Fire-resistance test on a load-bearing vertical separating element

Test Report

Author: Chris Wojcik
Report number: FSV 1708B
Date: 7 March 2016
(This report supersedes issue dated 24 November 2015)

Client: Fire Combat Australia Pty Ltd t/a FireCrunch Australia

Commercial-in-confidence

NATA Accredited Laboratory
Number: 165
Corporate Site No 3625
Accredited for compliance with ISO/IEC 17025

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The Client

Fire Combat Australia Pty Ltd t/a FireCrunch Australia
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Report Status and Revision History:

VERSION	STATUS	DATE	DISTRIBUTION	ISSUE NUMBER
Revision A	Draft for internal review	02/09/2015	CSIRO	FSV 1708
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Revision C	Minor change	24/11/2015	CSIRO/CLIENT	FSV 1708A
Revision D	Amendment	01/03/2016	CSIRO/CLIENT	FSV 1708B

Report Authorization:

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		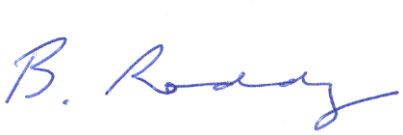
7 March 2016	7 March 2016	7 March 2016

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Important disclaimer

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Fire-resistance test on a load-bearing vertical separating element

Sponsored Investigation No. FSV 1708B

1 Introduction

1.1 Identification of specimen

The sponsor identified the specimen as a load-bearing steel-framed wall system, lined on both sides with one layer of 10-mm thick MBE-10 FireCrunch boards.

1.2 Sponsor

Fire Combat Australia Pty Limited t/a FireCrunch Australia
Suite 19, Level 44 MLC Centre
19 Martin Place
Sydney NSW 2000

1.3 Manufacturer

Fire Combat Australia Pty Limited t/a FireCrunch Australia has provided full manufacturers details to CSIRO in relation to the 10-mm thick MBE-10 magnesium oxide boards which are manufactured in Shandon Province China. Fire Combat Australia Pty Limited t/a FireCrunch Australia has advised that the FireCrunch MBE-10 magnesium oxide board is manufactured in accordance with Fire Combat Australia Pty Limited t/a FireCrunch Australia specification in relation to the percentage mix of the MgO and other composite materials.

1.4 Test standards

Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4-2005, Fire-resistance tests of elements of construction.

Section 3: Walls – Vertical Separating Elements.

1.5 Test number

CSIRO Reference test number FS4512/3885.

1.6 Test date

The fire-resistance test was conducted on 24 August 2015.

2 Description of specimen

2.1 General

The specimen consisted of a load-bearing framed wall system of overall nominal dimensions 3000-mm high x 3000-mm wide x 110-mm thick. The wall consisted of a steel stud frame lined on both sides with MBE-10 FireCrunch boards, and the cavity filled with glass wool insulation.

Structural framework

The wall frame consisted of six 90-mm x 45-mm x 1.0-mm BMT steel studs fixed into top and bottom 90-mm x 45-mm x 1.0-mm BMT steel tracks. The studs were spaced at nominal 400-mm centres, two back to back studs were used along each of the board joints, as shown in drawing numbered 1, undated, by FireCrunch Australia Pty Limited. Steel noggings, 90-mm x 45-mm x 1.0-mm BMT were fixed between the studs at 1000-mm centres. The steel frame was screwed together using 10 gauge 25-mm long steel screws.

Lining and cavity insulation

The frame was faced on each side of the studs with one layer of 10-mm thick MBE-10 FireCrunch magnesium oxide boards orientated vertically. The sheets were nominally 1200-mm wide x 3000-mm long x 10-mm thick, with stated density of 950 kg/m^3.

Before the boards were fixed onto the frame, a 3-mm x 10-mm bead of PROMASEAL A acrylic sealant was applied to the flanges of both tracks and studs and allowed to set overnight. The boards were then secured to the studs with 6-gauge x 25-mm long bugle head drywall screws at 200-mm centres, through pre-drilled holes, and no less than 100-mm from the top and bottom to avoid the tracks. The boards were not fixed to the top or bottom tracks.

A nominal 6-mm gap was left between all board joints which was later sealed to the full depth using PROMASEAL A acrylic sealant, taped and set using a setting compound.

The wall cavity was filled with one layer of Fletcher Insulation R2.7 Pink SonoBatts. The batts had a stated density of 32 kg/m^3, measured 1160-mm in length, 430-mm in width and were 90-mm thick.

2.2 Orientation

The wall system was of symmetrical construction.

2.3 Dimensions

The wall specimen was nominally 3000-mm wide x 3000-mm high x 110-mm thick. All dimensions are nominal.

2.4 Restraints

The specimen was unrestrained along both sides. The resulting gaps along the unrestrained edges were sealed with compressed ceramic fibre.

2.5 Load

A total load of 55 kN (~18.3 kN/m) was applied to the specimen for the duration of the test. The load determined by the sponsor, was applied uniformly by a steel platen acting along the top of the wall.

2.6 Conditioning

The specimen wall was constructed on 20 August 2015.

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

The construction 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:

- drawing numbered 1, undated, by FireCrunch Australia Pty Limited.

Due to the purpose of the test, no confidential information about the test specimen has been submitted to CSIRO Materials Science and Engineering.

4 Equipment

4.1 Furnace

The furnace had a nominal opening of 3000-mm x 3000-mm for attachment of vertical 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.

4.2 Temperature

The temperature in the furnace chamber was measured by eight type K, 3-mm diameter, 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.

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

4.3 Pressure

The furnace pressure was measured by a differential low-pressure transducer with a range of ± 50 Pa.

The pressure probe was located approximately 1000-mm above the sill of the furnace, where the pressure was controlled at 4 Pa.

4.4 Measurement system

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

5 Ambient temperature

The temperature of the test area was 17°C at the commencement of the test.

6 Departure from standard

There were no departures from the requirements of AS 1530.4-2005.

7 Termination of the test

The test was terminated at 93 minutes by the agreement with the sponsor.

8 Test results

8.1 Critical observations

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

6 minutes -	Smoke is emitted from along the perimeter of the wall.
28 minutes -	Amount of smoke emitted from the specimen has increased.
30 minutes -	A crack has developed in the stopping along the right board joint (photograph 4).
50 minutes -	Steel framing outline is visible on the unexposed face of the wall (photograph 5).
66 minutes -	Glow is visible through the crack noted at 30 minutes (photograph 6).

70 minutes - Cotton wool pad test applied over the glowing joint noted at 66 minutes – no ignition of cotton noted.

74 minutes - Integrity failure - cotton wool pad test applied over the glowing joint noted at 66 minutes – ignition of cotton noted.

76 minutes - Insulation failure – maximum temperature rise limit of 180 deg Celsius is exceeded on the unexposed face of the wall, adjacent to the cracked panel joint at ¾ height.

Joint stopping material is starting to discolour along the crack noted at 30 minutes.

90 minutes - Crack along the panel joint noted at 70 minutes is approximately 6-8-mm in width (photograph 8).

93 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 Furnace pressure

Figure 3 shows the curve of average pressure versus time inside the furnace chamber recorded during the heating period.

8.5 Specimen temperature

Figure 4 shows curves of average and maximum temperature versus time recorded on the unexposed face of the specimen.

Figure 5 shows the curve of maximum temperature versus time recorded around the perimeter of the specimen.

Figure 6 shows the curve of maximum temperature versus time recorded next to the panel joints.

8.6 Specimen deflection

Figure 7 shows the curves of maximum lateral deflection versus time recorded at the centre and the edge of the wall.

Figure 8 shows the curves of maximum axial deflection versus time recorded at both edges of the wall.

8.7 Performance

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

Structural adequacy	-	no failure at 93 minutes
Integrity	-	74 minutes
Insulation	-	76 minutes

This report details methods of construction, the test conditions and the results obtained when 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 of the test specimen was 90/60/60.

The fire-resistance level of the wall system is applicable when the system is exposed to fire from either direction.

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.

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 3.8 of AS1530.4-2005, have been made provided no individual component is removed or reduced.

11 Tested by

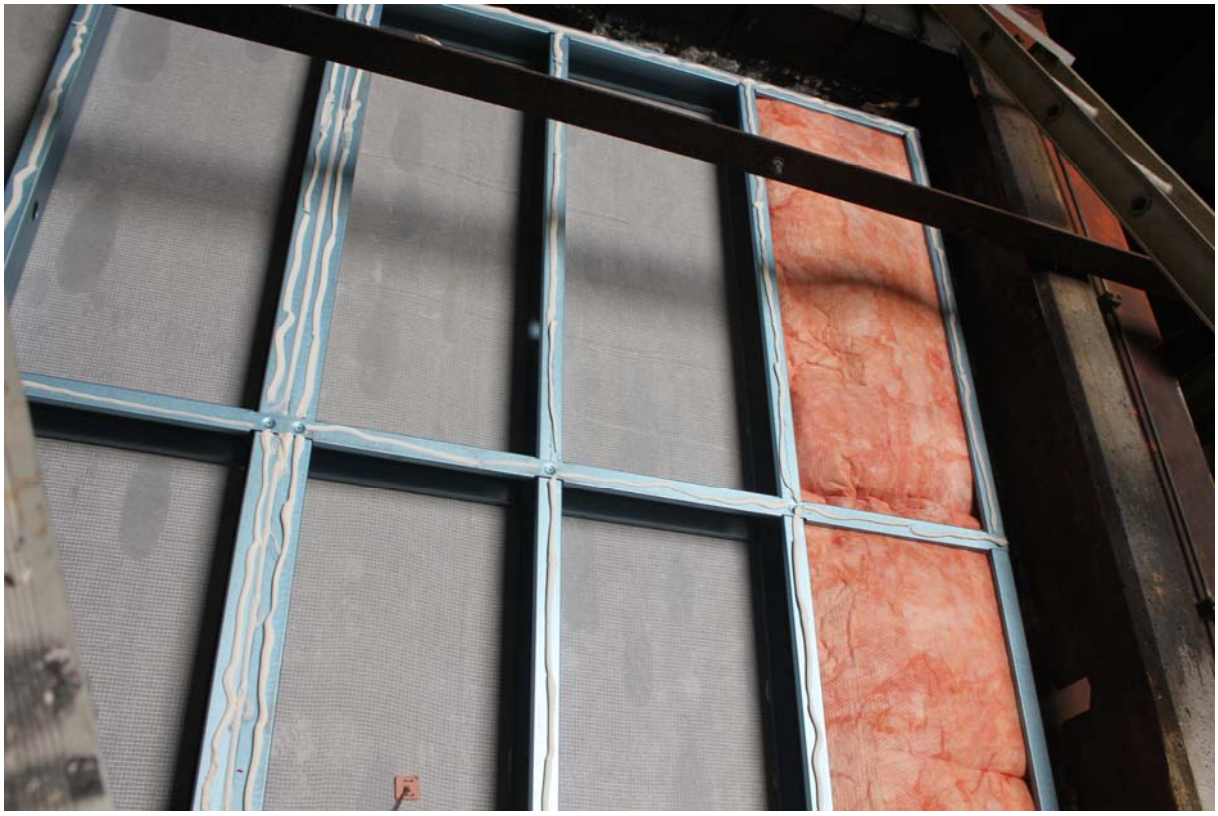
Chris Wojcik
Testing Officer

Appendices

Appendix A – Measurement location

Measurement Location		
Group location	**T/C Position**	**T/C designation**
Specimen		
Stud #1 – left of centre – mid height	On exposed flange	S1
	On the web	S2
	On unexposed flange	S3
Stud #2 (back to back studs) – right of centre – mid-height	On exposed flange	S4
	On the web	S5
	On unexposed flange	S6
Unexposed face of the exposed board	Left of centre	S7
	Right of centre	S8
Unexposed Face	Top Left Quarter Point	S9
	Top Right Quarter Point	S10
	Bottom Left Quarter Point	S11
	Bottom Right Quarter Point	S12
	Centre	S13
Perimeter	100-mm from the left free edge-centre height	S14
	Head – over a stud	S15
	Head – mid-width	S16
	Head – over a control joint	S17
	100-mm from the left free edge-centre height	S18
Left joint	15-mm from the joint @ ¾ height	S19
	15-mm from the joint @ ½ height	S20
Right joint	15-mm from the joint @ ¾ height	S21
	15-mm from the joint @ ½ height	S22
Rover		S23
Ambient		S24

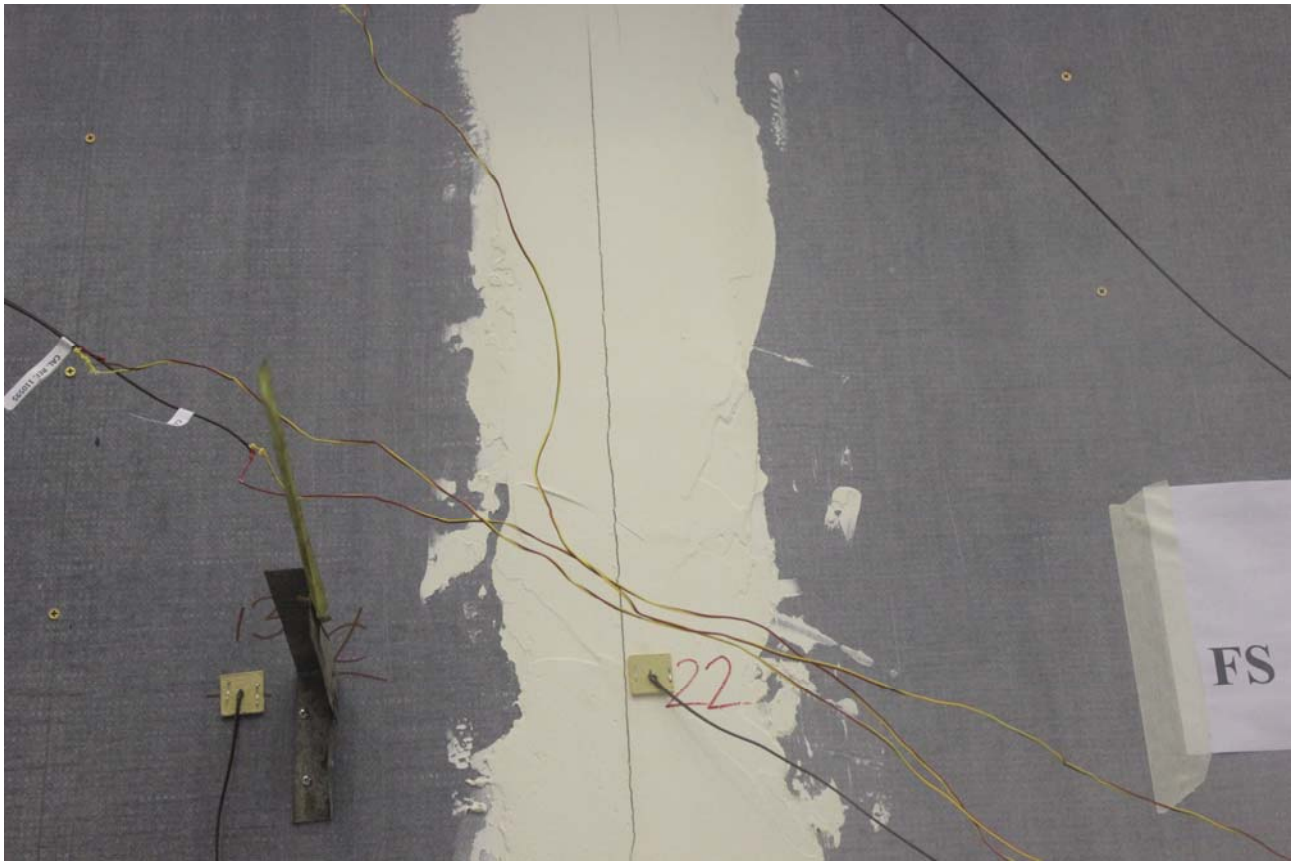
Appendix B – Test photographs



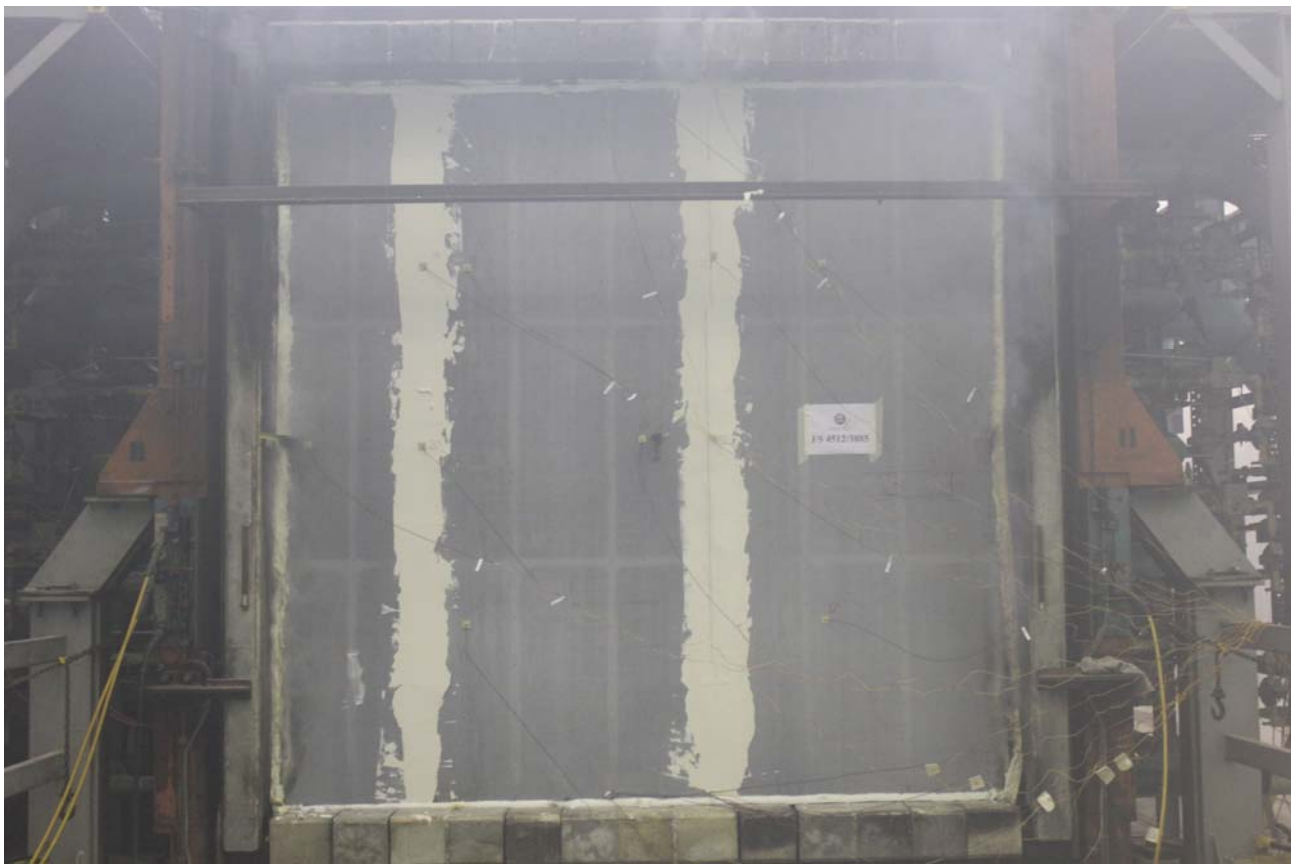
PHOTOGRAPH 1 – SPECIMEN CONSTRUCTION

PHOTOGRAPH 2 – UNEXPOSED FACE OF THE SPECIMEN PRIOR TO TESTING

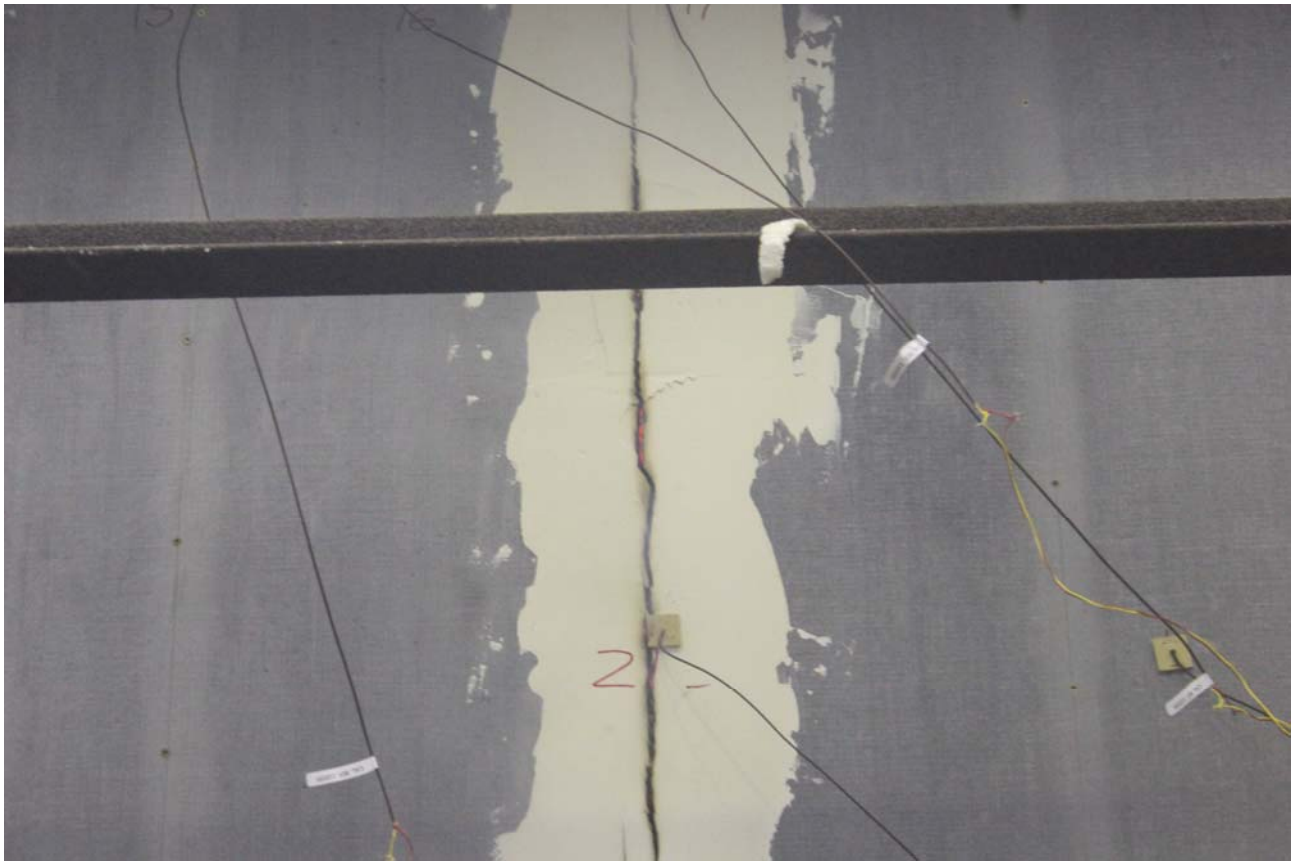
PHOTOGRAPH 3 – UNEXPOSED FACE OF THE SPECIMEN PRIOR TO TESTING



PHOTOGRAPH 4 – SPECIMEN AT 34 MINUTES INTO THE TEST



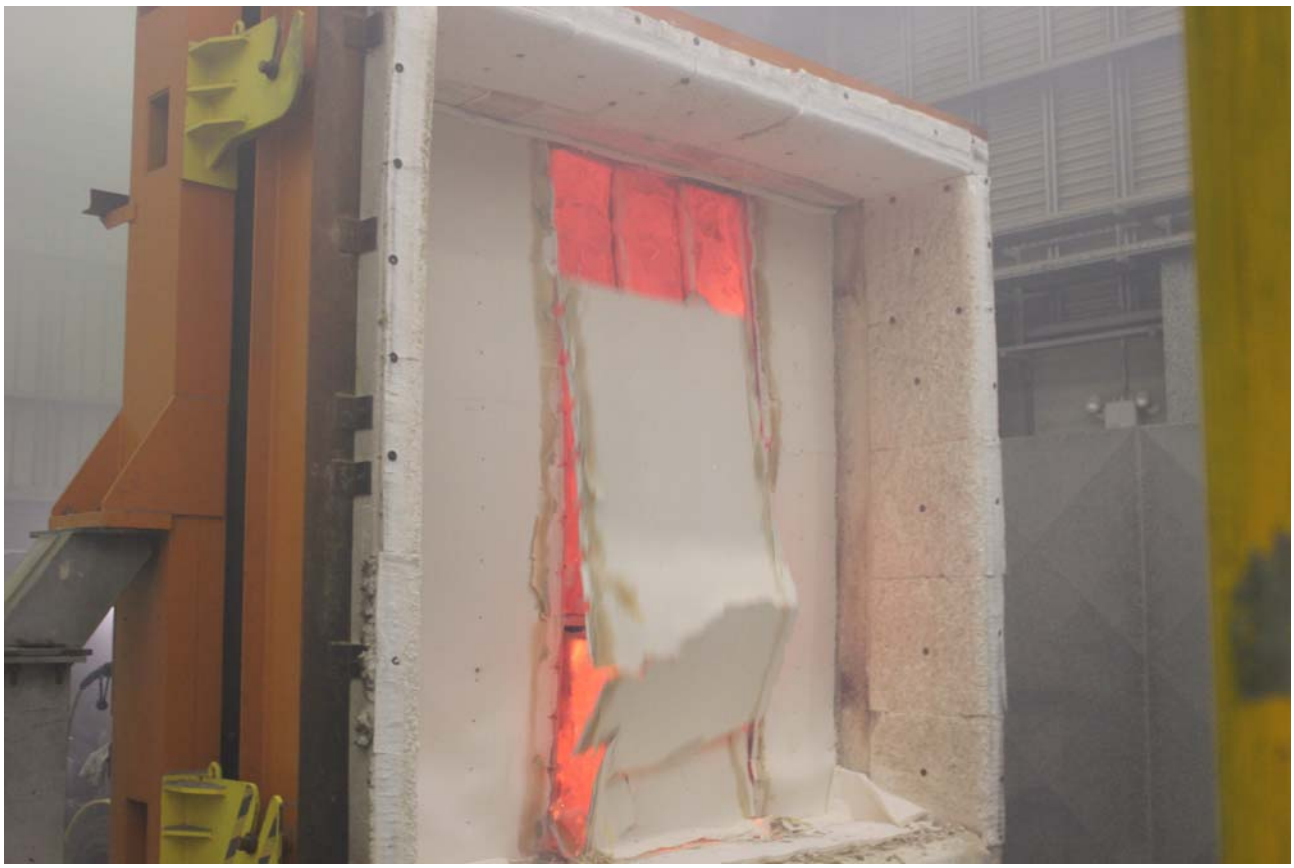
PHOTOGRAPH 5 – SPECIMEN AT 60 MINUTES INTO THE TEST



PHOTOGRAPH 6 – SPECIMEN AT 71 MINUTES INTO THE TEST

PHOTOGRAPH 7 – SPECIMEN AT 76 MINUTES INTO THE TEST

PHOTOGRAPH 8 – SPECIMEN AT THE CONCLUSION OF TESTING



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

Appendix C – Test data charts

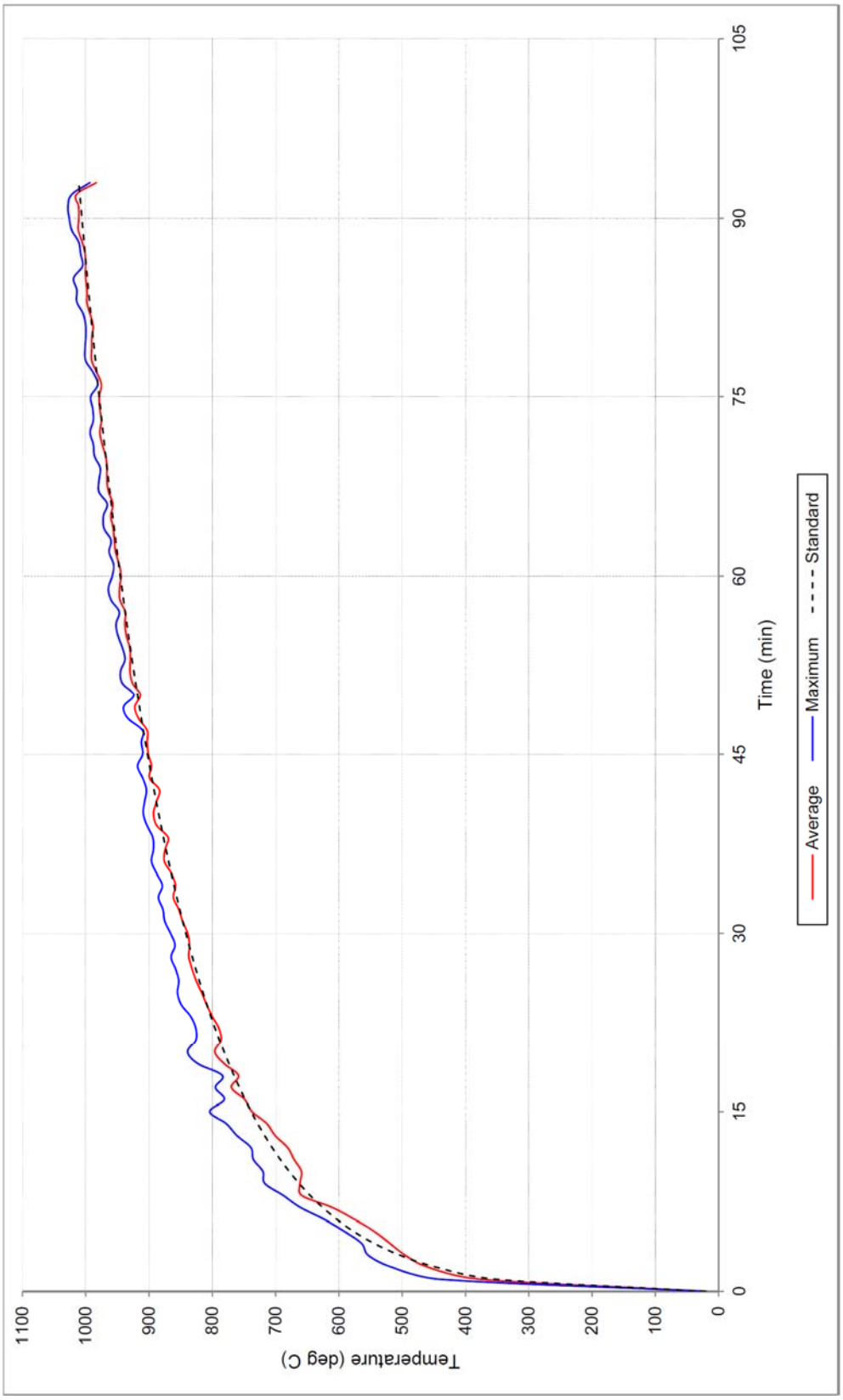


FIGURE 1 – FURNACE TEMPERATURE

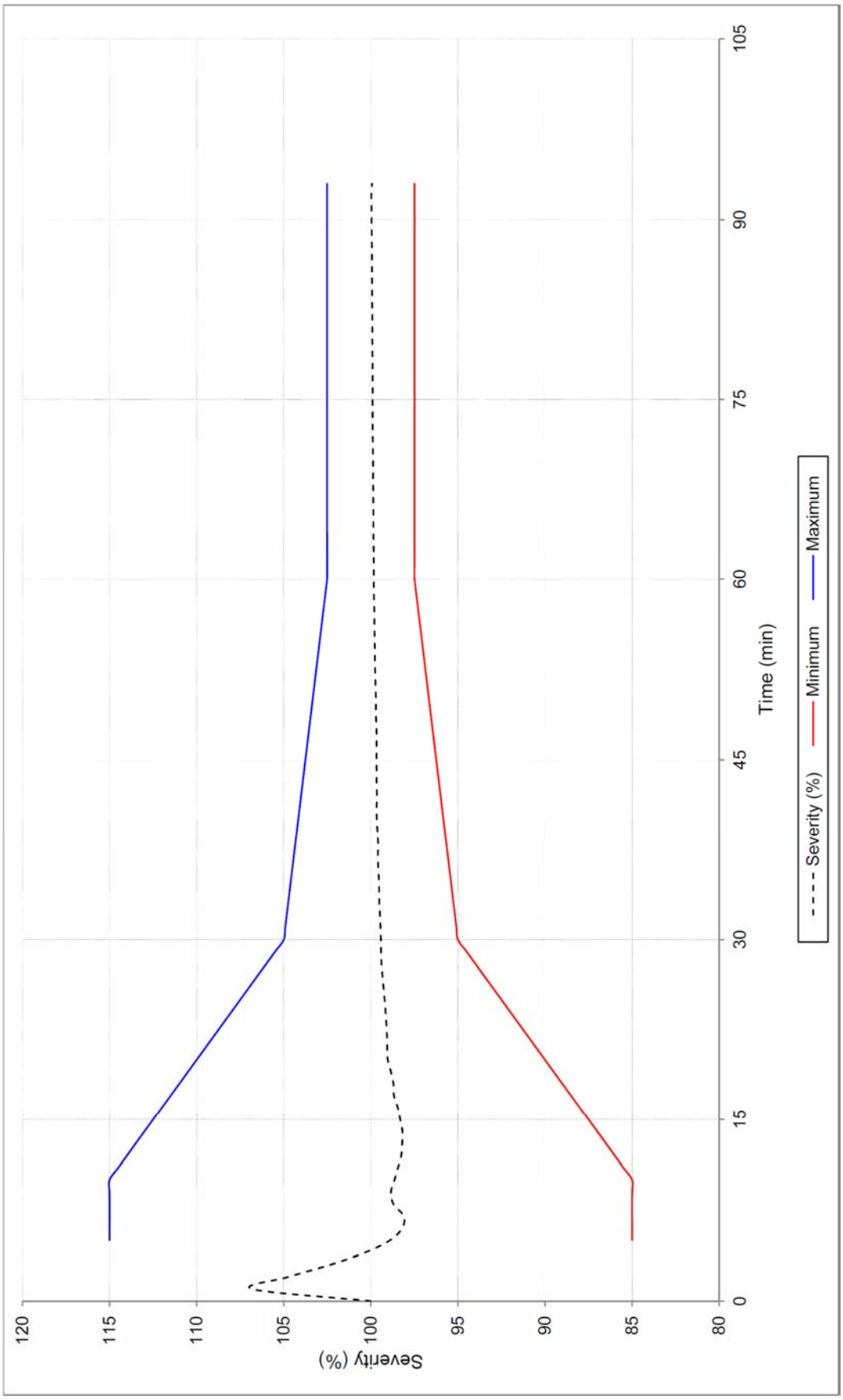


FIGURE 2 – FURNACE SEVERITY

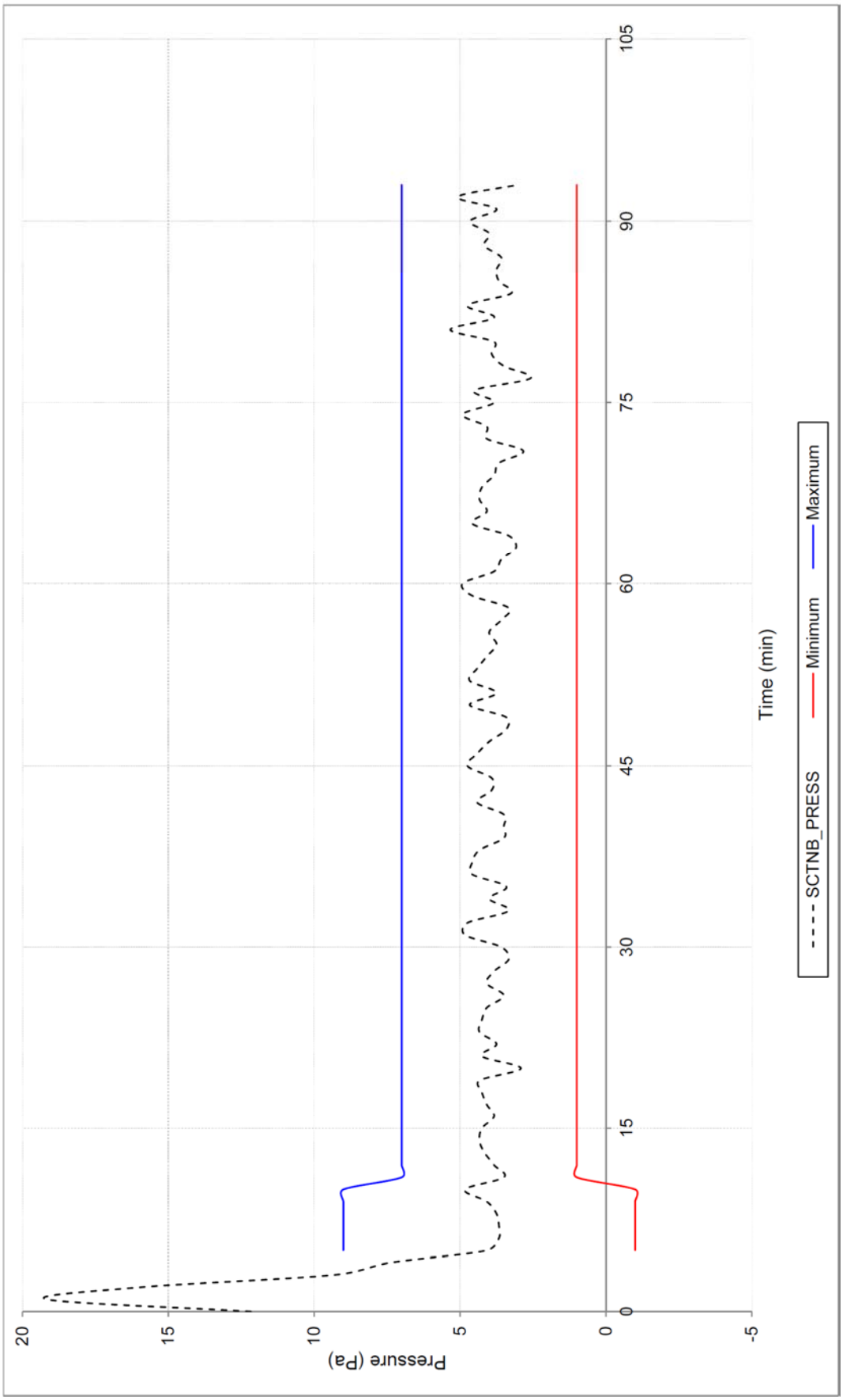


FIGURE 3 – FURNACE PRESSURE

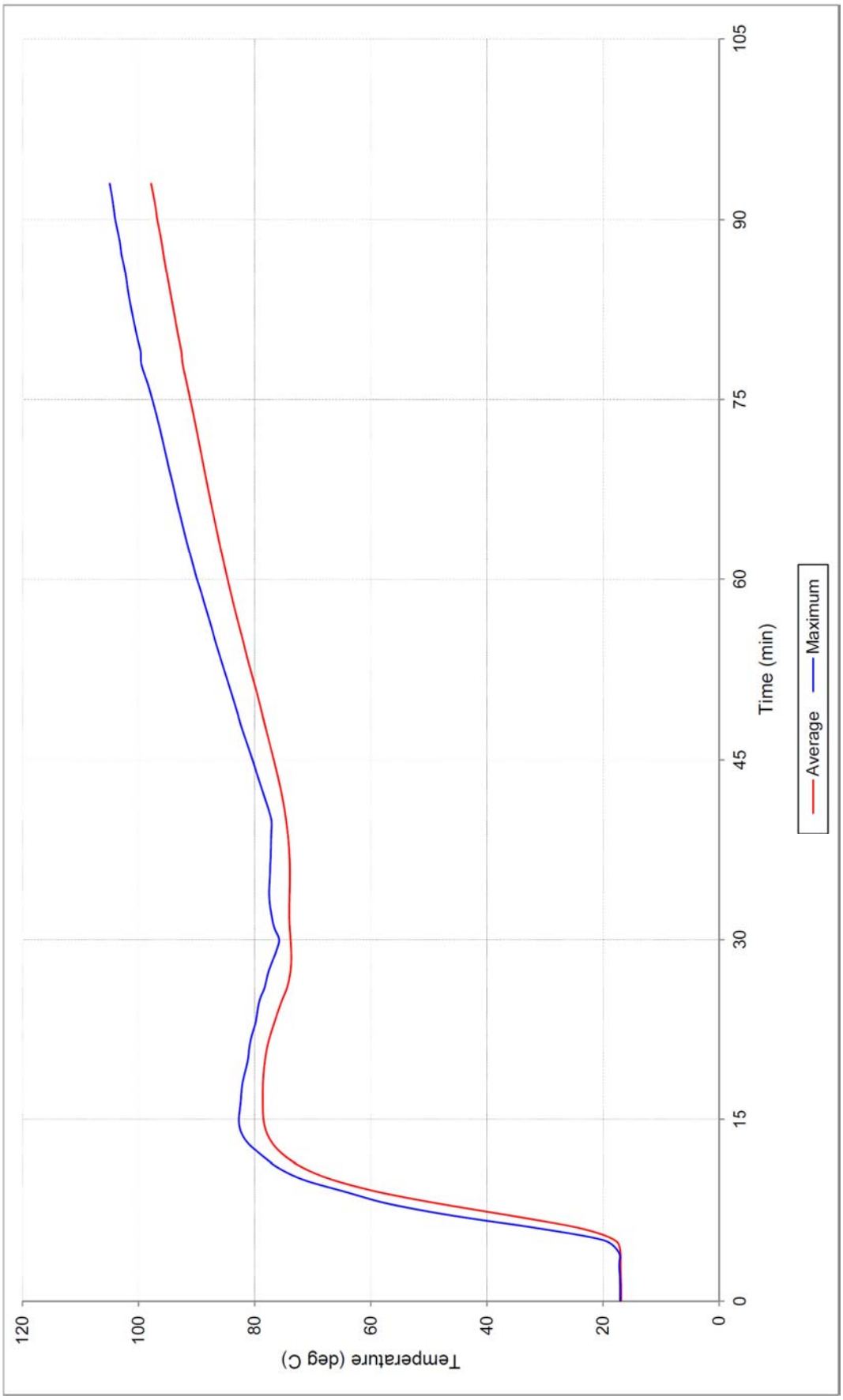


FIGURE 4 – SPECIMEN TEMPERATURE – UNEXPOSED FACE OF THE SPECIMEN

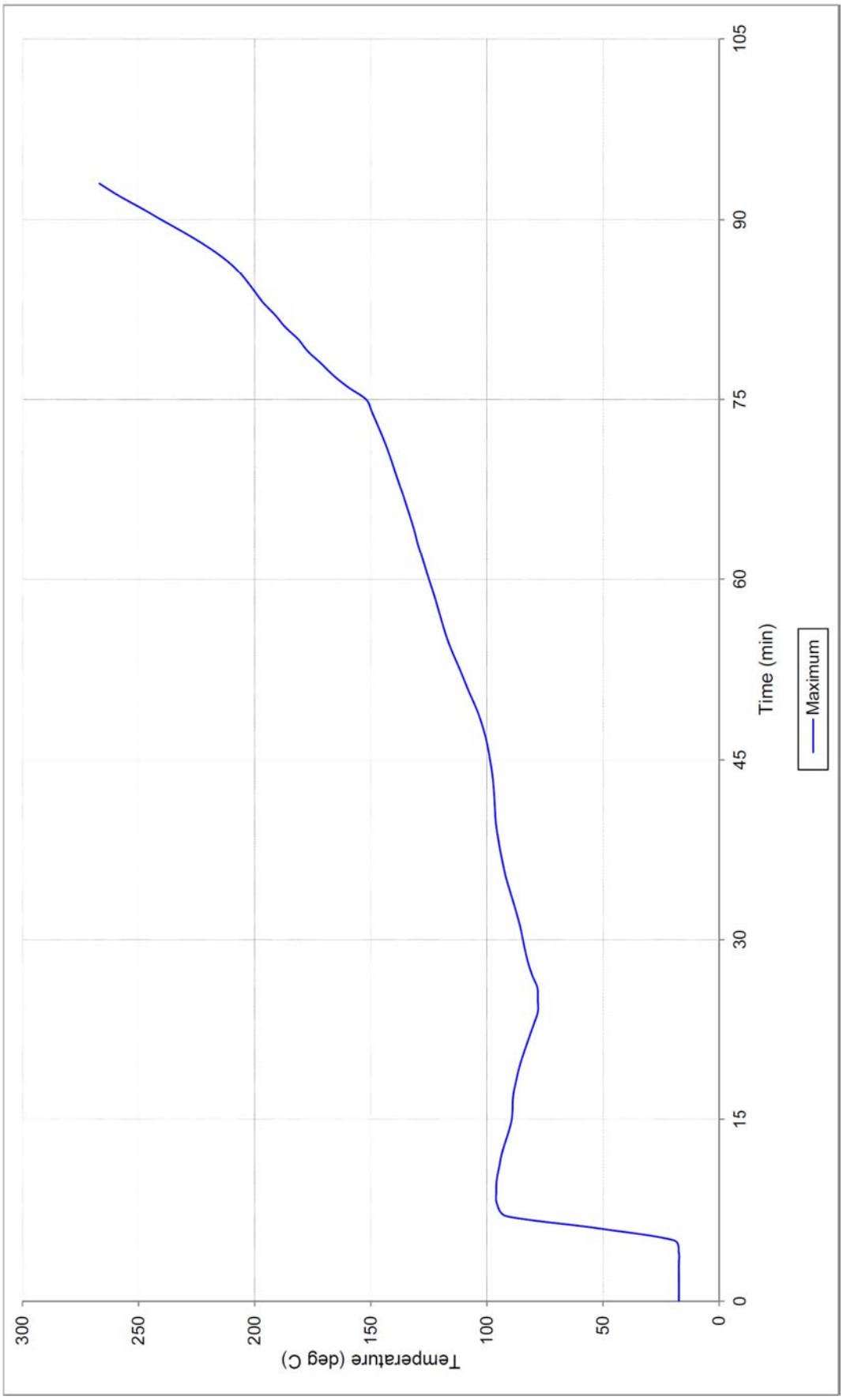


FIGURE 5 – SPECIMEN TEMPERATURE – UNEXPOSED FACE - PERIMETER

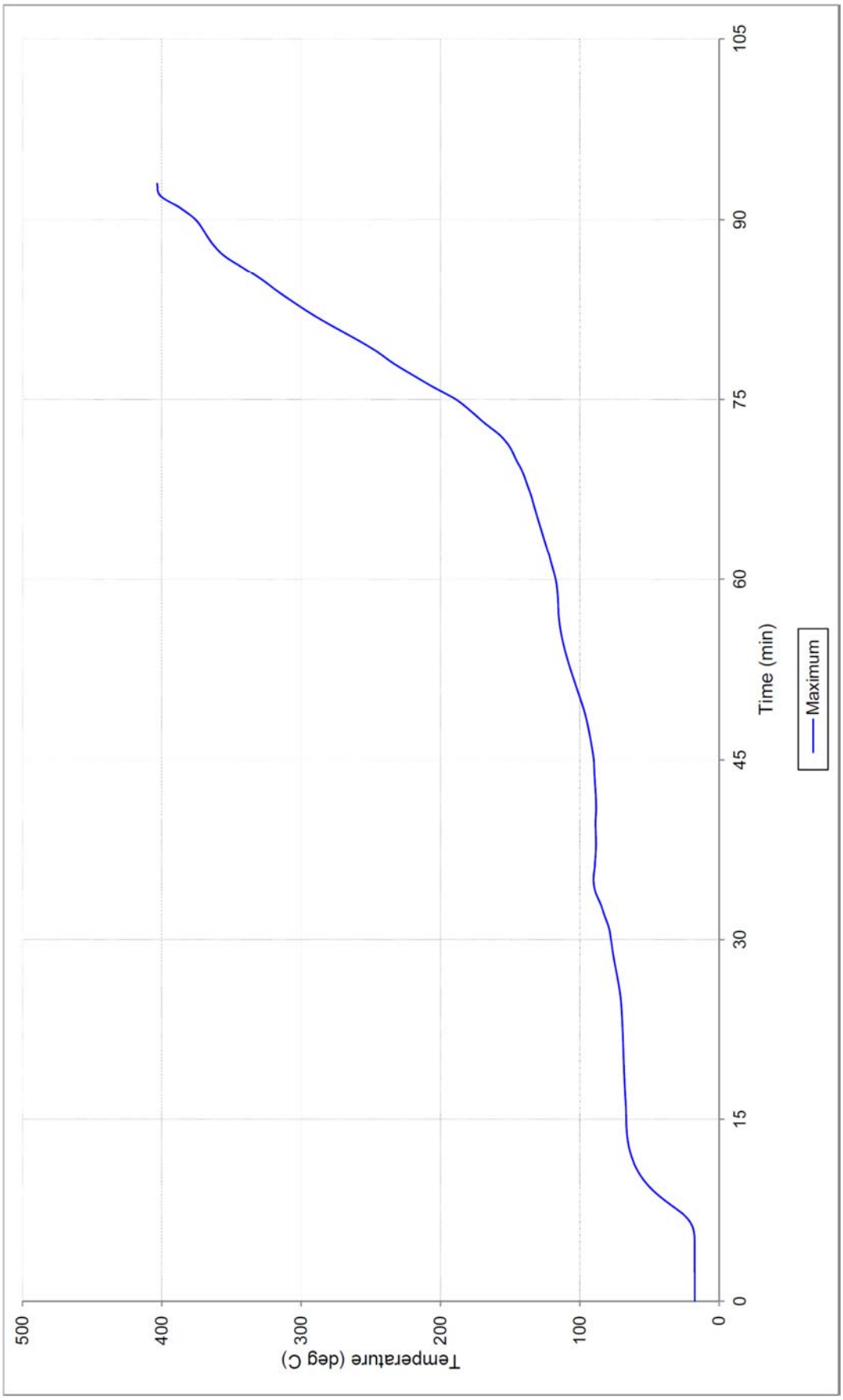


FIGURE 6 – SPECIMEN TEMPERATURE – UNEXPOSED FACE – JOINTS

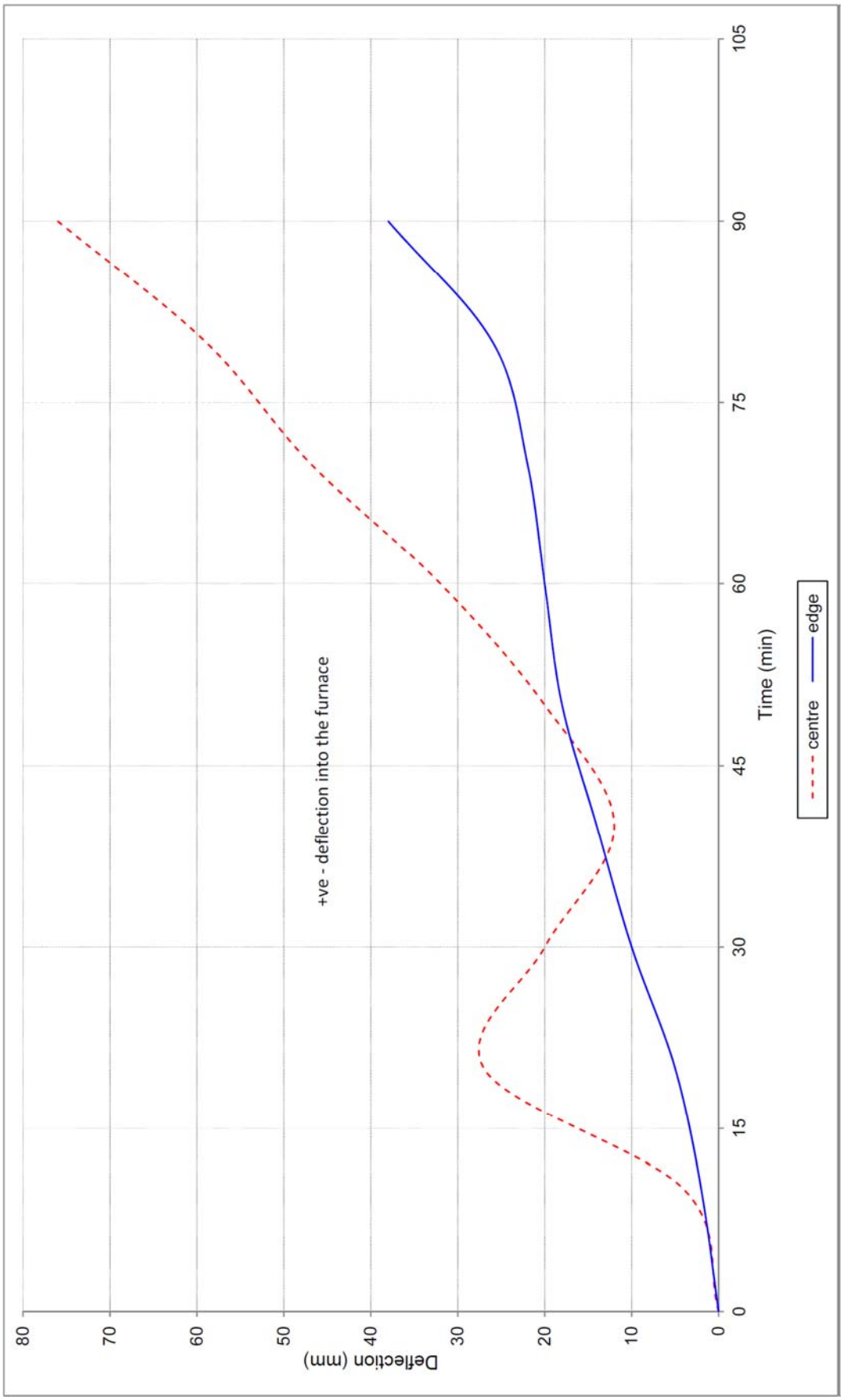


FIGURE 7 – SPECIMEN LATERAL DEFLECTION

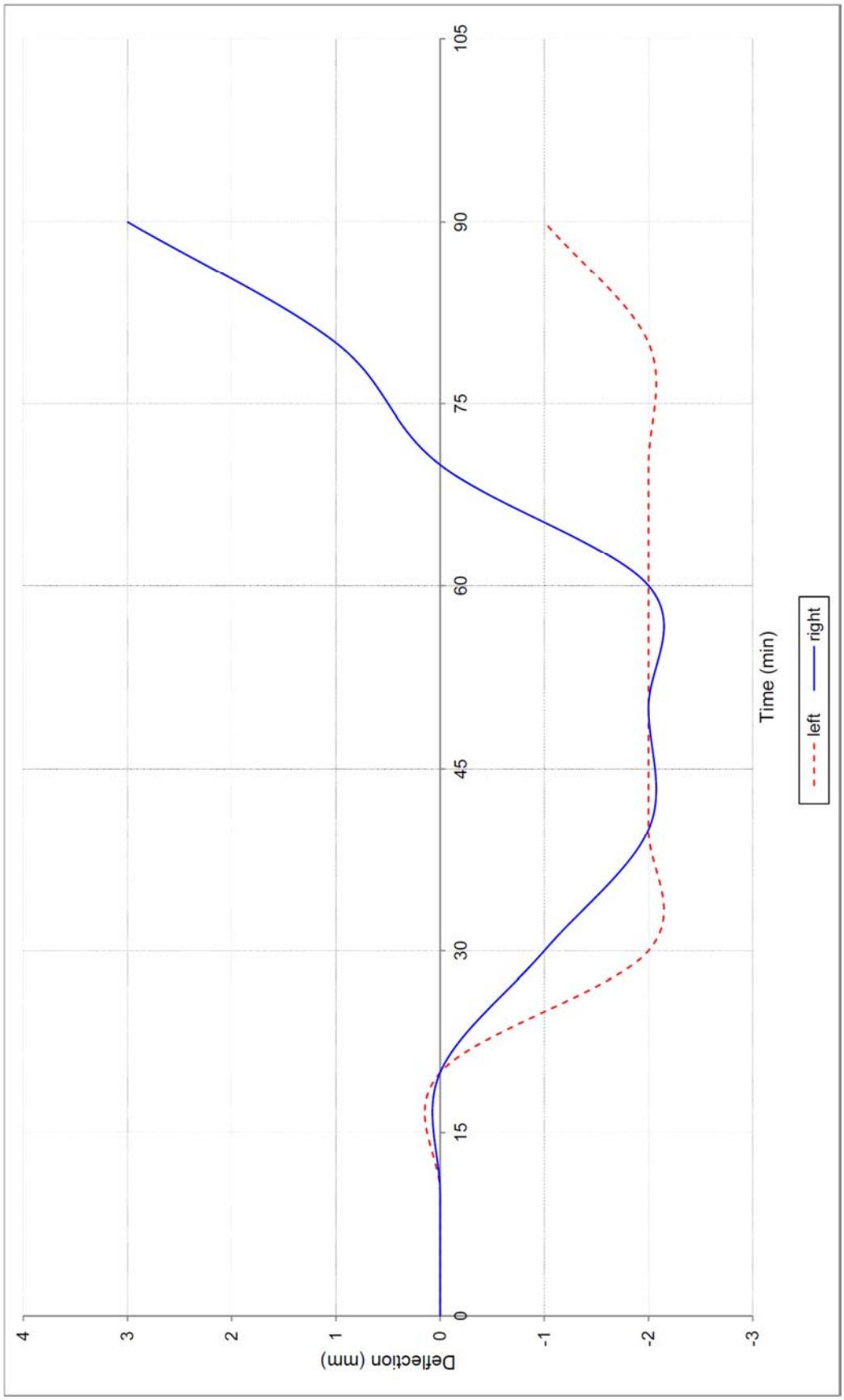
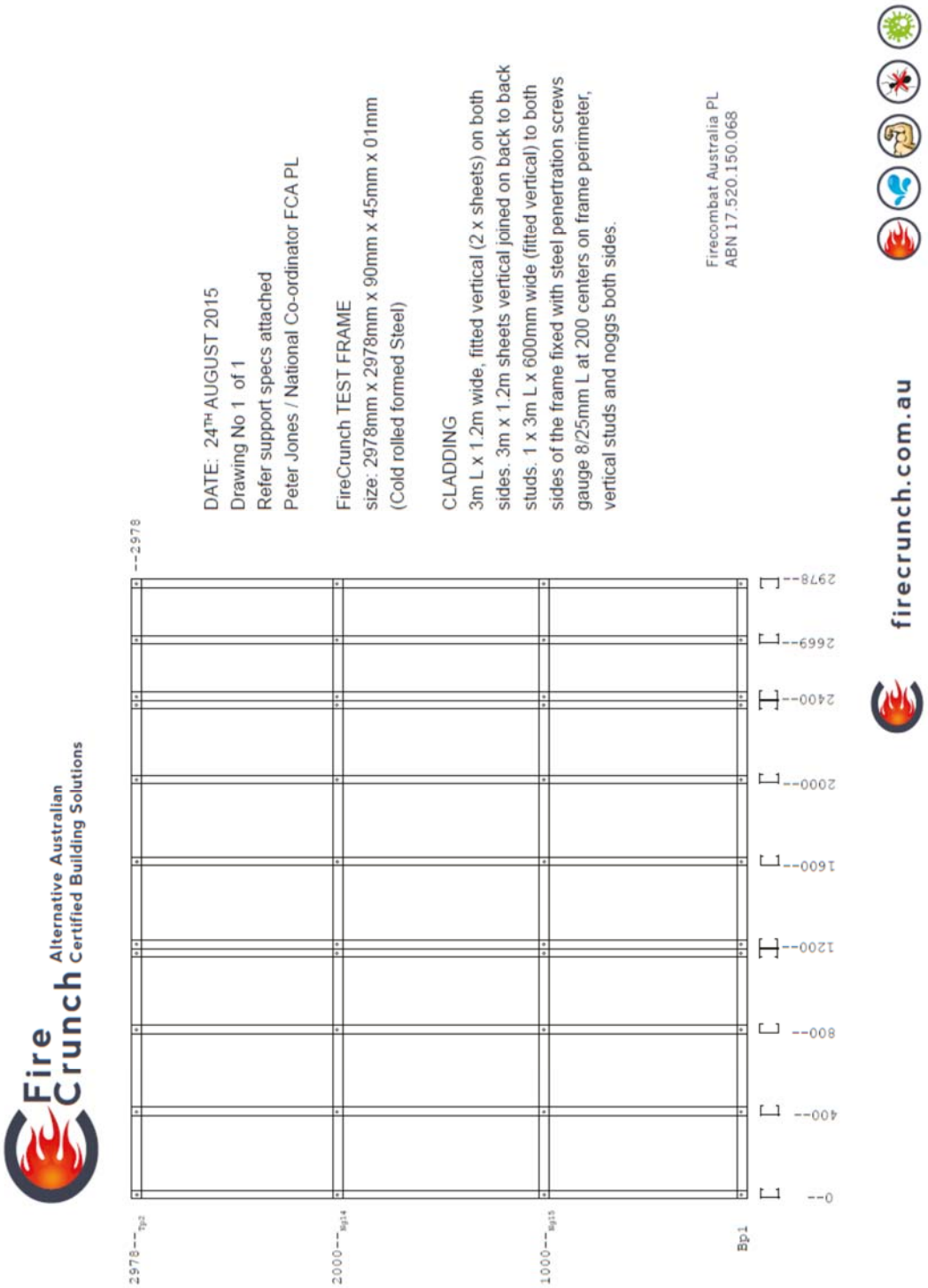


FIGURE 8 – SPECIMEN AXIAL DEFLECTION

Appendix D – Specimen drawings



DRAWING NUMBERED 1, UNDATED BY FIRECRUNCH AUSTRALIA PTY LIMITED

Appendix E – Certificate of Test

INFRASTRUCTURE TECHNOLOGIES
www.csiro.au

14 Julius Avenue, North Ryde NSW 2113
PO Box 310, North Ryde NSW 1670, Australia
T (02) 9490 5444 • ABN 41 687 119 230

Certificate of Test

No. 2674B

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

Fire Combat Australia Pty Limited t/a FireCrunch Australia
Suite 19, Level 44 MLC Centre
19 Martin Place
Sydney NSW 2000

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSV 1708B.

Product Name: Load-bearing steel-framed wall system, lined on both sides with one layer of 10-mm thick MBE-10 FireCrunch boards.

Description: The specimen consisted of a load-bearing framed wall system of overall nominal dimensions 3000-mm high x 3000-mm wide x 110-mm thick. The wall consisted of a steel stud frame lined on both sides with MBE-10 FireCrunch boards with the cavity filled with glass woo insulation. The wall frame consisted of six 90-mm x 45-mm x 1.0-mm BMT steel studs fixed into the top and bottom 90-mm x 45-mm x 1.0-mm BMT steel tracks. The studs were spaced at nominal 400-mm centres, two back to back studs were used along each of the board joints, as shown in drawing dated 24 August 2015, by FireCrunch Australia Pty Limited. The frame was faced on each side of the studs with one layer of 10-mm thick MBE-10 FireCrunch magnesium oxide boards orientated vertically. The sheets were nominally 1200-mm wide x 3000-mm long x 10-mm thick, with a stated density of 950 kg/m^3. Before the boards were fixed onto the frame, a 3-mm x 10-mm bead of PROMASEAL A acrylic sealant was applied to the flanges of both tracks and studs and allowed to set overnight. The boards were then secured to the studs with 6-gauge x 25-mm long bugle head drywall screws at 200-mm centres, through pre-drilled holes, and no less than 100-mm from the top and bottom to avoid the tracks. The boards were not fixed to the top or bottom tracks. A nominal 6-mm gap was left between all board joints which was later sealed to the full depth using PROMASEAL A acrylic sealant, taped and set using a setting compound. The wall cavity was filled with one layer of Fletcher Insulation R2.7 Pink SonoBatts. The batts had a density of 32 kg/m^3, measured 1160-mm in length, 430-mm in width and were 90-mm thick. A total load of 55 kN (~18.3kN/m) was applied to the specimen for the duration of the test. The load determined by the client, was applied uniformly by a steel platten acting along the top of the wall.

The element of construction described above satisfied the following criteria for fire-resistance for the period stated.

Structural Adequacy	no failure at 93 minutes
Integrity	74 minutes
Insulation	76 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of 90/60/60. The FRL is applicable for exposure to fire from either direction. This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Chris Wojcik Date of Test: 24 August 2015
Issued on the 7th day of March 2016 without alterations or additions. This Certificate supersedes that dated 24/11/15.

Brett Roddy
Manager, Fire Testing and Assessments

NATA	**NATA Accredited Laboratory** **Number: 165** **Corporate Site No 3625** **Accredited for compliance with ISO/IEC 17025**

COPY OF CERTIFICATE OF TEST – NO.2674B

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.

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