

Fire-resistance test on services penetrating a Shaftliner wall system

Test Report

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Commercial-in-confidence



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Sponsored Investigation No. FSP 2073

1 Introduction

1.1 Identification of specimen

The sponsor identified the specimen as a Knauf Shaftliner wall system penetrated by three (3) service penetrations protected by Boss FireMastic-HPE.

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 2036

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 4946/4436

1.7 Test date

The fire-resistance test was conducted on 13th January 2020.

2 Description of specimen


2.1 General

The specimens comprised a PE-Xa Rehau Rautitan pipe, a PVC pipe and a bath breaching piece with two tap handles and a tap penetrating the exposed face of the Knauf Shaftliner wall system.

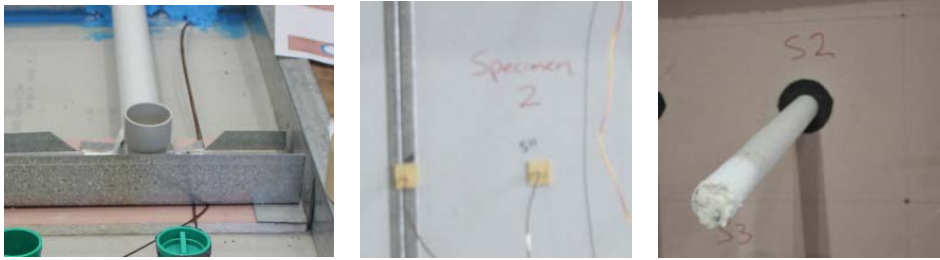
The penetrated wall contained consisted of a 128-mm thick plasterboard lined framed wall system comprising a 25 mm thick Knauf Shaftliner board on the exposed side and two layers of 13-mm thick Knauf Fireshield plasterboard on the unexposed side of the 102 mm x 0.55 BMT CH-stud wall framing with 102 mm x 0.55 BMT CH-studs. 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 aperture on the exposed face sealed with FireMastic HPE sealant.
2	A 43-mm diameter PVC pipe penetrating a 90-mm aperture on the exposed face sealed with FireMastic HPE sealant.
3	A Hansgrohe wall mounted faucet incorporating a 3 piece hand basin tap set penetrating three 75-mm apertures on the exposed face protected with FireMastic HPE sealant.


Specimen 1 – A 20-mm diameter PE-Xa Rehau Rautitan pipe penetrating a 55-mm aperture on the exposed face sealed 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 exposed side of the 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 2.8-mm wall thickness incorporating a Rehau PX No.12 90 Degree elbow. The pipe extended 500-mm away from the exposed 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	Internally to the unexposed wall face at the elbow joint.
FIRE STOPPING SYSTEM	
Name	FireMastic-HPE
Description	FireMastic-HPE is a graphite-based, thixotropic, one part acrylic emulsion.
Application	Inside the wall cavity on the unexposed side a 200-mm high x 600-mm wide piece of 13-mm FireShield plasterboard was fixed to the Shaftliner using 10-mm x 38-mm laminating screws at 300-mm centres. Steel angles, 200-mm long x 50-mm x 50-mm x 0.7 BMT were fixed to the two centre C-studs using four screws. A 600-mm long piece of 0.8mm BMT J-track was then fixed to the two angles using 10g X 16-mm flat top drill point tek screws. The 20-mm PE-Xa pipe was then fixed at the elbow joint to the J-track with an Auspex Clip and a 25-mm metal tek screw. The annular gap between the pipe and FireShield plasterboard wall on the fire side was sealed with FireMastic-HPE to a depth of approximately 26-mm and finished flush with the wall.
Photograph	 <div style="display: flex; justify-content: space-around; margin-top: 5px;"> Inside the wall cavity Unexposed face Exposed face </div>
Drawing	Drawing Titled “Knauf Service Penetration Pilot Fire test SP4436 FRL -/90/90 Shaft Wall System with 2x13mm FireShield”, dated 5 September 2019 by Knauf Plasterboard Pty Ltd.

Specimen 2 – A 43-mm diameter PVC pipe penetrating a 90-mm aperture on the exposed face sealed 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 90-mm diameter aperture on the exposed side of the 128-mm thick wall.	
PENETRATING SERVICE	
Description	A single Vinidex PVC pipe incorporating a 90° elbow.
Size	A PVC pipe with 43-mm OD and 2.3-mm wall thickness incorporating a 90° PVC elbow. The pipe extended 500-mm away from the exposed 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	Internally to the unexposed wall face at the elbow joint.
FIRE STOPPING SYSTEM	
Name	FireMastic-HPE
Description	FireMastic-HPE is a graphite-based, thixotropic, one part acrylic emulsion
Application	Inside the wall cavity on the unexposed side a 200-mm high x 600-mm wide piece of 13-mm FireShield plasterboard was fixed to the Shaftliner using 10-mm x 38-mm laminating screws at 300-mm centres. Steel angles, 200-mm long, 50-mm x 50-mm x 0.7 BMT were fixed to the two centre C-studs using four screws. A 600-mm long piece of 0.8mm BMT J-track was then fixed to the two angles with 10g X 16-mm flat top drill point tek screws. The 43-mm PVC pipe was then fixed at the elbow joint to the J-track with a nylon coated metal saddle flush clip and 10g x 16-mm flat top drill point tek screws. The annular gap between the pipe and FireShield plasterboard wall on the fire side was sealed with FireMastic-HPE to a depth of approximately 26-mm and finished flush with wall.
Photograph	 <div style="display: flex; justify-content: space-around; margin-top: 5px;"> Inside the wall cavity Unexposed face Exposed face </div>
Drawing	Drawing Titled “Knauf Service Penetration Pilot Fire test SP4436 FRL -/90/90 Shaft Wall System with 2x13mm FireShield”, dated 5 September 2019 by Knauf Plasterboard Pty Ltd.

Specimen 3 – A Hansgrohe wall mounted faucet incorporating a 3 piece hand basin tap set penetrating three 75-mm apertures on the exposed 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	
Three 75-mm diameter apertures, 125-mm apart on the exposed side of the 128-mm thick wall.	
PENETRATING SERVICE	
Description	A Hansgrohe (IAS SF009A) wall mounted faucet with an Axor Citterio (36107000) 3 piece wall sink set projecting out of the exposed face of the wall and two PE-Xa Rehau Rautitan pipes (Red and Black) running through in the wall cavity.
Size	A Hansgrohe (IAS SF009A) wall mounted faucet with 40-mm OD plastic sleeves fixed over the spindle valves and tap outlet, 25-mm OD 4-mm thick PE-Xa Rehau Rautitan.
End conditions	The tap on the exposed face was left open, the two tap spindle valves were in the closed position and PE-Xa Rehau Rautitan pipes inside the wall were the left open.
Supports	Internally to the unexposed wall face screwed through the wall mounted faucet.
FIRE STOPPING SYSTEM	
Name	FireMastic-HPE
Description	FireMastic-HPE is a graphite-based, thixotropic, one part acrylic emulsion
Application	Inside the wall cavity on the unexposed side a nominal 200-mm high x 600-mm wide piece of 13-mm FireShield plasterboard was fixed to the wall with two x 200-mm long, 50-mm x 50-mm x 0.7 BMT steel angles that were fixed to the C-studs using four screws. A 200-mm wide x 600-mm wide sheet of 12-mm plywood was then fixed over the steel angles using 3 x 6g 25-mm long fine thread bugle screws over each angle. The two corners of the faucet were then fixed to the plywood with two 6g x 25-mm long fine thread bugle screws. The three annular gaps around the plastic sleeves and the FireShield plasterboard wall were sealed with FireMastic-HPE to a depth of approximately 26-mm and finished flush with wall. The chrome escutcheon plates were not installed for this test.
Photograph	 <div> Inside the wall cavity Exposed face Unexposed face </div>
Drawing	Drawing Titled “Knauf Service Penetration Pilot Fire test SP4436 FRL -/90/90 Shaft Wall System with 2x13mm FireShield”, dated 5 September 2019 by Knauf Plasterboard Pty Ltd.

2.2 Dimensions

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

2.3 Orientation

The wall was placed vertically against the furnace chamber with the two pipes, tap handles and tap spout extending into the furnace chamber.

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 SP4436 FRL -/90/90 Shaft Wall system with 2 x 13mm FireShield”, dated 5 September 2019 by Knauf Plasterboard Pty Ltd.
- Drawing 3 titled “Knauf Service Penetration Pilot Fire Test SP4436 FRL -/90/90 Shaft Wall system with 2 x 13mm FireShield”, dated 23 October 2019 by Knauf Plasterboard Pty Ltd.
- Technical Data sheet titled “ FireMastic-HPE” dated 2017 by BOSS Fire & Safety Pty Ltd
- Document labelled “Hydraulic wall fixtures apartments”, dated 19 June 2019 provide by Knauf.

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. Additional thermocouples were placed on the frame on the unexposed face at the head of specimen wall, inside the wall cavity adjacent to Specimen 3 and inside the wall on a C-H stud which were not taken into consideration for the insulation criterion. Thermal data from these thermocouples is depicted in separate graphs.

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 21°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:

- 30 minutes - No visible change noted on any of the specimens.
- 60 minutes - No visible change noted on any of the specimens.
- 90 minutes - No visible change noted on any of the specimens.
- 120 minutes - No visible change noted on any of the specimens throughout the test.
- 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 on the frame at the head of specimen wall.

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

Figure 8 shows the curve of temperature versus time inside the wall cavity of Specimen 3.

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 aperture on the exposed face sealed 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 aperture on the exposed face sealed with FireMastic HPE sealant.

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

Specimen 3 – A Hansgrohe wall mounted faucet incorporating a 3 piece hand basin tap set penetrating three 75-mm apertures 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

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



Peter Gordon
Testing Officer

Appendices

Appendix A – Measurement location

SPECIMEN	T/C Position	Designation
Steel stud – Inside wall cavity	On H-stud hot flange, mid height	S1
	On H-stud mid height web	S2
	On H-stud cold flange, mid height	S3
Specimen 3 - Inside wall cavity	On copper pipe cold water side	S4
	On copper pipe hot water side	S5
	On P/B wall unexposed face 35-mm from hot water tap handle and tap	S6
	On P/B wall unexposed face 35-mm from cold water tap handle and tap	S7
	On P/B centre of cavity	S8
Specimen 1 – 20-mm OD Rehau Rautitan PE-Xa pipe, having a wall thickness of 2.8-mm running through the cavity and penetrating the exposed face of the wall through a 55-mm opening. The annular gap around the outside of the pipe and wall was sealed with Boss FireMastic-HPE to a depth of 26 mm and finished flush with the plasterboard.	On Shaftliner board in line with 25-mm PE-Xa opening.	S9
	On C-H stud adjacent PE-Xa pipe opening	S10
Specimen 2 - 43-mm OD Iplex pipe (PVC) having a wall thickness of 2.3-mm running through the cavity and penetrating the exposed face of the wall through a 90-mm opening. The annular gap around the outside of the pipe and wall was sealed with Boss FireMastic-HPE to a depth of 26 mm and finished flush with the plasterboard wall.	On Shaftliner board in line with PVC pipe opening.	S11
	On C-H stud adjacent PVC pipe opening	S12
Specimen 3 – Three piece tap faucet penetrating the exposed face of the wall through three 75-mm openings. The tap faucet incorporated 2 x Rehau PEX-a pipes 25-mm OD and a wall thickness of 4-mm inside the wall cavity. The annular gap between the wall and the 40-mm OD plastic casting (around both spindle valves and the tap) were sealed with Boss FireMastic-HPE to a depth of 26-mm and finished flush with the plasterboard wall.	On Shaftliner in line with hot water tap handle opening. RHS Red PE-Xa	S13
	On Shaftliner in line with water tap opening	S14
	On Shaftliner in line with cold water tap handle opening. LHS Black PE-Xa	S15
	On C-H stud adjacent hot tap opening	S16
	On C-H stud adjacent cold tap pipe opening	S17
Head of Wall	On centre of frame	S18
Rover		S19
Ambient		S20

Appendix B – Test photographs



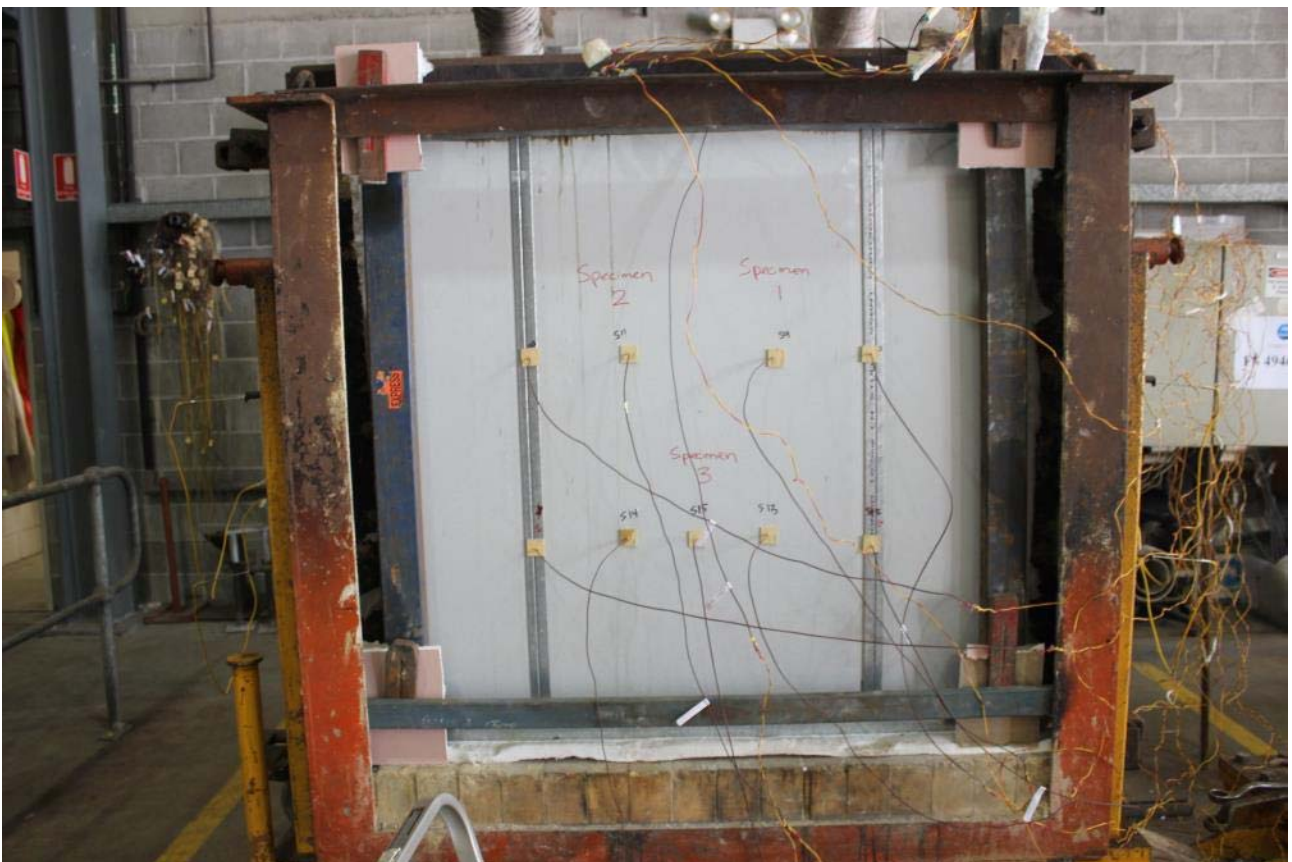
PHOTOGRAPH 1 –SPECIMEN DURING CONSTRUCTION PRIOR TO TESTING



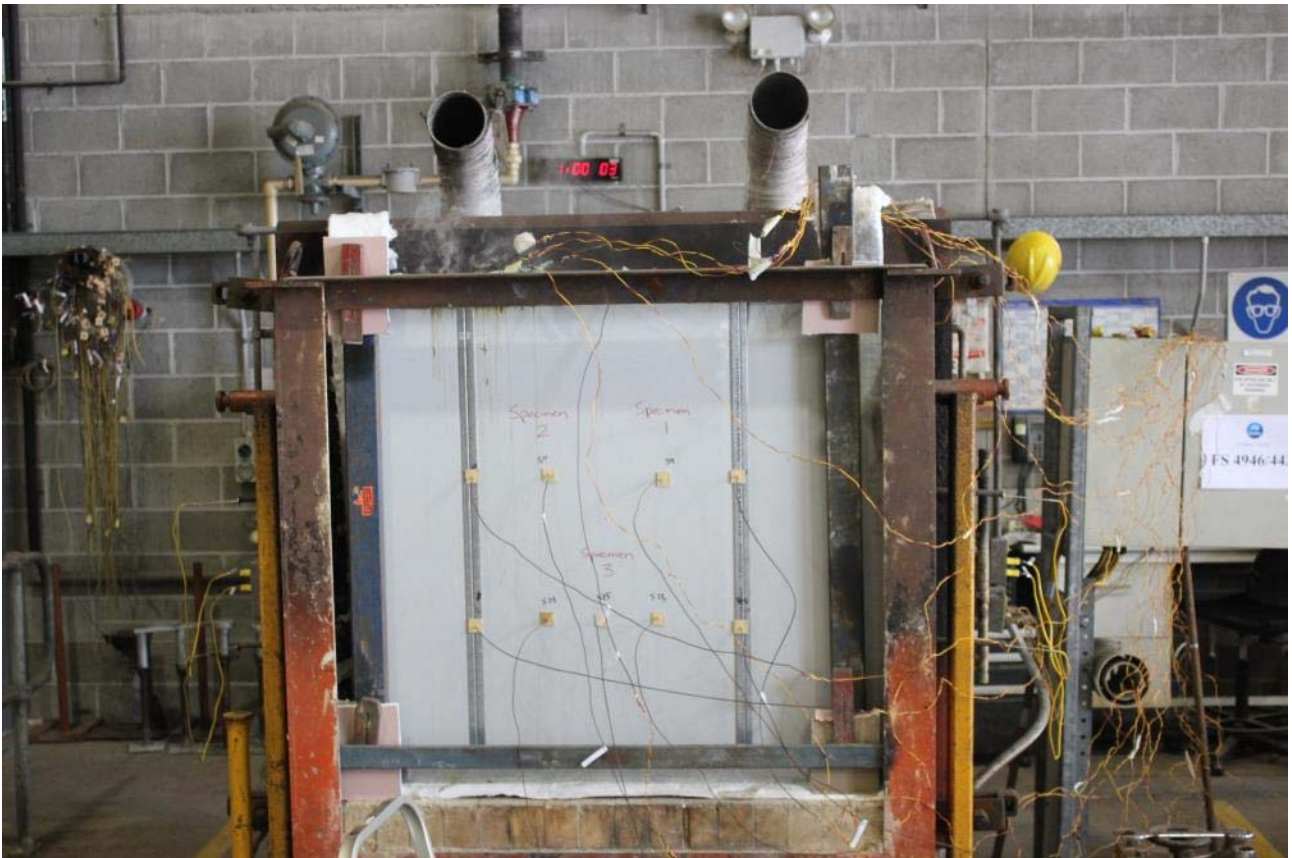
PHOTOGRAPH 2 – EXPOSED SIDE OF SPECIMEN PRIOR TO TESTING



PHOTOGRAPH 3 – UNEXPOSED SIDE OF SPECIMEN PRIOR TO TESTING



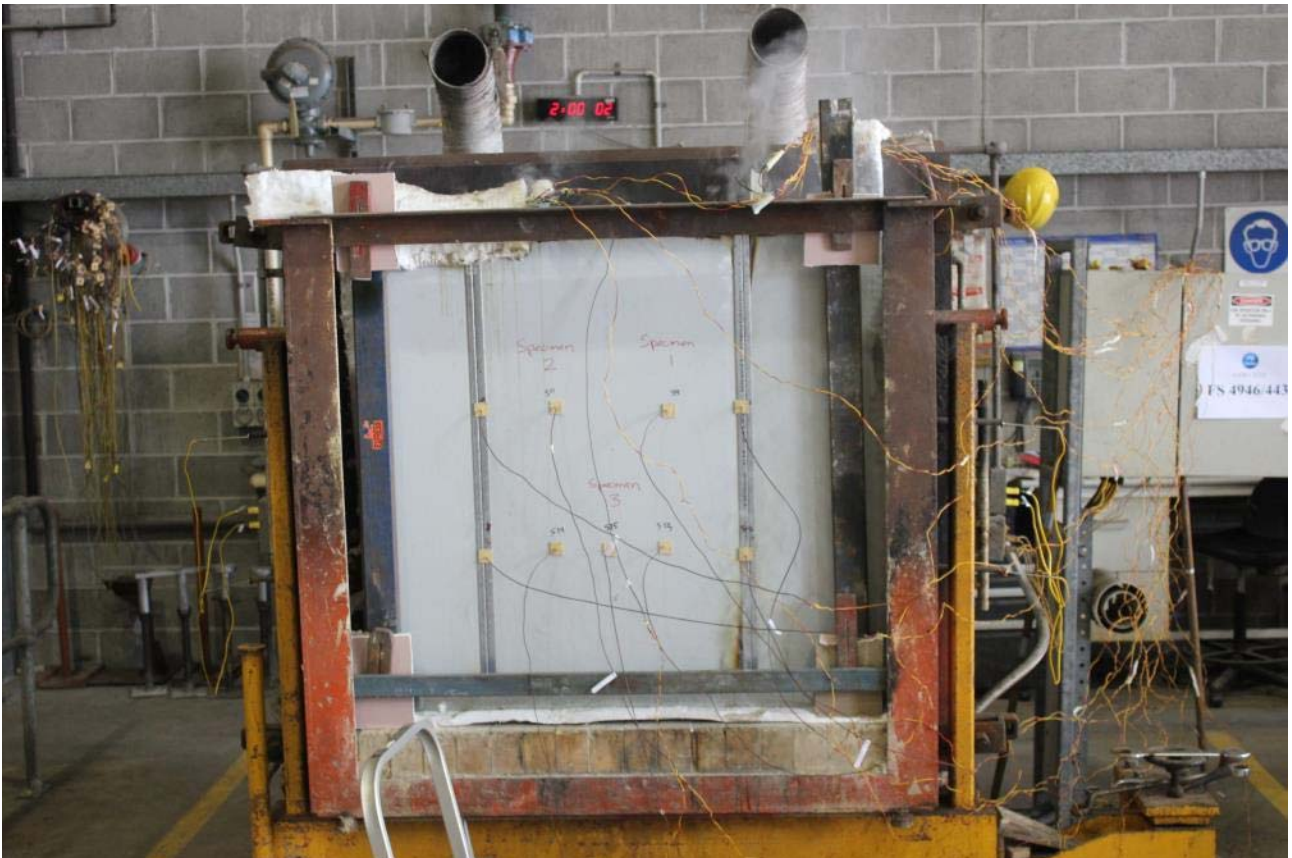
PHOTOGRAPH 4 – SPECIMEN AFTER 30 MINUTES OF TESTING



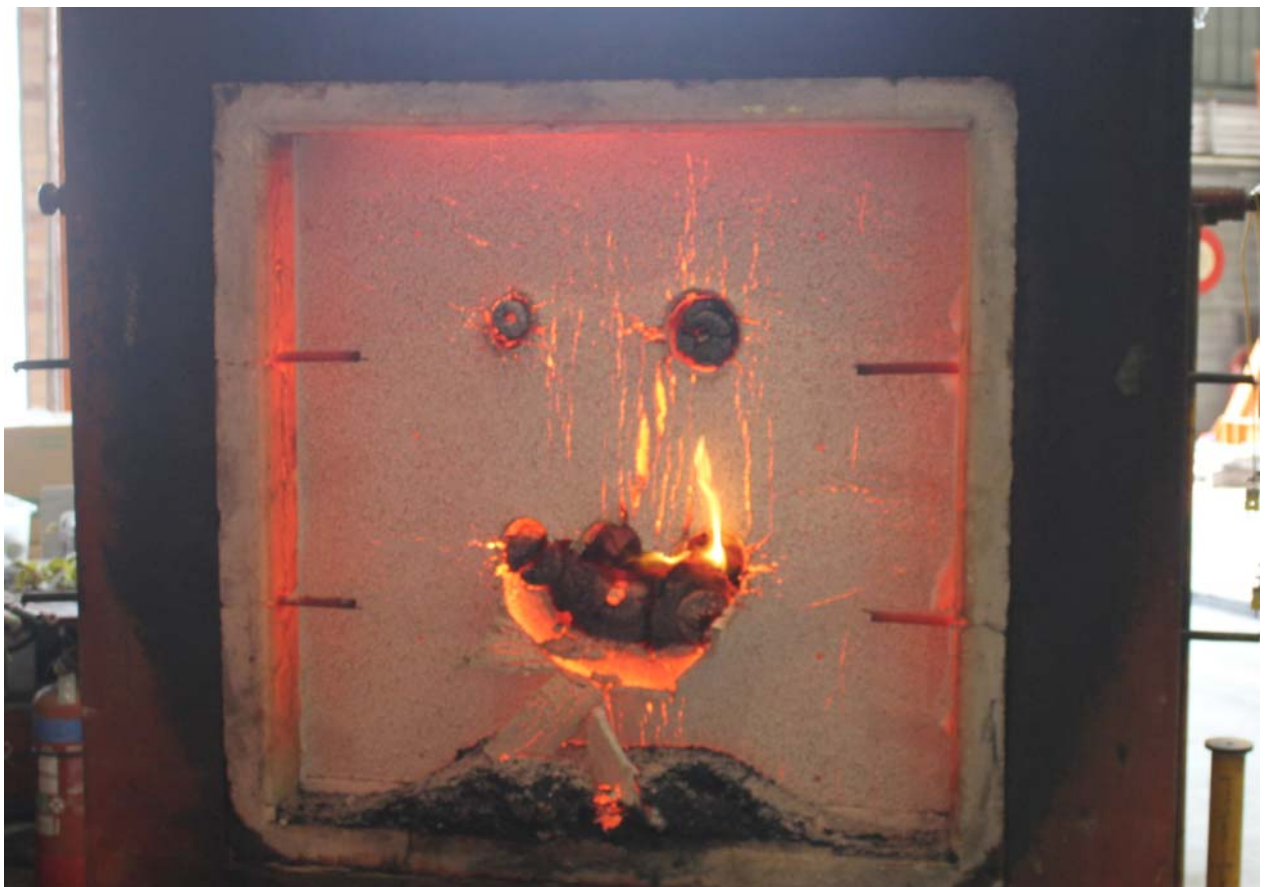
PHOTOGRAPH 5 – SPECIMEN AFTER 60 MINUTES OF TESTING



PHOTOGRAPH 6 – SPECIMEN AFTER 90 MINUTES OF TESTING



PHOTOGRAPH 7 – SPECIMEN AFTER 120 MINUTES OF TESTING



PHOTOGRAPH 8 – SPECIMENS EXPOSED FACE AFTER THE CONCLUSION OF TESTING

Appendix C – Test data charts

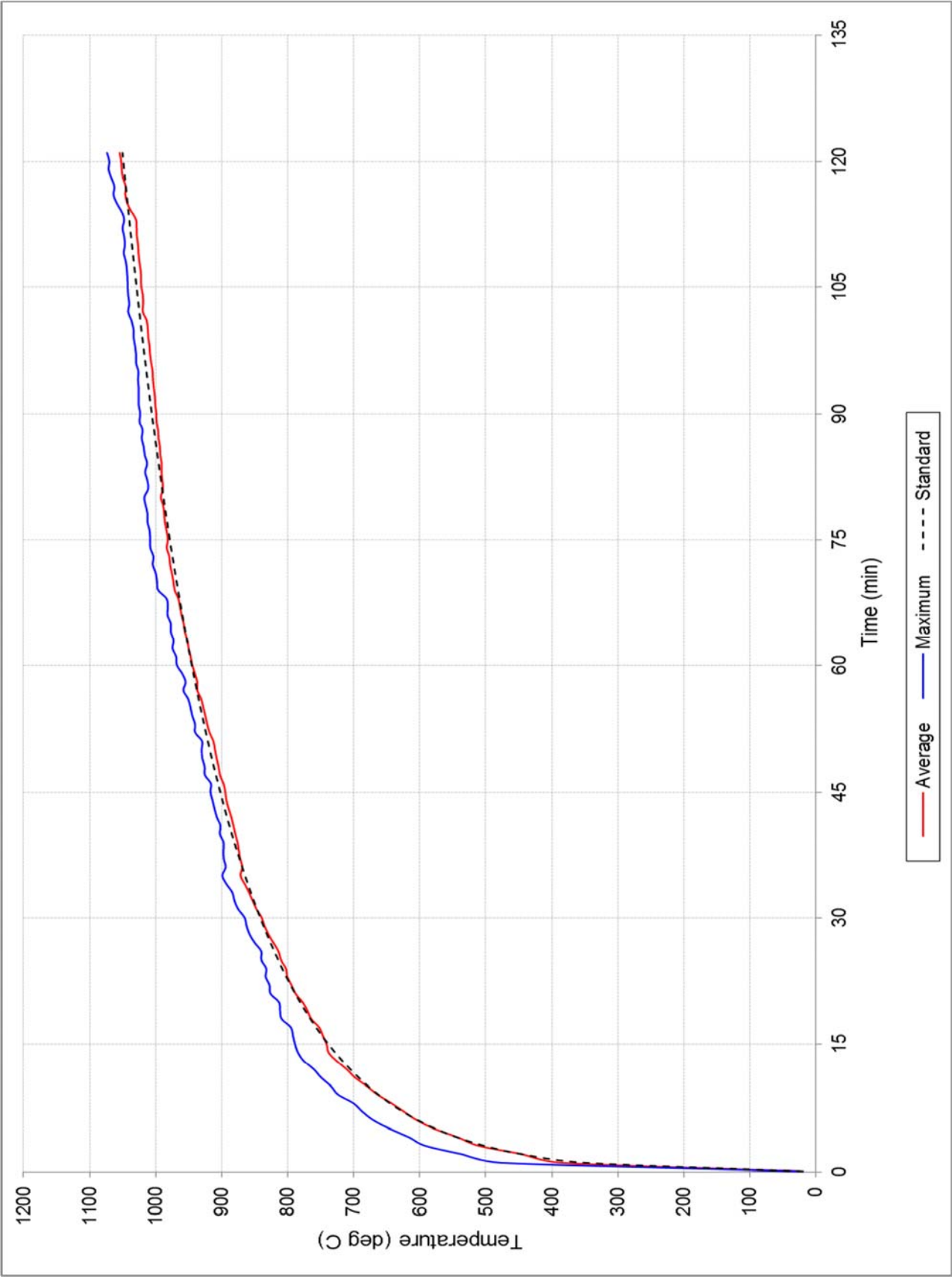


FIGURE 1 – FURNACE TEMPERATURE

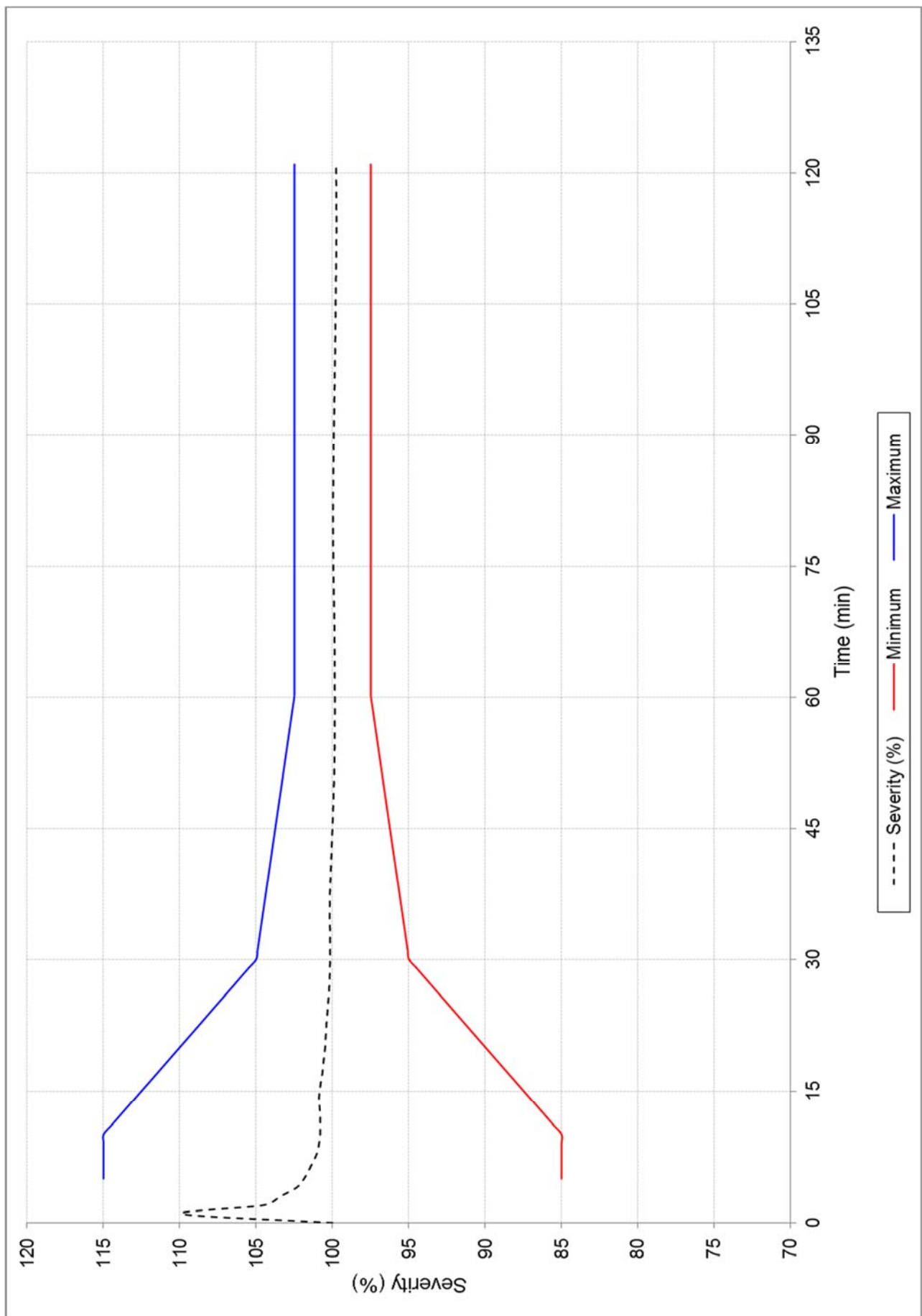


FIGURE 2 – FURNACE SEVERITY

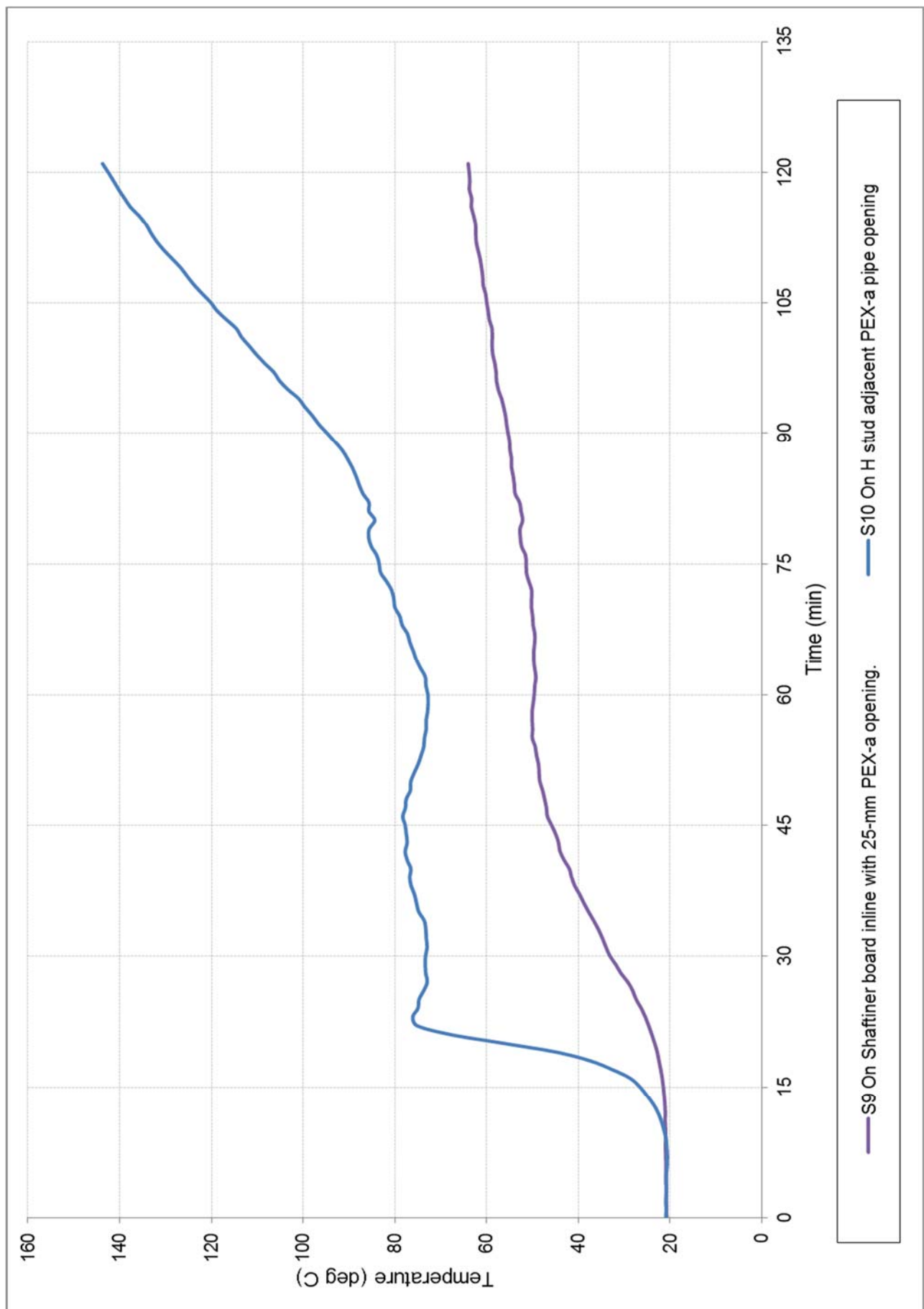


FIGURE 3 – SPECIMEN TEMPERATURE – ASSOCIATED WITH SPECIMEN 1

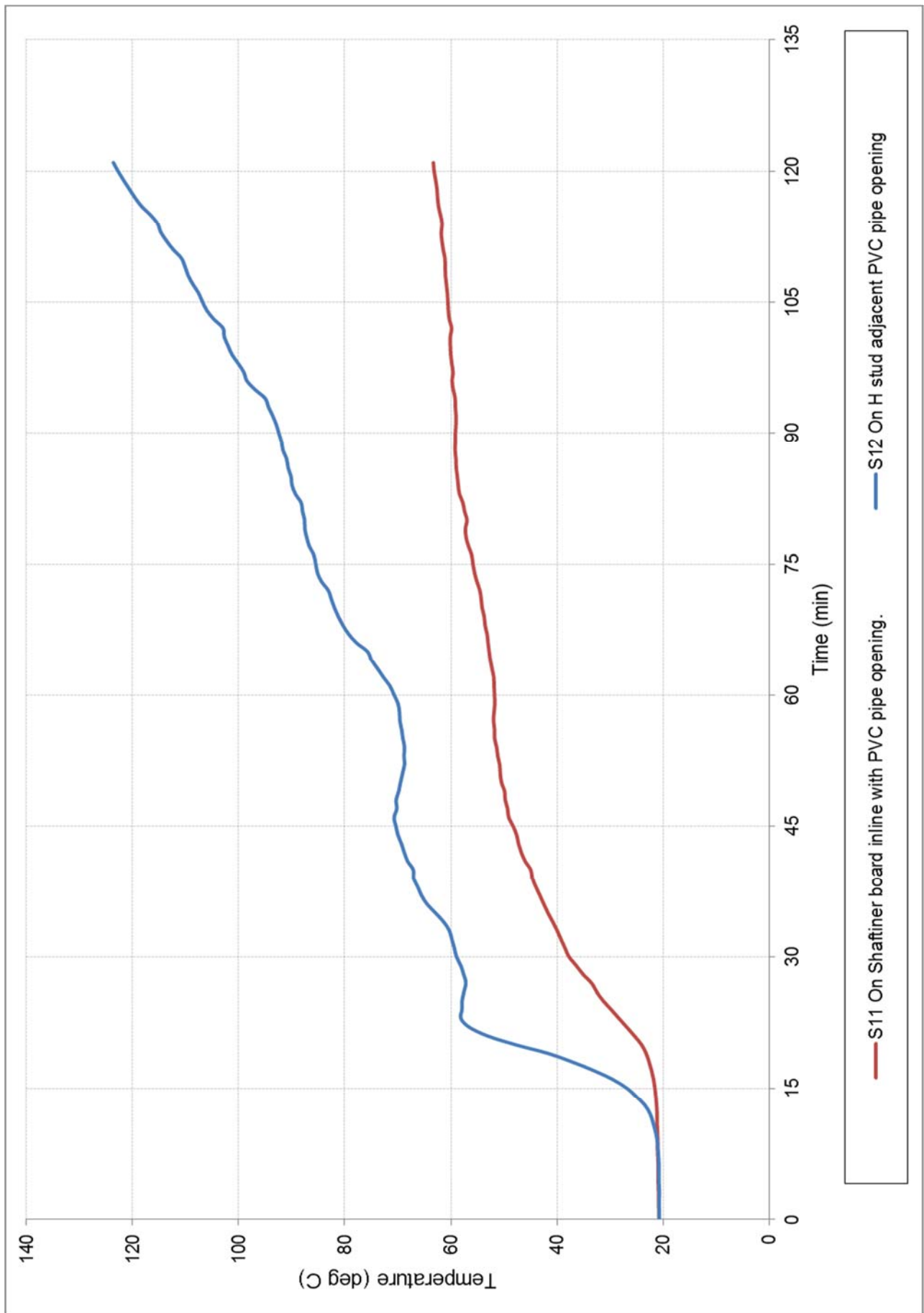


FIGURE 4 – SPECIMEN TEMPERATURE – ASSOCIATED WITH SPECIMEN 2

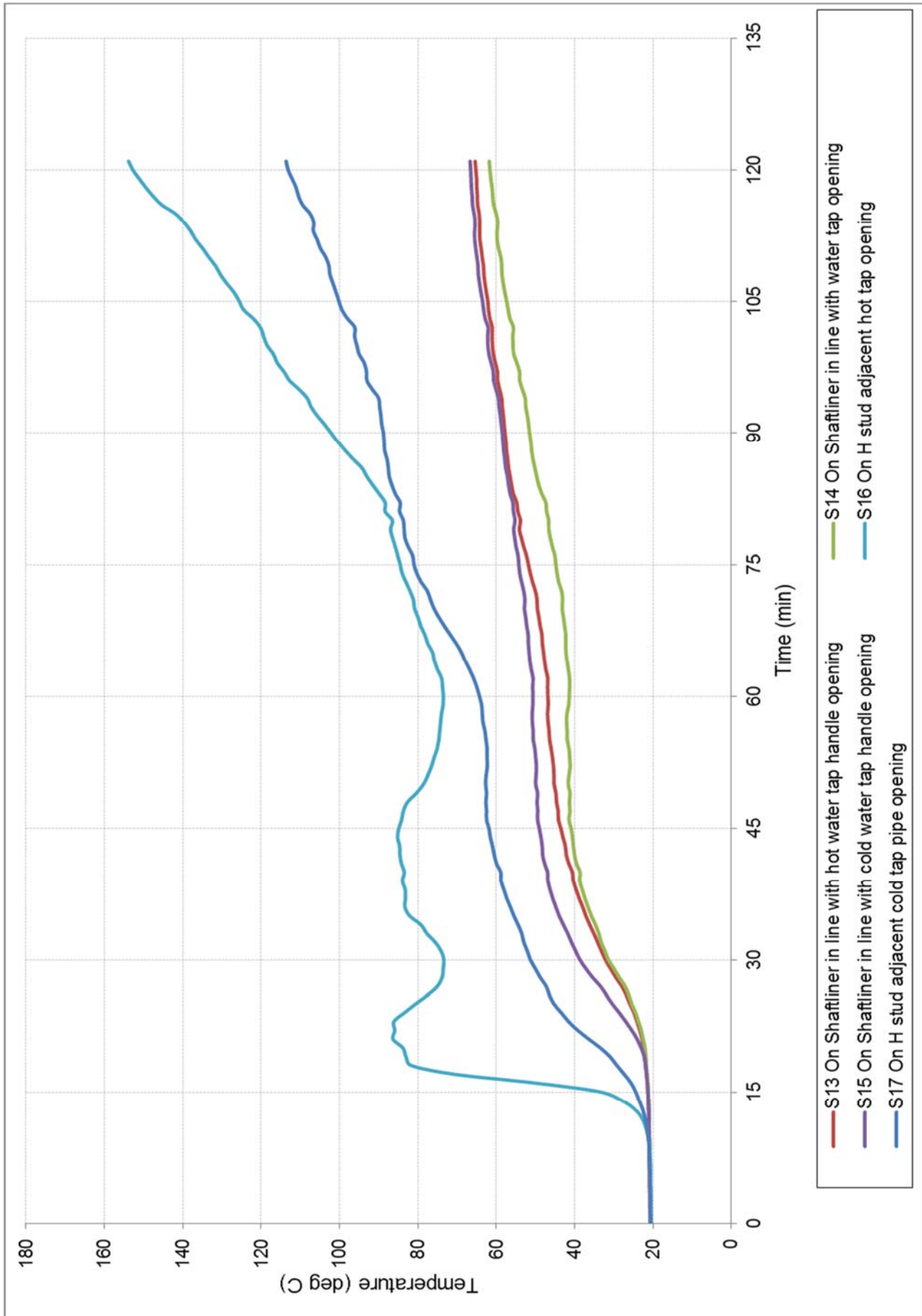


FIGURE 5 – SPECIMEN TEMPERATURE – ASSOCIATED WITH SPECIMEN 3

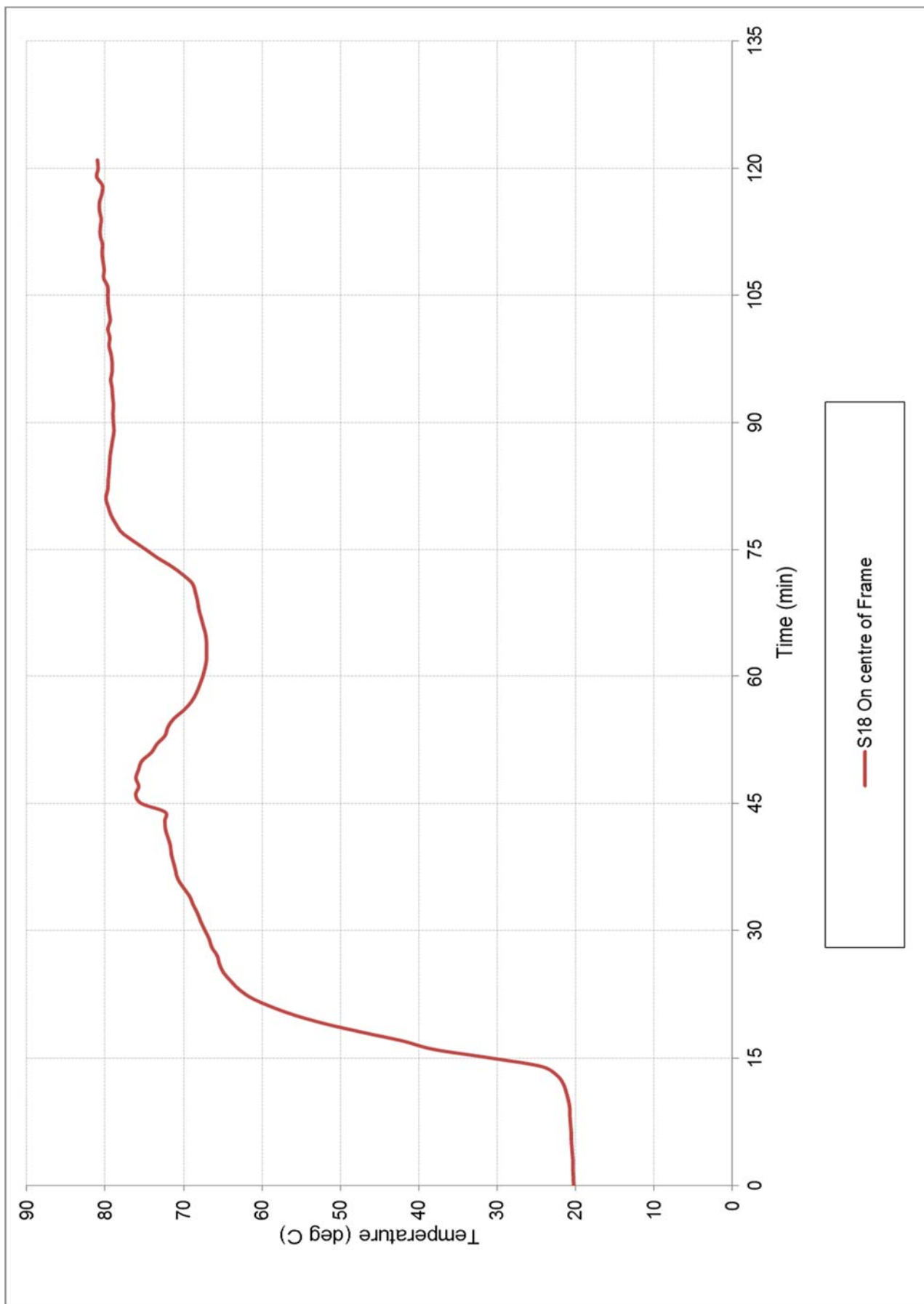


FIGURE 6 – HEAD OF SPECIMEN WALL TEMPERATURE

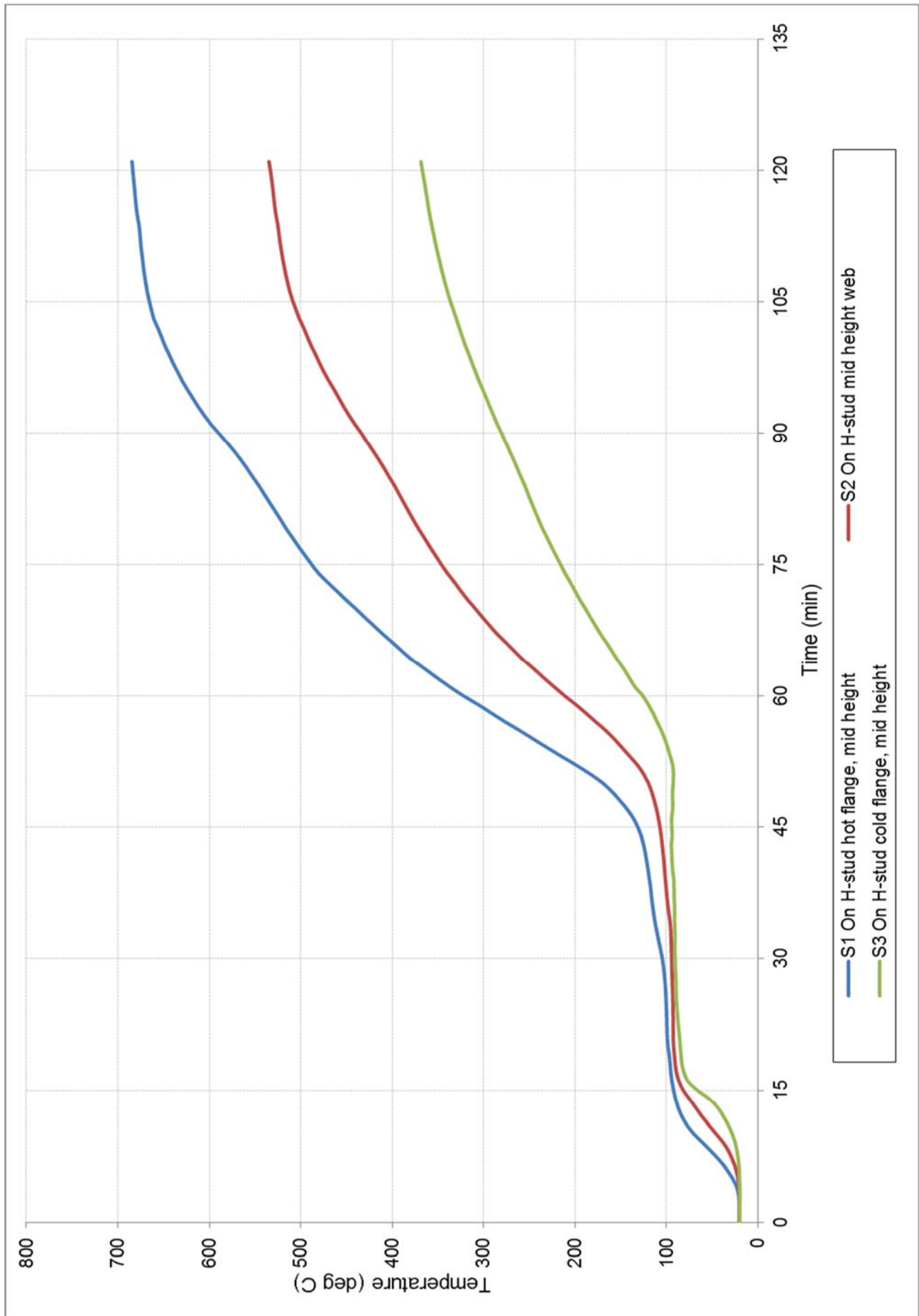


FIGURE 7 – SPECIMEN TEMPERATURE – SPECIMEN TEMPERATURE – INTERNAL C-H STEEL STUD

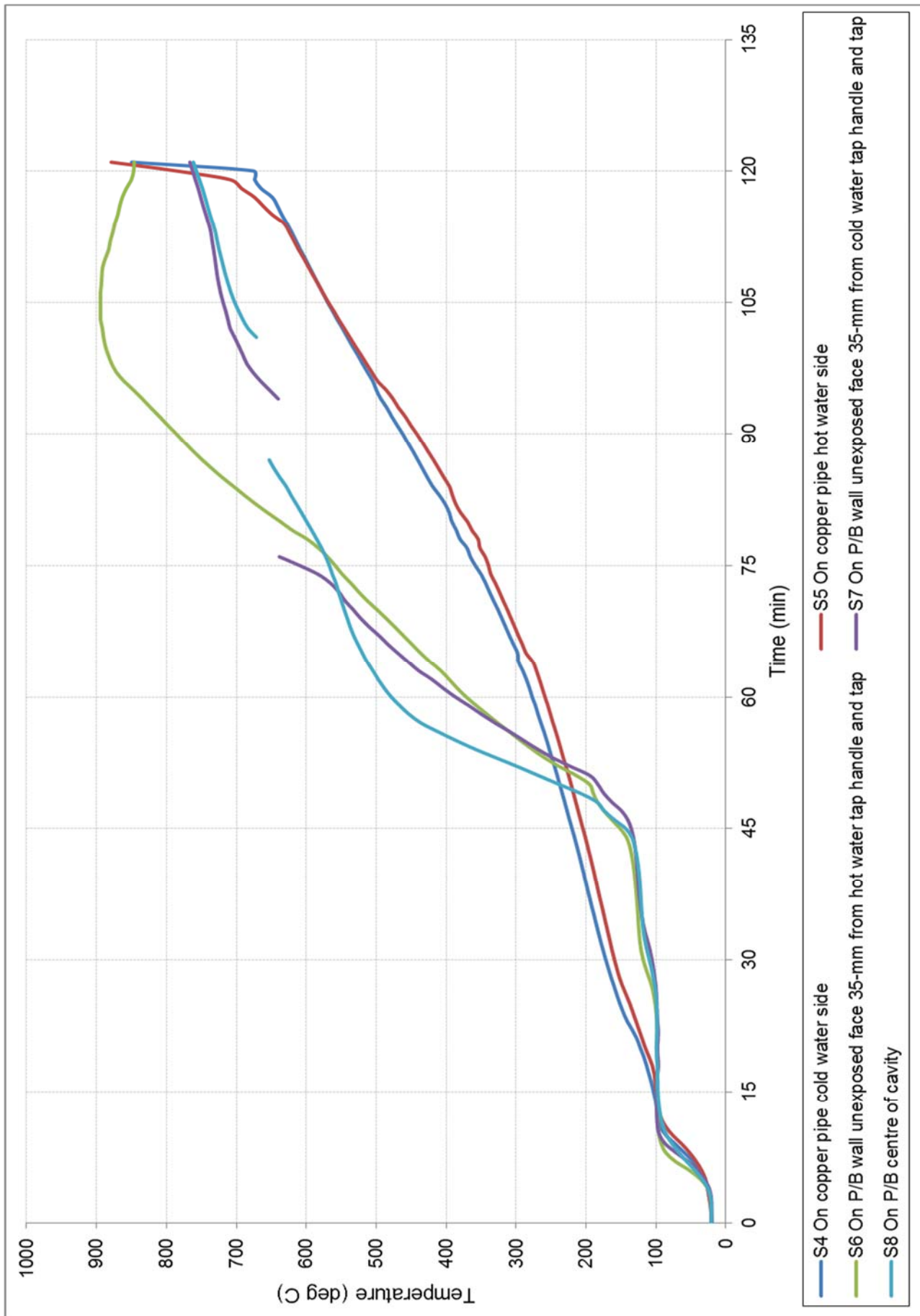
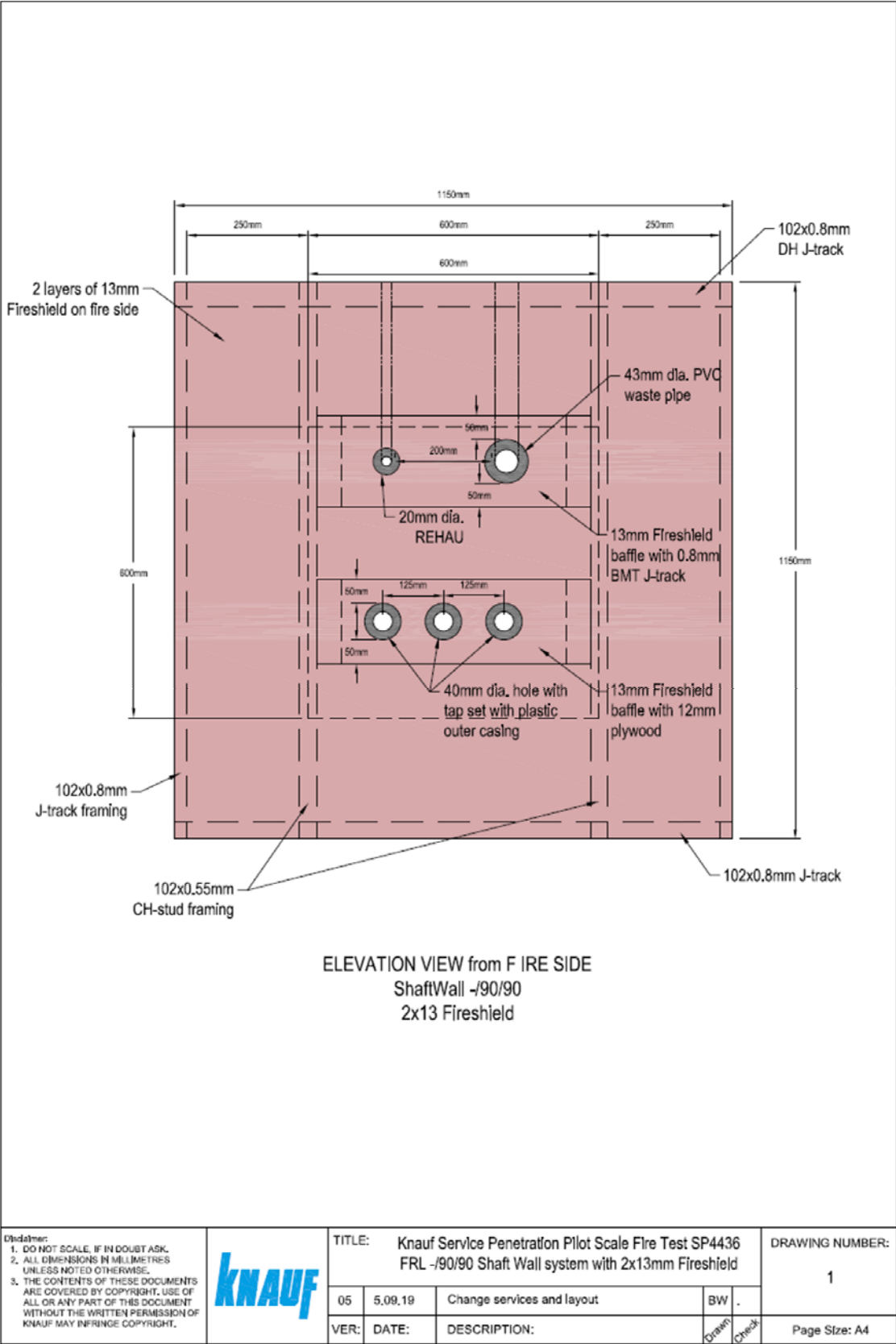
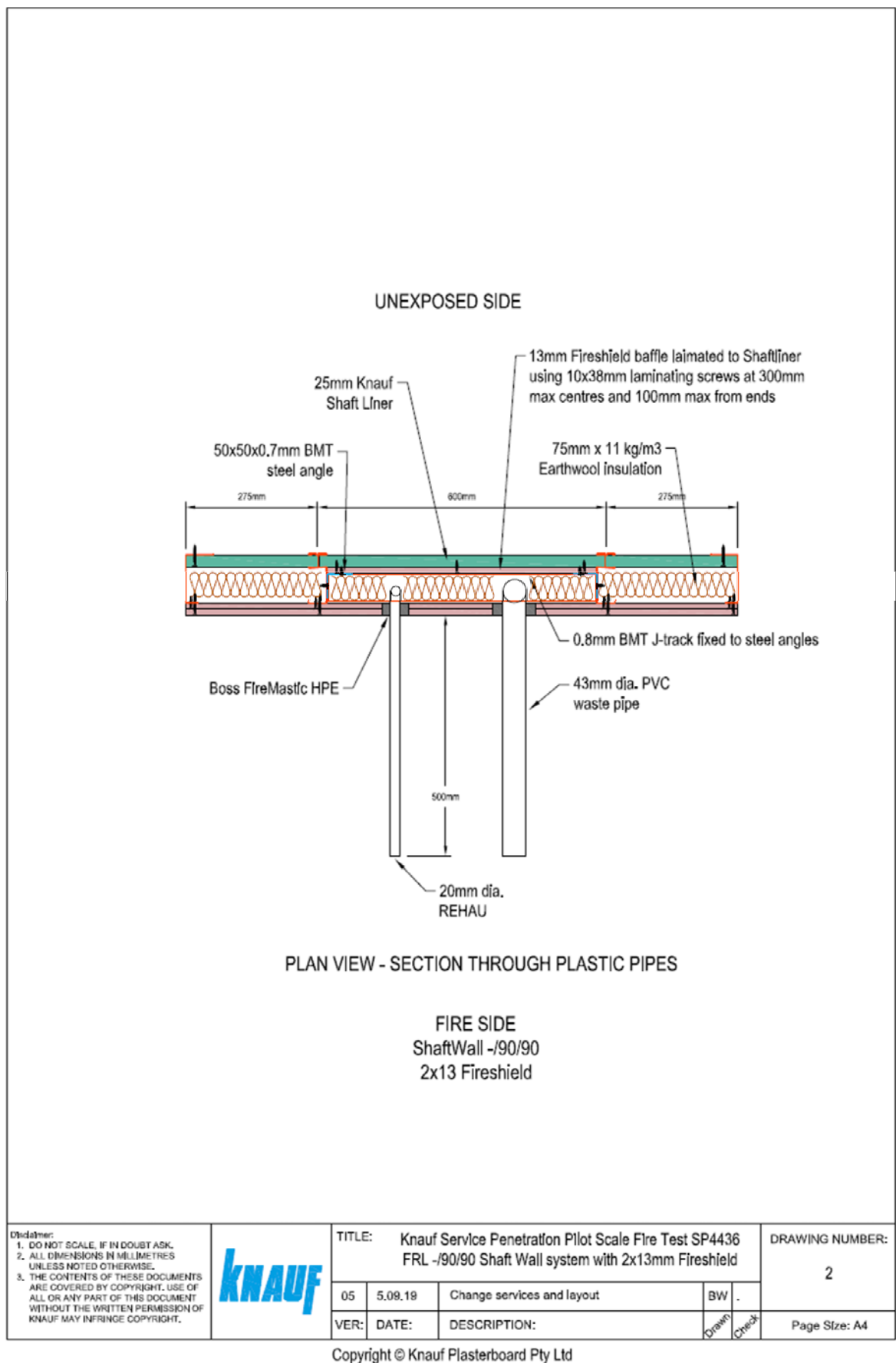


FIGURE 8 – SPECIMEN TEMPERATURE –INSIDE THE WALL CAVITY OF SPECIMEN 3

Appendix D – Specimen drawings

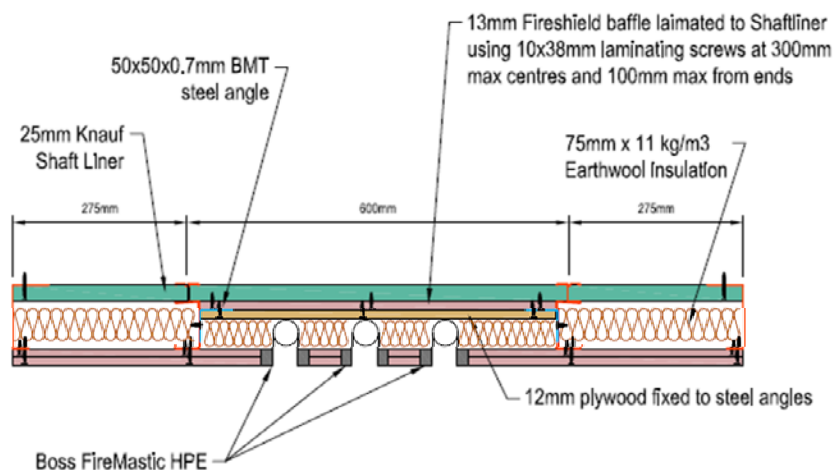


DRAWING NUMBER 1, TITLED “KNAUF SERVICE PENETRATIONS PILOT SCALE FIRE TEST SP4436 FRL-/90/90 SHAFT WALL SYSTEM WITH 2 X13MM FIRESHIELD”, DATED 5 SEPTEMBER 2019 BY KNAUF



DRAWING NUMBER 2, TITLED “KNAUF SERVICE PENETRATIONS PILOT SCALE FIRE TEST SP4436 FRL-/90/90 SHAFT WALL SYSTEM WITH 2 X13MM FIRESHIELD”, DATED 5 SEPTEMBER 2019 BY KNAUF

UNEXPOSED SIDE



PLAN VIEW - SECTION THROUGH TAP-SET

FIRE SIDE
ShaftWall -/90/90
2x13 Fireshield

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FRL -/90/90 Shaft Wall system with 2x13mm Fireshield

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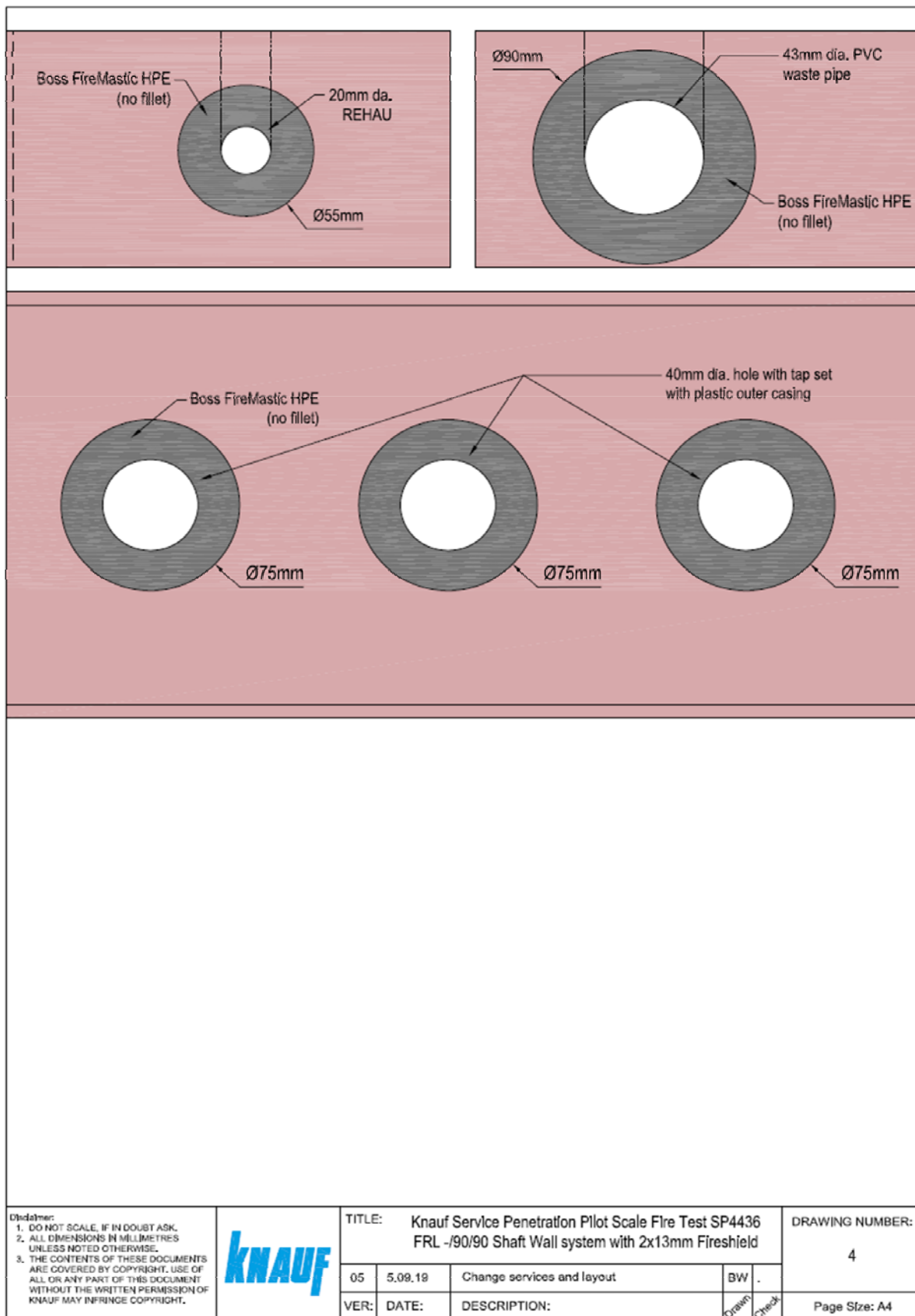
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VER:	DATE:	DESCRIPTION:	Drawn Check

Page Size: A4

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DRAWING NUMBER 3, TITLED "KNAUF SERVICE PENETRATIONS PILOT SCALE FIRE TEST SP4436 FRL-/90/90 SHAFT WALL SYSTEM WITH 2 X13MM FIRESHIELD", DATED 23 OCTOBER 2019 BY KNAUF



DRAWING NUMBER 4, TITLED “KNAUF SERVICE PENETRATIONS PILOT SCALE FIRE TEST SP4436 FRL-/90/90 SHAFT WALL SYSTEM WITH 2 X13MM FIRESHIELD”, DATED 5 SEPTEMBER 2019 BY KNAUF

References

The following informative documents are referred to in this Report:

- | | |
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| 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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