Hilti CFS-HFF Firestop Flute Filler

Submission Folder

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Firestop Flute Fliter CFS-HFF

ADVANTAGES

- Fast and simple to install - minimal preparation needed
- Cost-effective - very low total installed cost
- Easy to cut to the required installation depth
- No mess and zero waste - no caulking or tools required
- Reliable product solution - easy to inspect
- Pre-formed product - emission-free and immediately functional after installation
- Reliability - durable material for long-term performance
- Excellent firestop properties - sound and acoustic tested
- Flexible solution - CFS-HFF flute filler can easily be retrofitted where flexible walls are already in place
- Easy modification of flexible walls - CFS-HFF flute filler can be exchanged and removed without leaving any residue

APPLICATIONS

- Firestop flute filler for flexible walls attached to Holorib composite slabs
- Smoke- and sound-seal solution for flexible walls attached to Holorib composite slabs

Technical data	
Chemical basis	Polyurethane foam
Color	Anthracite
Application temperature range	-5 - 50 °C
Temperature resistance range	-15 - 50 °C
Storage and transportation temperature range	-15 - 50 °C
Dimensions	750 mm x 35mm x 65mm
Reaction to Fire acc. EN13501-1	Class E

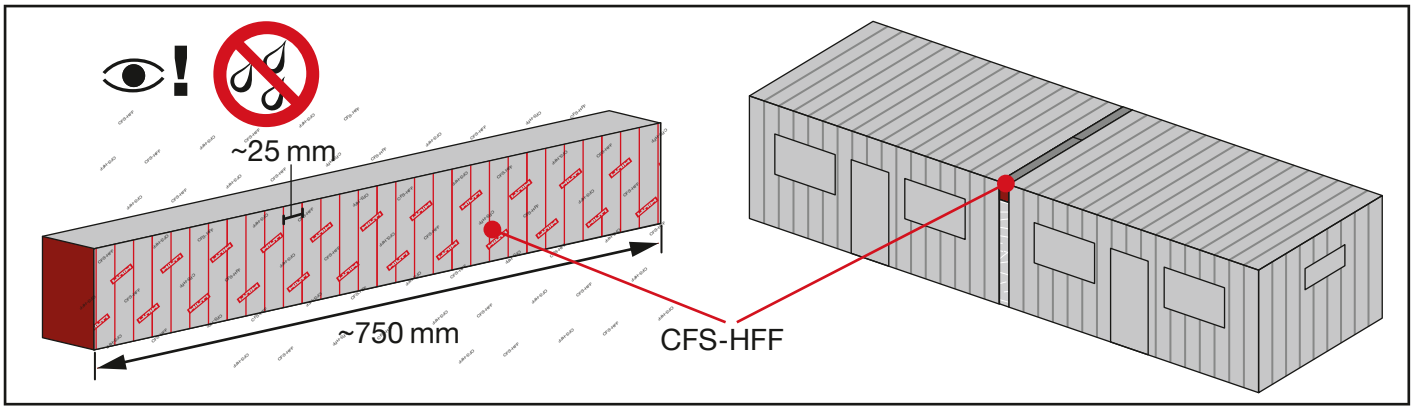
Order Now

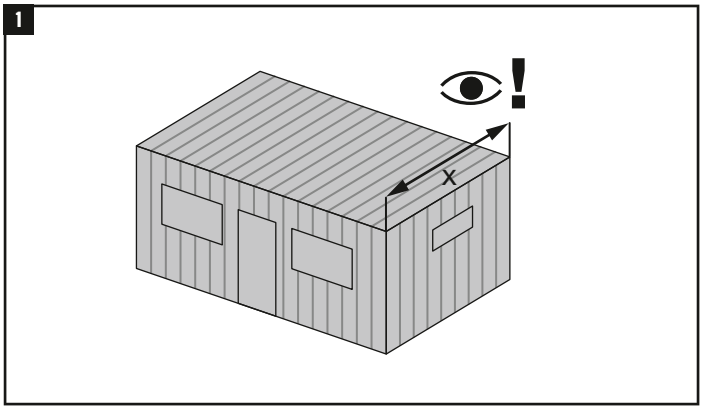
Ordering designation	Dimensions	Sales pack quantity	Item number
CFS-HFF	750 mm x 65 mm x 35 mm	22 pc	**2423387**

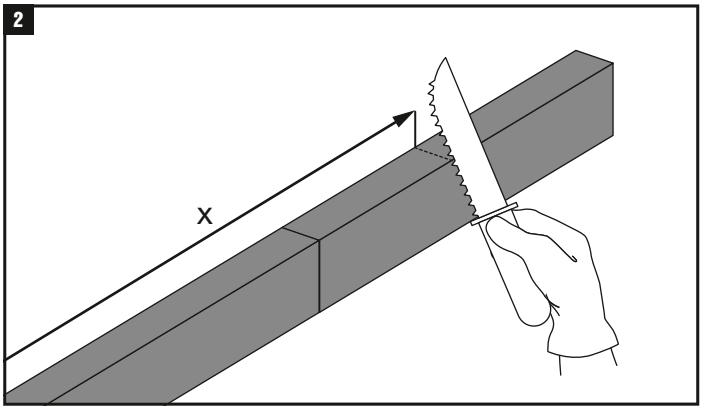
Please visit Hilti website for the latest item numbers and related products

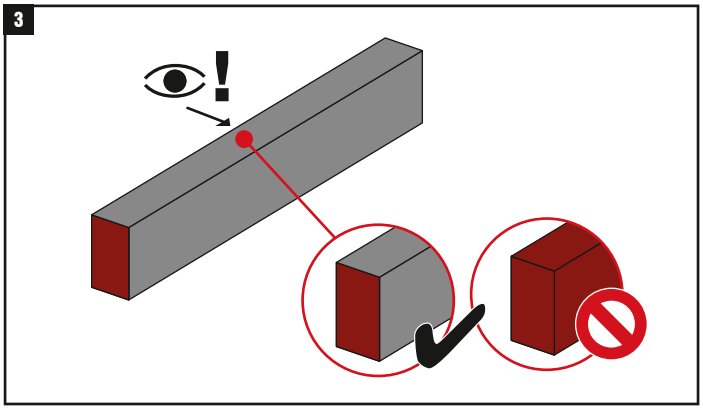
Subject: **Method Statement of CFS-HFF for Cavity Barrier**
Material: CFS-HFF Firestop Flute Filler

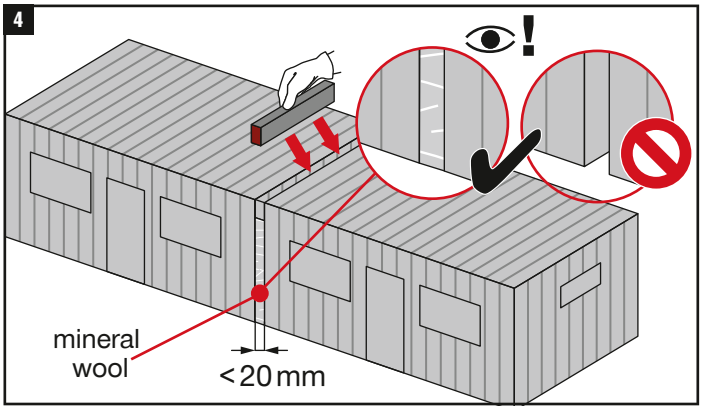
Before handling and for pecific application details, refer to Hilti product literature, 3rd party published listings and national approvals. For professional use only.

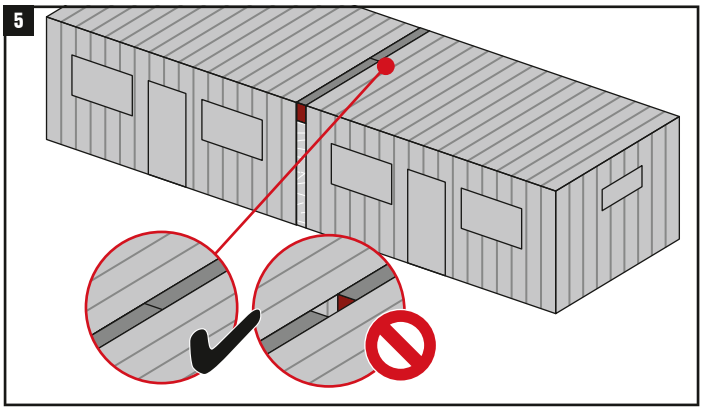


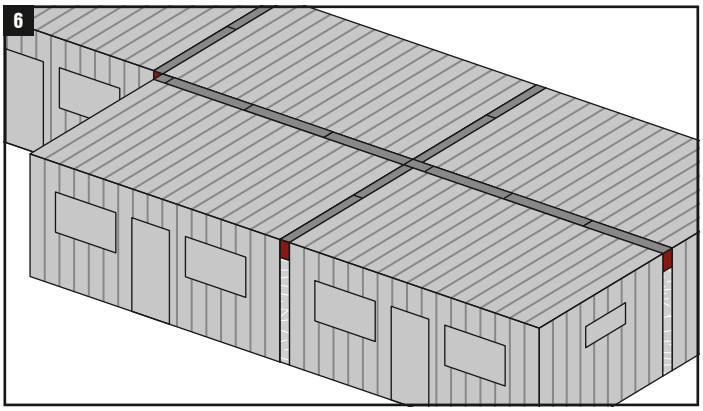












RESEARCH ENGINEERING DEVELOPMENT FAÇADE CONSULTANTS LIMITED -
Fire and Facade Testing Laboratory
雄略幕牆顧問有限公司 - 消防及幕牆檢測實驗中心
DD134, Lung Kwu Tan, Tuen Mun, N.T., Hong Kong

HOKLAS 091 TEST

FIRE RESISTANCE TEST IN ACCORDANCE WITH BS 476: PART 20: 1987

On 3 nos. of Cavity Barriers

Test Report No.: R19L23-1A

Identification No.: Q19K22-1

Issue Date: 19th March 2020

Testing Location:

RED Hong Kong Main Laboratory
DD 134, Lung Kwu Tan, Tuen Mun,
N.T., Hong Kong

Test Sponsor

Hilti (Hong Kong) Limited
701-704, 7/F, Tower A, Manulife Financial Centre,
223 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong

APPROVED SIGNATORY: _____

Ir. Dr. YUEN Sai-wing, MHKIE (FIRE)

CONTENT

1 SUMMARY

Fire resistance test conducted in accordance with BS 476: Part 20: 1987 on 3 nos. of Cavity Barriers.

Three specimens of Cavity Barriers, namely specimens 'A', 'B' and 'C' (refer to photos 1 and 2), had been subjected to a test in accordance with BS 476: Part 20: 1987, in order to determine their fire resistance performances. As requested by the test sponsor, the specimens were mounted within concrete line specimens holder as shown in the test sponsor's drawings (see the appendix). The specimens were symmetrical and only one side of specimens was tested.

Specimen 'A' was comprised of 2 nos. of steel hollows with sizes of 4,000 mm long by 150 mm wide by 150 mm deep by 6.3 mm thick. The gap between the steel hollows was with sizes of 51 mm wide by 150 mm deep and was filled with 58 mm wide (before compression) by 100 mm thick 'Rockwool' cavity barrier with density of 160 kg/m^3, 25 mm from top surface (refer to test sponsor's drawings).

Specimen 'B' was comprised of 2 nos. of steel hollows with sizes of 4,000 mm long by 150 mm wide by 150 mm deep by 6.3 mm thick. The gap between the steel hollows was with sizes of 40 mm wide by 150 mm deep and was filled with 70 mm wide (before compression) by 65 mm thick 'Hilti CFS-HFF' cavity barrier with density of 195 kg/m^3 (refer to test sponsor's drawings).

Specimen 'C' was comprised of 2 nos. of steel hollows with sizes of 4,000 mm long by 150 mm wide by 150 mm deep by 6.3 mm thick. The gap between the steel hollows was with sizes of 51 mm wide by 150 mm deep and was filled with 60 mm wide (before compression) by 100 mm thick 'Rockwool' cavity barrier with density of 160 kg/m^3, 25 mm from top surface (refer to test sponsor's drawings).

The three specimens were welded to 50 mm by 100 mm by 5 mm thick C-channels as perimeter frame and ceiling membranes system was installed in between each specimen and between specimen and perimeter frame to cover the opening of furnace.

The specimens satisfied the performance requirements specified in BS 476: Part 20: 1987 for the following periods:

Specimen 'A'

Integrity:		**61** Minutes (No failure)
Insulation (Rockwool):	**Mean Temperature Rise**	**29** Minutes
	Maximum Temperature Rise	**31** Minutes
Insulation (Steel Hollows):	**Mean Temperature Rise**	**22** Minutes
	Maximum Temperature Rise	**22** Minutes

Specimen 'B'		
Integrity:		**61** Minutes (No failure)
Insulation (Hilti CFS-HFF):	**Mean Temperature Rise**	**26** Minutes
	Maximum Temperature Rise	**29** Minutes
Insulation (Steel Hollows):	**Mean Temperature Rise**	**19** Minutes
	Maximum Temperature Rise	**21** Minutes

Specimen 'C'		
Integrity:		**61** Minutes (No failure)
Insulation (Rockwool):	**Mean Temperature Rise**	**28** Minutes
	Maximum Temperature Rise	**29** Minutes
Insulation (Steel Hollows):	**Mean Temperature Rise**	**22** Minutes
	Maximum Temperature Rise	**22** Minutes

The test was discontinued after a heating period of 61 minutes.

2 INTRODUCTION

The objective of the test is to determine the fire resistance performance of 3 nos. of Cavity Barriers when tested in accordance with BS 476: Part 20: 1987, 'Methods for determination of the fire resistance of elements of construction (general principles)'.

3 TEST INFORMATION

3.1 Test Sponsor

Hilti (Hong Kong) Limited

701-704, 7/F, Tower A, Manulife Financial Centre,

223 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong

3.2 Testing Location

Research Engineering Development Façade Consultants Limited, Hong Kong Main Laboratory of DD 134, Lung Kwu Tan, Tuen Mun, New Territories, Hong Kong

3.3 Date of Test

21st November 2019

3.4 Witness of the test

The test was led by Mr. Solaris Chan of Research Engineering Development Façade Consultants Limited (RED) and was witnessed by Miss Dorothy Wai, Miss Selina Lin and Miss Lorainne Leung, the representatives of test sponsor.

4 EQUIPMENT

Nine (9) 'type K' thermocouples to monitor the temperature of the furnace, which were kept at 100 mm from the exposed face of the specimens (see Figure 1).

Fifteen (15) 'type K' thermocouples to monitor the temperature of the unexposed face of the specimens (see Figure 2).

A 'type K' roving thermocouple to measure temperature on hot spots of unexposed surface of specimens.

A micro-manometer provided to monitor the furnace pressure.

Cotton pads, 6 mm and 25 mm gap gauges.

Two (2) transducers and steel ruler relative to taut wire to measure the vertical displacement of the specimens.

A radiometer placed at 1,000 mm away from the unexposed surface to measure the radiation of unexposed surface of specimens.

5 CONDITIONING

The specimens' storage, construction, and test preparation took place in the test laboratory over a total, combined time of 8 days. Throughout this period of time, both of the temperature and humidity of the laboratory were measured and recorded as being within a range of 18 °C to 31 °C and 42 % to 84 % respectively.

6 TEST SPECIMENS CONSTRUCTION

The specimens were welded to C-channels as perimeter frame to form the test construction. The details of the fixings were outlined in Appendix D.

A comprehensive description of the test specimens construction was presented in the appendix, which was based on a survey of the specimens and information supplied by the test sponsor.

7 TEST PROCEDURES

The test was conducted in accordance with the procedures specified in BS 476: Part 20: 1987. The ambient temperature of the test area during the test was measured. After the first 5 minutes of the test, the furnace pressure was maintained at 20 ± 2 Pa relative to atmosphere, at 100 mm from the exposed side of specimens.

The furnace was monitored by nine (9) thermocouples so that the mean furnace temperature complied with the requirements of Clause 3.1 of BS 476: Part 20: 1987.

The temperature of the unexposed face was monitored by means of fifteen (15) thermocouples fixed to the unexposed surface (see Figure 2 for the locations and reference numbers of the thermocouples). Thermocouples S1 – S3 were fixed on the Rockwool of specimen 'A' for mean and maximum temperatures of the unexposed surface of Rockwool of specimen 'A'. Thermocouples S4 – S5 were fixed on the steel hollows of specimen 'A' for mean and maximum temperatures of the unexposed surface of steel hollows of specimen 'A'. Thermocouples S6 – S8 were fixed on the Hilti CFS-HFF of specimen 'B' for mean and maximum temperatures of the unexposed surface of Hilti CFS-HFF of specimen 'B'. Thermocouples S9 – S10 were fixed on the steel hollows of specimen 'B' for mean and maximum temperatures of the unexposed surface of steel hollows of specimen 'B'. Thermocouples S11 – S13 were fixed on the Rockwool of specimen 'C' for mean and maximum temperatures of the unexposed surface of Rockwool of specimen 'C'. Thermocouples S14 – S15 were fixed on the steel hollows of specimen 'C' for mean and maximum temperatures of the unexposed surface of steel hollows of specimen 'C'. The mean and maximum temperatures were recorded.

The cotton pads and gap gauges were used, if considered appropriate, to determine compliance with the integrity criterion of the standard. The occurrence of sustained flaming on the unexposed surface was monitored to determine compliance with this criterion. The vertical deflection of specimens was measured by transducers and steel ruler relative to taut wire and recorded. The radiation of specimens was measured and recorded.

8 TEST DATA AND INFORMATION

The ambient temperature of the test area during the test was 23 °C.

The furnace was controlled so that the mean furnace temperature complied with the requirements of BS 476: Part 20: 1987. The temperature recorded was shown graphically in Figure 4.

The mean and maximum temperatures of the unexposed surface of Rockwool of specimen 'A' were shown graphically in Figure 5.

The mean and maximum temperatures of the unexposed surface of steel hollows of specimen 'A' were shown graphically in Figure 6.

The mean and maximum temperatures of the unexposed surface of Hilti CFS-HFF of specimen 'B' were shown graphically in Figure 7.

The mean and maximum temperatures of the unexposed surface of steel hollows of specimen 'B' were shown graphically in Figure 8.

The mean and maximum temperatures of the unexposed surface of Rockwool of specimen 'C' were shown graphically in Figure 9.

The mean and maximum temperatures of the unexposed surface of steel hollows of specimen 'C' were shown graphically in Figure 10.

The furnace pressure obtained was shown graphically in Figure 11.

The radiation obtained was shown graphically in Figure 12.

A summary of the observations made on the general behaviour of the specimens was given in 'APPENDIX B - OBSERVATION'.

The vertical deflection obtained was summarized in Table 1.

The mean furnace temperature obtained was summarized in Table 2.

The temperature rises of specimens obtained were summarized in Table 3.

The test was discontinued after a heating period of 61 minutes.

9 RESULTS

When tested in accordance with BS 476: Part 20: 1987, the requirements of the standard were satisfied for the following periods:

Specimen 'A'		
Integrity:		**61** Minutes (No failure)
Insulation (Rockwool):	**Mean Temperature Rise**	**29** Minutes
	Maximum Temperature Rise	**31** Minutes
Insulation (Steel Hollows):	**Mean Temperature Rise**	**22** Minutes
	Maximum Temperature Rise	**22** Minutes
Specimen 'B'		
Integrity:		**61** Minutes (No failure)
Insulation (Hilti CFS-HFF):	**Mean Temperature Rise**	**26** Minutes
	Maximum Temperature Rise	**29** Minutes
Insulation (Steel Hollows):	**Mean Temperature Rise**	**19** Minutes
	Maximum Temperature Rise	**21** Minutes
Specimen 'C'		
Integrity:		**61** Minutes (No failure)
Insulation (Rockwool):	**Mean Temperature Rise**	**28** Minutes
	Maximum Temperature Rise	**29** Minutes
Insulation (Steel Hollows):	**Mean Temperature Rise**	**22** Minutes
	Maximum Temperature Rise	**22** Minutes

Insulation - It is required that the mean temperature rise of the unexposed surface shall not be greater than 140 °C and that maximum temperature rise shall not be greater than 180 °C. Insulation failure also occurs simultaneously with integrity failure.

Specimen 'A'

Rockwool

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 29 minutes. The 180 °C rise of the maximum temperature of the unexposed surface of specimen reached and measured by thermocouple S1 after a heating period of 31 minutes. The maximum temperature rise was 449 °C measured by thermocouple S1 after a heating period of 61 minutes.

Steel Hollows

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 22 minutes. The 180 °C rise of the maximum temperature of the unexposed surface of specimen reached and measured by thermocouple S4 after a heating period of 22 minutes. The maximum temperature rise was 583 °C measured by thermocouple S4 after a heating period of 61 minutes.

Specimen 'B'

Hilti CFS-HFF

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 26 minutes. The 180 °C rise of the maximum temperature of the unexposed surface of specimen reached and measured by thermocouple S8 after a heating period of 29 minutes. The maximum temperature rise was 465 °C measured by thermocouple S8 after a heating period of 61 minutes.

Steel Hollows

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 19 minutes. The 180 °C rise of the maximum temperature of the unexposed surface of specimen reached and measured by thermocouple S9 after a heating period of 21 minutes. The maximum temperature rise was 556 °C measured by thermocouple S9 after a heating period of 60 minutes.

Specimen 'C'

Rockwool

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 28 minutes. The 180 °C rise of the maximum temperature of the unexposed surface of specimen reached and measured by thermocouple S11 after a heating period of 29 minutes. The maximum temperature rise was 506 °C measured by thermocouple S12 after a heating period of 61 minutes.

Steel Hollows

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 22 minutes. The 180 °C rise of the maximum temperature of the unexposed surface of specimen reached and measured by thermocouple S14 after a heating period of 22 minutes. The maximum temperature rise was 550 °C measured by thermocouple S14 after a heating period of 61 minutes.

Integrity - It is required that there is no collapse for the specimen, no sustained flaming on the unexposed surface and no loss of impermeability.

Specimen 'A'

The specimen met the integrity requirements after a heating period of 61 minutes.

Specimen 'B'

The specimen met the integrity requirements after a heating period of 61 minutes.

Specimen 'C'

The specimen met the integrity requirements after a heating period of 61 minutes.

10 LIMITATIONS

The results relate only to the behaviour of the specimen of the element of construction under the particular conditions of the test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use nor do they reflect the actual behaviour in fires (see Clause 12 of BS 476: Part 20: 1987).

The fire resistance performance of the specimen may change if substantially different gaps are used. Application of the results to the specimen of different dimensions or supported other than by a concrete wall or incorporating different components shall be the subject of a design appraisal.

APPENDIX A – Photos and Test Record

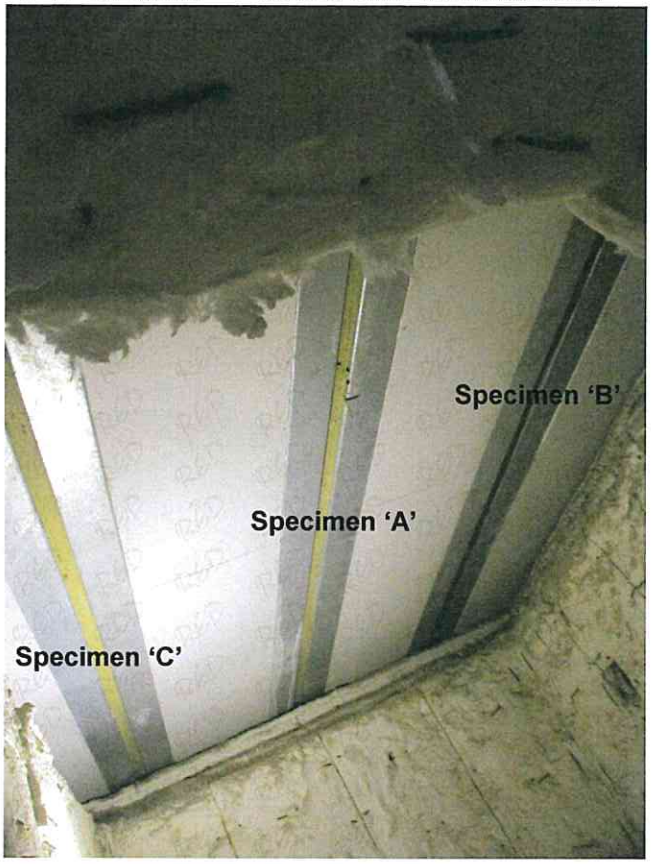


Photo 1: The exposed face of the specimens before the test.

Photo 2: The unexposed face of the specimens before the test.

Photo 3: The unexposed face of the specimens after a heating period of 30 minutes.

Photo 4: The unexposed face of the specimens after a heating period of 60 minutes.

Photo 5: The unexposed face of the specimens after the test.

Photo 6: The exposed face of the specimens after the test.

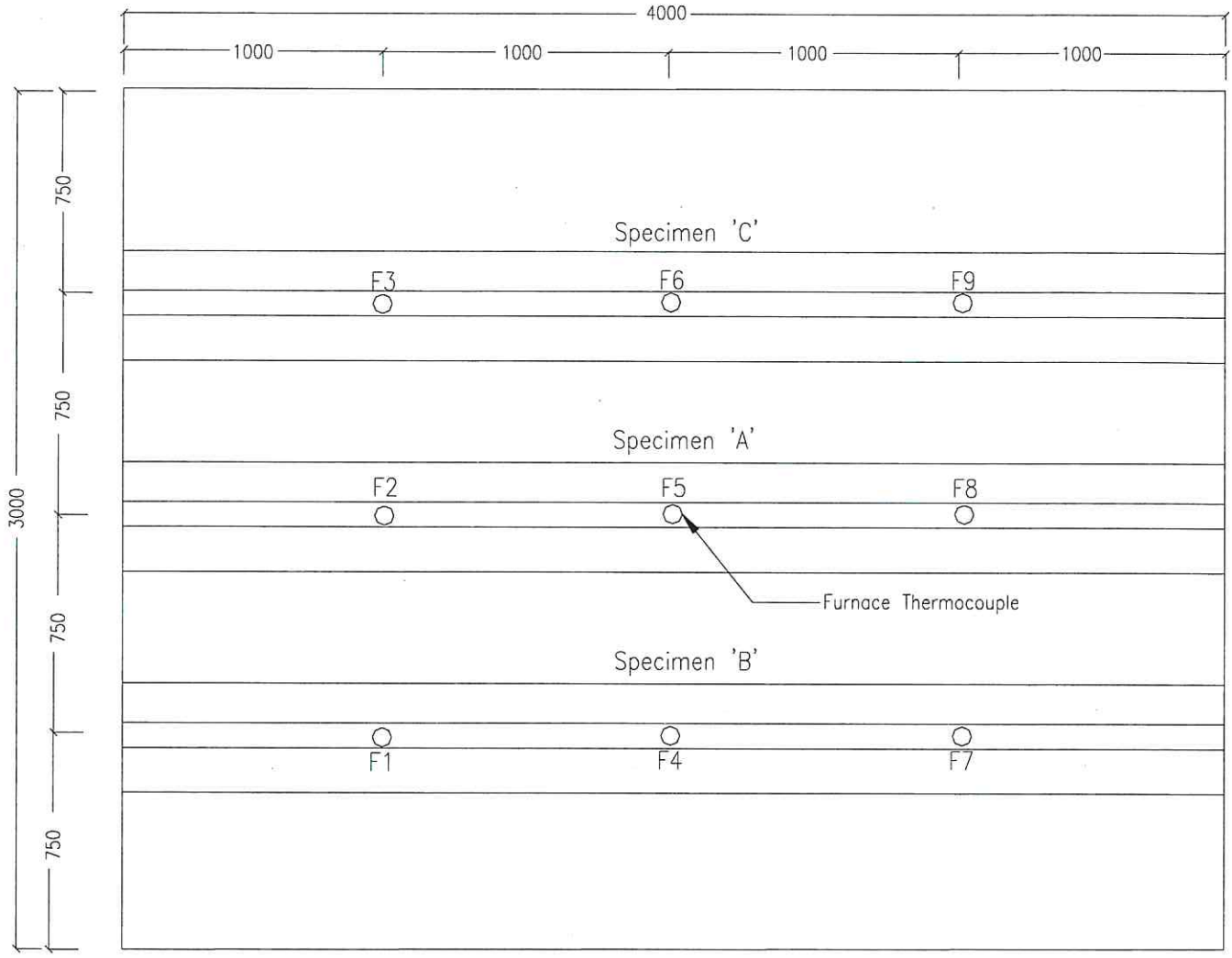


Figure 1 – Locations and reference numbers of furnace thermocouples.
(This figure is not to scale and all dimensions are in millimetres.)

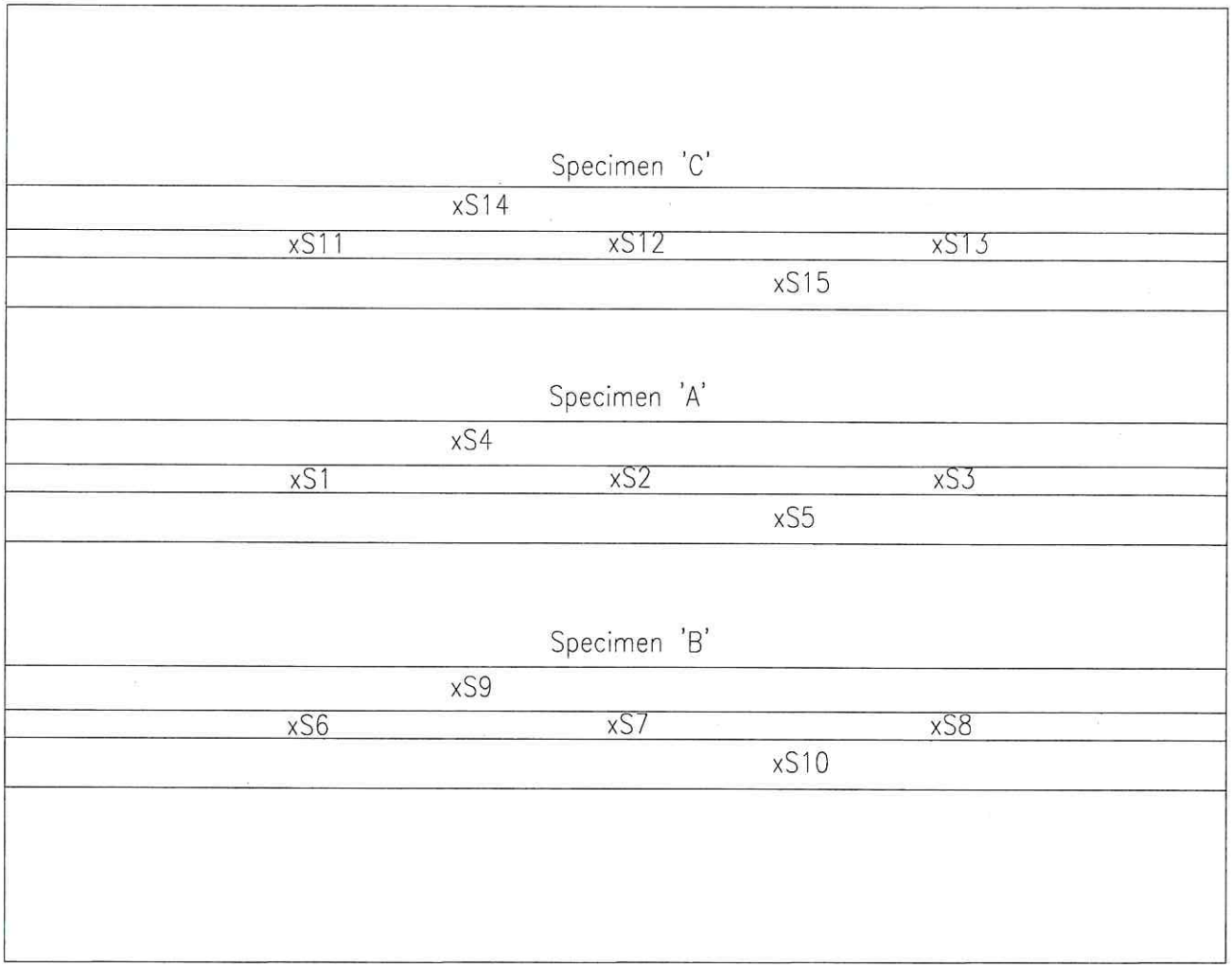


Figure 2 – Locations and reference numbers of thermocouples to monitor the temperature of unexposed surface of the specimens.

(This figure is not to scale.)

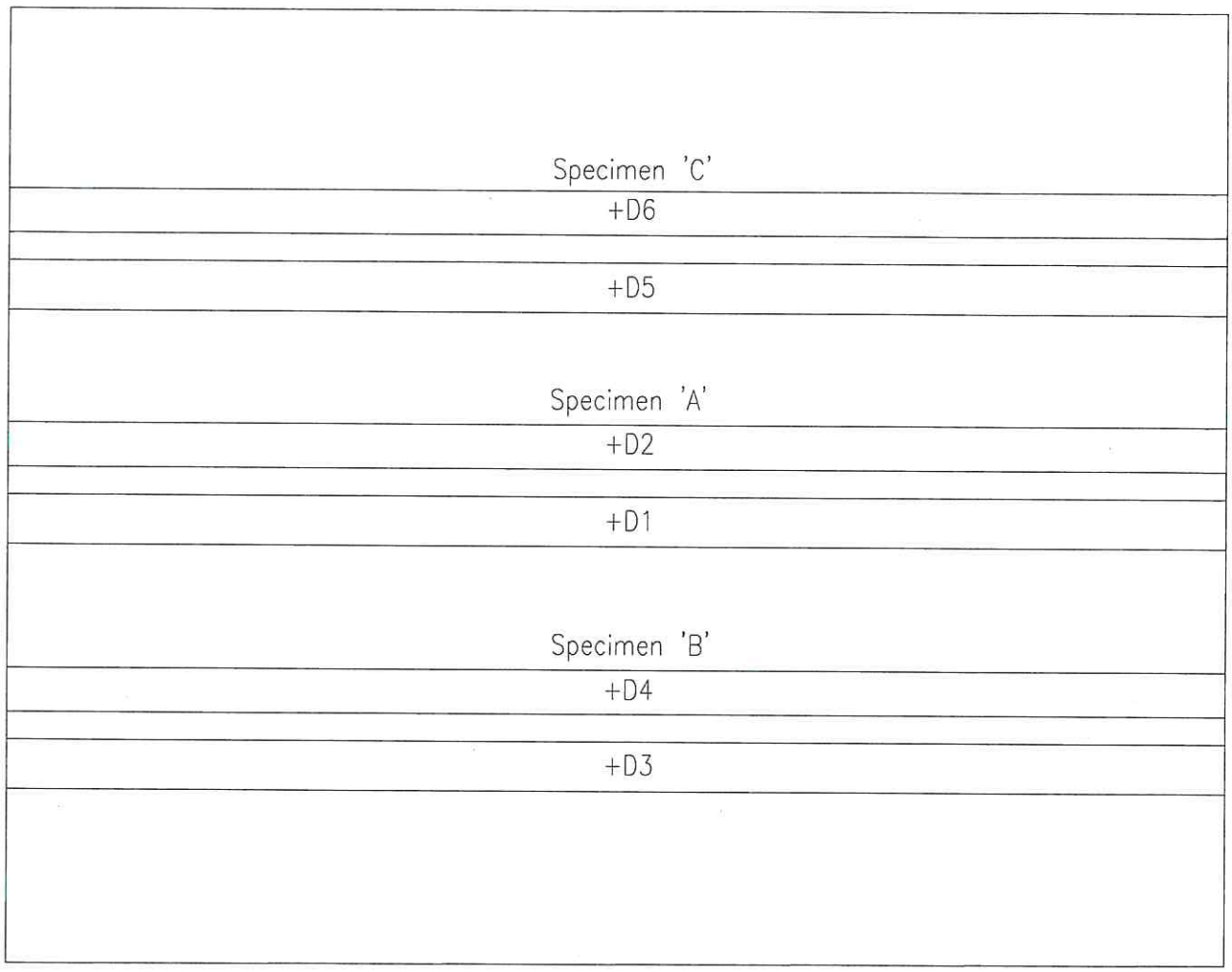


Figure 3 – Locations and reference numbers of displacement measurements.
(This figure is not to scale.)

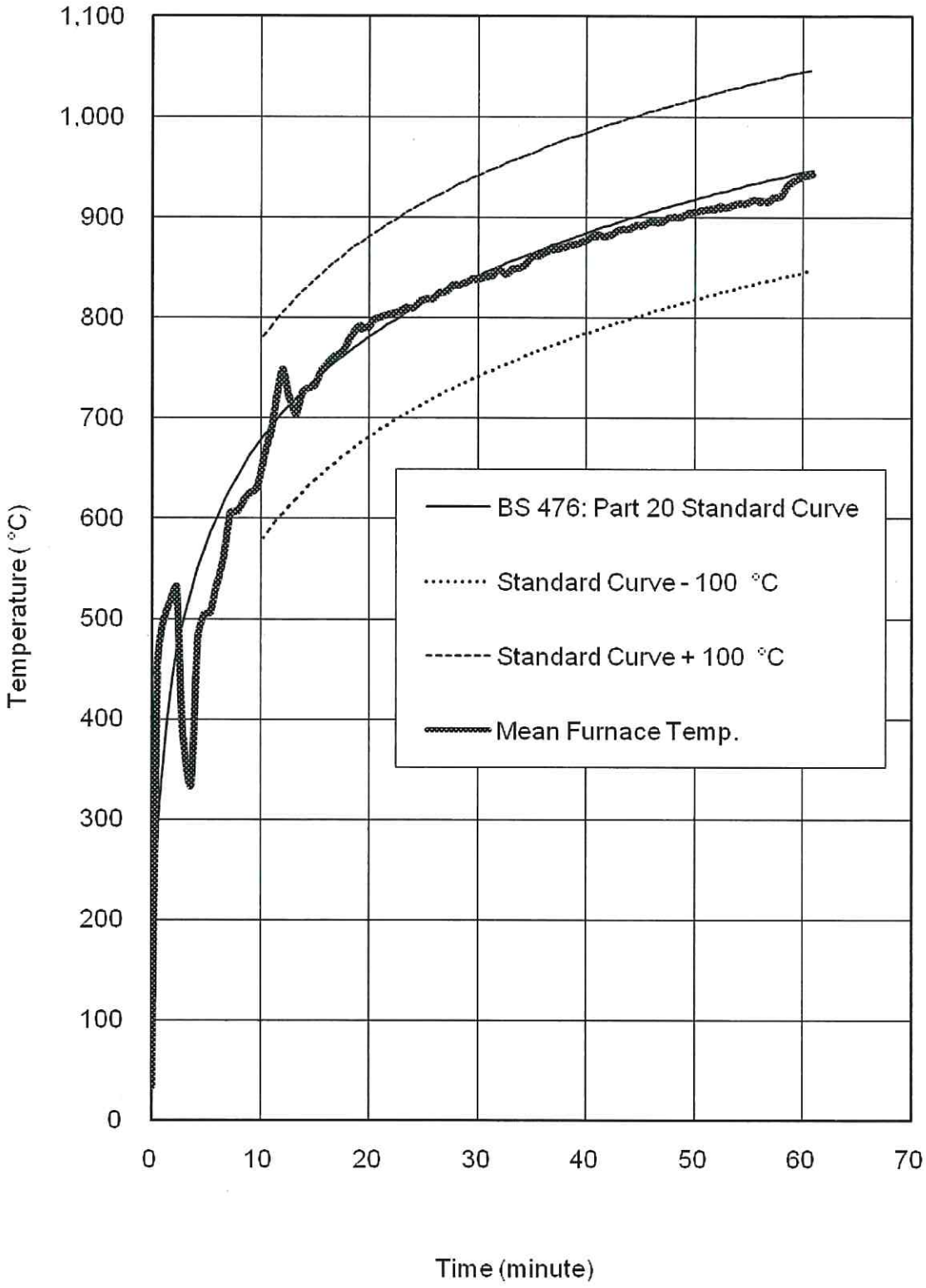


Figure 4 – Mean furnace temperature.

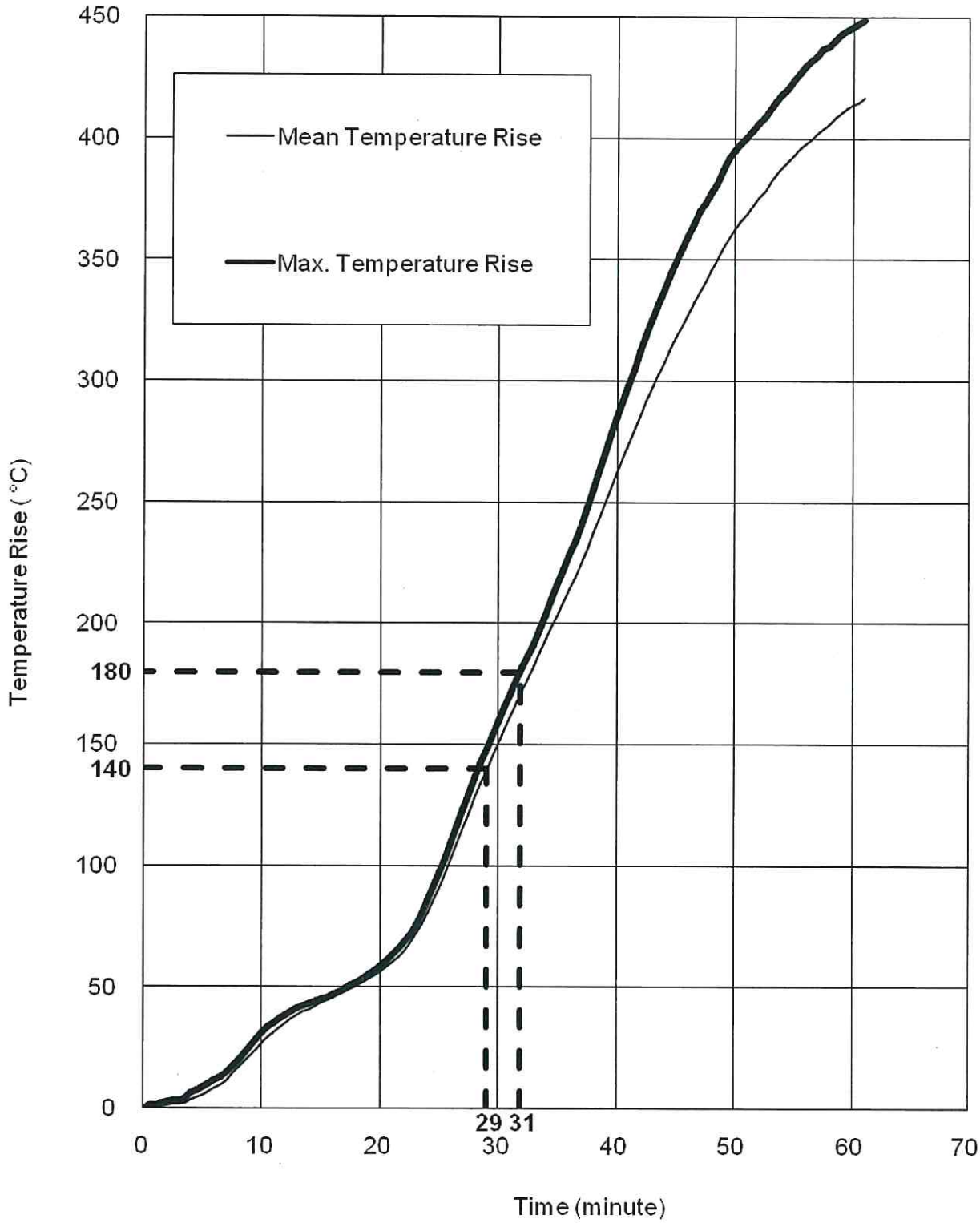


Figure 5 – Temperature rises of unexposed surface of Rockwool of specimen 'A'.

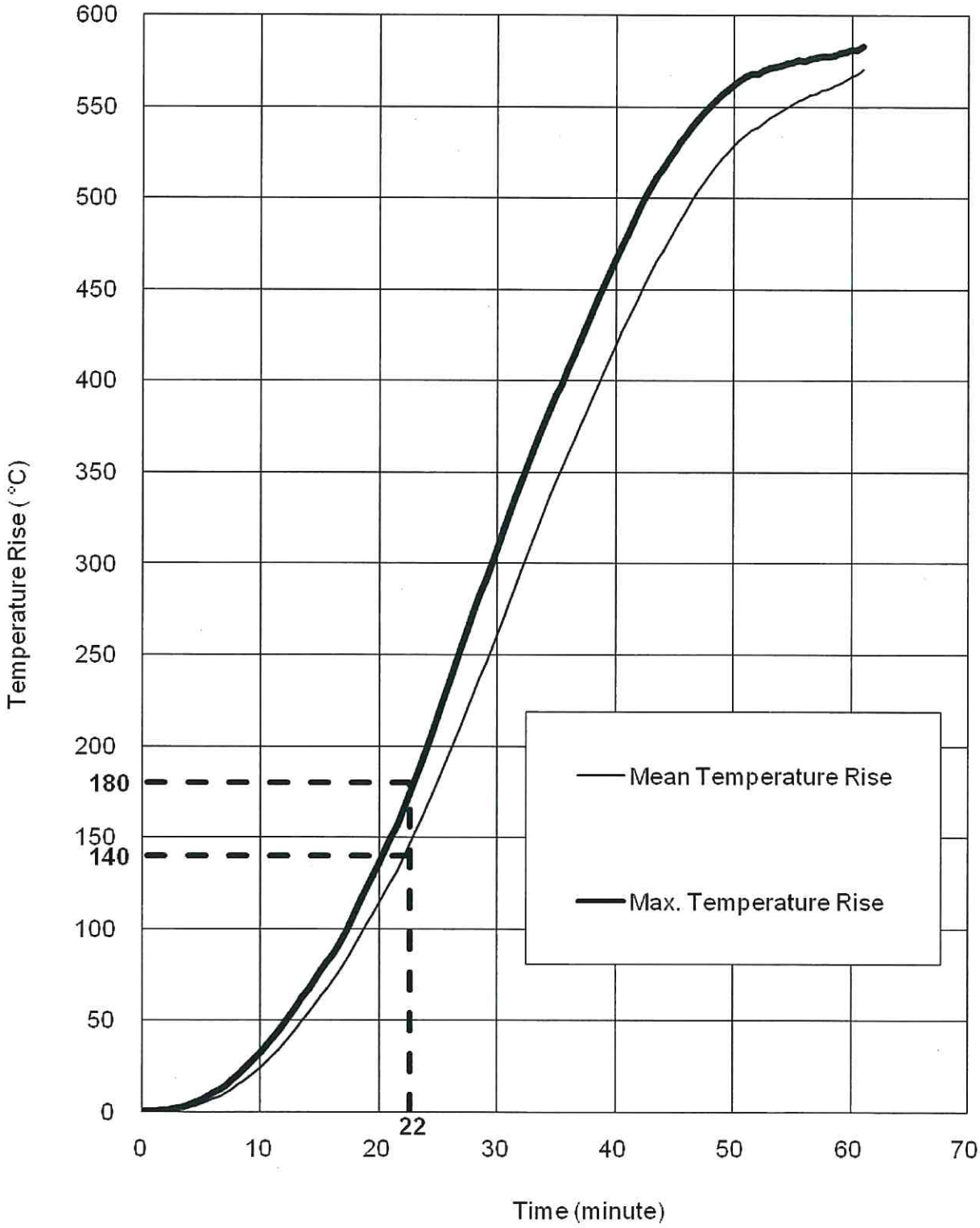


Figure 6 – Temperature rises of unexposed surface of steel hollows of specimen 'A'.

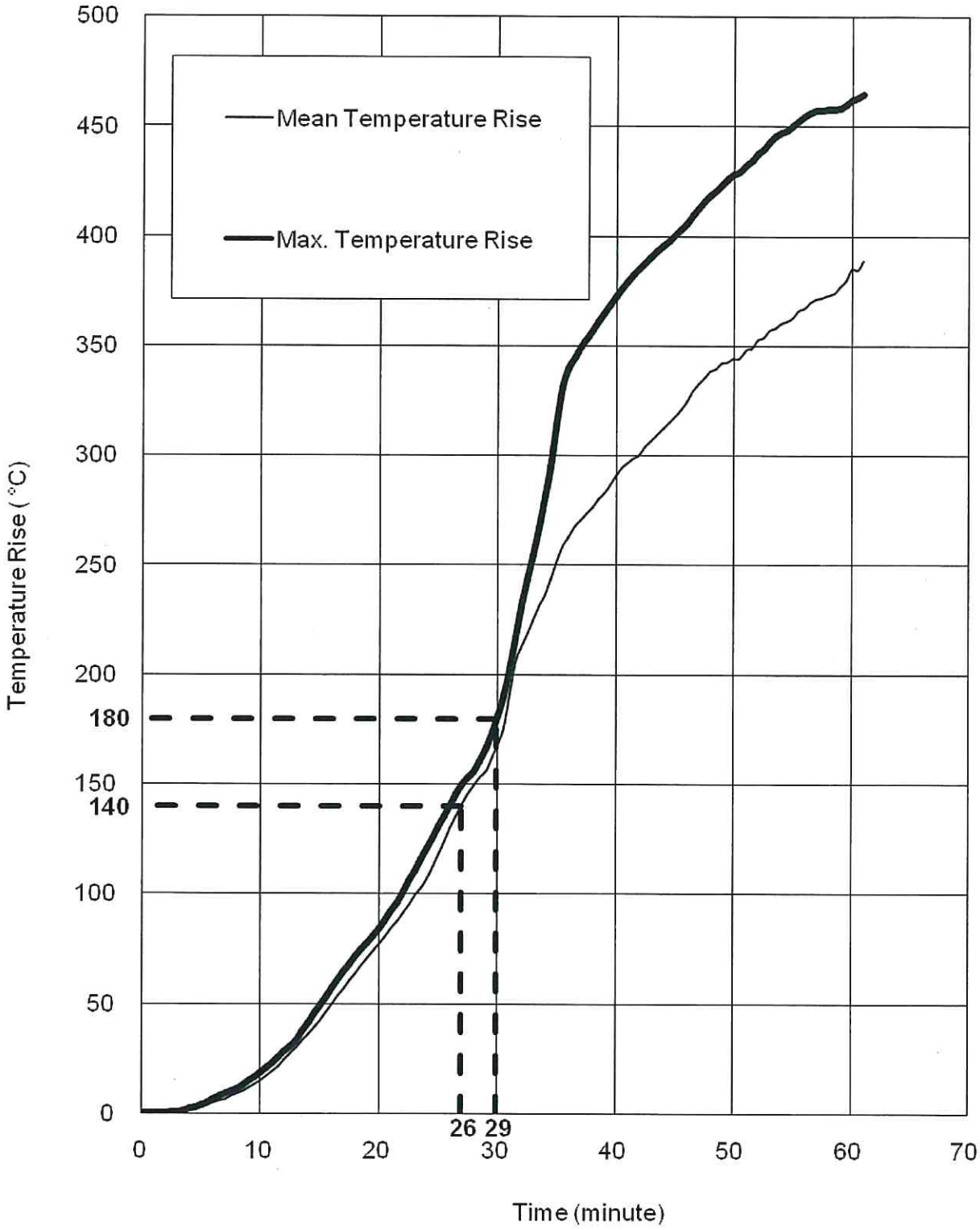


Figure 7 – Temperature rises of unexposed surface of Hilti CFS-HFF of specimen 'B'.

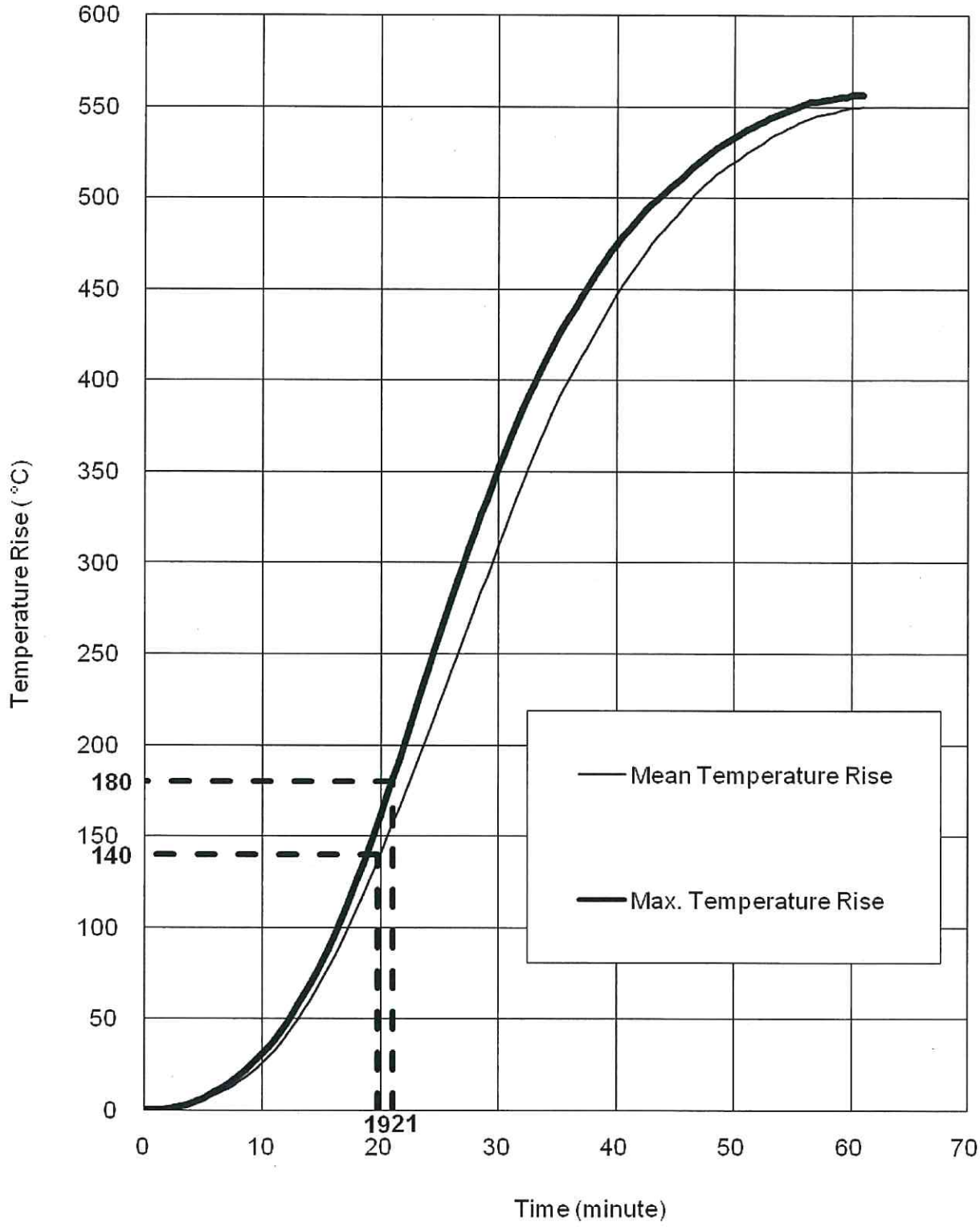


Figure 8 – Temperature rises of unexposed surface of steel hollows of specimen 'B'.

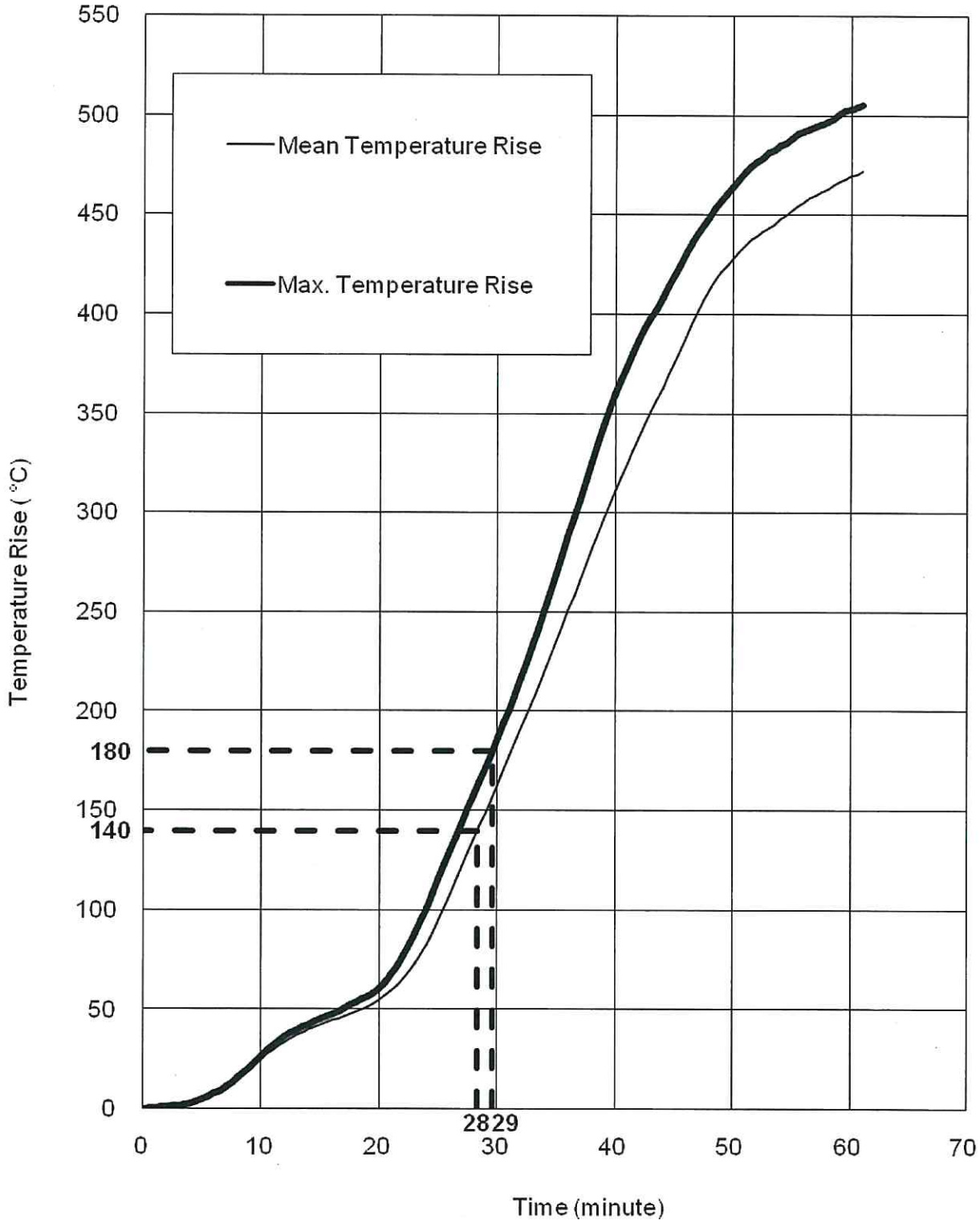


Figure 9 – Temperature rises of unexposed surface of Rockwool of specimen 'C'.

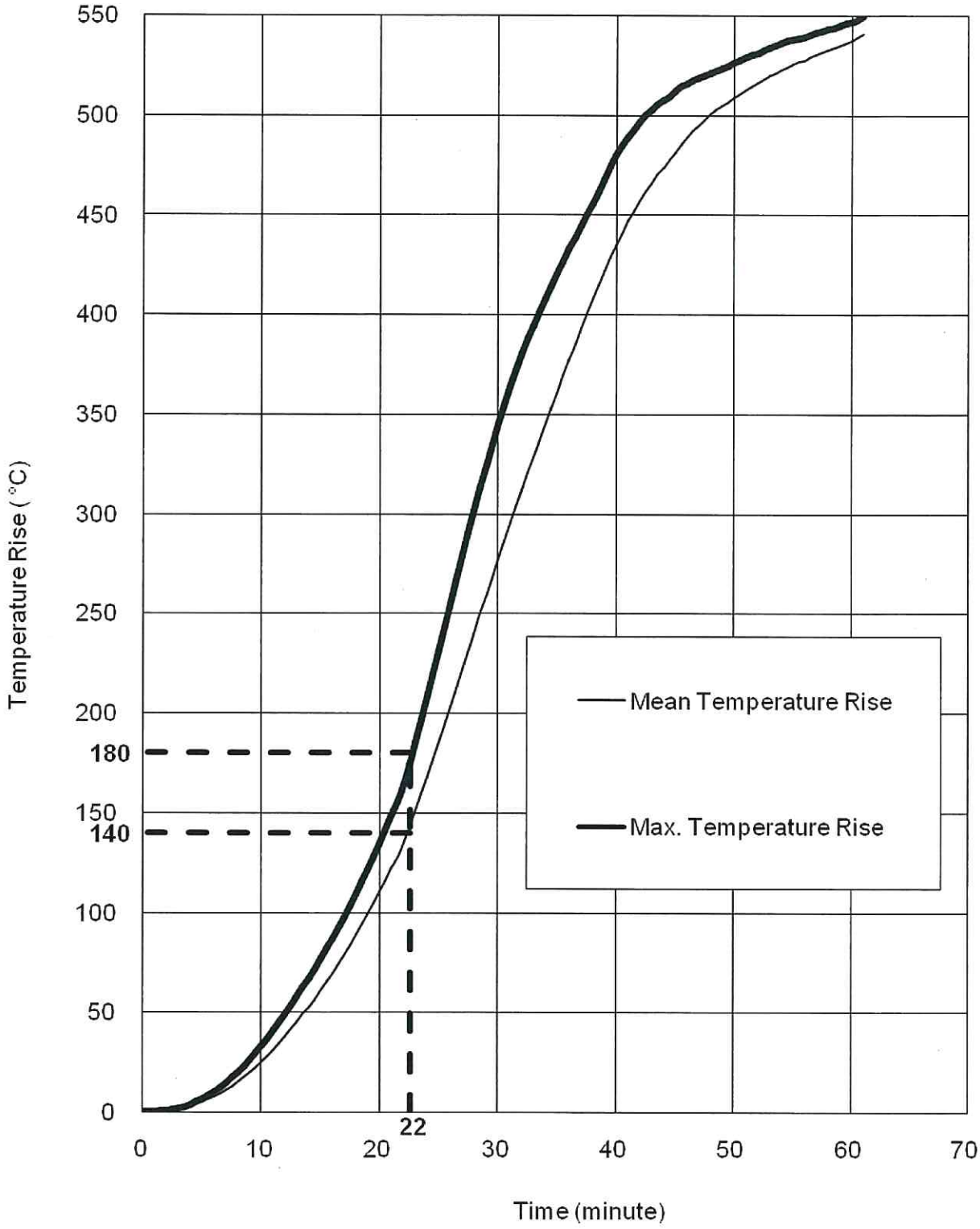


Figure 10 – Temperature rises of unexposed surface of steel hollows of specimen 'C'.

After the first 5 minutes of the test, the furnace pressure was maintained at 20 ± 2 Pa relative to atmosphere, at 100 mm from the exposed side of specimens.

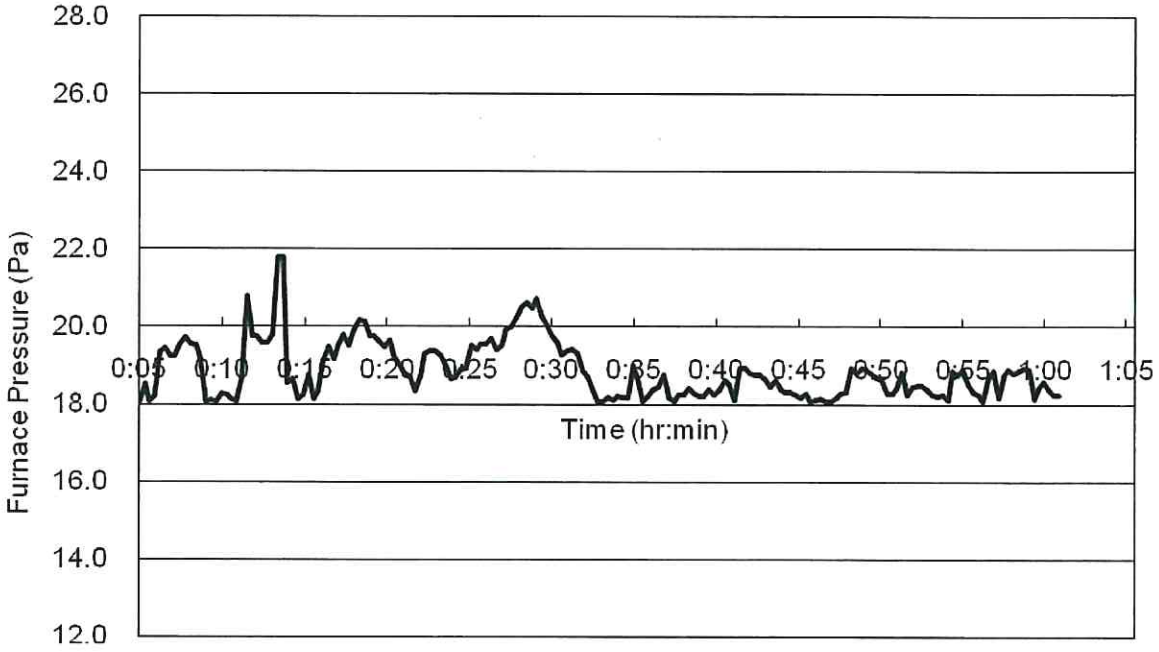


Figure 11 – Furnace pressure.

A radiometer placed at 1,000 mm away from the unexposed surface to measure the radiation of unexposed surface of specimens.

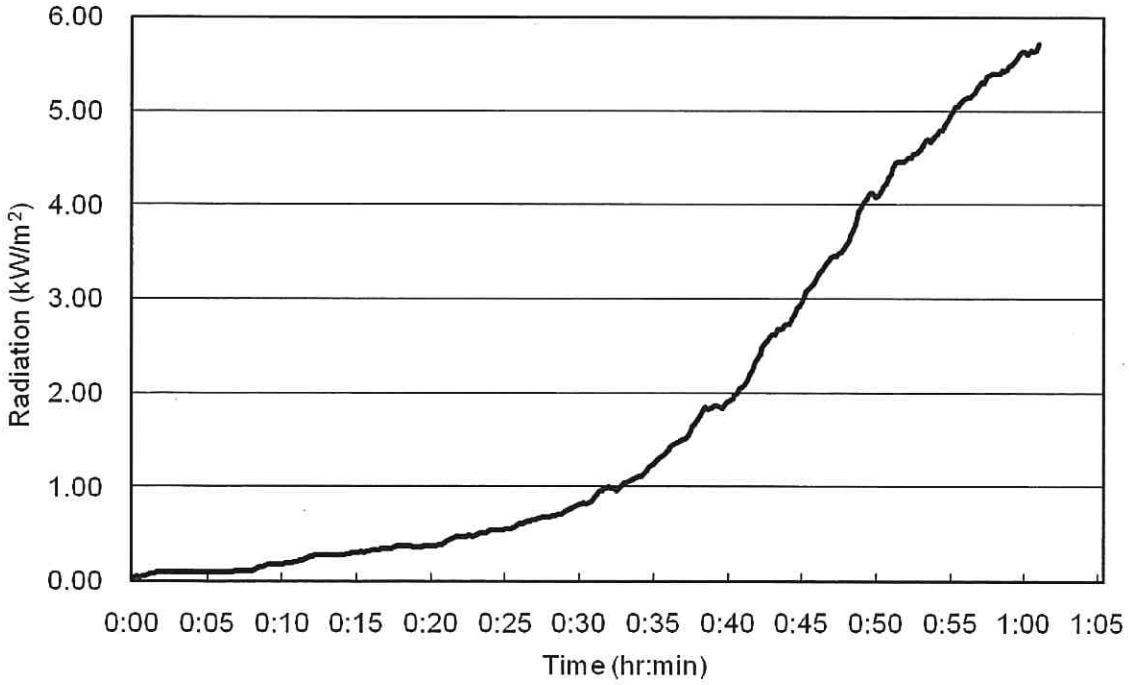


Figure 12 – Radiation.

APPENDIX B – Observation

Time (min.sec)	Exposed (E) or Unexposed (U)	Observation
00.00	-	Test started.
21.10	U	Visible deformation was observed from steel hollows of all specimens.
25.20	E	Cracks developed on the surface of fire rated boards.
30.00	U	All specimens satisfied the integrity performance requirements.
32.30	U	Smoke started releasing from all specimens.
33.39	U	Cotton pad test was applied at the gap of steel hollows of specimen 'B', near Hilti CFS-HFF and the test passed.
34.07	U	Cotton pad test was applied at the gap of steel hollows of specimen 'A', near Rockwool and the test passed.
34.33	U	Cotton pad test was applied at the gap of steel hollows of specimen 'C', near Rockwool and the test passed.
46.50	U	Hilti CFS-HFF of specimen 'B' turned dark.
55.50	E	Fire rated boards started to detach from the specimens.
60.00	U	All specimens satisfied the integrity performance requirements.
61.13	-	Test was terminated as requested by test sponsor.

APPENDIX C – Data Recorded During the Test

Table 1 - Vertical deflection (mm) of specimens during the test, as viewed from the unexposed face.

Location \ Time (mins)	0	15	30	45	60
D1	0	53	62	46	41
D2	0	54	67	66	65
D3	0	47	62	48	49
D4	0	60	66	51	52
D5	0	54	65	55	60
D6	0	57	66	58	61

Positive deflection indicates movement towards the furnace (see also Figure 3 for the locations).

The maximum deflection of specimen 'A' occurred at location D2 was 67 mm moving towards the furnace after the heating period of 30 minutes.

The maximum deflection of specimen 'B' occurred at location D4 was 66 mm moving towards the furnace after the heating period of 30 minutes.

The maximum deflection of specimen 'C' occurred at location D6 was 66 mm moving towards the furnace after the heating period of 30 minutes.

Table 2 - Mean furnace temperature.

Time (minute)	BS 476: Part 20 Standard Temp. Curve (°C)	Actual Mean Furnace Temp. (°C)
0	20	35
5	588	507
10	681	657
15	739	734
20	784	799
25	816	819
30	842	839
35	864	862
40	886	879
45	903	892
50	918	905
55	933	917
60	946	941
61	947	943

Notes: Locations of furnace thermocouples are shown in Figure 1.

The test was terminated as requested by the test sponsor after a heating period of 61 minutes.

Table 3 - Time and related temperature rises measured by thermocouples S1 – S15.

Time (min)	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	5	9	4	7	3	4	3	3	7	5	4	4	5	7	4
10	31	29	21	33	17	19	15	12	31	21	27	24	25	34	17
15	45	45	42	78	49	43	49	37	82	62	45	45	37	77	45
20	56	59	54	136	92	70	84	77	162	120	60	60	45	134	86
25	97	97	80	217	146	101	131	122	261	186	116	104	65	232	140
30	160	158	135	309	214	155	169	182	353	268	187	183	121	346	210
35	216	211	184	392	298	188	253	315	424	354	262	269	174	421	302
40	285	269	233	467	372	180	320	373	475	419	342	360	233	480	390
45	350	321	284	526	439	193	361	401	508	472	397	419	312	512	451
50	395	365	327	562	495	210	395	429	533	506	432	464	388	527	492
55	424	391	364	574	528	232	406	451	549	530	456	489	413	538	513
60	446	408	389	581	552	273	420	462	556	543	470	503	436	547	529
61	449	410	393	583	558	279	423	465	556	545	472	506	438	550	532

Notes: Locations of thermocouples S1 – S15 are shown in Figure 2.

The test was terminated as requested by the test sponsor after a heating period of 61 minutes.

APPENDIX D – Information from Test Sponsor

(The information provided by the test sponsor, which was not verified by RED or unless specified.)

Specimen 'A'

Item	Description	
1	**Steel Hollows**	
	Material	: Galvanized mild steel.
	Dimensions	: 4,000 mm long by 150 mm wide by 150 mm deep by 6.3 mm thick.*
	Fixing method	: The steel hollows were welded to 50 mm by 100 mm by 5 mm thick C-channels as perimeter frame.#
2	**Rockwool**	
	Brand	: Rockwool.#
	Dimensions	: 58 mm wide (before compression) by 100 mm thick.*
	Density	: 160 kg/m^3.*
	Applied location	: Filled the gap between steel hollows as cavity barrier.#

*Notes: * Verified on site by RED.*

 # As shown on the test construction.

Appendix D – Information from Test Sponsor

(The information provided by test sponsor, which was not verified by RED or unless specified.)

Specimen 'B'

Item	Description	
1	**Steel Hollows**	
	Material	: Galvanized mild steel.
	Dimensions	: 4,000 mm long by 150 mm wide by 150 mm deep by 6.3 mm thick.*
	Fixing method	: The steel hollows were welded to 50 mm by 100 mm by 5 mm thick C-channels as perimeter frame.#
2	**Hilti CFS-HFF**	
	Brand	: Hilti CFS-HFF.#
	Material	: Polyurethane foam.
	Dimensions	: 70 mm wide (before compression) by 65 mm thick.*
	Density	: 195 kg/m^3.
	Applied location	: Filled the gap between steel hollows as cavity barrier.#

*Notes: * Verified on site by RED.*

 # As shown on the test construction.

Appendix D – Information from Test Sponsor

(The information provided by test sponsor, which was not verified by RED or unless specified.)

Specimen 'C'

Item	Description	
1	**Steel Hollows**	
	Material	: Galvanized mild steel.
	Dimensions	: 4,000 mm long by 150 mm wide by 150 mm deep by 6.3 mm thick.*
	Fixing method	: The steel hollows were welded to 50 mm by 100 mm by 5 mm thick C-channels as perimeter frame.#
2	**Rockwool**	
	Brand	: Rockwool.#
	Dimensions	: 60 mm wide (before compression) by 100 mm thick.*
	Density	: 160 kg/m^3.*
	Applied location	: Filled the gap between steel hollows as cavity barrier.#

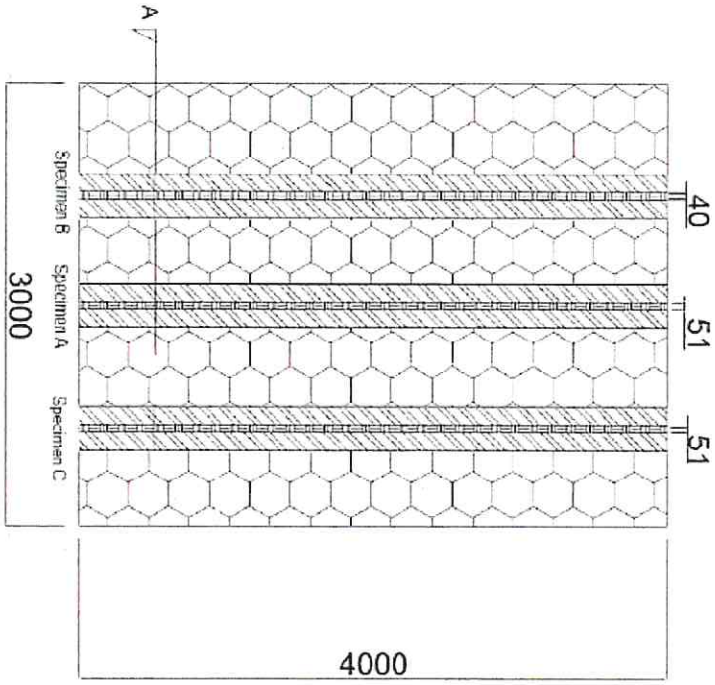
*Notes: * Verified on site by RED.*

 # As shown on the test construction.

Drawings from Test Sponsor

(The drawings provided by test sponsor, which were not verified by RED, except those specified and described in 'information from test sponsor'.)

Top view

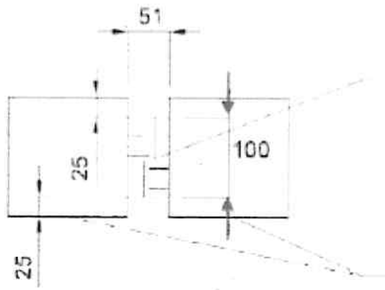


Legend

150x150x6.3mm thk SHS, S355, J0

Cavity Barrier

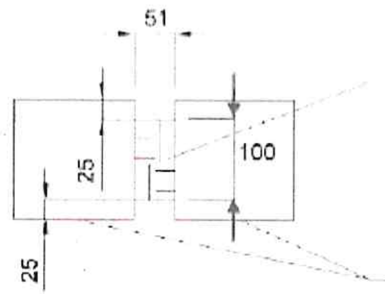
1 hr FRR board



100mm thk Mineral Wool of 160kg/m3
(58mm mineral wool compressed into 51mm gap)

150X150x6.3mm thk SHS, S355, J0

Specimen A



100mm thk Mineral Wool of 160kg/m3
(60mm mineral wool compressed into 51mm gap)

150X150x6.3mm thk SHS, S355, J0

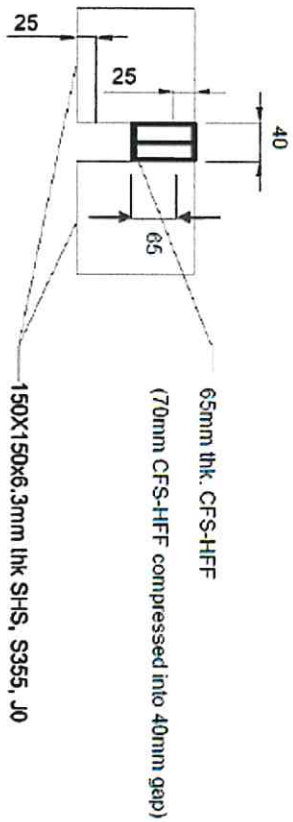
Specimen C

RED Fire and Facade Consultants

Session view

2

Session view



Specimen B

3

- End of report -

RESEARCH ENGINEERING DEVELOPMENT FAÇADE CONSULTANTS LIMITED -
Fire and Facade Testing Laboratory
雄略幕牆顧問有限公司 - 消防及幕牆檢測實驗中心
DD134, Lung Kwu Tan, Tuen Mun, N.T., Hong Kong

HOKLAS 091 TEST

FIRE RESISTANCE TEST IN ACCORDANCE WITH BS 476: Part 20 & 21: 1987

On 5 nos. of Cavity Barriers

Test Report No.: R19L23-2A

Identification No.: Q19K22-2

Issue Date: 19th March 2020

Testing Location:

RED Hong Kong Main Laboratory
DD 134, Lung Kwu Tan, Tuen Mun,
N.T., Hong Kong

Test Sponsor

Hilti (Hong Kong) Limited

701-704, 7/F, Tower A, Manulife Financial Centre,
223 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong

APPROVED SIGNATORY: _____

Ir. Dr. YUEN Sai-wing, MHKIE (FIRE)

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CONTENT

1 SUMMARY

Fire resistance test conducted in accordance with BS 476: Part 20 & 21: 1987 on 5 nos. of Cavity Barriers.

Five specimens of Cavity Barriers, namely specimens 'A', 'B', 'C', 'D' and 'E' (refer to photos 1 and 2), had been subjected to a test in accordance with BS 476: Part 20 & 21: 1987, in order to determine their fire resistance performances. As requested by the test sponsor, the specimens were mounted within concrete line specimens holder as shown in the test sponsor's drawings (see the appendix). The specimens were symmetrical and only one side of specimens was tested.

Specimen 'A' was comprised of 2 nos. of steel hollows with sizes of 150 mm wide by 150 mm deep by 6.3 mm thick. The gap between the steel hollows was with sizes of 58 mm wide by 150 mm deep and was filled with 67 mm wide (before compression) by 120 mm thick 'Rockwool' cavity barrier with density of 160 kg/m^3 (refer to test sponsor's drawings).

Specimen 'B' was comprised of 2 nos. of steel hollows with sizes of 150 mm wide by 150 mm deep by 6.3 mm thick. The gap between the steel hollows was with sizes of 51 mm wide by 150 mm deep and was filled with 70 mm wide (before compression) by 130 mm thick 'Hilti CFS-HFF' cavity barrier with density of 195 kg/m^3 (refer to test sponsor's drawings).

Specimen 'C' was comprised of 2 nos. of steel hollows with sizes of 150 mm wide by 150 mm deep by 6.3 mm thick. The gap between the steel hollows was with sizes of 58 mm wide by 150 mm deep and was filled with 67 mm wide (before compression) by 150 mm thick 'Rockwool' cavity barrier with density of 160 kg/m^3 (refer to test sponsor's drawings).

Specimen 'D' was comprised of 2 nos. of steel hollows with sizes of 150 mm wide by 150 mm deep by 6.3 mm thick surrounded with a layer of 15 mm thick fire rated boards. The gap between the steel hollows was with sizes of 51 mm wide by 150 mm deep and was filled with 59 mm wide (before compression) by 120 mm thick 'Rockwool' cavity barrier with density of 160 kg/m^3 (refer to test sponsor's drawings).

Specimen 'E' was comprised of 2 nos. of steel hollows with sizes of 150 mm wide by 150 mm deep by 6.3 mm thick surrounded with a layer of 15 mm thick fire rated boards. The gap between the steel hollows was with sizes of 51 mm wide by 150 mm deep and was filled with 70 mm wide (before compression) by 130 mm thick 'Hilti CFS-HFF' cavity barrier with density of 195 kg/m^3 (refer to test sponsor's drawings).

The five specimens were welded to 10 mm thick mild steel plate and fixed with 4 nos. of M12 anchor bolts at both ends. Ceiling membranes system was installed in between each specimen to cover the opening of furnace. As requested by test sponsor, the test load was 392.4 kN and 2 nos. of load cells, together with loading beam, were evenly distributed on top of specimen 'D'. The total load of 392,400N + 7,848N (2% tolerance) was applied to centre line of specimen 'D' not less than 15 minutes before the test.

Specimens 'A', 'B', 'C' and 'E' satisfied the performance requirements specified in BS 476: Part 20: 1987 for the following periods:

Specimen 'A'		
Integrity:		**59** Minutes[@]
Insulation (Rockwool):	**Mean Temperature Rise**	**27** Minutes
	Maximum Temperature Rise	**30** Minutes
Insulation (Steel Hollows):	**Mean Temperature Rise**	**21** Minutes
	Maximum Temperature Rise	**23** Minutes
Specimen 'B'		
Integrity:		**64** Minutes
Insulation (Hilti CFS-HFF):	**Mean Temperature Rise**	**23** Minutes
	Maximum Temperature Rise	**25** Minutes
Insulation (Steel Hollows):	**Mean Temperature Rise**	**20** Minutes
	Maximum Temperature Rise	**21** Minutes
Specimen 'C'		
Integrity:		**59** Minutes[@]
Insulation (Rockwool):	**Mean Temperature Rise**	**29** Minutes
	Maximum Temperature Rise	**32** Minutes
Insulation (Steel Hollows):	**Mean Temperature Rise**	**20** Minutes
	Maximum Temperature Rise	**22** Minutes
Specimen 'E'		
Integrity:		**64** Minutes (No failure)
Insulation (Hilti CFS-HFF):	**Mean Temperature Rise**	**64** Minutes
	Maximum Temperature Rise	**64** Minutes
Insulation (Steel Hollows:	**Mean Temperature Rise**	**64** Minutes
with Fire Rated Boards)	**Maximum Temperature Rise**	**64** Minutes

[@]*Note: The specimens were covered by ceramic fibre blanket as requested by test sponsor after a heating period of 59 minutes due to insulation failure.*

Specimen 'D' satisfied the performance requirements specified in BS 476: Part 21: 1987 for the following periods:

Specimen 'D'		
Loadbearing Capacity:		**36** Minutes^
Integrity:		**36** Minutes$^{\Omega}$
Insulation (Rockwool):	**Mean Temperature Rise**	**36** Minutes$^{\Omega}$
	Maximum Temperature Rise	**36** Minutes$^{\Omega}$
Insulation (Steel Hollows:	**Mean Temperature Rise**	**36** Minutes$^{\Omega}$
with Fire Rated Boards)	**Maximum Temperature Rise**	**36** Minutes$^{\Omega}$

The test was discontinued after a period of 64 minutes.

^*Note: The test load was released as requested by test sponsor after a heating period of 36 minutes.*

$^{\Omega}$*Note: Integrity and insulation performances were deemed not to be satisfied as a consequential effect of failing loadbearing capacity performance as mentioned in clause 10.3 and 10.4 of BS 476 Part 20: 1987. The integrity performance and insulation performance against mean and maximum temperature rises criteria of the specimen were as given in page 8 of this report.*

2 INTRODUCTION

The objective of the test is to determine the fire resistance performance of specimens of 5 nos. of Cavity Barriers when tested in accordance with BS 476: Part 20: 1987, 'Method for determination of the fire resistance of elements of construction (general principles)' and BS 476: Part 21: 1987, 'Methods for determination of the fire resistance of loadbearing elements of construction'.

3 TEST INFORMATION

3.1 Test Sponsor

Hilti (Hong Kong) Limited

701-704, 7/F, Tower A, Manulife Financial Centre,

223 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong

3.2 Testing Location

Research Engineering Development Façade Consultants Limited, Hong Kong Main Laboratory of DD 134, Lung Kwu Tan, Tuen Mun, New Territories, Hong Kong

3.3 Date of Test

3rd December 2019

3.4 Witness of the test

The test was led by Mr. Solaris Chan of Research Engineering Development Façade Consultants Limited (RED) and was witnessed by Miss Dorothy Wai, Miss Selina Lin and Miss Lorainne Leung, the representatives of the test sponsor.

4 EQUIPMENT

Nine (9) 'type K' thermocouples to monitor the temperature of the furnace, which were kept at 100 mm from the exposed face of the specimens (see Figure 1).

Twenty-five (25) 'type K' thermocouples to monitor the temperature of the unexposed face of the specimens (see Figure 2).

A 'type K' roving thermocouple to measure temperature on hot spots of unexposed surface of specimens.

A micro-manometer provided to monitor the furnace pressure.

Cotton pads, 6 mm and 25 mm gap gauges.

Steel ruler relative to taut wires to measure the lateral displacement of the specimens.

A transducer to measure the vertical displacement of the specimen.

A radiometer placed at 3,000 mm away from the unexposed surface to measure the radiation of unexposed surface of specimens.

5 CONDITIONING

The specimens' storage, construction, and test preparation took place in the test laboratory over a total, combined time of 12 days. Throughout this period of time, both of the temperature and humidity of the laboratory were measured and recorded as being within a range of 13 °C to 31 °C and 29 % to 80 % respectively.

6 TEST SPECIMENS CONSTRUCTION

The specimens were installed into a concrete specimens holder with pre-prepared opening to form the test construction. The details of the fixings were outlined in Appendix D.

A comprehensive description of the test specimens' construction is presented in the appendix, which is based on a survey of the specimens and information supplied by the test sponsor.

7 TEST PROCEDURES

The test was conducted in accordance with the procedures specified in BS 476: Part 20: 1987 and BS 476: Part 21: 1987. The ambient temperature of the test area during the test was measured. After the first 5 minutes of the test, the furnace pressure was maintained at 0 ± 2 Pa relative to atmosphere, at 1,000 mm from the notional floor level.

The furnace was monitored by nine (9) thermocouples so that the mean furnace temperature complied with the requirements of Clause 3.1 of BS 476: Part 20: 1987.

The temperature of the unexposed face was monitored by means of twenty-five (25) thermocouples fixed to the unexposed surface (see Figure 2 for the locations and reference numbers of the thermocouples). Thermocouples S1 – S3 were fixed on the Rockwool of specimen 'A' for mean and maximum temperatures of the unexposed surface of Rockwool of specimen 'A'. Thermocouples S4 – S5 were fixed on the steel hollows of specimen 'A' for mean and maximum temperatures of the unexposed surface of steel hollows of specimen 'A'. Thermocouples S6 – S8 were fixed on the Hilti CFS-HFF of specimen 'B' for mean and maximum temperatures of the unexposed surface of Hilti CFS-HFF of specimen 'B'. Thermocouples S9 – S10 were fixed on the steel hollows of specimen 'B' for mean and maximum temperatures of the unexposed surface of steel hollows of specimen 'B'. Thermocouples S11 – S13 were fixed on the Rockwool of specimen 'C' for mean and maximum temperatures of the unexposed surface of Rockwool of specimen 'C'. Thermocouples S14 – S15 were fixed on the steel hollows of specimen 'C' for mean and maximum temperatures of the unexposed surface of steel hollows of specimen 'C'. Thermocouples S16 – S18 were fixed on the Rockwool of specimen 'D' for mean and maximum temperatures of the unexposed surface of Rockwool of specimen 'D'. Thermocouples S19 – S20 were fixed on the steel hollows with fire rated boards of specimen 'D' for mean and maximum temperatures of the unexposed surface of steel hollows with fire rated boards of specimen 'D'. Thermocouples S21 – S23 were fixed on the Hilti CFS-HFF of specimen 'E' for mean and maximum temperatures of the unexposed surface of Hilti CFS-HFF of specimen 'E'. Thermocouples S24 – S25 were fixed on the steel hollows with fire rated boards of specimen 'E' for mean and maximum temperatures of the unexposed surface of steel hollows with fire rated boards of specimen 'E'. The mean and maximum temperatures were recorded.

The cotton pads and gap gauges were used, if considered appropriate, to determine compliance with the integrity criterion of the standard. The occurrence of sustained flaming on the unexposed surface was monitored to determine compliance with this criterion. The lateral deflection of specimens was measured by steel ruler relative to taut wires and vertical deflection of specimen was measured by transducer and recorded. The radiation of specimens was measured and recorded.

8 TEST DATA AND INFORMATION

The ambient temperature of the test area during the test was 21 °C.

The furnace was controlled so that the mean furnace temperature complied with the requirements of Clause 3.1 of BS 476: Part 20: 1987. The temperature recorded was shown graphically in Figure 4.

The mean and maximum temperatures of the unexposed surface of Rockwool of specimen 'A' were shown graphically in Figure 5.

The mean and maximum temperatures of the unexposed surface of steel hollows of specimen 'A' were shown graphically in Figure 6.

The mean and maximum temperatures of the unexposed surface of Hilti CFS-HFF of specimen 'B' were shown graphically in Figure 7.

The mean and maximum temperatures of the unexposed surface of steel hollows of specimen 'B' were shown graphically in Figure 8.

The mean and maximum temperatures of the unexposed surface of Rockwool of specimen 'C' were shown graphically in Figure 9.

The mean and maximum temperatures of the unexposed surface of steel hollows of specimen 'C' were shown graphically in Figure 10.

The mean and maximum temperatures of the unexposed surface of Rockwool of specimen 'D' were shown graphically in Figure 11.

The mean and maximum temperatures of the unexposed surface of steel hollows with fire rated boards of specimen 'D' were shown graphically in Figure 12.

The mean and maximum temperatures of the unexposed surface of Hilti CFS-HFF of specimen 'E' were shown graphically in Figure 13.

The mean and maximum temperatures of the unexposed surface of steel hollows with fire rated boards of specimen 'E' were shown graphically in Figure 14.

The furnace pressure obtained was shown graphically in Figure 15.

The radiation obtained was shown graphically in Figure 16.

The vertical deflection of specimen 'D' was shown graphically in Figure 17.

The rate of vertical deflection of specimen 'D' was shown graphically in Figure 18.

A summary of the observations made on the general behaviour of the specimens was given in 'APPENDIX B - OBSERVATION'.

The lateral deflection of specimens obtained was summarized in Table 1.

The vertical deflection of specimen 'D' obtained was summarized in Table 2.

The mean furnace temperature obtained was summarized in Table 3.

The temperature rises of specimens obtained were summarized in Tables 4 - 5.

The test was discontinued after a period of 64 minutes.

9 RESULTS

When tested in accordance with BS 476: Part 20: 1987, the requirements of the standards were satisfied for the following periods:

Specimen 'A'		
Integrity:		**59** Minutes[@]
Insulation (Rockwool):	**Mean Temperature Rise**	**27** Minutes
	Maximum Temperature Rise	**30** Minutes
Insulation (Steel Hollows):	**Mean Temperature Rise**	**21** Minutes
	Maximum Temperature Rise	**23** Minutes

Specimen 'B'		
Integrity:		**64** Minutes
Insulation (Hilti CFS-HFF):	**Mean Temperature Rise**	**23** Minutes
	Maximum Temperature Rise	**25** Minutes
Insulation (Steel Hollows):	**Mean Temperature Rise**	**20** Minutes
	Maximum Temperature Rise	**21** Minutes

Specimen 'C'		
Integrity:		**59** Minutes[@]
Insulation (Rockwool):	**Mean Temperature Rise**	**29** Minutes
	Maximum Temperature Rise	**32** Minutes
Insulation (Steel Hollows):	**Mean Temperature Rise**	**20** Minutes
	Maximum Temperature Rise	**22** Minutes

Specimen 'E'		
Integrity:		**64** Minutes (No failure)
Insulation (Hilti CFS-HFF):	**Mean Temperature Rise**	**64** Minutes
	Maximum Temperature Rise	**64** Minutes
Insulation (Steel Hollows:	**Mean Temperature Rise**	**64** Minutes
with Fire Rated Boards)	**Maximum Temperature Rise**	**64** Minutes

When tested in accordance with BS 476: Part 21: 1987, the requirements of the standards were satisfied for the following periods:

Specimen 'D'		
Loadbearing Capacity:		**36** Minutes[^]
Integrity:		**36** Minutes[Ω]
Insulation (Rockwool):	**Mean Temperature Rise**	**36** Minutes[Ω]
	Maximum Temperature Rise	**36** Minutes[Ω]
Insulation (Steel Hollows:	**Mean Temperature Rise**	**36** Minutes[Ω]
with Fire Rated Boards)	**Maximum Temperature Rise**	**36** Minutes[Ω]

[@], [^] and [Ω] see note on page 4

Note: Uncertainty in deflection measurements of displacement transducers is ± 0.5 mm with k=2.

Insulation - It is required that the mean temperature rise of the unexposed surface shall not be greater than 140 °C and that maximum temperature rise shall not be greater than 180 °C. Insulation failure also occurs simultaneously with integrity failure.

Specimen 'A'

Rockwool

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 27 minutes. The 180 °C rise of the maximum temperature of the unexposed surface of specimen reached and measured by thermocouple S3 after a heating period of 30 minutes. The maximum temperature rise was 456 °C measured by thermocouple S3 after a heating period of 64 minutes.

Steel Hollows

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 21 minutes. The 180 °C rise of the maximum temperature of the unexposed surface of specimen reached and measured by thermocouple S5 after a heating period of 23 minutes. The maximum temperature rise was 598 °C measured by thermocouple S5 after a heating period of 64 minutes.

Specimen 'B'

Hilti CFS-HFF

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 23 minutes. The 180 °C rise of the maximum temperature of the unexposed surface of specimen reached and measured by thermocouple S8 after a heating period of 25 minutes. The maximum temperature rise was 611 °C measured by thermocouple S6 after a heating period of 64 minutes.

Steel Hollows

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 20 minutes. The 180 °C rise of the maximum temperature of the unexposed surface of specimen reached and measured by thermocouple S9 after a heating period of 21 minutes. The maximum temperature rise was 604 °C measured by thermocouple S10 after a heating period of 64 minutes.

Specimen 'C'

Rockwool

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 29 minutes. The 180 °C rise of the maximum temperature of the unexposed surface of specimen reached and measured by thermocouple S12 after a heating period of 32 minutes. The maximum temperature rise was 426 °C measured by thermocouple S12 after a heating period of 64 minutes.

Steel Hollows

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 20 minutes. The 180 °C rise of the maximum temperature of the unexposed surface of specimen reached and measured by thermocouple S15 after a heating period of 22 minutes. The maximum temperature rise was 571 °C measured by thermocouple S15 after a heating period of 64 minutes.

Specimen 'D'

Rockwool

The 140 °C rise of the mean temperature of the unexposed surface of specimen did not reach during the test. The 180 °C rise of the maximum temperature of the unexposed surface of specimen did not reach during the test. The maximum temperature rise was 70 °C measured by thermocouple S16 after a heating period of 64 minutes. Insulation performance was deemed not to be satisfied as a consequential effect of failing integrity performance as mentioned in clause 10.4 of BS 476 Part 20: 1987.

Steel Hollows with Fire Rated Boards

The 140 °C rise of the mean temperature of the unexposed surface of specimen did not reach during the test. The 180 °C rise of the maximum temperature of the unexposed surface of specimen did not reach during the test. The maximum temperature rise was 69 °C measured by thermocouple S19 after a heating period of 64 minutes. Insulation performance was deemed not to be satisfied as a consequential effect of failing integrity performance as mentioned in clause 10.4 of BS 476 Part 20: 1987.

Specimen 'E'

Hilti CFS-HFF

The 140 °C rise of the mean temperature of the unexposed surface of specimen did not reach during the test. The 180 °C rise of the maximum temperature of the unexposed surface of specimen did not reach during the test. The maximum temperature rise was 78 °C measured by thermocouple S23 after a heating period of 58 minutes.

Steel Hollows with Fire Rated Boards

The 140 °C rise of the mean temperature of the unexposed surface of specimen did not reach during the test. The 180 °C rise of the maximum temperature of the unexposed surface of specimen did not reach during the test. The maximum temperature rise was 68 °C measured by thermocouple S25 after a heating period of 64 minutes.

Integrity - It is required that there is no collapse for the specimen, no sustained flaming on the unexposed surface and no loss of impermeability.

Specimen 'A'

The specimen was covered by ceramic fibre blanket as requested by test sponsor after a heating period of 59 minutes due to insulation failure.

The specimen did not meet the integrity requirements after a heating period of 59 minutes.

Specimen 'B'

25 mm gap gauge was applied at the gap between steel hollows and passed through into the furnace after a heating period of 64 minutes.

The specimen did not meet the integrity requirements after a heating period of 64 minutes.

Specimen 'C'

The specimen was covered by ceramic fibre blanket as requested by test sponsor after a heating period of 59 minutes due to insulation failure.

The specimen did not meet the integrity requirements after a heating period of 59 minutes.

Specimen 'D'

No failure was observed regarding to the criteria of cotton pad, gap gauge and sustained flaming during the test. Integrity performance was deemed not to be satisfied as a consequential effect of failing loadbearing capacity performance as mentioned in clause 10.3 of BS 476 Part 20: 1987.

The specimen did not meet the integrity requirements after a heating period of 36 minutes.

Specimen 'E'

No failure was observed regarding to the criteria of cotton pad, gap gauge and sustained flaming during the test.

The specimen met the integrity requirements after a heating period of 64 minutes.

Loadbearing Capacity - It is required that the maximum vertical deflection is not greater than 120 mm.

Specimen 'D'

The maximum vertical deflection of the specimen occurred at location D11 was 3.8 mm after a heating period of 36 minutes.

The maximum rate of vertical deflection was 1.65 mm/min after a heating period of 36 minutes.

The test load was released as requested by test sponsor after a heating period of 36 minutes.

The specimen did not meet the loadbearing capacity requirements after a heating period of 36 minutes.

10 LIMITATIONS

The results relate only to the behaviour of the specimen of the element of construction under the particular conditions of the test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use nor do they reflect the actual behaviour in fires (see Clause 12 of BS 476: Part 20: 1987).

The fire resistance performance of the specimen may change if substantially different gaps are used. Application of the results to the specimen of different dimensions or supported other than by a concrete wall or incorporating different components shall be the subject of a design appraisal.

APPENDIX A – Photos and Test Record

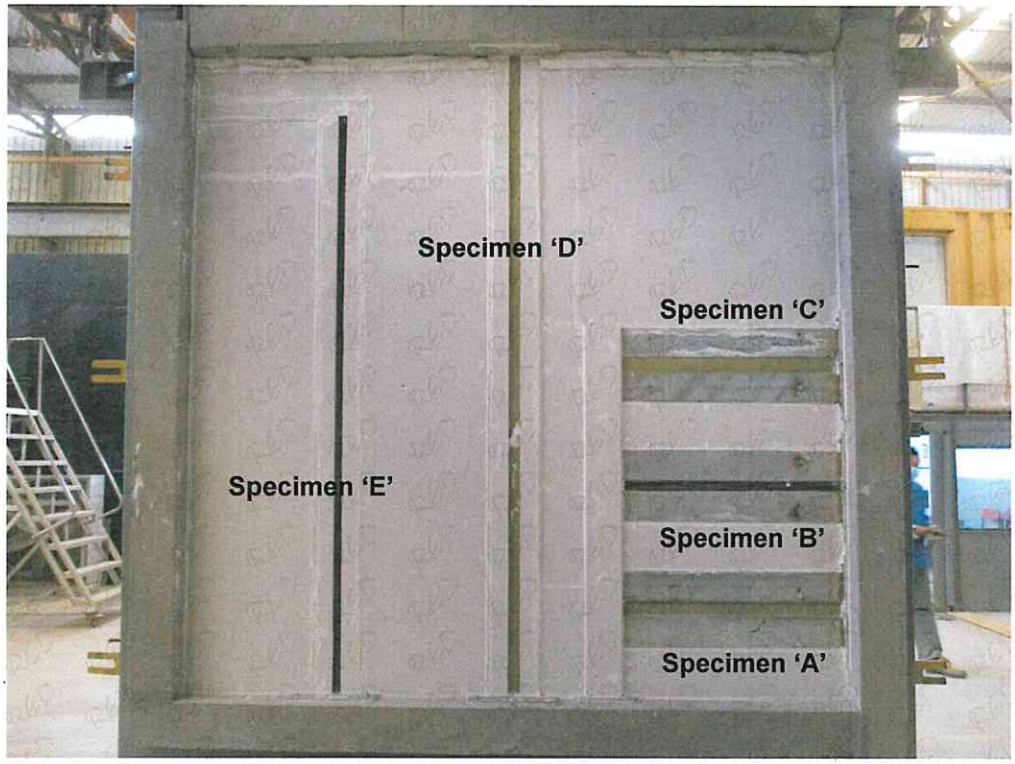


Photo 1: The exposed face of the specimens before the test.

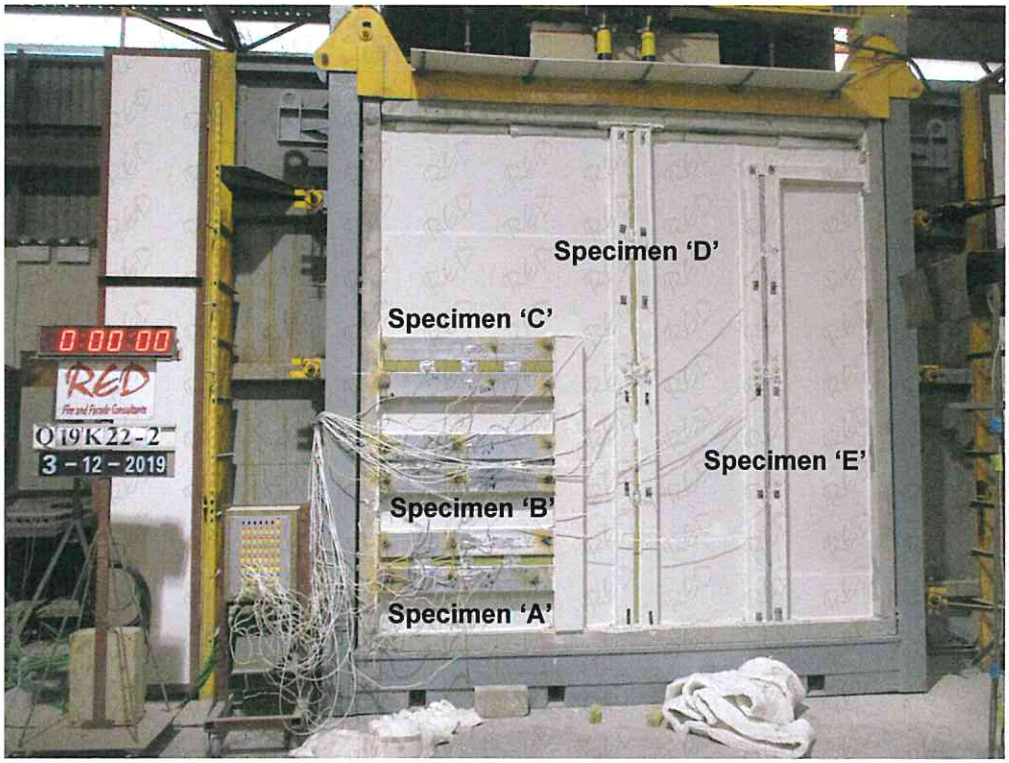


Photo 2: The unexposed face of the specimens before the test.

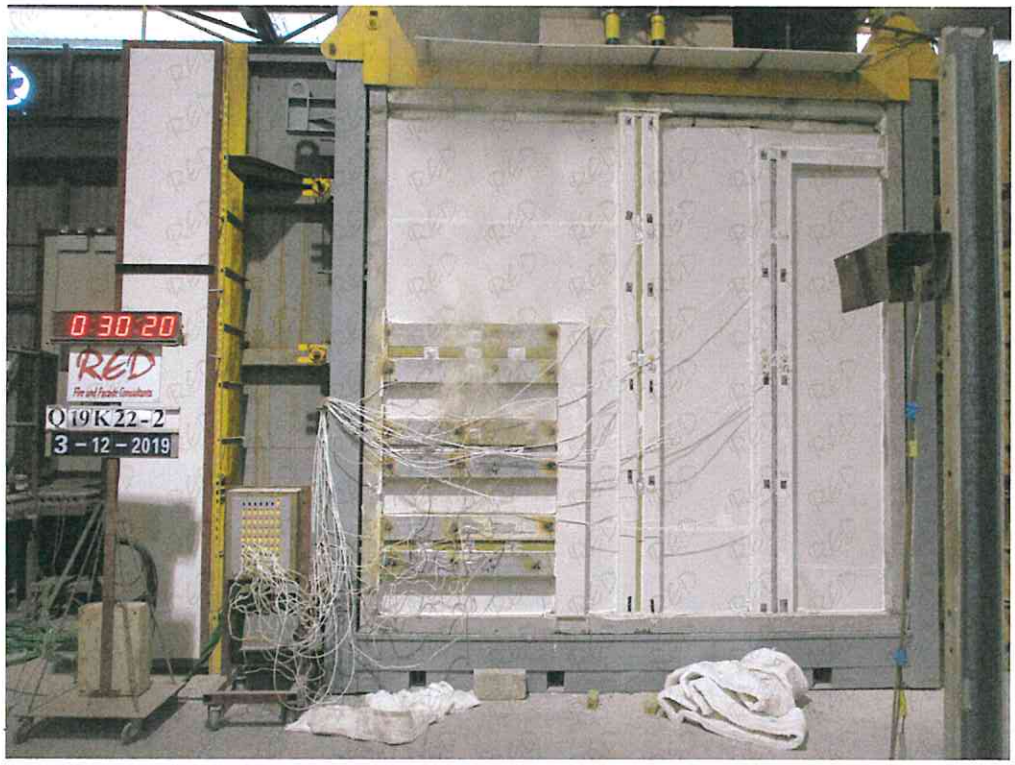


Photo 3: The unexposed face of the specimens after a heating period of 30 minutes.

Photo 4: The unexposed face of the specimens after a heating period of 60 minutes.

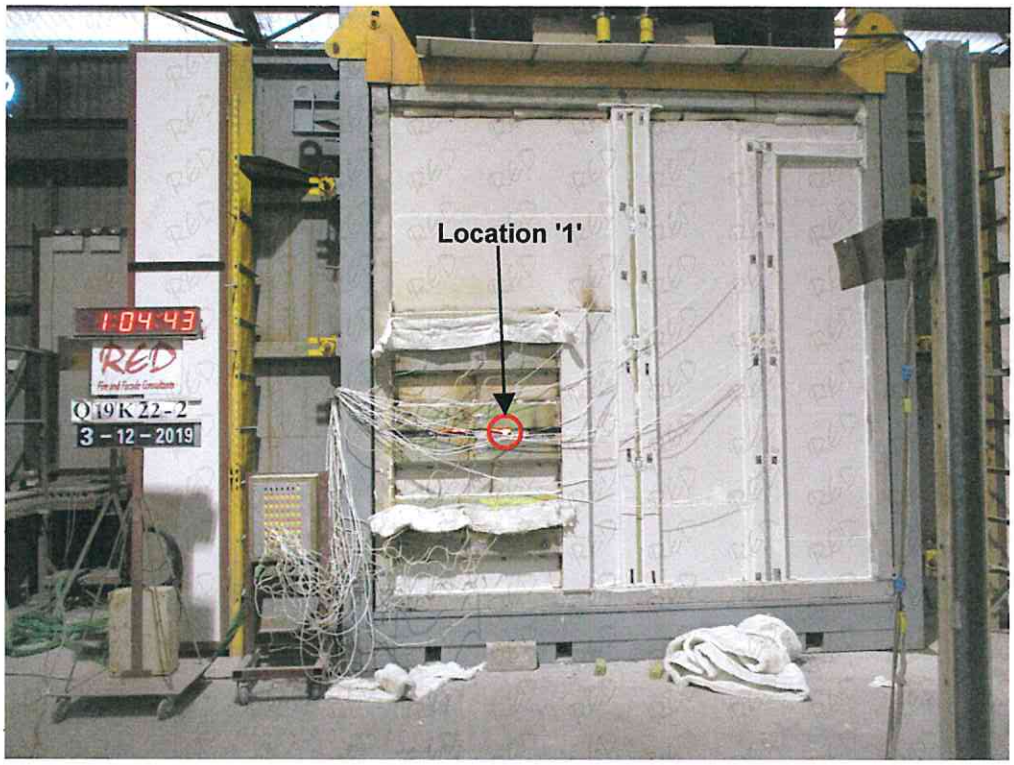


Photo 5: The unexposed face of the specimens after the test.

Photo 6: The exposed face of the specimens after the test.

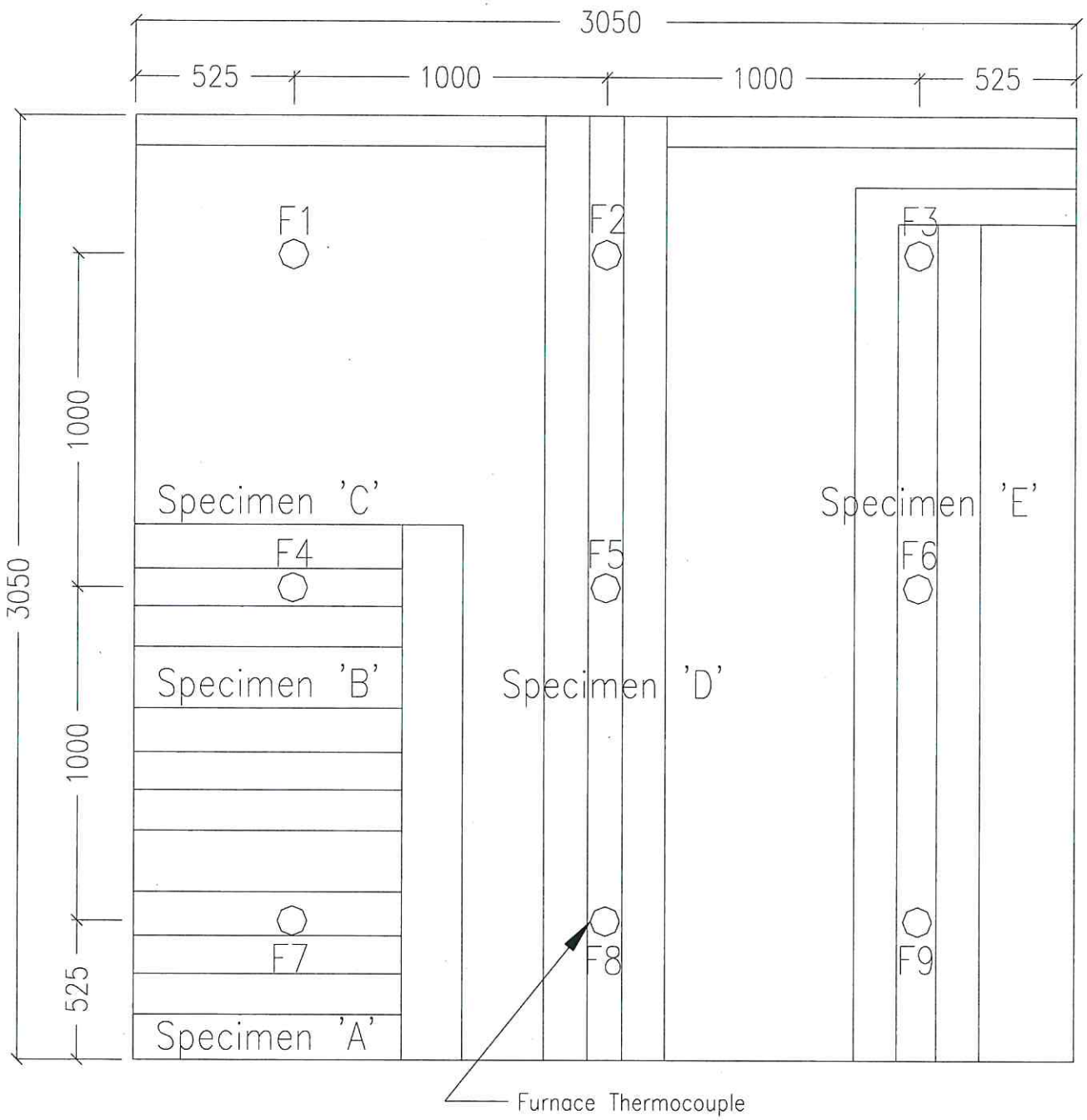


Figure 1 – Locations and reference numbers of furnace thermocouples.
(This figure is not to scale and all dimensions are in millimetres.)

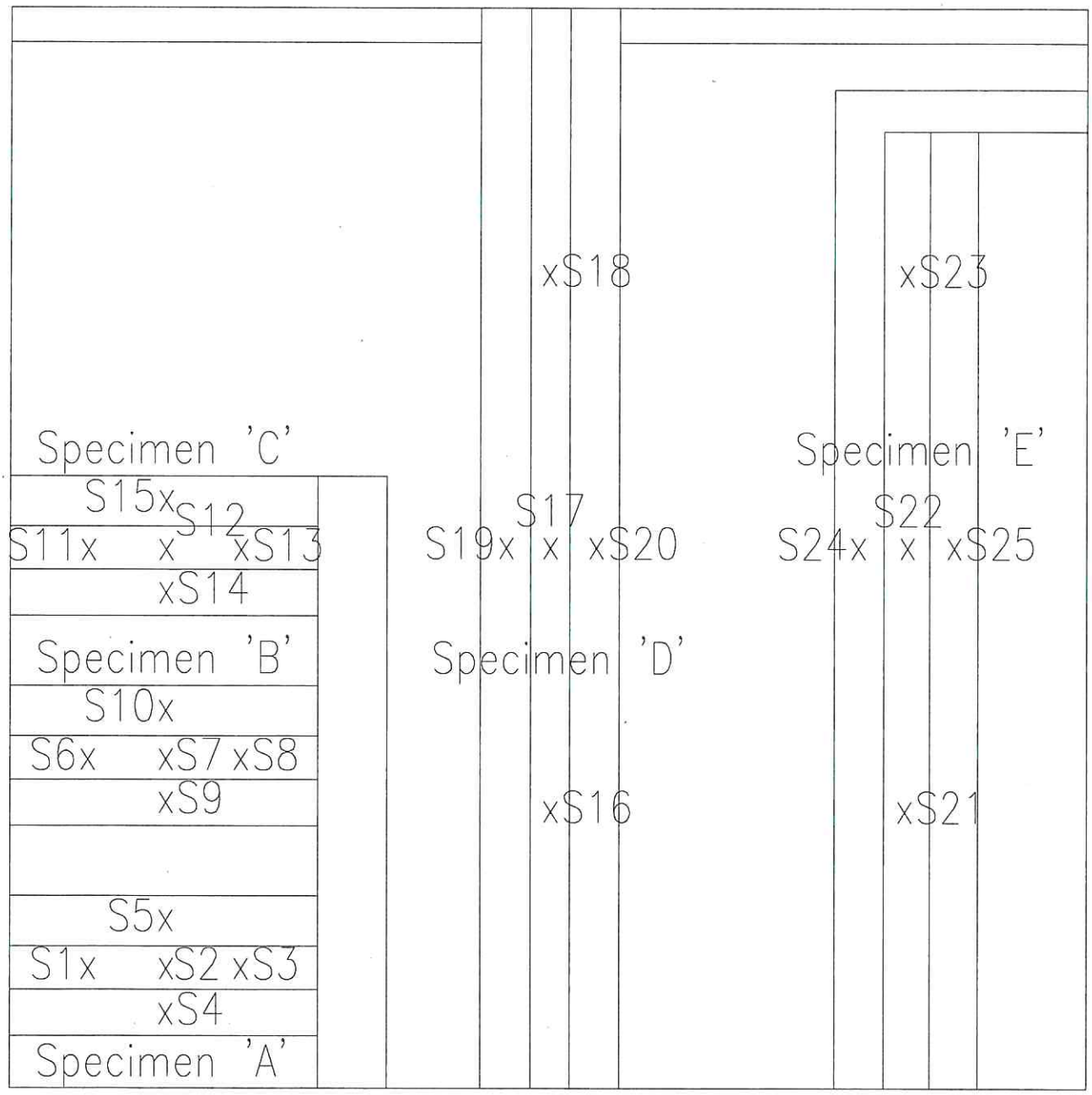


Figure 2 – Locations and reference numbers of thermocouples to monitor the temperature of unexposed surface of the specimens.

(This figure is not to scale.)

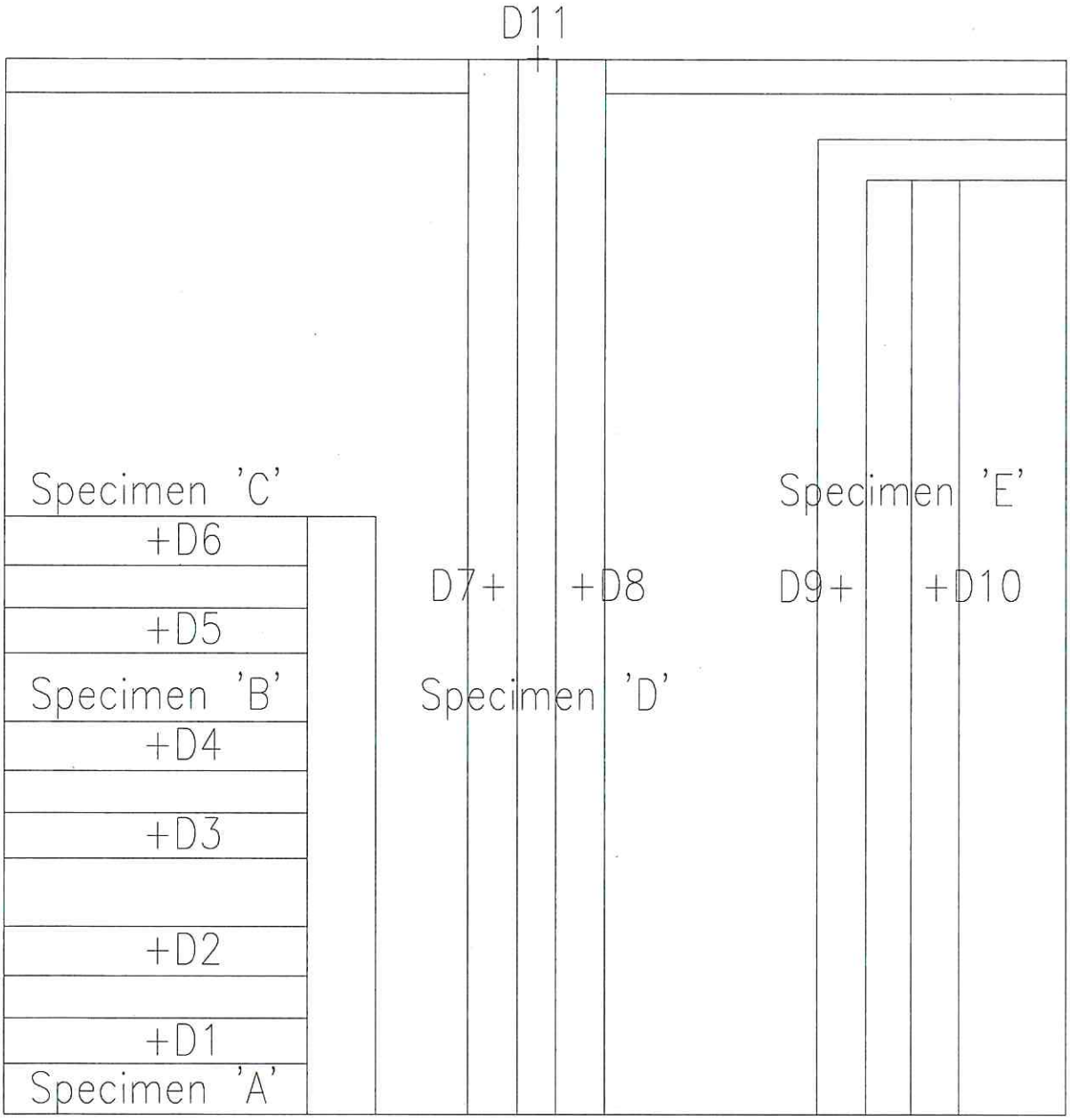


Figure 3 – Locations and reference numbers of displacement measurements.

(This figure is not to scale.)

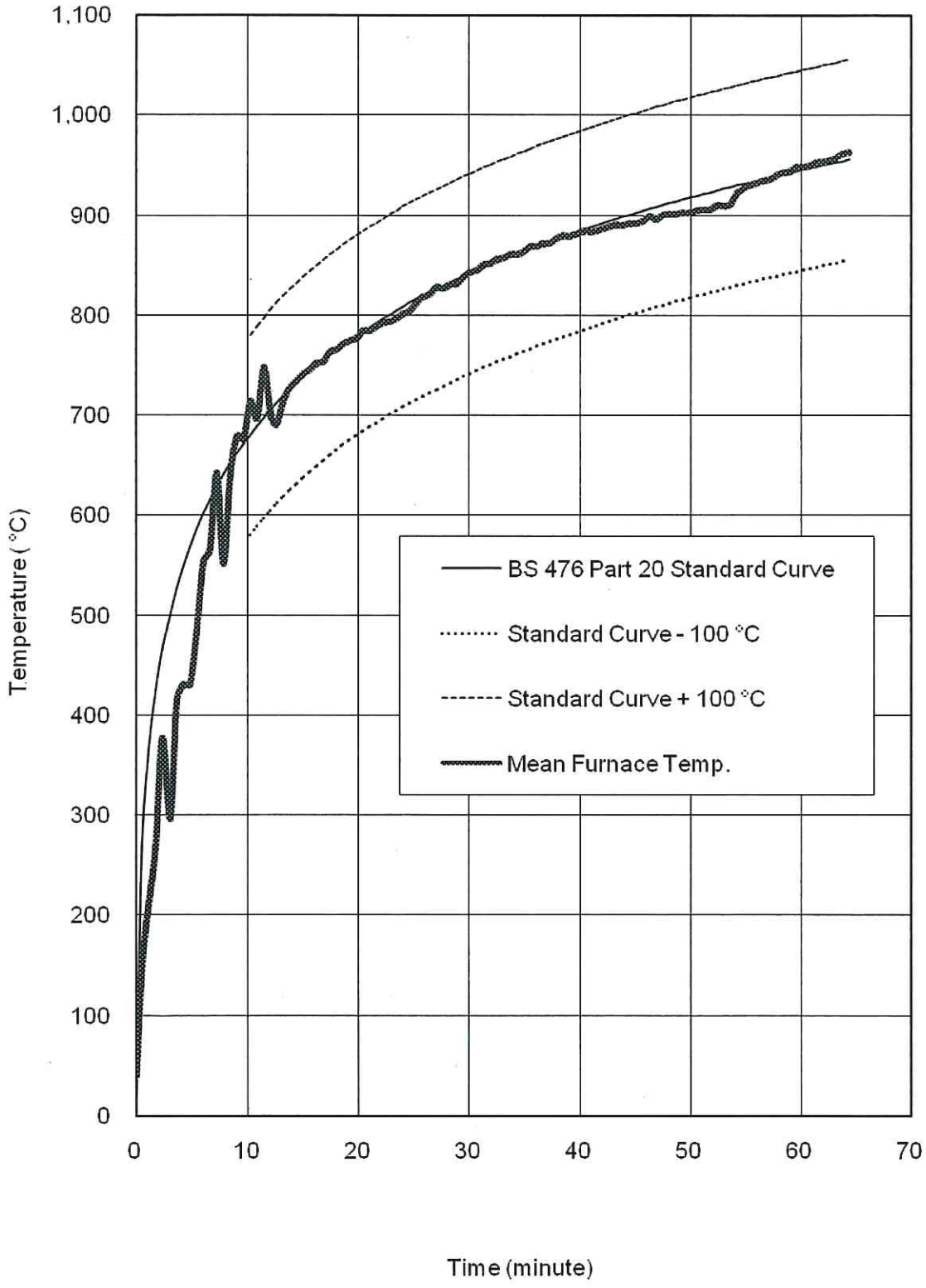


Figure 4 – Mean furnace temperature.

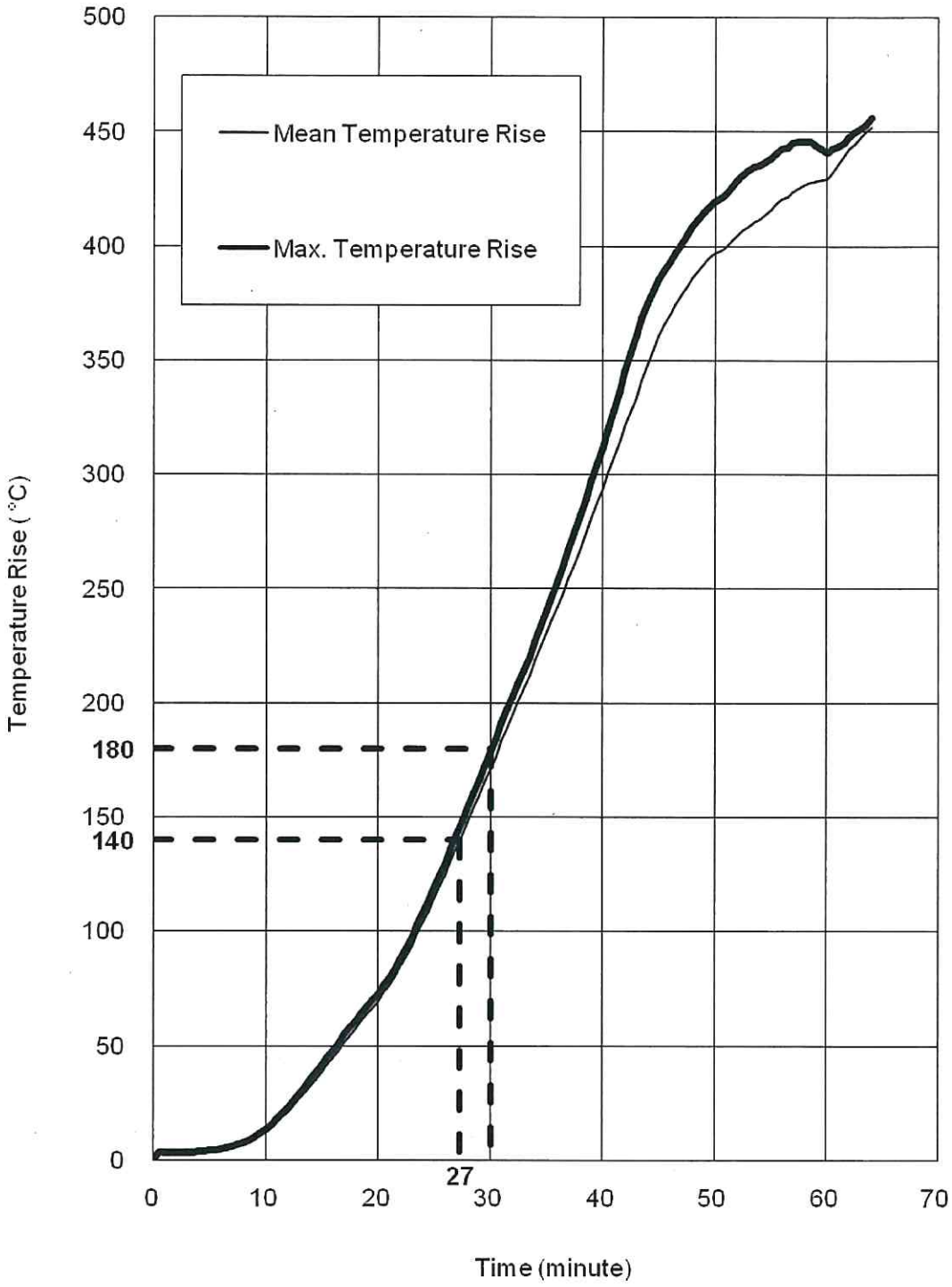


Figure 5 – Temperature rises of unexposed surface of Rockwool of specimen 'A'.

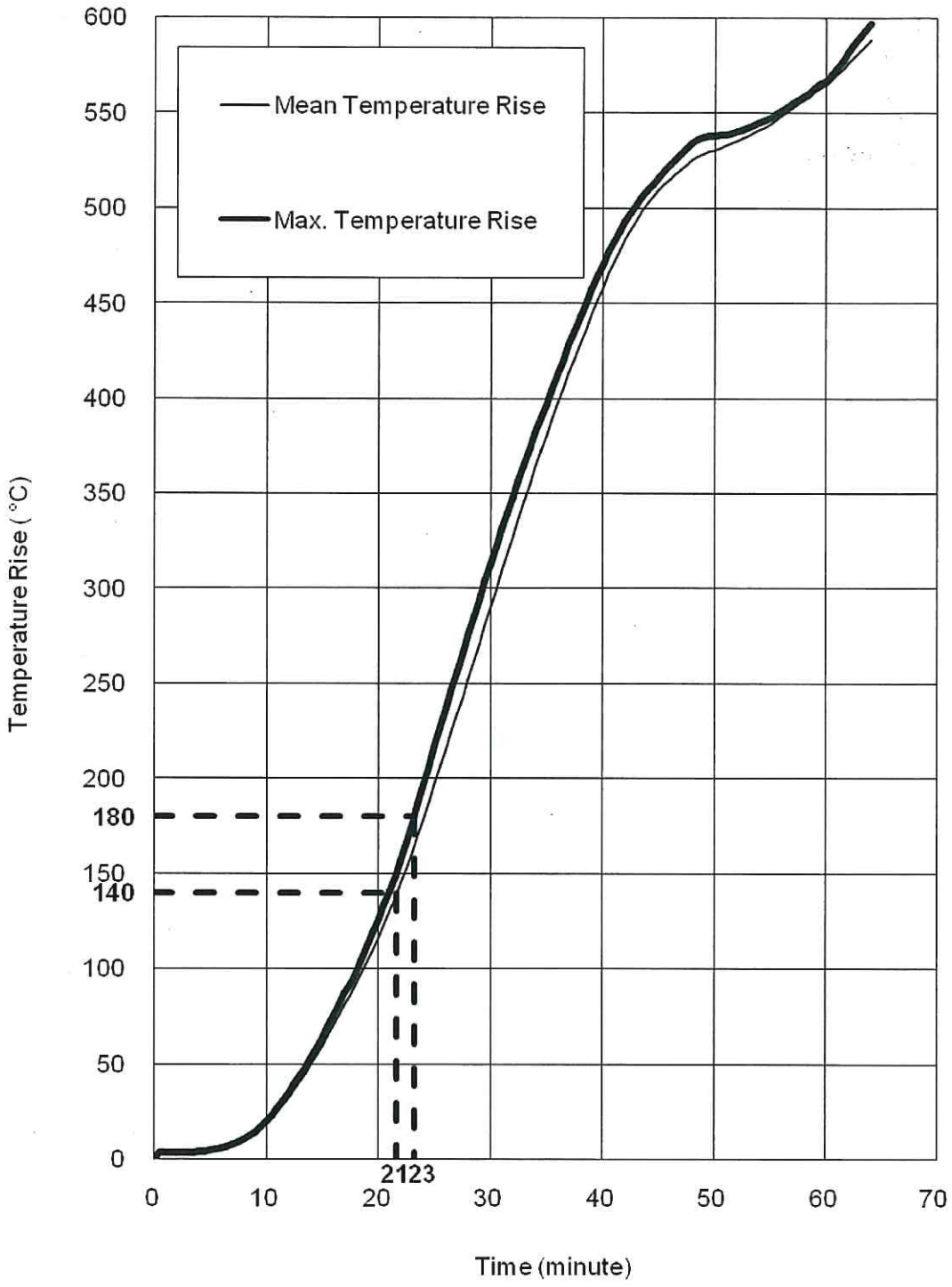


Figure 6 – Temperature rises of unexposed surface of steel hollows of specimen 'A'.

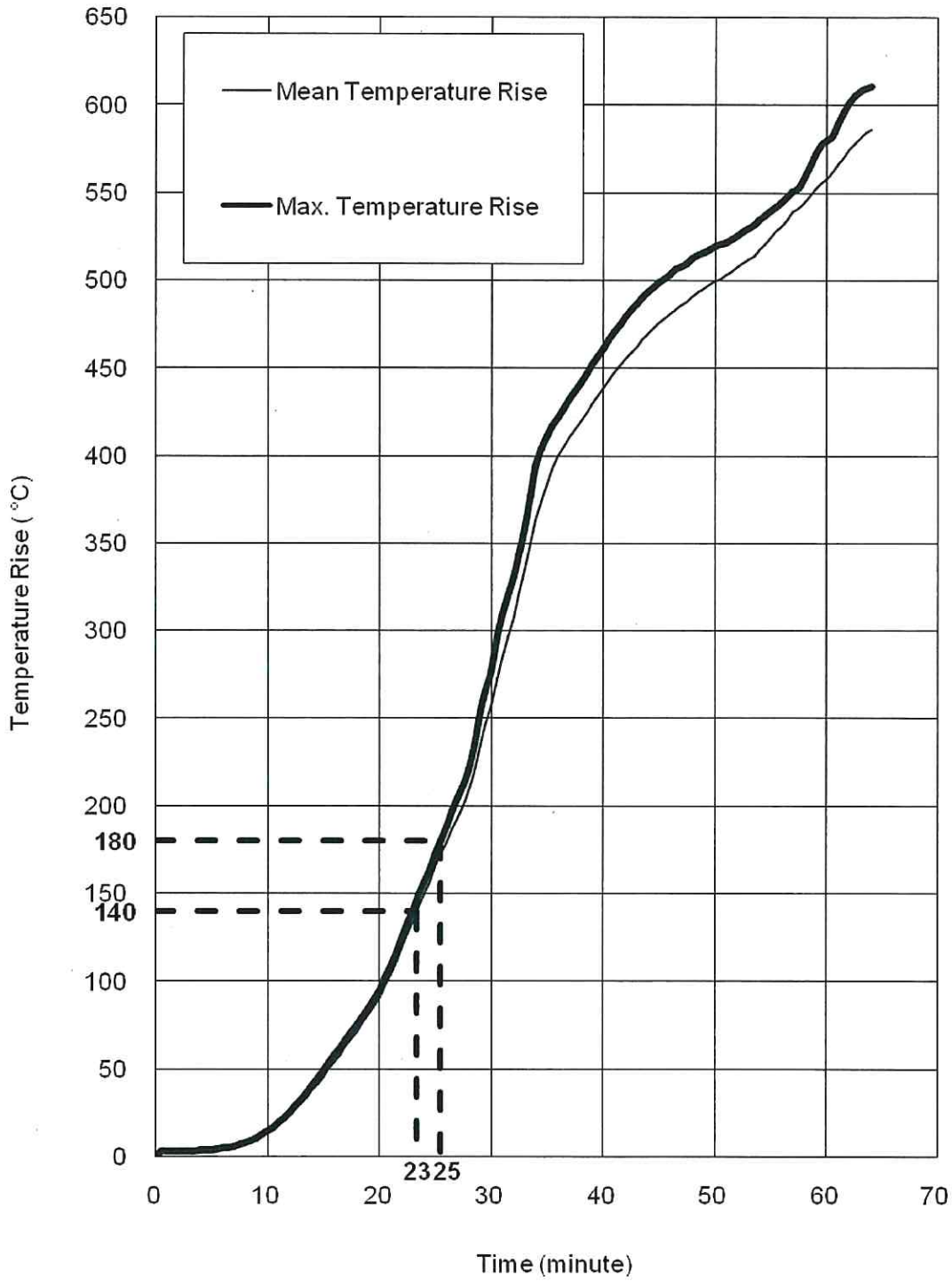


Figure 7 – Temperature rises of unexposed surface of Hilti CFS-HFF of specimen 'B'.

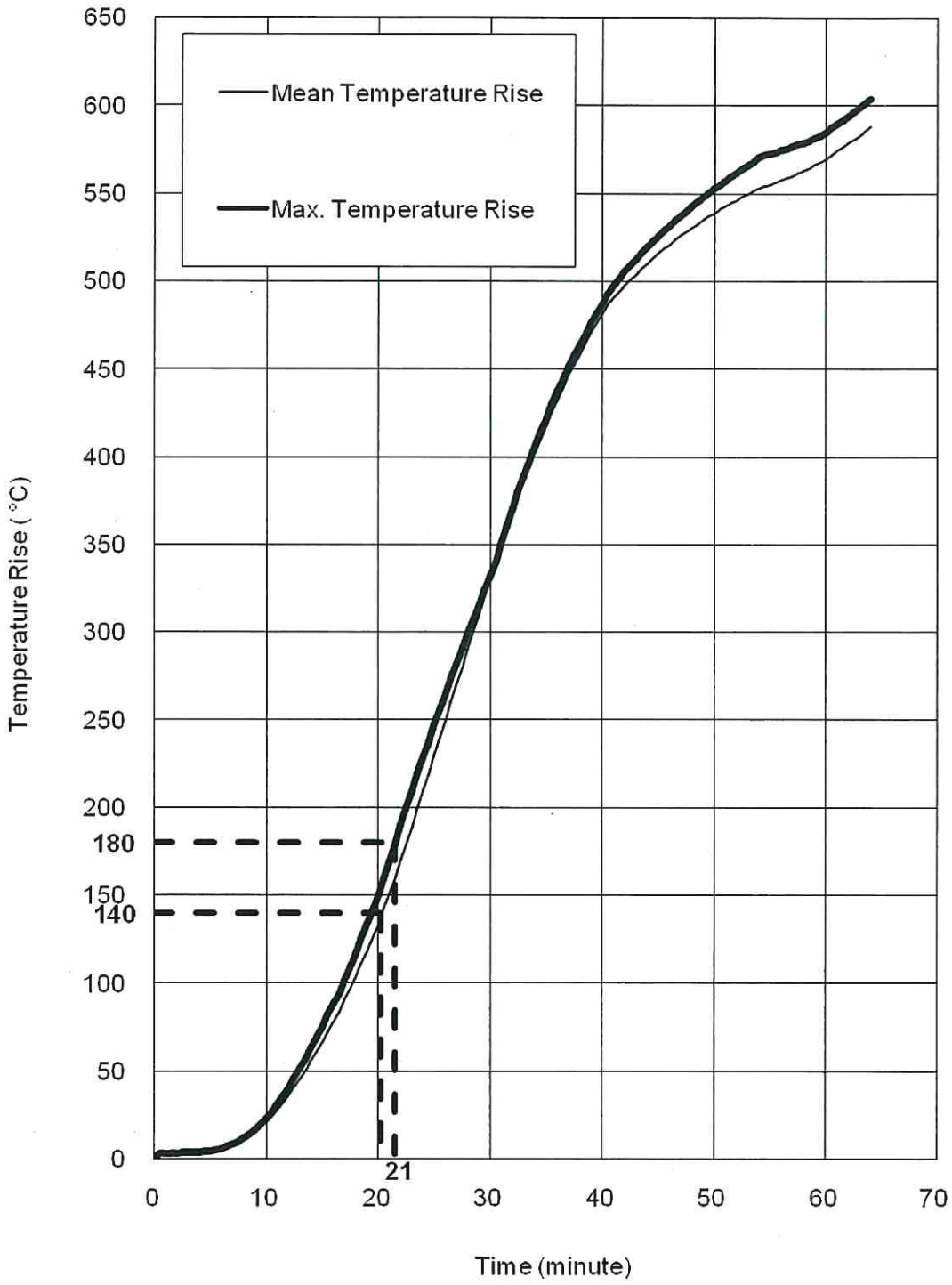


Figure 8 – Temperature rises of unexposed surface of steel hollows of specimen 'B'.

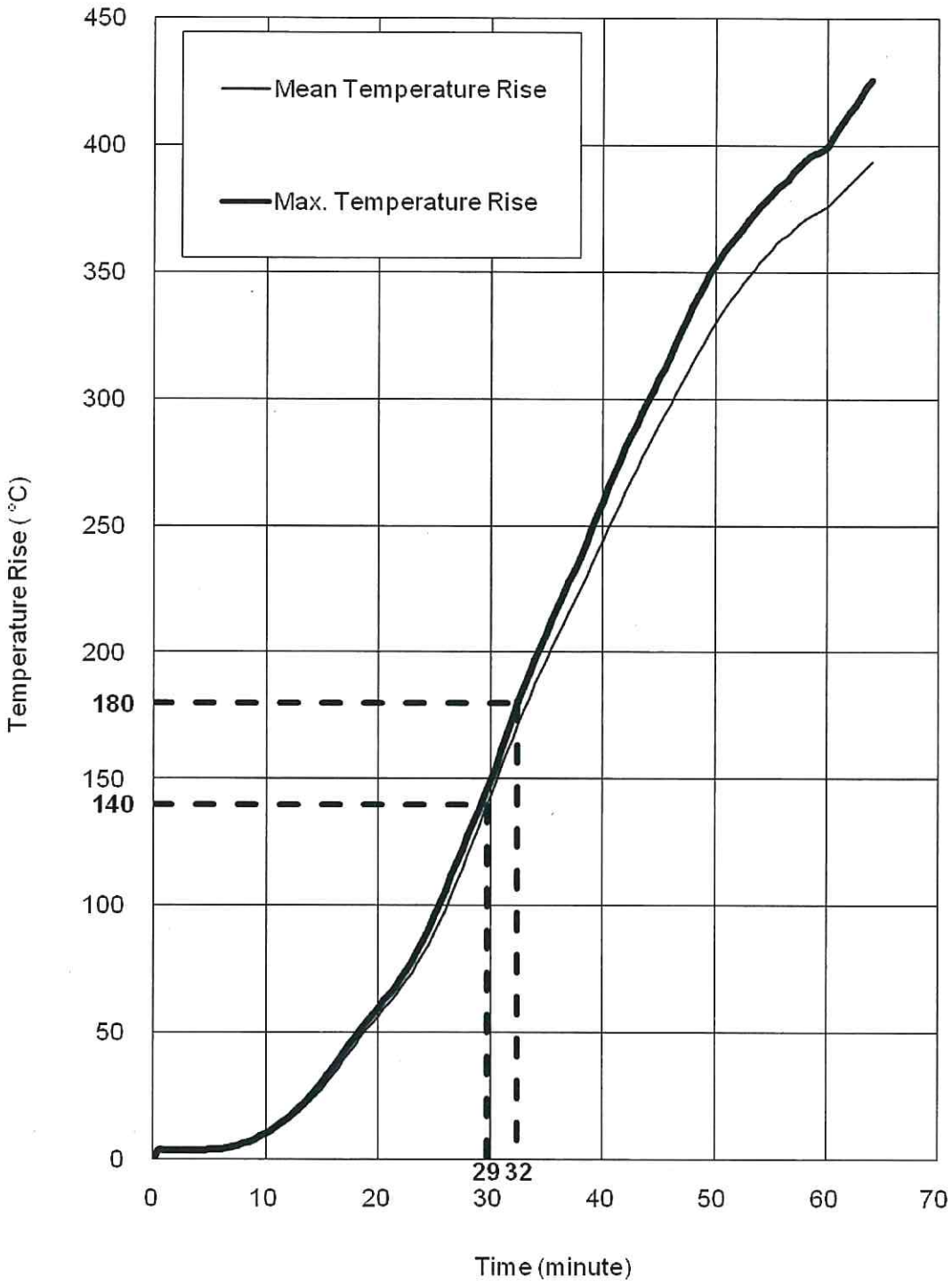


Figure 9 – Temperature rises of unexposed surface of Rockwool of specimen 'C'.

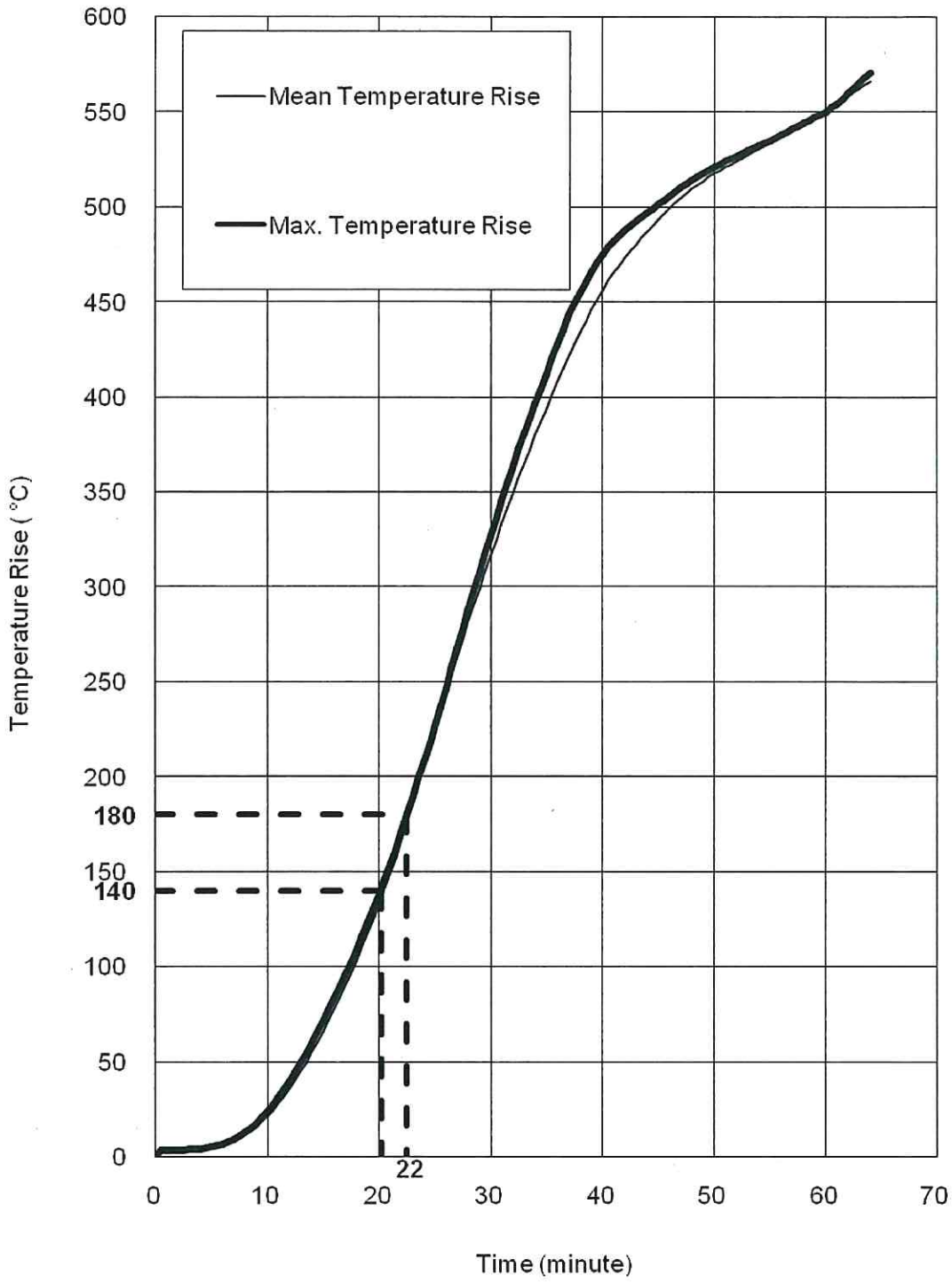


Figure 10 – Temperature rises of unexposed surface of steel hollows of specimen 'C'.

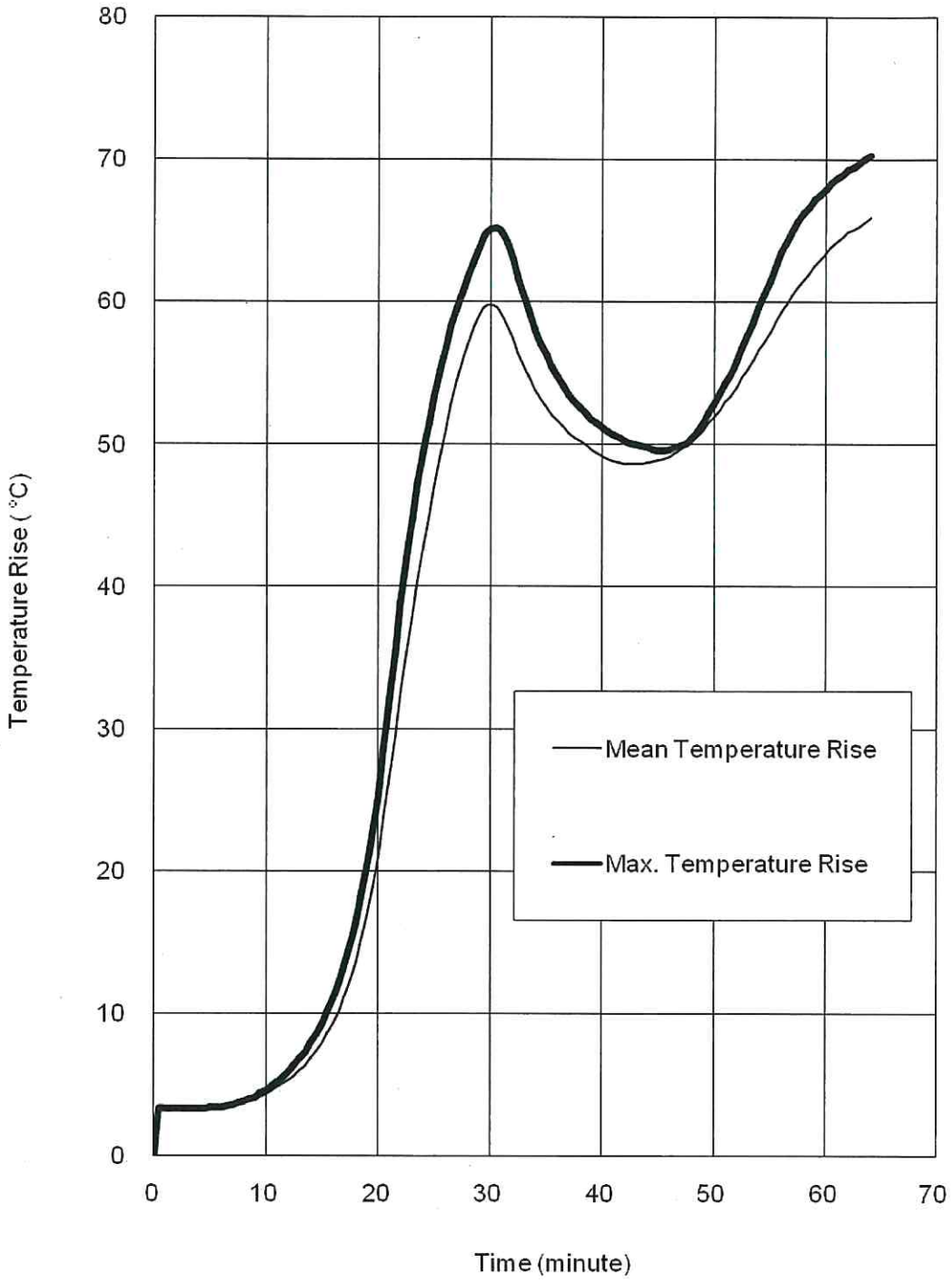


Figure 11 – Temperature rises of unexposed surface of Rockwool of specimen 'D'.

Note: The test load was released as requested by test sponsor after a heating period of 36 minutes.

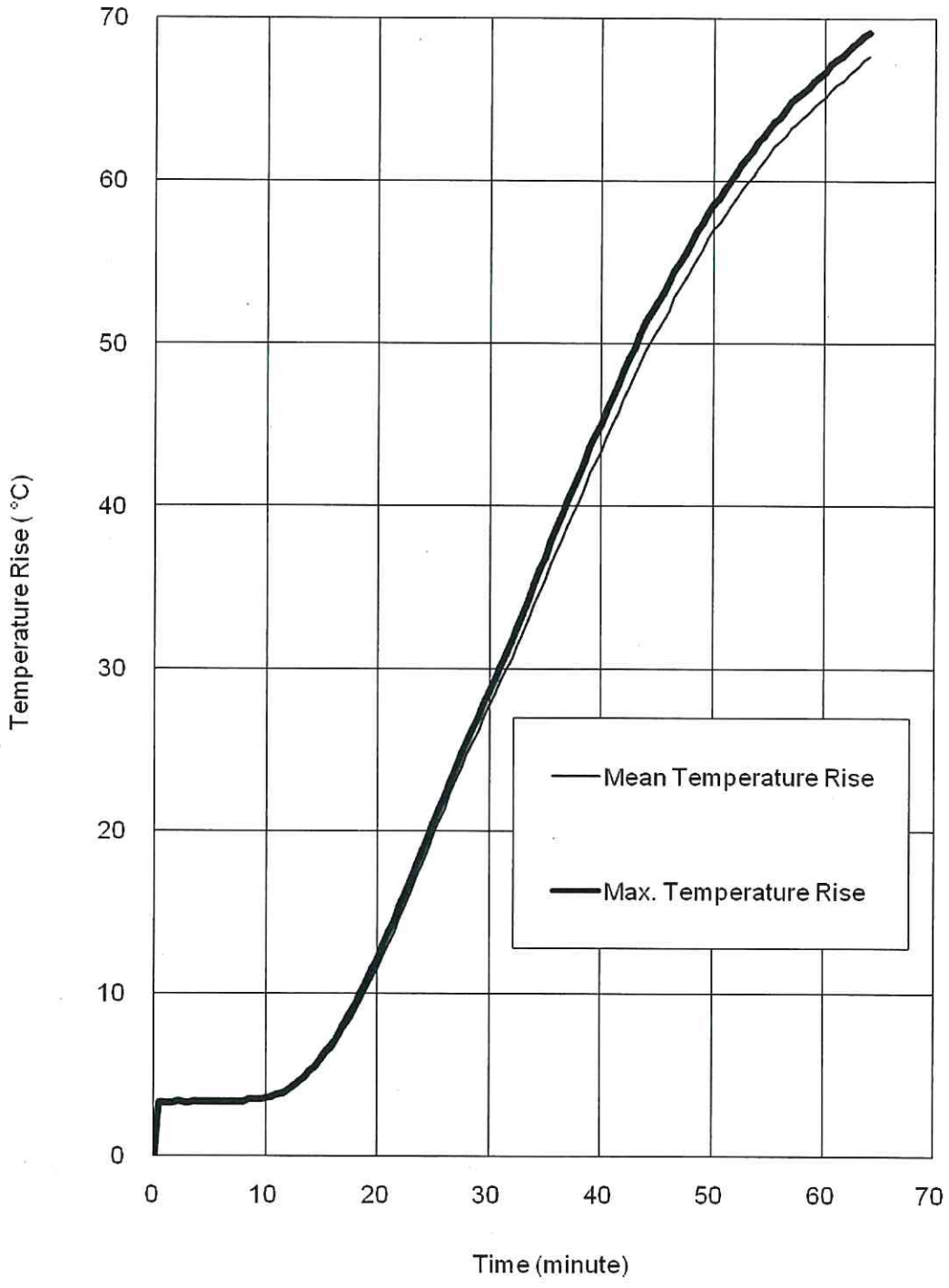


Figure 12 – Temperature rises of unexposed surface of steel hollows with fire rated boards of specimen 'D'.

Note: The test load was released as requested by test sponsor after a heating period of 36 minutes.

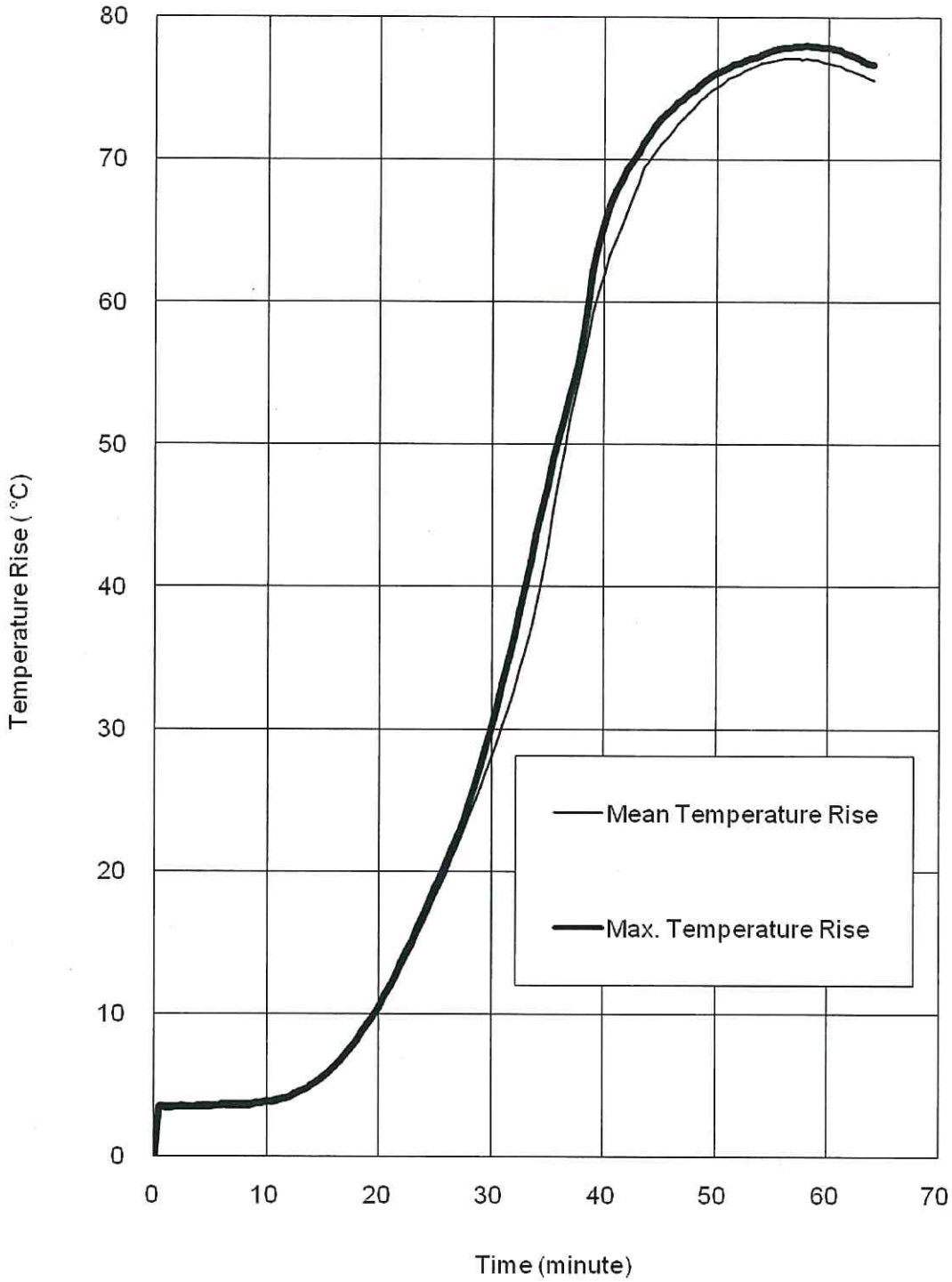


Figure 13 – Temperature rises of unexposed surface of Hilti CFS-HFF of specimen 'E'.

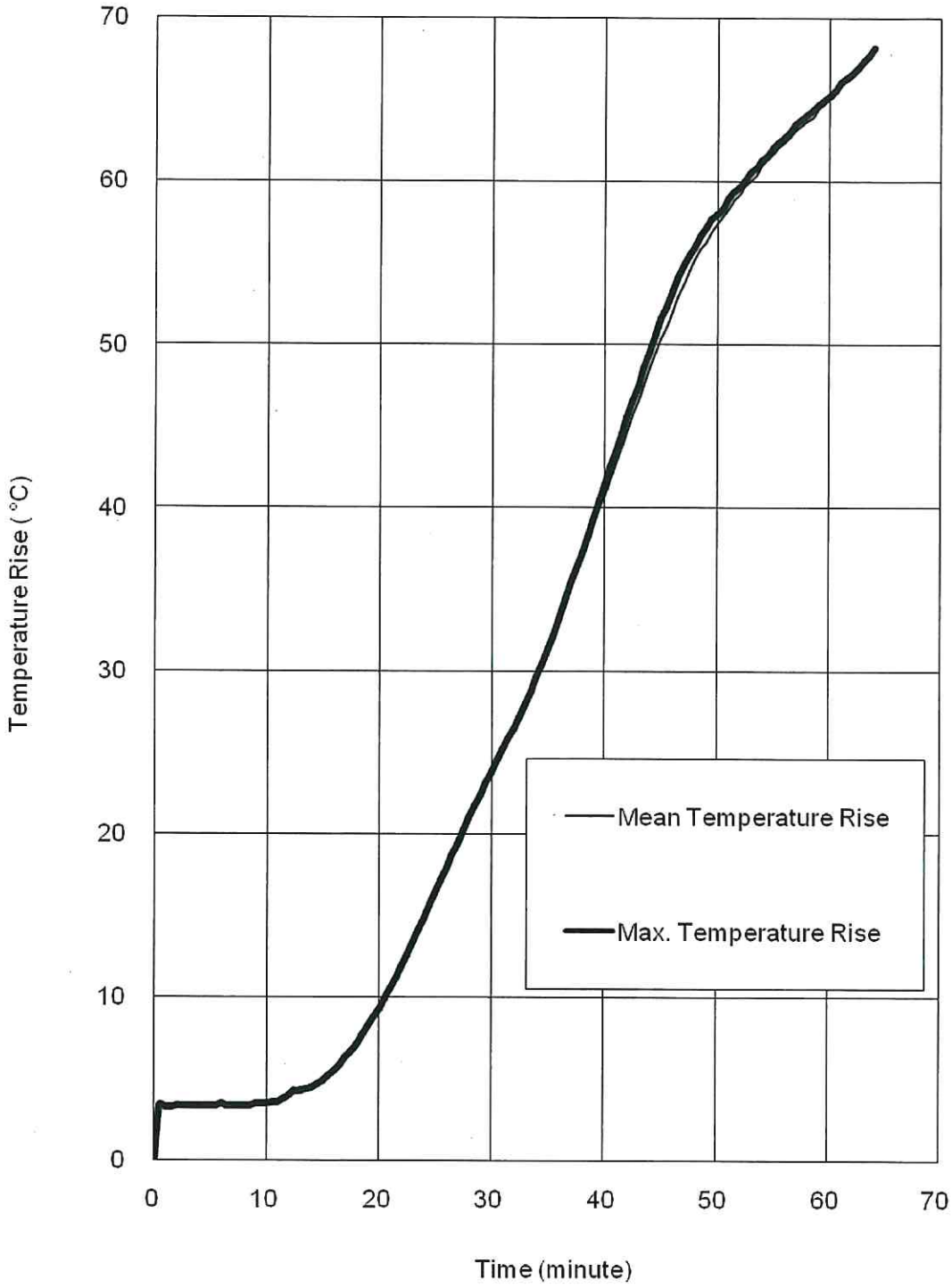


Figure 14 – Temperature rises of unexposed surface of steel hollows with fire rated boards of specimen 'E'.

After the first 5 minutes of the test, the furnace pressure was maintained at 0 ± 2 Pa relative to atmosphere, at 1,000 mm from the notional floor level.

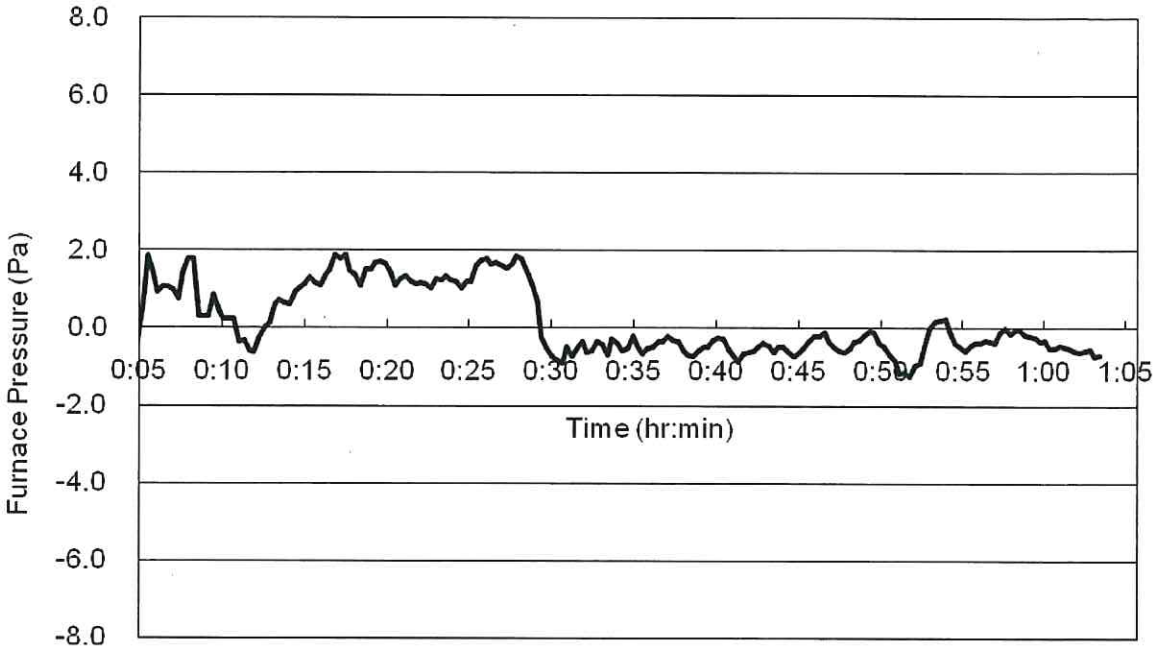


Figure 15 – Furnace pressure.

A radiometer placed at 3,000 mm away from the unexposed surface to measure the radiation of unexposed surface of the specimen.

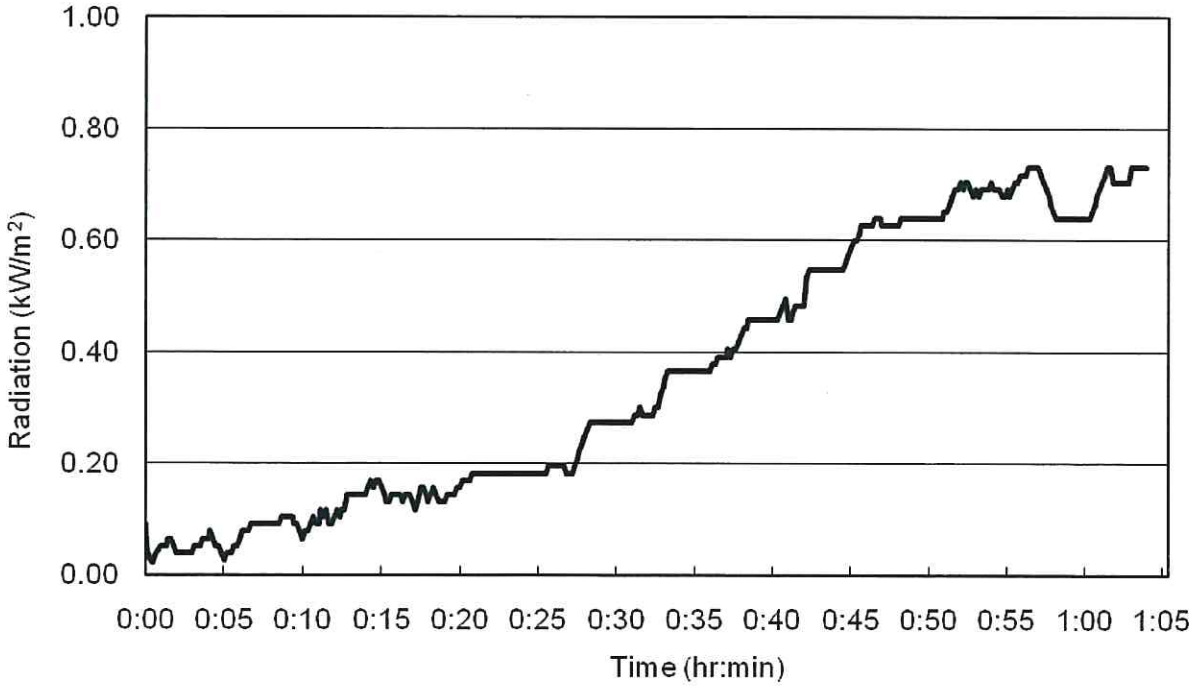


Figure 16 – Radiation.

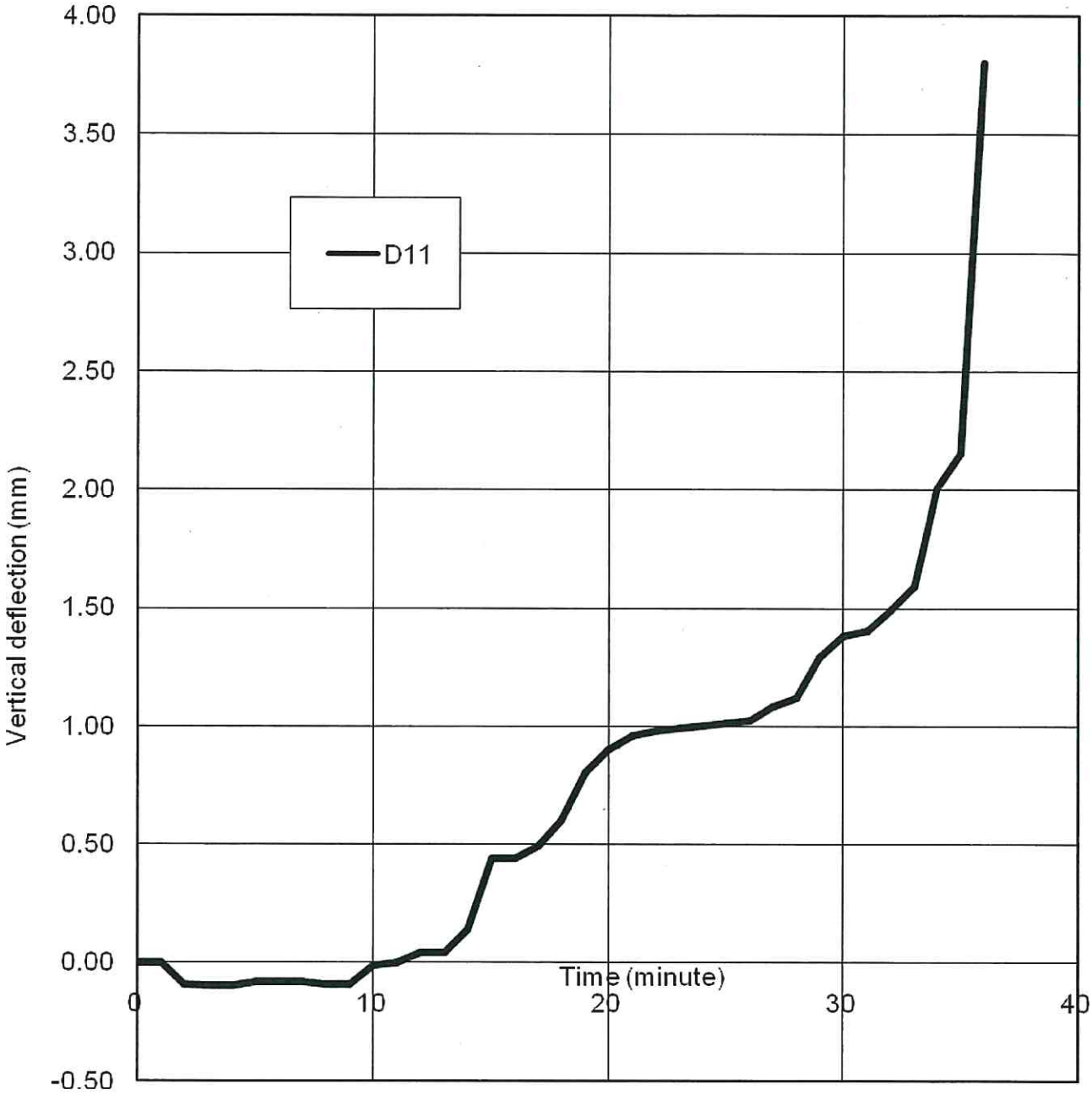


Figure 17 - Vertical deflection of specimen 'D'.

Notes: Negative vertical deflection indicates downward movement.

Positive vertical deflection indicates upward movement.

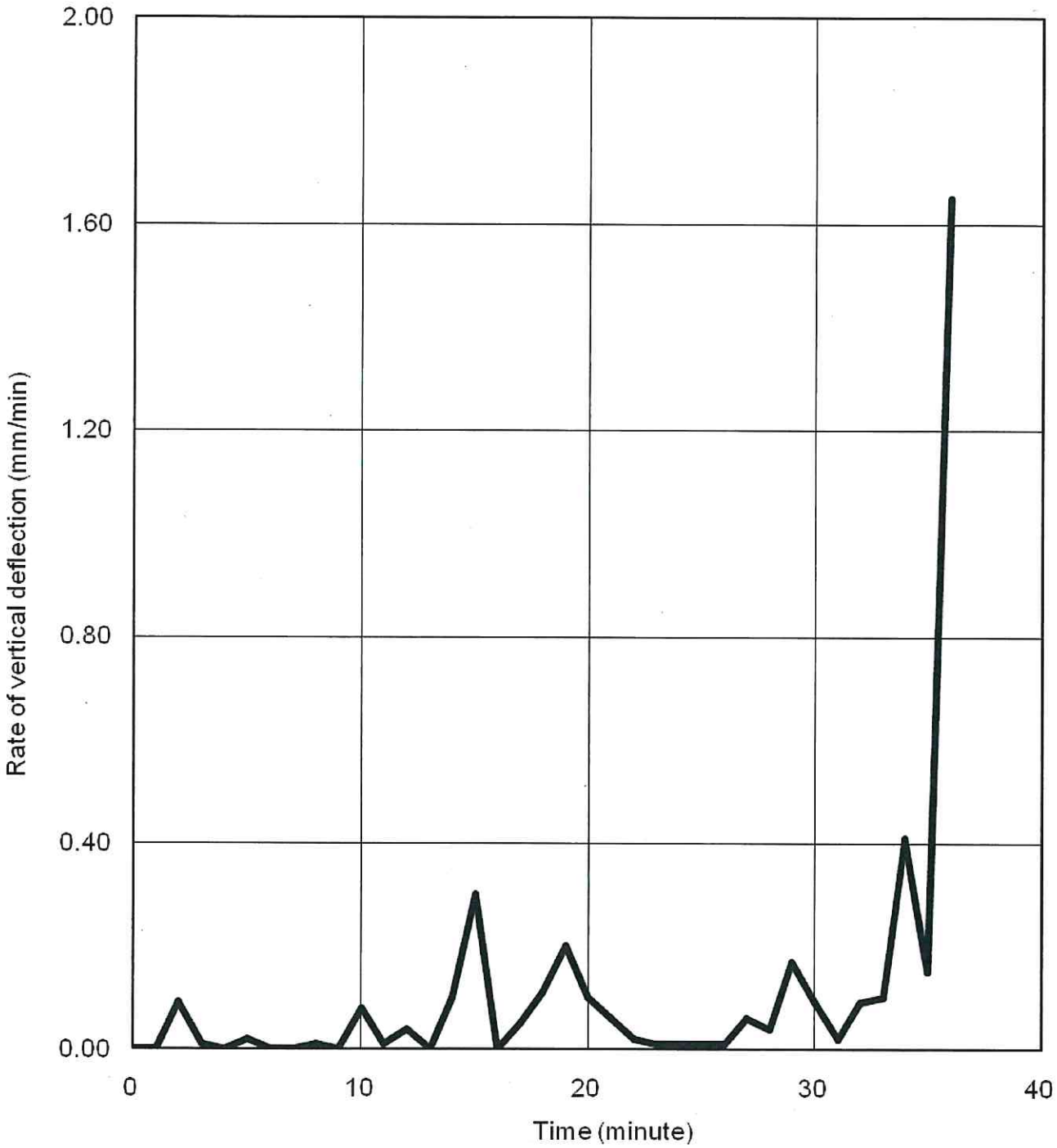


Figure 18 - Rate of vertical deflection of specimen 'D'.

APPENDIX B – OBSERVATION

Time (min.sec)	Exposed (E) or Unexposed (U)	Observation
00.00	-	Test started.
06.05	U	Smoke started releasing from specimen 'B'.
08.30	U	Smoke started releasing from specimen 'E'.
30.00	U	Specimens 'A', 'B' and 'C' satisfied integrity performance requirements. Specimen 'D' satisfied loadbearing capacity, integrity and insulation performance requirements. Specimen 'E' satisfied integrity and insulation performance requirements.
32.03	U	Cotton pad test was applied at centre portion of specimen 'D' and the test passed.
32.27	U	Cotton pad test was applied at top portion of specimen 'E' and the test passed.
36.29	U	The test load applied on specimen 'D' was released as requested by test sponsor. **Loadbearing capacity failure.**
48.50	U	Hilti CFS-HFF of specimen 'B' turned dark.
55.09	U	25 mm gap gauge was applied at the gap of steel hollows of specimen 'B', near Hilti CFS-HFF and did not pass through into the furnace.
58.08	U	Cotton pad test was applied at top portion of specimen 'E' and the test passed.
59.55	U	Specimens 'A' and 'D' were covered by ceramic fibre blanket as requested by test sponsor. **Integrity failure.**
60.00	U	Specimen 'B' satisfied integrity performance requirements. Specimen 'E' satisfied integrity and insulation performance requirements.
64.12	U	25 mm gap gauge was applied at the gap of steel hollows of specimen 'B', near Hilti CFS-HFF and passed through into the furnace (refer to location '1' in photo 5). **Integrity failure.**
64.43	-	Test was terminated as requested by the test sponsor.

APPENDIX C – DATA RECORDED DURING THE TEST

Table 1 – Lateral deflection (mm) of the specimens during the test, as viewed from the unexposed face.

Time (mins) / Location	0	15	30	45	60
D1	0	2	1	--	--
D2	0	2	1	--	--
D3	0	3	4	--	--
D4	0	2	3	--	--
D5	0	0	0	--	--
D6	0	-1	0	--	--
D7	0	6	6	--	--
D8	0	5	5	--	--
D9	0	3	3	4	5
D10	0	8	5	8	9

Positive deflection indicates movement towards the furnace (see also Figure 3 for the locations).

The maximum lateral deflection of specimen 'A' occurred at location D1 and D2 was 2 mm moving towards the furnace after a heating period of 15 minutes.

The maximum lateral deflection of specimen 'B' occurred at location D3 was 4 mm moving towards the furnace after a heating period of 30 minutes.

The maximum lateral deflection of specimen 'C' occurred at location D6 was 1 mm moving away from the furnace after a heating period of 15 minutes.

The maximum lateral deflection of specimen 'D' occurred at location D7 was 6 mm moving towards the furnace after a heating period of 15 minutes.

The maximum lateral deflection of specimen 'E' occurred at location D10 was 9 mm moving towards the furnace after a heating period of 60 minutes.

Table 2 – Time and related vertical deflection (mm) and rate of vertical deflection (mm/min) of specimen 'D' measured by transducer.

Time (minute)	D11	Rate of vertical deflection
0	0.0	--
5	-0.1	0.0
10	0.0	0.1
15	0.4	0.3
20	0.9	0.1
25	1.0	0.0
30	1.4	0.1
35	2.2	0.2
36	3.8	1.7

Notes: Location of transducer is shown in Figure 3.

The test load was released as requested by test sponsor after a heating period of 36 minutes.

Table 3 – Mean furnace temperature.

Time (minute)	BS 476: Part 20 Standard Temp. Curve (°C)	Actual Mean Furnace Temp. (°C)
0	20	40
5	588	484
10	681	714
15	739	742
20	784	785
25	816	812
30	842	843
35	864	865
40	886	885
45	903	892
50	918	903
55	933	930
60	946	949
64	956	963

Notes: Locations of furnace thermocouples are shown in Figure 1.

The test was terminated as requested by the test sponsor after a heating period of 64 minutes.

Table 4 – Time and related temperature rises measured by thermocouples S1 – S15.

Time (min)	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	4	4	4	4	5	4	4	4	5	5	4	4	4	5	6
10	12	13	14	18	20	14	13	15	23	19	11	9	9	19	24
15	35	39	42	55	64	44	44	50	76	57	30	28	25	61	72
20	65	72	73	107	127	87	92	96	150	117	60	57	53	128	138
25	105	119	119	177	217	154	170	172	247	213	96	91	81	226	225
30	157	177	178	267	313	238	259	277	332	329	149	148	132	327	306
35	214	241	239	365	398	355	387	412	413	422	201	208	184	412	376
40	275	312	296	447	471	421	434	462	477	488	249	260	225	475	438
45	345	386	352	504	517	463	466	499	506	526	296	308	266	502	486
50	386	420	385	524	538	494	486	520	525	553	337	353	300	521	515
55	405	438	406	541	548	527	508	540	538	573	364	381	333	535	534
60	422	441	426	563	567	580	537	558	554	585	378	400	351	550	549
64	447	453	456	579	598	611	575	573	573	604	389	426	366	563	571

Notes: Locations of thermocouples S1 – S15 are shown in Figure 2.

The test was terminated as requested by the test sponsor after a heating period of 64 minutes.

Table 5 – Time and related temperature rises measured by thermocouples S16 – S25.

Time (min)	S16	S17	S18	S19	S20	S21	S22	S23	S24	S25
0	0	0	0	0	0	0	0	0	0	0
5	3	3	3	3	3	3	3	4	3	3
10	4	4	5	4	4	4	4	4	4	3
15	7	8	9	6	6	5	5	6	5	5
20	18	20	26	12	11	10	10	11	9	9
25	43	45	53	21	19	18	18	19	16	16
30	54	60	65	29	27	30	26	28	24	23
35	48	54	56	37	34	47	39	43	31	31
40	46	50	51	45	42	66	61	60	40	42
45	48	49	50	53	49	73	69	72	49	52
50	53	51	52	59	56	76	74	76	57	58
55	62	56	57	63	60	77	76	78	61	62
60	68	60	62	67	64	77	76	78	65	65
64	70	63	64	69	66	75	75	77	68	68

Notes: Locations of thermocouples S16 – S25 are shown in Figure 2.

The test load was released as requested by test sponsor after a heating period of 36 minutes.

The test was terminated as requested by the test sponsor after a heating period of 64 minutes.

APPENDIX D – INFORMATION FROM TEST SPONSOR

(The information provided by test sponsor, which was not verified by RED or unless specified.)

Specimen 'A'

Item	Description	
1	**Steel Hollows**	
	Material	: Galvanized mild steel.
	Dimensions	: 150 mm wide by 150 mm deep by 6.3 mm thick.*
	Fixing method	: The steel hollows were welded to 10 mm thick mild steel plate and fixed with 4 nos. of M12 anchor bolts at both ends.#
2	**Rockwool**	
	Brand	: Rockwool.#
	Dimensions	: 67 mm wide (before compression) by 120 mm thick.*
	Density	: 160 kg/m^3.*
	Applied location	: Filled the gap between steel hollows as cavity barrier.#

*Notes: * Verified on site by RED.*

 # As shown on the test construction.

Appendix D – Information from Test Sponsor

(The information provided by test sponsor, which was not verified by RED or unless specified.)

Specimen 'B'

Item	Description	
1	**Steel Hollows**	
	Material	: Galvanized mild steel.
	Dimensions	: 150 mm wide by 150 mm deep by 6.3 mm thick.*
	Fixing method	: The steel hollows were welded to 10 mm thick mild steel plate and fixed with 4 nos. of M12 anchor bolts at both ends.#
2	**Hilti CFS-HFF**	
	Brand	: Hilti CFS-HFF.#
	Material	: Polyurethane foam.
	Dimensions	: 70 mm wide (before compression) by 130 mm thick.*
	Density	: 195 kg/m^3.
	Applied location	: Filled the gap between steel hollows as cavity barrier.#

*Notes: * Verified on site by RED.*

 # As shown on the test construction.

Appendix D – Information from Test Sponsor

(The information provided by test sponsor, which was not verified by RED or unless specified.)

Specimen 'C'

Item	Description	
1	**Steel Hollows**	
	Material	: Galvanized mild steel.
	Dimensions	: 150 mm wide by 150 mm deep by 6.3 mm thick.*
	Fixing method	: The steel hollows were welded to 10 mm thick mild steel plate and fixed with 4 nos. of M12 anchor bolts at both ends.#
2	**Rockwool**	
	Brand	: Rockwool.#
	Dimensions	: 67 mm wide (before compression) by 150 mm thick.*
	Density	: 160 kg/m^3.*
	Applied location	: Filled the gap between steel hollows as cavity barrier.#

*Notes: * Verified on site by RED.*

 # As shown on the test construction.

Appendix D – Information from Test Sponsor

(The information provided by test sponsor, which was not verified by RED or unless specified.)

Specimen 'D'

Item	Description	
1	**Steel Hollows**	
	Material	: Galvanized mild steel.
	Dimensions	: 150 mm wide by 150 mm deep by 6.3 mm thick.*
	Fixing method	: The steel hollows were welded to 10 mm thick mild steel plate and fixed with 4 nos. of M12 anchor bolts at both ends.#
	Insulation method	: The steel hollows were surrounded with a layer of 15 mm thick fire rated boards.#
2	**Rockwool**	
	Brand	: Rockwool.#
	Dimensions	: 59 mm wide (before compression) by 120 mm thick.*
	Density	: 160 kg/m^3.*
	Applied location	: Filled the gap between steel hollows as cavity barrier.#

*Notes: * Verified on site by RED.*

 # As shown on the test construction.

Appendix D – Information from Test Sponsor

(The information provided by test sponsor, which was not verified by RED or unless specified.)

Specimen 'E'

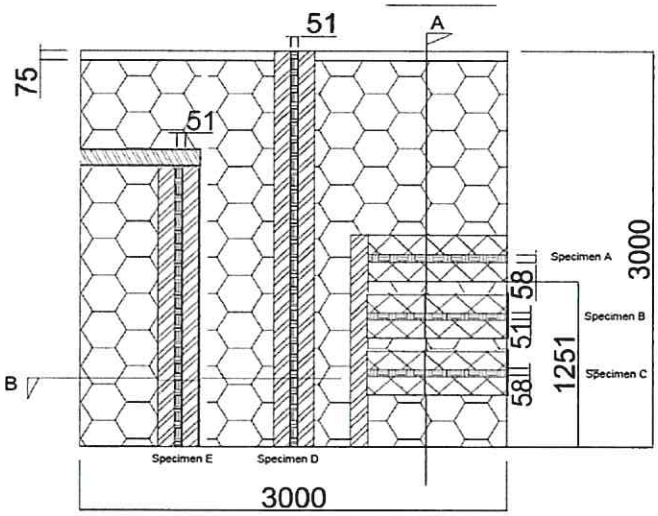
Item	Description	
1	**Steel Hollows**	
	Material	: Galvanized mild steel.
	Dimensions	: 150 mm wide by 150 mm deep by 6.3 mm thick.*
	Fixing method	: The steel hollows were welded to 10 mm thick mild steel plate and fixed with 4 nos. of M12 anchor bolts at both ends.#
	Insulation method	: The steel hollows were surrounded with a layer of 15 mm thick fire rated boards.#
2	**Hilti CFS-HFF**	
	Brand	: Hilti CFS-HFF.#
	Material	: Polyurethane foam.
	Dimensions	: 70 mm wide (before compression) by 130 mm thick.*
	Density	: 195 kg/m^3.
	Applied location	: Filled the gap between steel hollows as cavity barrier.#

*Notes: * Verified on site by RED.*

 # As shown on the test construction.

Drawings from Test Sponsor

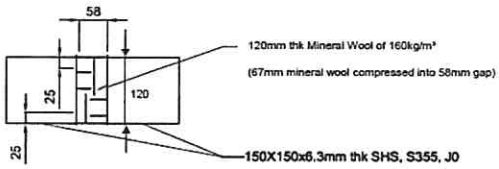
(The drawings provided by test sponsor, which were not verified by RED, except those specified and described in 'information from test sponsor'.)



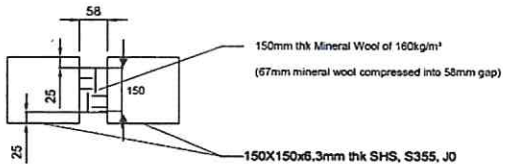
Legend

- 120x80x8mm thk RHS, S355, J0 with FRR board
- 150x150x6.3mm thk SHS, S355, J0
- Cavity Barrier
- FRR board

Elevation / 1

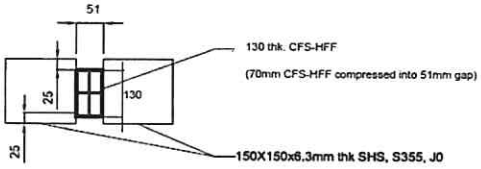


Specimen A



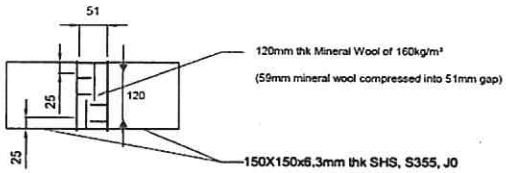
Specimen C

Section A_Specimen A &C / 2



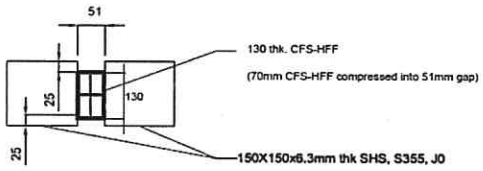
Specimen B

Section A_Specimen B / 3



Specimen D

Section B_Specimen D / 4



Specimen E

Section B_Specimen E / 5

- End of report -

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VOC EMISSION TEST REPORT
Indoor Air Comfort®

14 April 2018

1 Sample Information

Sample name	CFS-HFF
Batch no.	13748545
Production date	25/01/2018
Product type	Joint insulation
Sample reception	06/02/2018

2 Brief Evaluation of the Results

Regulation or protocol	Conclusion	Version of regulation or protocol
French VOC Regulation		Regulation of March and April 2011 (DEVL1101903D and DEVL1104875A)
French CMR components	Pass	Regulation of March and April 2011 (DEVL1101903D and DEVL1104875A)
AgBB/ABG	Pass	Anforderungen an bauliche Anlagen bezüglich des Gesundheitsschutzes (ABG), Entwurf 31.08.2017
Belgian Regulation	Pass	Royal decree of May 2015 (C-2014/24239)
Indoor Air Comfort®	Pass	Indoor Air Comfort 6.0 of February 2017
BREEAM International	Compliant	GN22 v2.3 (March 2018): BREEAM Recognised Schemes for VOC Emissions from Building Products

Full details based on the testing and direct comparison with limit values are available in the following pages

Rasmus Stengaard Christensen
Analytical Service Manager, MSc in Chemistry

Nanna Boholm
Chemist

Attn. : To whom it may concern

Date : 26 September 2023
Ref. : 079/FP/DY/23

Subject : Country of Origin- Hilti CFS-HFF Firestop Flute Filler

Dear Sir / Madam,

Enclosed please find the information of Hilti CFS-HFF Firestop Flute Filler

Brand Name : Hilti

Model Name : Hilti CFS-HFF Firestop Flute Filler

Manufacturer : Hilti Corporation

Address of Manufacturer : FL-9494, Principality of Liechtenstein.

Manufacturer Contact Person : Dennis Yeung

Supplier : Hilti (Hong Kong) Ltd

Address of Supplier : 701-704, 7/F, Tower A, Manulife Financial Centre,
223 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong

Supplier Contact Person : Dennis Yeung (+852 9723 4621)

Country of Origin : Germany

Should you have further questions, please do not hesitate to contact our Technical Representatives, Customer Service Hotline at 8228-8118, or email us at hksales@hilti.com.

Yours faithfully,

Dennis Yeung
Head of Product Leadership Strategy, F&P

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www.hilti.com.hk

8 May 2024
REF: 070/FP/DY/24

Attn: To whom it may concern

Subject: Item number change for Firestop flute filler CFS-HFF

We confirm there is only item number change from #2195448 to #2423387 for Hilti Firestop flute filler CFS-HFF.

There is no change in the naming, production plant, chemical composition and packaging which shall remain unchanged.

Should you have further questions, please do not hesitate to contact our Technical Representatives or Customer Service Hotline at 8228-8118.

Yours Faithfully,

Dennis Yeung
Head of Product Leadership Strategy, F&P

Hilti (Hong Kong) Ltd.
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Attn. : To whom it may concern

Date : 20 October 2023
Ref. : 168/FP/DY/23

Subject : Hilti CFS-HFF Firestop Flute Filler

Dear Sir / Madam,

Subject: Hilti CFS-HFF Firestop Flute Filler

- CFS-HFF Firestop Flute Filler is manufactured in Germany.
- The package of CFS-HFF Firestop Flute Filler can be completely recycled.
- There is no recycled content in CFS-HFF Firestop Flute Filler and it cannot be recycled
- CFS-HFF Firestop Flute Filler does not share any rapidly renewable materials

Should you have further questions, please do not hesitate to contact our Technical Representatives, Customer Service Hotline at 8228-8118, or email us at hksales@hilti.com.

Yours faithfully,

Dennis Yeung
Head of Product Leadership Strategy, F&P

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Attn. : To whom it may concern

Date : 20 October 2023
Ref. : 169/FP/DY/23

Subject : Hilti CFS-HFF Firestop Flute Filler

Dear Sir / Madam,

Subject: Hilti Firestop Products non-CFC and Ozone Confirmation

Referring to your enquiry about the captioned subject, please be advised that:

Hilti firestop products, CFS-HFF Firestop Flute Filler is free of CFC, HCFC nor other ozone depletion elements.

CFC, HCFC and ozone depletion elements were not used during the product process neither.

Should you have further questions, please do not hesitate to contact our Technical Representatives, Customer Service Hotline at 8228-8118, or email us at hksales@hilti.com.

Yours faithfully,

Dennis Yeung
Head of Product Leadership Strategy, F&P

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Hilti CFS-HFF Firestop Flute Filler Job Reference

Year	Project Name	Customer Name	Project type
2021	HKU, HIGH WEST - STUDENT HOSTEL	AGGRESSIVE CONSTRUCTION COMPANY	Residential
2022	JAT MIN CHUEN LOT 28, ELDERLY HOME	CHEVALIER (CONSTRUCTION) CO LTD	Health
2023	38 CHEUNG SHUN ST -TRANSITIONAL HOUSING	TECHOY CONSTRUCTION COMPANY	Residential