

Fire-resistance test on services penetrating a Shaftliner wall system

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Commercial-in-confidence




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Fire-resistance test on services penetrating a Shaftliner wall system

Sponsored Investigation No. FSP 2054

1 Introduction

1.1 Identification of specimen

The sponsor identified the test specimens as four (4) services penetrating a Knauf Shaftliner wall system protected by various fire stopping systems.

1.2 Sponsor

Knauf Plasterboard Pty Limited
31 Military Road
Matraville, NSW 2036

1.3 Manufacturer

Knauf Plasterboard Pty Limited
31 Military Road
Matraville, NSW

BOSS Products (Australia) Pty Ltd
Unit 8, 15-23 Kumulla Rd
Caringbah NSW

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 4924/4437

1.7 Test date

The fire-resistance test was conducted on 23rd October 2019.

2 Description of specimen




2.1 General

The specimens comprised a PE-Xa Rehau Rautitan Pipe, a PVC pipe, a single lagged copper pipe and a SHS 65-mm x 65-mm x 6-mm thick support arm penetrating the exposed face of the Knauf Shaftliner wall system.


The penetrated wall consisted of a 128-mm thick plasterboard lined framed wall system comprising 25-mm thick Knauf Shaftliner board on the exposed side and two layers of 13-mm thick Knauf Fireshield plasterboard on the unexposed side of the 102 mm x 0.55 BMT CH-stud wall framing. The wall cavity was filled with 75-mm thick Knauf Earthwool (density of 11 kg/m³). The FRL of the Knauf Shaftliner wall system has not been verified by the test sponsor.

Specimen No.	Penetration details
1	A 20-mm diameter PE-Xa Rehau Rautitan pipe penetrating a 55-mm diameter aperture on the unexposed face protected with FireMastic HPE sealant.
2	A 43-mm diameter PVC pipe penetrating a 55-mm diameter aperture on the unexposed face protected with FireMastic HPE sealant.
3	A lagged 38.5-mm diameter copper penetrating a 127-mm diameter aperture protected with Knauf Bindex Fire and Acoustic sealant.
4	A SHS 65-mm x 65-mm x 6-mm thick support arm penetrating the unexposed face of the wall through a 75-mm x 75-mm square opening protected with Knauf Bindex Fire and Acoustic sealant and 13-mm thick Fireshield.



Specimen 1 – A 20-mm diameter PE-Xa Rehau Rautitan pipe penetrating a 55-mm diameter aperture on the unexposed face protected with FireMastic-HPE sealant.

SEPARATING ELEMENT	
The Knauf Shaftliner wall system comprised 25-mm thick Knauf Shaftliner on the exposed side and two layers of 2 x 13-mm thick Knauf Fireshield on the unexposed side of the 102-mm x 0.55 BMT CH-wall studs. The cavity of the wall was filled with 75-mm thick Knauf Earthwool. The FRL of the Knauf Shaftliner wall system had not been verified by the test sponsor.	
TYPE AND SIZE OF CONSTRUCTION	
A 55-mm diameter aperture on the unexposed side of a 128-mm thick wall.	
PENETRATING SERVICE	
Description	A single PE-Xa Rehau Rautitan pipe incorporating a 90° elbow joint.
Size	A 20-mm OD pipe, with a 2.8-mm wall thickness incorporating a Rehau PX No.12 90 Degree elbow. The pipe extended 2000-mm away from the unexposed face and approximately 500-mm upwards inside the wall cavity.
End conditions	Pipe was plugged on the exposed side with ceramic fibre and left open inside the wall cavity.
Supports	Approximately 600-mm and 1200-mm away from the wall on the unexposed face.
FIRE STOPPING SYSTEM	
Trade names	FireMastic-HPE
Manufacturers	BOSS Fire & Safety Pty Ltd
Description	FireMastic-HPE is a graphite-based, thixotropic, one part acrylic emulsion sealant.
Application	Inside the wall cavity on the fire side a 200-mm high x 600-mm wide piece of 13-mm Fireshield was fixed to the back of the Shaftliner inside the wall cavity using 10-mm x 38-mm laminating screws at 300-mm centres. A 0.8-mm BMT J-track was then fixed to the 13-mm Fireshield and wall studs with 50-mm x 50-mm x 0.7-mm BMT angles and four 10g X 16-mm flat top drill point tek screws. The 20-mm diameter PE-Xa pipe was then fixed at the elbow joint to the J-track with a saddle bracket. The annular gap between the pipe and FireShield wall was sealed with FireMastic-HPE to a depth of approximately 26-mm and finished flush with wall.
Photograph	<div>    </div> <div> Inside the wall cavity Unexposed face Exposed face </div>
Drawing	Drawings 1 to 4 Title “Knauf Service Penetration Pilot Fire Test SP4437 FRL -/90/90 Shaft Wall system with 2 x 13mm Fireshield”, by Knauf Plasterboard Pty Ltd.



Specimen 2 – A 43-mm diameter PVC pipe penetrating a 90-mm diameter aperture on the exposed face protected with FireMastic-HPE sealant.

SEPARATING ELEMENT	
<p>The Knauf Shaftliner wall system comprised 25-mm thick Knauf Shaftliner on the exposed side and two layers of 2 x 13-mm thick Knauf Fireshield on the unexposed side of the 102-mm x 0.55 BMT CH-wall studs. The cavity of the wall was filled with 75-mm thick Knauf Earthwool. The FRL of the Knauf Shaftliner wall system had not been verified by the test sponsor.</p>	
TYPE AND SIZE OF CONSTRUCTION	
A 90-mm diameter aperture on the unexposed side of a 128-mm thick wall.	
PENETRATING SERVICE	
Description	A single Vinidex PVC pipe incorporating a 90° PVC elbow.
Size	A 43-mm OD pipe with 2.3-mm wall thickness incorporating a 90° PVC elbow. The pipe extended 2000-mm away from the unexposed face and approximately 500-mm upwards inside the wall cavity.
End conditions	The pipe was plugged on the exposed side with ceramic fibre and left open inside the wall cavity.
Supports	Approximately 600-mm and 1200-mm away from the wall on the unexposed face.
FIRE STOPPING SYSTEM	
Trade names	FireMastic-HPE
Manufacturers	BOSS Fire & Safety Pty Ltd
Description	FireMastic-HPE is a graphite-based, thixotropic, one part acrylic emulsion sealant.
Application	Inside the wall cavity on the fire side a 200-mm high x 600-mm wide piece of 13-mm Fireshield was fixed to the back of the Shaftliner inside the wall using 10-mm x 38-mm laminating screws at 300-mm centres. A 0.8-mm BMT J-track was then fixed to the 13-mm Fireshield and studs using 50-mm x 50-mm x 0.7-mm BMT angles and four 10g X 16-mm flat top drill point tek screws. The 43-mm OD PVC pipe was then fixed at the elbow joint to the J-track with a saddle bracket. The annular gap between the pipe and FireShield wall was sealed with FireMastic-HPE to a depth of approximately 26-mm and finished flush with wall.
Photograph	 <div> Inside the wall cavity Unexposed face Exposed face </div>
Drawing	Drawings 1 to 4 Title “Knauf Service Penetration Pilot Fire Test SP4437 FRL -/90/90 Shaft Wall system with 2 x 13mm Fireshield”, by Knauf Plasterboard Pty Ltd.

Specimen 3 – A nominal 40-mm diameter lagged copper pipe penetrating a 127-mm diameter aperture protected with Knauf Bindex Fire and Acoustic sealant.

SEPARATING ELEMENT	
<p>The Knauf Shaftliner wall system comprised 25-mm thick Knauf Shaftliner on the exposed side and two layers of 2 x 13-mm thick Knauf Fireshield on the unexposed side of the 102-mm x 0.55 BMT CH-wall studs. The cavity of the wall was filled with 75-mm thick Knauf Earthwool. The FRL of the Knauf Shaftliner wall system had not been verified by the test sponsor.</p>	
TYPE AND SIZE OF CONSTRUCTION	
127-mm diameter apertures through the 128-mm thick wall.	
PENETRATING SERVICE	
Description	A single lagged copper pipe.
Size	A 38.5-mm copper pipe with a wall thickness of 1-mm lagged with 38-mm thick foil faced Rockwool. The pipe extended 700-mm from the unexposed side and 500-mm from the exposed face. The continuous lagging penetrated the wall and extended 500-mm from both sides of the wall.
End conditions	Sealed on the exposed end using ceramic fibre and left open on the unexposed end.
Supports	Approximately 100-mm and 500-mm away from the wall on the unexposed face.
FIRE STOPPING SYSTEM	
Trade names	Knauf Bindex Fire and Acoustic sealant
Manufacturers	Knauf Plasterboard Pty Limited
Description	Knauf Bindex Fire and Acoustic sealant is a one part acrylic sealant.
Application	The annular gap between the pipe lagging and the wall was sealed with Knauf Bindex Fire and Acoustic sealant to the depth of 26-mm and finished flush with the wall.
Photograph	<div>   </div> <div> Unexposed face Exposed face </div>
Drawing	Drawings 1 to 4 Title “Knauf Service Penetration Pilot Fire Test SP4437 FRL -/90/90 Shaft Wall system with 2 x 13mm Fireshield”, by Knauf Plasterboard Pty Ltd.

Specimen 4 – A SHS 65-mm x 65-mm x 6mm thick support arm penetrating the unexposed face of the wall through a 75-mm x 75-mm square opening protected with Knauf Bindex Fire and Acoustic sealant and 13-mm thick Fireshield.

SEPARATING ELEMENT	
<p>The Knauf Shaftliner wall system comprised of 25 mm thick Knauf Shaftliner on the exposed side and two layers of 2 x 13-mm thick Knauf Fireshield on the unexposed side of the, 102 mm x 0.55 BMT CH-wall studs. The cavity of the wall was filled with 75-mm thick Knauf Earthwool. The FRL of the Knauf Shaftliner wall system has not been verified by the test sponsor.</p>	
TYPE AND SIZE OF CONSTRUCTION	
A 75-mm square aperture on the unexposed side of a 128-mm thick wall.	
PENETRATING SERVICE	
Description	A steel SHS support arm.
Size	A SHS 65-mm x 65-mm x 6-mm thick arm welded at 90° to SHS 65-mm x 65-mm x 6mm beam. The arm extended 500-mm away from the unexposed face and the beam extended the full height inside the wall cavity.
End conditions	The arm was left open on the unexposed side.
Supports	Self-supporting at the internal weld in the wall cavity.
FIRE STOPPING SYSTEM	
Trade names	Knauf Bindex Fire and Acoustic sealant, Fireshield
Manufacturers	Knauf Plasterboard Pty Limited
Description	<p>Knauf Bindex Fire and Acoustic sealant is a one part acrylic sealant.</p> <p>13-mm thick Fireshield Plasterboard.</p>
Application	The annular gap between SHS arm and the wall on the unexposed side was sealed with Knauf Bindex Fire and Acoustic sealant to the depth of approximately 26-mm and finished flush with the wall. Four (4) pieces of Fireshield plasterboard, approximately 78-mm x 300-mm of 13-mm thick were then fixed around the base of the arm using two 12 gauge x 50-mm CSK self-tapping screws per sheet.
Photograph	<div style="display: flex; justify-content: space-around; align-items: center;">   </div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> Unexposed face Exposed face </div>
Drawing	Drawings 1 to 4 Title “Knauf Service Penetration Pilot Fire Test SP4437 FRL -/90/90 Shaft Wall system with 2 x 13mm Fireshield”, by Knauf Plasterboard Pty Ltd.

2.2 Dimensions

The overall dimension of the framed wall was normally 1150-mm wide x 1150-mm long x 128-mm thick, to suit the opening in the specimen containing frame.

2.3 Orientation

The framed wall was placed vertically against the furnace chamber with the three penetrations extending into the furnace the exposed side.

2.4 Conditioning

The specimen construction was completed on 11 September 2019 and left to cure under standard laboratory atmospheric conditions until the test date.

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

The supporting wall construction and specimen installation was organised by the sponsor. CSIRO was not involved in the selection of the materials.

3 Documentation

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

- Drawings 1, 2 and 4 titled “Knauf Service Penetration Pilot Fire Test SP4437 FRL -/90/90 Shaft Wall system with 2 x 13mm Fireshield”, dated 6 September 2019 by Knauf Plasterboard Pty Ltd.
- Drawing 2 titled “Knauf Service Penetration Pilot Fire Test SP4437 FRL -/90/90 Shaft Wall system with 2 x 13mm Fireshield”, dated 6 September 2019 by Knauf Plasterboard Pty Ltd.
- Technical Data sheet titled “ FireMastic-HPE” dated 2017 by BOSS Fire & Safety Pty Ltd

No confidential information about the test specimen has been submitted to CSIRO Infrastructure Technologies.

4 Equipment

4.1 Furnace

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

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

4.2 Temperature

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

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

Location of the thermocouples on the unexposed face of the specimens 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 24°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 121 minutes by the agreement with the sponsor.

8 Test results

8.1 Critical observations

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

- 3 minutes - Light smoke is fluing from the end of the pipes of Specimens 1 and 2.
- 8 minutes - Smoke has ceased fluing from Specimen 1.
- 22 minutes - Smoke has ceased fluing from Specimen 2.
- 37 minutes - Steam has begun venting at the base of Specimen 4.
- 41 minutes - Condensation is visible on the plasterboard wall directly above Specimen 4.
- 43 minutes - Light smoke has resumed fluing from the end of the pipe of Specimen 2.
- 45 minutes - Smoke/steam has begun venting from the sealant at the base of Specimen 3.
- 56 minutes - The sealant around the base of Specimen 3 has begun to swell.
- 60 minutes - The level of smoke fluing from the end of pipes of Specimen 2 has increased.
- 62 minutes - Light smoke has resumed fluing from the end of the pipe of Specimen 1.
- 65 minutes - Smoke has ceased fluing from Specimen 1.
- 66 minutes - Smoke has ceased venting from sealant around the base Specimen 3.
- 70 minutes - Smoke has ceased venting from the base Specimen 4.
- 90 minutes - Smoke continues fluing from the end of pipe of Specimen 2.
- 100 minutes - A small quantity of smoke is venting from the base of Specimen 4.
- 121 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.

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

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

Figure 7 shows the curve of temperature versus time associated with internal steel stud.

Figure 8 shows the curve of temperature versus time associated with the internal SHS.

8.5 Performance

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

Specimen 1 – A 20-mm diameter PE-Xa Rehau Rautitan pipe penetrating a 55-mm diameter aperture on the unexposed face protected with FireMastic HPE sealant.

Structural adequacy	-	Not applicable
Integrity	-	no failure at 121 minutes
Insulation	-	no failure at 121 minutes

Specimen 2 – A 43-mm diameter PVC pipe penetrating a 90-mm diameter aperture on the exposed face protected with FireMastic HPE sealant.

Structural adequacy	-	Not applicable
Integrity	-	no failure at 121 minutes
Insulation	-	no failure at 121 minutes

Specimen 3 – A lagged 38.5-mm diameter copper penetrating a 127-mm diameter aperture protected with Knauf Bindex Fire and Acoustic sealant.

Structural adequacy	-	Not applicable
Integrity	-	no failure at 121 minutes
Insulation	-	no failure at 121 minutes

Specimen 4 – A SHS 65-mm x 65-mm x 6mm thick support arm penetrating the unexposed face of the wall through a 75-mm x 75-mm square opening protected with Knauf Bindex Fire and Acoustic sealant and 13-mm thick Fireshield.

Structural adequacy	-	Not applicable
Integrity	-	no failure at 121 minutes
Insulation	-	no failure at 121 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 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 1530.4-20014, have been made provided no individual component is removed or reduced.

10 Tested by

A handwritten signature in blue ink, appearing to read 'Peter Gordon', with a checkmark at the end.

Peter Gordon
Testing Officer

Appendices

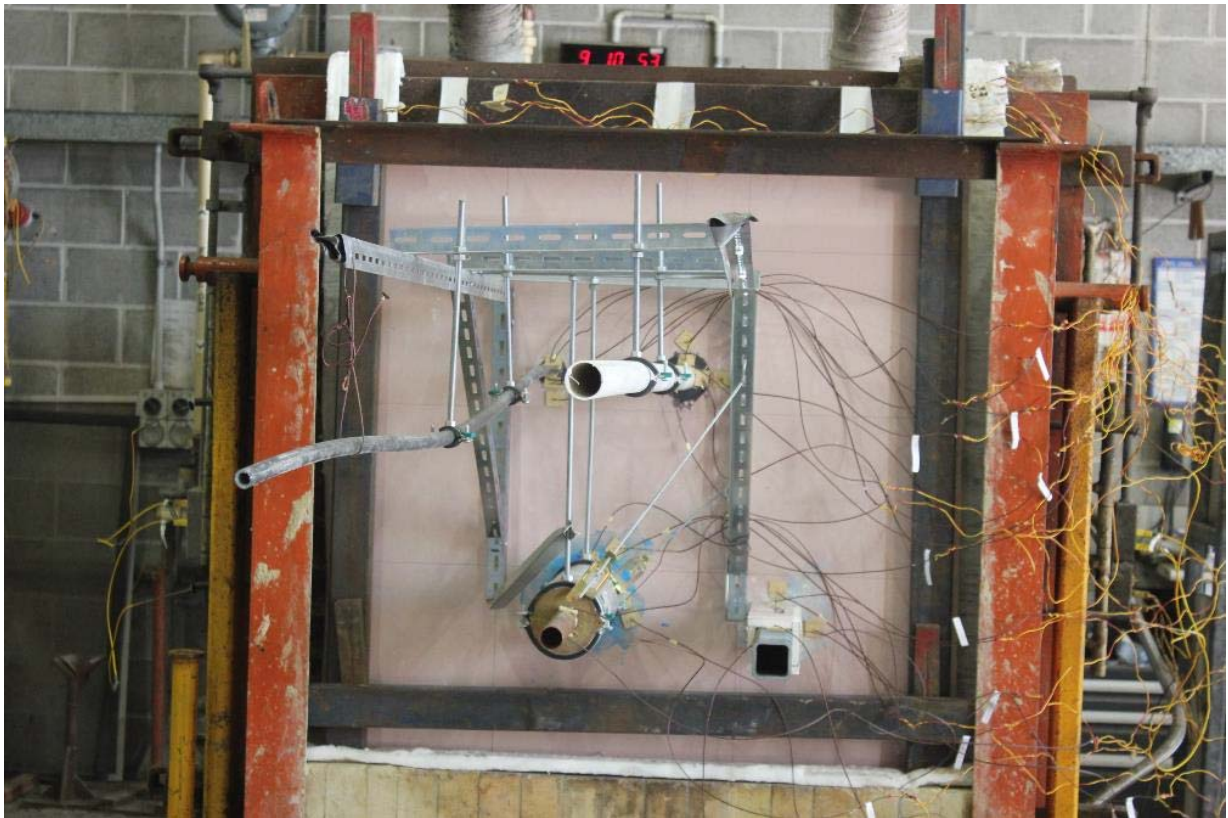
Appendix A – Measurement location

Specimen	T/C Position	T/C designation
Internal steel stud	On stud hot flange, mid height	S1
	On stud mid height web	S2
	On stud cold flange, mid height	S3
Internal SHS	On exposed edge, mid height	S4
	On unexposed edge, mid height	S5
SPECIMEN 1 – 20-mm OD Rehau PE-Xa Rehau Rautitan pipe, having a wall thickness of 2.8-mm penetrating the unexposed face of the wall through a 55-mm opening. The annular gap was sealed Boss FireMastic-HPE.	On P/B, 25-mm below mastic	S6
	On P/B, 25-mm right of mastic	S7
	On Mastic, below pipe	S8
	On Mastic, right of pipe	S9
	On top of pipe, 25-mm from mastic	S10
	On bottom of pipe, 25-mm from mastic	S11
SPECIMEN 2 – 43-mm OD Iplex pipe (PVC) having a wall thickness of 2.3-mm penetrating the exposed face of the wall through a 90-mm opening. The annular gap around the pipe and the wall was sealed Boss FireMastic-HPE.	On P/B, 25-mm above mastic	S12
	On P/B, 25-mm right of mastic	S13
	On Mastic, above pipe	S14
	On Mastic, right of pipe	S15
	On top of pipe, 25-mm from mastic	S16
	On bottom of pipe, 25-mm from mastic	S17
SPECIMEN 3 – The lagged copper pipe having a 38.5-mm OD and a wall thickness of 1-mm lagged with 38-mm thick Rockwood with a foil facing. The lagged pipe penetrated through a 106-mm opening. The annular gap between the lagging and the wall was sealed with Knauf Bindex Fire and Acoustic sealant.	On P/B, 25-mm above sealant	S18
	On P/B, 25-mm right of sealant	S19
	On sealant, above lagging	S20
	On sealant, right of lagging	S21
	On top of lagging, 25-mm from sealant	S22
	On lagging, 25-mm right of sealant	S23
	On top of pipe, 25-mm from lagging	S24
	On bottom of pipe, 25-mm from lagging	S25
SPECIMEN 4 – A SHS (65-mm x 65-mm x 6-mm thick with a right angle arm penetrating the unexposed face of the wall through a 75-mm opening. The annular gap between the SHS arm and the wall was sealed with Bindex Fire and Acoustic sealant; a single of 13-mm FireShield was then fixed around the Arm.	On P/B wall, 25-mm above arm	S26
	On P/B wall, 25-mm right of arm	S27
	On P/B arm, 25-mm above wall	S28
	On P/B arm, 25-mm right of wall	S29
	On top of SHS, 25-mm from P/B on arm	S30
	On left side of SHS, 25-mm from P/B on arm	S31
Rover		S32
Ambient		S33

Appendix B – Test photographs



PHOTOGRAPH 1 – EXPOSED SIDE OF SPECIMEN PRIOR TO TESTING



PHOTOGRAPH 2 – UNEXPOSED SIDE OF SPECIMEN PRIOR TO TESTING



PHOTOGRAPH 3 – SPECIMEN AFTER 30 MINUTES OF TESTING



PHOTOGRAPH 4 – SPECIMENS 3 AND 4 AFTER 46 MINUTES OF TESTING



PHOTOGRAPH 5 – SPECIMEN AFTER 60 MINUTES OF TESTING



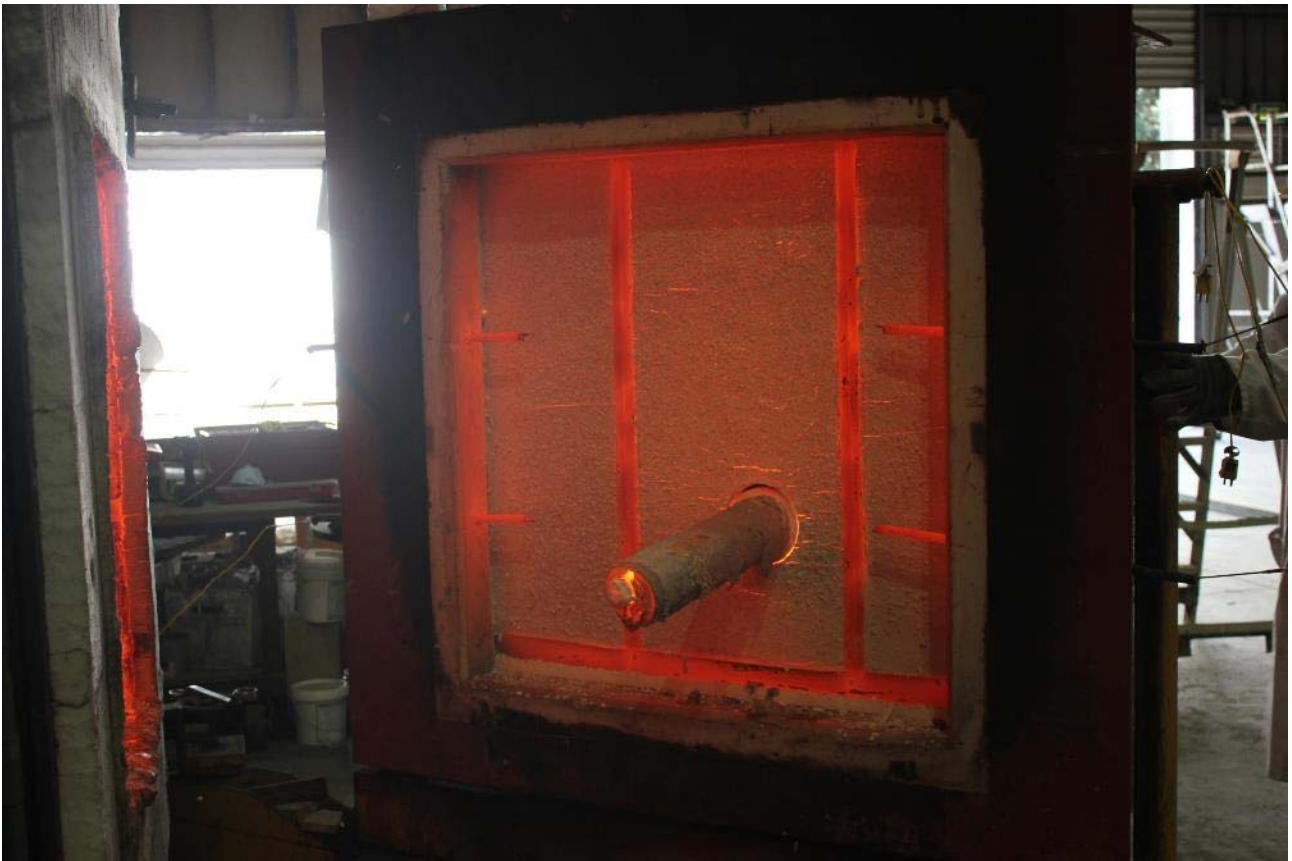
PHOTOGRAPH 6 – SPECIMEN AFTER 90 MINUTES OF TESTING



PHOTOGRAPH 7 – SPECIMEN AFTER 60 MINUTES OF TESTING



PHOTOGRAPH 8 – SPECIMENS 2 AND 4 AT THE CONCLUSION OF TESTING



PHOTOGRAPH 9 – EXPOSED FACE OF SPECIMENS AFTER THE CONCLUSION OF TESTING

Appendix C – Test data charts

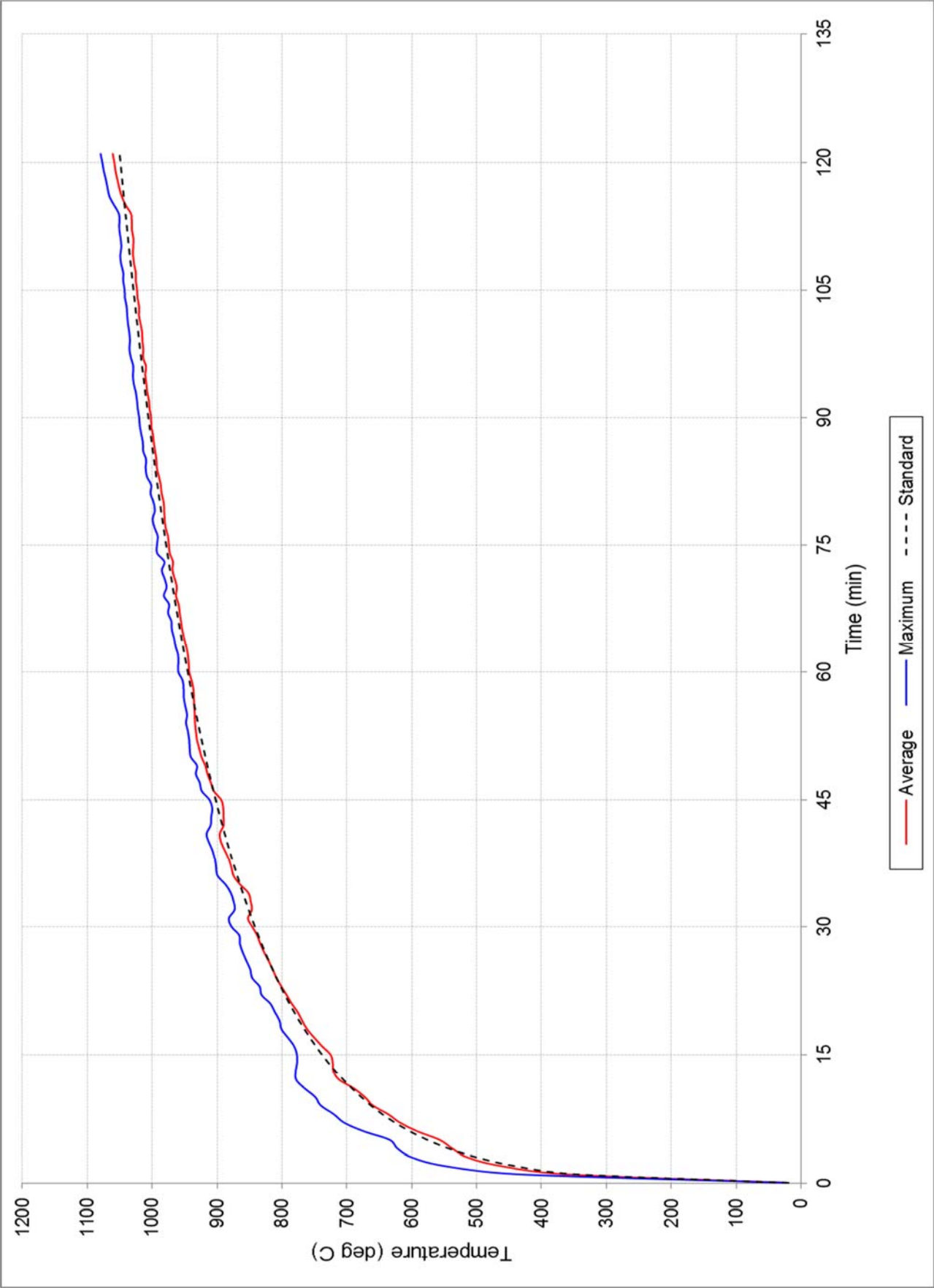


FIGURE 1 – FURNACE TEMPERATURE

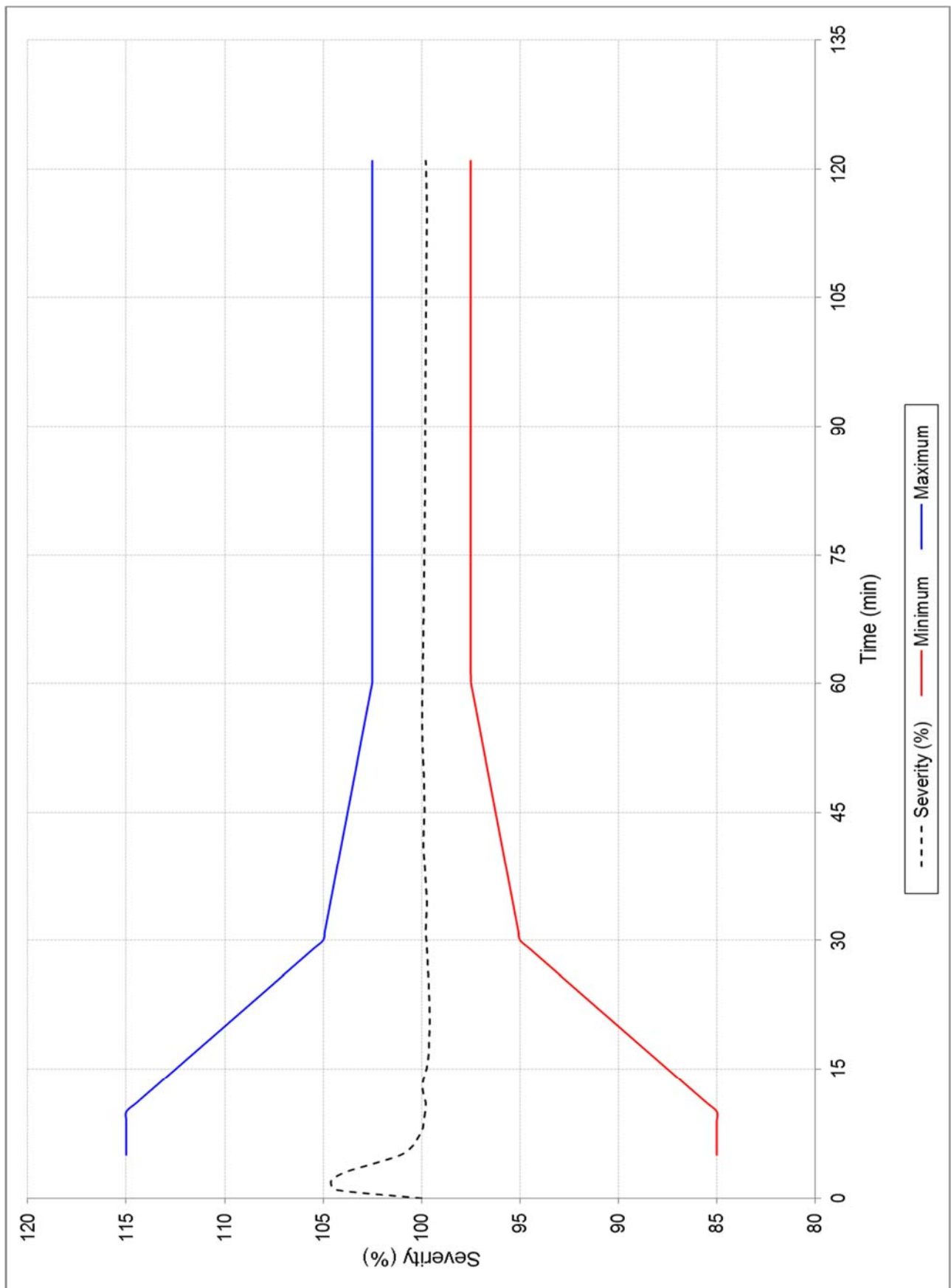


FIGURE 2 – FURNACE SEVERITY

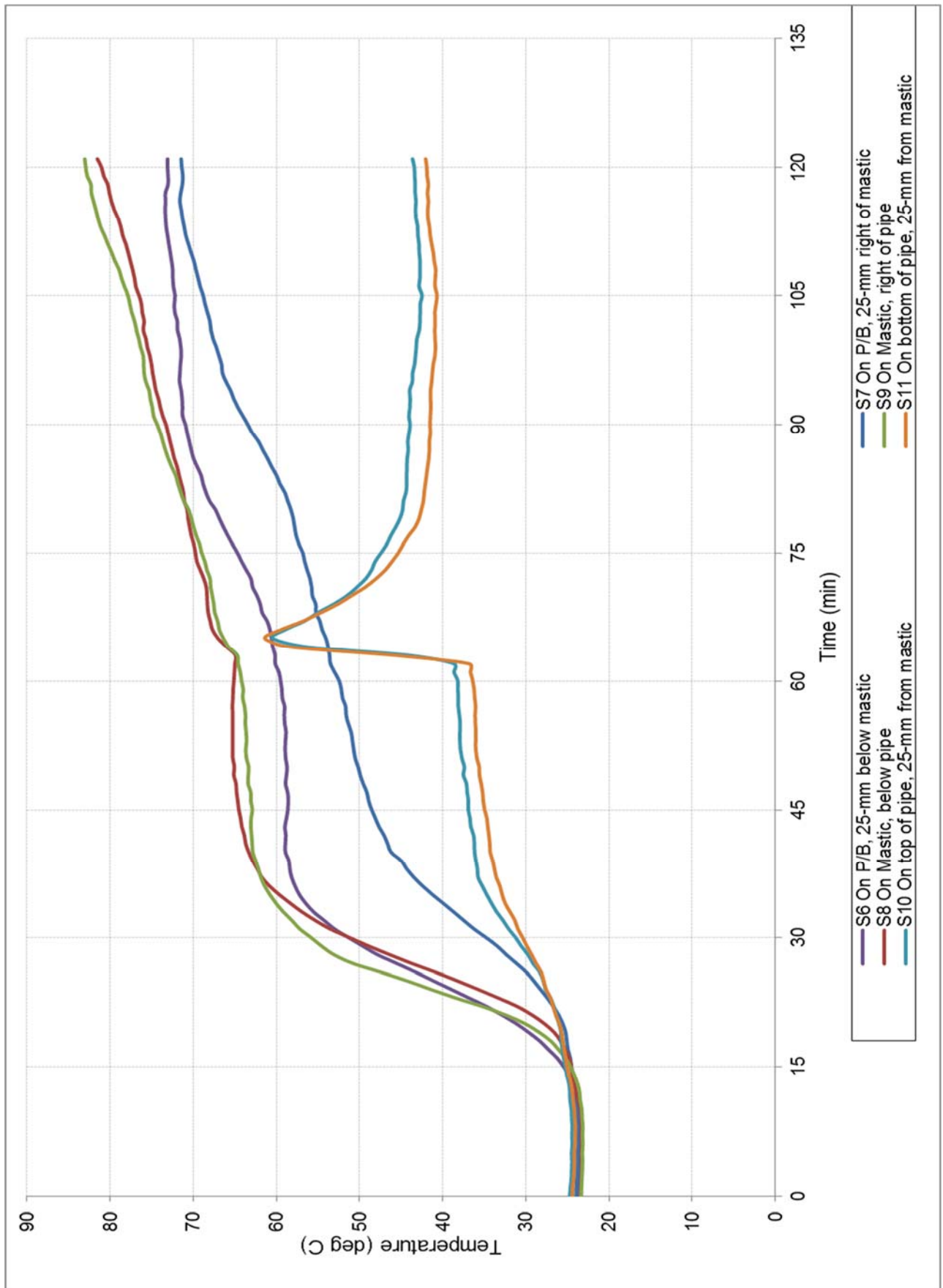


FIGURE 3 – SPECIMEN TEMPERATURE – ASSOCIATED WITH SPECIMEN 1

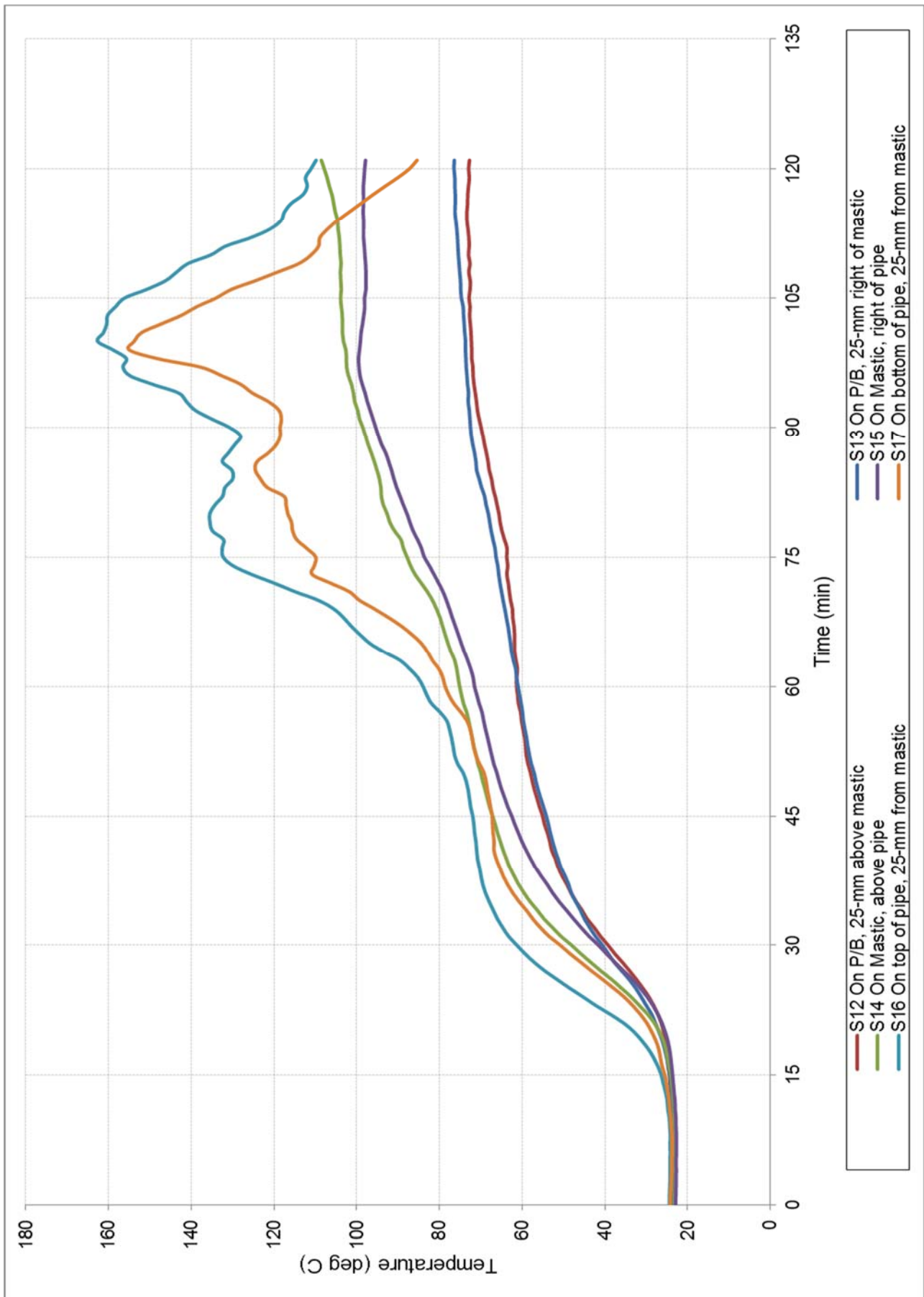


FIGURE 4 – SPECIMEN TEMPERATURE – ASSOCIATED WITH SPECIMEN 2

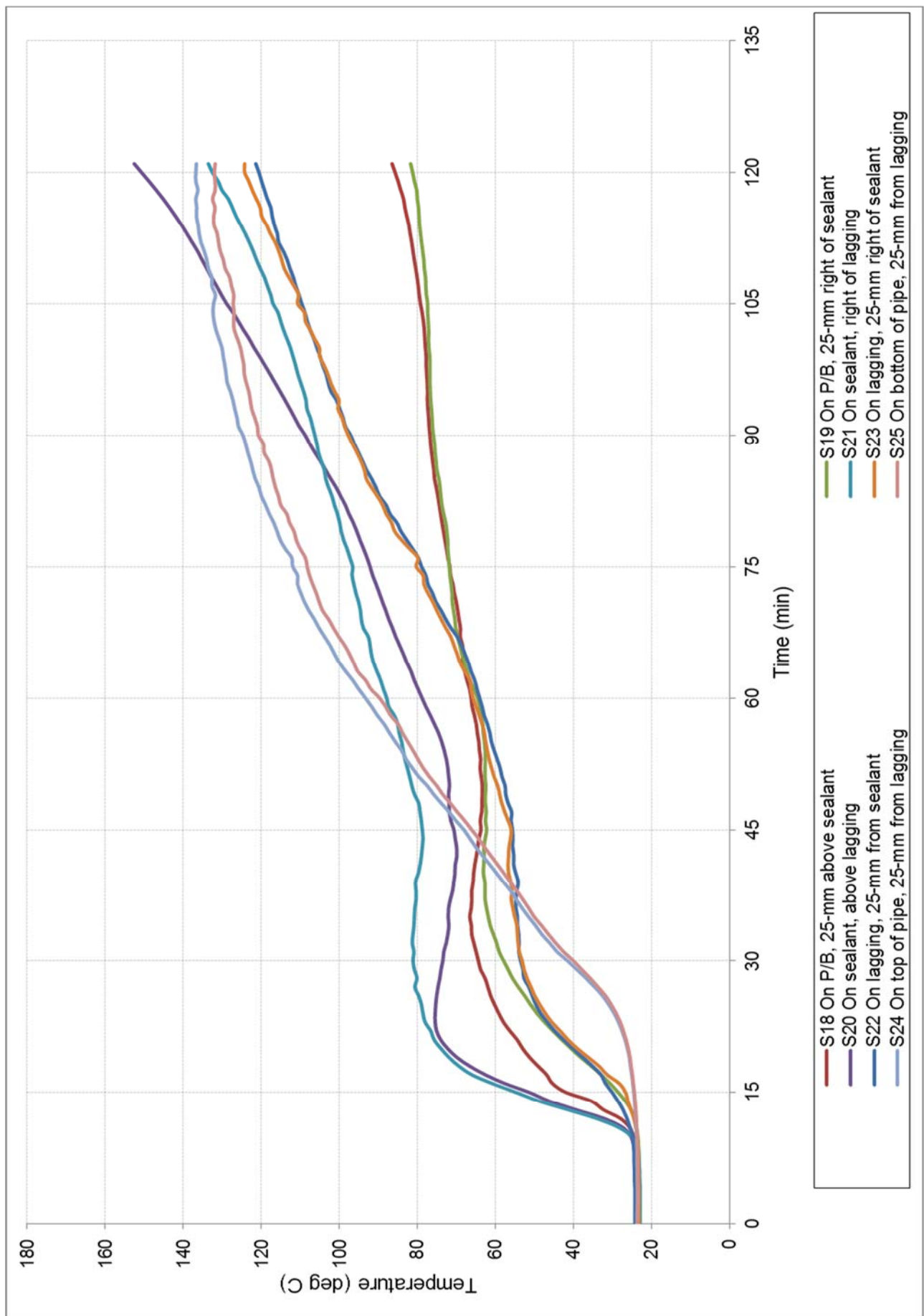


FIGURE 5 – SPECIMEN TEMPERATURE – ASSOCIATED WITH SPECIMEN 3

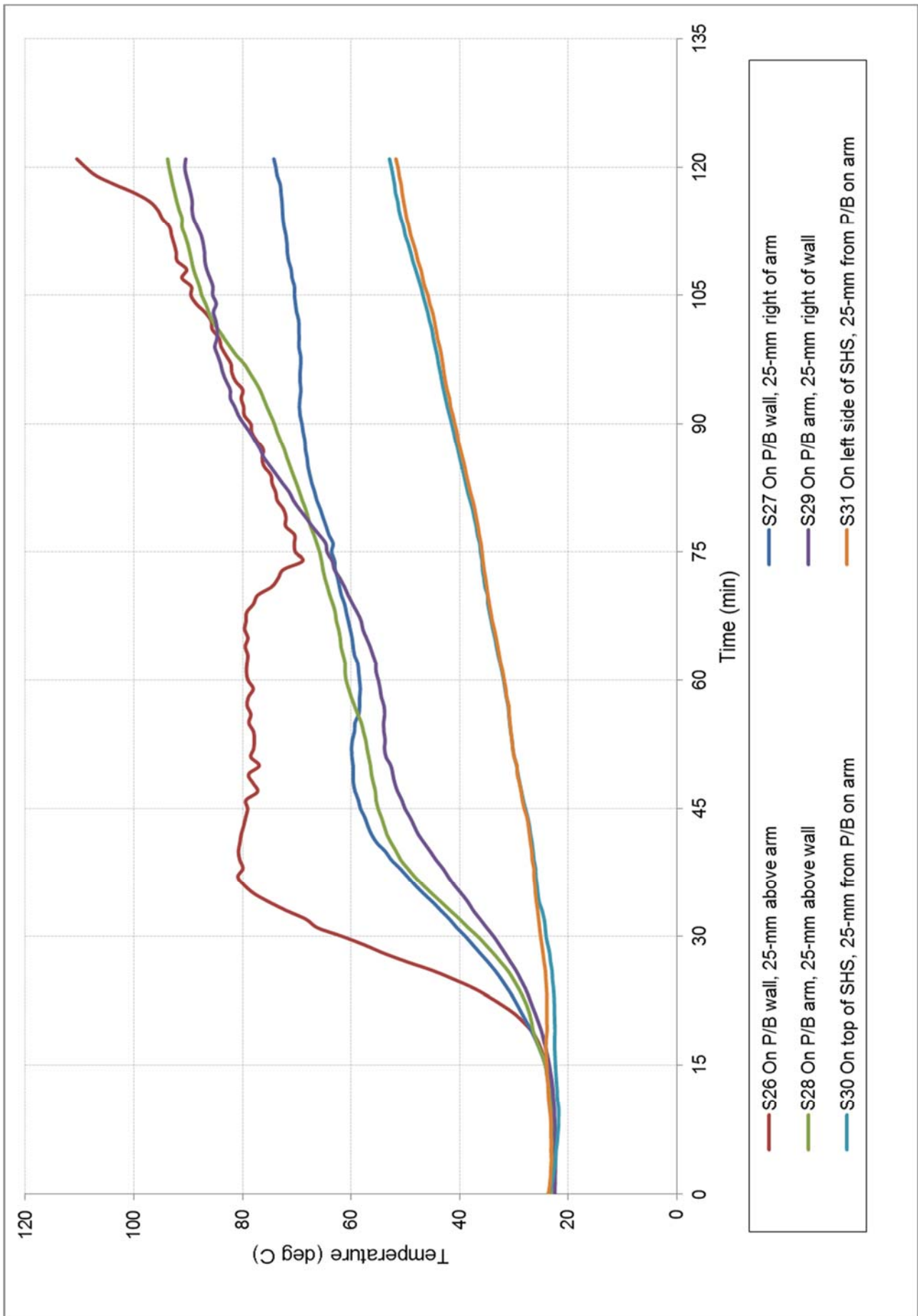


FIGURE 6 – SPECIMEN TEMPERATURE – ASSOCIATED WITH SPECIMEN 4

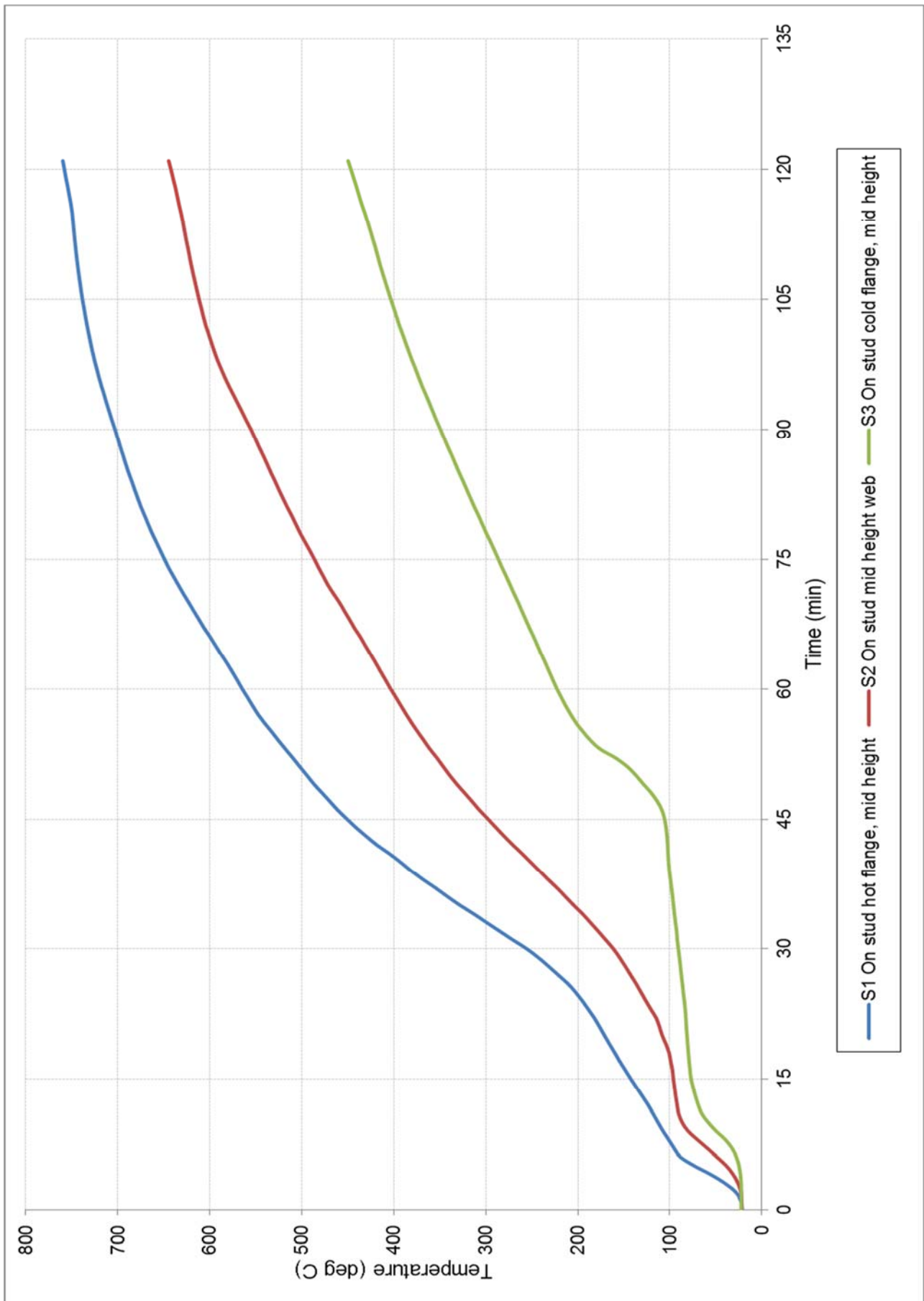


FIGURE 7 – SPECIMEN TEMPERATURE –INTERNAL STEEL STUD

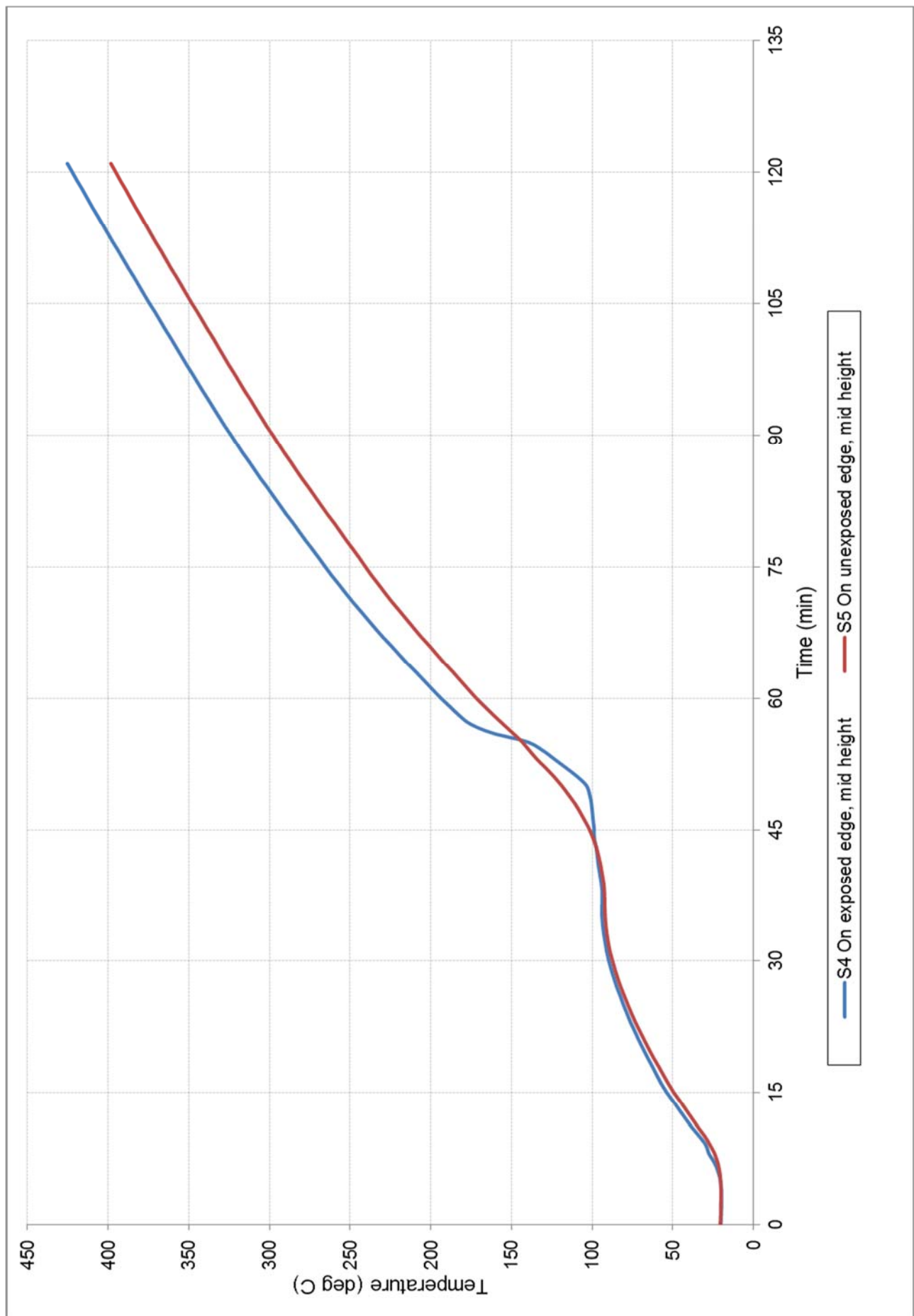
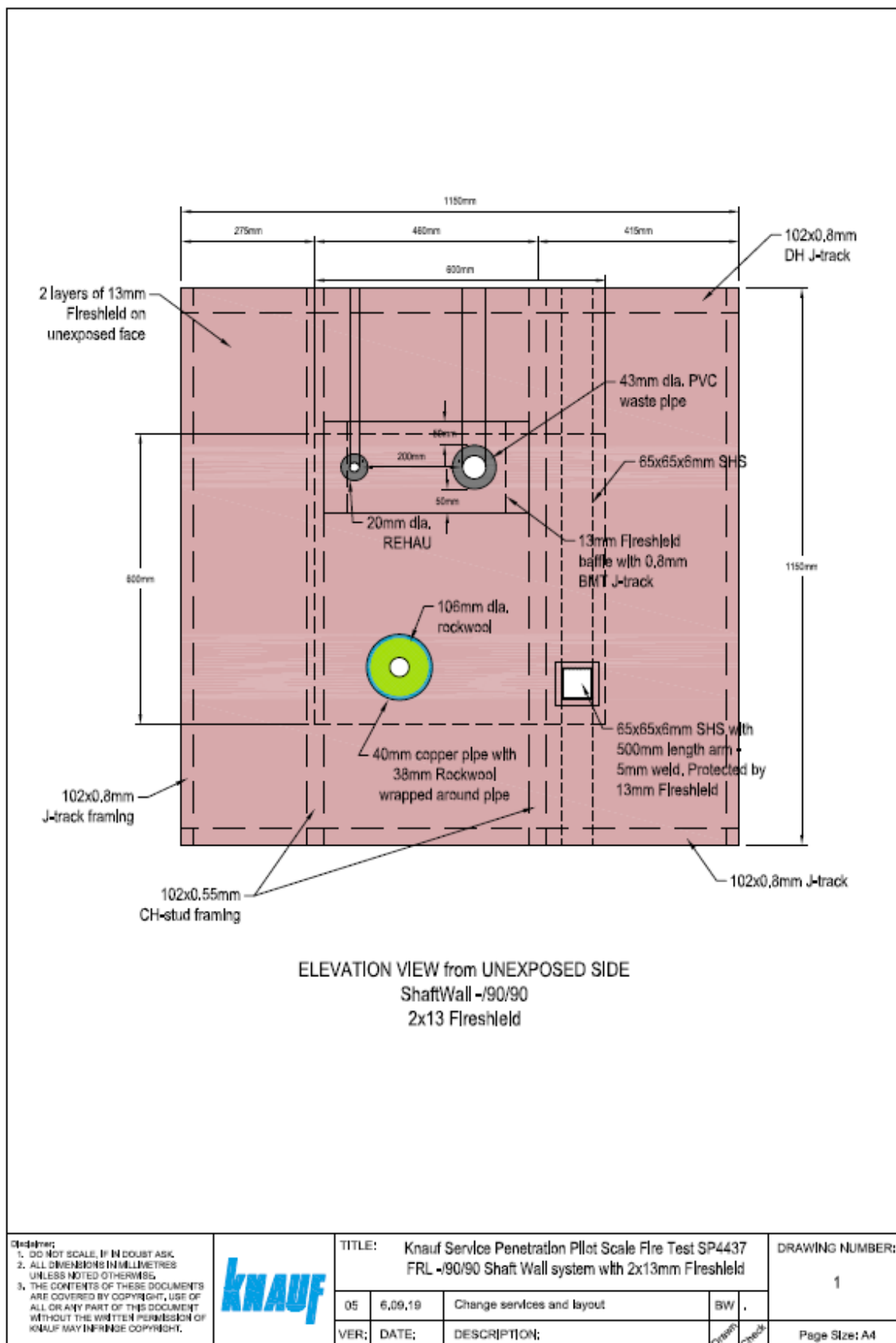
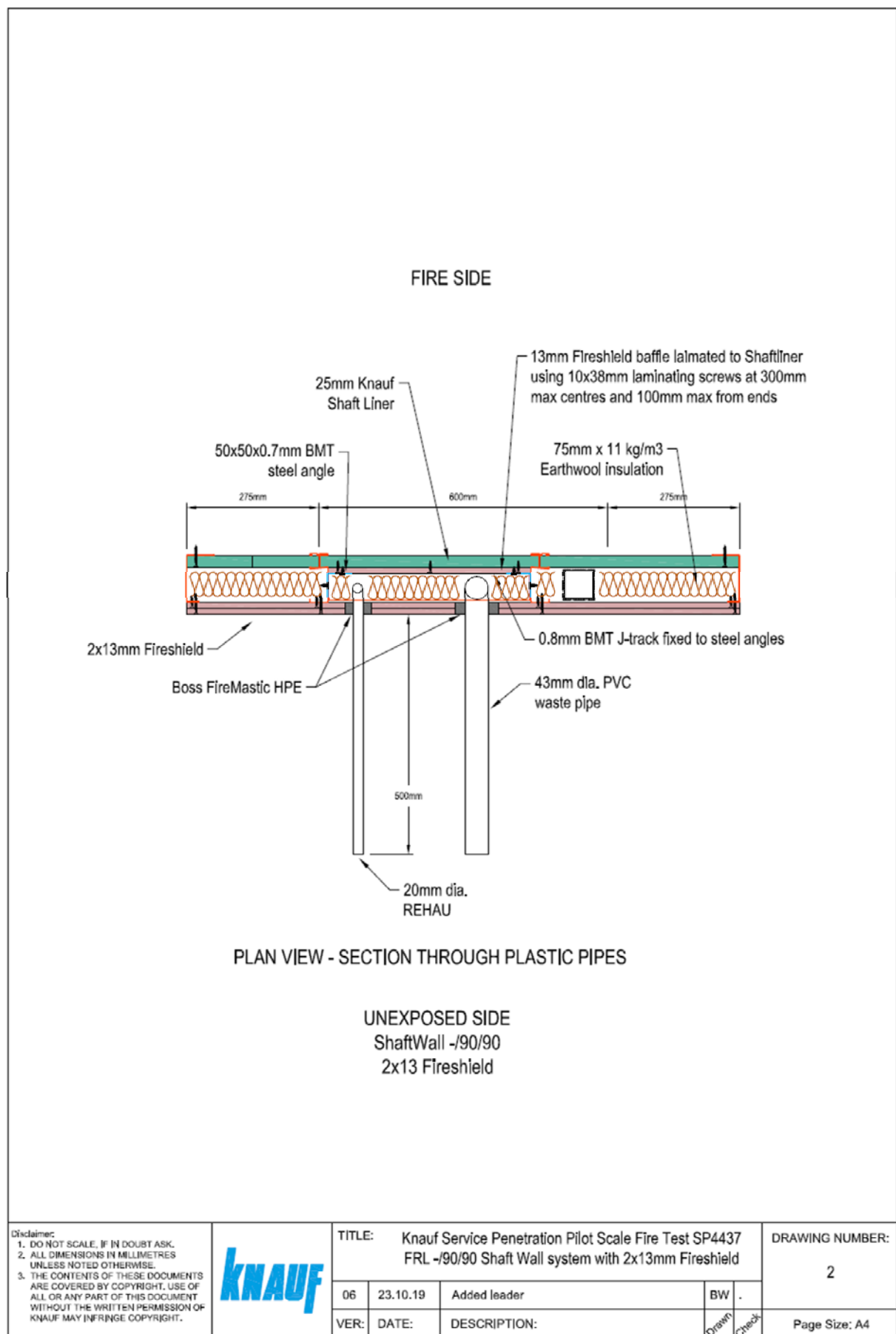


FIGURE 8 – SPECIMEN TEMPERATURE –INTERNAL SHS

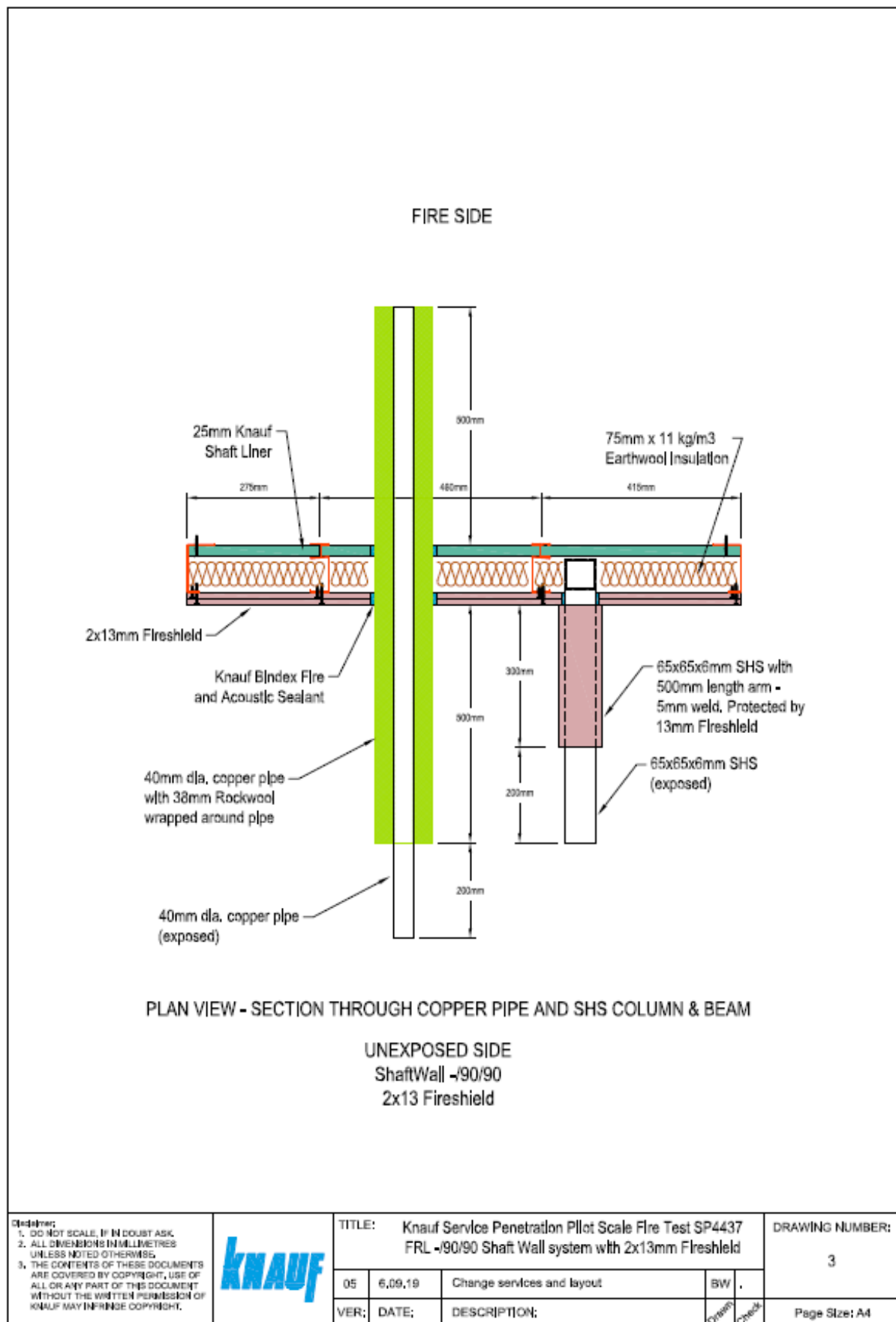
Appendix D – Specimen drawings



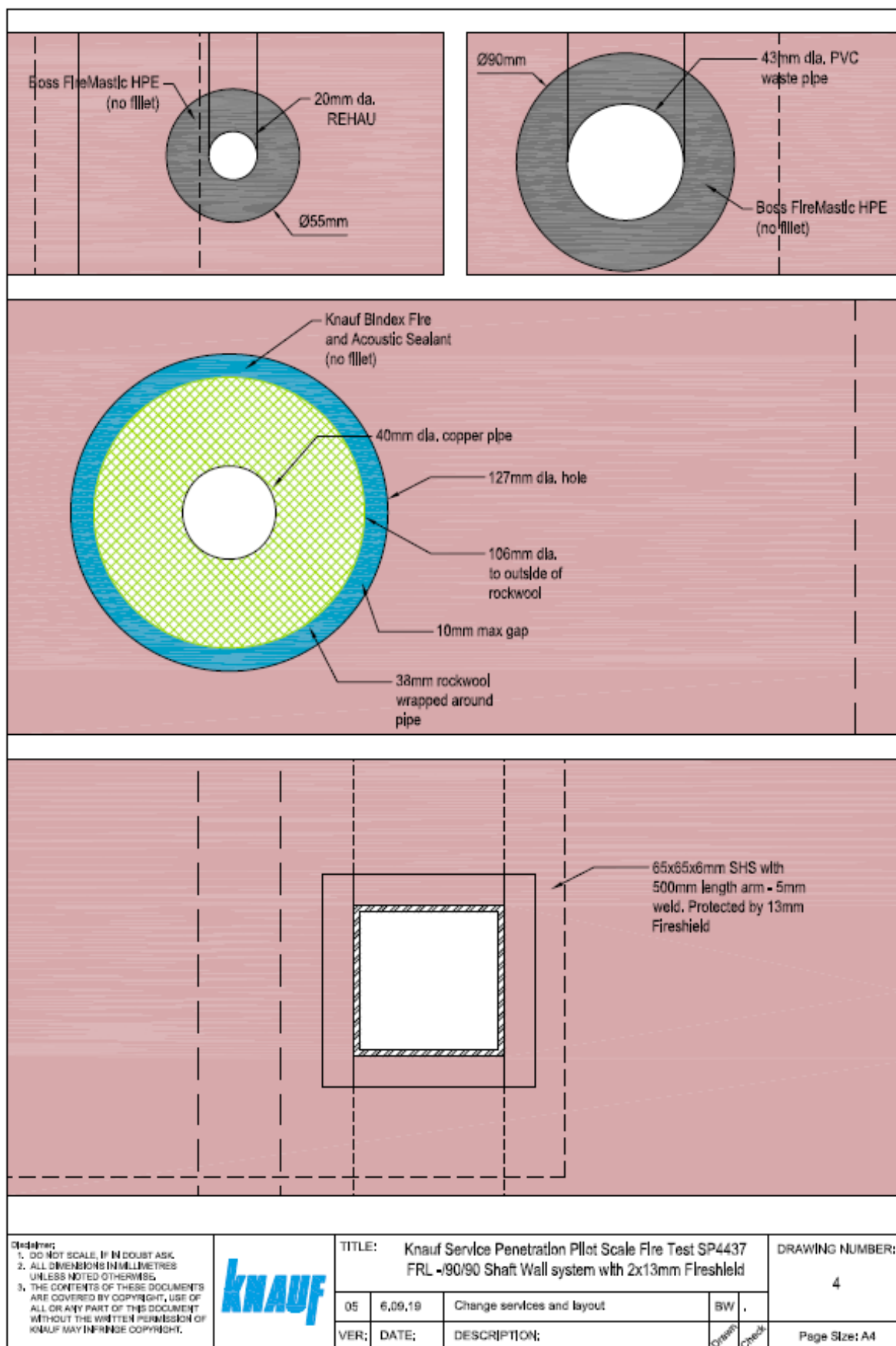
DRAWING NUMBER 1, TITLED “KNAUF SERVICE PENETRATIONS PILOT SCALE FIRE TEST SP4437 FRL -/90/90 SHAFT WALL SYSTEM WITH 2 X 13-MM FIRESHIELD”, DATED 6 SEPTEMBER 2019 BY KNAUF



DRAWING NUMBER 2, TITLED “KNAUF SERVICE PENETRATIONS PILOT SCALE FIRE TEST SP4437 FRL -/90/90 SHAFT WALL SYSTEM WITH 2 X 13-MM FIRESHIELD”, DATED 23 OCTOBER 2019 BY KNAUF



DRAWING NUMBER 3, TITLED “KNAUF SERVICE PENETRATIONS PILOT SCALE FIRE TEST SP4437 FRL -/90/90 SHAFT WALL SYSTEM WITH 2 X 13-MM FIRESHIELD”, DATED 6 SEPTEMBER 2019 BY KNAUF



DRAWING NUMBER 4, TITLED “KNAUF SERVICE PENETRATIONS PILOT SCALE FIRE TEST SP4437 FRL -/90/90 SHAFT WALL SYSTEM WITH 2 X 13-MM FIRESHIELD”, DATED 6 SEPTEMBER 2019 BY KNAUF

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. |

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