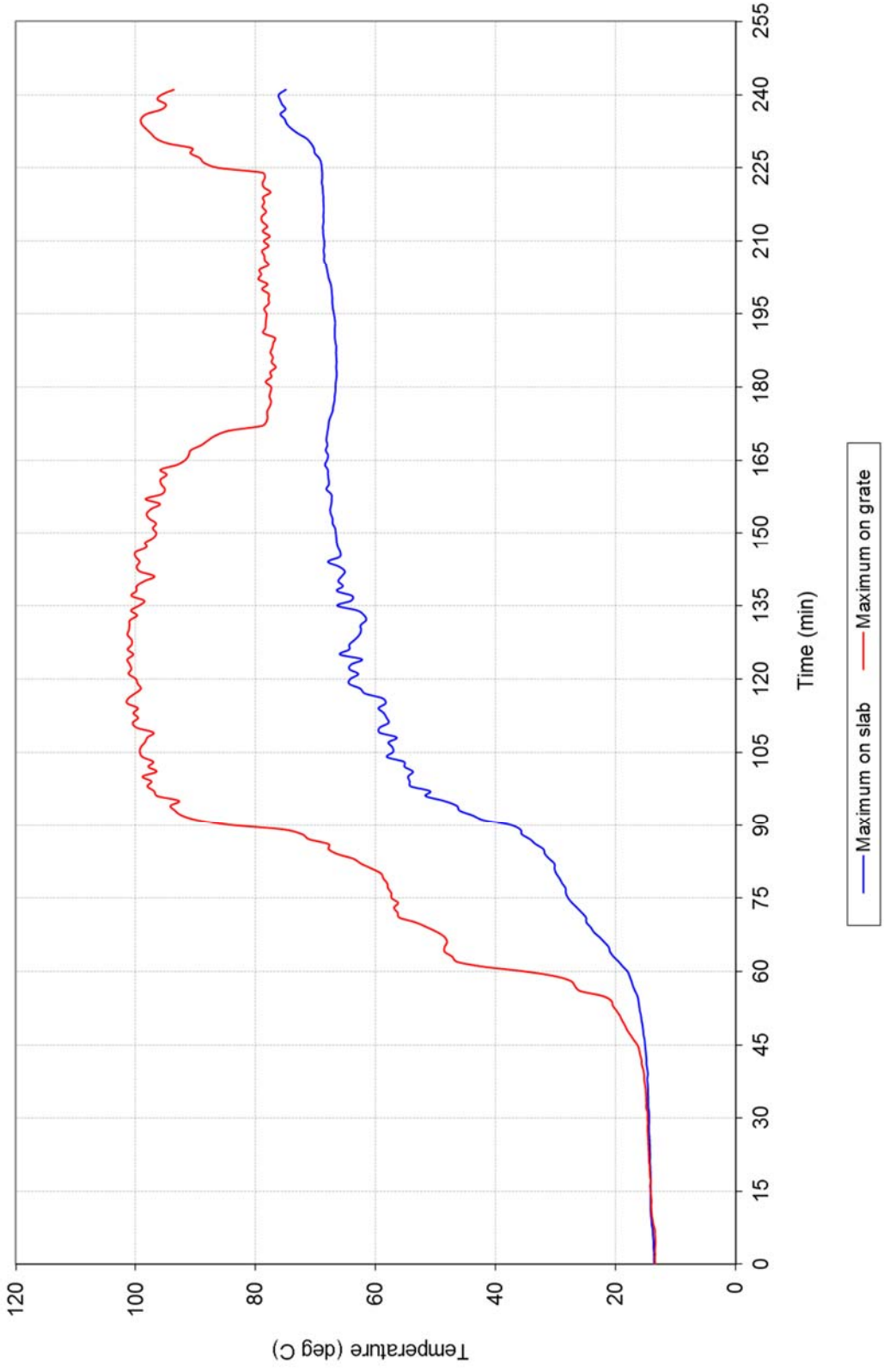
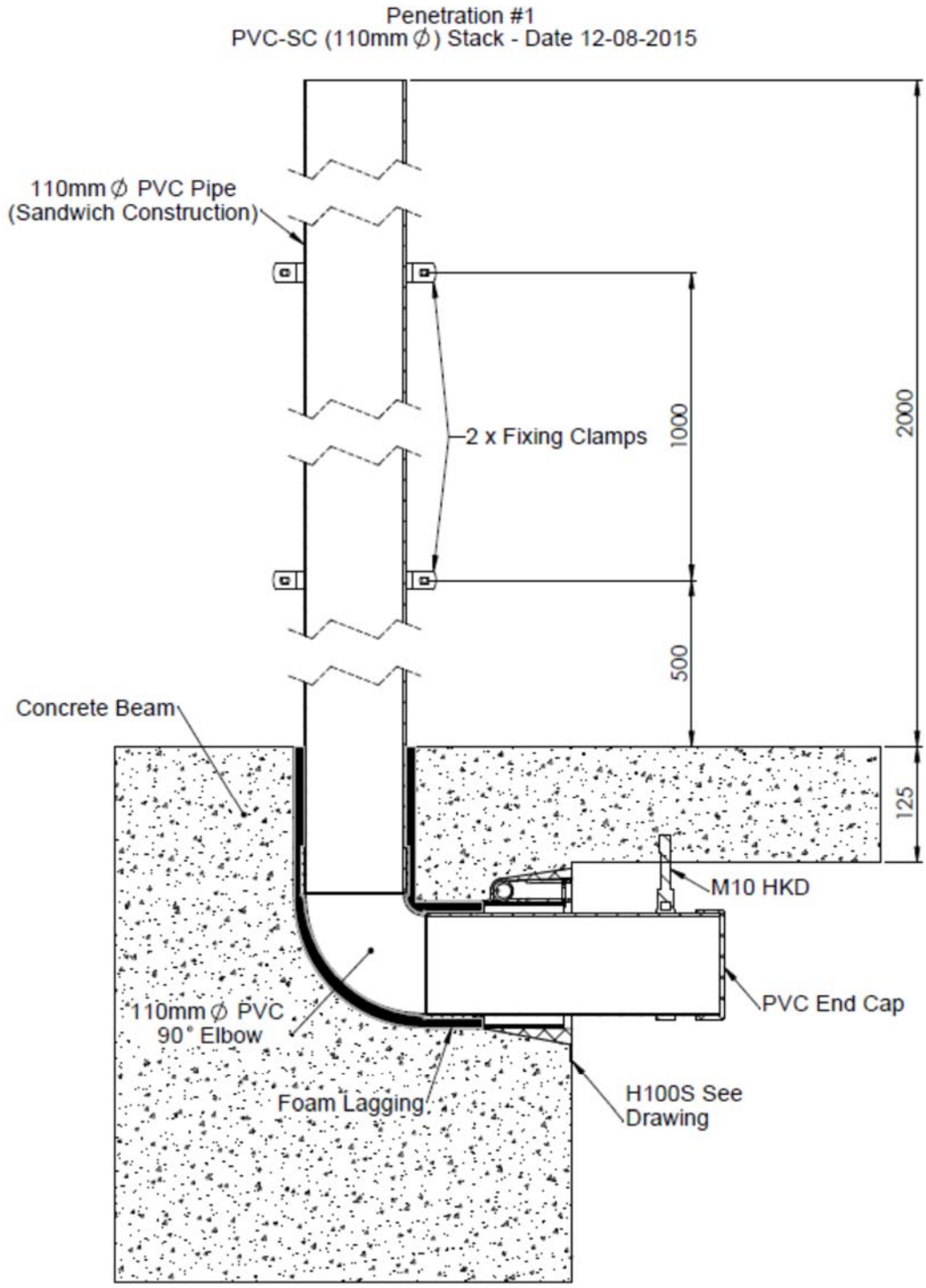


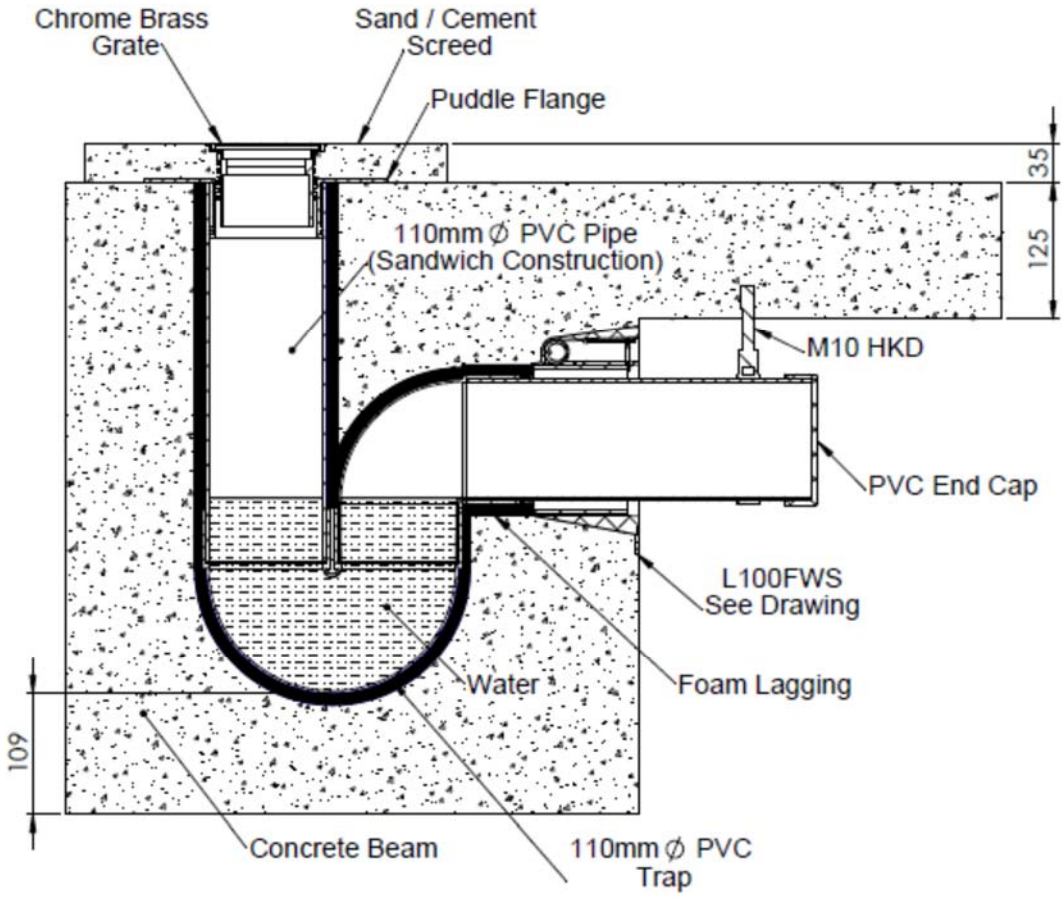
FIGURE 4 – SPECIMEN TEMPERATURE – ASSOCIATED WITH PENETRATION 2

Appendix D – Installation drawings



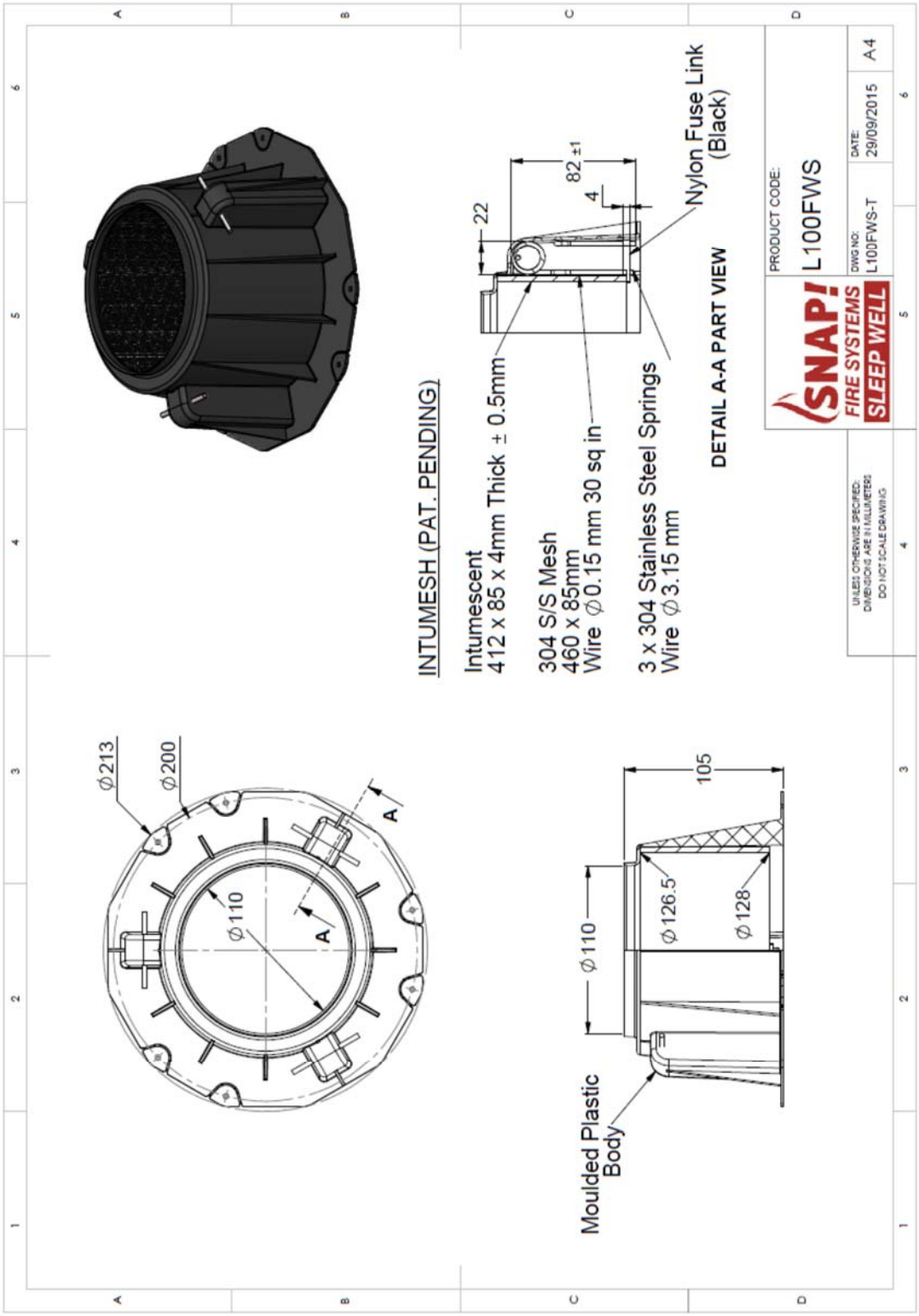
DRAWING TITLED "PENETRATION #1 - PVC-SC (110-MM Ø) STACK", DATED 12 AUGUST 2015, BY SNAP FIRE SYSTEMS PTY LTD

Penetration #2
PVC-SC (110mm ∅) Floor Waste - Date 12-08-2015

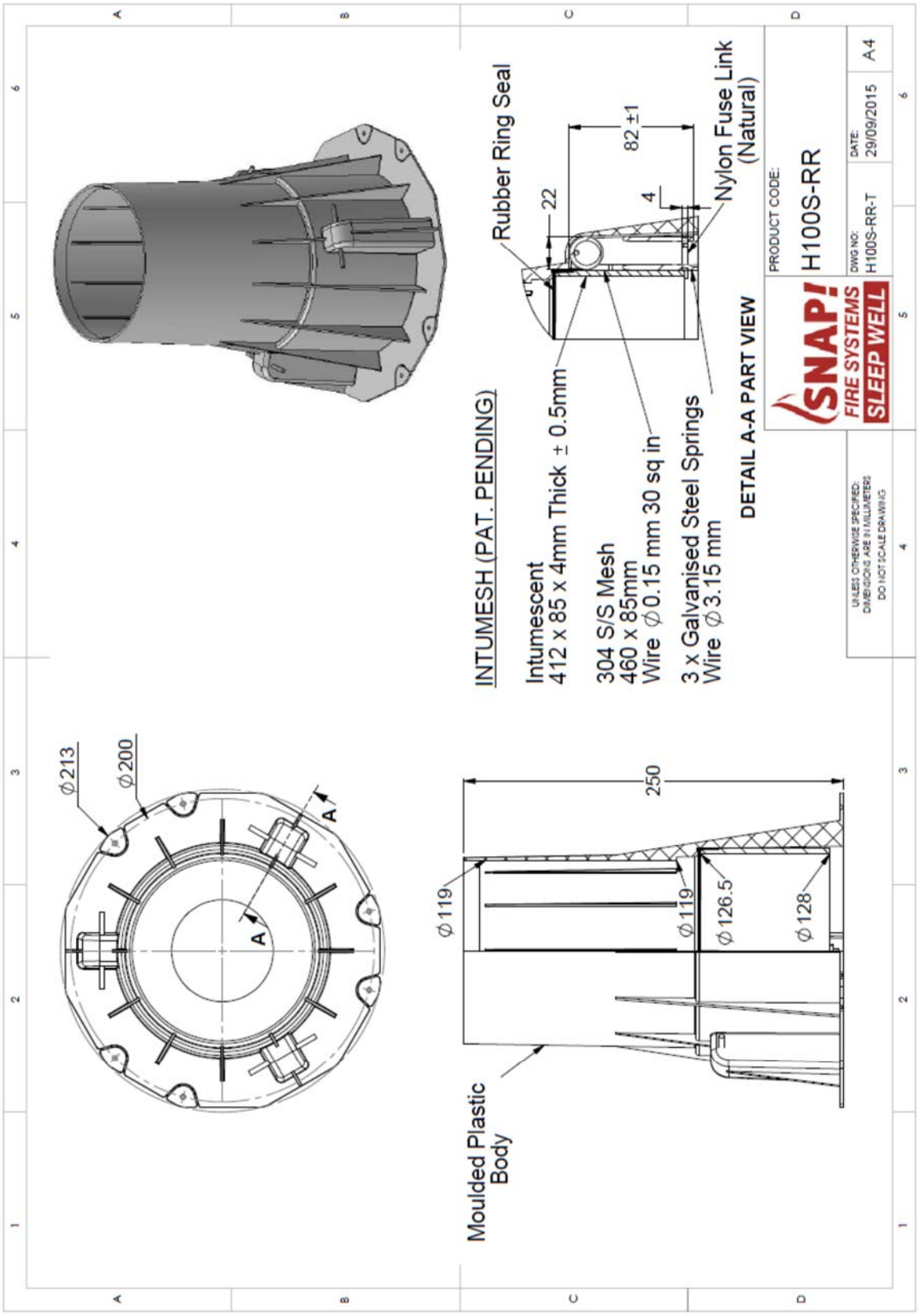


DRAWING TITLED "PENETRATION #2 – PVC-SC (110-MM Ø) FLOORWASTE" DATED 12 AUGUST 2015, BY SNAP FIRE SYSTEMS PTY LTD.

Appendix E – Specimen Drawings



DRAWING NUMBERED L100FWS-T DATED 29 SEPTEMBER 2015, BY SNAP FIRE SYSTEMS PTY LTD



DRAWING NUMBERED H100S-RR-T DATED 29 SEPTEMBER 2015, BY SNAP FIRE SYSTEMS PTY LTD

Appendix F – Certificates

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www.csiro.au

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

Certificate of Test

No. 2657

This is to certify that the element of construction described below was tested by the CSIRO Division of Materials Science and Engineering in accordance with Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4-2005 on behalf of:

Snap Fire Systems Pty Ltd
Unit 2/160 Redland Bay Road
CAPALABA QLD

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSP 1715.

Product Name: Penetration 1 – H100 S-RR cast-in fire collar protecting a 110-mm diameter Stack pipe

Description: The SNAP Cast-in H100 S-RR fire collar comprised a 1.6-mm thick polypropylene casing with an 119 mm inner diameter and a 213-mm diameter base flange. The 250-mm high collar casing incorporated a 412-mm x 85 mm x 4-mm thick Intumesh intumescent material and a rubber ring seal. The closing mechanism comprised three galvanised steel springs bound with a nylon fuse link (natural) and a 460 mm x 85-mm stainless steel mesh as shown in drawing numbered H100S-RR-T dated 29 September 2015, by SNAP Fire Systems Pty Ltd. The collar was cast in the concrete beam horizontally as shown in Photograph # 1. The penetrating service comprised a 110-mm Vinidex Stack pipe, with a wall thickness of 3.4-mm fitted through the collar's sleeve. The pipe projected vertically 2000-mm above the concrete and 300 mm horizontally into the furnace chamber as shown in drawing titled "Penetration #1 - PVC-SC (110-mm Ø) Stack", dated 12 August 2015, by Snap Fire Systems Pty Ltd. The pipe was supported at 500-mm and 1000 mm from the unexposed face of the concrete slab. On the exposed side of the slab, a 110-mm PVC 90° elbow was connected to the penetrating pipe within the concrete beam and slab. The elbow was supported by an M10 HKD clamp fixed to the concrete slab as shown in drawing titled "Penetration #1 - PVC-SC (110-mm Ø) Stack", dated 12 August 2015, by Snap Fire Systems Pty Ltd. On the exposed end, the pipe was capped with a PVC End Cap.

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 FRL is applicable for exposure to the fire from the same direction as tested.

This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Mario Lara-Ledermann Date of Test: 29 July 2015

Issued on the 13th day of November 2015 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
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COPY OF CERTIFICATE OF TEST – NO. 2657

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

Certificate of Test

No. 2658

This is to certify that the element of construction described below was tested by the CSIRO Division of Materials Science and Engineering in accordance with Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4-2005 on behalf of:

Snap Fire Systems Pty Ltd
Unit 2/160 Redland Bay Road
CAPALABA QLD

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSP 1715.

Product Name: Penetration 2 – L100FWS cast-in fire collar protecting a 110-mm diameter PVC-SC Floor waste

Description: The SNAP Cast-in L100FWS fire collar comprised a 1.6-mm thick polypropylene casing with an 110 mm inner diameter and a 213-mm diameter base flange. The 105-mm high collar casing incorporated a 412-mm x 85 mm x 4-mm thick Intumesh intumescent material and a rubber ring seal. The closing mechanism comprised three stainless steel springs bound with nylon fuse link (black) and a 460 mm x 85-mm stainless steel mesh as shown in drawing numbered L100FWS-T dated 29 September 2015, by SNAP Fire Systems Pty Ltd. The collar was cast in the concrete beam horizontally as shown in Photograph # 1. The penetrating service comprised a 110-mm Vinidex pipe, with a wall thickness of 3.4-mm fitted through the collar's sleeve. The floor waste system was fitted on the unexposed face with a Chrome brass floor waste grate. On the exposed side of the slab, a Vinidex 110-mm PVC Teap was connected to the penetrating pipe within the concrete beam and slab. The elbow was supported by a M10 HKD clamp fixed to the concrete slab as shown in drawing titled "Penetration #2 – PVC-SC (110-mm Ø) Floorwaste" dated 12 August 2015, by Snap Fire Systems Pty Ltd. The trap was filled with water before the start of the test to the level shown in drawing titled "Penetration #2 – PVC-SC (110-mm Ø) Floorwaste" dated 12 August 2015, 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 FRL is applicable for exposure to the fire from the same direction as tested.

This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Mario Lara-Ledermann Date of Test: 29 July 2015

Issued on the 13th day of November 2015 without alterations or additions.

B. Roddy

Brett Roddy
Manager, Fire Testing and Assessments

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COPY OF CERTIFICATE OF TEST – NO. 2658

References

The following informative documents are referred to in this Report:

AS 1530.4-2005	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.

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