

TEST REPORT FOR FIRE PROPAGATION CHARACTERISTICS OF EXTERIOR WALL ASSEMBLIES

Test Sponsor:

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Test Assembly:

4mm thick WELLBOND-A2 Aluminium Composite Panel (ACP) Cladding Assembly.

Test Standard:

NFPA 285: Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components, 2019 Edition.





Accreditation

Testing

ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories with

International Accreditation Service (IAS) - Testing Laboratory: **TL-626**
www.iasonline.org



Memberships

Members of European Group of Organization for Fire Testing, Inspection and Certification

www.egolf.org.uk

Member of Association for Specialist Fire Protection

www.asfp.org.uk

Member of Centre for Window and Cladding Technology

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The work which is the subject of this report falls under the accreditation of ISO 17025 IAS.



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1. INTRODUCTION

This report outlines the determination of the fire propagation characteristics of a 4mm thick WELLBOND-A2 Aluminum Composite Panel (ACP) Cladding Assembly according to:

NFPA 285: Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components, 2019 Edition.

2. SPONSOR

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3. TESTING LABORATORY

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4. DATE OF TEST

The test was conducted on 13-Oct-22, and has been witnessed by the following parties:

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5. TEST SAMPLES

5.1. General Assembly Description

The specimen was constructed on to a base wall onto which wall brackets were fixed, anchored into the studs of the base wall. Runners were then fixed to the wall brackets, along the height of the base wall. Once, the framing system was in place, cavity fire barriers were installed onto the exterior face of the base wall vertically as well as horizontally, followed by installing exterior face mineral wool insulation slabs in the spaces between the cavity fire barriers and the frame profiles. Aluminium Composite Panels (ACP) were then installed and fixed onto the runners with the support of panel hook and panel hook holders. The vertical and horizontal gaps between adjacent panels were filled with sealant backing material and ceramic fiber, followed by the application of silicone sealant.

The specimen was installed in a capacity where it bore no external load. Loads resulting from the weight of the system components have not been evaluated and are not within the scope of this report, nor are the effects of any wind loading or weather conditions.

5.2. Standard Specific Requirements

Section 5 of NFPA 285:2019 outlines a series of construction requirements, primarily related to joint location, and this section describes the presence of them, or their absence and resulting limitation to field application. All section references below are related to NFPA 285:2019.

In accordance with section 5.7.2.1.2, a horizontal panel joint which spanned the entire width of the specimen was located between 1 foot (305mm) and 3 feet (914mm) above the top of the window head.

In accordance with section 5.7.2.2.2, a vertical joint was included in the construction, extending continuously from the window head to the head of the specimen, and was within 1 foot (305mm) of the window opening center line.

In accordance with section 5.7.3, the window header, jambs, and sill were covered with a 1mm thick sheet of aluminum which overlapped the interior of the base wall by no more than 51mm, was flush with the exterior face of the specimen, and was fixed using screws that were no closer than 152mm c/c. However, the return flange of the cladding panel extended up to the exterior face of the base wall, which is specifically not in compliance with the requirements of NFPA 285:2019. As such, the scope of this test report is limited to the configuration tested, and not alternative materials.

Additionally, the specimen included cavity insulation immediately around the termination of the window opening, which is not in compliance with section 5.7.3.2 of the standard. As such, the scope of this test report is limited to the configuration tested, and not alternative materials.

5.3. Supporting Construction

The test assembly was installed on a substrate base wall, which was in turn installed on a moveable test frame constructed of 150 x 150mm steel I-beams with 3 Nos. of 100 x 100mm steel angles welded horizontally at locations specified by the NFPA 285 standard.

The assembly was secured onto the laboratory's intermediate scale multi-story test apparatus (ISMA) and the gaps between the substrate wall and the test room were filled with ceramic fiber blanket with a density of 128kg/m³.

6. SPECIMEN DEFINITION & INSTALLATION

6.1. Specimen Definition & Verification of the Test Specimen.

TBWIC testing laboratory has not been involved in the selection or design of the specimen. However, the panels were selected, marked, and signed by Mr. Suresh Kumar from TBWIC Certification Division (Certification Body) on 7-Jun-22 as shown below.



There are contexts where information has been provided by the sponsor and verification of information has been done through either technical datasheet or other document submission, or as indicated directly by the sponsor. For this reason, materials have been tested in an as-received



condition and TBWIC bears no liability for the legitimacy of the submitted information. Similarly, the results of the test apply only to the samples as received.

6.2. Specimen Installation

Installation of the specimen: Grand Dubai Aluminium & Glass.

Frame and base wall preparation: TBWIC.

The specimen was delivered on 28-Sep-22 and installed between 5-Oct-22 and 10-Oct-22. The specimen after installation was stored in ambient conditions at temperatures ranging between 27°C and 36°C and 49% to 65% humidity.

After the completion of the assembly installation, the sealant applied into the panel joints were allowed to cure for a minimum of 1 day as requested by the test sponsor.

7. METHOD OF TEST

The fire test was carried out according to NFPA 285: 2019 Edition. The assembly was tested based on values obtained during the most recent calibration as per the NFPA 285 standard, expressed in Appendix 2 of this report.

7.1. Specimen Instrumentation & Measurements

A Keysight DAQ970A data acquisition system was used to record the output of the thermocouples on 15 second intervals.

A total of 54 Type-K thermocouples were used on the specimen, with all interior thermocouples fixed within the specimen placed at mid-depth of the air cavity (92mm), nominally 220mm from the interior face of the base wall, as per figure 6.1(b), Detail H in the NFPA 285 standard, shown in Appendix 1, Figure 4 of this report.

The burn room thermocouples were placed at 6 inches below the first story test room ceiling and distributed according to NFPA 285; Fig. 6.1(d).

Thermocouples 55 to 80 were not included in the test as the base wall and exterior cavity insulation were not considered inherently combustible, and their interior temperatures are not required to be monitored.

The window burner was centered on the vertical centerline of the window, 9 inches below the top of the opening, and with the longitudinal centerline of the burner at 3.5 inches from the plane of the exterior wall, consistent with the standard and the calibration of the test apparatus.

For graphs and tabulated data, refer to Appendix 5 & 8.

8. FIRE TEST

8.1. Ambient Conditions & Test Situation

The ambient temperature at the commencement of the test was recorded as 83.5°F and the relative humidity was recorded as 64%. The airflow, measured with an anemometer placed at a right angle and within 1 meter of the test face, at the beginning at test was recorded at less than 0.1m/s. Video recording digital photographs, visual observations and data collection were performed prior, during, and after testing was completed.

8.2. Pre-Test Observations

The specimen was found satisfactory and fit to be tested.



8.3.Fire Test Observations

Time (mm:ss)	Observations From in Front of the Specimen (Exterior Face) <i>Heights referenced are from the head of the window opening, unless otherwise stated.</i> <i>Note: For panel location & reference, see drawing 6 in Appendix 4</i>
0:00	The test was started. Room burner ignited.
0:47	Window head flashing had started to deform.
1:15	Continuous smoke was observed escaping from the test room through the edges of the window head.
5:00	The window burner was ignited.
6:25	Coating on the panel 07R was observed peeling off till 2 feet.
7:00	Flashing along the window head and jambs was observed deforming.
8:15	Coating on the panels 07L & 07R had peeled off till 2 feet along the center.
9:13	Source of flame was observed to have propagated on the assembly up to 3 feet.
10:00	The specimen was stable.
10:15	Coating on the panels were observed peeling off till 3 feet near to the bottom surface of panel 04R.
10:20	Flame debris was observed falling on the test room floor.
12:00	A portion of the sealant backing material located at 2.5 feet was observed to have dislocated and was caught on fire.
12:30	Source of flame was witnessed to have propagated down to 2.5 feet on the horizontal joint near to the center.
14:12	Window opening flashing was observed continuously deforming and melting, where some of the melted portions were observed falling onto the test room floor.
15:00	The specimen was stable.
15:40	Coating on the panels were observed peeling off till 3.5 feet.
20:00	The specimen was stable.
20:30	Coating on the panels were observed peeling off till 4.5 feet.
20:45	Source of flame was still observed on the horizontal joint at 2.5 feet, referenced at 12:30 minutes.
22:30	Exterior face insulation slabs were exposed till 2 feet along the center of the assembly.
25:00	The specimen was stable.
25:25	A portion of the panel 07L, was witnessed dislodging, resulting in the exposure of the inner components of the assembly.
25:50	Portion of the panel referenced at 25:25 minutes was witnessed collapsing.
25:55	Source of flame was now observed on the cladding at 4 feet near to the center.
27:07	A large portion of the panel 07L was witnessed collapsing onto the floor.
27:50	Continuous flame debris was observed falling onto the test room floor.
27:55	The horizontal cavity fire barrier located at 2.5 feet was slightly exposed.
30:00	The specimen was stable, the test was stopped and gas shut off, as per the NFPA 285 Standard, and the 10-minute observation period began.
30:01	Residual flaming was observed on the horizontal joints approximately at 2.5 feet in line with the window jambs, on the surface of the horizontal cavity fire barrier located on the right hand-side and on the left window jamb.
33:00	Except for residual flaming at 2.5 feet, all other flaming was observed to have subsided and ceased.
35:20	Left-hand side residual flame located at 2.5 feet had ceased.



37:17	Right-hand side residual flame located at 2.5 feet had ceased.
38:00	No further activities were observed.
40:00	The observation period was ended as per the NFPA 285 standard and the NFPA 285 test was completed.

8.4. Second Floor Test Room Observations

Time (mm:ss)	Observations From The 2 nd Floor Room (Interior Face)
0:00	The test was started
5:00	The second-floor room was stable.
10:00	The second-floor room was stable.
15:00	The second-floor room was stable.
17:14	Light smoke was witnessed issuing from the edge between the base wall and the L-angle near to the location of the thermocouple 50.
20:00	The second-floor room was stable.
25:00	The second-floor room was stable.
30:00	The 2nd floor room was stable, no flaming was observed, the test was stopped and gas shut off, as per the NFPA 285 Standard, and the 10-minute observation period began.
35:00	The second-floor room was stable. No activity was observed.
40:00	The observation period was ended as per the NFPA 285 standard and the NFPA 285 test was completed.

9. EXTENT OF DAMAGE

9.1. Exterior Face Observations

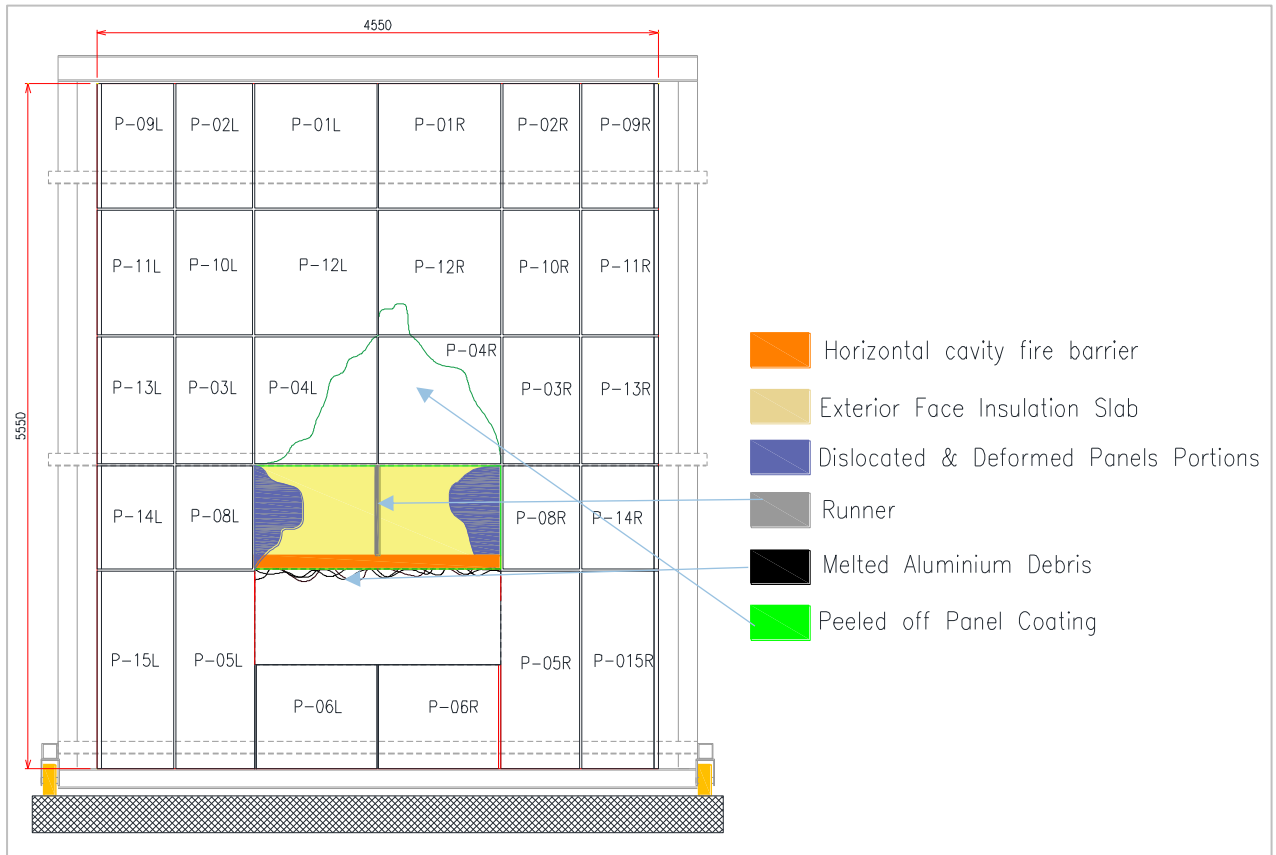
Soot stains were observed centrally along the height of the specimen from the window head. Mineral wool insulation was exposed up to approximately 2.5 feet above the window head. The horizontal cavity fire barrier located just above the window head was exposed and slightly damaged. The base of the horizontal cavity fire barrier located at 3 feet above the window head was visible. The ACP coating had peeled off till a maximum height of 6.5 feet above the window head. Window flashing had completely deformed, melted and were barely in place.

9.2. Interior Face Observations

No damage was observed to the interior of the base wall in the second-floor test room. The gypsum within the first-floor test room was badly burned, but still intact.

9.3. Dismantling Observations

Damage was largely limited to the window head section and upon removal of the remaining intact panels around the exposed area, high smoke damage was observed on the backside of the panels 07L & 07R. Light smoke stains were observed on the top horizontal cavity fire barriers.



Sketch 1: Sketched view of the assembly after the test.
(Drawing by TBWIC)



10. FIRE PROPAGATION ANALYSIS

Test Performance Evaluation Summary Table		
Test Requirement	Test Observation	Pass/Fail
Flames emitting from the surface of the exterior face of the test specimen shall not reach a height of 10ft or greater above the top of the window opening.	Flames did not reach 10 feet above the window opening.	Pass
Flames emitting from the surface of the exterior face of the test specimen shall not reach a horizontal distance of 5ft or greater from the vertical centerline of the window opening.	Flames did not reach a lateral distance of 5ft from the vertical centerline.	Pass
Flames shall not occur beyond the intersection of the test specimen and the side walls of the test apparatus.	There was no visible flaming beyond the intersection of the side walls and test apparatus.	Pass
Flames shall not occur in the second-story test room.	There was no visible flaming in the second story test room.	Pass
Temperatures shall not exceed 1000°F as measured by thermocouples Tc-11 and Tc-14 through Tc-17.	Tc-11 and Tc-14 through Tc-17 did not exceed the 1000°F limit.	Pass
Temperatures in the wall cavity air space shall not exceed 1000°F as measured by thermocouples Tc-18 and Tc-19.	Tc-18 and Tc-19 did not exceed the 1000°F limit.	Pass
Temperatures in the wall cavity air space shall not exceed 1000°F as measured by thermocouples Tc28 and Tc-31 through 40.	Tc-28 and Tc-31 through Tc-40 did not exceed the 1000°F limit.	Pass
Temperatures measured 1 in. (25mm) from the interior surface of the test specimen within the second story test room shall not exceed 500 °F above ambient air temperature of test facility at the start of fire test as measured by Tc-49 through Tc-54.	Tc-49 through Tc-54 did not exceed the maximum temperature of 583.5°F. (500°F + Initial Ambient Temperature = 500°F + 83.5°F = 583.5°F).	Pass

11. SUMMARY OF RESULTS

The 4mm thick WELLBOND-A2 Aluminium Composite Panel Cladding Assembly has been evaluated in accordance with NFPA 285: Standard Test Method for Evaluation of Fire Propagation Characteristic of Exterior Wall Assemblies Containing Combustible Components, 2019 Edition.

The results of the fire performance evaluation conducted on the exterior cladding assembly described herein indicate that the assembly **met** the acceptance criteria stated in the standard.



12. LIMITATION

The results of this test report are only applicable to the type and orientation of the installation which relate to what has been tested. Uncertainty factors with respect to a large-scale fire or changes in design are not considered within the scope of this test report.

TBWIC is wholly responsible for data and information provided in this report, except where indicated by the limitations specified in section 6.1 of this report. This report and all records of the test to which it relates may not be retained by TBWIC beyond 5 years from the date of testing.

This test report is respectfully submitted by: Thomas Bell-Wright International Consultants

Prepared By:

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Report Revision Tracking		
Revision No.	Date Issued	Notes & Amendments
Rev.00	18-Nov-22	This is the first issue of the report. No revisions are included.



13. APPENDIX 1 – ORIENTATION OF THERMOCOUPLES

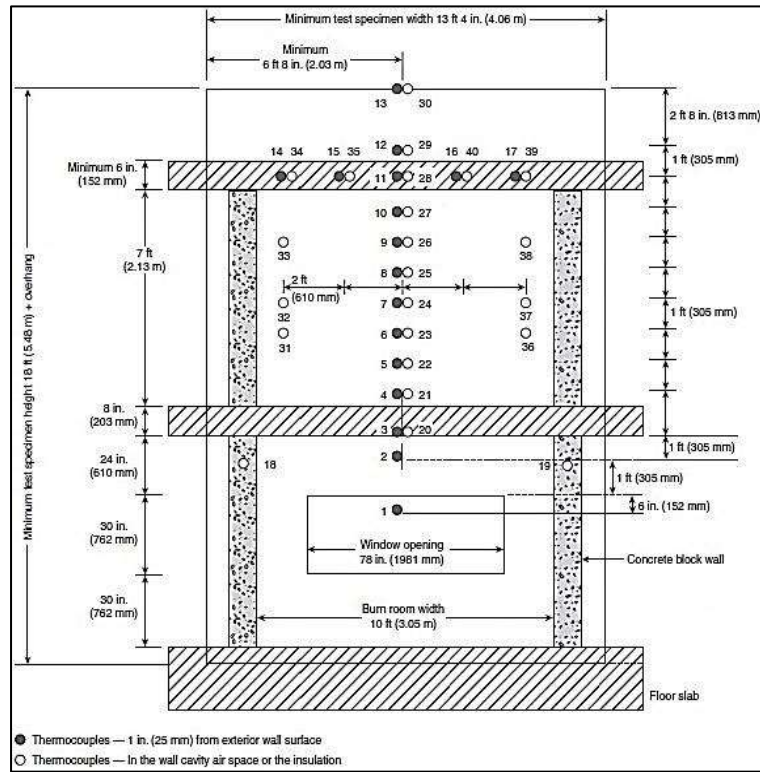


Figure 1: Overall instrumentation on the exterior wall surface and air cavity.

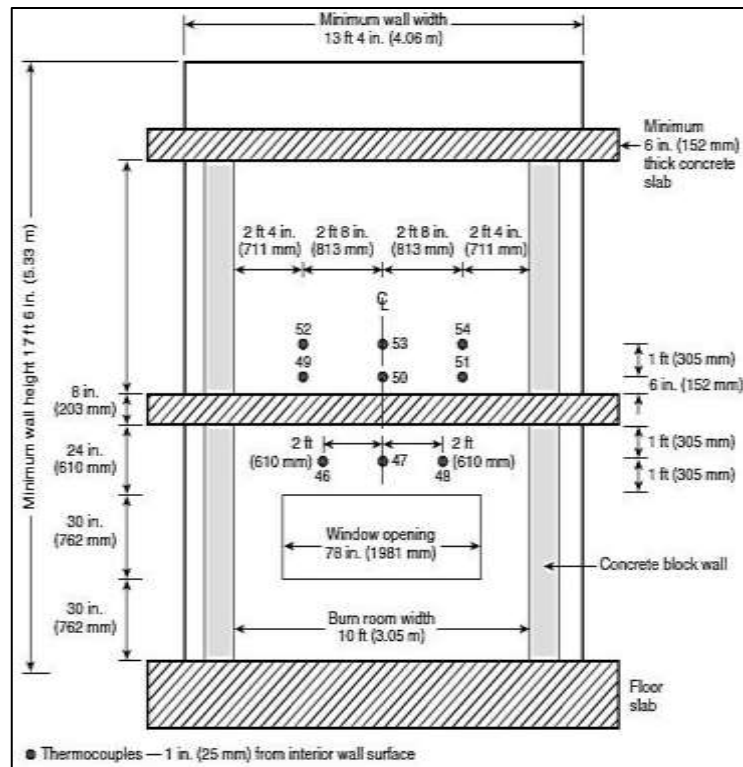


Figure 2: Overall instrumentation on the interior wall

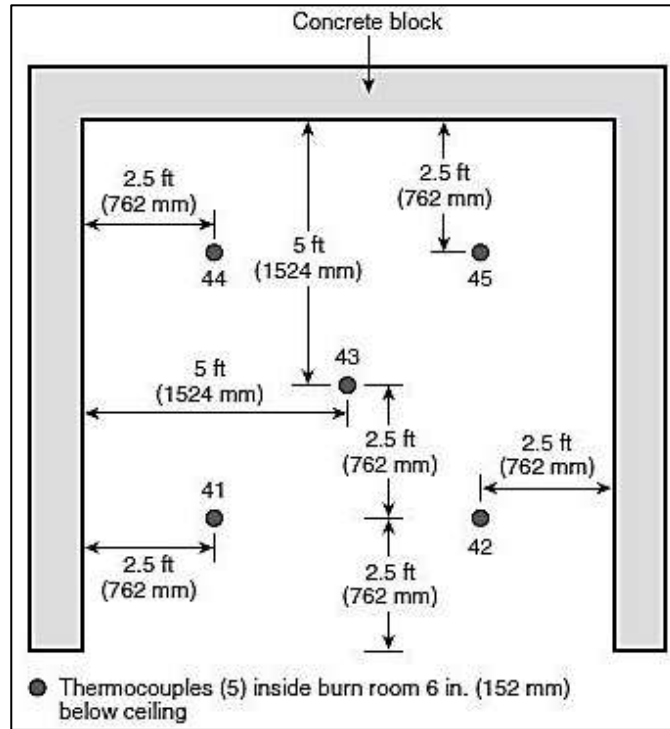


Figure 3: Overall instrumentation inside of the 1st story burn room (Top View)

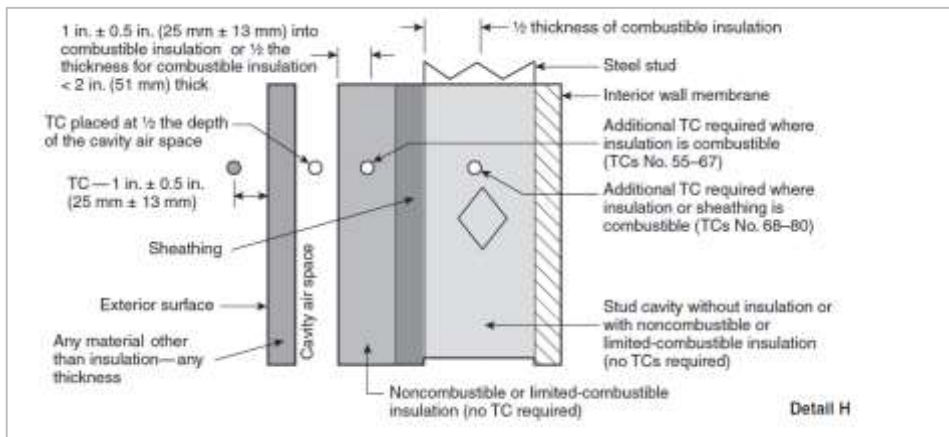


Figure 4: Figure 6.1(b) Detail H of the NFPA 285 standard, showing the thermocouple depth specifications of the specimen.



14. APPENDIX 2 – CALIBRATION & BURNER GAS FLOW DATA

The calibration for the test rig was performed on 27th April, 2022 and followed the procedure and practices outlined for calibration in NFPA 285:2019, Chapter 7.

Table 1 shows gas flow values during the test and during the calibration, table 2 shows the average heat flux, and table 3 shows the average temperature obtained during the calibration test. The values are within the allowable ranges as specified in table 7.1.11 ($\pm 10\%$ allowable tolerance). The flowmeters used in the test were externally calibrated using air as a medium, and SCFM values shown below have been converted from SCFM Air to SCFM Natural Gas using a scaling factor of 1.25 LPM of Natural Gas for every 1 LPM of Air.

Time	During Fire Test		During Calibration	
	Room Burner	Window Burner	Room Burner	Window Burner
0 – 5 mins	30.3 SCFM	0.0 SCFM	30.3 SCFM	0.0 SCFM
5 – 10 mins	35.4 SCFM	5.9 SCFM	35.4 SCFM	5.9 SCFM
10 – 15 mins	37.9 SCFM	6.5 SCFM	37.9 SCFM	6.5 SCFM
15 – 20 mins	40.5 SCFM	7.6 SCFM	40.5 SCFM	7.6 SCFM
20 – 25 mins	43.0 SCFM	8.7 SCFM	43.0 SCFM	8.7 SCFM
25 – 30 mins	45.5 SCFM	9.2 SCFM	45.5 SCFM	9.2 SCFM

*SCFM: Standard Cubic Feet per Minute

Time Interval (min)	Average Heat Flux 2FT (W/cm ²)	Average Heat Flux 3FT (W/cm ²)	Average Heat Flux 4FT (W/cm ²)
0:00-5:00	1.36*	1.07	0.93
5:00-10:00	2.94*	2.18	2.12*
10:00-15:00	3.49*	2.26	2.16
15:00-20:00	3.99*	2.60	2.18
20:00-25:00	4.69*	3.02	2.42
25:00-30:00	5.48*	3.39	3.13

Time Interval (min)	Avg. Burn Room Temp (°F)	Avg. Int. Wall Temp (°F)	Avg. 1 FT Temp (°F)	Avg. 2 FT Temp (°F)	Avg. 3 FT Temp (°F)	Avg. 4 FT Temp (°F)	Avg. 5 FT Temp (°F)	Avg. 6 FT Temp (°F)
0:00-5:00	1110.2	1029.2	617.1	631.2	582.6	542.0	486.6	451.4
5:00-10:00	1388.3	1377.7	996.3	997.0	939.3	915.0	840.9	754.7
10:00-15:00	1521.2	1529.4	1108.6	1084.7	1017.3	949.8	883.0	784.8
15:00-20:00	1642.0	1677.1	1204.5*	1188.9	1097.9	1024.8	956.0	848.8
20:00-25:00	1732.2	1819.4	1307.6*	1297.6	1226.1	1098.0	1019.5	897.8
25:00-30:00	1804.2	1914.7	1404.6*	1393.2	1313.7	1183.3	1087.6	950.9

Note: Values indicated with an "*" were values which were nominally in excess of the values stated in the calibration.



15. APPENDIX 3 – COMPONENTS DESCRIPTION

Note: All information provided herein Appendix 3 has been provided either by TBWIC or Test Sponsor. Information marked with a single asterisk indicates information provided by the Test Sponsor which has been checked against the materials used in the test where appropriate, however does not fall under the responsibility of TBWIC. All dimensions are expressed in millimeters (mm), unless otherwise specified.

A. Base Wall:

Base wall Components				
<p style="text-align: center;">STUDS</p>		<p style="text-align: center;">TRACKS</p>		
	Stud & Track	Gypsum Board	Jointing Tape	Jointing Compound
Material	Galvanized Steel	Gypsum core with paper lines	Fiberglass tape	Calcium carbonate base
Manufacturer	JB Mechanical Services	Knauf LLC	Knauf LLC	Knauf LLC
Reference	N/A	15.9mm Type X (GW-TX)	Knauf Joint Tape	Knauf Readygips
Dimension	As Shown Cut to Required Length	1220 x 2400 x 15.9mm (w x h x thk.)	50mm wide	N/A
Fixing method & Application	<p>The gypsum base wall was built and provided by the laboratory as a substrate wall for which to install the system on, and is not a part of the sponsors tested system, but is represented in this component description for continuity of detail and as required by the testing standard. It does not lend itself to a particular type of fire rating, but is also understood to not contribute to or diminish the performance of the tested specimen.</p> <p>Studs were fixed at edge of the wall span and nominally spaced to match the distribution of the wall brackets (see drawings 1 in Appendix 4). The top and bottom edges were welded within tracks at the head and sill of the base wall and also around the window opening. Both were welded directly to the standardized test frame at appropriate locations.</p> <p>The boards were fixed with Knauf TB 3.5 x 35mm self-tapping screws, spaced nominally at 300mm c/c vertically on each stud. Jointing compound was applied along all exterior meeting edges of the boards, with ample drying time and single strips of jointing tape embedded within the first layer of jointing compound.</p> <p>The jointing compound was also applied over all exposed screw heads.</p>			

B. Framing System:

T-Bracket		
<p style="text-align: center;">Top View</p>	<p style="text-align: right;">Side View</p>	<p style="text-align: right;">Front View</p>
	T- Brackets	Fasteners
Material	Aluminium*	Galvanized Steel*
Alloy/Grade	6063-T6*	5*
Manufacturer	WELLBOND*	TUF-FIX
Reference	Aluminium Wall Bracket*	Hex. Head Self-Tapping
Dimension	As shown above 2.5mm thick	Ø6 x 50mm
Fixing Method	The T-brackets were fixed onto the studs via exterior face of the base wall using two nos. of Ø6 x 50mm long stainless-steel hexagonal head self-tapping screws with washer which were spaced nominally 100mm apart. (For layout and spacing refer to drawing 3 in Appendix 4).	

L-Bracket		
	L-Bracket	Fasteners
Material	Aluminium*	Galvanized Steel*
Alloy/Grade	6063-T6*	5*
Manufacturer	WELLBOND*	TUF-FIX
Reference	L-Angle bracket*	Hex. Head Self-Tapping
Dimension	As shown above 6mm thick	Ø6 x 50mm
Fixing Method	Two nos. of L-brackets were fixed on to the exterior face of the base wall and they were spaced 50mm from each other. The L-brackets were fixed using two nos. of hexagonal head self-tapping screws of size Ø6 x 50mm on each bracket. They were used only at specific locations such as at the terminations of the runners on the wall. (For location and layout, refer to drawing 3 in Appendix 4)	



Runner Profile		
	Runner	Fasteners
Material	Aluminium*	Galvanized Steel*
Alloy/Grade	6063-T6*	5*
Manufacturer	WELLBOND*	TUF-FIX
Reference	Runner Profile WG 5050	Hex. Head Self-Tapping
Dimension	As shown above 2mm thick	Ø6 x 25mm
Fixing Method	The runners were fixed within the wall brackets on either side using two nos. of stainless-steel hexagonal head bolts of dimensions Ø6 x 25mm supported with washer. (Refer to drawing 4 in Appendix 4 for reference).	

Hook Holder		
	Hook Holder	Fasteners
Material	Aluminium*	Galvanized Steel*
Alloy/Grade	6063-T6*	5*
Manufacturer	WELLBOND*	TUF-FIX
Reference	Hanging Profile WG 5049	Pan-head screw
Dimension	As shown above 2.5mm thick	Ø4 x 19mm
Fixing Method	The hook holders were slotted into the runner profiles and were partially fixed in place with the support of stainless-steel grub screws of size Ø5 x 16mm. Once the panels are hooked onto the hook holders and aligned properly, the hook holders were further strengthened in place by using a pan head screw of size Ø4 x 19mm onto the runner via the face of the hook holder.	



C. Insulation System:

Cavity Fire Barrier System		
	Vertical & Horizontal Cavity Fire Barrier	Fixing Brackets
Material	Non-combustible stone wool lamella core pre-compressed with reinforced aluminium foil faces	Galvanized Steel
Manufacturer	Siderise® Insulation Ltd.	Siderise® Insulation Ltd.
Reference	CH-CB (constructed from CWFS 120)	B65/110 G
Density	75kg/m ³ (stated)	NA
Dimensions	150 x 120mm (depth x thk.)	225 x 25 x 1mm (l x w x thk.)
Fixing Method	<p>The cavity fire barriers were fixed both vertically and horizontally onto the exterior face of the base wall. Vertically, the cavity fire barriers were fixed at two locations, along the jambs of the window opening with an offset of 36mm from the left and right vertical ends of the window opening. Horizontally, the cavity fire barriers were fixed at four different locations and was fixed at an offset of 5mm from the window head and sill edges. The cavity fire barriers were fixed with the support of SIDERISE fixing brackets (Ref: B65/110 G).</p> <p>The fixing brackets were initially fixed impaled to the cavity fire barriers at mid-depths and were then together fixed onto the exterior face of the base wall using stainless steel Fischer CSK screws of size Ø4.4 x 40mm with steel wall plug. The brackets were spaced at a nominal distance of 600mm c/c.</p> <p>Note: The cavity fire barrier system was part of a larger catalogued Siderise system which includes different configurations. However, scope of the results of this test applies only to the tested configuration, and not others outlined in system catalogue.</p>	

Exterior Face Insulation System			
	Exterior Face Insulation Slab	Rockwool Pins	Joint Tape
Material	Mineral Wool	Steel*	30-micron Aluminium foil tape
Manufacturer	Fujairah Rockwool Factory	ULTRA	Siderise® Insulation Ltd.
Reference	S2XX	ULTRA Rockwool Pin	RFT120
Density	70kg/m ³ (stated)	NA	NA
Dimensions	50mm thick	Ø8 x 90mm	120mm wide
Fixing Method	<p>Fixed onto the exterior face of the base wall with the support of rockwool pins. A hole was drilled through the insulation slabs and the void was then filled by inserting the rockwool pins by hammering onto the head of the pins, ultimately holding the system in place.</p> <p>Joint tape was cut to required length and applied along the joints between two adjacent exterior face insulation slabs and at the termination joints where the horizontal cavity fire barrier abuts the vertical cavity fire barrier.</p>		



Exterior Cladding			
Material	Aluminium Composite Panel		
Manufacturer	WELLBOND		
Reference	Wellbond A2		
Thickness	4mm		
Top Skin	Alloy: 3003*	Finish: PVDF Coating*	Thickness: 0.5mm
Bottom Skin	Alloy: 3003*	Finish: PE Coating*	Thickness: 0.5mm
Core	3mm thick		
Panel Dimensions	Refer to drawing 6 in Appendix 4 for dimensions and layout		
Fixing Method	The panels were pre-fabricated with panel hooks which were located along its flanges and they were fixed onto the hook holder with the support of hooking rod which were pre-fabricated within the hook holder. Once the panels were hooked, the hook holder was screw fixed onto the runners using steel pan-head screws of size $\varnothing 4 \times 19\text{mm}$. A nominal gap of 16mm was maintained between the adjacent panels both vertically and horizontally.		
External Cavity Dimensions	A total gap of 142mm existed between the exterior face of the base wall and the interior face of the ACP, and a total air cavity of 92mm existed between the exterior face insulation and the interior face of the panels.		

Panel Hook (Aluminum Strip)		
	Panel Hook	Rivet
Material	Aluminum*	Stainless Steel
Alloy/Grade	6063-T6*	314
Manufacturer	WELLBOND	Retail
Reference	Hook Profile*	Blind rivet
Dimension	As shown 3mm thick	$\varnothing 4 \times 16\text{mm}$
Fixing Method	The hook brackets were pre-fixed onto the flanges of the panels with the support of three nos. of blind rivets of size $\varnothing 4 \times 14\text{mm}$. The hook brackets were spaced at a nominal distance of 360mm c/c and 85mm from the ends.	



Corner Reinforcement plate	
Material	Aluminium*
Alloy/Grade	6063-T6*
Manufacturer	WELLBOND
Reference	2mm thick Aluminium angle
Dimension	As shown 1.5mm thick
Fixing Method	The corner reinforcement plates were pre-fixed onto the corner flanges of each panel with the support of two nos. of blind rivets of size $\varnothing 4 \times 14$ mm.

D. Accessories:

Panel Joint System			
	Sealant Backing Material (SBM)	Ceramic Fiber	Sealant
Material	Fibre*	Ceramic Fibre*	Silicone
Manufacturer/Supplier	Acromax Building Materials Trading LLC	CHUTAT ceramic fibres	TRITON Middle East
Reference	Enrich SBM	CHUTAT® Ceramic Blanket	TRITOSIL W70 FR
Density	NA	128kg/m ³	NA
Dimensions	$\varnothing 12$ mm	20 x 20mm (w x h)	NA
Fixing Method	<p>The sealant backing material were cut to required length and initially inserted and pressure fitted into the panel gaps horizontally and vertically. Once the SBM were in place, ceramic fiber material was cut to required length and were also pressure fitted into the panel joints in front of the SBM.</p> <p>Once both SBM and ceramic fiber were in place in the panel joints, silicone sealant was applied into the remaining gaps of the panel joints at a total nominal depth of 10mm.</p>		

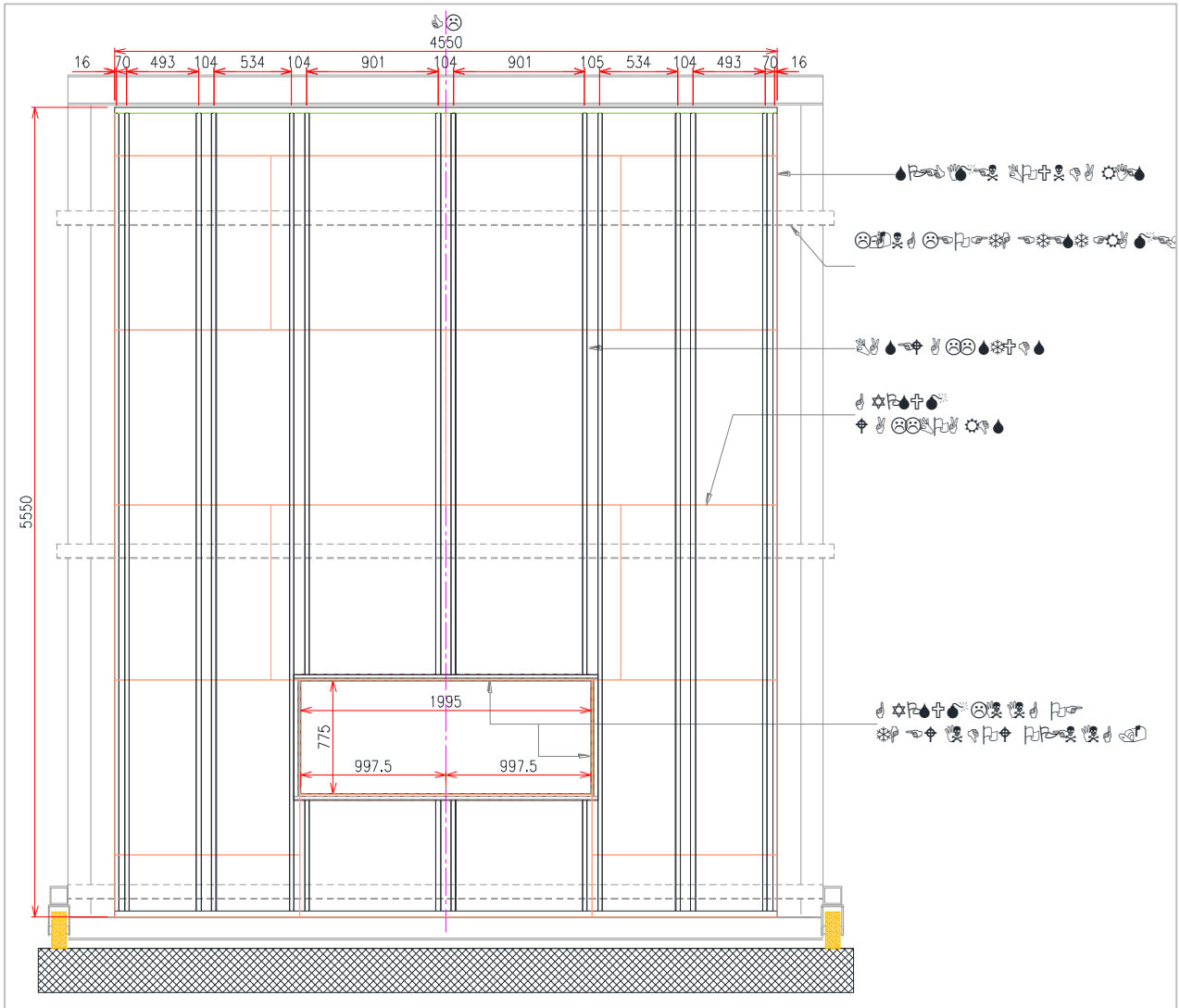
Window Termination Detail		
	Flashing	Fasteners
Material	Aluminium*	Galvanized steel*
Alloy/Grade	6063-T6*	5*
Manufacturer	Retail	TUF-FIX
Reference	N/A	Self-tapping screws*
Dimension	0.9mm thick	$\varnothing 4 \times 25$ mm
Fixing Method & Application	<p>The window header, jambs, and sill were covered with a 0.9mm thick sheet of aluminum which overlapped the interior of the base wall by 50mm, was flush with the exterior face of the specimen, and was fixed using stainless steel pan-head screws of size $\varnothing 4 \times 25$mm at a nominal spacing of 300mm c/c and 90mm from the ends.</p>	



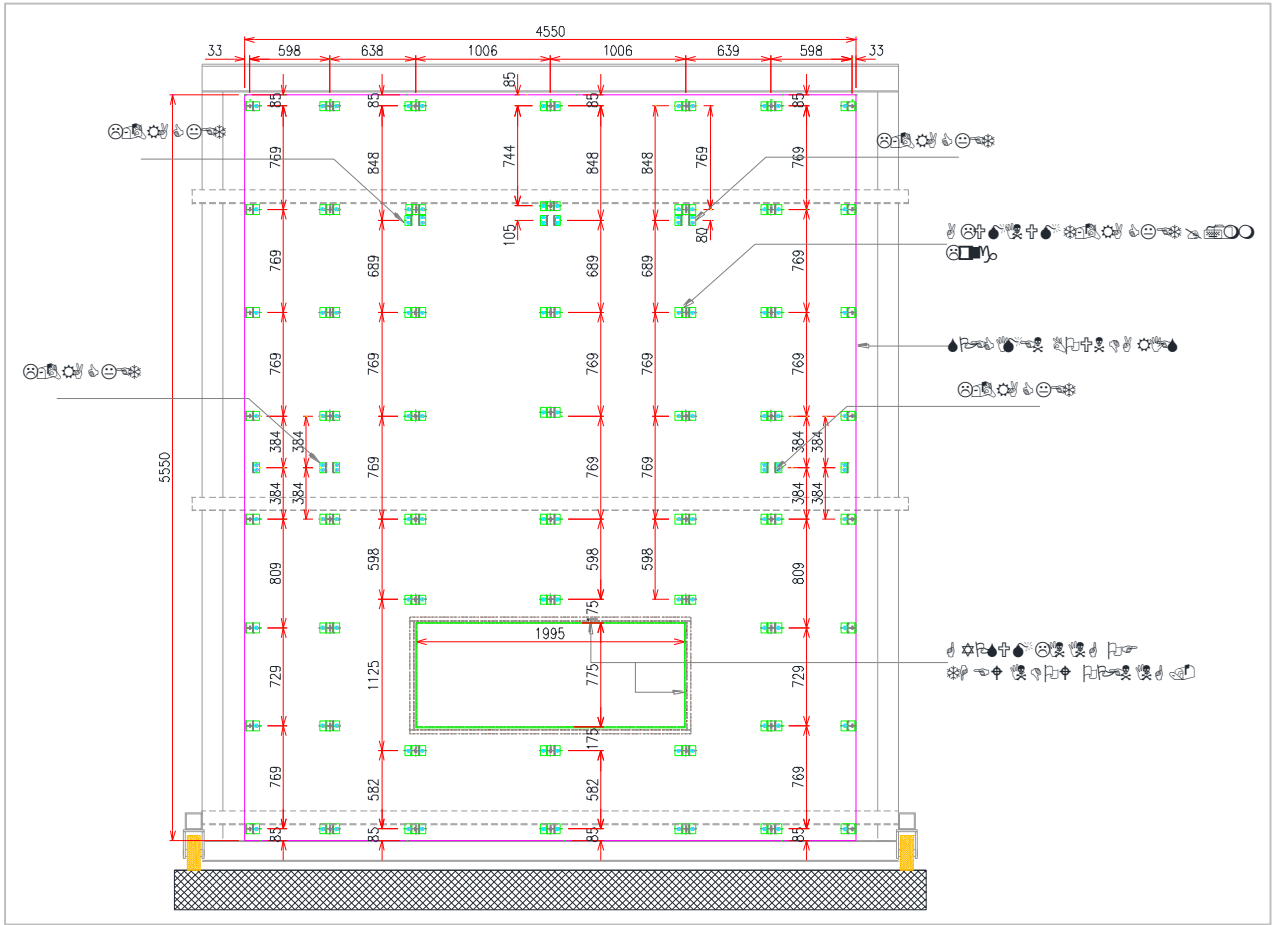
Window Perimeter Framing		
	Tube Channel	L-Angle Support
Material	Aluminium*	Aluminium*
Alloy/Grade	6063-T6*	6063-T6*
Manufacturer	WELLBOND*	WELLBOND*
Reference	1.5mm thick Aluminium Tube	2mm thick Aluminum angle
Dimension	As shown above 1.5mm thick	As shown above 2mm thick 150mm long
Fixing Method	<p>The tube channels were cut to required lengths and were fixed along the perimeter edge of the window opening and the specimen on the exterior face of the base wall such that there was an offset of 5mm from the window opening edges. The tube channels were fixed with the support of L-angle support brackets. The L-bracket was fixed onto the tube channels via stainless-steel hexagonal head bolts of dimensions $\text{Ø}6 \times 25\text{mm}$. Two nos. of L-angle support brackets were used along the vertical edges of the tube channels and three nos. of brackets were used along the horizontal edges of the tube channels and they were fixed in place via stainless-steel hexagonal head bolts of dimensions $\text{Ø}6 \times 50\text{mm}$. The brackets were spaced at a nominal distance of 760mm c/c vertically and 990mm c/c horizontally.</p>	



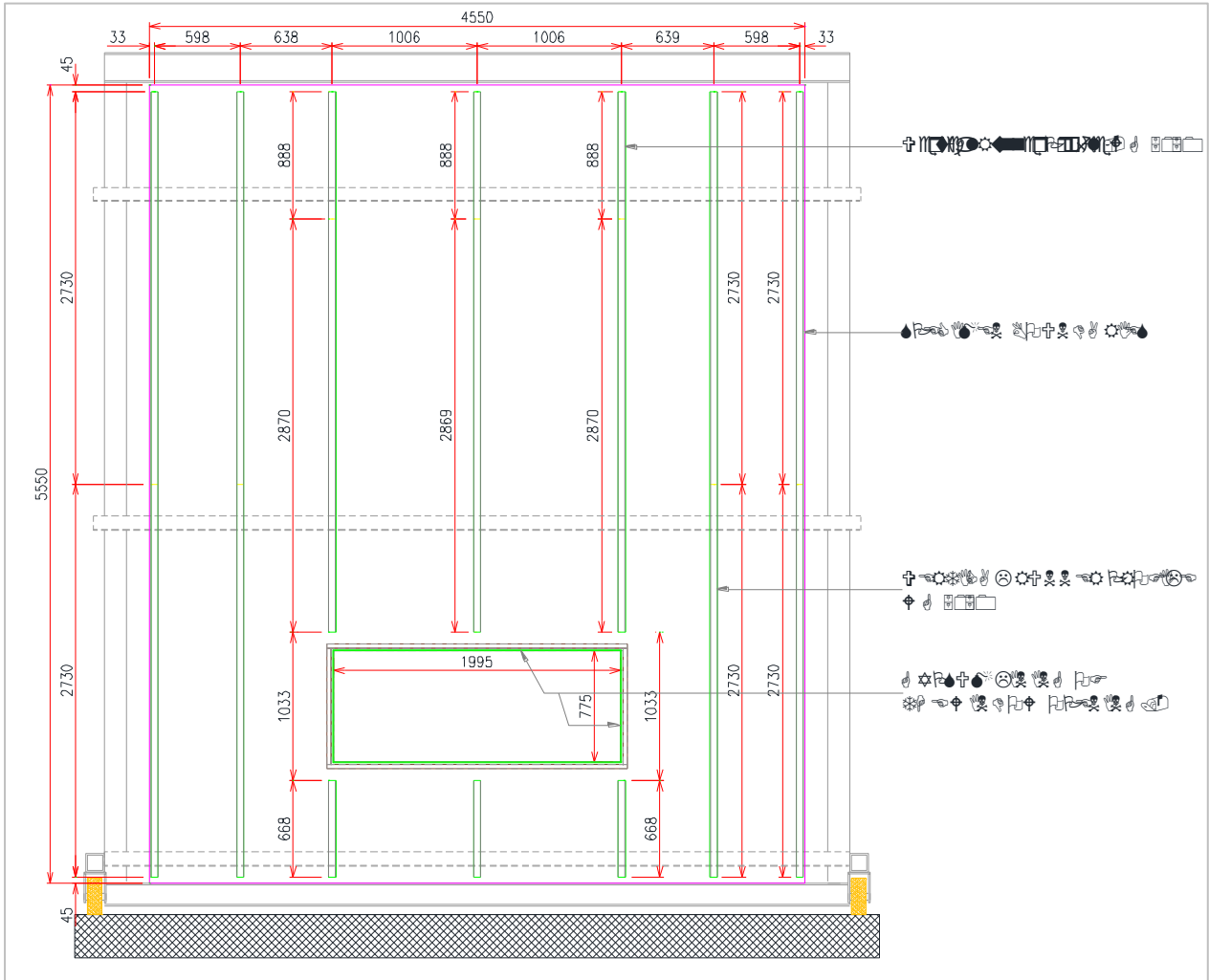
16. APPENDIX 4 – ASSEMBLY DRAWINGS



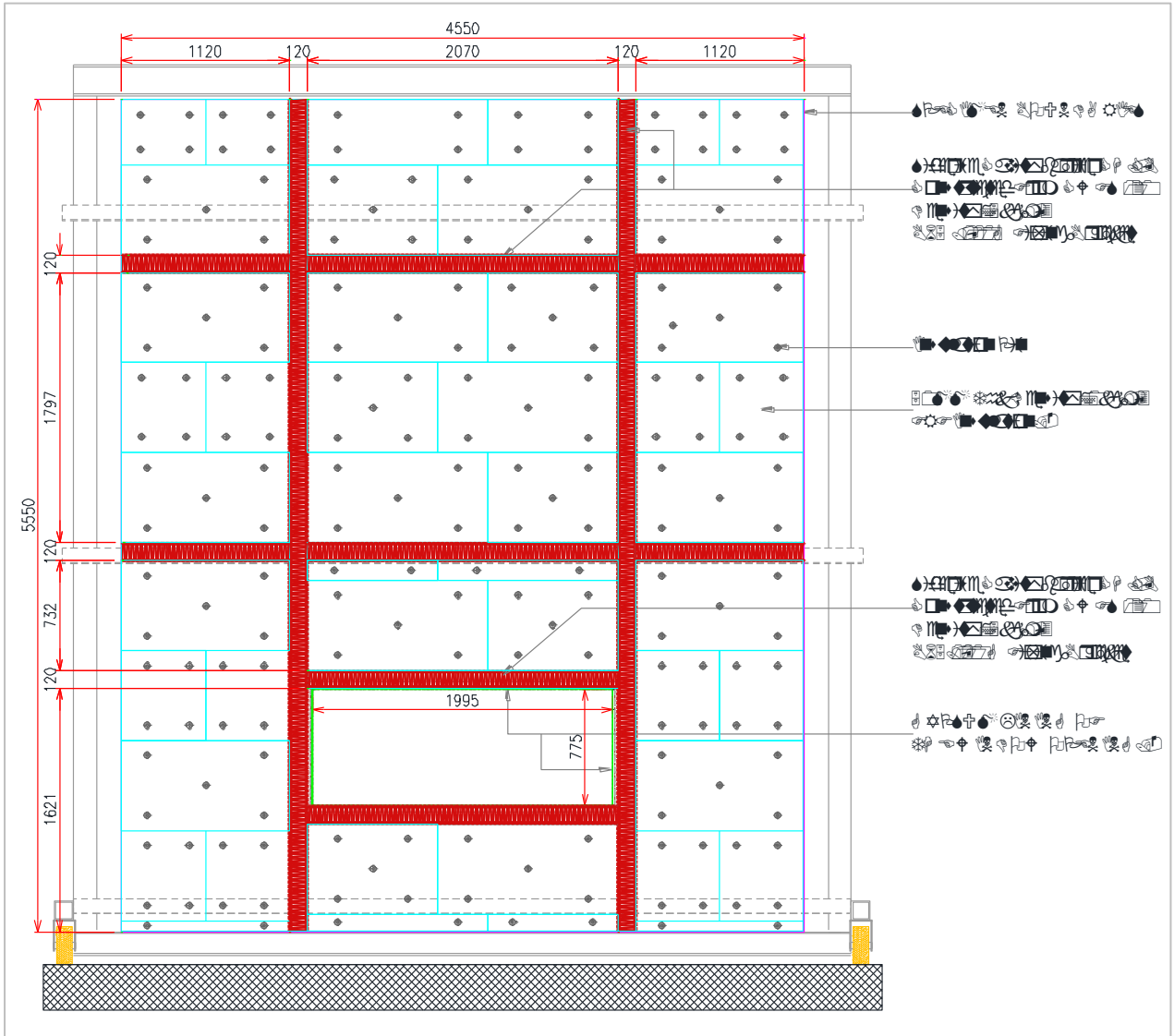
Drawing 1: Elevation view of the test specimen.
(Drawing provided by test sponsor)



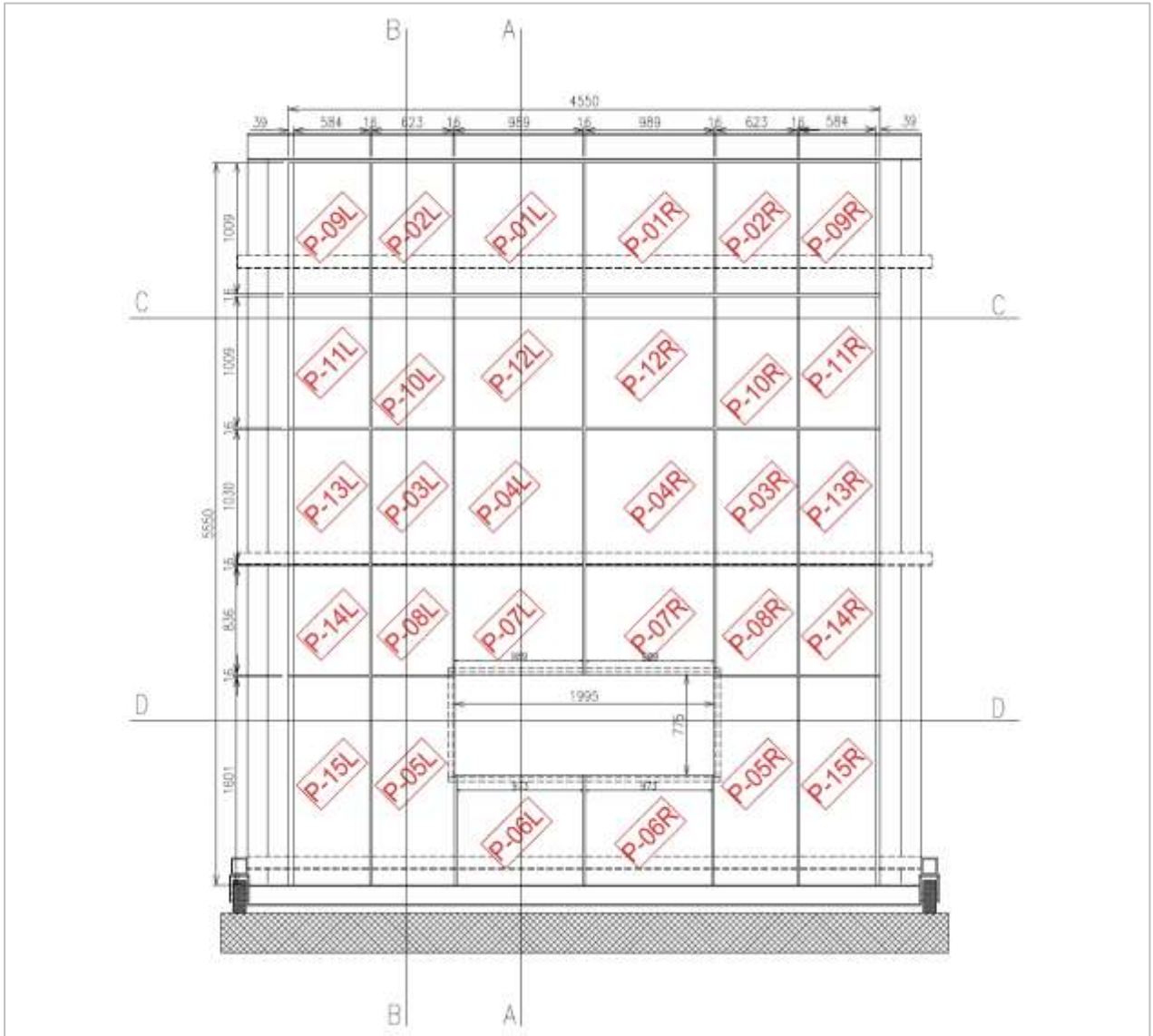
Drawing 3: Elevation view of the wall brackets layout.
(Drawing provided by test sponsor)



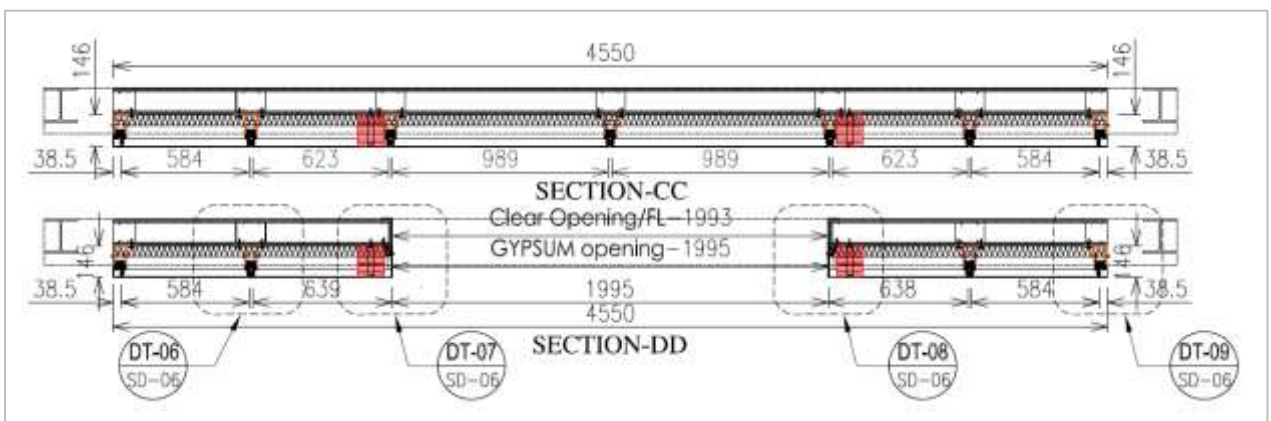
Drawing 4: Elevation view of the runner layout.
(Drawing provided by test sponsor)



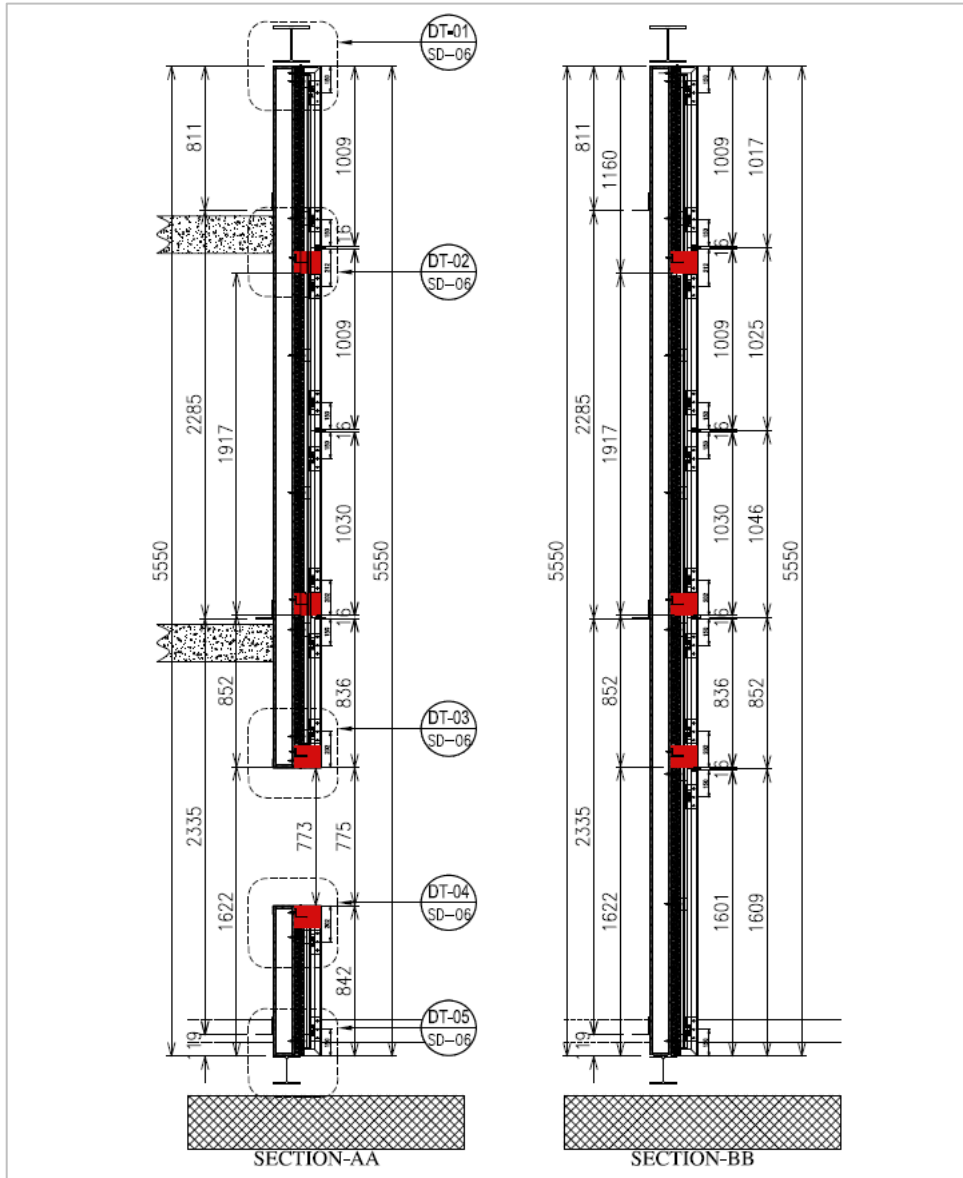
Drawing 5: Elevation view of the insulation system.
(Drawing provided by test sponsor)



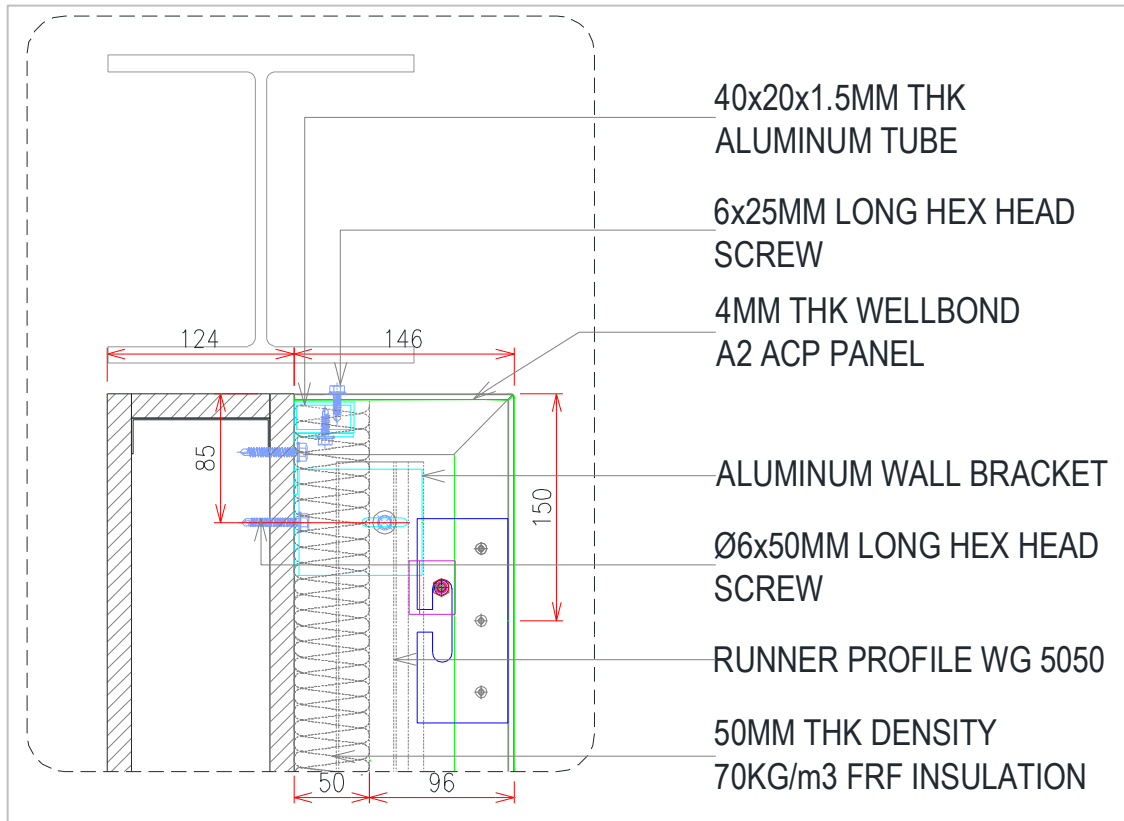
Drawing 6: Elevation view of the completed cladding assembly.
(Drawing provided by test sponsor)



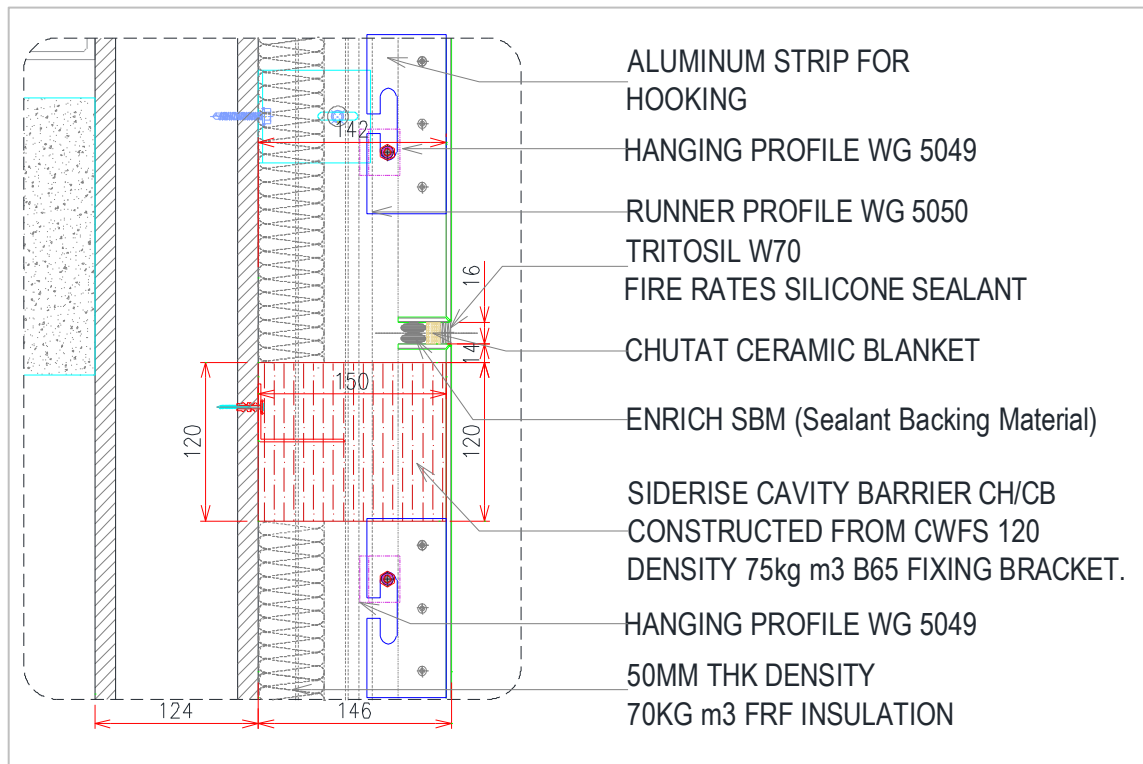
Drawing 7: Horizontal sectional views of drawing 5.
(Drawing provided by test sponsor)



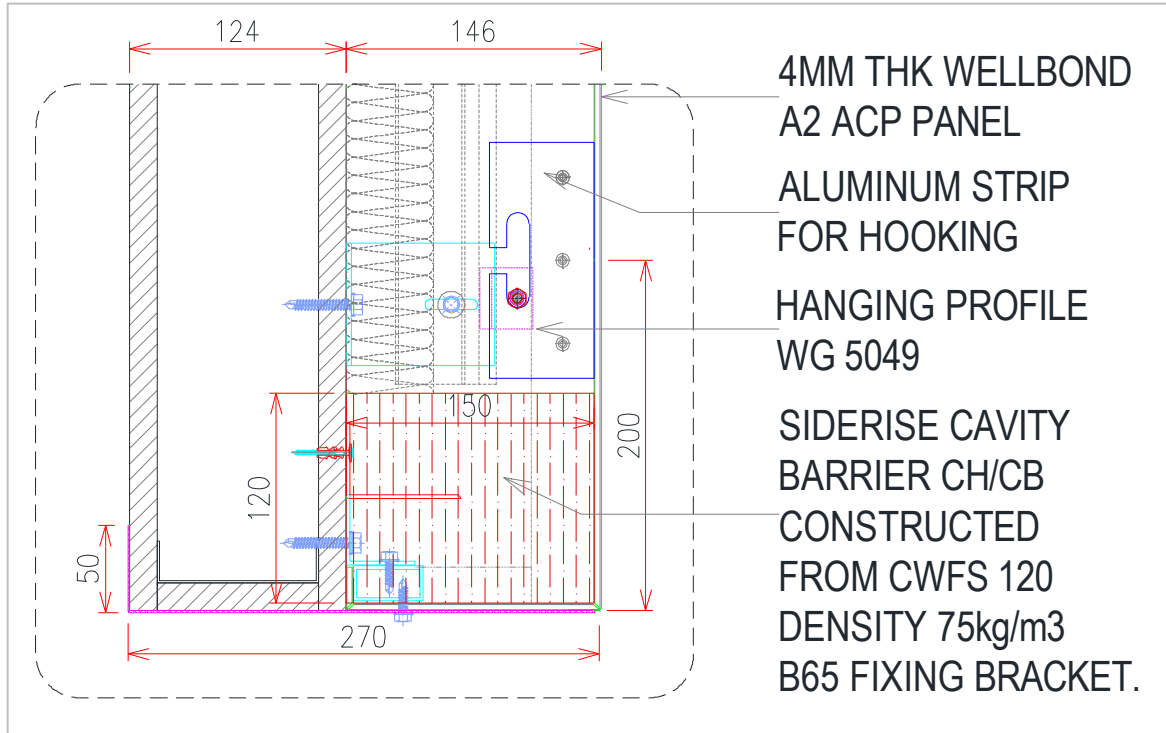
Drawing 8: Vertical sectional views of drawing 5.
(Drawing provided by test sponsor)



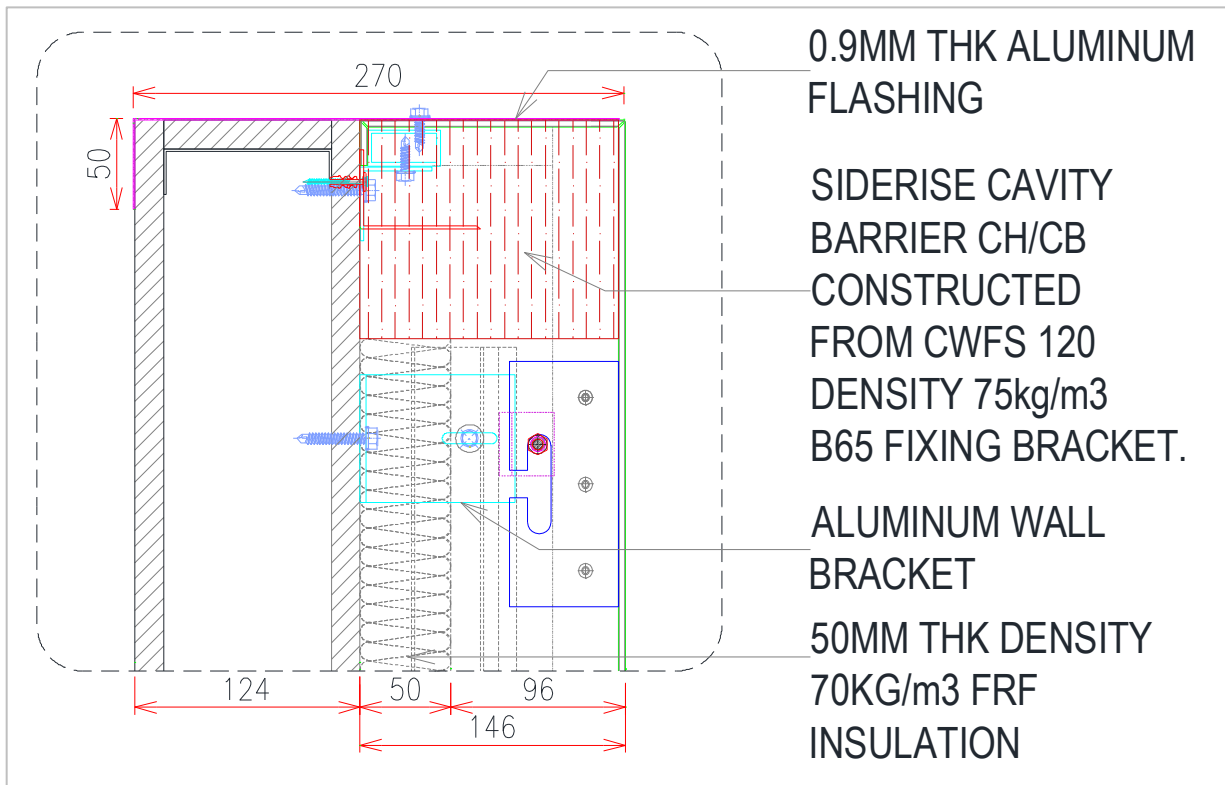
Drawing 9: Detail 01 of drawing 8.
(Drawing provided by test sponsor)



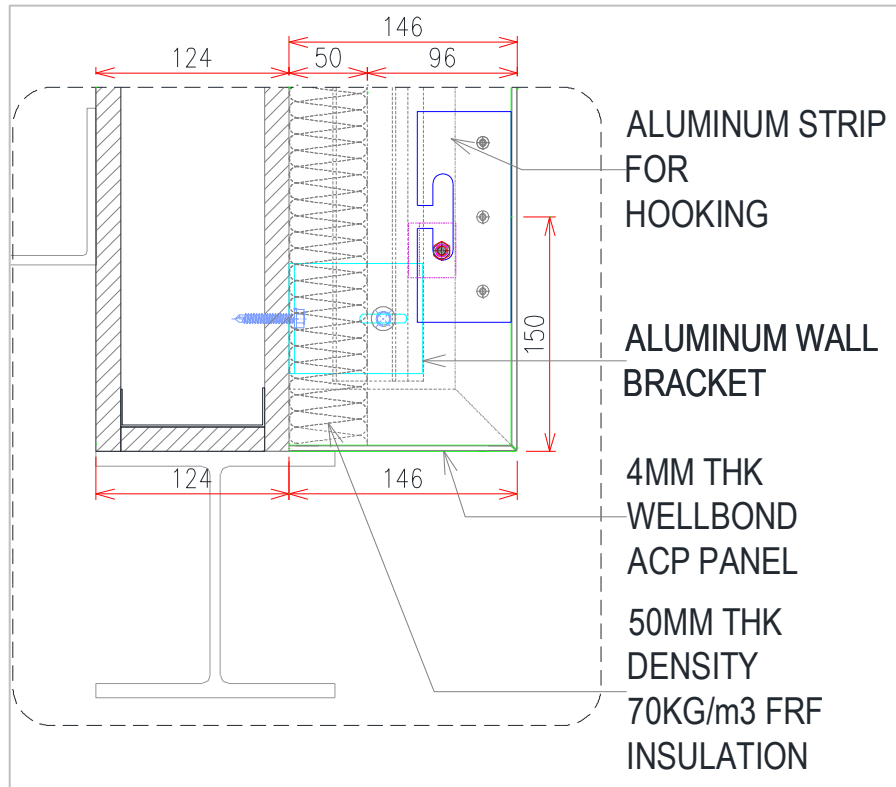
Drawing 10: Detail 02 of drawing 8.
(Drawing provided by test sponsor)



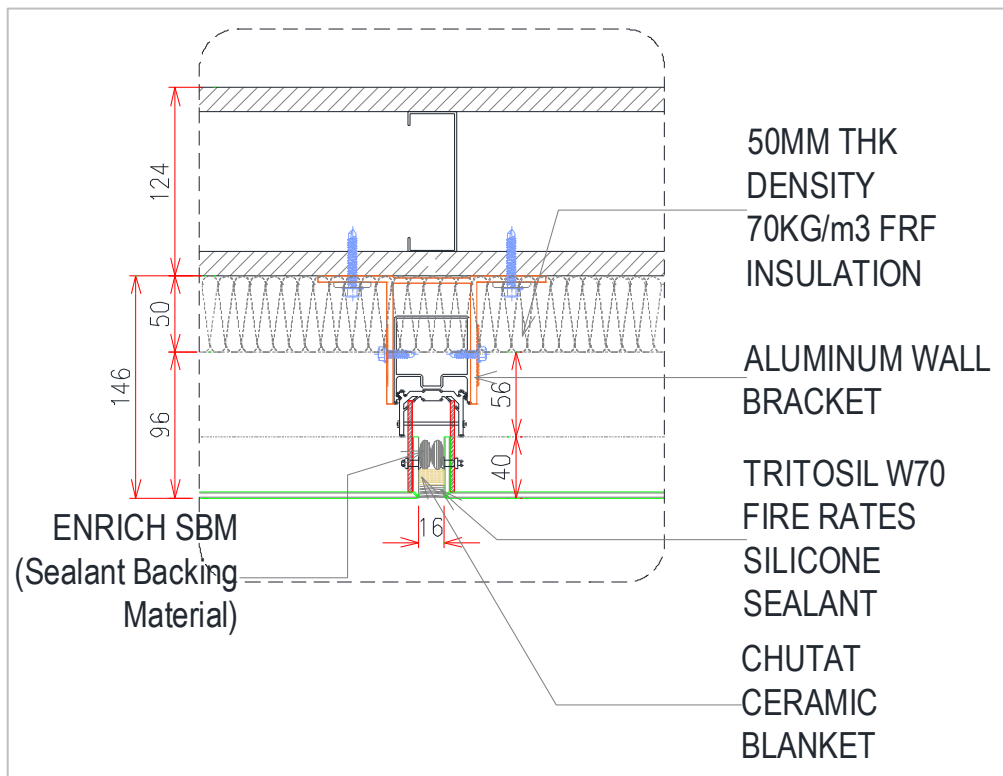
Drawing 11: Detail 03 of drawing 8.
(Drawing provided by test sponsor)



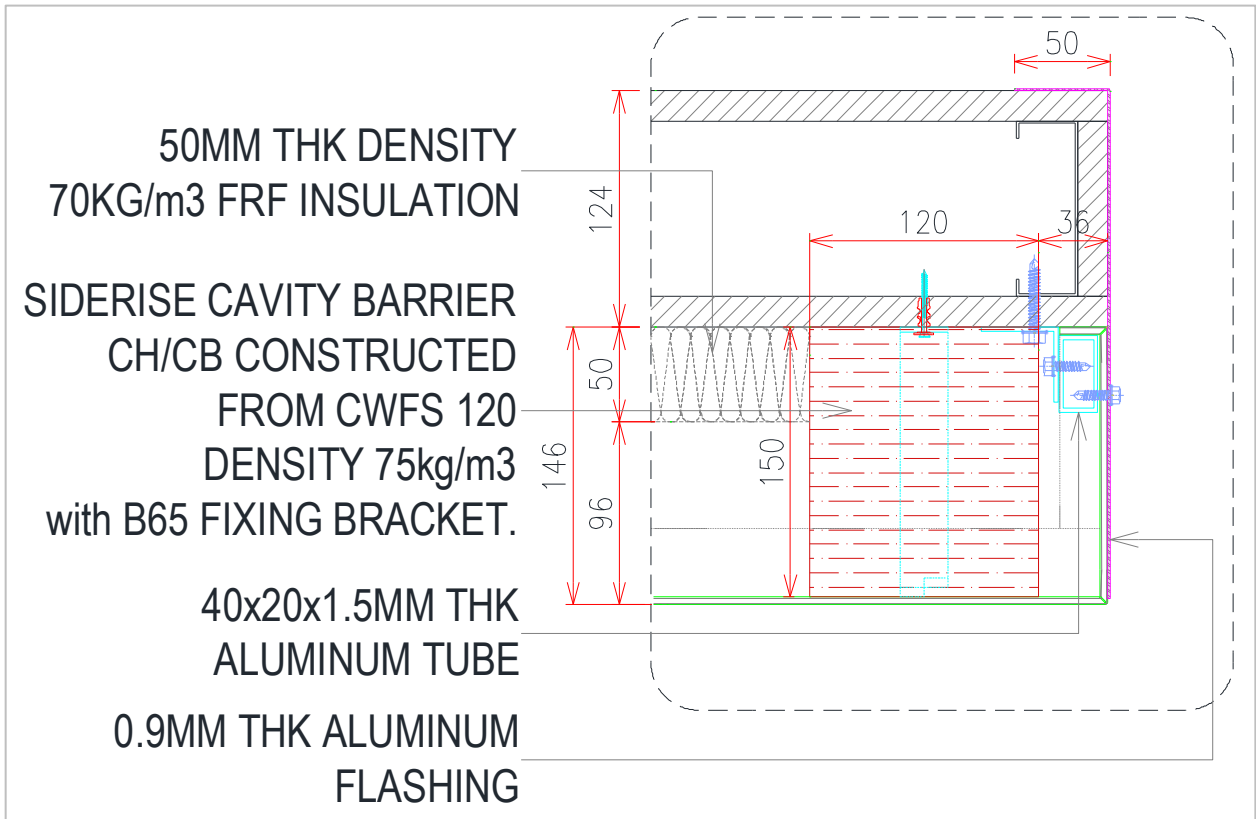
Drawing 12: Detail 04 of drawing 8.
(Drawing provided by test sponsor)



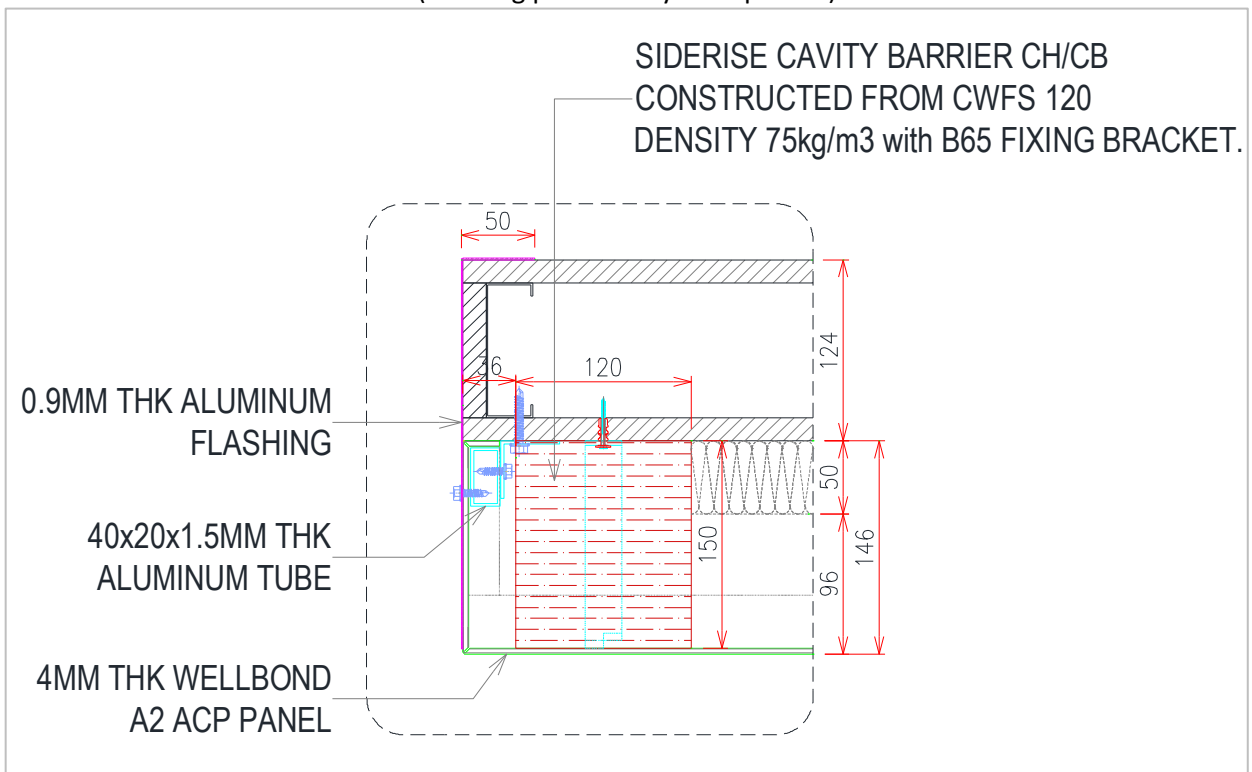
Drawing 13: Detail 05 of drawing 8.
(Drawing provided by test sponsor)



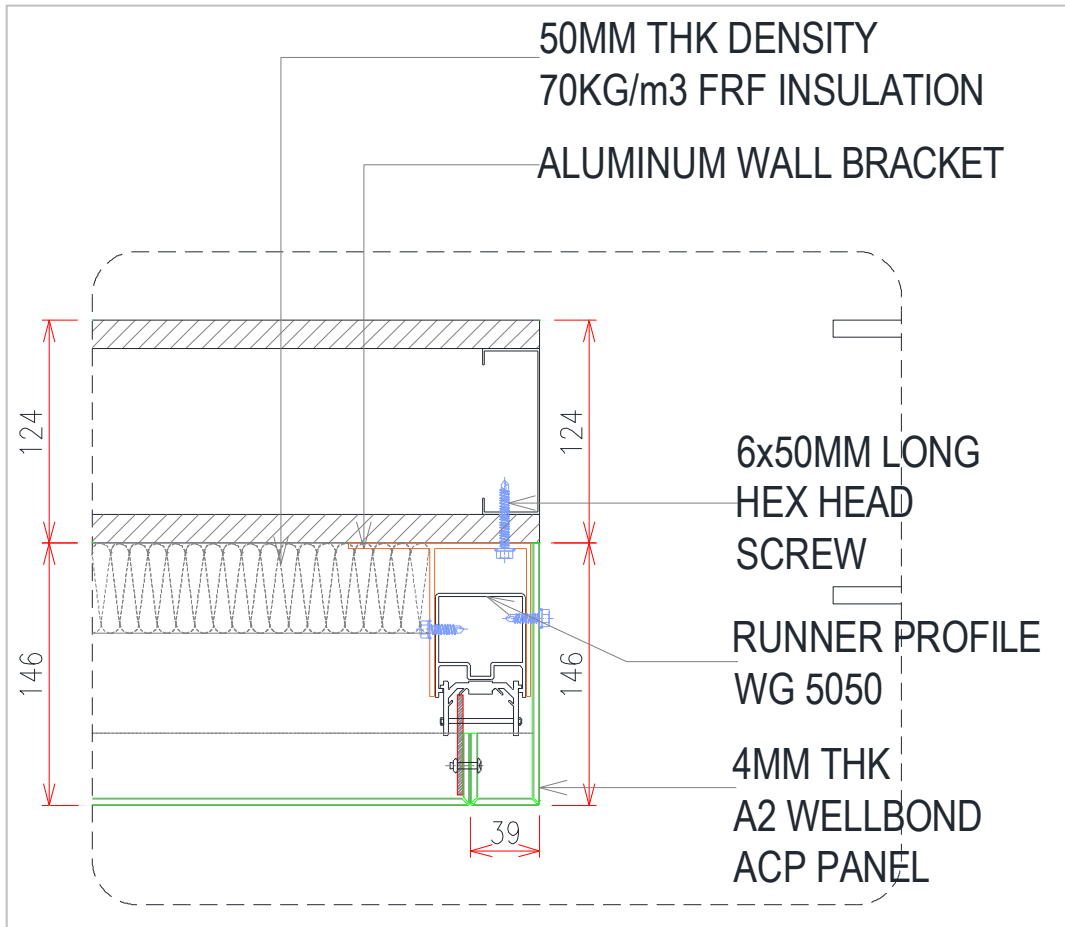
Drawing 14: Detail 06 of drawing 7.
(Drawing provided by test sponsor)



Drawing 15: Detail 07 of drawing 7.
(Drawing provided by test sponsor)



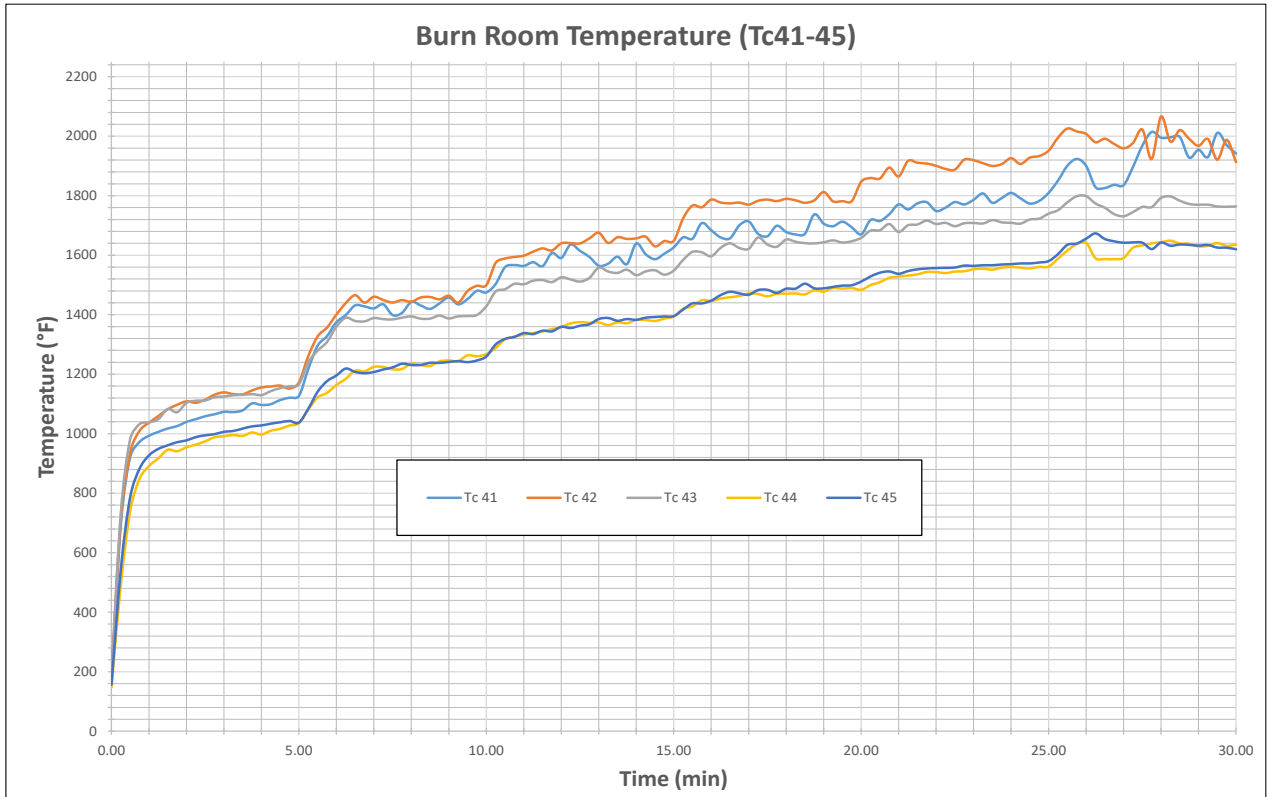
Drawing 16: Detail 08 of drawing 7.
(Drawing provided by test sponsor)



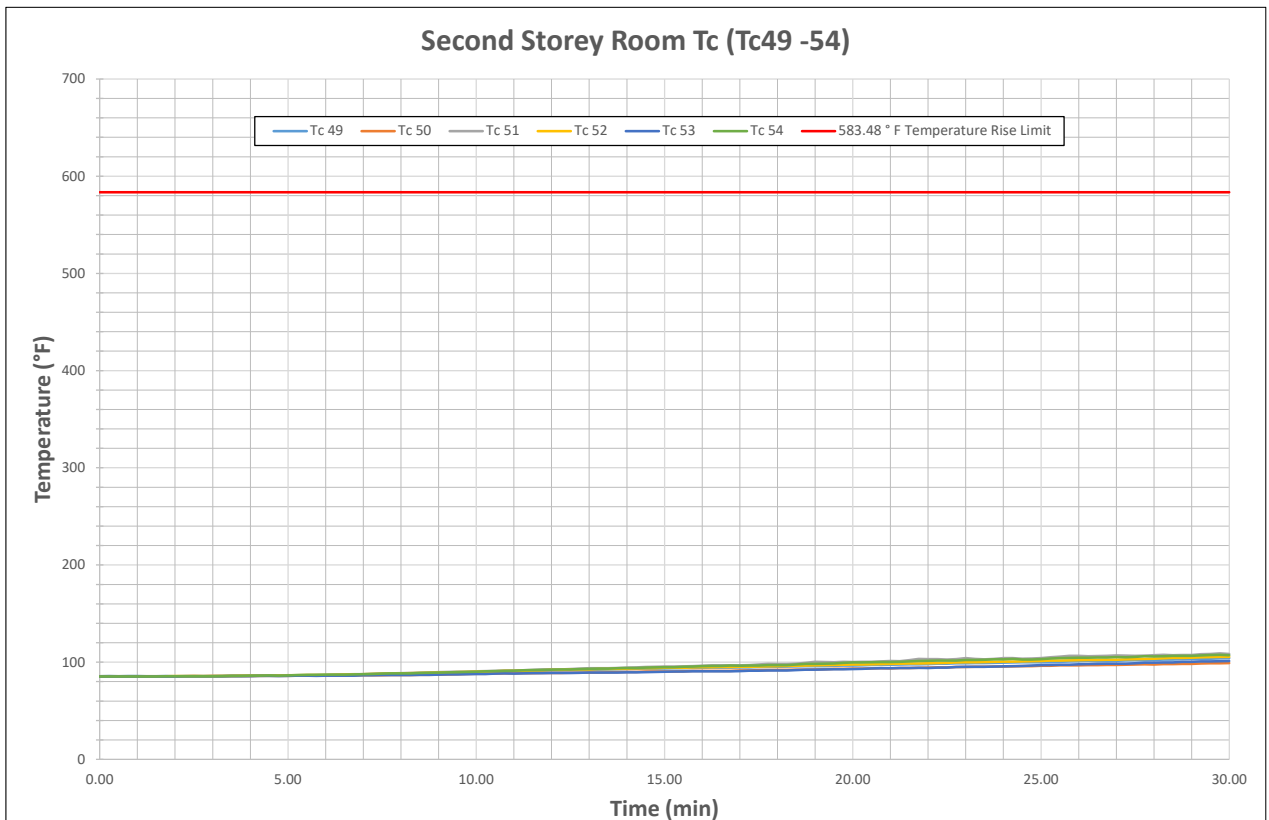
Drawing 17: Detail 09 of drawing 7.
(Drawing provided by test sponsor)



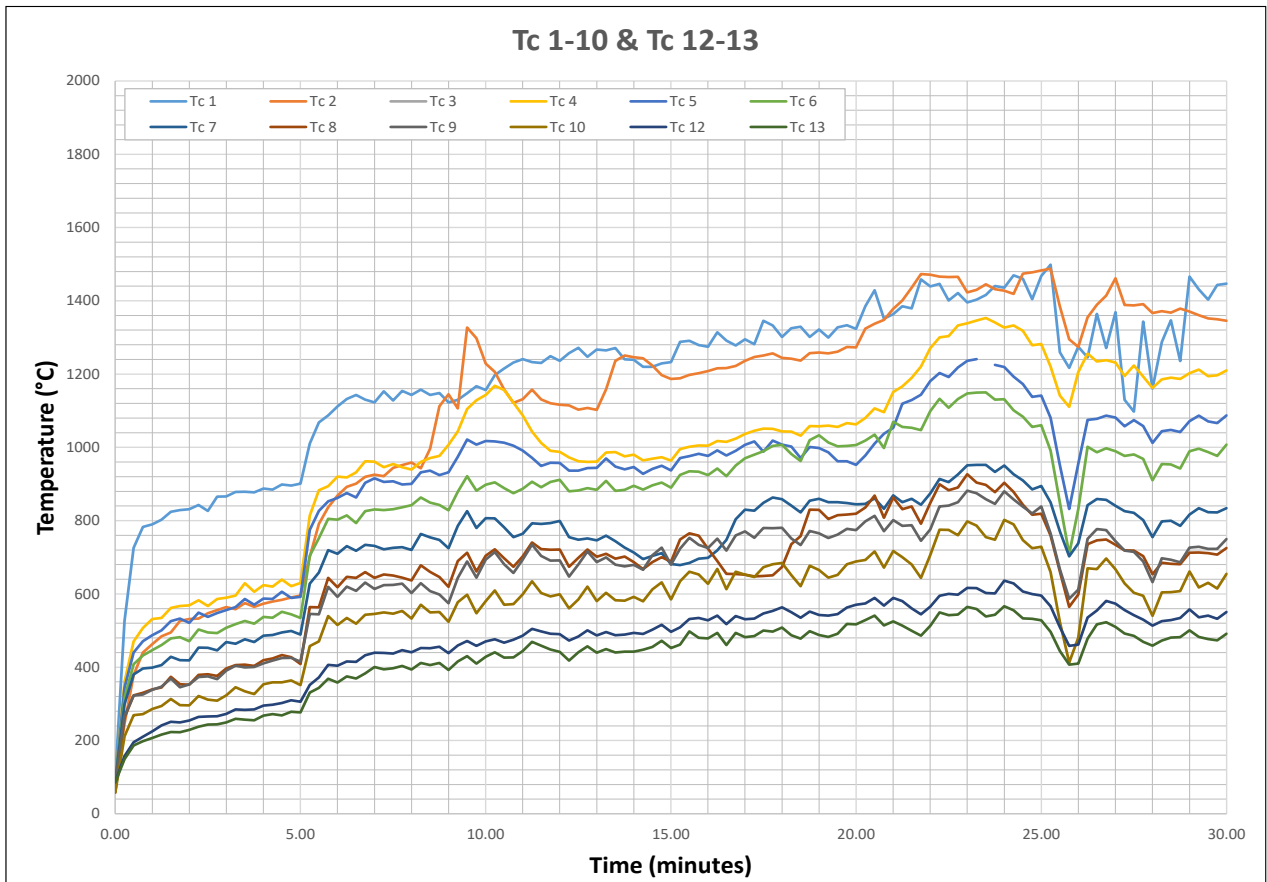
17. APPENDIX 5 – GRAPHS



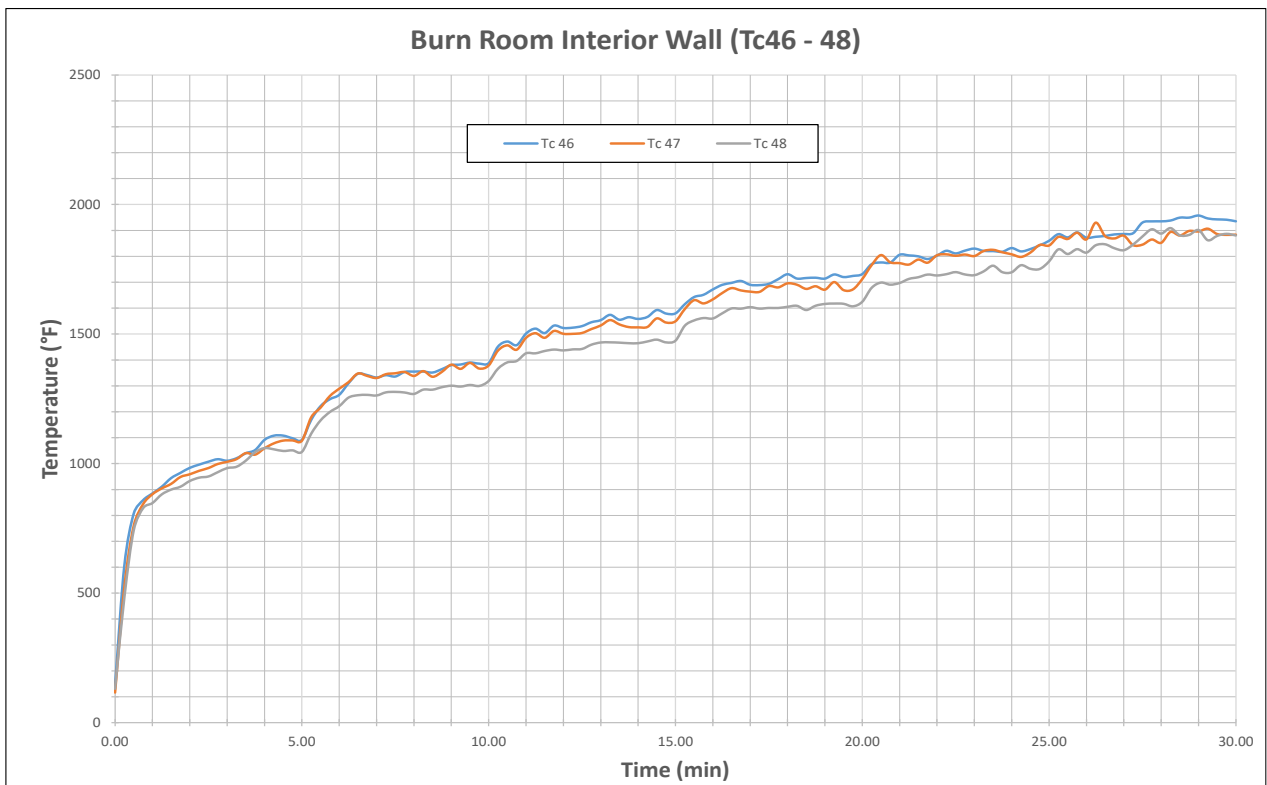
Graph 1: Burn room thermocouple temperature (Tc41 – Tc45)



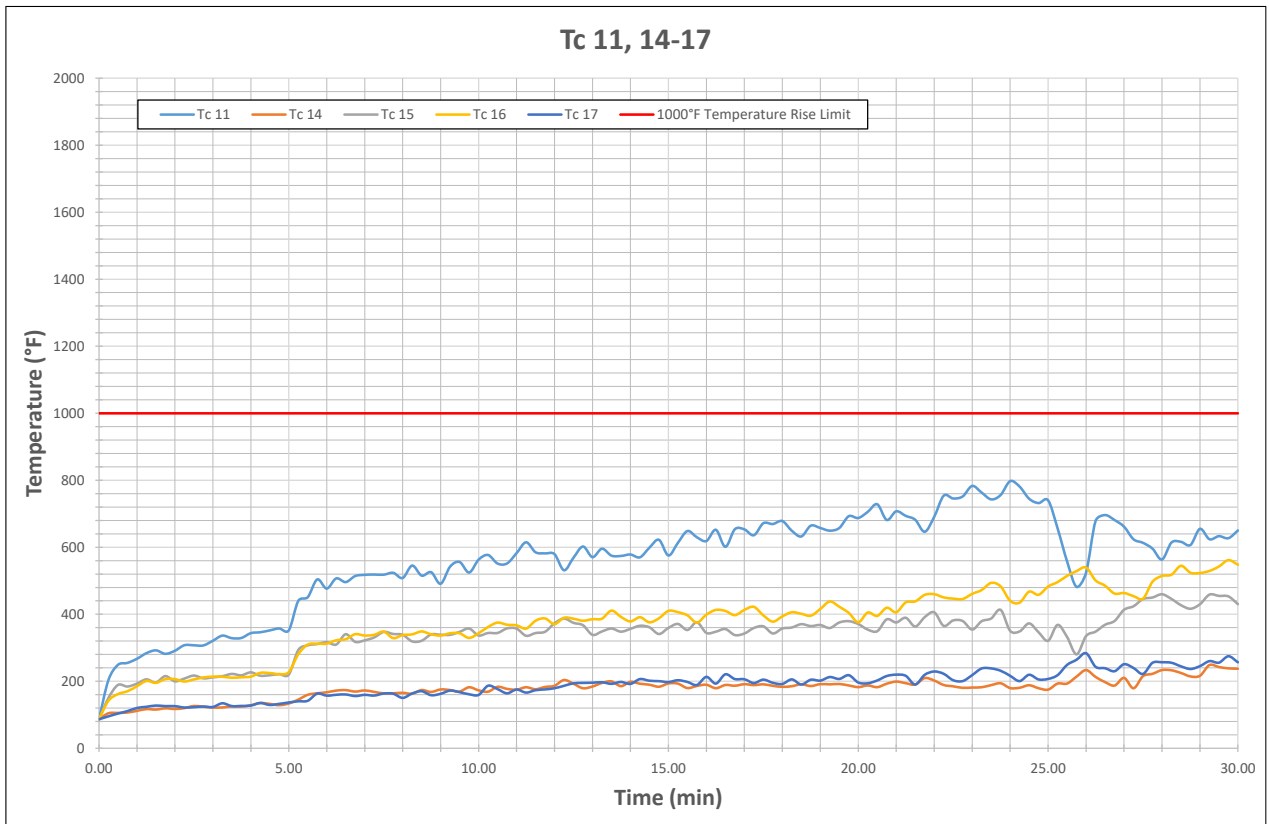
Graph 2: Second story room thermocouple temperatures (Tc49-Tc54)



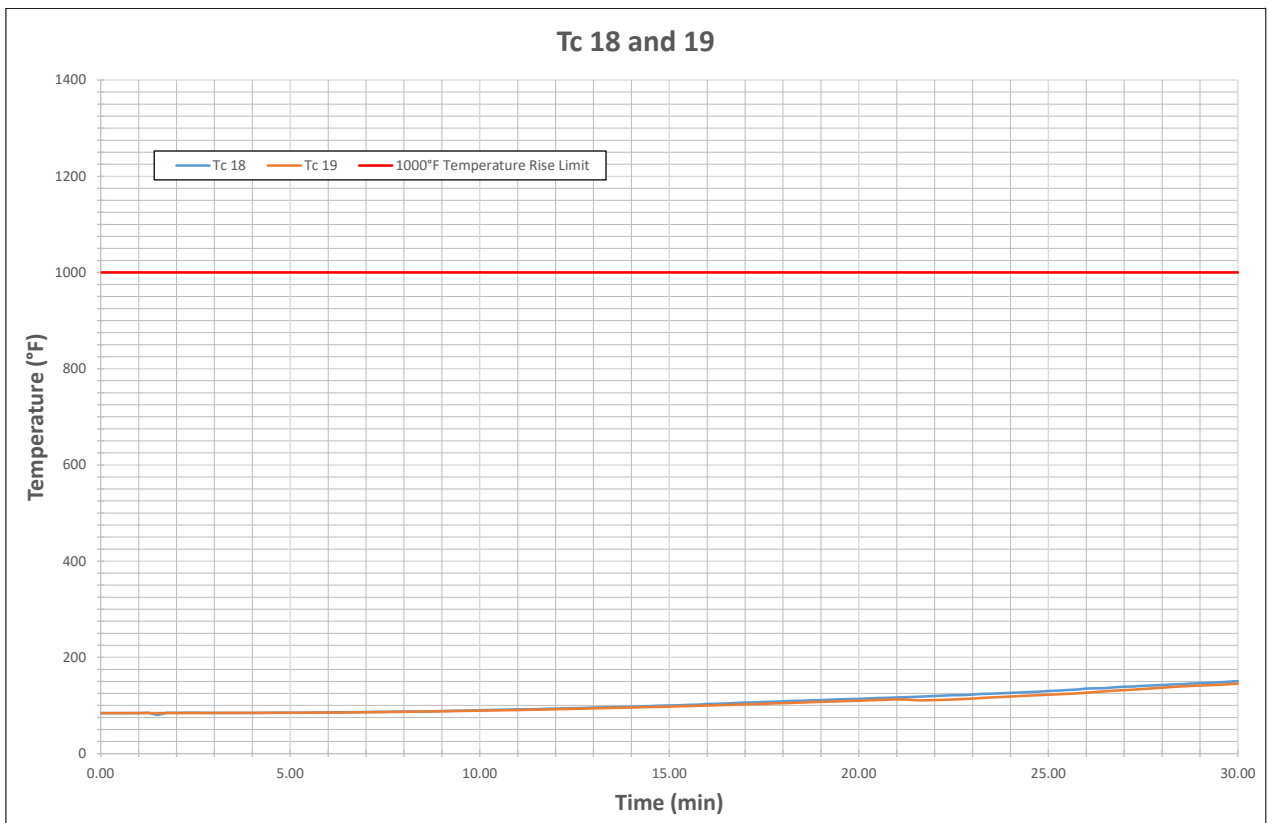
Graph 3: Thermocouple temperatures for Tc1 -Tc10 and Tc12 – Tc23.



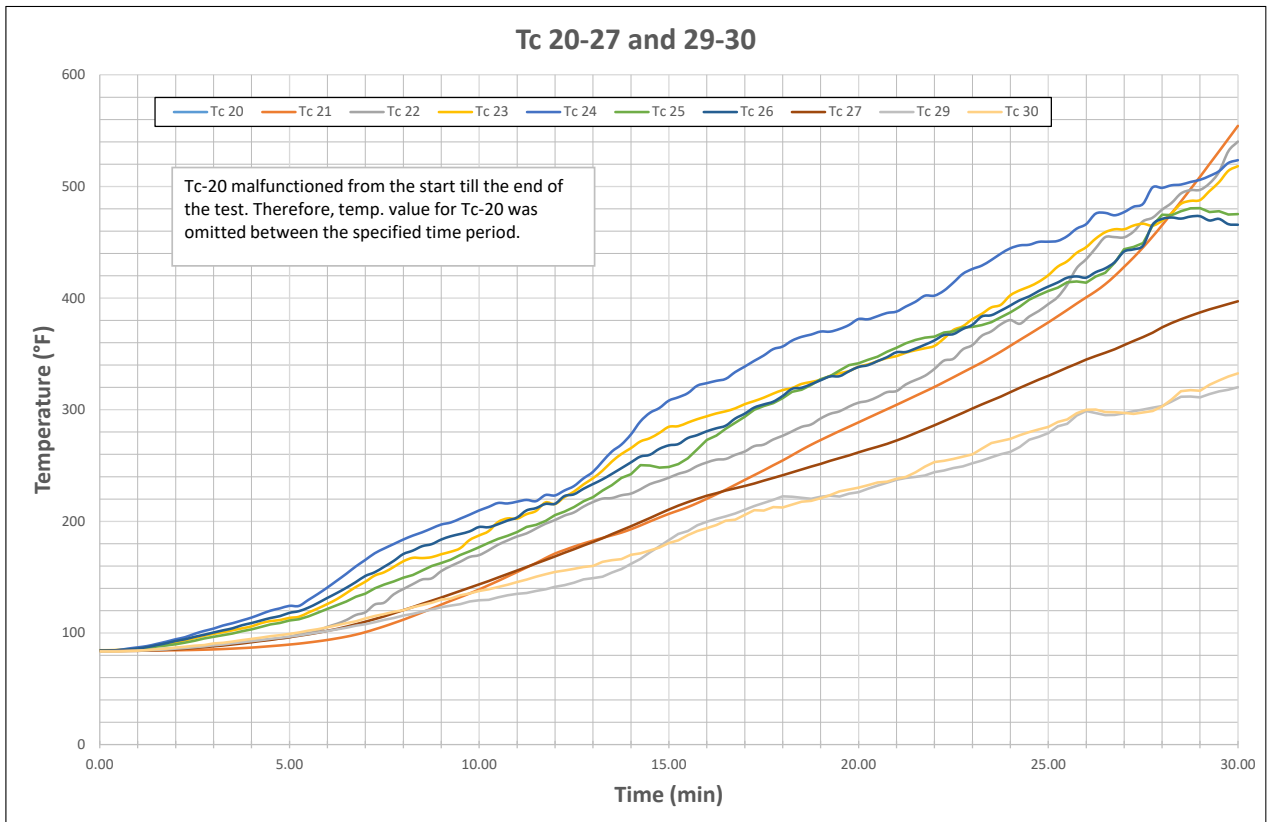
Graph 4: Burn room interior wall temperature (Tc46 – Tc48)



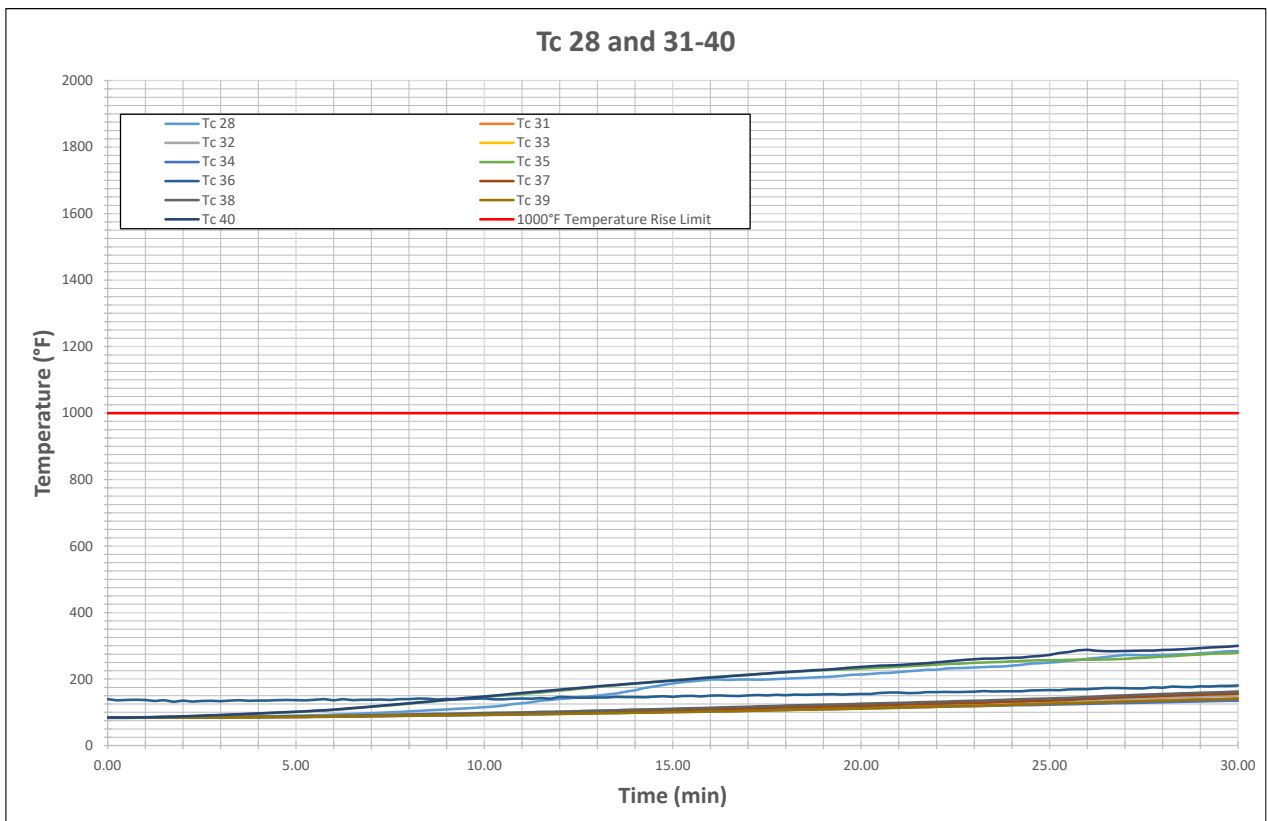
Graph 5: Thermocouple temperatures for Tc11 and Tc14 – Tc17.



Graph 6: Thermocouple temperatures for Tc18 and Tc19.



Graph 7: Thermocouple temperatures for Tc20 – Tc27 and Tc29 – Tc30.



Graph 8: Thermocouple temperatures for Tc28 and Tc31 – Tc40.



18. APPENDIX 6 – CONSTRUCTION PHOTOGRAPHS



Picture 1: View of the wall brackets fixed onto the base wall.



Picture 2: View of the steel tube channels fixed along the perimeter edge of the window opening.



Picture 3: A close-up side view of the window perimeter tube channel.



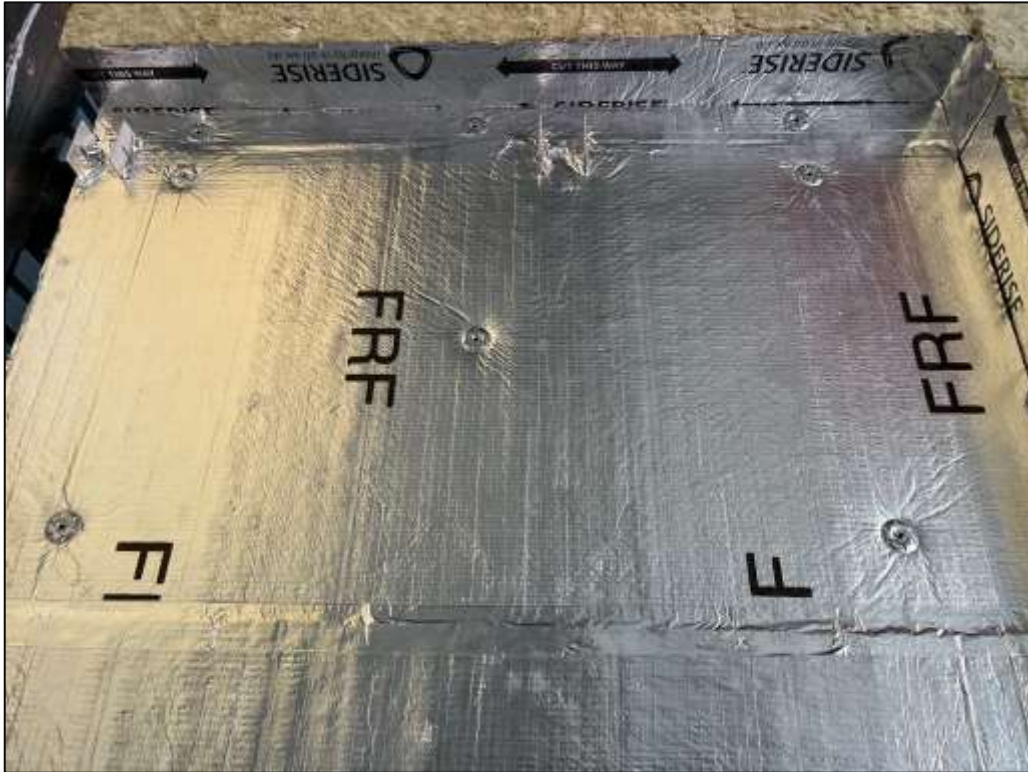
Picture 4: View of the completion of the cavity fire barriers and start of the exterior insulation.



Picture 5: View of the runner to wall bracket fixing method.



Picture 6: Panel holding clamps supported onto the runners.



Picture 7: View of the method of fixing the exterior insulation slabs in place.



Picture 8: A typical view of the backside of the panel.



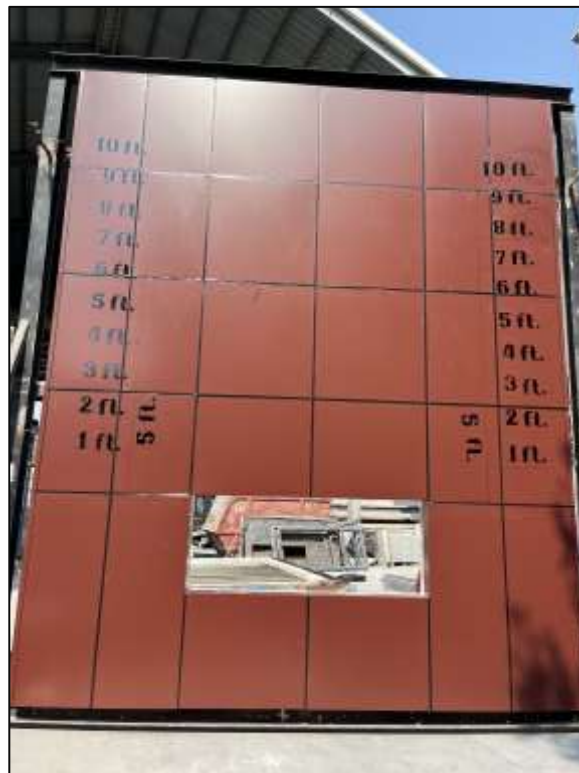
Picture 9: Method of fixing the panel in place with the support of panel clamps.



Picture 10: Ceramic piece being inserted into the panel joints after fixing the spiral threaded backers.



Picture 11: View of installing the cladding panels.



Picture 12: Completed view of the installation.



19. APPENDIX 7 – TEST PHOTOGRAPHS



Picture 13: The specimen at the beginning of the test.



Picture 14: The interior of the base wall in the second-floor test room at the beginning of the test.



Picture 15: The specimen at 5:00 minutes and when the window burner was ignited.



Picture 16: The specimen at 10:00 minutes.



Picture 17: The specimen at 15:00 minutes.



Picture 18: The specimen at 20:00 minutes.



Picture 19: The specimen at 25:00 minutes.



Picture 20: The specimen immediately after the gas was shut off, starting the observation period.



Picture 21: The interior of the base wall in the second-floor test room at the end of the test.



Picture 20: The specimen at the end of the observation period and end of the NFPA 285 test.



Picture 21: Dismantling view.



Picture 22: Assembly after the removal of panels and insulation system.



20. APPENDIX 8 – THERMOCOUPLE DATA

Time (min:sec)	Tc 1 (°F)	Tc 2 (°F)	Tc 3 (°F)	Tc 4 (°F)	Tc 5 (°F)	Tc 6 (°F)	Tc 7 (°F)	Tc 8 (°F)	Tc 9 (°F)
0:00	96	87	86	86	86	86	86	58	86
0:15	527	247	272	360	344	317	299	263	266
0:30	726	379	383	470	440	408	380	323	323
0:45	783	440	448	507	471	432	397	330	326
1:00	790	463	479	531	487	447	399	340	339
1:15	803	484	490	534	501	461	406	345	347
1:30	824	495	515	562	526	479	429	374	369
1:45	829	526	510	567	533	482	419	353	346
2:00	831	532	542	569	521	471	419	352	353
2:15	843	533	536	583	549	503	454	379	373
2:30	826	547	533	567	537	495	453	381	375
2:45	866	556	557	586	548	493	446	376	368
3:00	866	564	554	590	556	508	469	396	391
3:15	878	558	566	595	564	518	464	406	404
3:30	879	575	605	629	586	526	476	407	399
3:45	877	565	590	606	571	519	469	404	400
4:00	887	574	597	624	587	538	486	419	410
4:15	885	580	610	620	586	535	488	424	418
4:30	899	584	623	639	606	551	495	433	425
4:45	896	590	606	621	589	544	499	428	426
5:00	901	596	620	630	592	535	489	409	415
5:15	1010	701	738	814	775	705	628	564	545
5:30	1068	791	812	883	827	752	658	563	544
5:45	1087	836	836	894	853	805	720	644	620
6:00	1111	868	868	920	862	803	709	618	592
6:15	1132	892	873	918	876	814	731	647	620
6:30	1143	901	900	932	863	794	718	644	608
6:45	1130	920	924	962	903	826	734	660	631
7:00	1123	925	930	961	916	831	731	644	613
7:15	1153	921	926	946	906	829	722	653	624
7:30	1128	944	935	954	908	831	726	650	624
7:45	1154	952	939	946	899	836	728	644	628
8:00	1143	958	940	939	901	842	720	637	603
8:15	1158	943	956	961	932	863	764	678	629
8:30	1143	996	979	971	936	849	755	660	608
8:45	1148	1112	988	977	924	843	748	646	598
9:00	1123	1145	1013	1007	932	829	725	619	575
9:15	1130	1106	1031	1043	974	879	786	690	644
9:30	1148	1327	1087	1105	1021	921	826	713	689
9:45	1167	1298	1094	1129	1007	882	780	661	644



Time (min:sec)	Tc 1 (°F)	Tc 2 (°F)	Tc 3 (°F)	Tc 4 (°F)	Tc 5 (°F)	Tc 6 (°F)	Tc 7 (°F)	Tc 8 (°F)	Tc 9 (°F)
10:00	1157	1228	1066	1143	1017	898	807	704	694
10:15	1197	1206	1077	1168	1016	905	806	722	714
10:30	1215	1158	1088	1156	1013	889	782	697	681
10:45	1232	1121	1094	1122	1004	875	755	674	657
11:00	1241	1132	1088	1087	991	887	764	703	694
11:15	1232	1158	1069	1043	971	906	793	741	734
11:30	1231	1131	1077	1012	949	891	791	722	704
11:45	1249	1121	1061	991	958	906	793	721	691
12:00	1236	1117	1061	988	957	911	799	721	691
12:15	1257	1115	1053	972	937	880	755	674	647
12:30	1272	1103	1040	962	937	882	748	698	681
12:45	1247	1108	1033	960	944	889	752	721	716
13:00	1267	1102	1038	961	944	884	746	702	687
13:15	1265	1158	1063	986	970	908	759	709	700
13:30	1271	1236	1082	987	947	881	744	696	680
13:45	1241	1251	1075	976	940	884	727	702	675
14:00	1239	1246	1079	980	946	895	713	687	680
14:15	1220	1243	1064	964	928	885	695	668	666
14:30	1220	1223	1066	969	941	896	704	687	706
14:45	1229	1197	1065	973	950	904	712	700	726
15:00	1233	1187	1062	964	937	890	682	688	680
15:15	1288	1188	1082	996	971	925	679	749	723
15:30	1291	1198	1092	1002	976	935	685	766	753
15:45	1279	1203	1099	1005	982	933	696	759	734
16:00	1275	1208	1100	1005	977	924	698	724	726
16:15	1314	1216	1108	1017	992	942	719	690	751
16:30	1291	1216	1107	1015	978	921	748	655	719
16:45	1278	1222	1112	1024	991	951	804	654	759
17:00	1295	1236	1124	1037	1007	970	830	653	771
17:15	1282	1247	1135	1045	1016	980	827	648	754
17:30	1346	1250	1140	1051	988	990	849	649	780
17:45	1333	1256	1143	1051	1018	1004	863	651	779
18:00	1302	1244	1133	1044	1007	1007	859	674	780
18:15	1325	1242	1131	1043	1002	982	841	736	752
18:30	1329	1237	1120	1032	971	963	822	758	734
18:45	1301	1257	1142	1058	1001	1020	855	830	772
19:00	1322	1259	1136	1058	998	1033	860	829	766
19:15	1300	1256	1136	1059	987	1013	851	804	753
19:30	1328	1261	1141	1056	962	1003	851	815	762
19:45	1333	1274	1160	1066	962	1004	848	817	777



Time (min:sec)	Tc 1 (°F)	Tc 2 (°F)	Tc 3 (°F)	Tc 4 (°F)	Tc 5 (°F)	Tc 6 (°F)	Tc 7 (°F)	Tc 8 (°F)	Tc 9 (°F)
20:00	1324	1273	1163	1063	952	1006	844	819	774
20:15	1385	1324	1183	1080	978	1018	846	836	798
20:30	1429	1337	1202	1106	1011	1035	861	868	813
20:45	1351	1348	1205	1096	1037	998	832	808	771
21:00	1363	1378	1255	1151	1054	1070	869	863	802
21:15	1385	1401	1271	1166	1119	1056	850	831	786
21:30	1380	1436	1294	1189	1129	1053	860	839	788
21:45	1458	1473	1332	1220	1144	1047	843	792	745
22:00	1439	1472	1367	1271	1181	1099	875	848	776
22:15	1446	1466	1371	1300	1203	1132	914	899	839
22:30	1401	1465	1393	1304	1192	1108	905	883	841
22:45	1421	1465	1414	1333	1218	1132	926	891	850
23:00	1396	1423	1377	1339	1236	1147	951	927	882
23:15	1403	1430	1349	1346	1241	1150	952	904	875
23:30	1416	1445	1354	1353	1248	1150	952	898	859
23:45	1440	1432	1345	1341	1225	1130	933	878	846
24:00	1436	1428	1350	1327	1220	1132	950	904	880
24:15	1469	1419	1378	1333	1193	1101	927	878	858
24:30	1460	1474	1378	1318	1173	1084	910	843	838
24:45	1404	1478	1349	1278	1138	1056	886	816	819
25:00	1468	1483	1385	1282	1141	1060	895	819	839
25:15	1498	1487	1353	1220	1081	992	850	759	765
25:30	1260	1384	1205	1141	951	850	771	661	667
25:45	1217	1295	1176	1111	832	709	702	565	587
26:00	1275	1274	1275	1205	955	831	738	599	612
26:15	1246	1355	1375	1256	1075	1002	842	736	750
26:30	1364	1389	1372	1234	1078	987	859	746	777
26:45	1271	1414	1397	1238	1087	998	857	749	774
27:00	1369	1462	1397	1232	1081	989	840	734	744
27:15	1130	1389	1346	1195	1058	977	826	719	719
27:30	1098	1387	1380	1223	1075	981	821	719	715
27:45	1343	1391	1354	1193	1058	968	801	703	689
28:00	1161	1367	1355	1162	1012	910	755	654	632
28:15	1287	1372	1358	1186	1044	955	798	685	697
28:30	1347	1368	1343	1190	1048	953	800	682	693
28:45	1236	1379	1356	1187	1042	942	786	681	686
29:00	1466	1370	1356	1202	1072	990	817	713	726
29:15	1431	1361	1335	1213	1087	997	834	713	729
29:30	1403	1352	1321	1195	1071	987	823	711	723
29:45	1443	1350	1329	1197	1066	977	823	707	723
30:00	1447	1345	1325	1210	1087	1007	834	726	750



Time (min:sec)	Tc 10 (°F)	Tc 11 (°F)	Tc 12 (°F)	Tc 13 (°F)	Tc 14 (°F)	Tc 15 (°F)	Tc 16 (°F)	Tc 17 (°F)	Tc 18 (°F)
0:00	58	86	86	86	86	87	87	87	84
0:15	212	203	158	149	104	150	142	95	84
0:30	269	249	195	187	105	189	162	104	84
0:45	272	255	211	198	107	184	170	111	84
1:00	286	267	225	207	112	193	185	120	84
1:15	294	284	241	216	117	206	201	124	85
1:30	313	292	251	223	115	196	195	128	80
1:45	296	282	249	223	119	215	206	126	85
2:00	296	291	254	229	117	200	206	126	85
2:15	321	307	264	237	120	208	199	122	85
2:30	312	307	266	243	126	217	205	123	85
2:45	309	307	266	244	124	209	211	125	85
3:00	323	321	273	249	122	212	214	123	84
3:15	345	336	285	259	122	215	214	134	84
3:30	334	328	284	257	125	222	211	126	84
3:45	327	329	285	255	124	218	212	126	85
4:00	354	343	295	268	128	227	214	128	85
4:15	359	346	297	272	135	217	225	135	85
4:30	359	352	302	269	132	218	225	129	85
4:45	364	357	310	279	129	221	221	133	85
5:00	351	352	306	277	133	220	227	137	85
5:15	458	440	352	331	145	293	280	140	85
5:30	470	451	372	343	160	307	309	142	85
5:45	540	504	406	368	164	311	312	163	85
6:00	515	476	404	358	167	317	312	157	85
6:15	535	507	416	375	172	310	322	160	86
6:30	519	496	415	369	173	340	325	161	86
6:45	543	514	432	383	169	318	341	156	86
7:00	545	517	440	401	172	322	337	160	86
7:15	549	518	439	394	168	331	339	157	86
7:30	546	518	437	397	164	347	348	163	87
7:45	554	523	447	404	164	341	329	163	87
8:00	533	508	441	394	165	339	338	150	87
8:15	571	545	452	412	163	319	340	164	87
8:30	549	515	452	406	174	321	349	170	88
8:45	551	525	456	412	168	340	340	158	88
9:00	524	491	439	392	175	339	336	163	88
9:15	577	542	459	416	174	339	343	172	89
9:30	598	556	472	431	169	347	343	167	89
9:45	547	524	458	410	182	357	329	161	90



Time (min:sec)	Tc 10 (°F)	Tc 11 (°F)	Tc 12 (°F)	Tc 13 (°F)	Tc 14 (°F)	Tc 15 (°F)	Tc 16 (°F)	Tc 17 (°F)	Tc 18 (°F)
10:00	580	563	470	429	173	337	343	159	90
10:15	610	577	476	441	169	344	362	187	90
10:30	571	551	467	426	183	344	375	177	91
10:45	572	551	475	427	177	358	369	164	91
11:00	599	582	486	444	175	357	367	175	92
11:15	634	615	505	469	182	336	357	166	92
11:30	603	585	498	459	176	344	381	173	92
11:45	593	581	491	449	183	348	387	176	93
12:00	599	579	490	442	186	373	371	179	93
12:15	561	531	473	418	204	387	390	186	94
12:30	585	569	484	441	192	374	387	194	94
12:45	620	602	501	457	179	367	381	195	95
13:00	580	570	487	439	184	338	385	196	95
13:15	603	595	496	449	195	349	387	197	96
13:30	583	575	487	440	200	357	411	192	97
13:45	582	574	489	443	185	348	392	198	97
14:00	592	578	494	442	198	356	378	192	97
14:15	580	570	491	448	193	366	391	206	98
14:30	612	599	502	456	190	361	376	202	99
14:45	632	622	516	472	184	341	388	200	99
15:00	585	575	497	452	193	359	410	198	100
15:15	635	613	509	462	193	371	406	203	100
15:30	661	648	531	498	180	353	397	198	101
15:45	653	629	534	481	186	376	375	189	102
16:00	627	618	528	479	189	344	399	213	103
16:15	668	652	541	494	179	348	413	193	104
16:30	613	601	518	460	189	356	410	221	104
16:45	661	654	540	494	187	338	397	207	105
17:00	652	653	531	482	191	342	413	206	106
17:15	646	636	533	485	188	359	422	195	106
17:30	673	671	547	500	191	364	397	205	107
17:45	681	669	553	497	186	343	378	195	108
18:00	685	678	563	508	183	357	394	192	108
18:15	651	649	550	488	185	360	406	206	109
18:30	621	632	535	478	191	370	401	190	110
18:45	677	664	552	498	186	365	396	205	111
19:00	665	657	542	488	191	368	416	202	111
19:15	644	649	541	483	191	359	438	213	112
19:30	652	657	545	491	192	375	422	207	113
19:45	681	692	563	518	187	379	404	218	113



Time (min:sec)	Tc 10 (°F)	Tc 11 (°F)	Tc 12 (°F)	Tc 13 (°F)	Tc 14 (°F)	Tc 15 (°F)	Tc 16 (°F)	Tc 17 (°F)	Tc 18 (°F)
20:00	689	687	571	517	182	371	376	196	114
20:15	693	705	574	529	187	354	405	194	114
20:30	716	728	589	541	182	349	395	202	115
20:45	672	681	568	514	193	385	419	216	116
21:00	717	707	589	525	199	376	406	220	117
21:15	700	693	580	514	194	389	435	216	117
21:30	681	682	561	500	190	363	438	190	118
21:45	644	646	545	486	209	391	458	219	119
22:00	706	690	566	513	202	406	460	229	120
22:15	775	754	595	550	189	365	450	222	120
22:30	775	745	600	542	185	382	447	203	122
22:45	760	751	598	544	180	380	445	201	122
23:00	798	783	617	565	181	354	461	218	123
23:15	786	763	616	559	182	379	472	238	124
23:30	755	743	603	539	188	387	494	238	124
23:45	748	756	602	543	194	413	483	231	125
24:00	802	797	636	567	180	351	440	216	126
24:15	790	781	629	556	180	349	435	200	127
24:30	747	745	607	533	188	373	467	219	128
24:45	725	732	600	532	179	346	458	205	129
25:00	729	740	596	528	175	321	483	207	130
25:15	659	656	566	497	193	368	496	218	131
25:30	523	557	510	444	193	332	514	249	132
25:45	413	481	458	407	214	280	529	264	133
26:00	480	524	462	410	233	335	539	284	135
26:15	670	678	536	478	213	348	501	243	135
26:30	668	696	555	517	197	369	485	239	136
26:45	697	681	581	523	191	380	462	230	137
27:00	667	661	573	510	210	413	463	251	139
27:15	629	623	556	492	231	424	454	240	139
27:30	603	613	542	485	215	445	446	222	141
27:45	595	596	530	469	222	450	497	255	142
28:00	540	563	513	459	233	460	514	257	142
28:15	605	614	526	473	233	446	518	255	144
28:30	605	616	528	481	225	427	544	244	144
28:45	608	607	535	482	214	416	524	237	145
29:00	661	655	558	501	216	430	523	245	146
29:15	618	624	536	483	248	458	529	260	147
29:30	630	633	541	477	242	455	542	255	148
29:45	615	627	532	474	238	453	561	275	149
30:00	655	650	551	492	237	430	548	257	150



Time (min:sec)	Tc 19(°F)	Tc 20(°F)	Tc 21(°F)	Tc 22(°F)	Tc 23(°F)	Tc 24(°F)	Tc 25(°F)	Tc 26(°F)	Tc 27(°F)
0:00	84	Tc-20 malfunctioned from the start till the end of the test. Therefore, temperature values for Tc-20 were omitted between the specified time period.	84	84	84	84	84	84	84
0:15	84		84	84	85	84	84	84	84
0:30	84		84	84	85	85	84	85	84
0:45	84		84	85	85	86	85	85	84
1:00	84		84	85	86	87	86	86	84
1:15	84		84	85	87	88	87	87	84
1:30	84		84	86	88	90	88	89	85
1:45	84		84	86	90	92	89	91	85
2:00	84		85	86	92	94	90	93	85
2:15	84		85	87	93	96	91	94	86
2:30	84		85	88	95	99	93	96	87
2:45	84		85	88	97	102	95	98	87
3:00	85		85	89	99	104	96	100	88
3:15	85		86	89	101	107	98	102	89
3:30	85		86	90	102	109	100	104	90
3:45	85		87	92	104	111	102	107	91
4:00	85		87	93	106	114	103	109	92
4:15	85		88	93	109	117	106	111	93
4:30	85		88	94	111	120	108	113	94
4:45	85		89	95	112	122	109	115	95
5:00	85		90	96	113	124	111	118	96
5:15	85		91	99	114	124	112	120	97
5:30	85		92	100	118	130	115	123	99
5:45	85		93	102	122	135	118	127	100
6:00	85		94	105	126	141	122	131	102
6:15	85		95	108	130	147	125	136	104
6:30	86		97	112	136	153	128	140	106
6:45	86		99	116	141	160	132	146	108
7:00	86		101	119	146	165	135	151	110
7:15	86		103	126	151	171	140	154	112
7:30	86	106	127	154	176	143	159	115	
7:45	87	109	135	159	180	146	165	118	
8:00	87	112	139	164	184	150	171	120	
8:15	87	115	144	167	187	152	174	123	
8:30	88	119	148	167	190	156	178	126	
8:45	88	122	149	168	194	160	180	129	
9:00	88	125	155	170	197	163	184	132	
9:15	88	129	160	173	199	166	187	135	
9:30	89	132	164	176	202	170	189	138	
9:45	89	135	168	183	206	173	191	141	



Time (min:sec)	Tc 19(°F)	Tc 20(°F)	Tc 21(°F)	Tc 22(°F)	Tc 23(°F)	Tc 24(°F)	Tc 25(°F)	Tc 26(°F)	Tc 27(°F)
10:00	89	Tc-20 malfunctioned from the start till the end of the test. Therefore, temperature values for Tc-20 were omitted between the specified time period.	139	170	187	210	177	195	144
10:15	90		143	174	191	213	181	195	147
10:30	90		147	179	199	217	184	197	150
10:45	90		151	183	203	216	187	201	153
11:00	91		155	186	202	218	190	203	156
11:15	91		159	189	206	219	195	210	159
11:30	91		163	194	209	218	197	212	162
11:45	92		167	198	217	224	200	216	165
12:00	92		171	201	216	223	205	216	169
12:15	93		174	205	222	228	209	223	172
12:30	93		177	208	227	232	213	224	175
12:45	94		180	213	233	239	218	229	178
13:00	94		183	217	239	244	222	233	182
13:15	95		185	220	245	254	228	238	185
13:30	95		188	221	254	263	232	243	189
13:45	95		190	223	260	269	239	248	192
14:00	96		193	225	266	278	242	253	196
14:15	96		196	229	272	289	250	258	199
14:30	97		200	233	274	297	250	260	203
14:45	97		203	236	279	302	248	265	207
15:00	98		207	239	285	308	249	268	211
15:15	98		210	243	285	311	251	269	214
15:30	99		213	245	288	315	256	275	217
15:45	99		216	250	292	322	265	277	220
16:00	100		220	253	294	324	273	281	223
16:15	101		224	255	297	326	277	283	225
16:30	101		228	256	299	328	283	286	228
16:45	102		233	260	301	334	288	292	230
17:00	102		237	263	305	339	294	296	232
17:15	103		241	267	308	344	300	302	234
17:30	104	246	269	311	349	303	305	236	
17:45	104	250	273	314	354	306	307	239	
18:00	105	255	277	318	357	310	312	241	
18:15	106	259	281	319	362	316	319	244	
18:30	106	264	285	323	365	318	320	247	
18:45	107	269	287	325	367	322	323	249	
19:00	108	273	292	327	370	327	326	252	
19:15	108	277	296	330	370	330	330	254	
19:30	109	281	299	333	372	335	330	257	
19:45	109	285	303	335	376	340	334	259	



Time (min:sec)	Tc 19(°F)	Tc 20(°F)	Tc 21(°F)	Tc 22(°F)	Tc 23(°F)	Tc 24(°F)	Tc 25(°F)	Tc 26(°F)	Tc 27(°F)
20:00	110	Tc-20 malfunctioned from the start till the end of the test. Therefore, temperature values for Tc-20 were omitted between the specified time period.	289	306	339	381	342	338	262
20:15	111		293	308	341	381	345	340	264
20:30	111		297	311	344	384	348	344	267
20:45	112		301	316	346	387	352	347	269
21:00	113		304	317	348	388	356	352	272
21:15	112		308	323	351	392	360	352	276
21:30	111		312	327	353	397	363	355	279
21:45	111		316	330	355	402	365	358	283
22:00	111		320	337	357	402	366	362	286
22:15	112		325	344	364	407	369	367	290
22:30	113		329	346	371	414	370	368	293
22:45	113		334	354	375	422	374	372	297
23:00	114		338	358	381	426	374	376	301
23:15	116		342	366	386	429	376	384	305
23:30	117		347	370	392	434	378	385	308
23:45	118		352	376	394	440	383	389	312
24:00	119		357	380	402	445	387	393	316
24:15	120		363	377	407	447	392	398	320
24:30	121		368	383	410	448	399	402	323
24:45	121		373	388	415	450	403	406	327
25:00	122		378	395	420	451	406	410	330
25:15	123		384	401	428	451	409	414	334
25:30	124		389	412	433	455	414	418	338
25:45	125		395	427	441	462	415	420	341
26:00	127		401	435	446	466	414	418	345
26:15	128		406	445	453	476	419	423	348
26:30	129		412	455	459	476	423	427	351
26:45	131		420	455	462	474	432	432	354
27:00	132		428	454	462	477	444	442	358
27:15	133		436	460	465	482	446	444	362
27:30	134	446	469	467	484	449	447	365	
27:45	136	455	472	465	499	465	466	369	
28:00	137	465	479	469	499	475	471	374	
28:15	138	476	485	476	501	474	472	378	
28:30	140	487	494	485	502	478	471	381	
28:45	141	498	497	487	504	480	473	384	
29:00	141	509	497	488	506	481	473	387	
29:15	142	520	503	496	509	477	470	390	
29:30	143	531	513	504	514	478	471	392	
29:45	144	543	532	514	521	475	466	395	
30:00	145	554	540	518	524	475	466	397	



Time (min:sec)	Tc 28(°F)	Tc 29(°F)	Tc 30(°F)	Tc 31(°F)	Tc 32(°F)	Tc 33(°F)	Tc 34(°F)	Tc 35(°F)	Tc 36(°F)
0:00	83	84	83	85	85	85	84	84	140
0:15	83	84	83	85	85	85	84	84	136
0:30	83	84	83	85	85	85	84	84	137
0:45	83	84	84	85	85	85	84	85	138
1:00	84	84	84	85	85	85	84	85	137
1:15	84	84	85	85	85	85	84	85	134
1:30	84	85	85	85	86	85	84	86	136
1:45	84	85	86	85	86	86	84	87	132
2:00	84	86	87	85	86	86	84	88	135
2:15	85	87	88	85	86	86	84	88	132
2:30	85	87	89	85	86	86	84	90	134
2:45	85	88	89	85	86	86	85	91	135
3:00	86	89	91	85	86	86	85	92	133
3:15	86	90	91	85	87	87	85	93	135
3:30	87	91	92	85	87	87	85	94	136
3:45	87	92	94	86	87	87	85	95	135
4:00	88	93	95	86	87	87	85	96	135
4:15	88	94	96	86	87	88	85	98	135
4:30	89	95	97	86	88	88	85	99	137
4:45	89	96	98	86	88	88	86	100	137
5:00	90	97	99	86	88	88	86	101	137
5:15	90	98	101	86	88	89	86	102	136
5:30	91	99	102	87	89	89	86	104	138
5:45	92	101	103	87	89	90	86	106	139
6:00	93	102	105	87	90	90	87	107	136
6:15	94	103	107	87	90	91	87	109	140
6:30	95	105	109	88	91	91	87	112	136
6:45	96	107	111	88	91	92	88	114	138
7:00	98	108	113	89	92	92	88	116	138
7:15	99	110	115	89	92	93	88	119	139
7:30	100	112	117	89	93	94	89	121	137
7:45	101	113	119	90	94	94	89	123	140
8:00	103	116	120	90	94	95	89	126	140
8:15	104	117	123	90	94	95	90	129	142
8:30	106	119	125	91	95	96	90	131	141
8:45	107	121	127	91	95	97	90	134	138
9:00	109	123	130	91	96	97	91	136	140
9:15	110	124	131	92	96	98	91	139	139
9:30	111	126	134	92	97	98	91	141	140
9:45	114	128	135	93	98	99	92	144	141



Time (min:sec)	Tc 28(°F)	Tc 29(°F)	Tc 30(°F)	Tc 31(°F)	Tc 32(°F)	Tc 33(°F)	Tc 34(°F)	Tc 35(°F)	Tc 36(°F)
10:00	116	129	138	93	98	99	92	146	142
10:15	117	130	139	94	98	100	92	148	139
10:30	120	132	141	94	99	101	93	151	139
10:45	125	134	143	94	99	101	93	153	141
11:00	127	135	146	95	100	102	94	155	142
11:15	130	136	148	95	100	102	94	158	141
11:30	135	138	150	96	101	103	94	160	143
11:45	137	139	153	96	101	103	95	163	141
12:00	140	141	155	97	102	104	96	165	146
12:15	142	143	156	97	103	105	96	168	145
12:30	146	145	157	98	104	105	96	170	144
12:45	147	148	159	98	104	106	97	173	144
13:00	150	149	160	98	105	107	97	176	145
13:15	153	151	164	99	105	108	98	179	145
13:30	157	154	165	99	106	108	98	181	146
13:45	162	157	166	100	107	109	99	184	146
14:00	167	162	170	100	107	109	99	187	146
14:15	173	166	171	101	108	110	100	189	145
14:30	177	172	174	101	108	111	100	192	147
14:45	182	178	177	102	109	111	101	194	149
15:00	187	183	181	102	110	112	101	196	147
15:15	191	189	183	103	110	113	101	199	149
15:30	193	191	188	104	111	114	102	201	150
15:45	196	197	191	104	111	114	102	203	148
16:00	199	200	194	105	111	114	103	206	150
16:15	199	202	197	105	112	115	103	207	151
16:30	198	204	201	105	113	116	104	209	150
16:45	199	207	201	106	114	116	104	211	149
17:00	198	210	206	106	114	117	105	213	151
17:15	198	214	210	107	115	117	105	215	152
17:30	199	216	210	108	115	118	106	217	151
17:45	200	219	213	108	116	119	106	219	152
18:00	201	222	212	109	116	119	107	220	152
18:15	202	222	215	109	117	120	108	222	153
18:30	204	221	218	110	118	121	108	223	152
18:45	205	220	218	110	118	121	109	225	153
19:00	206	222	221	111	119	122	109	227	154
19:15	207	223	224	112	120	122	110	228	154
19:30	210	222	227	112	120	123	111	229	153
19:45	213	225	228	113	121	124	111	230	155



Time (min:sec)	Tc 28(°F)	Tc 29(°F)	Tc 30(°F)	Tc 31(°F)	Tc 32(°F)	Tc 33(°F)	Tc 34(°F)	Tc 35(°F)	Tc 36(°F)
20:00	214	226	230	114	122	124	112	232	155
20:15	215	229	232	114	122	125	113	233	155
20:30	218	232	235	115	123	126	113	234	158
20:45	218	235	236	116	124	127	114	235	160
21:00	221	237	238	116	124	127	114	237	159
21:15	223	239	240	117	125	128	115	239	158
21:30	226	240	244	118	126	129	116	240	158
21:45	228	241	249	118	126	129	116	242	161
22:00	228	244	253	119	127	130	117	243	160
22:15	232	246	254	120	127	131	117	245	161
22:30	233	248	256	120	128	131	118	246	161
22:45	234	249	258	121	128	132	118	247	161
23:00	235	252	260	122	129	132	119	249	162
23:15	236	254	265	122	129	133	119	250	164
23:30	237	257	270	123	130	134	120	251	163
23:45	238	260	272	123	130	134	120	252	163
24:00	240	262	274	124	131	135	121	253	163
24:15	243	267	277	124	132	135	121	255	163
24:30	247	273	280	125	132	136	122	256	166
24:45	247	276	282	126	133	136	122	256	166
25:00	250	279	285	127	133	137	123	257	167
25:15	252	285	289	127	134	137	124	257	166
25:30	255	287	291	128	134	138	124	258	169
25:45	257	295	297	129	135	139	125	258	170
26:00	261	299	300	129	136	140	125	258	170
26:15	263	297	300	131	138	141	126	258	171
26:30	266	295	298	132	139	142	127	259	173
26:45	270	295	298	133	139	143	128	260	173
27:00	273	297	297	134	140	144	128	261	172
27:15	272	299	296	134	141	145	129	262	172
27:30	271	300	298	135	142	145	129	264	172
27:45	272	302	299	136	143	147	130	266	175
28:00	273	303	303	137	144	148	130	267	174
28:15	274	307	309	138	144	149	131	269	178
28:30	275	312	317	138	146	149	132	271	176
28:45	275	312	318	139	146	151	132	273	176
29:00	277	311	317	139	147	152	133	274	178
29:15	279	314	322	140	148	152	133	275	178
29:30	281	316	326	141	149	153	134	277	179
29:45	284	318	330	142	149	154	134	278	179
30:00	284	320	333	142	150	155	135	279	180



Time (min:sec)	Tc 37(°F)	Tc 38(°F)	Tc 39(°F)	Tc 40(°F)	Tc 41(°F)	Tc 42(°F)	Tc 43(°F)	Tc 44(°F)	Tc 45(°F)
0:00	85	85	84	84	155	191	187	148	156
0:15	85	85	84	84	696	712	735	494	545
0:30	85	85	84	84	922	938	982	741	787
0:45	85	85	84	85	972	1010	1032	849	883
1:00	85	85	84	85	993	1037	1038	891	927
1:15	85	85	84	85	1006	1059	1049	917	949
1:30	85	85	84	86	1017	1082	1083	946	961
1:45	85	85	84	87	1025	1097	1072	941	972
2:00	85	86	84	88	1040	1109	1104	955	978
2:15	86	86	84	89	1049	1104	1111	963	989
2:30	86	86	85	90	1059	1115	1112	975	995
2:45	86	86	85	91	1065	1131	1123	988	999
3:00	86	86	85	92	1073	1139	1125	992	1007
3:15	86	87	85	93	1073	1133	1129	996	1009
3:30	86	87	85	94	1079	1133	1131	993	1017
3:45	86	87	85	96	1102	1145	1133	1004	1025
4:00	87	87	85	97	1097	1155	1130	997	1028
4:15	87	87	85	98	1099	1159	1143	1010	1034
4:30	87	88	86	99	1113	1162	1153	1017	1039
4:45	87	88	86	101	1121	1152	1160	1028	1043
5:00	87	88	86	102	1127	1172	1166	1036	1037
5:15	87	88	86	103	1218	1261	1240	1081	1084
5:30	88	89	87	105	1296	1327	1279	1122	1141
5:45	88	89	87	106	1328	1357	1308	1137	1177
6:00	88	89	87	108	1375	1400	1360	1164	1196
6:15	89	90	88	110	1399	1439	1390	1185	1219
6:30	89	90	88	113	1431	1466	1379	1212	1208
6:45	89	91	88	115	1428	1441	1378	1210	1203
7:00	90	91	89	117	1421	1460	1389	1225	1207
7:15	90	92	89	120	1435	1449	1385	1224	1216
7:30	91	92	89	122	1399	1441	1384	1217	1223
7:45	91	93	90	125	1406	1449	1390	1218	1235
8:00	92	93	90	127	1443	1444	1394	1236	1231
8:15	92	94	90	130	1431	1458	1387	1231	1231
8:30	92	94	91	132	1420	1459	1387	1228	1238
8:45	93	95	91	135	1438	1452	1397	1243	1238
9:00	93	95	91	138	1458	1464	1388	1247	1241
9:15	94	96	92	141	1435	1441	1395	1244	1244
9:30	94	96	92	143	1453	1480	1396	1264	1241
9:45	95	97	92	146	1480	1497	1399	1260	1246



Time (min:sec)	Tc 37(°F)	Tc 38(°F)	Tc 39(°F)	Tc 40(°F)	Tc 41(°F)	Tc 42(°F)	Tc 43(°F)	Tc 44(°F)	Tc 45(°F)
10:00	95	97	93	148	1475	1499	1429	1268	1260
10:15	96	98	93	150	1504	1574	1478	1289	1300
10:30	96	98	93	153	1560	1589	1486	1318	1319
10:45	97	99	93	156	1567	1594	1504	1326	1326
11:00	97	100	94	158	1564	1598	1502	1333	1338
11:15	98	100	94	161	1577	1612	1514	1339	1335
11:30	98	101	94	163	1563	1623	1517	1344	1346
11:45	99	101	95	166	1608	1616	1510	1352	1344
12:00	99	102	95	169	1591	1640	1526	1359	1359
12:15	100	103	95	171	1636	1641	1519	1371	1355
12:30	100	103	96	173	1614	1640	1511	1375	1363
12:45	101	104	96	176	1594	1657	1524	1373	1368
13:00	102	105	97	178	1565	1675	1558	1374	1386
13:15	102	105	97	180	1572	1641	1545	1365	1389
13:30	103	106	98	183	1595	1660	1541	1375	1380
13:45	103	107	98	185	1570	1655	1552	1371	1385
14:00	104	108	98	187	1640	1656	1533	1383	1383
14:15	105	108	99	189	1603	1662	1546	1382	1390
14:30	105	109	99	191	1587	1630	1549	1379	1392
14:45	106	110	100	193	1605	1648	1535	1387	1394
15:00	106	111	100	195	1627	1648	1548	1394	1395
15:15	107	112	101	197	1660	1724	1584	1420	1417
15:30	108	112	101	200	1656	1767	1611	1428	1438
15:45	108	113	102	202	1708	1761	1610	1449	1438
16:00	109	114	102	205	1684	1787	1597	1447	1447
16:15	109	115	103	206	1660	1777	1625	1455	1466
16:30	110	115	103	209	1657	1774	1640	1459	1477
16:45	111	116	104	211	1701	1777	1625	1463	1472
17:00	112	117	104	212	1714	1770	1622	1472	1467
17:15	113	118	105	215	1672	1783	1660	1470	1483
17:30	113	119	106	217	1664	1787	1636	1462	1484
17:45	114	119	106	219	1699	1782	1629	1471	1474
18:00	115	120	107	221	1678	1789	1653	1471	1488
18:15	115	121	107	223	1670	1784	1645	1472	1488
18:30	116	121	108	225	1673	1776	1641	1469	1505
18:45	117	122	108	227	1737	1784	1640	1483	1489
19:00	117	123	109	228	1706	1812	1644	1478	1489
19:15	118	124	109	230	1698	1781	1650	1490	1494
19:30	119	124	110	232	1713	1782	1643	1488	1498
19:45	119	125	111	235	1694	1782	1647	1490	1499



Time (min:sec)	Tc 37(°F)	Tc 38(°F)	Tc 39(°F)	Tc 40(°F)	Tc 41(°F)	Tc 42(°F)	Tc 43(°F)	Tc 44(°F)	Tc 45(°F)
20:00	120	126	111	237	1670	1847	1659	1484	1512
20:15	120	126	112	239	1719	1859	1683	1500	1529
20:30	121	127	112	240	1715	1858	1684	1510	1541
20:45	122	128	113	241	1738	1895	1705	1524	1546
21:00	123	128	114	242	1771	1865	1678	1529	1538
21:15	124	129	114	244	1754	1917	1701	1532	1547
21:30	124	130	115	246	1774	1911	1703	1536	1553
21:45	125	131	116	248	1778	1908	1716	1544	1555
22:00	126	132	116	250	1749	1900	1705	1543	1557
22:15	127	132	117	253	1760	1890	1709	1540	1558
22:30	127	133	118	255	1779	1888	1698	1545	1559
22:45	128	134	118	258	1771	1921	1708	1546	1565
23:00	129	135	119	260	1786	1919	1709	1553	1564
23:15	129	135	120	261	1808	1909	1707	1555	1566
23:30	130	137	121	262	1776	1900	1718	1552	1566
23:45	132	137	122	263	1792	1906	1711	1558	1569
24:00	132	138	123	264	1810	1926	1709	1561	1570
24:15	133	139	123	265	1791	1907	1706	1558	1572
24:30	134	140	124	268	1774	1928	1720	1556	1573
24:45	134	141	125	270	1783	1933	1723	1561	1576
25:00	136	142	126	273	1810	1951	1740	1562	1580
25:15	136	143	126	278	1851	1995	1751	1589	1604
25:30	137	143	127	281	1901	2026	1778	1616	1635
25:45	139	145	128	286	1924	2016	1798	1638	1639
26:00	141	146	129	288	1901	2008	1799	1642	1656
26:15	142	147	130	285	1829	1979	1774	1590	1673
26:30	143	149	130	284	1826	1992	1760	1587	1654
26:45	144	150	131	284	1837	1974	1738	1587	1647
27:00	145	151	132	285	1836	1959	1731	1591	1642
27:15	146	152	133	285	1897	1977	1745	1625	1643
27:30	147	153	133	286	1968	2022	1762	1633	1642
27:45	148	154	134	286	2014	1923	1762	1640	1621
28:00	149	155	135	287	1995	2066	1793	1644	1643
28:15	150	156	136	288	1996	1982	1798	1649	1632
28:30	151	157	136	290	1998	2021	1783	1640	1636
28:45	152	158	137	291	1928	1991	1772	1639	1635
29:00	153	159	138	293	1954	1968	1770	1630	1632
29:15	154	160	138	295	1930	1991	1770	1632	1634
29:30	155	160	139	296	2011	1921	1764	1641	1626
29:45	155	161	140	298	1970	1987	1763	1632	1625
30:00	156	162	141	300	1942	1913	1764	1636	1620



Time (min:sec)	Tc 46(°F)	Tc 47(°F)	Tc 48(°F)	Tc 49(°F)	Tc 50(°F)	Tc 51(°F)	Tc 52(°F)	Tc 53(°F)	Tc 54(°F)
0:00	146	117	131	86	86	85	86	85	85
0:15	607	525	485	86	86	85	86	85	85
0:30	807	760	743	86	86	85	86	85	85
0:45	859	844	828	86	86	85	86	85	85
1:00	885	882	848	86	86	85	86	85	85
1:15	911	905	881	86	86	85	86	85	85
1:30	944	922	900	86	86	85	86	85	85
1:45	964	949	911	86	86	86	86	85	85
2:00	984	959	933	86	86	86	86	85	85
2:15	996	972	946	86	86	86	86	85	86
2:30	1007	983	950	86	86	86	86	85	86
2:45	1017	999	967	86	86	86	86	85	86
3:00	1011	1007	983	86	86	86	86	85	86
3:15	1021	1017	988	86	86	86	86	86	86
3:30	1040	1041	1011	86	86	86	86	86	86
3:45	1052	1035	1044	86	86	86	86	86	86
4:00	1092	1059	1060	86	86	86	86	86	86
4:15	1108	1078	1055	86	86	86	86	86	86
4:30	1108	1089	1049	86	86	86	86	86	86
4:45	1098	1090	1051	86	86	86	86	86	86
5:00	1092	1088	1045	86	86	86	87	86	86
5:15	1169	1179	1115	86	86	86	87	86	87
5:30	1222	1216	1166	86	86	87	87	86	87
5:45	1248	1261	1199	87	86	87	87	86	87
6:00	1265	1289	1221	87	86	87	87	86	87
6:15	1310	1315	1255	87	86	87	87	86	87
6:30	1347	1348	1264	87	86	87	87	86	87
6:45	1341	1339	1265	87	86	88	87	86	87
7:00	1332	1331	1263	87	87	88	88	87	88
7:15	1341	1345	1275	88	87	88	88	87	88
7:30	1336	1349	1277	88	87	88	88	87	88
7:45	1354	1354	1274	88	87	88	88	87	88
8:00	1355	1339	1269	88	87	89	88	87	89
8:15	1355	1357	1285	88	87	89	89	87	89
8:30	1351	1335	1285	89	87	89	89	87	89
8:45	1365	1355	1295	89	87	89	89	87	89
9:00	1380	1382	1301	89	87	90	89	87	89
9:15	1382	1366	1297	89	87	90	90	87	89
9:30	1390	1389	1303	89	88	90	90	88	90
9:45	1386	1367	1300	90	88	90	90	88	90



Time (min:sec)	Tc 46(°F)	Tc 47(°F)	Tc 48(°F)	Tc 49(°F)	Tc 50(°F)	Tc 51(°F)	Tc 52(°F)	Tc 53(°F)	Tc 54(°F)
10:00	1388	1379	1319	90	88	91	90	88	90
10:15	1452	1437	1366	90	88	91	90	88	91
10:30	1471	1457	1391	90	88	91	91	88	91
10:45	1457	1440	1396	91	88	91	91	88	91
11:00	1502	1486	1426	91	88	91	91	88	91
11:15	1521	1504	1425	91	89	92	91	88	92
11:30	1504	1486	1434	91	89	92	92	89	92
11:45	1533	1512	1440	91	89	93	92	89	92
12:00	1523	1501	1437	92	89	93	92	89	92
12:15	1524	1501	1441	92	89	93	92	89	93
12:30	1530	1505	1442	92	89	93	92	89	93
12:45	1545	1520	1459	92	89	93	92	89	93
13:00	1554	1533	1467	92	89	94	93	89	93
13:15	1574	1554	1468	92	89	94	93	89	93
13:30	1555	1537	1467	92	89	94	93	89	93
13:45	1565	1527	1465	93	90	94	93	89	94
14:00	1558	1526	1465	93	90	94	93	90	94
14:15	1566	1528	1471	93	90	95	94	90	94
14:30	1592	1561	1478	93	90	95	94	90	94
14:45	1579	1545	1468	93	90	95	94	90	95
15:00	1580	1550	1474	94	90	96	94	90	95
15:15	1615	1597	1532	94	90	96	94	90	95
15:30	1643	1631	1552	94	91	96	94	90	95
15:45	1651	1619	1562	94	91	96	95	91	95
16:00	1672	1634	1560	94	91	96	95	91	96
16:15	1690	1659	1580	94	91	97	95	91	96
16:30	1697	1678	1599	94	91	97	95	91	96
16:45	1705	1669	1598	94	91	97	95	91	97
17:00	1690	1664	1604	95	91	97	95	91	96
17:15	1689	1663	1598	95	92	97	95	91	96
17:30	1694	1686	1601	95	92	98	96	91	97
17:45	1712	1680	1600	95	92	98	96	92	97
18:00	1731	1696	1605	95	92	98	96	92	97
18:15	1714	1691	1609	96	92	98	96	92	97
18:30	1716	1675	1593	96	92	98	96	92	98
18:45	1717	1685	1609	96	92	99	97	92	98
19:00	1714	1672	1616	96	93	100	97	92	98
19:15	1730	1701	1618	96	93	100	97	93	99
19:30	1720	1670	1617	96	93	100	97	93	99
19:45	1724	1673	1607	96	93	100	97	93	99



Time (min:sec)	Tc 46(°F)	Tc 47(°F)	Tc 48(°F)	Tc 49(°F)	Tc 50(°F)	Tc 51(°F)	Tc 52(°F)	Tc 53(°F)	Tc 54(°F)
20:00	1731	1713	1624	97	93	100	98	93	100
20:15	1769	1766	1678	97	93	100	98	93	100
20:30	1776	1805	1698	97	94	100	98	94	100
20:45	1776	1777	1690	97	94	101	98	94	100
21:00	1806	1774	1697	97	94	101	98	94	100
21:15	1803	1769	1713	98	94	101	98	94	100
21:30	1800	1788	1719	98	94	102	99	94	101
21:45	1789	1776	1730	98	94	103	99	94	101
22:00	1803	1804	1726	98	94	103	99	94	101
22:15	1821	1808	1731	98	95	103	99	94	102
22:30	1811	1802	1739	99	95	103	99	95	102
22:45	1822	1807	1730	99	95	103	100	95	102
23:00	1830	1801	1727	99	95	104	100	95	102
23:15	1821	1821	1742	99	95	103	100	95	102
23:30	1820	1825	1764	99	95	103	100	95	103
23:45	1817	1816	1739	99	96	103	100	96	103
24:00	1832	1808	1738	100	96	104	101	96	103
24:15	1819	1798	1766	100	96	104	101	96	103
24:30	1828	1815	1752	100	96	104	101	96	103
24:45	1842	1844	1751	100	96	104	101	96	103
25:00	1860	1842	1780	100	96	104	101	97	103
25:15	1885	1875	1827	100	96	105	102	97	104
25:30	1873	1867	1809	100	97	106	102	97	104
25:45	1892	1891	1827	101	97	106	102	97	104
26:00	1872	1866	1814	101	97	107	102	98	105
26:15	1875	1930	1843	101	97	106	102	98	105
26:30	1878	1878	1846	101	97	106	102	98	105
26:45	1884	1869	1831	101	97	106	102	98	105
27:00	1886	1880	1823	101	97	107	103	98	105
27:15	1889	1844	1845	102	97	107	103	98	105
27:30	1930	1845	1876	102	98	107	103	99	105
27:45	1935	1865	1904	102	98	107	103	99	106
28:00	1935	1853	1888	102	98	107	103	99	106
28:15	1938	1894	1909	103	98	108	104	100	106
28:30	1949	1881	1881	103	98	107	104	100	106
28:45	1949	1898	1882	103	98	107	104	100	107
29:00	1957	1896	1901	103	98	107	105	100	107
29:15	1946	1907	1862	103	99	108	105	101	107
29:30	1942	1886	1879	104	99	108	105	101	107
29:45	1941	1883	1887	104	99	109	105	101	108
30:00	1935	1884	1880	104	99	108	106	101	107

----- End of Test Report -----