Hilti CFS-COS Firestop Composite Sheet

Submission Folder

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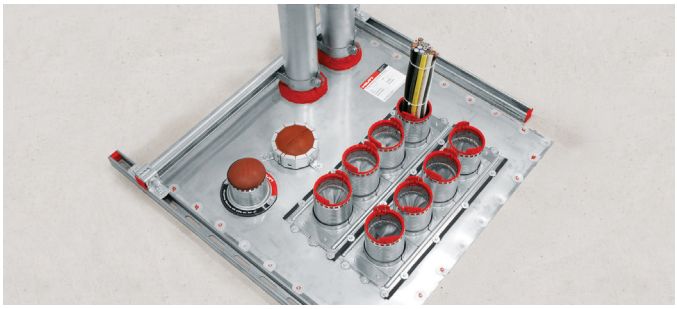
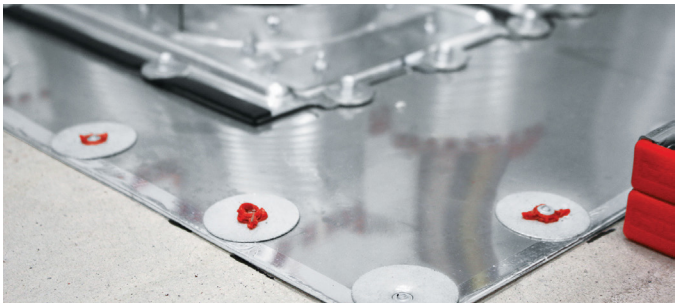
Firestop composite sheet CFS-COS





APPLICATIONS

- For use with large wall and floor fire-rated assemblies
- Compatible with Hilti Speed Sleeve and gangplate for floor gang applications
- Intumescent sheet with #304 stainless steel backing for firestopping large openings

ADVANTAGES

- For use with fire-rated assemblies (up to 4 hrs)
- Compatible with Hilti sleeve devices for easy cable management
- Can be fastened using Hilti screw anchor , GX or BX tools – to increase installation efficiency and productivity
- Multi-board systems allow very large openings
- Non-magnetic #304 stainless steel construction ensures good weatherability and no inductive loss in cables
- Fast installation system requires fewer anchors

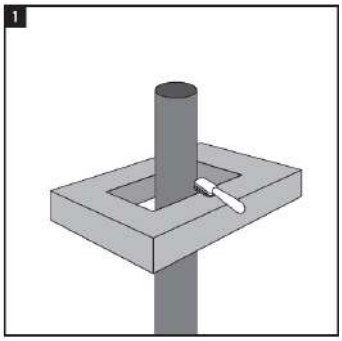
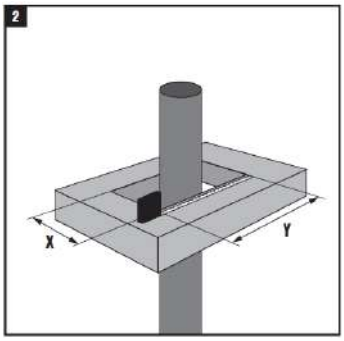
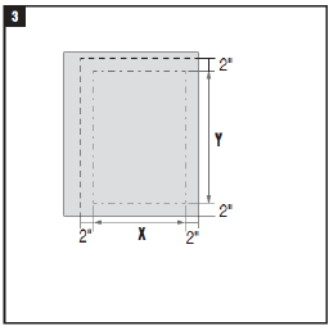
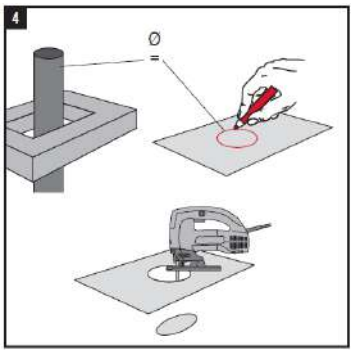
Technical data	
Application temperature range	-30 to 48°C
Temperature resistance range	-30 to 120°C
Expansion ratio (unrestricted, up to)	1:18
Storage and transportation temperature range	-30 to 48°C
Color	Silver
Dimensions (LxWxH)	910 x 910 x 3.8 mm
Intumescent	Yes

[1] at 77°F/25°C and 50% relative humidity; from date of manufacture

Ordering designation	Package contents	Sales pack quantity	Item number
Firestop Composite Sheet CFS-COS	1x CFS-COS Firestop Composite Sheet	4 pc	**2135884**

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

Subject: **Method Statement of CFS-COS**
Material: **CFS-COS Firestop composite sheet**

Setting Operation		
1	Clean the opening to be sealed free from dust or grease.	
2	Measure opening size.	
3	Mark required dimension on firestop composite sheet CFS-COS.	
4	Mark required dimension of penetrating item on firestop composite sheet CFS-COS if applicable.	

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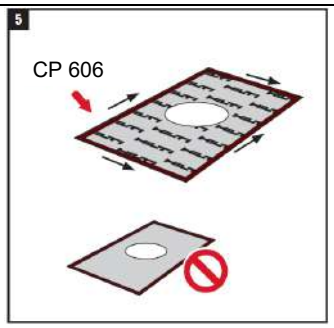
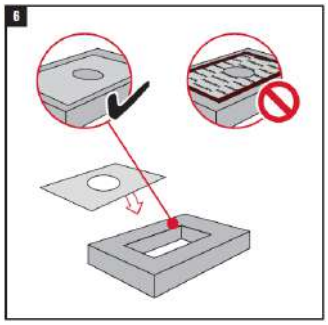
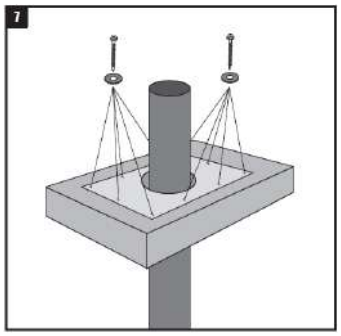
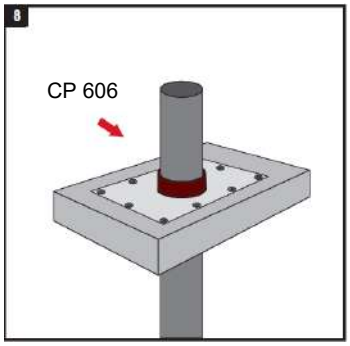
5	Apply CP 606 sealant at the edges of composite sheet only if water tightness is required.	
6	Place firestop composite sheet with logo side facing against wall/floor surface.	
7	Fix firestop composite sheet CFS-COS to wall/floor surface with screw anchor or direct fastening nail. If installation is to flush with wall/floor surface, an angle bracket can be added for fixing purpose.	
8	Apply CP 606 sealant to annular gap of penetrating item and opening of firestop composite sheet CFS-COS if applicable.	

ASSESSMENT REPORT

Fire Resistance Performance of
Lift Landing Doorset Related Linear Joint / Penetration Seal Systems

Report No.: R23D18-1A

Issue Date: 26 September, 2023

Date of Review: 25 September, 2026

Report Sponsor

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CONTENT

REVISION HISTORY

Issue date (DD/MM/YYYY)	Issue number	Remark
25/09/2023	0	Initial version

FIRE RESISTNACE PERFORMANCE OF LIFT LANDING DOORSET RELATED LINEAR JOINT/ PENTRATION SEALING SYSTEMS

1 INTRODUCTION

This assessment report presents an appraisal for the fire resistance performance of lift landing doorset related linear joint / penetration sealing system using the Hilti "CP 636" firestop mortar, "CP617" firestop putty pad and "CFS-COS" firestop composite sheet that was tested under the reference WARRES Nos. 62305/B, 167424, 167427, 167428 and 167429 issued by Warringtonfire and R16L28-1D and R18G14-2A issued by Research Engineering Development Façade Consultants Limited. It is prepared for Hilti (Hong Kong) Limited of 701-704 & 708B, Tower A, Manulife Finance Centre, 223 Wai Yip Street, Kwun Tong, Kowloon, HK.

The proposed sealing systems are required to provide a fire resistance performance of up to 120 minutes integrity performance (and insulation performance for switch box backing application) with respect to BS 476: Part 20: 1987.

2 ASSUMPTIONS

The proposed systems are assumed to be installed in a similar manner to that of the previously tested system by competent installers. It is assumed that the modified systems will be constructed in a similar manner from materials and components of the same manufacture and equivalent quality as tested with supporting test evidence or otherwise appraised by RED. Further assumptions related to the specific modifications will be stated in the report.

It is also assumed that the supporting structures to which the perimeter of the systems will be fixed are capable of supporting the proposed structure effectively.

Assuming that the issue of the original test report is valid, the current testing standard or testing experience has not been changed and the procedures adopted for the original report have been re-examined and reviewed that there have been no changes to the specification of the construction considered in the original report. If contradictory data or any related evidence becomes available to RED, the assessment will be unconditionally withdrawn and the sponsor will be notified. This report is based on the given information, in which is declared by report sponsor that no contradictory data has become available.

3 SUPPORTING DATA

3.1 Summary of Supporting Test Evidence

Report no.	Sections	Description
Primary Test Evidence		
WARRES No. 62305/B	4.1	Supporting test evidence for the use of the Hilti 'CP 636' fire prevention mortar for penetration sealing systems for fire resistance performance up to 240 minutes integrity and 86 minutes insulation.
RED test report no. R16L28-1D	4.1	Supporting test evidence for the use of Hilti "CP617" putty pad for sealing the electrical sockets
RED test report no. R18G14-1A	4.1	Supporting test evidence for the use of Hilti "CFS-COS" Composite sheet for slab aperture sealing.
RED test report no. R18G14-2A	4.1	Supporting test evidence for the use of Hilti "CFS-COS" Composite sheet for wall aperture sealing.
Secondary Test Evidence		
WF No. 164724	4.1	Supporting test evidence for the use of the Hilti "CP617" putty pad for the sealing of mortise electrical sockets within the drywall system.
WF No. 164727	4.1	Supporting test evidence for the use of the Hilti "CP617" putty pad for the sealing of mortise electrical sockets within the drywall system.
WF No. 164728	4.1	Supporting test evidence for the use of the Hilti "CP617" putty pad for the sealing of mortise electrical sockets within the drywall system.
WF No. 164729	4.1	Supporting test evidence for the use of the Hilti "CP617" putty pad for the sealing of mortise electrical sockets within the drywall system.

3.2 Primary Test Evidence

3.2.1 WARRES Test Report No. 62305/B*

A fire resistance test stated to be in accordance with BS 476: Part 20: 1987 and in conjunction with the EN 1366-3: 1993 of the Hilti "CP 636" fire prevention mortar^ of a 120 mm thick masonry wall at a position where it had been provided with a 600 mm square aperture to allow for its penetration by various electrical services was performed at the Warringtonfire Laboratory on 16th August, 1994. The test sponsor was Hilti AG, who had given permission to use this data.

In this test report, the section of wall contained a 600 mm square centre aperture which was penetrated by one 200 mm wide, one 300 mm wide and one 500 mm wide cable tray, each supporting various electrical cables. The aperture was sealed with a 100 mm thick layer of Hilti "CP 636" fire prevention mortar^. The penetrating services were coated within the thickness of the barrier with a 0.5 mm thickness of Hilti CP 611A mastic.

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

Integrity	**240** Minutes
Insulation	**86** Minutes

The test was discontinued after a heating period of 240 minutes (See WARRES no. 62305/B for details).

*Note: The test data is more than five years old; we have reviewed this data against the current test procedures as per BS 476: Part 20: 1987 and found it suitable for this assessment.

^Note: The Hilti "CP636" fire prevention mortar is renamed as Hilti "CP636" Firestop Mortar as declared in the report.

3.2.2 *RED Test Report No. R16L28-1D**

A fire resistance test in accordance with BS 476: Part 20: 1987 on two specimens of steel boxed protected by Hilti 'CP 617' firestop putty pad was performed at the RED Laboratory on 20th January, 2017. The test sponsor was Hilti (Hong Kong) Limited. As requested by the test sponsor, the specimens were mounted within concrete line specimen holder. The specimens referenced '4' and '5' were asymmetrical and the fire side of specimen was determined by the test sponsor.

Specimen '4' was comprised of a steel box with sizes of 1,050 mm wide by 300 mm high by 100 mm deep by nominal 1 mm thick protected by a layer of nominal 3 mm thick 'CP617' firestop patty pad at the exposed side.

Specimen '5' was comprised of a steel box with sizes of 200 mm wide by 800 mm high by 100 mm deep by nominal 1 mm thick protected by a layer of nominal 3 mm thick 'CP617' firestop patty pad at the exposed side.

The gaps between the concrete wall and specimen '4' were filled with mineral wool with density of 100kg/m³ and 'Hilti CP606' firestop sealant, while the gaps between the concrete wall and specimen '5' were filled with 'Hilti CP606' firestop sealant.

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

	Integrity	Insulation
Specimen '4'	**121** Minutes (No failure)	N/A
Specimen '5'	**121** Minutes (No failure)	**79** Minutes

The test was discontinued after a heating period of 121 minutes (See RED test report no. R16L28-1D for details).

*Note: The test data is more than five years old; we have reviewed this data against the current test procedures as per BS 476: Part 20: 1987 and found it suitable for this assessment.

3.2.3 *RED Test Report No. R18G14-1A**

A fire resistance test in accordance with BS 476: Part 20: 1987 on a total of four specimens of firestop composite sheets, namely specimens 'A', 'B', 'C' and 'D' was conducted at the Research Engineering Development Façade Consultants Limited (RED) Laboratory on 18 July 2018. The test sponsor was Hilti (Hong Kong) Limited.

As requested by the test sponsor, the specimens were mounted within concrete line specimen holder. The specimens were asymmetrical and only one side of specimens was tested, in which the fire side was determined by the test sponsor.

Specimen 'A' was comprised of Firestop Composite Sheets and Rockwool. The overall sizes of the Firestop Composite Sheets were 1,300 mm long by 1,100 mm wide by 3.8 mm thick. The Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Rockwool was installed at the bottom of Firestop Composite Sheets and had the thickness of 50 mm and density of 160 kg/m^3. The Rockwool was supported by C-channel with sizes of 50 mm wide by 125 mm high by 1 mm thick at one side and L-angles with sizes of 50 mm by 50 mm by 3 mm thick at three sides. Both the channel and L-angles were fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The separation distance between the Firestop Composite Sheets and Rockwool was 70 mm.

Specimen 'B' was comprised of 2 layers of Firestop Composite Sheets and Rockwool. The overall sizes of the first layer of Firestop Composite Sheets were 1,300 mm long by 1,100 mm wide by 3.8 mm thick. The first layer of Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Rockwool was installed at the bottom of first layer of Firestop Composite Sheets and had the thickness of 50 mm and density of 160 kg/m^3. The second layer of Firestop Composite Sheets with the same construction as the first layer was placed at the bottom of the Rockwool. The Rockwool and second layer of Firestop Composite Sheets were supported by C-channel with sizes of 50 mm wide by 125 mm high by 1 mm thick at one side and L-angles with sizes of 50 mm by 50 mm by 3 mm thick at three sides. Both the C-channel and L-angles were fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The separation distance between the first layer of Firestop Composite Sheets and Rockwool was 100 mm.

*Note: The test data is more than five years old; we have reviewed this data against the current test procedures as per BS 476: Part 20: 1987 and found it suitable for this assessment.

Specimen 'C' was comprised of Firestop Composite Sheets. The overall sizes of the Firestop Composite Sheets were 1,750 mm long by 1,100 mm wide by 3.8 mm thick. The Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Firestop Composite Sheets were supported by L-angle with sizes of 50 mm by 50 mm by 3 mm thick which was fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres at one side.

Specimen 'D' was comprised of Firestop Composite Sheets. The overall sizes of the Firestop Composite Sheets were 1,600 mm long by 1,100 mm wide by 3.8 mm thick. An opening with sizes of 300 mm diameter by 200 mm deep by 0.7 mm thick was created at the surface of Firestop Composite Sheets. The Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Firestop Composite Sheets were supported by L-angle with sizes of 50 mm by 50 mm by 3 mm thick which was fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres at one side. The Rockwool with thickness of 50 mm and density of 160 kg/m^3 was used to cover the opening.

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

	Integrity	Insulation
Specimen 'A'	**219** Minutes	**36** Minutes
Specimen 'B'	**288** Minutes (No failure)	**69** Minutes
Specimen 'C'	**199** Minutes	N/A
Specimen 'D'	**209** Minutes	N/A

The test was discontinued after a heating period of 288 minutes (See R18G14-1A for full details).

3.2.4 *RED Test Report No. R18G14-2A**

A fire resistance test in accordance with BS 476: Part 20: 1987 on nine specimens of penetration sealing systems was performed at the RED Laboratory on 28th September, 2018. The test sponsor was Hilti (Hong Kong) Limited. As requested by the test sponsor, the specimens were mounted within concrete line specimen holder. The specimens were asymmetrical and only one side of specimens was tested, in which the fire side was determined by the test sponsor. Only specimen nos.: "12" to"15" are considered in this report.

Specimen '12' was comprised of Firestop Composite Sheets. The overall and exposed sizes of the Firestop Composite Sheets were 910 mm wide by 910 mm high by 3.8 mm thick. The Firestop Composite Sheets were joined together with M5 by 25 mm long screws at 250 mm nominal centres and fixed to L-angles with sizes of 50 mm by 50 mm by 5 mm thick at four sides. The L-angles was fixed the concrete with M6 by 54 mm long anchor bolts at 250 mm nominal centres. Stainless steel facing was faced at exposed side.

Specimen '13' had overall dimensions 910 mm wide by 1,200 mm high by 3.8 mm thick with exposed area 810 mm wide by 1,100 mm high. It was comprised of Firestop Composite Sheets and a G.I. squared pipe. The G.I. squared pipe with sizes of 250 mm wide by 250 mm high by 1 mm thick was penetrated in the centre of specimen. The Firestop Composite Sheets were joined together with M5 by 25 mm long screws at 250 mm nominal centres and fixed to the concrete with M6 by 54 mm long anchor bolts at 250 mm nominal centres. Stainless steel facing was faced at unexposed side.

Specimen '14' had overall dimensions of 1,010 mm wide by 910 mm high by 3.8 mm thick with clear opening area 900 mm wide by 810 mm high. It was comprised of two layers of Firestop Composite Sheets and a G.I. pipe. The G.I. pipe with sizes of 500 mm wide by 200 mm high by 1 mm thick was penetrated in the centre of specimen. The Firestop Composite Sheets were joined together with M5 by 25 mm long screws at 250 mm nominal centres and fixed to the concrete with M6 by 54 mm long anchor bolts at 250 mm nominal centres. Stainless steel facing was faced at both.

Specimen '15' had overall dimensions of 600 mm wide by 300 mm high by 81 mm thick. It was comprised of two nos. of socket boxes with 'Hilti CP617' firestop putty pad incorporated with 75 mm thick 'Ytong' lightweight block wall with nominal 3 mm thick plaster on both sides. Each socket box with cover with sizes of 70 mm by 70 mm by 50 mm deep by 3.5 mm thick was incorporated in each side of block wall. 'Hilti CP617' firestop putty pad was placed inside the socket boxes.

*Note: The test data is more than five years old; we have reviewed this data against the current test procedures as per BS 476: Part 20: 1987 and found it suitable for this assessment.

All penetrated pipes were supported by fixed to 40 mm by 20 mm by 3 mm thick steel L-angles, located at 100 mm from the concrete wall on both sides. The steel angles were supported by 2 nos. of M10 steel rods to the concrete lining. The opening was covered by nominal 40 mm thick rockwool with density 160 kg/m^3.

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

	Integrity	Insulation
Specimen '12'	**242** Minutes (No failure)	**8** Minutes
Specimen '13'	**242** Minutes (No failure)	**6** Minutes
Specimen '14'	**242** Minutes (No failure)	**27** Minutes
Specimen '15'	**242** Minutes (No failure)	**242** Minutes

The test was discontinued after a heating period of 242 minutes (See Report R18G14-2A for full details).

3.3 Secondary Test Evidence

3.3.1 WF Test Report No. 167424^

An indicative fire resistance test stated to be utilizing the general heating condition and principle of BS EN 1363-1: 1999 on the electrical socket protected by the use of the Hilti "CP 617" putty pad incorporated within the drywall partition was performed at the Warringtonfire Laboratory on 24th September, 2007. The test sponsor was Hilti (Great Britain) Ltd., who had given permission to use this data. As stated in the report, the test was not conducted under the requirements of UKAS accreditation. However, the report is still accepted to be used as the secondary test evidence for the application of the Hilti CP617 putty pad.

In this test report, two apertures were cut through each face of a drywall assembly composed of plasterboards. The electrical sockets were position back to back with each other. An electrical socket complete with its rear plastic box and a connected 3-core electrical wire tail was installed into each aperture. The overall size of the back boxes were fixed to the plasterboards with two steel screws.

Specimen 'A' incorporated the self-adhesive putty pad moulded over the face of each back box within the drywall cavity and onto the adjacent plasterboard over a distance of approximately 15 mm.

Specimen 'B' incorporated the self-adhesive putty pad moulded internally within each back box.

Thermocouples attached to and around the sockets recorded a maximum temperature rise of 109 °C after 120 minutes.

The test was discontinued after a heating period of 184 minutes (See WF report no. 167424 for full details).

3.3.2 WF Test Report No. 167427^

An indicative fire resistance test stated to be utilizing the general heating condition and principle of BS EN 1363-1: 1999 on the electrical socket protected by the use of the Hilti "CP 617" putty pad incorporated within the drywall partition was performed at the Warringtonfire Laboratory on 24th September, 2007. The test sponsor was Hilti (Great Britain) Ltd., who had given permission to use this data. As stated in the report, the test was not conducted under the requirements of UKAS accreditation. However, the report is still accepted to be used as the secondary test evidence for the application of the Hilti CP617 putty pad.

In this test report, two apertures were cut through each face of a drywall assembly composed of plasterboards. The electrical sockets were position back to back with each other. An electrical socket complete with its rear plastic box and a connected 3-core electrical wire tail was installed into each aperture. The overall size of the back box was 132 mm x 73 mm x 36 mm deep with a cover plate size of 145 mm x 85 mm. The back boxes were fixed to the plasterboards with two steel screws.

Specimen 'A' incorporated the self-adhesive putty pad moulded over the face of each back box within the drywall cavity and onto the adjacent plasterboard over a distance of approximately 15 mm.

Specimen 'B' incorporated the self-adhesive putty pad moulded internally within each back box.

^Note: The test data is more than five years old; we have reviewed this data against the current test procedures as per BS EN 1363-1 and found it suitable for this assessment.

Thermocouples attached to and around the sockets recorded a maximum temperature rise of 111 °C after 120 minutes.

The test was discontinued after a heating period of 164 minutes (See WF report no. 167427 for full details).

*3.3.3 WF Test Report No. 167428^*

An indicative fire resistance test stated to be utilizing the general heating condition and principle of BS EN 1363-1: 1999 on the electrical socket protected by the use of the Hilti "CP 617" putty pad incorporated within the drywall partition was performed at the Warringtonfire Laboratory on 24th September, 2007. The test sponsor was Hilti (Great Britain) Ltd., who had given permission to use this data. As stated in the report, the test was not conducted under the requirements of UKAS accreditation. However, the report is still accepted to be used as the secondary test evidence for the application of the Hilti CP617 putty pad.

In this test report, two apertures were cut through each face of a drywall assembly composed of plasterboards. The electrical sockets were position back to back with each other. An electrical socket complete with its rear plastic box and a connected 3-core electrical wire tail was installed into each aperture. The overall size of the back box was 132 mm x 73 mm x 36 mm deep with a cover plate size of 145 mm x 85 mm. The back boxes were fixed to the plasterboards with two steel screws.

Specimen 'A' incorporated a self-adhesive putty pad moulded over the face of the back box within the drywall cavity and onto the adjacent plasterboard over a distance of approximately 15 mm to the socket on 'exposed' face. In addition Specimen 'A' incorporated a self-adhesive putty pad moulded internally within the back box on the 'unexposed' face of the drywall.

Specimen 'B' incorporated a self-adhesive putty pad moulded over the face of the back box within the drywall cavity and onto the adjacent plasterboard over a distance of approximately 15 mm to the socket on 'unexposed' face. In addition Specimen 'B' incorporated a self-adhesive putty pad moulded internally within the back box on the 'exposed' face of the drywall.

Thermocouples attached to and around the sockets recorded a maximum temperature rise of 92 °C after 120 minutes.

The test was discontinued after a heating period of 149 minutes (See WF report no. 167428 for full details).

^Note: The test data is more than five years old; we have reviewed this data against the current test procedures as per BS EN 1363-1 and found it suitable for this assessment.

3.3.4 *WF Test Report No. 167429^*

An indicative fire resistance test stated to be utilizing the general heating condition and principle of BS EN 1363-1: 1999 on the electrical socket protected by the use of the Hilti "CP 617" putty pad incorporated within the drywall partition was performed at the Warringtonfire Laboratory on 24th September, 2007. The test sponsor was Hilti (Great Britain) Ltd., who had given permission to use this data. As stated in the report, the test was not conducted under the requirements of UKAS accreditation. However, the report is still accepted to be used as the secondary test evidence for the application of the Hilti CP617 putty pad.

In this test report, two apertures were cut through each face of a drywall assembly composed of plasterboards. The electrical sockets were position back to back with each other. An electrical socket complete with its rear plastic box and a connected 3-core electrical wire tail was installed into each aperture. The overall size of the back box was 132 mm x 73 mm x 36 mm deep with a cover plate size of 145 mm x 85 mm. The back boxes were fixed to the plasterboards with two steel screws.

Specimen 'A' incorporated a self-adhesive putty pad moulded over the face of the back box within the drywall cavity and onto the adjacent plasterboard over a distance of approximately 15 mm to the socket on 'exposed' face. In addition, Specimen 'A' incorporated a self-adhesive putty pad moulded internally within the back box on the 'unexposed' face of the drywall.

Specimen 'B' incorporated a self-adhesive putty pad moulded over the face of the back box within the drywall cavity and onto the adjacent plasterboard over a distance of approximately 15 mm to the socket on 'unexposed' face. In addition, Specimen 'B' incorporated a self-adhesive putty pad moulded internally within the back box on the 'exposed' face of the drywall.

Thermocouples attached to and around the sockets recorded a maximum temperature rise of 99 °C after 120 minutes.

The test was discontinued after a heating period of 149 minutes (See WF report no. 167429 for full details).

^Note: The test data is more than five years old; we have reviewed this data against the current test procedures as per BS EN 1363-1 and found it suitable for this assessment.

4 PROPOSAL & DISCUSSION

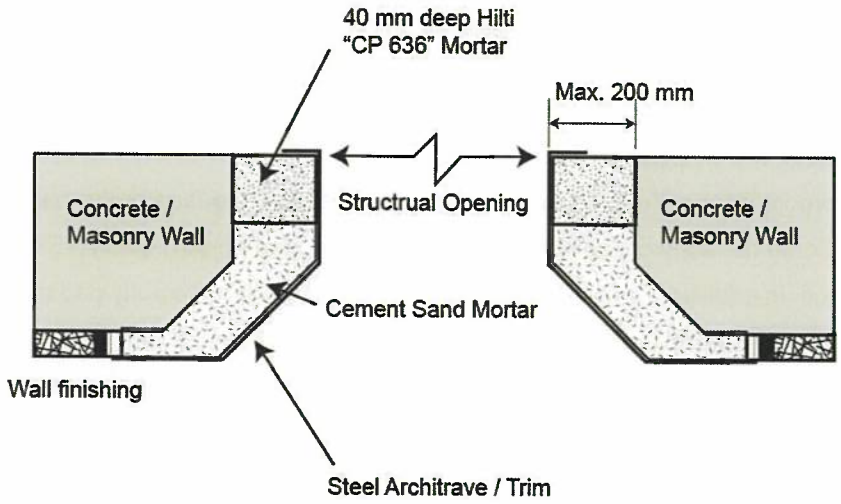
4.1 Fire Resistance Performance of Hilti CP 636 Firestop Mortar for 120 Minutes Integrity Only in Accordance with BS 476: Part 20/22: 1987

Proposal

It is proposed that previously fire tested lift landing doorsets with appropriate fire test evidence may be installed within a masonry/concrete construction with the use of Hilti "CP636" firestop mortar to adjust the structural opening sizes. The lift landing doorsets will be fixed to the supporting construction via the door trim/architrave in a similar means to that originally tested. The maximum allowable distance from the supporting construction to the door steel architrave/trim of 200 mm.

The illustration below indicates the proposed installation details of the Hilti CP 636:

Figure 1: Illustration of the installation details of Hilti "CP636" firestop mortar for lift-landing door opening



The Hilti "CP636" firestop mortar for use of lift-landing opening shall be capable to maintain the integrity performance for up to 120 minutes integrity performance when subjected to a test in accordance with BS 476: Part 20/22: 1987.

Discussion

The test evidence WARRES no. 62305/B described the test of the use of Hilti CP636 for the sealing of the aperture within the concrete wall that allows the penetration of various electrical service items. The specimen was a 600 mm by 600 mm aperture with the present of three cable trays. The Hilti "CP 636" firestop mortar was used to seal up the void in between the cable trays within the aperture. The thickness of the mortar was 100 mm thick. The system had achieved the fire resistance performance of 240 minutes integrity and 86 minutes insulation.

Actually, for the proposed design, the Hilti "CP 636" firestop mortar is used to filing the void in between the lift landing doorset architrave / trim while maintaining the fire resistance performance of the extension

from the wall. The tested specimen in WARRES 62305/B included a layer of 100 mm thick Hilti "CP636" firestop mortar which was directly exposed to fire.

In the proposal, the minimum 40 mm thick Hilti "CP 636" firestop mortar and backed with the sand/cement mortar to the full depth of the architrave/trim. Since both the Hilti "CP636" and the send/cement mortar infill are both non-combustible in nature, coupled with the retention afforded via the steel architrave/trim that ensure the mortar remain intact in position, this gives confidence in the ability for the proposed details to provide the fire resistance performance of 120 minutes integrity.

The maximum unsupported area of the seal in the test was approximately 250-300 mm high by 600 mm wide. This demonstrated the ability and resistance to collapse of the seal without support for the 240 minute test duration. Therefore, the proposal of the width up to 200 mm wide is considered as reasonable with the support of the available test evidence.

The tested seal had achieved the fire resistance performance of 240 minutes integrity which was equivalent to 100% performance overrun compared to the required fire resistance performance of 120 minutes integrity performance as proposed. This provides confidence buffer for the proposal as well.

4.2 *Fire Resistance Performance of Hilti CP 636 Firestop Mortar for 120 Minutes Integrity and Insulation in Accordance with BS 476: Part 20/22: 1987*

Proposal

It is proposed that the Hilti 'CP 636' firestop mortar and the 'CP 617' firestop putty pad for the switch control box may be used to seal up the switch control penetration for lift land doorset under the following conditions:

(a) For swich control box with maximum dimensions of up to 150 mm wide by 250 mm high by 150 mm deep incorporated within a minimum 250 mm thick concrete supporting construction, the back of the switch box fully filled with minimum 100 mm thick Hilti 'CP636' firestop mortar. The sealing provision shall be capable to maintain 120 minutes integrity and insulation performance with respect to BS 476: Part 20/22: 1987;

(b) For switch control box with maximum dimensions up to 300 mm wide by 600 mm high by 150 mm deep incorporated within a minimum 250 mm thick concrete supporting construction, one layer of 3 mm thick Hilti 'CP 617' fire stop putty pad shall be fitted either inside or outside of switch box and the back of the switch box may be fully filled with minimum 100 mm thick Hilti 'CP 636' firestop mortar. This sealing provision shall be capable to maintain 120 minutes integrity and insulation performance with respect to BS 476-20/22: 1987;

(c) For switch control box with the height exceeds the case in (a) and up to 1,050 mm high, the same requirement of the Hilti 'CP 617' and 'CP 636' shall be applied, but this sealing provision only capable to maintain 120 minutes integrity and 60 minutes insulation performance with respect to BS 476-20/22: 1987; or

(d) For switch control box maximum dimensions up to 200 mm wide by 1,050 mm high by 150 mm deep and make up 1 mm thick steel sheet, one layer of 3 mm thick Hilti 'CP 617' putty pad shall be applied on the heat exposure side. This sealing provision shall be capable to maintain 120 minutes integrity and 60 minutes insulation performance with respect to BS 476-20/22: 1987.

Table 4.2.1: The application of the firestop sealant

Switch control box sizes	Min. wall thickness	FS System	FRR
150 mm (w) x 250 mm (h) x 150 mm (d)	250 mm	100 mm CP 636	--/120/120
300 mm (w) x 600 mm (h) x 150 mm (d)	250 mm	100 mm CP636 + 3 mm CP617 putty pad	--/120/120
300 mm (w) x 1,050 mm (h) x 150 mm (d)	250 mm	100 mm CP636 + 3 mm CP617 putty pad	--/120/60
200 mm (w) x 1,050 mm (h) x 150 mm (d)	250 mm	3 mm thick CP 617 putty pad on the socket box at the heat exposure side	--/120/60

The illustration below indicates the proposed installation details for the switch box.

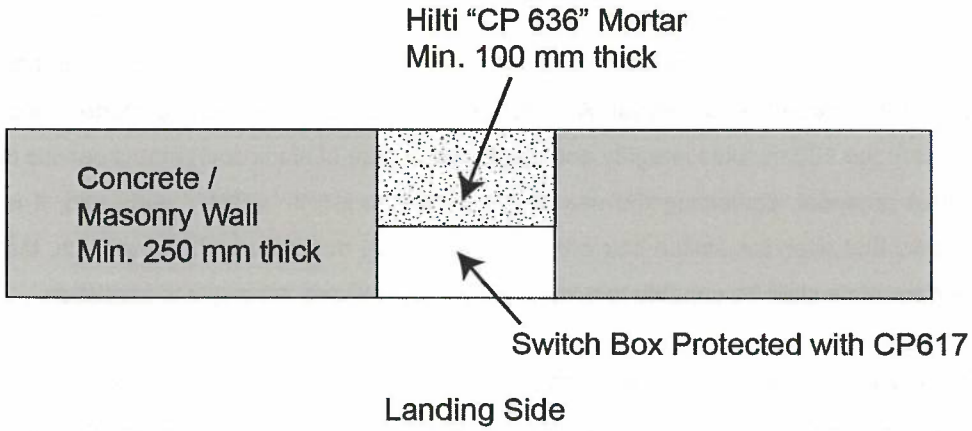


Figure 2: Illustration of the installation details of Hilti "CP636" firestop mortar for installation of switch box

Discussion

The test evidence WARRES no. 62305/B was used to support the usage of the Hilti "CP636" Firestop mortar for the usage of switch box backing. In the test evidence WARRES no. 62305/B, the tested system was the use of the Hilti 'CP636' firestop mortar to seal up a 600 mm x 600 mm concrete wall aperture with the service penetration through. The system had achieved the fire resistance performance of 240 minutes integrity and 86 minutes insulation. From the test observation and the recorded temperature, the failure in insulation is due to the maximum temperature rise measured on the penetration device exceed 180 °C. While for the rest of the area within this aperture that sealed up by the Hilti 'CP636' firestop mortar only, the achieved insulation performance was significantly in excess of the required 120 minutes.

(a) For the proposal applies to the switch box with maximum sizes of 150 mm wide by 250 mm high by 150 mm deep within a minimum 250 mm thick concrete / masonry wall adjacent to the lift landing doorset. The minimum 100 mm thick Hilti "CP 636" with the area of 150 mm by 250 mm is smaller than the maximum unsupported area in the test as stated above. Therefore, this proposal is considered as supported by the available test evidence with reasonable modification.

(b) While for the proposal that applied to larger switch box sizes up to 300 mm wide by 600 mm high by 150 mm deep within the same supporting construction, the supporting test evidence R16L28-1D is considered as the another supporting evidence for this proposed scope of application. In the test evidence R16L28-1D described the test of two specimens which were the 200 mm deep concrete aperture filled with steel box backed with one layer of 3 mm thick putty pad on the exposed side. Specimen 4 was a steel box with sizes of 1,050 mm wide x 300 mm high x 100 mm deep x 1 mm thick and specimen 5 was a steel box with sizes of 200 mm wide x 800 mm high x 100 mm deep x 1 mm thick. In specimen 4, the clearance gap between the steel box and the concrete wall was filled

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with 50 mm deep mineral wool and 10 mm deep CP 606 firestop sealant. In specimen 5, the clearance gap between the steel box and the concrete wall was sealed up with 10 mm deep CP606 firestop sealant. In this proposal, the switch box within the aperture is backed with additional 100 mm thick Hilti CP636 firestop mortar. As discussed in (a), the CP636 firestop mortar have the potential to provide the 120 minutes integrity and insulation in case of blank seal without service penetration, and it this proposal, combining the use of the 3 mm thick Hilti "CP617" putty pad, it is reasonable to expect that even the switch box with sizes up to 300 mm wide by 600 mm high, the fire resistance performance shall be capable to provide up to 120 minutes integrity and insulation.

(c) For the switch box sizes exceed 600 mm high, up to 1,050 mm high and with the steel box backed with 3 mm thick Hilti 'CP617', the system to provide 120 minutes integrity and 60 minutes insulation is considered as basically direct applied the result as referenced from R16L28-1D.

(d) For the switch box sizes with sizes of 200 mm wide x 1,050 mm high and 150 mm deep and the swich box shall be composed of minimum 1 mm thick steel sheet. The switch box may be fitted with a layer of 3 mm thick Hilti 'CP617' putty pad on either side of the switch box, provided that the putty pad is apply to the heat exposure side. This proposed scope is again considered as directly adopted the tested system as described in R16L28-1D.

4.3 Fire Resistance Performance of Hilti CFS-COS Composite Sheet for 180 or 240 Minutes Integrity in Accordance with BS 476: Part 20/22: 1987

Proposal

It is proposed that the Hilti "CFS-COS" composite sheet which was tested in R18G14-1A, R18G14-2A and appraised in R18M03-1A may be used to seal up the aperture fitted with lift control cabinet:

(a) Maximum aperture sizes up to 2,630 mm high by 1,770 mm wide fitted with one (1) layer of Hilti CFS-COS composite sheet at the back of the control cabinet to satisfy 180 minutes integrity performance; or
(b) Maximum aperture sizes up to 1,200 mm high by 910 mm wide fitted with one (1) layer of Hilti CFS-COS composite sheet at the back of the control cabinet to satisfy 240 minutes integrity performance.

Discussion

The test evidence R18G14-1A and R18G14-2A described the tests of the Hilti CFS-COS composite sheet that used to seal up the apertures that formed within concrete wall and slab construction to satisfy the fire resistance performance of up to 180 minutes or 240 minutes fire resistance performance with respect to BS 476: Part 20/22: 1987.

(a) The proposal to use the Hilti "CFS-COS" composite sheet to seal up the aperture within the concrete wall is considered directly supported by the test results of specimens '12' and '13' as tested in R18G14-2A. From the test, both cases had demonstrated the "CFS-COS" composite sheet with joints that had up to three panel jointed together, although some panels are not in their full sizes. And as similar case has been tested in R18G14-1A for horizontal configuration with up to six panels joined together. Based on this, it is reasonable to believe that the tested jointing method with the "CFS-COS" overlapping each other by 50 mm and screw fixed with M5 screws at maximum 300 mm c/c can provide the adequate engagement between. Provided 6 panels are in their full sizes, the maximum opening sizes that can be protected would be 2,630 mm high by 1,770 mm wide achieve the fire resistance performance of at least 180 minutes integrity. The fixing of the composite sheet shall be via 25 mm by 25 mm by 3 mm thick steel angle fixed to the supporting construction by M6 anchor bolts at 250 mm c/c.
(b) For the system requires to provide the fire resistance performance of 240 minutes integrity performance, the maximum sizes of 910 mm wide by 1,200 mm high which is the sizes of one "CFS-COS" composite sheet, and it is as tested in R18G14-2A that the system had achieved the 240 minutes integrity. The proposal is therefore directly supported by the test evidence.

5 CONCLUSION

The proposed use of Hilti "CP 636" firestop mortar, "CP617" putty pad, and "CFS-COS" composite sheet for the purpose of sealing up the lift-landing doorset related penetration seal as discussed in Section 4 of this report, is capable to maintain the fire resistance performance of up to 120 minutes, 180 minutes or 240 minutes integrity performance (and insulation performance for the usage of swich box backing) with respect to BS 476: Part 20/22: 1987.

6 DECLARATION BY APPLICANT

We, Hilti (Hong Kong) Limited, confirm that the material, component or element of structure, which is the subject of the test report being reviewed, has not to our knowledge been subjected to another test to the standard against which the assessment is being made.

We agree to withdraw this assessment from circulation should the component or element of structure be the subject of another test to the standard against which the assessment is being made.

We are not aware of any information that could affect the conclusions of this assessment.

If we subsequently become aware of any such information we agree to ask the assessing authority to withdraw the assessment.

7 VALIDITY

This assessment is based on test data, experience and the information supplied. The assessment will be invalidated if the assessed construction is subsequently tested since actual test data is deemed to take precedence over an expressed opinion. Any changes in the specification of product will invalidate this assessment. This assessment relates only to the specimen assessed and does not by itself infer that the product is approved under any other endorsements, approval or certification scheme. Since the appraisal method is under development, the laboratory reserved the right to supersede this assessment in case the appraisal method had been changed.

This report only relates to the specimen(s) tested and may only be reproduced by the sponsor in full, without comment, abridgement and modifications.

8 SIGNATORIES

Assessment by:

Dr. SZE Lip-kit
Test Consultant
Research Engineering Development
Façade Consultants Limited

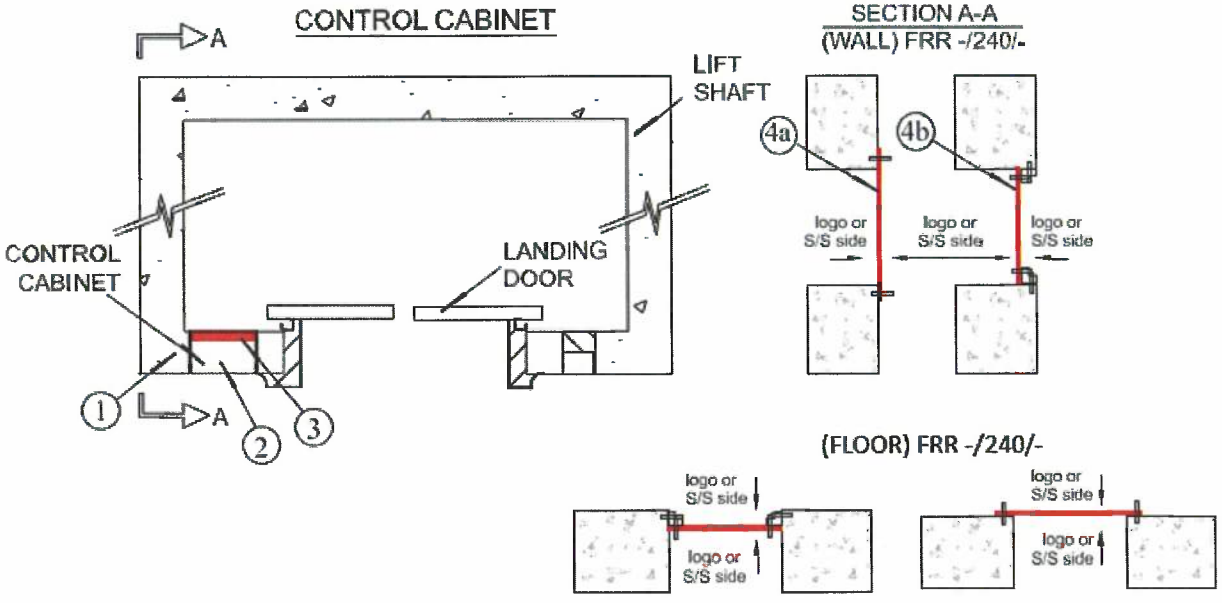
Reviewed by:

Ir Dr. YUEN Sai-wing, MHKIE (Fire)
Authorized Signature
Research Engineering Development
Façade Consultants Limited

APPENDIX – DRAWINGS PROVIDED BY THE CLIENT

Drawing refers to Section 4.3 on lift landing doorsets application by using CFS-COS

FIRE RESISTANCE RATING: UP TO -/240/-



1. CONCRETE WALL ASSEMBLY (120/120/120 F.R.R)
   - CONCRETE WALL OR FIRE-RATED BLOCKWALL
2. LIFT CONTROL CABINET
3. **CFS-COS FIRESTOP COMPOSITE SHEET** WITH EITHER LOGO OR S/S SIDE FACING THE FIRE SIDE, TO BE INSTALLED AT THE BACK OF CONTROL (SEE APPLICATION DETAILS)
4. CABINET WITH EITHER INSTALLATION METHOD AS INDICATED IN 4a AND 4b

Application Details:

	Layer(s) of CFS-COS	FRR
Wall / Floor Case (2630 mm Height x 1770 mm Width)	1	Up to -/180/-
Wall / Floor Case (910 mm Height x 1200 mm Width)	1	Up to -/240/-

- End of Report -

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

On 4 nos. of Firestop Composite Sheets

Test Report No.: R18G14-1A
Identification No.: Q18A11-1

Issue Date: 9th October 2018

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)

Hong Kong Accreditation Service (HKAS) has accredited this laboratory (HOKLAS 091- TEST) under Hong Kong Laboratory Accreditation Scheme (HOKLAS) for specific laboratory activities as listed in the HOKLAS directory of accreditation laboratories. The results shown in this test report were determined by this laboratory in accordance with its terms of accreditation. This report may not be reproduced except in full.

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CONTENT

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1 SUMMARY

Fire resistance test conducted in accordance with BS 476: Part 20: 1987 on 4 nos. of Firestop Composite Sheets.

Four specimens of Firestop Composite Sheets, namely specimens 'A', 'B', 'C' and 'D' (refer to photo 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 specimen holder as shown in the test sponsor's drawings (see the appendix). The specimens were asymmetrical and only one side of specimens was tested, in which the fire side was determined by the test sponsor.

Specimen 'A' was comprised of Firestop Composite Sheets and Rockwool. The overall sizes of the Firestop Composite Sheets were 1,300 mm long by 1,100 mm wide by 3.8 mm thick. The Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Rockwool was installed at the bottom of Firestop Composite Sheets and had the thickness of 50 mm and density of 160 kg/m^3. The Rockwool was supported by C-channel with sizes of 50 mm wide by 125 mm high by 1 mm thick at one side and L-angles with sizes of 50 mm by 50 mm by 3 mm thick at three sides. Both the C-channel and L-angles were fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The separation distance between the Firestop Composite Sheets and Rockwool was 70 mm (refer to test sponsor's drawings).

Specimen 'B' was comprised of 2 layers of Firestop Composite Sheets and Rockwool. The overall sizes of the first layer of Firestop Composite Sheets were 1,300 mm long by 1,100 mm wide by 3.8 mm thick. The first layer of Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Rockwool was installed at the bottom of first layer of Firestop Composite Sheets and had the thickness of 50 mm and density of 160 kg/m^3. The second layer of Firestop Composite Sheets with the same construction as the first layer was placed at the bottom of the Rockwool. The Rockwool and second layer of Firestop Composite Sheets were supported by C-channel with sizes of 50 mm wide by 125 mm high by 1 mm thick at one side and L-angles with sizes of 50 mm by 50 mm by 3 mm thick at three sides. Both the C-channel and L-angles were fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The separation distance between the first layer of Firestop Composite Sheets and Rockwool was 100 mm (refer to test sponsor's drawings).

Specimen 'C' was comprised of Firestop Composite Sheets. The overall sizes of the Firestop Composite Sheets were 1,750 mm long by 1,100 mm wide by 3.8 mm thick. The Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Firestop Composite Sheets were supported by L-angle with sizes of 50 mm by 50 mm by 3 mm thick which was fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres at one side (refer to test sponsor's drawings).

Specimen 'D' was comprised of Firestop Composite Sheets. The overall sizes of the Firestop Composite Sheets were 1,600 mm long by 1,100 mm wide by 3.8 mm thick. An opening with sizes of 300 mm diameter by 200 mm deep by 0.7 mm thick was created at the surface of Firestop Composite Sheets. The Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Firestop Composite Sheets were supported by L-angle with sizes of 50 mm by 50 mm by 3 mm thick which was fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres at one side. The Rockwool with thickness of 50 mm and density of 160 kg/m^3 was used to cover the opening (refer to test sponsor's drawings).

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

	Integrity	Insulation
Specimen 'A'	219 Minutes	36 Minutes
Specimen 'B'	288 Minutes (No failure)	69 Minutes
Specimen 'C'	199 Minutes	N/A
Specimen 'D'	209 Minutes	N/A

The test was discontinued after a heating period of 288 minutes.

2 INTRODUCTION

The objective of the test is to determine the fire resistance performance of 4 nos. of Firestop Composite Sheets 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

18th July 2018

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 Selina Lin and Mr. Dennis Yeung, 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 specimen (see Figure 1).

Twenty-two (22) '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.

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 7 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 27 °C to 37 °C and 50 % to 87 % respectively.

6 TEST SPECIMEN CONSTRUCTION

The specimens were installed into a concrete specimen 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 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 specimen.

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-two (22) thermocouples fixed to the unexposed surface (see Figure 2 for the locations and reference numbers of the thermocouples). Thermocouples S1 – S5 were fixed on specimen 'A' for mean and maximum temperatures of the unexposed surface of specimen 'A'. Thermocouples S6 – S10 were fixed on specimen 'B' for mean and maximum temperatures of the unexposed surface of specimen 'B'. Thermocouples S11 – S15 were fixed on specimen 'C' for mean and maximum temperatures of the unexposed surface of specimen 'C'.

Thermocouples S16 – S19 & S21 were fixed on specimen 'D' for mean and maximum temperatures of the unexposed surface of specimen 'D'. Thermocouples S22 – S23 were fixed on specimen 'D' for maximum temperatures of the unexposed surface of specimen 'D' only. 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 radiation of specimens was measured and recorded.

8 TEST DATA AND INFORMATION

The ambient temperature of the test area during the test was 31 °C.

The furnace was controlled so that the mean furnace temperature complied with the requirements of BS 476: Part 20: 1987. The temperature record was shown graphically in Figure 3.

The mean and maximum temperatures of the unexposed surface of specimen 'A' were shown graphically in Figure 4.

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

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

The mean and maximum temperatures of the unexposed surface of specimen 'D' were shown graphically in Figure 7.

The furnace pressure obtained was shown graphically in Figure 8.

The radiation obtained was shown graphically in Figure 9.

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

The mean furnace temperature obtained was summarized in Table 1.

The temperature rises of specimen obtained were summarized in Table 2 and 3.

The test was discontinued after a heating period of 288 minutes.

9 RESULTS

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

	Integrity	Insulation
Specimen 'A'	219 Minutes	36 Minutes
Specimen 'B'	288 Minutes (No failure)	69 Minutes
Specimen 'C'	199 Minutes	N/A
Specimen 'D'	209 Minutes	N/A

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'

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 36 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 46 minutes. The maximum temperature rise was 613 °C measured by thermocouple S3 after a heating period of 231 minutes.

Specimen 'B'

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 69 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 70 minutes. The maximum temperature rise was 296 °C measured by thermocouple S6 after a heating period of 288 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 did not meet the integrity requirements after a heating period of 219 minutes.

Specimen 'B'

The specimen met the integrity requirements after a heating period of 288 minutes.

Specimen 'C'

The specimen did not meet the integrity requirements after a heating period of 199 minutes.

Specimen 'D'

The specimen did not meet the integrity requirements after a heating period of 209 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.

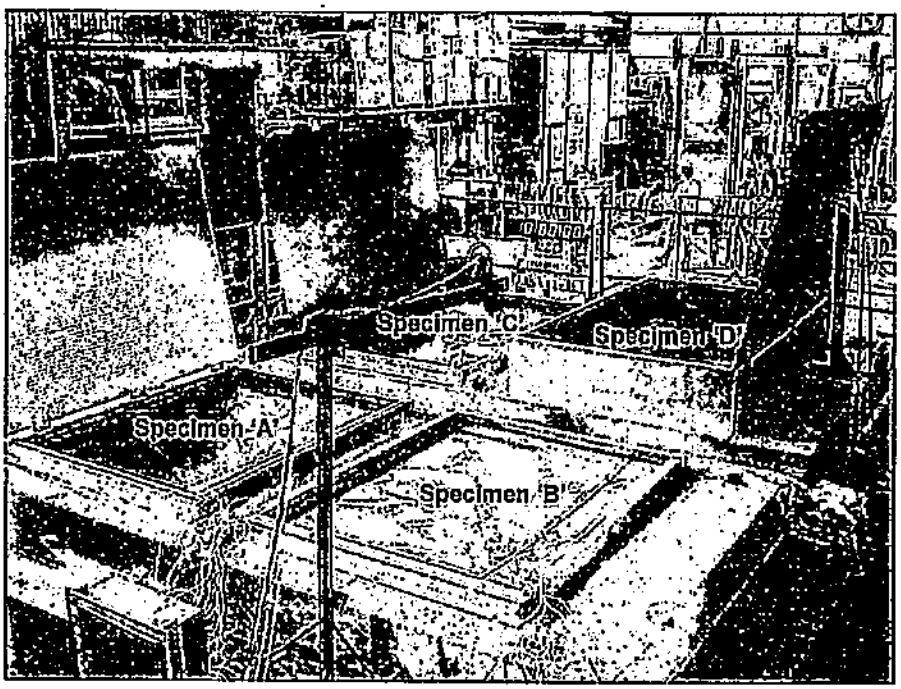

Photo 2: The unexposed face of the specimens before the test.

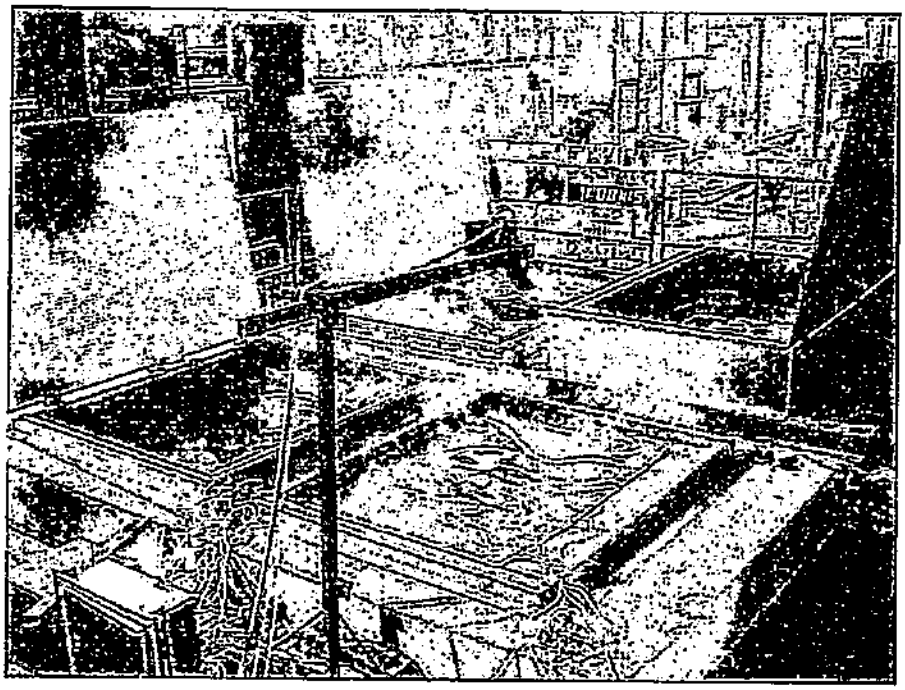

Photo 3: The unexposed face of the specimens after a heating period of 60 minutes.

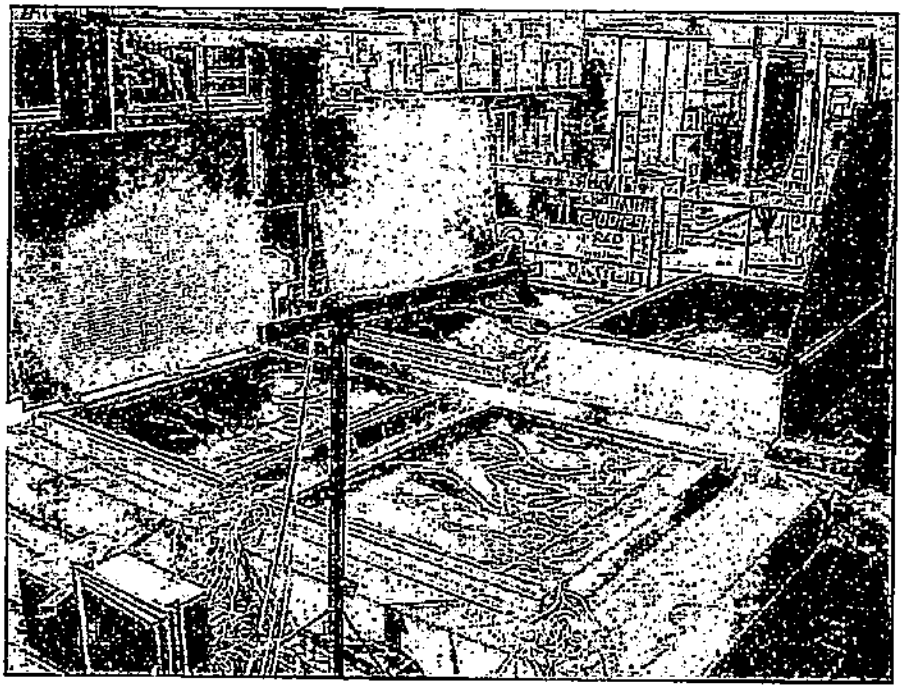

Photo 4: The unexposed face of the specimens after a heating period of 120 minutes.

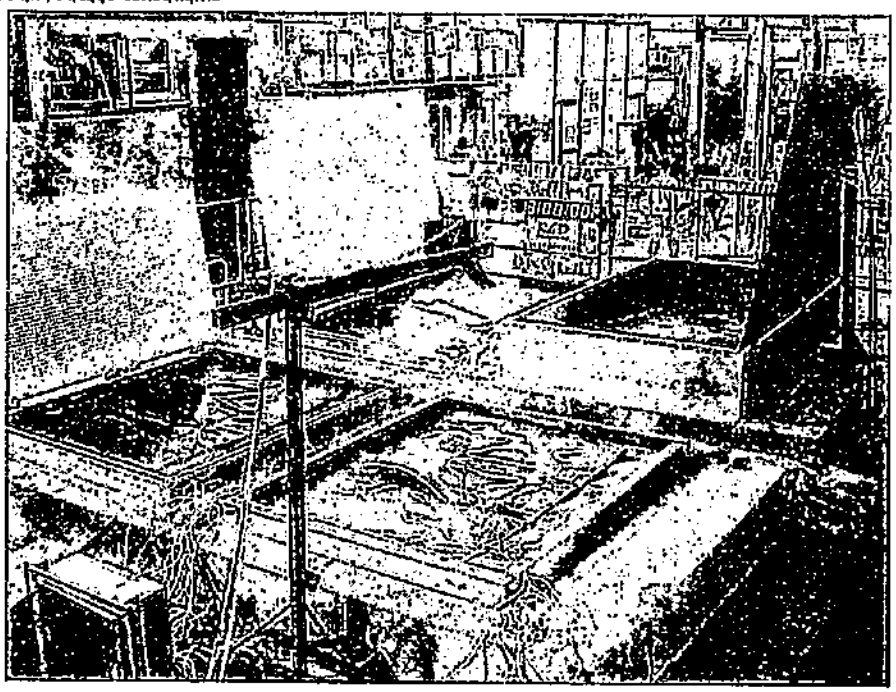

Photo 5: The unexposed face of the specimens after a heating period of 180 minutes.

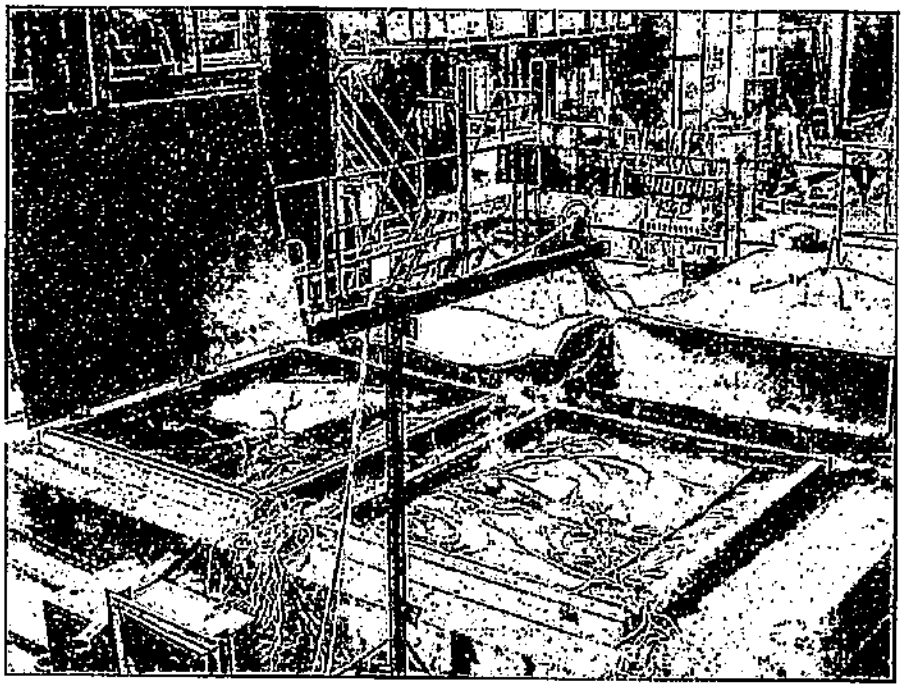

Photo 6: The unexposed face of the specimens after a heating period of 240 minutes.

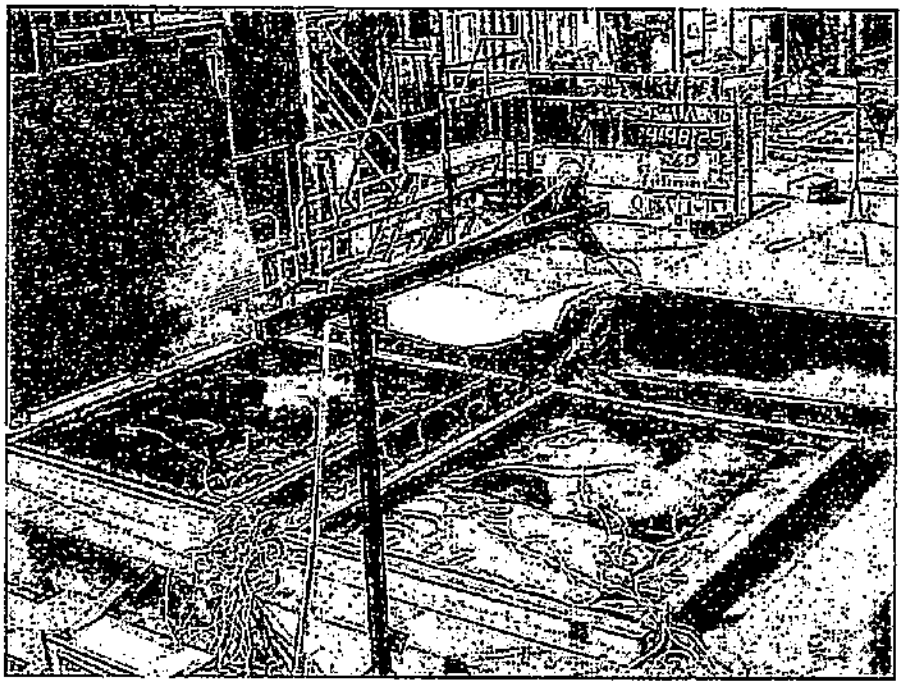

Photo 7: The unexposed face of the specimens after the test.

Photo 8: The exposed face of the specimens after the test.

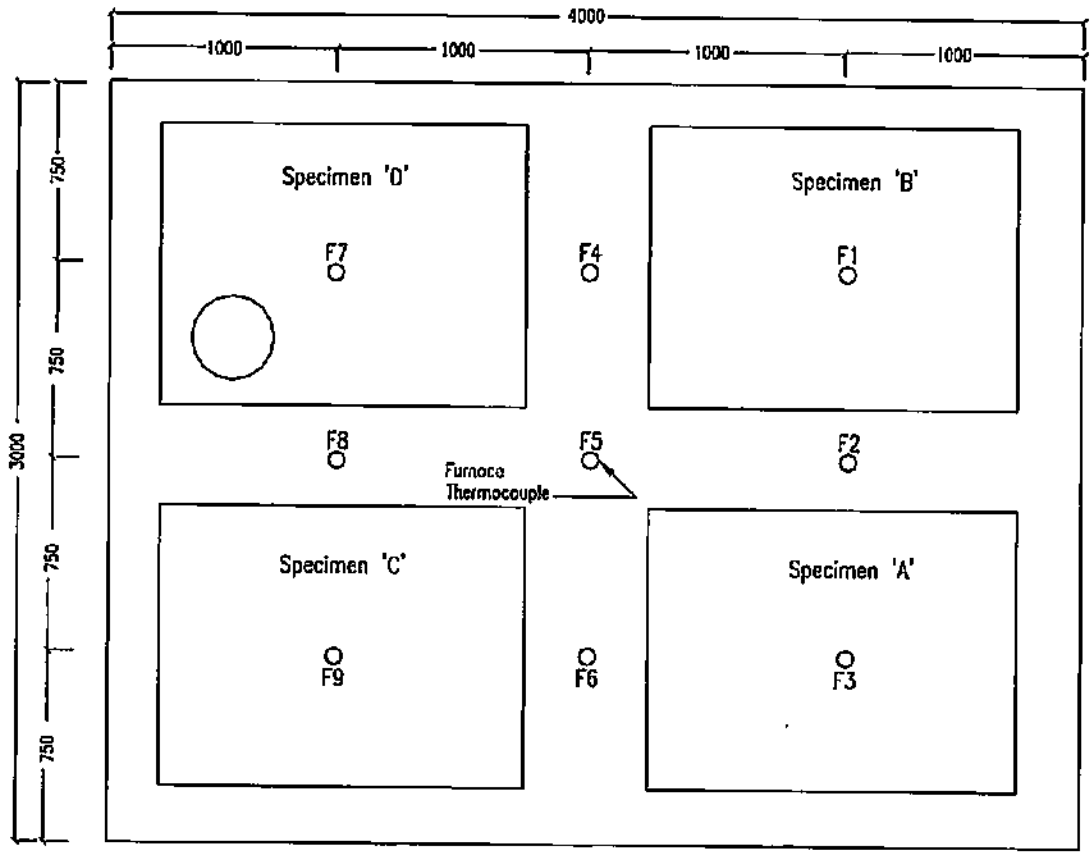

Figure 1 – Locations and reference numbers of furnace thermocouples.
(This figure is not to scale and all dimensions are in millimetres.)

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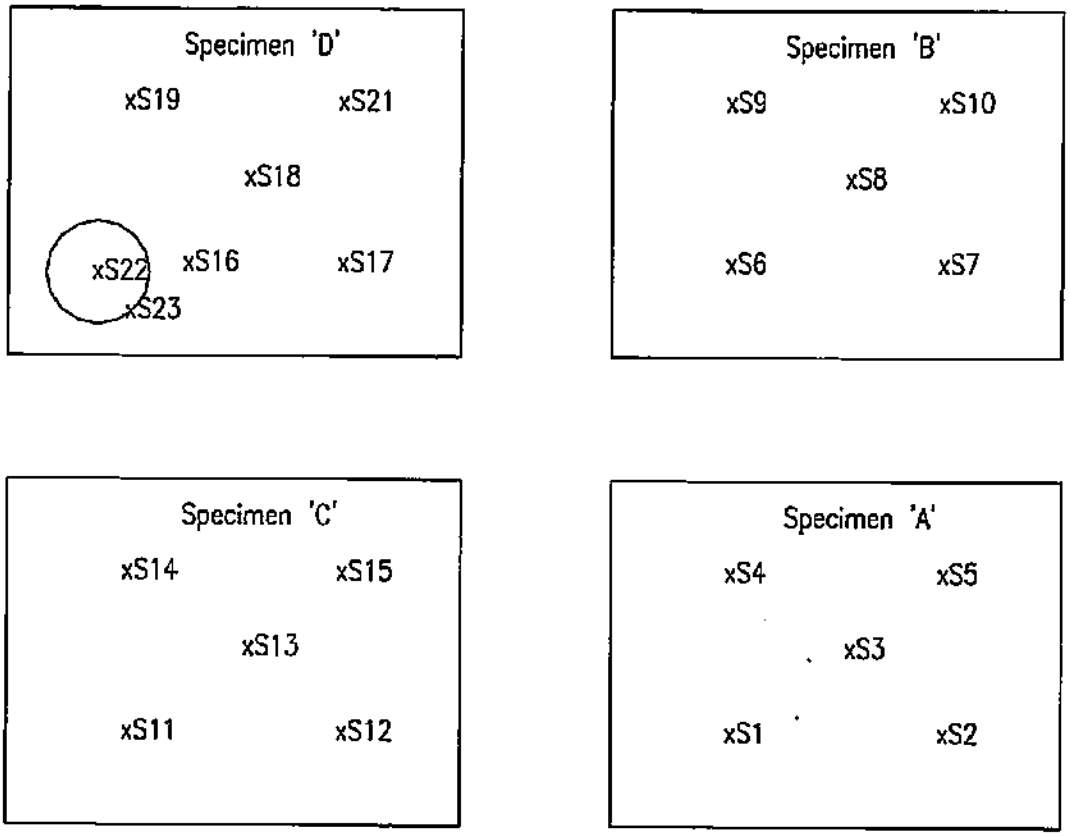

Figure 2 – Locations and reference number of thermocouples to monitor the temperature of unexposed surface of the specimens.
(This figure is not to scale.)

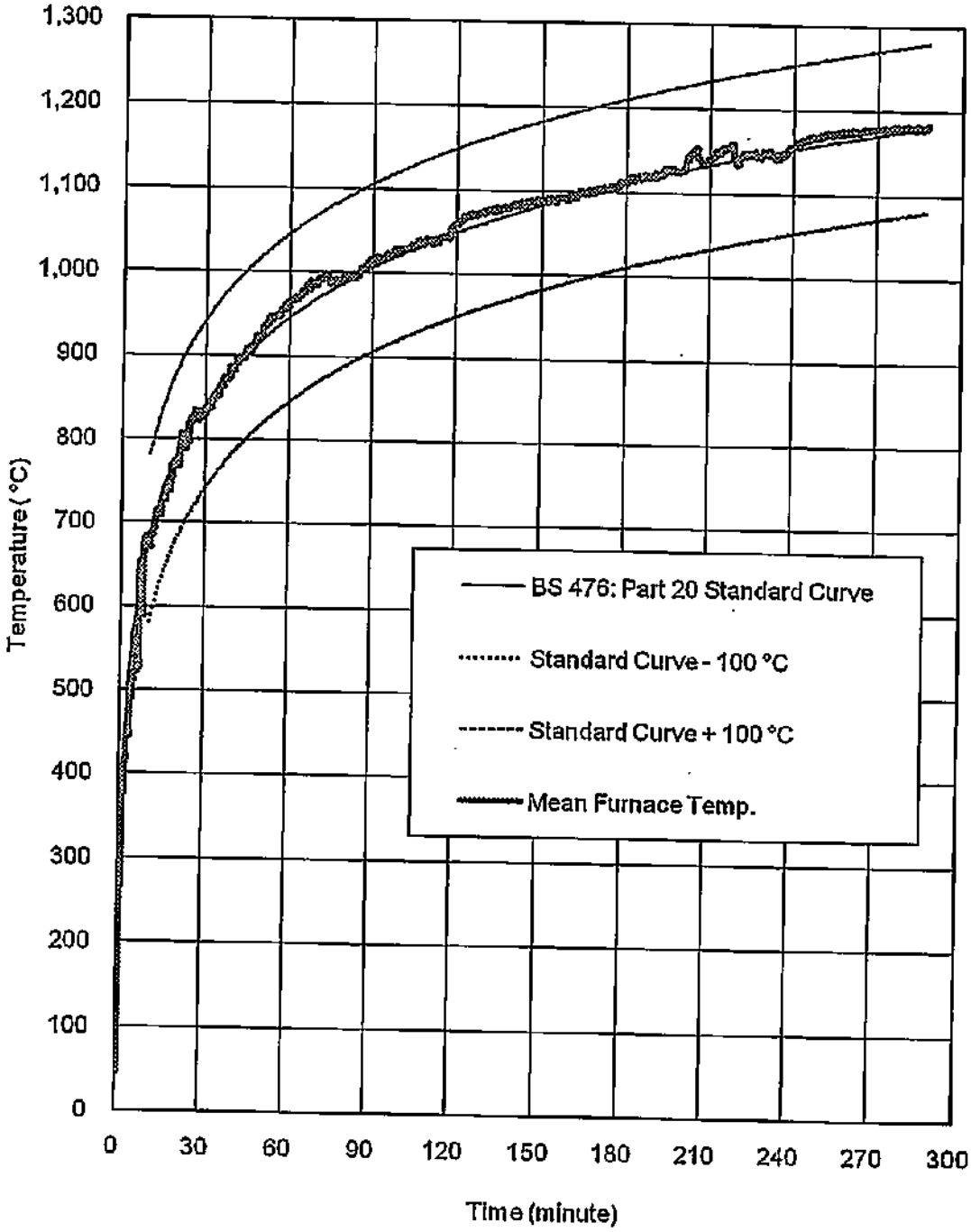

Figure 3 – Mean furnace temperature.

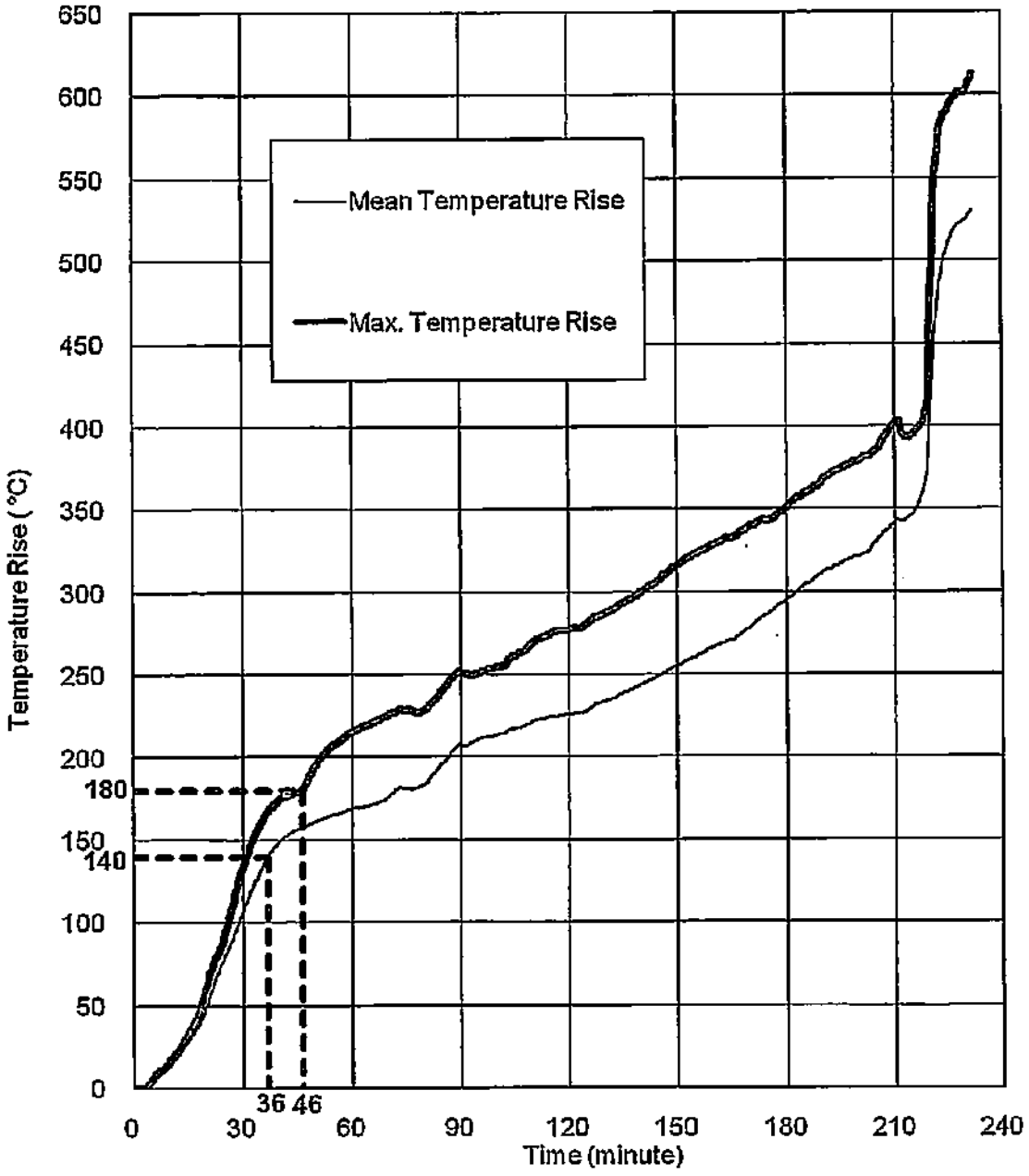

Figure 4 – Temperature rises of unexposed surface of specimen 'A'.

Note: Thermocouples S1 – S5 malfunctioned after a heating period of 232 minutes.

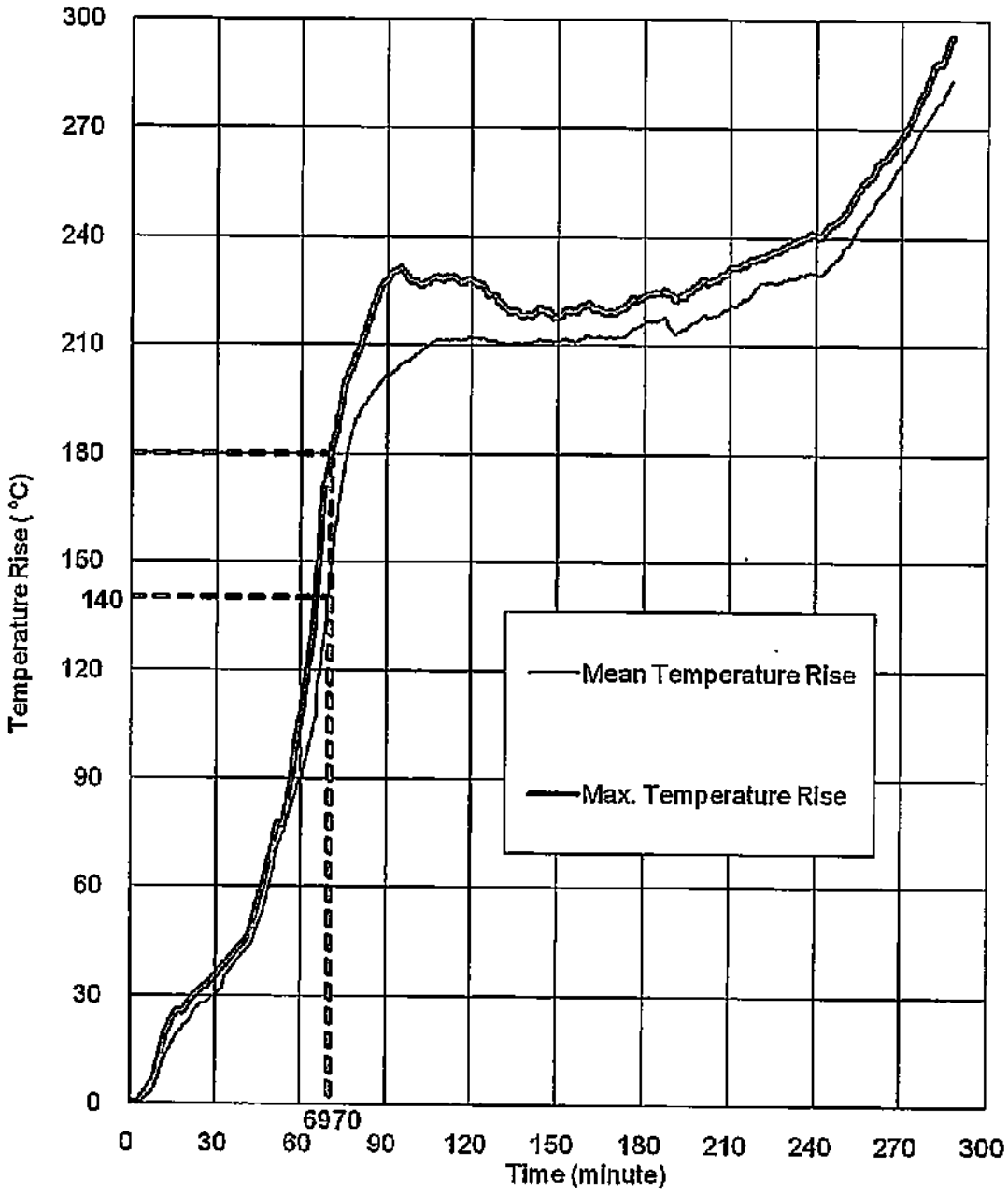

Figure 5 – Temperature rises of unexposed surface of specimen 'B'.

Note: Thermocouple S10 malfunctioned after a heating period of 66 minutes.

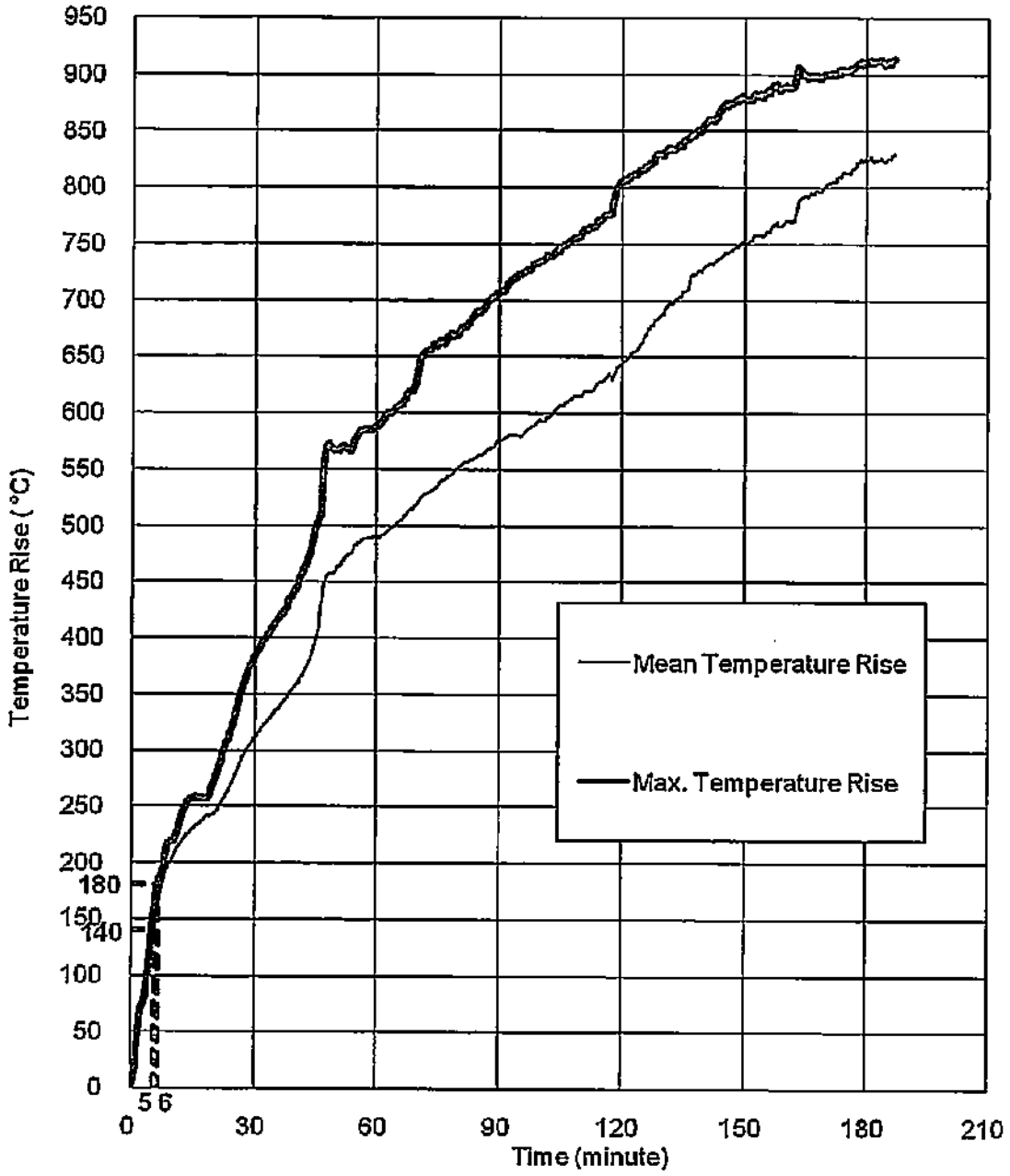

Figure 6 – Temperature rises of unexposed surface of specimen 'C'.

Note: Thermocouples S11 – S15 malfunctioned after a heating period of 187 minutes.

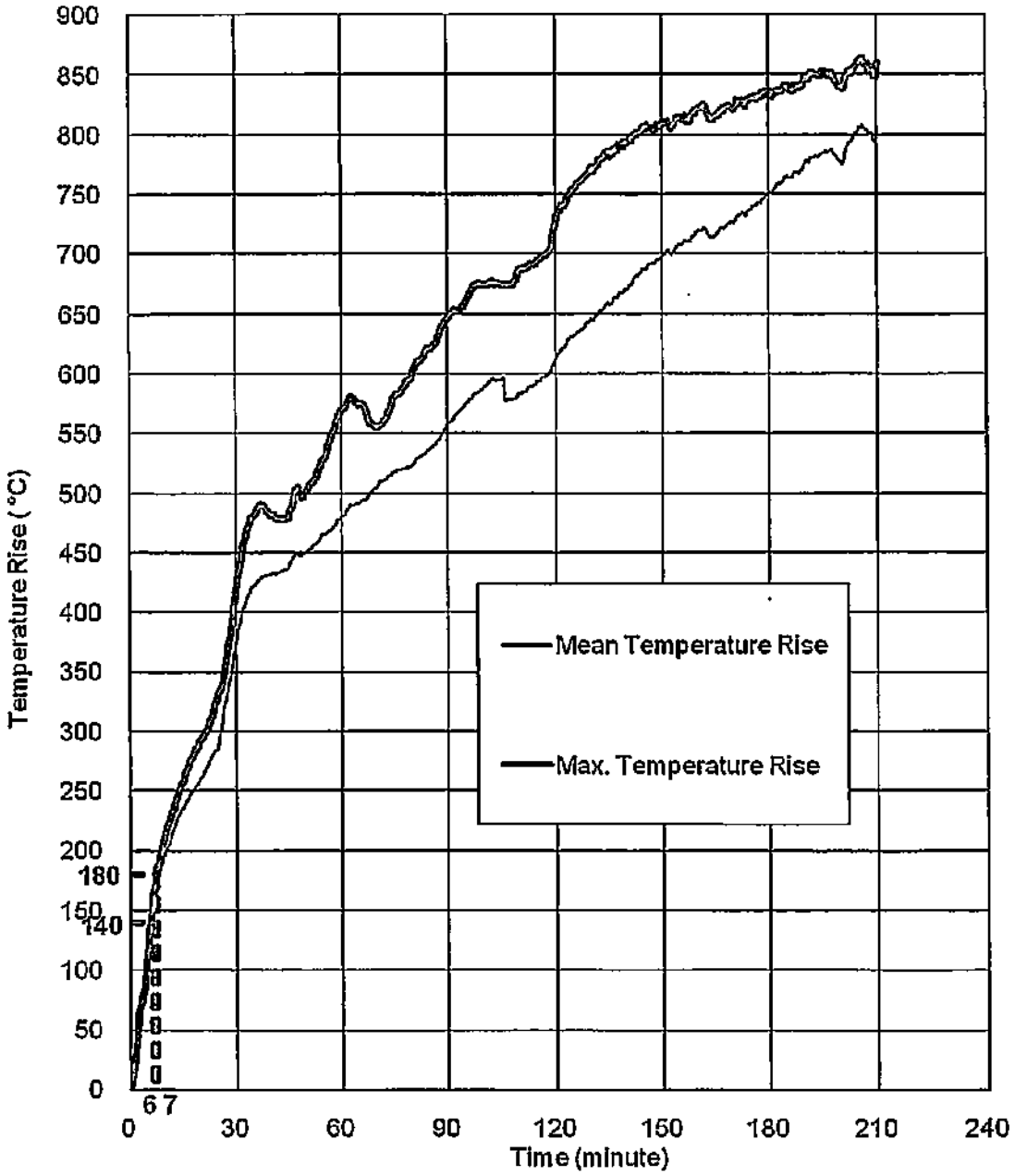

Figure 7 – Temperature rises of unexposed surface of specimen 'D'.

Notes: Thermocouple S16 malfunctioned after a heating period of 106 minutes.

Thermocouples S17 – S23 malfunctioned after a heating period of 211 minutes.

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 specimen.

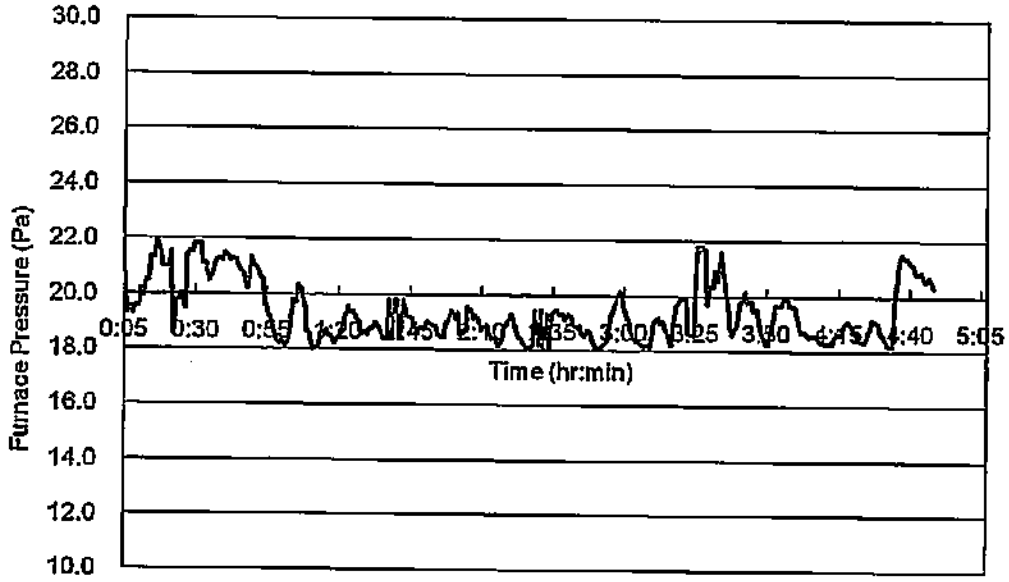

Figure 8 – Furnace pressure.

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

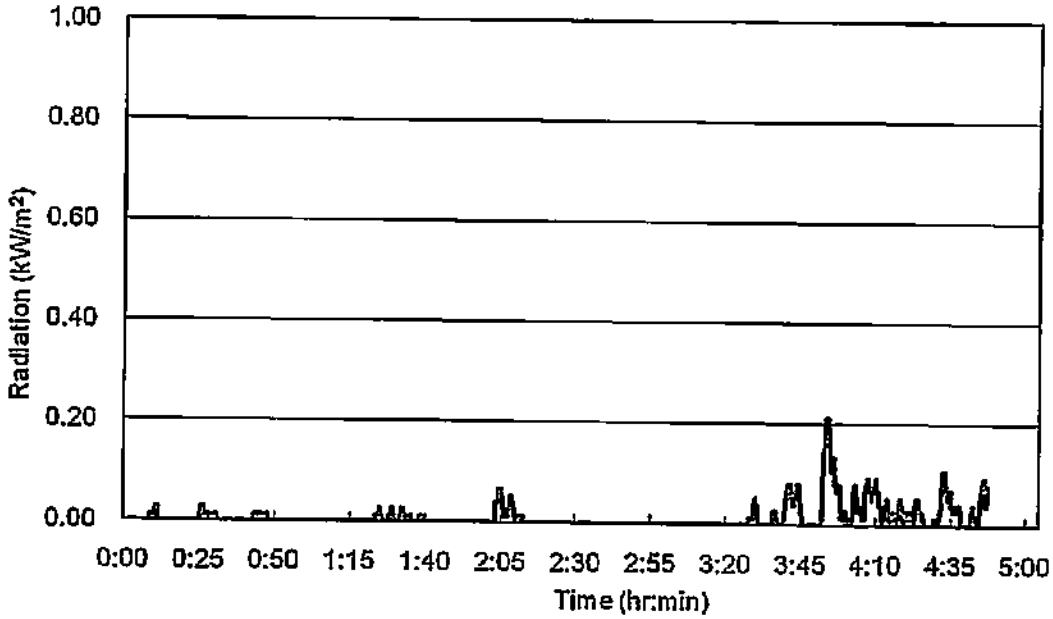

Figure 9 – Radiation.

APPENDIX B – Observation

Time (min.sec)	Exposed (E) or Unexposed (U)	Observation
00.00	-	Test started.
01.55	U	Smoke started releasing from specimen 'C'.
04.05	U	Smoke started releasing from specimen 'D'.
05.00	U	Smoke started releasing from specimen 'B'.
06.10	U	Visible deformation was observed from specimen 'C'.
07.30	E	Flaming was observed on the surface of specimen 'C'.
08.05	U	Smoke started releasing from specimen 'A'.
08.15	U	Smoke release increased from all specimens.
10.00	U	The surface of all specimens flattened.
14.45	E	The intumescent material from specimen 'D' started reacting.
15.15	U	The surface of specimens 'C' and 'D' around the joints turned dark.
16.50	U	The surface of specimen 'C' turned convex.
25.50	U	Smoke release further increased from specimen 'D'.
30.00	U	Specimens 'A' and 'B' satisfied the integrity and insulation performance requirements. Specimens 'C' and 'D' satisfied the integrity performance requirements.
41.30	U	The joints at the surface of specimens 'C' and 'D' enlarged.
56.59	U	Cotton pad test was applied at the centre of specimen 'B' and the test passed.
57.24	U	Cotton pad test was applied at the centre of specimen 'A' and the test passed.
59.20	U	The surface of specimen 'C' turned dark.
60.00	U	Specimen 'B' satisfied the integrity and insulation performance requirements. Specimens 'A', 'C' and 'D' satisfied the integrity performance requirements.
64.15	U	6 mm gap gauge was applied at the joint on the surface of specimen 'D' and did not pass through into the furnace.
69.38	U	6 mm gap gauge was applied at the joint on the surface of specimen 'C' and did not pass through into the furnace.
90.00	U	All specimens satisfied the integrity performance requirements.
115.46	U	Cotton pad test was applied at the centre of specimen 'A' and the test passed.
116.09	U	Cotton pad test was applied at the centre of specimen 'B' and the test passed.

(To be continued)

Appendix B – Observation (Con't)

Time (min.sec)	Exposed (E) or Unexposed (U)	Observation
117.28	U	6 mm gap gauge was applied at the joint on the surface of specimen 'C' and did not pass through into the furnace.
119.32	U	6 mm gap gauge was applied at the joint on the surface of specimen 'D' and did not pass through into the furnace.
120.00	U	All specimens satisfied the integrity performance requirements.
150.00	U	All specimens satisfied the integrity performance requirements.
153.00	U	Smoke release decreased from all specimens.
170.00	U	Intermitted flaming was observed at the joint on the surface of specimen 'C'.
170.30	U	Intermitted flaming was observed at the joint on the surface of specimen 'D'.
173.11	U	The intumescent material detached from the surface of specimens 'C' and 'D' and the surface of specimens 'C' and 'D' turned red.
180.00	U	All specimens satisfied the integrity performance requirements.
199.31	U	Sustained flaming was observed at the joint on the surface of specimen 'C'. **Integrity failed.**
201.07	U	Specimen 'C' was covered by durasteel board as requested by test sponsor. **It was deemed to be integrity failure.**
209.29	U	Sustained flaming was observed at the joint on the surface of specimen 'D'. **Integrity failed.**
210.00	U	Specimens 'A' and 'B' satisfied the integrity performance requirements.
211.00	U	Specimen 'D' was covered by durasteel board as requested by test sponsor. **It was deemed to be integrity failure.**
219.51	U	Sustained flaming was observed at the joint on the surface of specimen 'A'. **Integrity failed.**
234.00	U	The surface of specimen 'A' turned red.
235.39	U	Cotton pad test was applied at the centre of specimen 'B' and the test passed.
240.00	U	Specimen 'B' satisfied the integrity performance requirements.
268.50	U	Cotton pad test was applied at the centre of specimen 'B' and the test passed.
270.00	U	Specimen 'B' satisfied the integrity performance requirements.
288.25	U	Test was terminated as requested by test sponsor.

Fire and Facade Consultants

APPENDIX C – Data Recorded During the Test

Table 1 - Mean furnace temperature.

Time (minute)	BS 476: Part 20 Standard Temp. Curve (°C)	Actual Mean Furnace Temp. (°C)
0	20	46
5	579	522
10	681	671
15	742	728
20	780	767
25	815	826
30	842	834
35	866	864
40	886	887
45	902	908
50	918	926
55	933	948
60	946	966
65	958	977
70	968	990
75	979	989
80	989	995
85	998	1003
90	1007	1010
95	1014	1023
100	1022	1029
105	1029	1033
110	1036	1039
115	1042	1043
120	1049	1059
125	1055	1070
130	1061	1075
135	1067	1077
140	1072	1084

(To be continued)

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Table 1 - Mean furnace temperature (con't).

Time (minute)	BS 476: Part 20 Standard Temp. Curve (°C)	Actual Mean Furnace Temp. (°C)
145	1077	1088
150	1083	1086
155	1088	1092
160	1092	1093
165	1097	1099
170	1101	1104
175	1106	1103
180	1110	1112
185	1114	1117
190	1118	1122
195	1122	1128
200	1126	1128
205	1129	1153
210	1133	1140
215	1136	1152
220	1140	1135
225	1143	1147
230	1147	1147
235	1150	1143
240	1153	1157
245	1156	1165
250	1159	1170
255	1162	1172
260	1165	1175
265	1168	1176
270	1171	1179
275	1173	1181
280	1176	1179
285	1179	1181
288	1180	1182

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 288 minutes.

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Table 2 - Time and related temperature rises measured by thermocouples S1 – S10.

Time (min)	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
0	0	0	0	0	0	0	0	0	0	0
5	6	5	6	6	5	1	1	2	3	1
10	17	17	16	17	17	8	5	8	12	7
15	30	28	29	34	28	21	16	17	25	14
20	49	44	54	63	45	28	23	22	26	16
25	80	75	83	95	73	32	30	25	29	23
30	108	92	118	136	87	36	33	29	32	22
35	134	110	141	160	110	40	37	34	37	38
40	152	127	160	175	134	45	43	40	44	38
45	159	135	169	179	141	51	49	48	56	44
50	163	139	164	197	145	66	69	66	73	54
55	161	139	170	208	148	75	80	82	79	78
60	162	141	173	216	154	85	95	110	91	80
65	156	147	173	221	159	103	108	141	104	84
70	156	166	173	226	160	139	150	179	116	--
75	158	189	173	229	156	180	191	200	139	--
80	162	194	178	229	158	190	208	209	159	--
85	175	202	196	241	166	188	208	220	172	--
90	180	211	214	252	183	189	207	227	181	--
95	170	219	222	251	195	194	210	230	186	--
100	175	222	217	255	199	201	213	228	189	--
105	180	228	214	262	204	206	215	228	193	--
110	185	231	215	270	210	209	209	228	200	--
115	189	231	215	275	212	210	203	228	205	--
120	192	232	215	277	214	210	202	228	210	--
125	195	232	217	281	217	209	201	226	211	--
130	199	238	223	287	222	207	201	222	213	--
135	203	241	228	293	227	205	206	220	212	--
140	207	249	233	300	232	204	209	218	212	--
145	211	254	238	308	237	203	211	220	211	--
150	216	260	243	317	242	200	214	218	214	--

(To be continued)

Table 2 - Time and related temperature rises measured by thermocouples S1 – S10 (con't).

Time (min)	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
155	219	266	249	324	248	197	215	220	214	–
160	224	274	254	329	253	196	218	222	215	–
165	227	279	258	333	256	197	218	220	214	–
170	235	291	267	340	263	197	219	219	214	–
175	244	305	275	343	268	198	221	222	215	–
180	252	313	284	351	275	201	224	223	217	–
185	261	324	293	360	285	202	225	224	218	–
190	270	330	300	369	292	202	210	223	220	–
195	275	335	305	375	298	201	212	225	224	–
200	280	339	309	379	302	204	214	228	228	–
205	287	354	319	387	311	204	215	228	228	–
210	297	362	329	402	322	206	217	231	232	–
215	303	371	337	395	329	210	218	231	233	–
220	340	415	466	448	380	220	219	235	234	–
225	458	488	591	535	471	224	215	234	236	–
230	503	499	604	550	472	227	212	237	238	–
235	–	–	–	–	–	229	210	239	240	–
240	–	–	–	–	–	233	209	241	237	–
245	–	–	–	–	–	235	212	244	240	–
250	–	–	–	–	–	241	216	247	245	–
255	–	–	–	–	–	247	223	253	251	–
260	–	–	–	–	–	253	228	258	256	–
265	–	–	–	–	–	259	234	262	261	–
270	–	–	–	–	–	268	240	268	267	–
275	–	–	–	–	–	276	244	273	276	–
280	–	–	–	–	–	285	252	278	280	–
285	–	–	–	–	–	290	257	283	287	–
288	–	–	–	–	–	296	261	286	290	–

Notes: Locations of thermocouples S1 – S10 are shown in Figure 2.

Thermocouples S1 – S5 malfunctioned after a heating period of 232 minutes.

Thermocouple S10 malfunctioned after a heating period of 66 minutes.

The test was terminated as requested by the test sponsor after a heating period of 288 minutes.

Table 3 - Time and related temperature rises measured by thermocouples S11 – S19 & S21 – S23.

Time (min)	S11	S12	S13	S14	S15	S16	S17	S18	S19	S21	S22	S23
0	0	0	0	0	0	0	0	0	0	0	0	0
5	145	149	153	125	101	102	129	112	94	116	6	27
10	207	196	197	220	218	196	213	175	207	220	18	58
15	230	197	226	257	243	224	236	209	262	258	27	82
20	216	223	274	255	253	236	260	253	295	266	30	99
25	235	254	333	274	299	261	288	293	334	293	29	138
30	261	282	385	295	340	421	360	427	374	317	32	189
35	282	301	411	312	361	471	411	480	400	341	34	267
40	311	320	443	335	380	472	415	482	427	363	34	313
45	380	340	499	390	396	478	406	482	447	380	35	322
50	445	360	537	567	411	486	415	504	452	398	43	341
55	478	376	563	578	422	495	429	529	467	408	52	350
60	470	391	572	590	427	495	437	570	485	416	71	365
65	463	406	601	606	438	504	453	575	504	422	82	380
70	478	424	637	616	452	551	470	555	520	430	94	403
75	501	440	663	622	465	581	484	557	530	437	110	433
80	537	451	672	638	466	601	486	561	534	436	127	460
85	536	457	690	649	467	621	493	581	545	443	170	473
90	544	478	707	658	497	645	514	614	561	449	229	489
95	545	479	724	644	511	661	538	641	581	455	258	505
100	562	504	735	647	520	675	545	663	596	463	248	507
105	577	519	747	662	530	671	553	674	609	469	239	507
110	584	531	760	669	540	--	552	687	624	471	242	515
115	601	551	774	668	552	--	563	695	635	483	246	521
120	571	579	805	691	575	--	588	730	648	491	250	552
125	597	604	816	701	599	--	602	754	667	505	248	589
130	607	628	829	740	635	--	614	772	680	518	254	415
135	626	644	840	757	673	--	637	782	692	521	243	423
140	644	663	856	798	693	--	655	794	710	528	252	442
145	664	672	875	796	708	--	680	804	725	541	282	439
150	676	687	878	794	716	--	698	810	735	555	283	434

(To be continued)

Table 3 - Time and related temperature rises measured by thermocouples S11 – S19 & S21 – S23 (con't).

Time (min)	S11	S12	S13	S14	S15	S16	S17	S18	S19	S21	S22	S23
155	687	706	886	800	726	--	708	814	745	565	286	425
160	697	726	891	804	738	--	719	822	758	576	279	435
165	722	759	899	822	761	--	713	816	757	581	290	450
170	737	777	901	819	780	--	719	821	770	598	280	459
175	750	787	904	821	802	--	727	831	778	616	278	452
180	765	801	911	832	817	--	744	833	792	633	300	470
185	770	804	912	832	813	--	754	841	807	658	304	478
190	--	--	--	--	--	--	762	847	821	674	331	481
195	--	--	--	--	--	--	771	850	829	686	372	509
200	--	--	--	--	--	--	762	840	815	691	364	505
205	--	--	--	--	--	--	786	861	849	728	393	525
210	--	--	--	--	--	--	778	860	837	747	387	528

Notes: Locations of thermocouples S11 – S19 and S21 – S23 are shown in Figure 2.

Thermocouples S11 – S15 malfunctioned after a heating period of 187 minutes.

Thermocouple S16 malfunctioned after a heating period of 186 minutes.

Thermocouples S17 – S23 malfunctioned after a heating period of 211 minutes.

The test was terminated as requested by the test sponsor after a heating period of 288 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	**Firestop Composite Sheets** Brand : Hilti.# Model : CFS-COS.# Material : Intumescent stainless steel composite sheet. Overall sizes : 1,300 mm long by 1,100 mm wide by 3.8 mm thick.* Fixing method : The Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres.#
2	**Rockwool** Brand : ROCKWOOL.# Thickness : 50 mm.* Density : 160 kg/m^3.* Fixing method : The Rockwool was installed at the bottom of Firestop Composite Sheets and supported by C-channel with sizes of 50 mm wide by 125 mm high by 1 mm thick at one side and L-angles with sizes of 50 mm by 50 mm by 3 mm thick at three sides. Both the C-channel and L-angles were fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres and with C-channel and L-angles backed with "Hilti CP 606" firestop sealant. The separation distance between the Firestop Composite Sheets and Rockwool was 70 mm.#

*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 is not verified by RED or unless specified.)

Specimen 'B'

Item	Description		
1	**First Layer of Firestop Composite Sheets**		
	Brand	:	Hilti.#
	Model	:	CFS-COS.#
	Material	:	Intumescent stainless steel composite sheet.
	Overall sizes	:	1,300 mm long by 1,100 mm wide by 3.8 mm thick.*
	Fixing method	:	The first layer of Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres.#
2	**Rockwool**		
	Brand	:	ROCKWOOL.#
	Thickness	:	50 mm.*
	Density	:	160 kg/m^3.*
	Fixing method	:	The Rockwool was installed at the bottom of first layer of Firestop Composite Sheets. The second layer of Firestop Composite Sheets with the same construction as the first layer was placed at the bottom of the Rockwool. The Rockwool and second layer of Firestop Composite Sheets were supported by C-channel with sizes of 50 mm wide by 125 mm high by 1 mm thick at one side and L-angles with sizes of 50 mm by 50 mm by 3 mm thick at three sides. Both the C-channel and L-angles were fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres and with C-channel and L-angles backed with "Hilti CP 606" firestop sealant. The separation distance between the first layer of Firestop Composite Sheets and Rockwool was 100 mm.#

*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 is not verified by RED or unless specified.)

Specimen 'C'

Item	Description
1	**Firestop Composite Sheets**
	Brand : Hilti.#
	Model : CFS-COS.#
	Material : Intumescent stainless steel composite sheet.
	Overall sizes : 1,750 mm long by 1,100 mm wide by 3.8 mm thick.*
	Fixing method : The Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Firestop Composite Sheets were supported by L-angle with sizes of 50 mm by 50 mm by 3 mm thick which was fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres and with L-angle backed with "Hilti CP 606" firestop sealant at one side.#

*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 is not verified by RED or unless specified.)

Specimen 'D'

Item	Description		
1	**Firestop Composite Sheets**		
	Brand	:	Hilti.#
	Model	:	CFS-COS.#
	Material	:	Intumescent stainless steel composite sheet.
	Overall sizes	:	1,600 mm long by 1,100 mm wide by 3.8 mm thick.*
	Opening sizes	:	300 mm diameter by 200 mm deep by 0.7 mm thick.*
	Fixing method	:	The Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Firestop Composite Sheets were supported by L-angle with sizes of 50 mm by 50 mm by 3 mm thick which was fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres and with L-angle backed with "Hilti CP 606" firestop sealant at one side.#
2	**Rockwool**		
	Brand	:	ROCKWOOL.#
	Thickness	:	50 mm.*
	Density	:	160 kg/m^3.*
	Applied location	:	Covered the opening.#

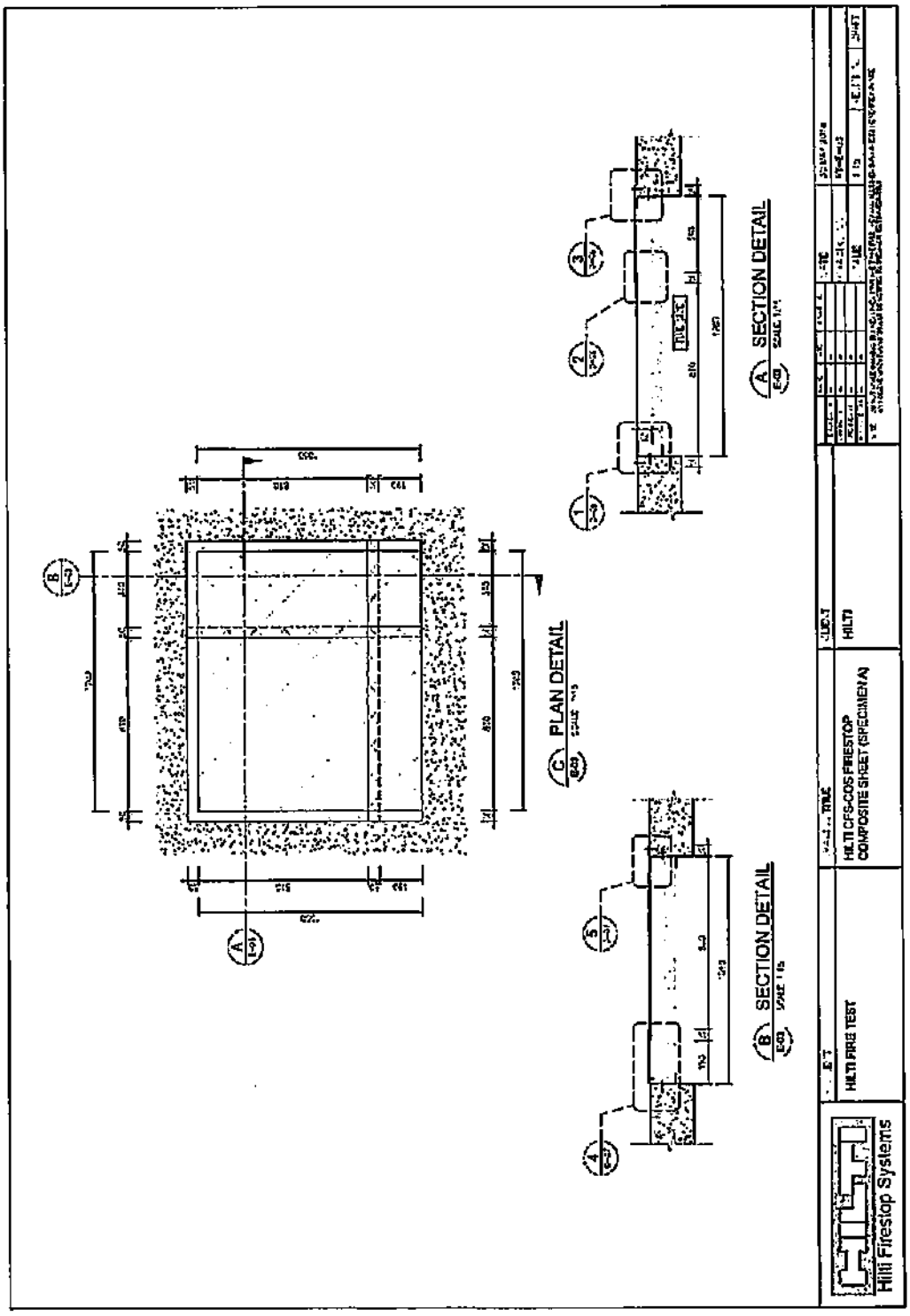
*Notes: * Verified on site by RED.*

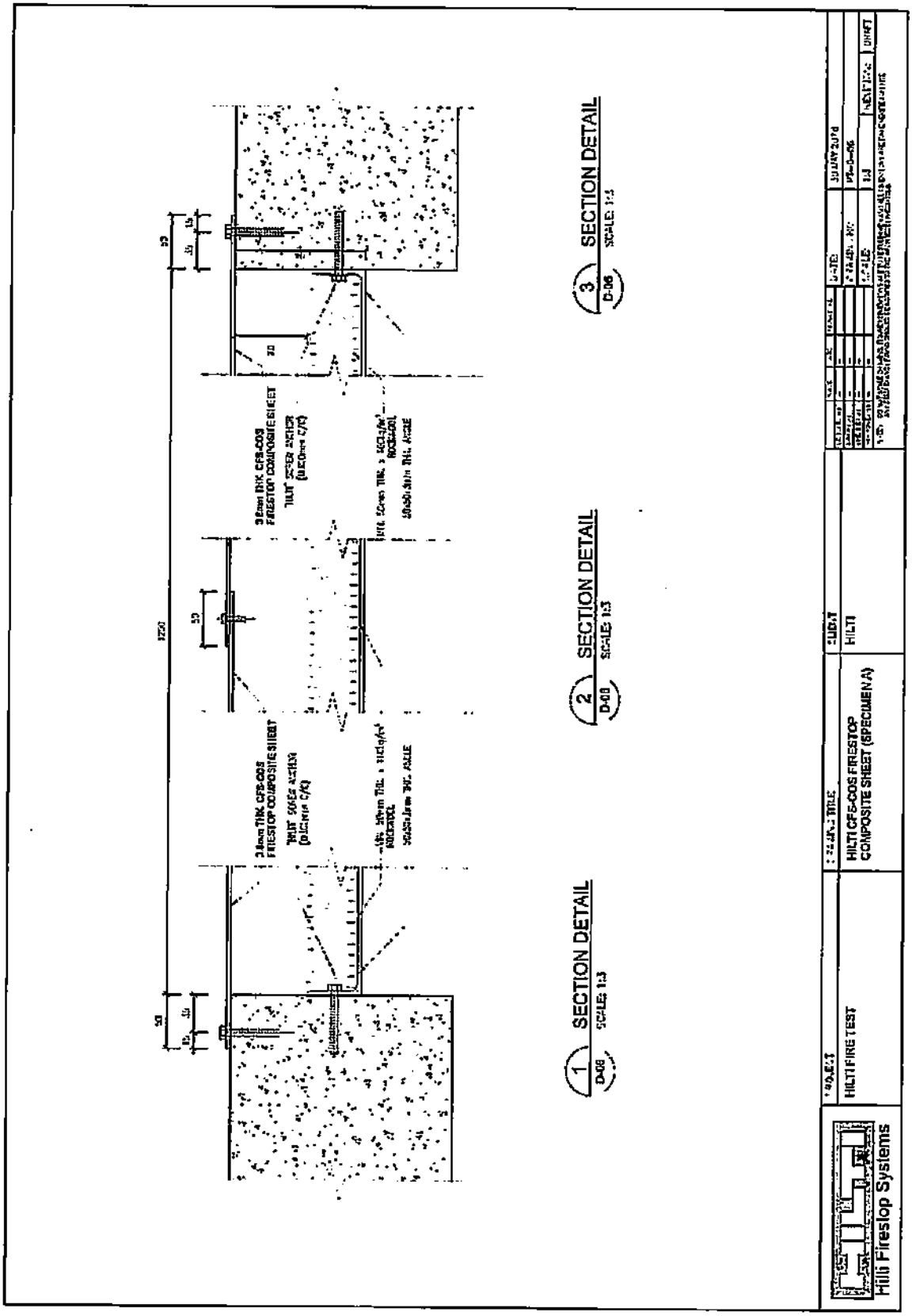
 # As shown on the test construction.

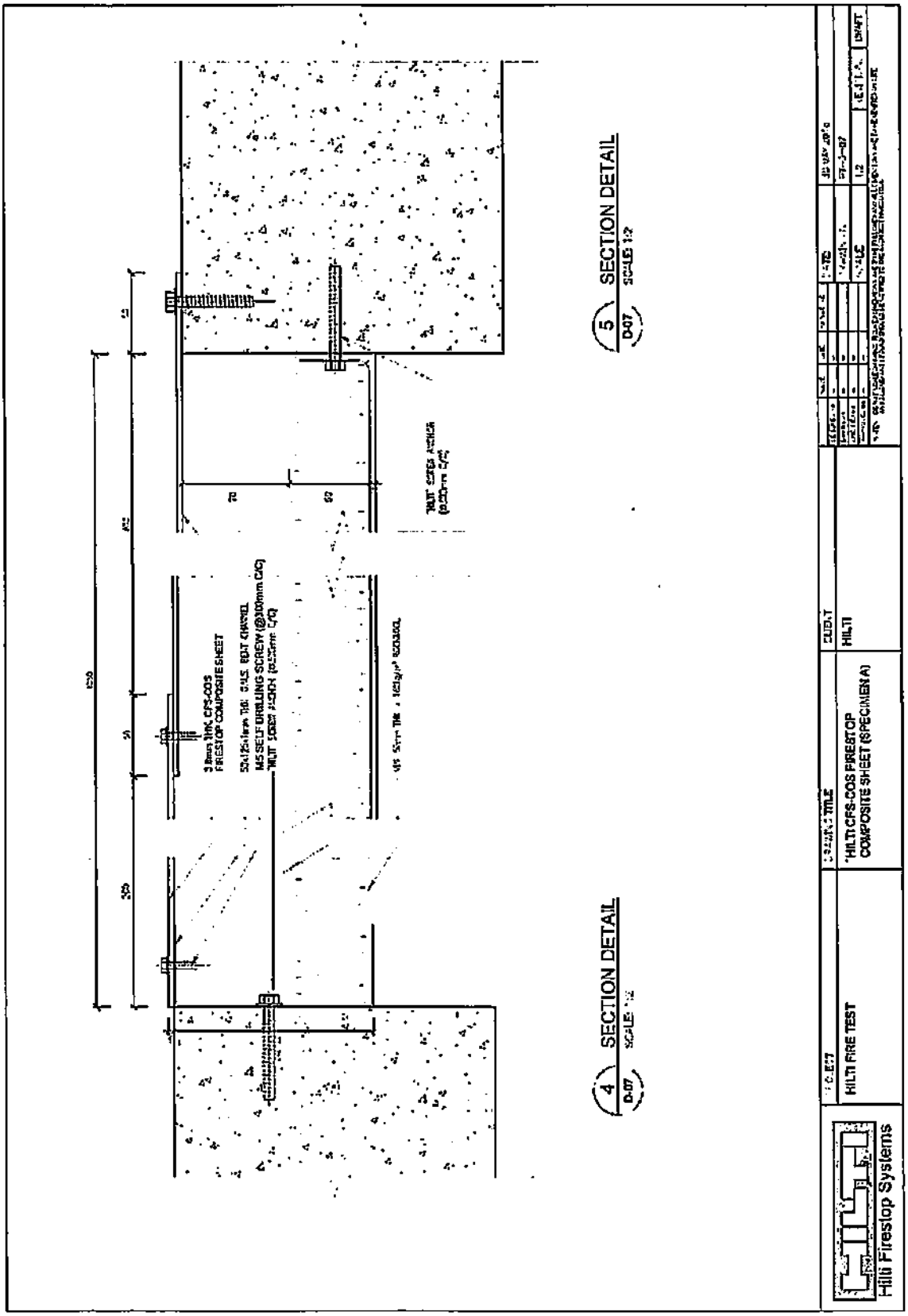
Drawings from Test Sponsor

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

Specimen 'A'




SECTION DETAIL
SECTION DETAIL
SECTION DETAIL
HILTI FIRE TEST
HILTI CFS-COS FIRESTOP COMPOSITE SHEET (SPECIMEN A)
HILTI
Hilti Firestop Systems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D-07
4 SECTION DETAIL
D-07
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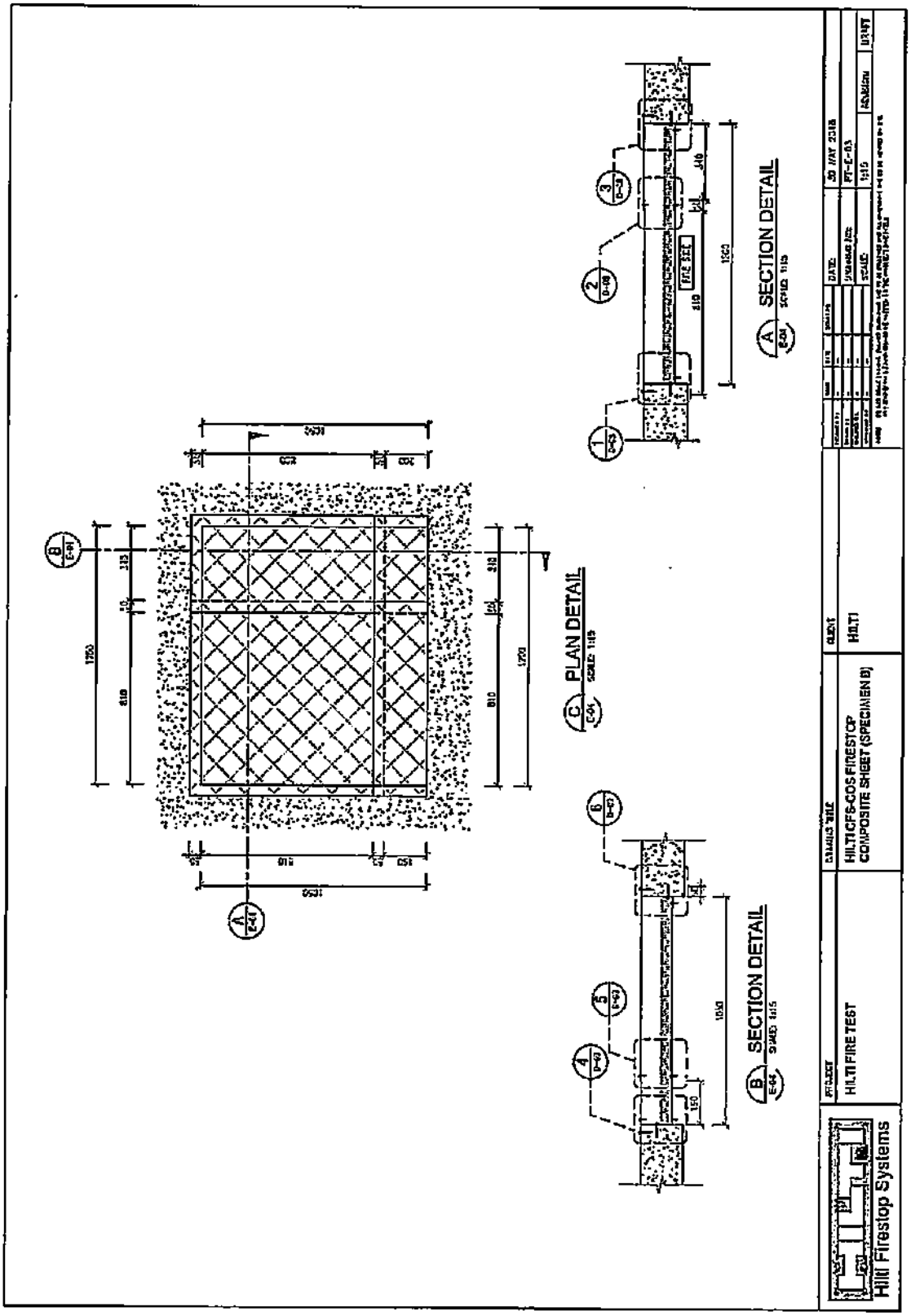
HILTI
Hilti Firestop Systems

Specimen 'B'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SECTION DETAIL
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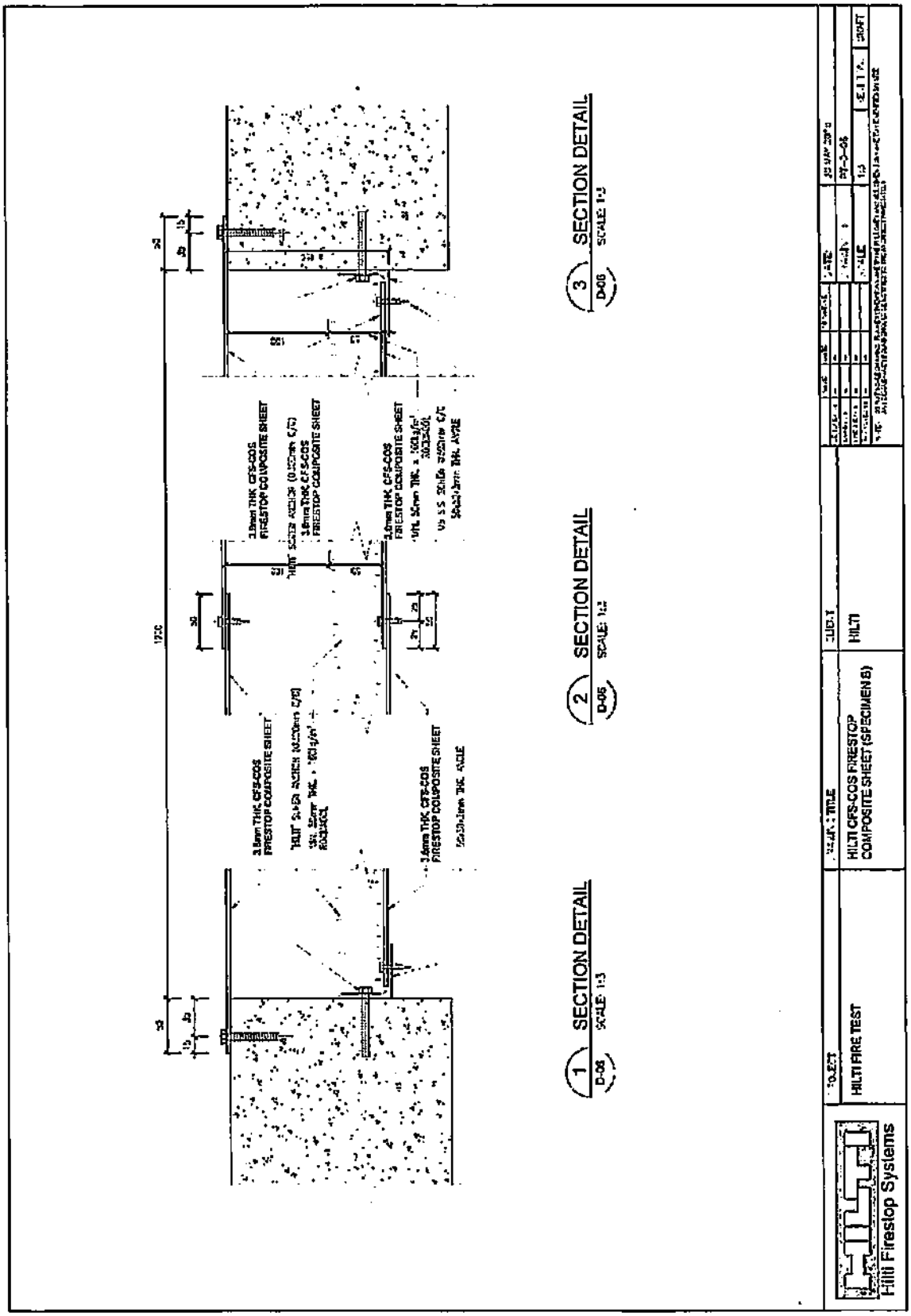
Hilti Firestop Systems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D-06 SCALE 1:3
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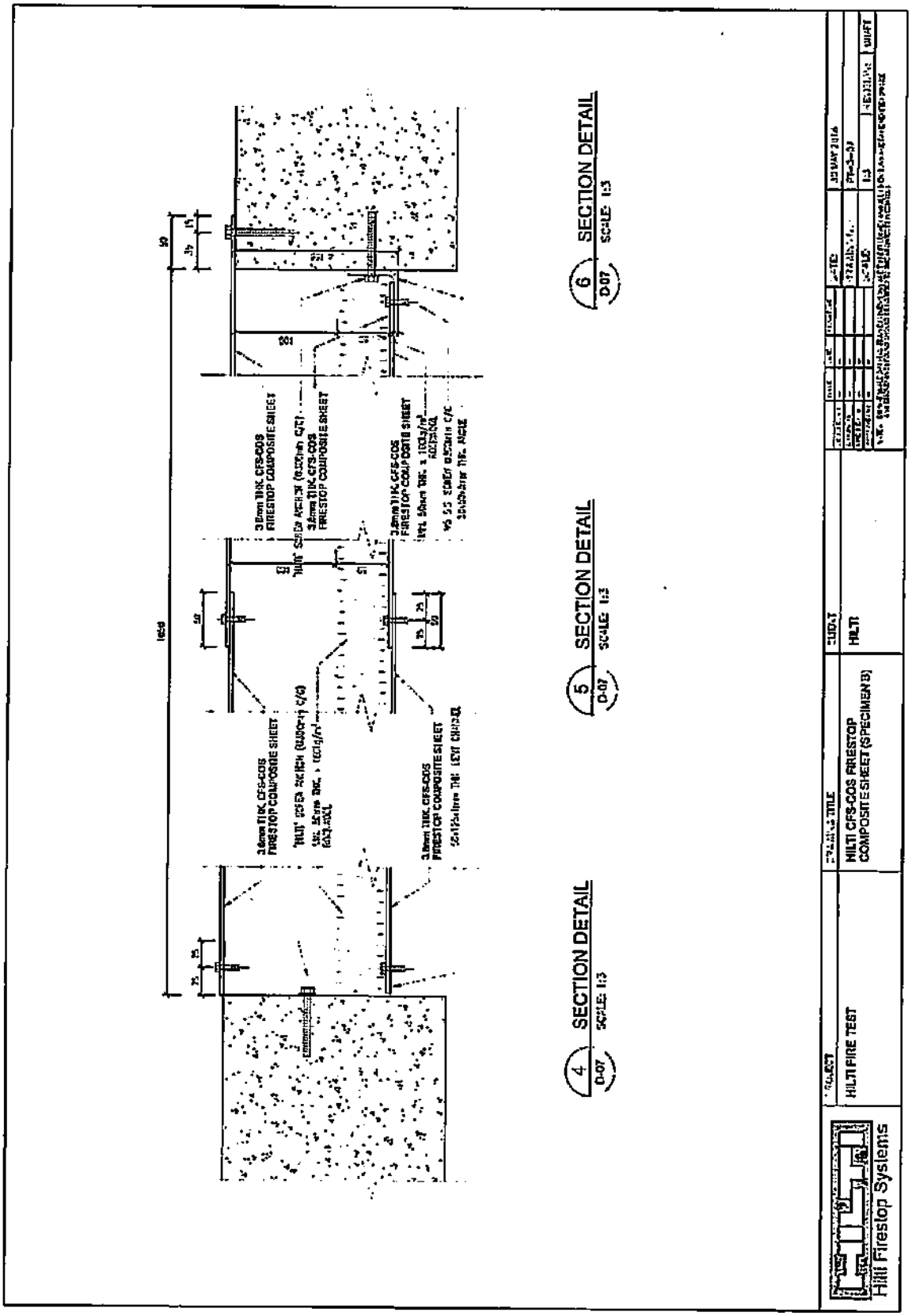
HILTI CFS-COS FIRESTOP COMPOSITE SHEET (SPECIMEN 6)
HILTI
Hilti Firestop Systems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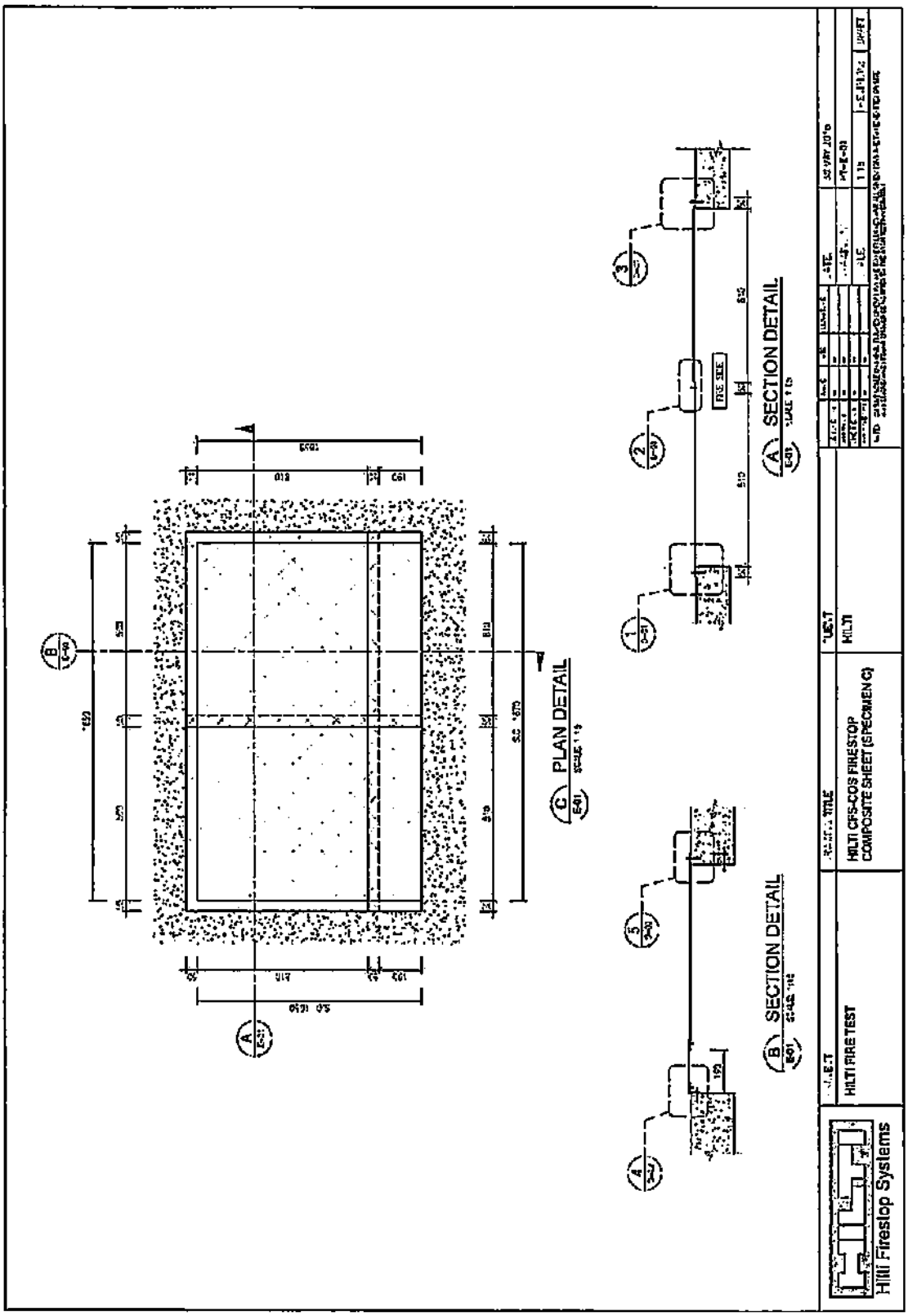
D-07 SCALE: 1:3
4 SECTION DETAIL
D-07 SCALE: 1:3
HILTI FIRE TEST
HILTI CFS-COS FIRESTOP COMPOSITE SHEET (SPECIMEN 3)
HILTI
Hilti Firestop Systems

Specimen 'C'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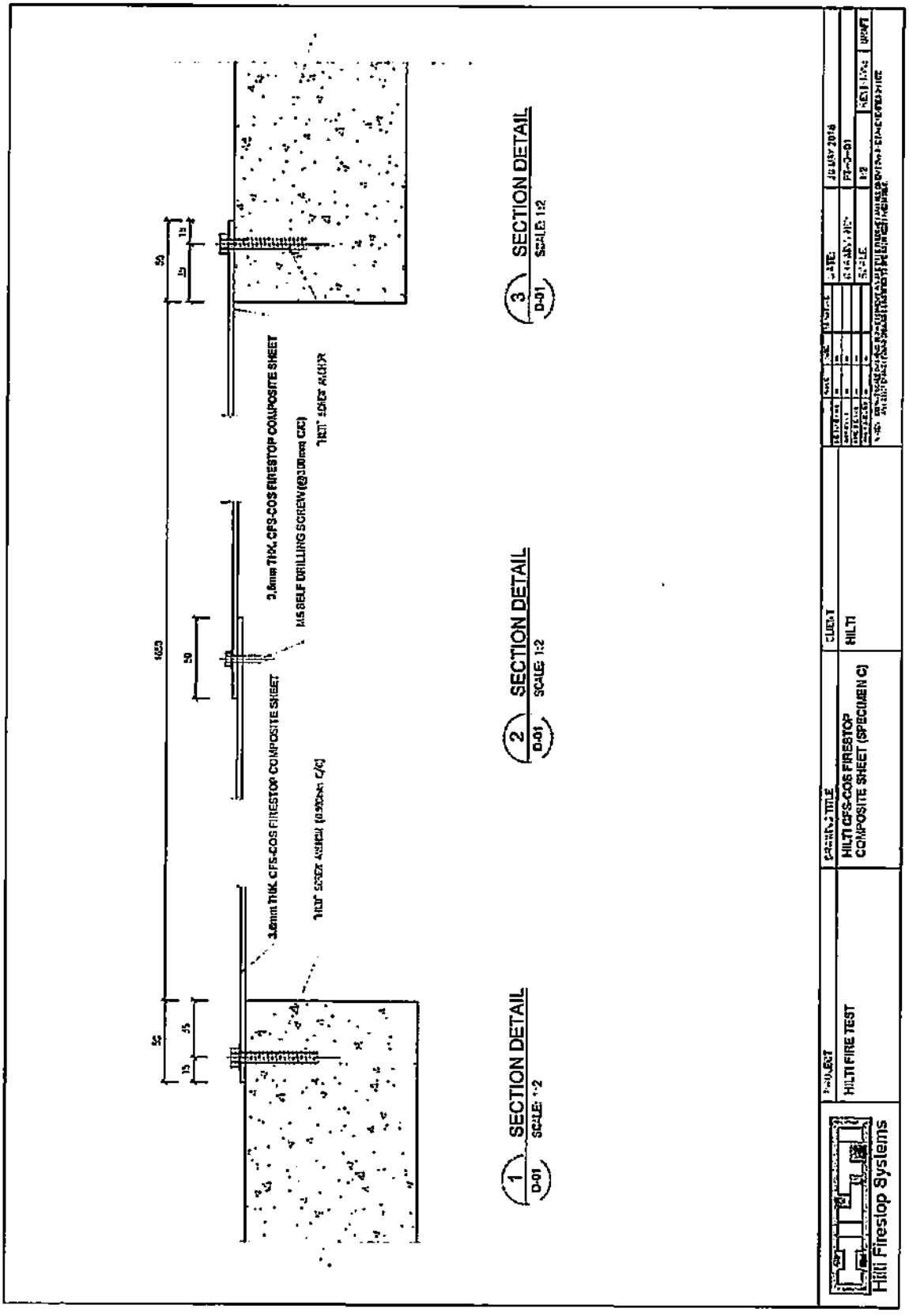
SECTION DETAIL
SECTION DETAIL
HILTI FIRE TEST
HILTI CFS-COS FIRESTOP COMPOSITE SHEET (SPECIMEN C)
HILTI
Hilti Firestop Systems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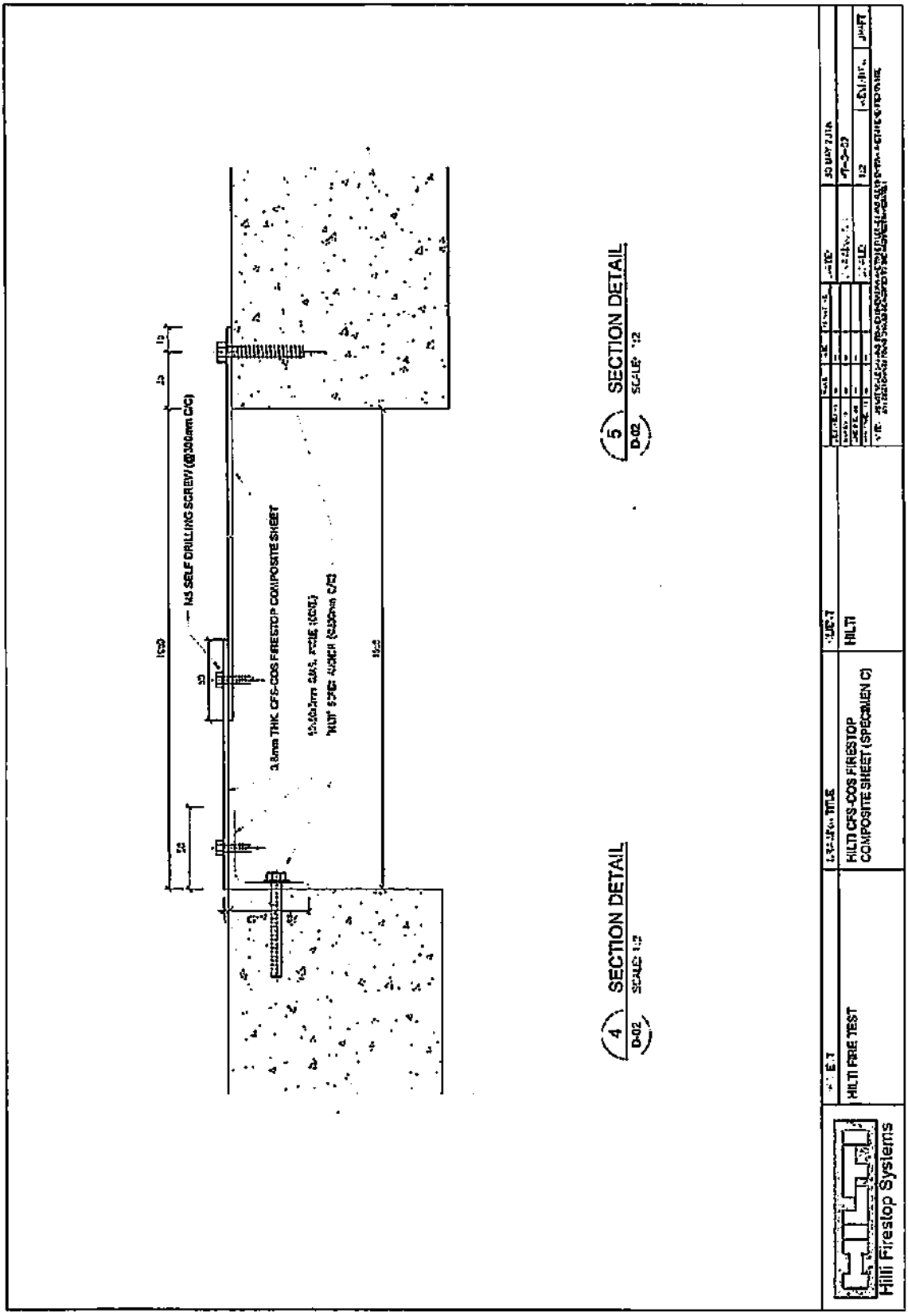
D-01 SCALE 1:2
1 SECTION DETAIL
D-01 SCALE 1:2
3.6mm THK. CFS-COS FIRESTOP COMPOSITE SHEET
M5 SELF DRILLING SCREW (@300mm C/C)
"HILTI" SCREW ANCHOR
HILTI
HILTI CFS-COS FIRESTOP COMPOSITE SHEET (SPECIMEN C)
HILTI FIRE TEST
Hilti Firestop Systems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D-02 SCALE: 1:2
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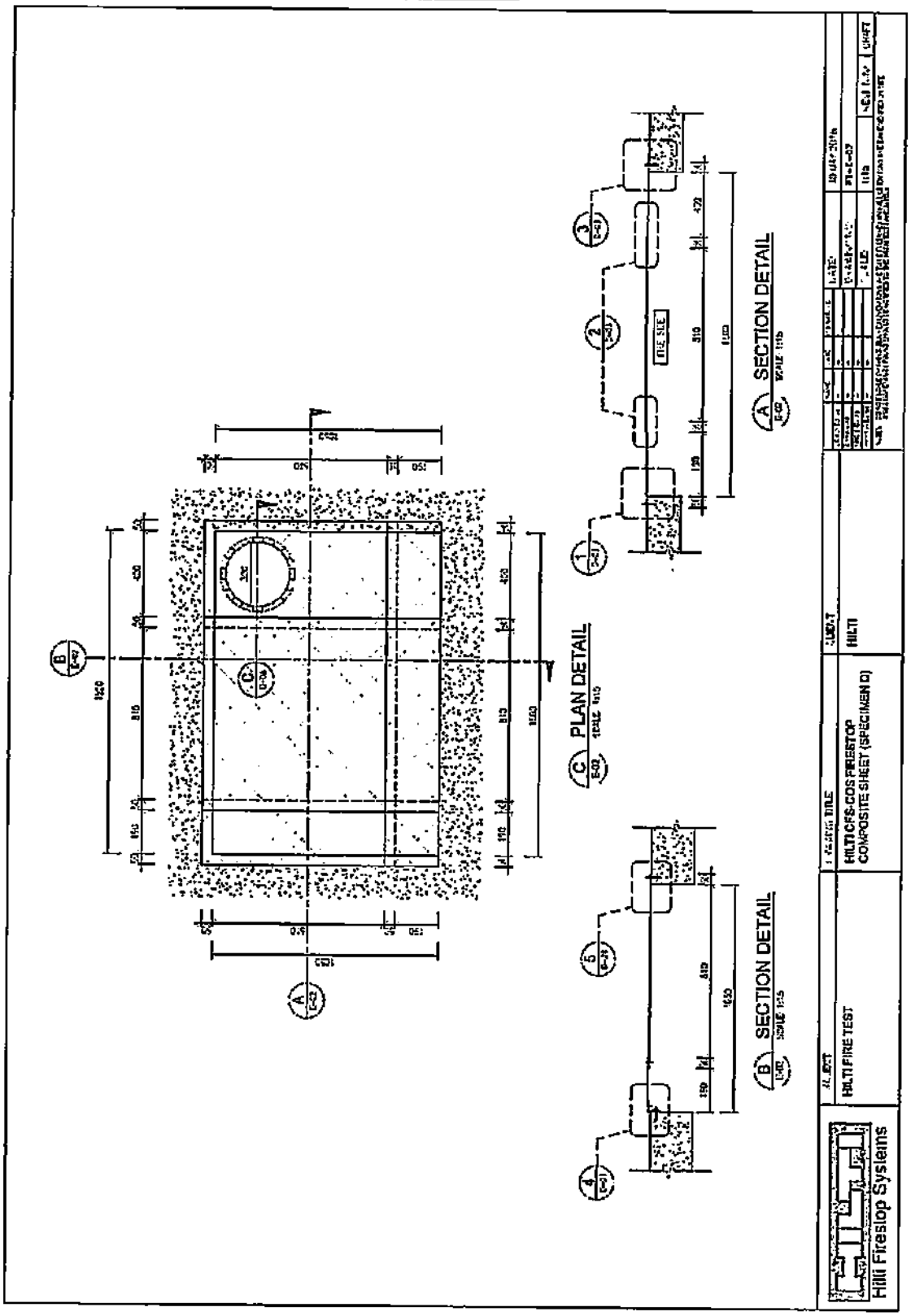
HILTI CFS-COS FIRESTOP COMPOSITE SHEET (SPECIMEN C)
HILTI
Hilti Firestop Systems

Specimen 'D'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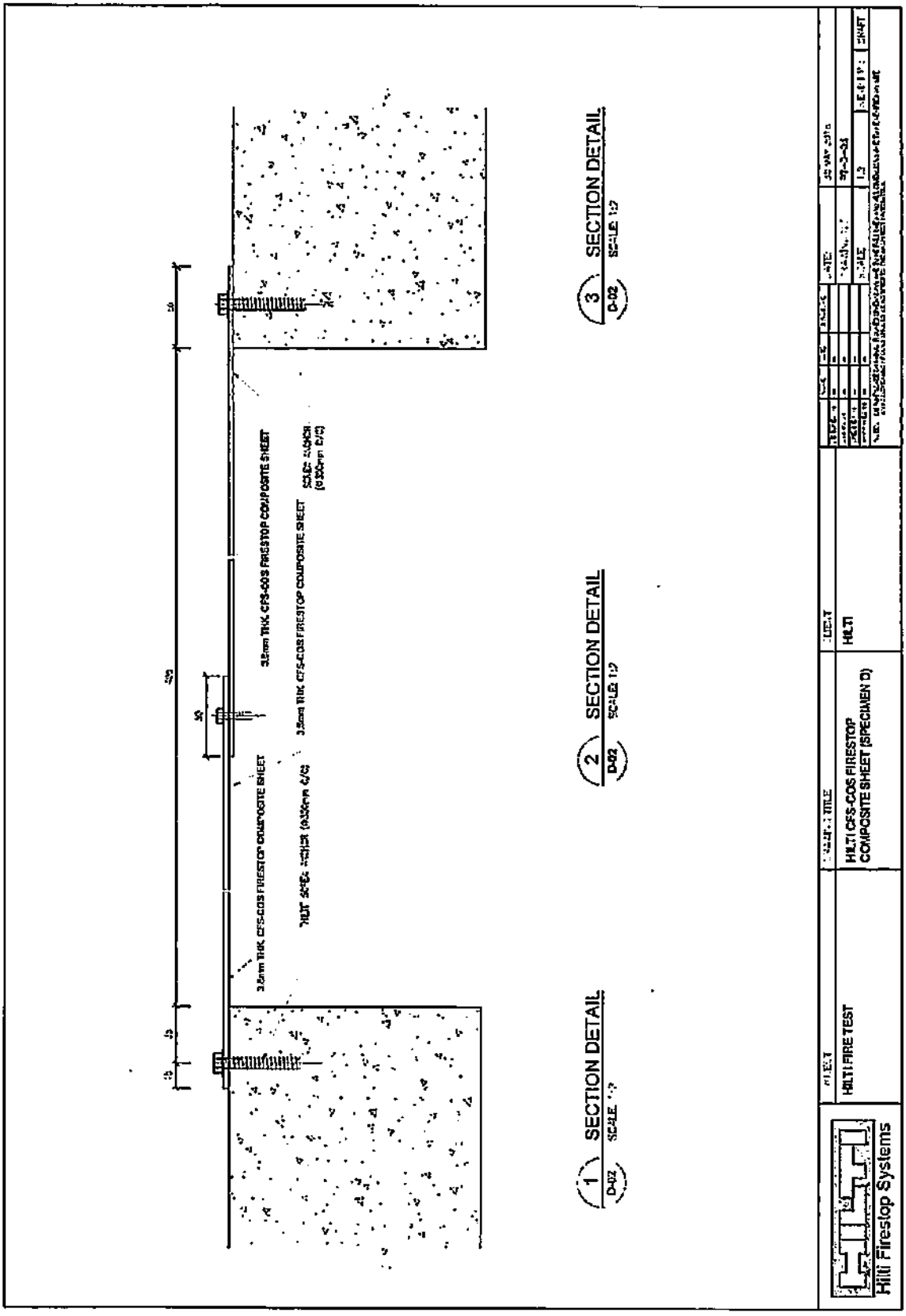
C PLAN DETAIL
B SECTION DETAIL
HILTI FIRE TEST
HILTI CFS-COS FIRESTOP COMPOSITE SHEET (SPECIMEN D)
HILTI
Hilti Firestop Systems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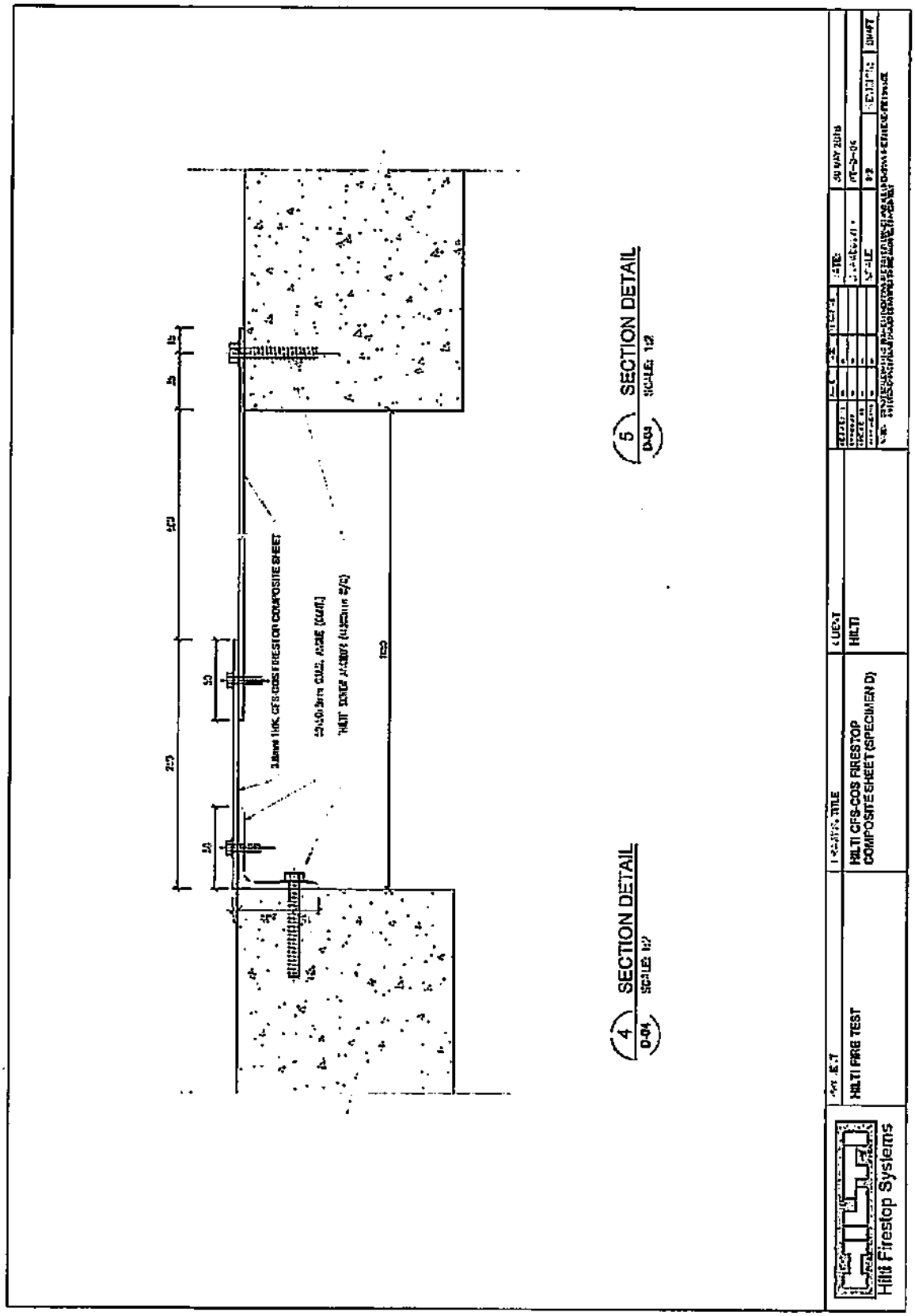
2 SECTION DETAIL
D-02 SCALE 1:2
1 SECTION DETAIL
D-02 SCALE 1:2
HILTI FIRE TEST
HILTI CFS-COS FIRESTOP COMPOSITE SHEET (SPECIMEN D)
HILTI
Hilti Firestop Systems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4 SECTION DETAIL
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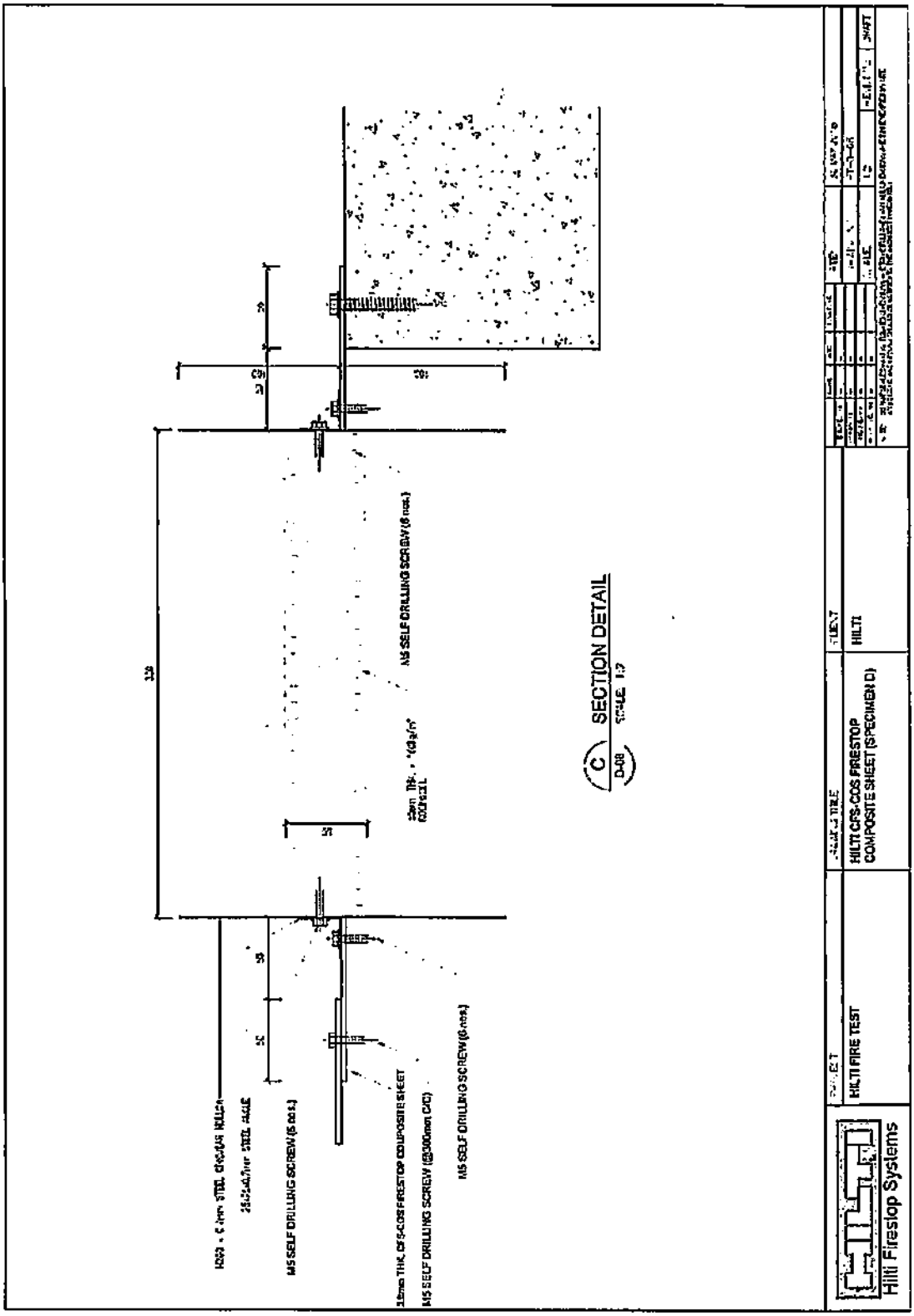
HILTI CFS-COS FIRESTOP COMPOSITE SHEET (SPECIMEN D)
HILTI
Hilti Firestop Systems



- 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: 1987

On 9 nos. of Penetration Systems

Test Report No.: R18G14-2A
Identification No.: Q18A11-2

Issue Date: 19th October 2018

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

雄略

APPROVED SIGNATORY: _____

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

Hong Kong Accreditation Service (HKAS) has accredited this laboratory (HOKLAS 091- TEST) under Hong Kong Laboratory Accreditation Scheme (HOKLAS) for specific laboratory activities as listed in the HOKLAS directory of accreditation laboratories. The results shown in this test report were determined by this laboratory in accordance with its terms of accreditation. This report may not be reproduced except in full.

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CONTENT

1 SUMMARY

Fire resistance test conducted in accordance with BS 476: Part 20: 1987 on 9 nos. of penetration systems.

Nine specimens of penetration systems, namely specimens '12', '13', '14', '15', '16', '17', '18', '19' and '20' (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 specimen holder as shown in the test sponsor's drawings (see the appendix). The specimens were asymmetrical and only one side of specimens was tested, in which the fire side was determined by the test sponsor.

Specimen '12' was comprised of Firestop Composite Sheets. The overall and exposed sizes of the Firestop Composite Sheets were 910 mm wide by 910 mm high by 3.8 mm thick. The Firestop Composite Sheets were joined together with M5 by 25 mm long screws at 250 mm nominal centres and fixed to L-angles with sizes of 50 mm by 50 mm by 5 mm thick at four sides. The L-angles was fixed the concrete with M6 by 54 mm long anchor bolts at 250 mm nominal centres. Stainless steel facing was faced at exposed side (refer to test sponsor's drawings).

Specimen '13' had overall dimensions 910 mm wide by 1,200 mm high by 3.8 mm thick with exposed area 610 mm wide by 1,100 mm high. It was comprised of Firestop Composite Sheets and a G.I. squared pipe. The G.I. squared pipe with sizes of 250 mm wide by 250 mm high by 1 mm thick was penetrated in the centre of specimen. The Firestop Composite Sheets were joined together with M5 by 25 mm long screws at 250 mm nominal centres and fixed to the concrete with M6 by 54 mm long anchor bolts at 250 mm nominal centres. Stainless steel facing was faced at unexposed side (refer to test sponsor's drawings).

Specimen '14' had overall dimensions of 1,010 mm wide by 910 mm high by 3.8 mm thick with clear opening area 900 mm wide by 810 mm high. It was comprised of two layers of Firestop Composite Sheets and a G.I. pipe. The G.I. pipe with sizes of 500 mm wide by 200 mm high by 1 mm thick was penetrated in the centre of specimen. The Firestop Composite Sheets were joined together with M5 by 25 mm long screws at 250 mm nominal centres and fixed to the concrete with M6 by 54 mm long anchor bolts at 250 mm nominal centres. Stainless steel facing was faced at both sides (refer to test sponsor's drawings).

Specimen '15' had overall dimensions of 600 mm wide by 300 mm high by 81 mm thick. It was comprised of two nos. of socket boxes with 'Hilti CP617' firestop putty pad incorporated with 75 mm thick 'Ytong' lightweight block wall with nominal 3 mm thick plaster on both sides. Each socket box with cover with sizes of 70 mm by 70 mm by 50 mm deep by 3.5 mm thick was incorporated in each side of block wall. 'Hilti CP617' firestop putty pad was placed inside the socket boxes (refer to test sponsor's drawings).

Specimen '16' had overall dimensions of 90 mm diameter by 1,200 mm long. It was comprised of a PVC pipe with sizes of 48 mm outer diameter by 4 mm thick, wrapped with a layer of nominal 25 mm thick by 750 mm long 'Armaflex' foam. The gaps between the pipe and concrete wall were applied with two layers of 'CFS-B' bandage and 'CP606' sealant (refer to test sponsor's drawings).

Specimen '17' had overall dimensions of 160 mm diameter by 1,200 mm long. It was comprised of a PVC pipe with sizes of 25 mm outer diameter by 2 mm thick, and 3 pairs of copper pipes with sizes of 12.7 mm outer diameter by 1 mm thick and 6.4 mm outer diameter by 1 mm thick. All pipes wrapped with a layer of nominal 25 mm thick by 750 mm long 'Armaflex' foam individually. The gaps between all the pipes and concrete wall were applied with 'CFS-F FX' foam and with 'Hilti CFS-C EL' collar endless at both opening ends (refer to test sponsor's drawings).

Specimen '18' had overall dimensions of 160 mm diameter by 1,200 mm long. It was comprised of a PVC pipe with sizes of 25 mm outer diameter by 2 mm thick, and 3 pairs of copper pipes with sizes of 12.7 mm outer diameter by 1 mm thick and 6.4 mm outer diameter by 1 mm thick. All pipes wrapped with a layer of nominal 25 mm thick by 750 mm long 'Armaflex' foam individually. The gaps between all the pipes and concrete wall were applied with two layers of 'CFS-B' bandage and 'Hilti CP606' sealant. Three pairs of copper pipes were wrapped together by the bandage and the PVC pipe was wrapped individually (refer to test sponsor's drawings).

Specimen '19' had overall dimensions of 160 mm diameter by 1,200 mm long. It was comprised of a G.M.S. pipe with sizes of 138 mm inner diameter by 1.5 mm thick. The gaps between the pipe and concrete wall were applied with 'Hilti CP606' sealant and 'Hilti CF-F 750' filling foam (refer to test sponsor's drawings).

Specimen '20' had overall dimensions of 160 mm diameter by 1,200 mm long. It was comprised of a PVC pipe with sizes of 25 mm outer diameter by 2 mm thick, and 3 pairs of copper pipes with sizes of 12.7 mm outer diameter by 1 mm thick and 6.4 mm outer diameter by 1 mm thick. All pipes wrapped with a layer of nominal 25 mm thick by 750 mm long 'Armaflex' foam individually. The gaps between all the pipe and concrete wall were applied with two layers of 'CFS-B' bandage and 'Hilti CP606' sealant. All pipes were wrapped together by the bandage (refer to test sponsor's drawings).

All penetrated pipes were supported by fixed to 40 mm by 20 mm by 3 mm thick steel L-angles, located at 100 mm from the concrete wall on both sides. The steel angles were supported by 2 nos. of M10 steel rods to the concrete lining. The opening was covered by nominal 40 mm thick rockwool with density 160 kg/m^3.

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

	Integrity	Insulation
Specimen '12'	242 Minutes (No failure)	8 Minutes
Specimen '13'	242 Minutes (No failure)	6 Minutes
Specimen '14'	242 Minutes (No failure)	27 Minutes
Specimen '15'	242 Minutes (No failure)	242 Minutes
Specimen '16'	242 Minutes (No failure)	242 Minutes
Specimen '17'	242 Minutes (No failure)	242 Minutes
Specimen '18'	242 Minutes (No failure)	242 Minutes
Specimen '19'	242 Minutes (No failure)	242 Minutes
Specimen '20'	242 Minutes (No failure)	242 Minutes

The test was discontinued after a heating period of 242 minutes.

2 INTRODUCTION

The objective of the test is to determine the fire resistance performance of 9 nos. of penetration systems 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

28th September 2018

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, the representative 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 specimen (see Figure 1).

Twenty-seven (27) '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.

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 26 °C to 38 °C and 50 % to 86 % respectively.

6 TEST SPECIMEN CONSTRUCTION

The specimens were installed into a concrete specimen 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 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 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-eight (28) thermocouples fixed to the unexposed surface (see Figure 2 for the locations and reference numbers of the thermocouples). Thermocouples S1 – S3 were fixed on specimen '12' for mean and maximum temperatures of the unexposed surface of specimen '12'.

Thermocouples S4 – S6 were fixed on specimen '13' for mean and maximum temperatures of the unexposed surface of specimen '13'. Thermocouple S7 was fixed on the pipe of specimen '13' for maximum temperature of the unexposed surface of specimen '13' only.

Thermocouples S8 – S10 were fixed on specimen '14' for mean and maximum temperatures of the unexposed surface of specimen '14'. Thermocouple S11 was fixed on the pipe of specimen '14' for maximum temperature of the unexposed surface of specimen '14' only.

Thermocouples S13 – S14 were fixed on specimen '15' for mean and maximum temperatures of the unexposed surface of specimen '15'. Thermocouples S12 & S15 were fixed on socket box or backed with socket box respectively of specimen '15' for maximum temperature of the unexposed surface of specimen '16' only. Thermocouple S16 was fixed inside the socket box for additional information only.

Thermocouples S19 – S20 were fixed on specimen '17' for mean and maximum temperatures of the unexposed surface of specimen '17'. Thermocouples S21 & S22 were fixed on the collar of specimen '17' for maximum temperature of the unexposed surface of specimen '17' only.

Thermocouples S23 – S24 were fixed on specimen '18' for mean and maximum temperatures of the unexposed surface of specimen '18'.

Thermocouples S25 – S26 were fixed on specimen '19' for mean and maximum temperatures of the unexposed surface of specimen '19'.

Thermocouples S27 – S28 were fixed on specimen '20' for mean and maximum temperatures of the unexposed surface of specimen '20'.

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 radiation of specimens was measured and recorded.

8 TEST DATA AND INFORMATION

The ambient temperature of the test area during the test was 35 °C.

The furnace was controlled so that the mean furnace temperature complied with the requirements of BS 476: Part 20: 1987. The temperature record was shown graphically in Figure 3.

The mean and maximum temperatures of the unexposed surface of specimen '12' were shown graphically in Figure 4.

The mean and maximum temperatures of the unexposed surface of specimen '13' were shown graphically in Figure 5.

The mean and maximum temperatures of the unexposed surface of specimen '14' were shown graphically in Figure 6.

The mean and maximum temperatures of the unexposed surface of specimen '15' were shown graphically in Figure 7.

The mean and maximum temperatures of the unexposed surface of specimen '16' were shown graphically in Figure 8.

The mean and maximum temperatures of the unexposed surface of specimen '17' were shown graphically in Figure 9.

The mean and maximum temperatures of the unexposed surface of specimen '18' were shown graphically in Figure 10.

The mean and maximum temperatures of the unexposed surface of specimen '19' were shown graphically in Figure 11.

The mean and maximum temperatures of the unexposed surface of specimen '20' were shown graphically in Figure 12.

The furnace pressure obtained was shown graphically in Figure 13.

The radiation obtained was shown graphically in Figure 14.

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

The mean furnace temperature obtained was summarized in Table 1.

The temperature rises of specimen obtained were summarized in Table 2 and 3.

The test was discontinued after a heating period of 242 minutes.

9 RESULTS

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

	Integrity	Insulation
Specimen '12'	242 Minutes (No failure)	8 Minutes
Specimen '13'	242 Minutes (No failure)	6 Minutes
Specimen '14'	242 Minutes (No failure)	27 Minutes
Specimen '15'	242 Minutes (No failure)	242 Minutes
Specimen '16'	242 Minutes (No failure)	242 Minutes
Specimen '17'	242 Minutes (No failure)	242 Minutes
Specimen '18'	242 Minutes (No failure)	242 Minutes
Specimen '19'	242 Minutes (No failure)	242 Minutes
Specimen '20'	242 Minutes (No failure)	242 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 '12'

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 8 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 9 minutes. The maximum temperature rise was 584 °C measured by thermocouple S2 after a heating period of 110 minutes.

Specimen '13'

The 140 °C rise of the mean temperature of the unexposed surface of specimen reached after a heating period of 6 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 7 minutes. The maximum temperature rise was 859 °C measured by thermocouple S4 after a heating period of 181 minutes.

Specimen '14'

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 S8 after a heating period of 32 minutes. The maximum temperature rise was 375 °C measured by thermocouple S8 after a heating period of 242 minutes.

Specimen '15'

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 111 °C measured by thermocouple S15 after a heating period of 242 minutes.

Specimen '16'

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 29 °C measured by thermocouple S17 after a heating period of 169 minutes.

Specimen '17'

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 170 °C measured by thermocouple S21 after a heating period of 242 minutes.

Specimen '18'

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 81 °C measured by thermocouple S25 after a heating period of 235 minutes.

Specimen '19'

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 179 °C measured by thermocouple S25 after a heating period of 242 minutes.

Specimen '20'

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 76 °C measured by thermocouple S27 after a heating period of 242 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 '12'

The specimen met the integrity requirements after a heating period of 242 minutes.

Specimen '13'

The specimen met the integrity requirements after a heating period of 242 minutes.

Specimen '14'

The specimen met the integrity requirements after a heating period of 242 minutes.

Specimen '15'

The specimen met the integrity requirements after a heating period of 242 minutes.

Specimen '16'

The specimen met the integrity requirements after a heating period of 242 minutes.

Specimen '17'

The specimen met the integrity requirements after a heating period of 242 minutes.

Specimen '18'

The specimen met the integrity requirements after a heating period of 242 minutes.

Specimen '19'

The specimen met the integrity requirements after a heating period of 242 minutes.

Specimen '20'

The specimen met the integrity requirements after a heating period of 242 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

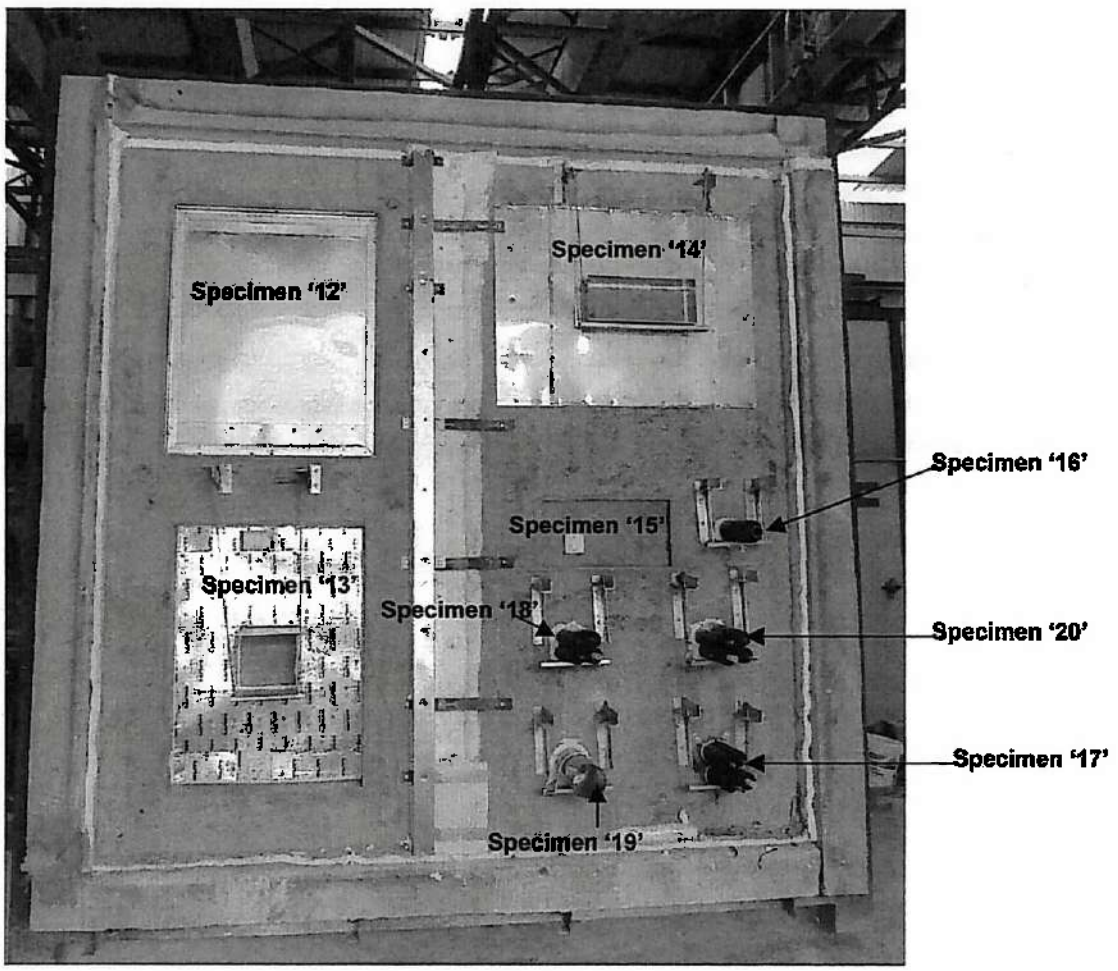


Photo 1: The exposed face of the specimens before the test.

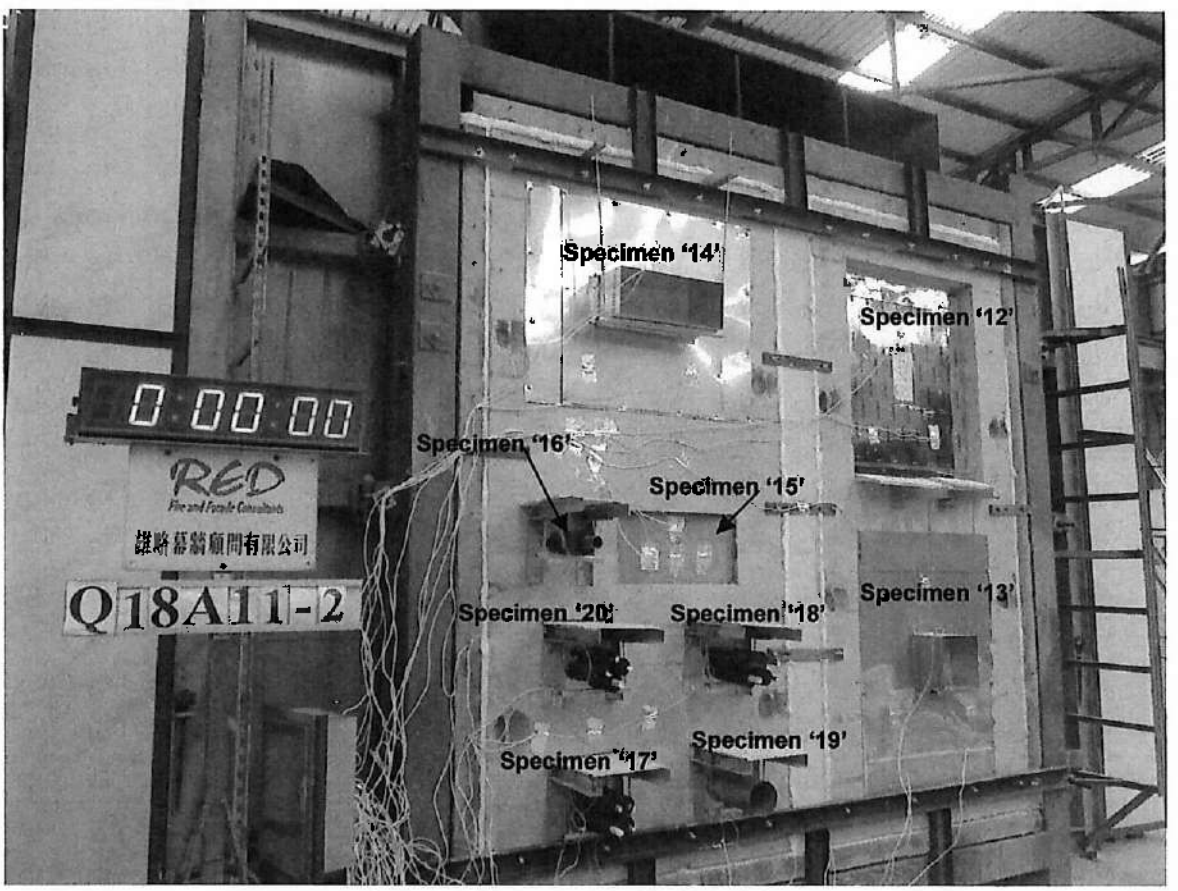


Photo 2: The unexposed face of the specimens before the test.

Photo 3: The unexposed face of the specimens after a heating period of 60 minutes.

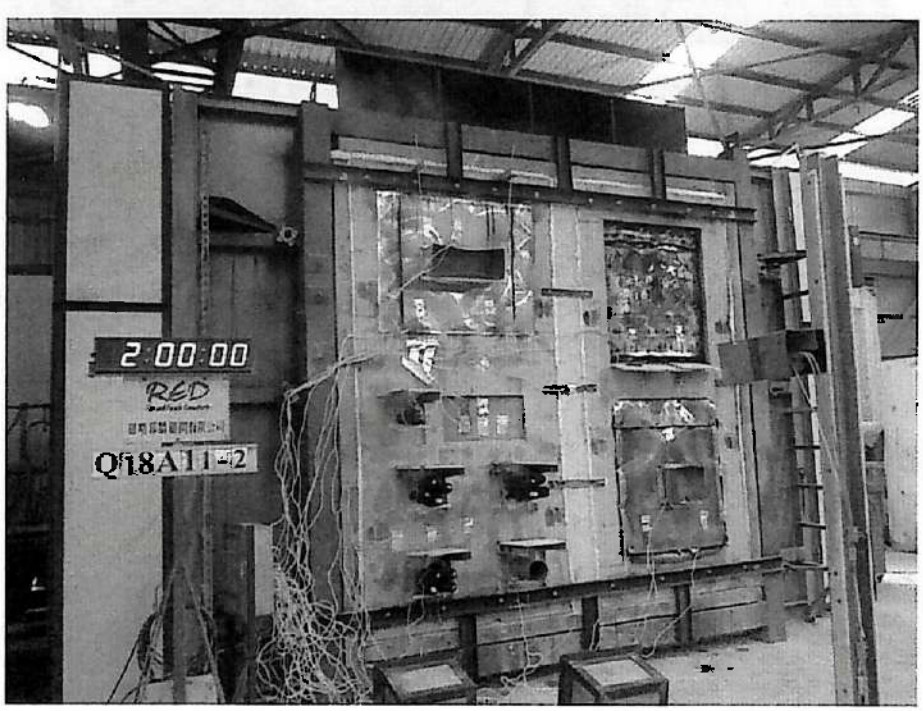


Photo 4: The unexposed face of the specimens after a heating period of 120 minutes.

Photo 5: The unexposed face of the specimens after a heating period of 180 minutes.

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

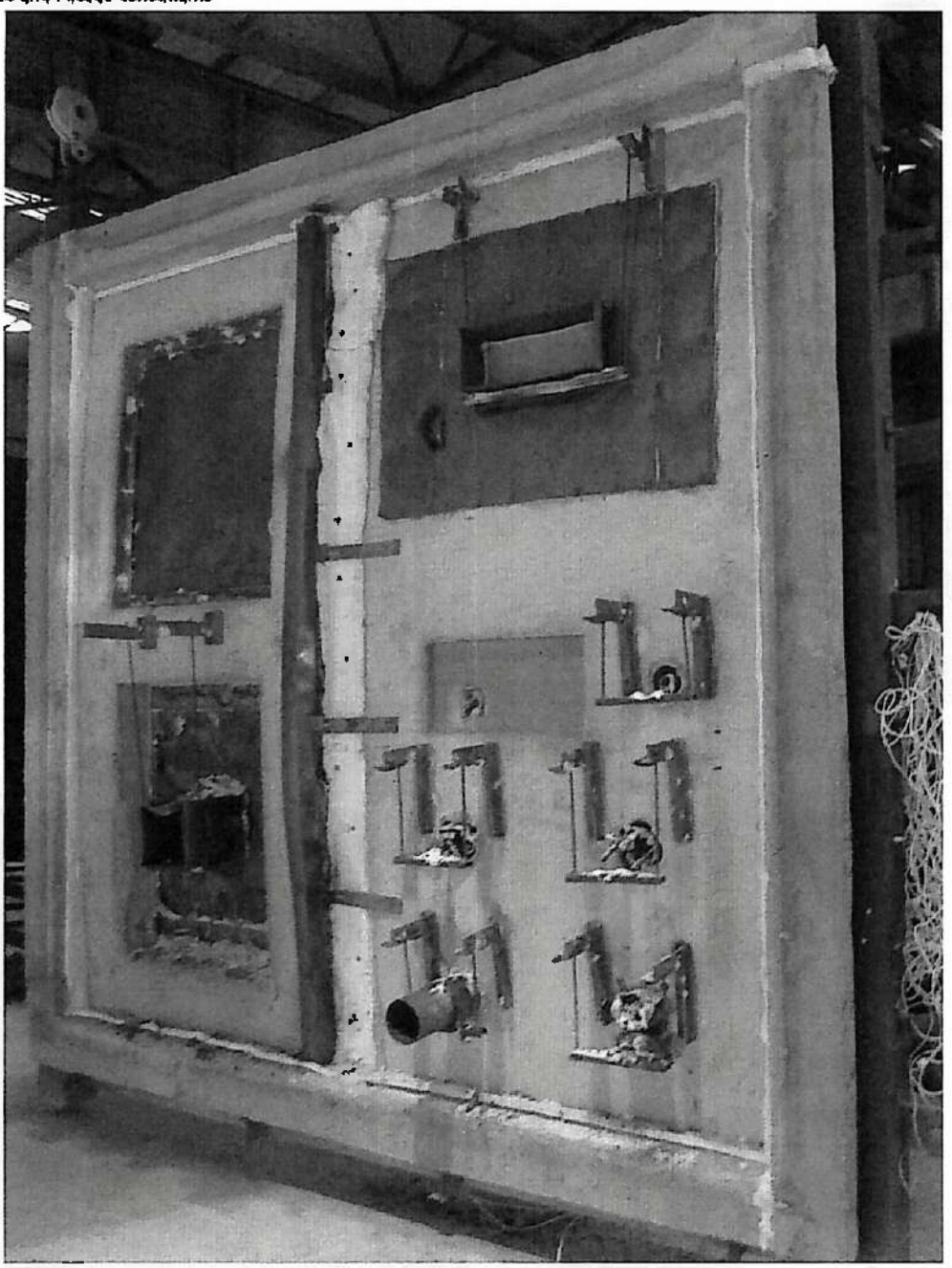


Photo 7: The exposed face of the specimens after the test.

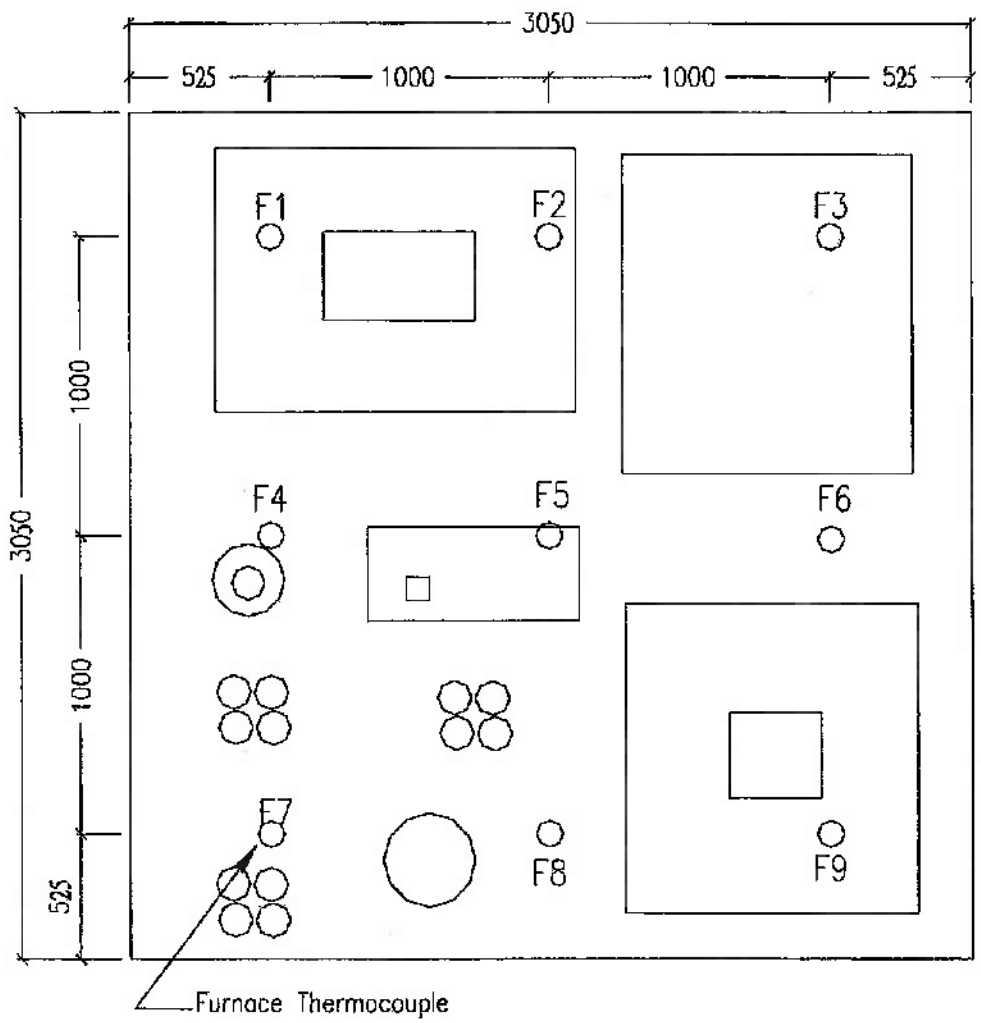


Figure 1 – Locations and reference numbers of furnace thermocouples.
(This figure is not to scale and all dimensions are in millimetres.)

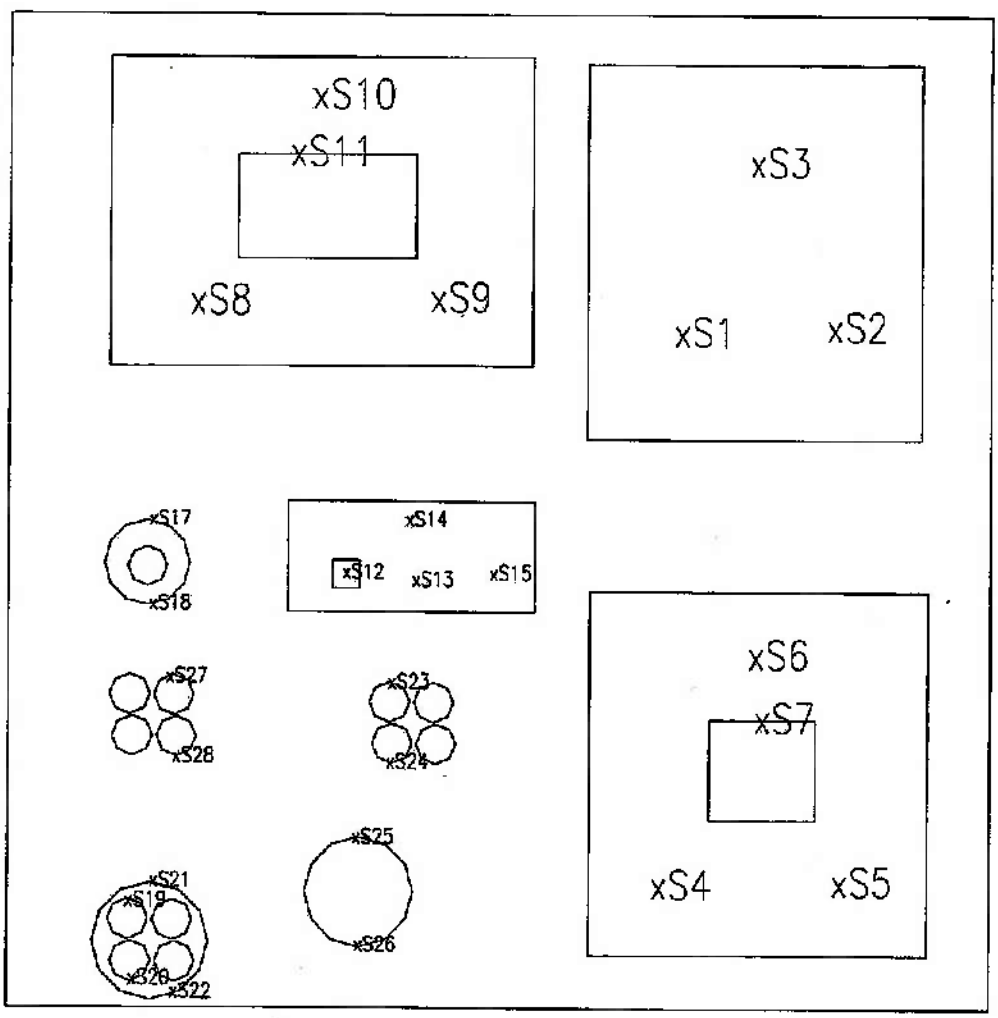


Figure 2 – Locations and reference number of thermocouples to monitor the temperature of unexposed surface of the specimens.
(This figure is not to scale.)

Note: Thermocouple S16 was fixed inside the socket box of specimen '15' for additional information only.

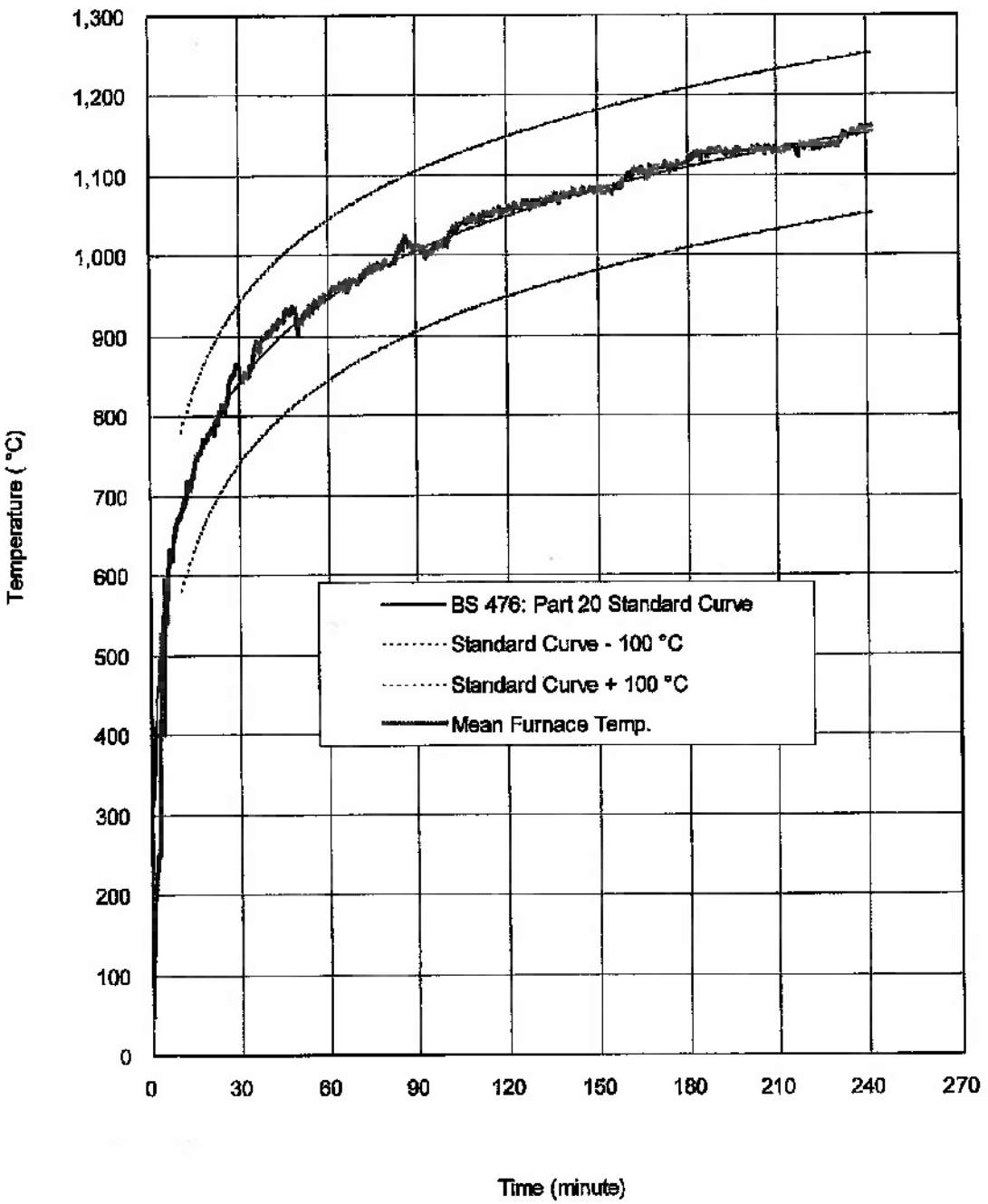


Figure 3 – Mean furnace temperature.

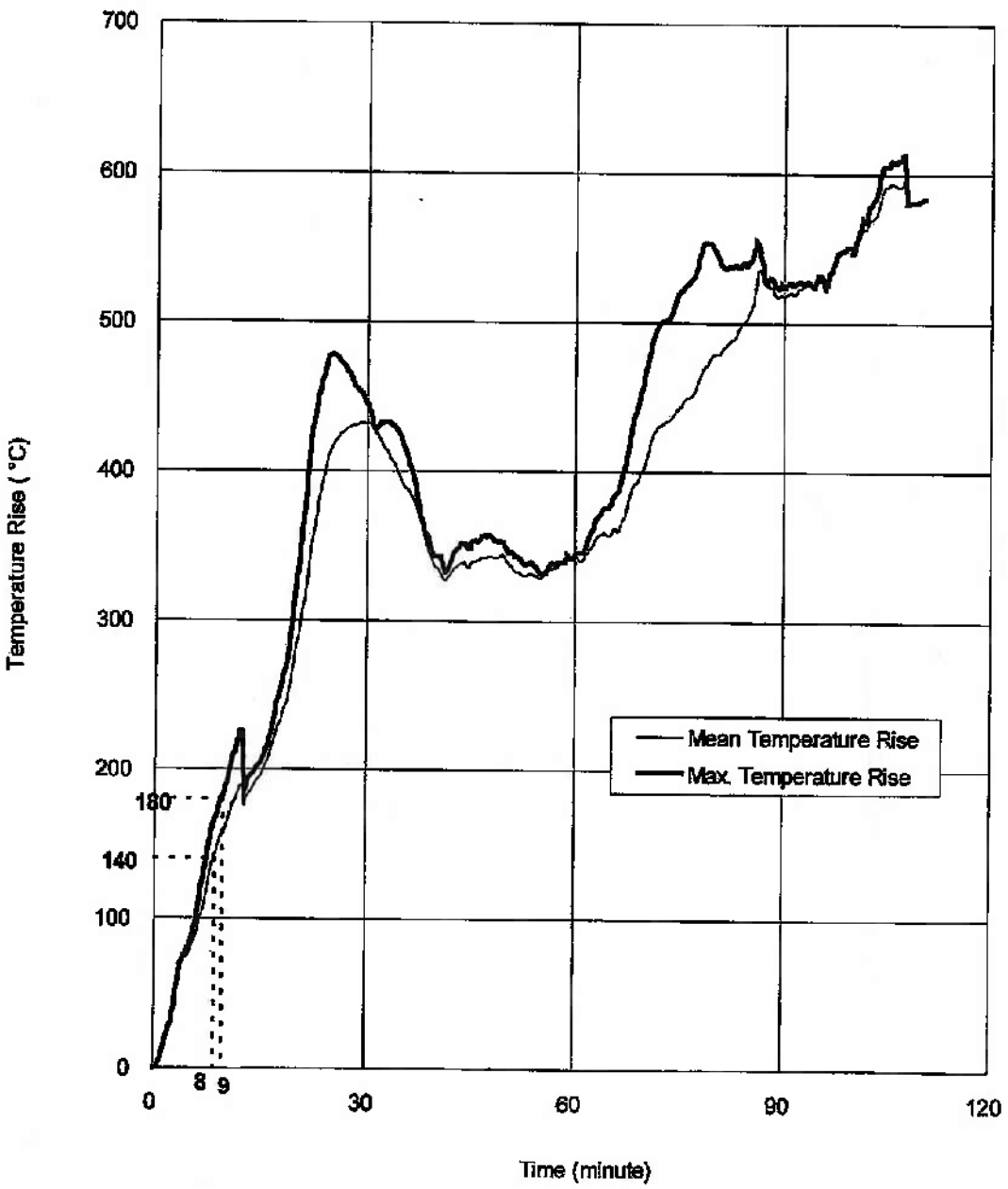


Figure 4 – Temperature rises of unexposed surface of specimen '12'.

Note: Thermocouples S1 – S3 malfunctioned after a heating period of 110 minutes.

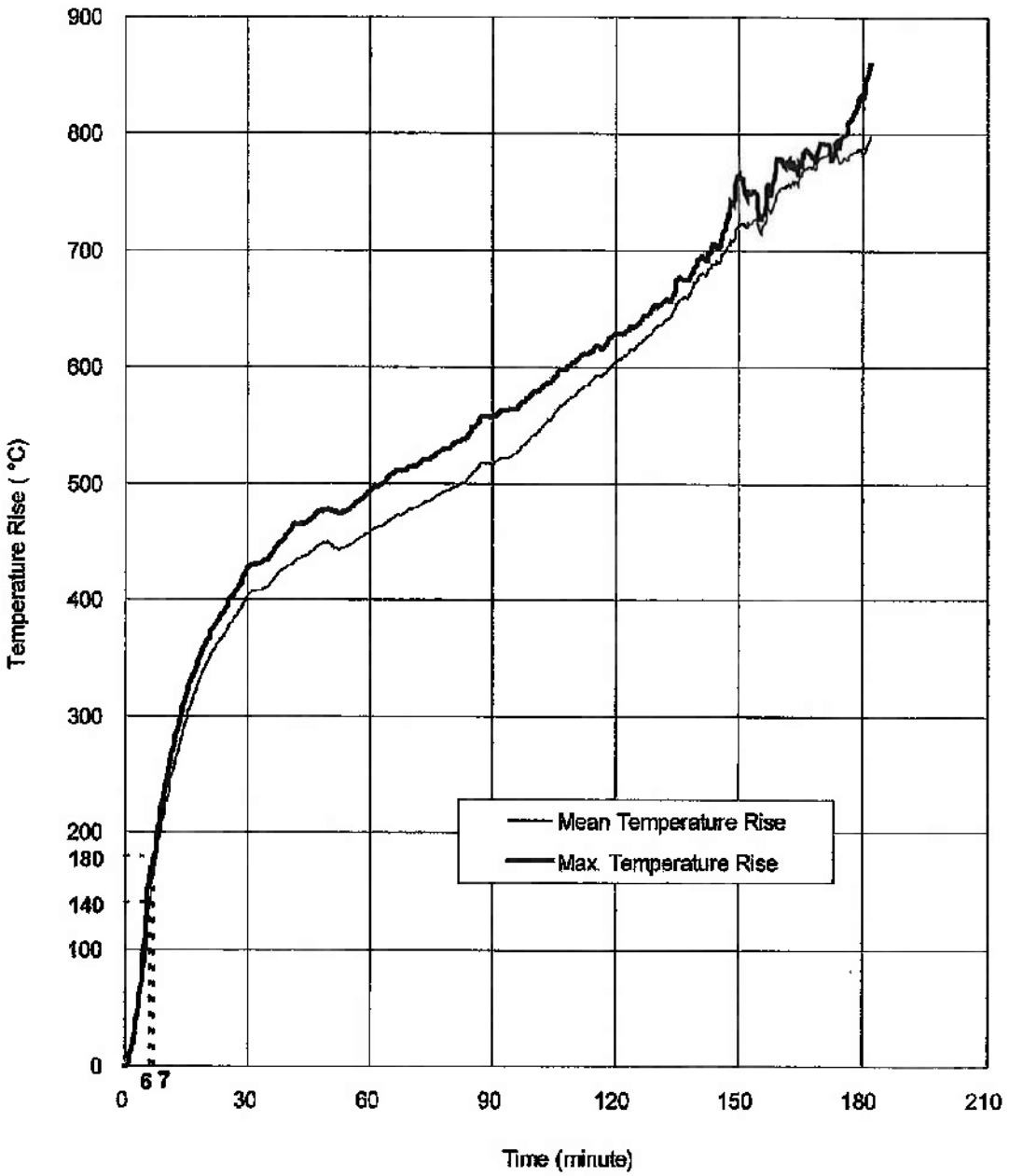


Figure 5 – Temperature rises of unexposed surface of specimen '13'.

Note: Thermocouples S4 - S7 malfunctioned after a heating period of 161 minutes.

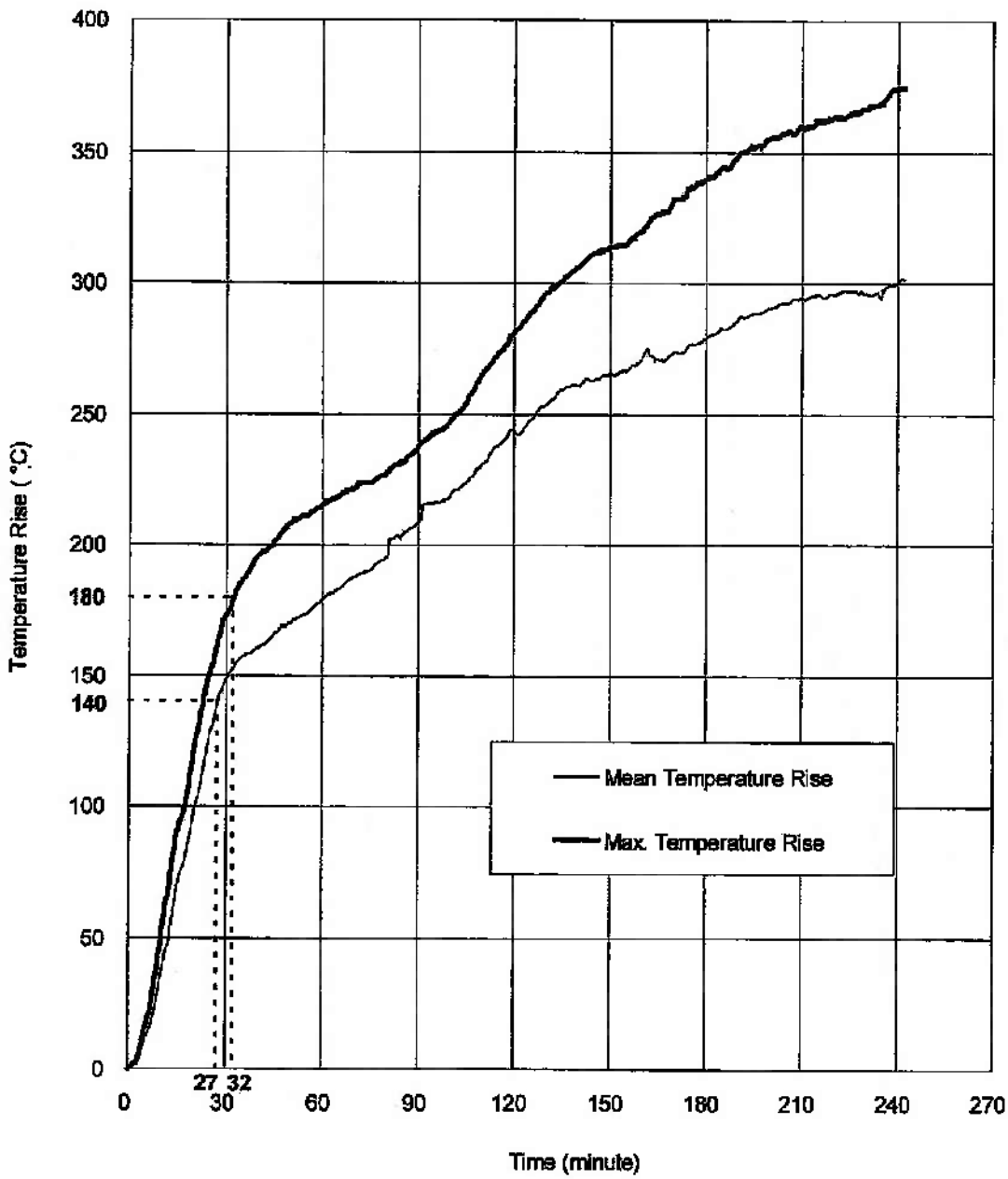


Figure 6 – Temperature rises of unexposed surface of specimen '14'.

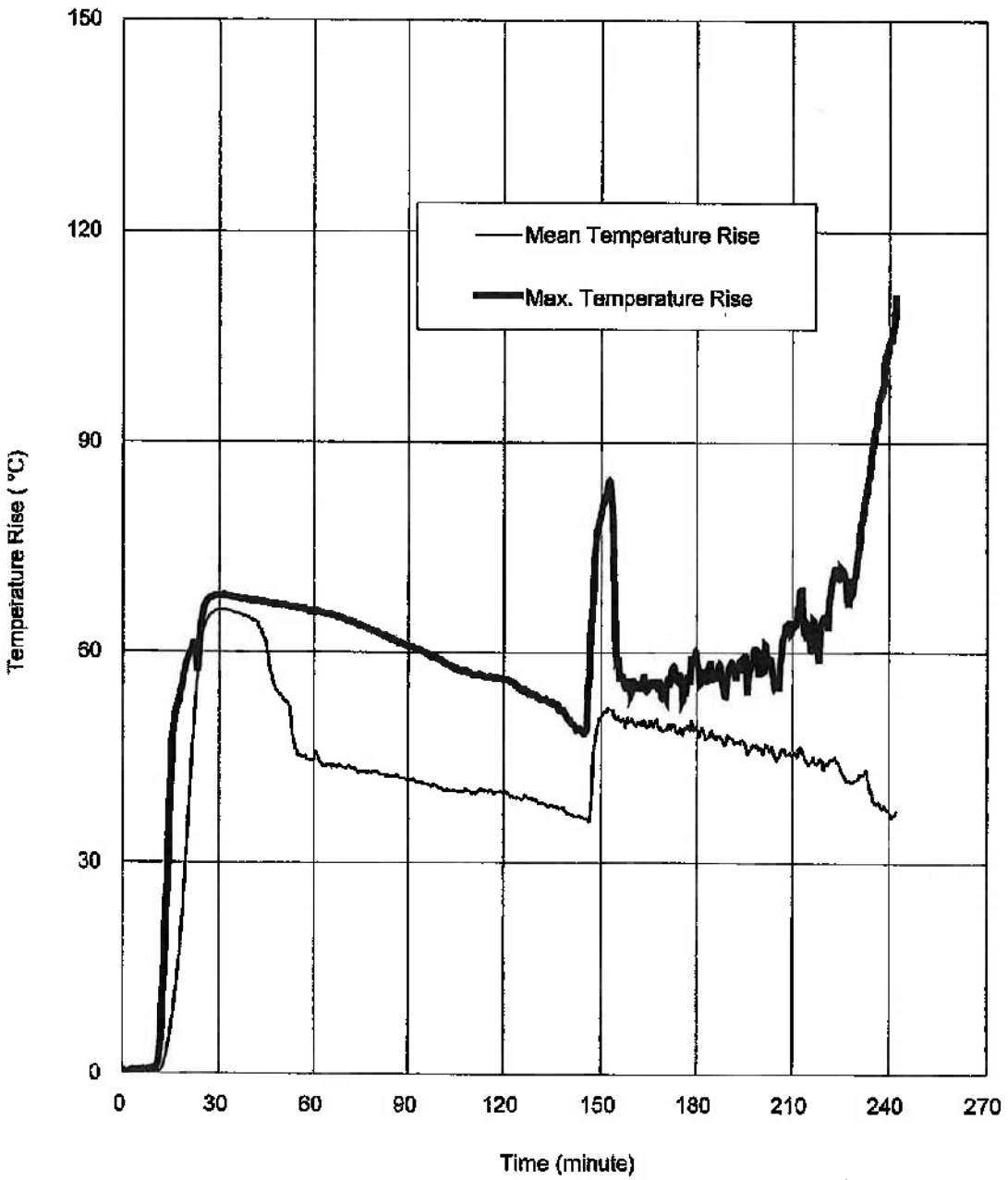


Figure 7 – Temperature rises of unexposed surface of specimen '15'.

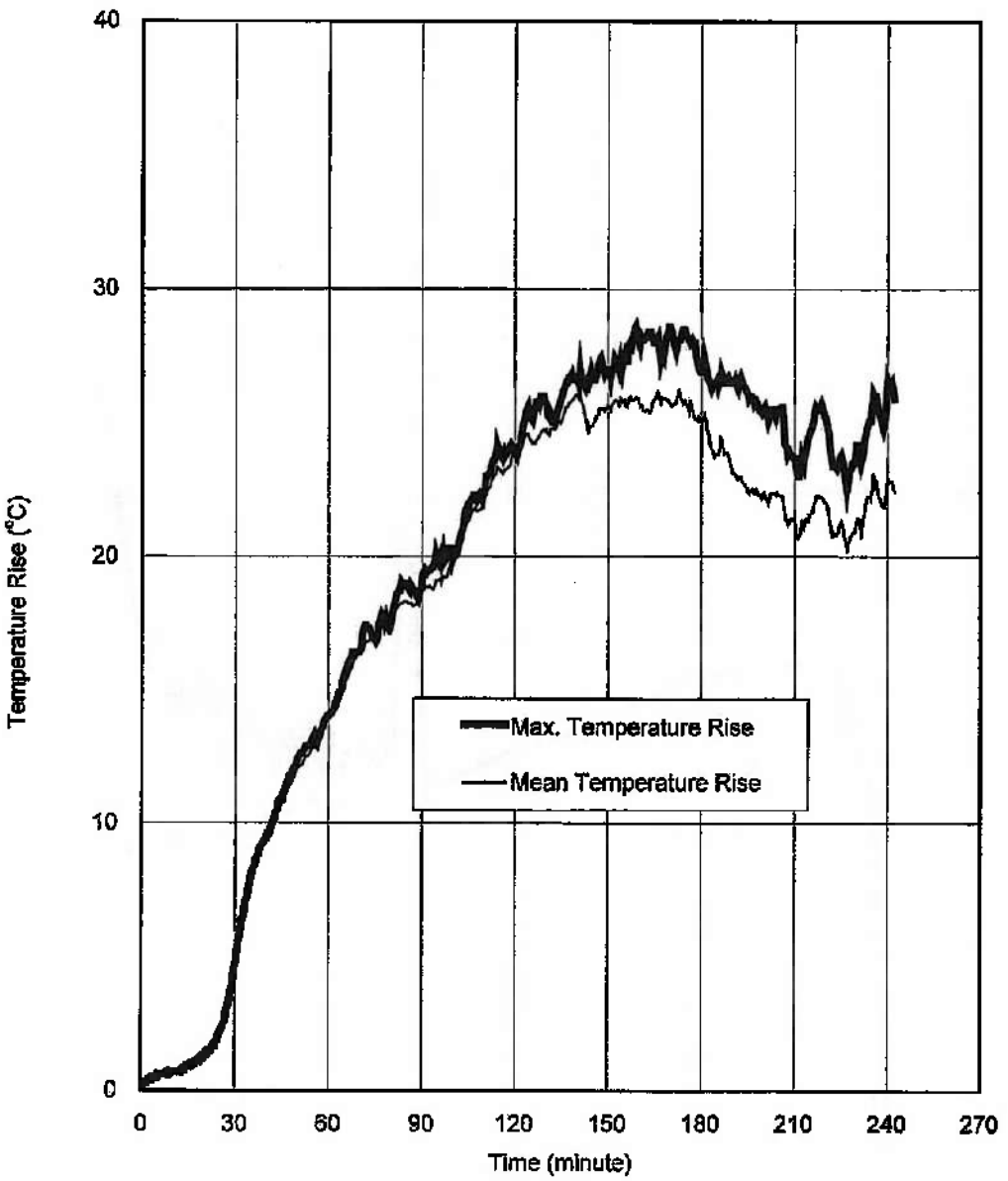


Figure 8 – Temperature rises of unexposed surface of specimen '16'.

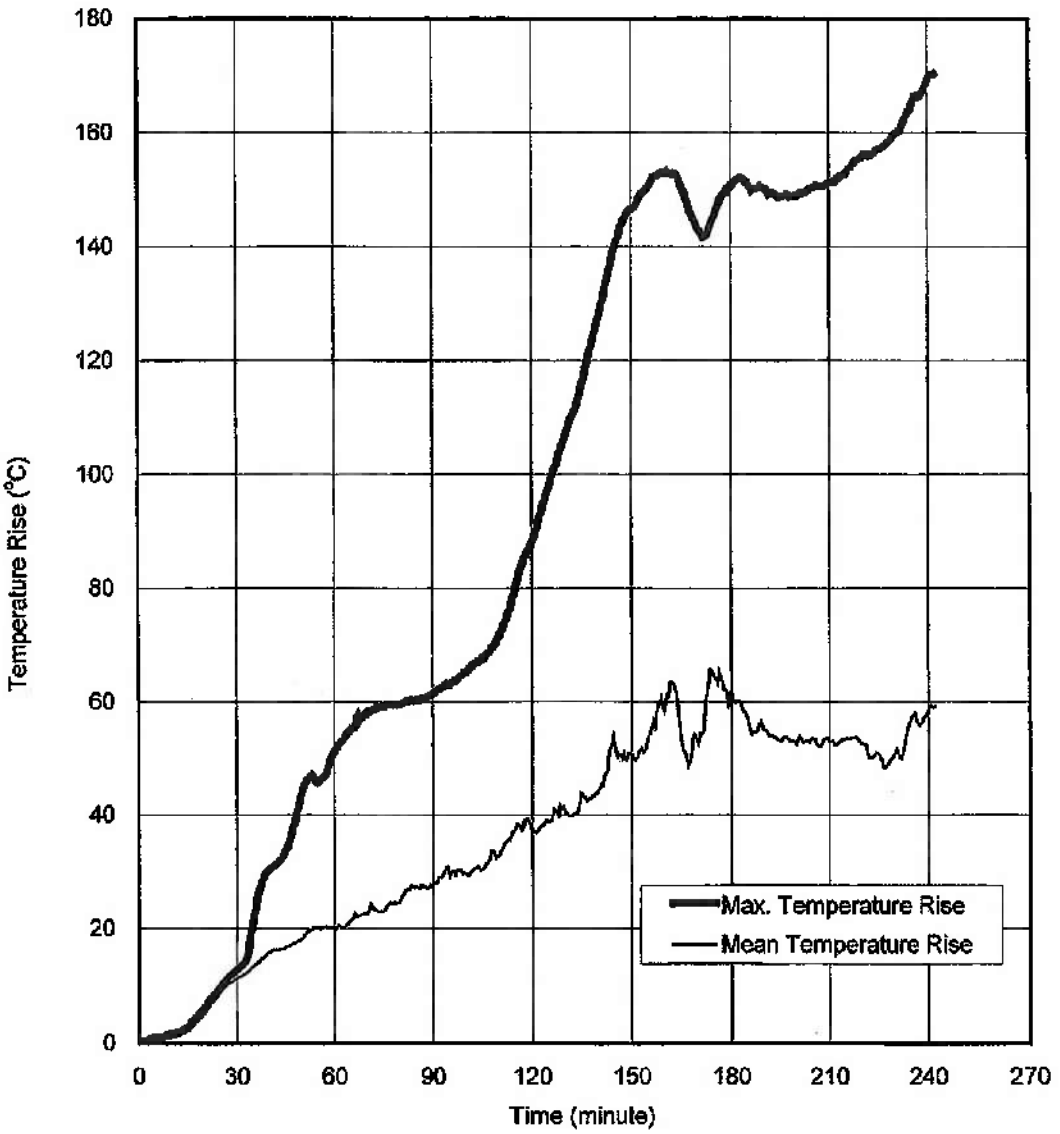


Figure 9 – Temperature rises of unexposed surface of specimen '17'.

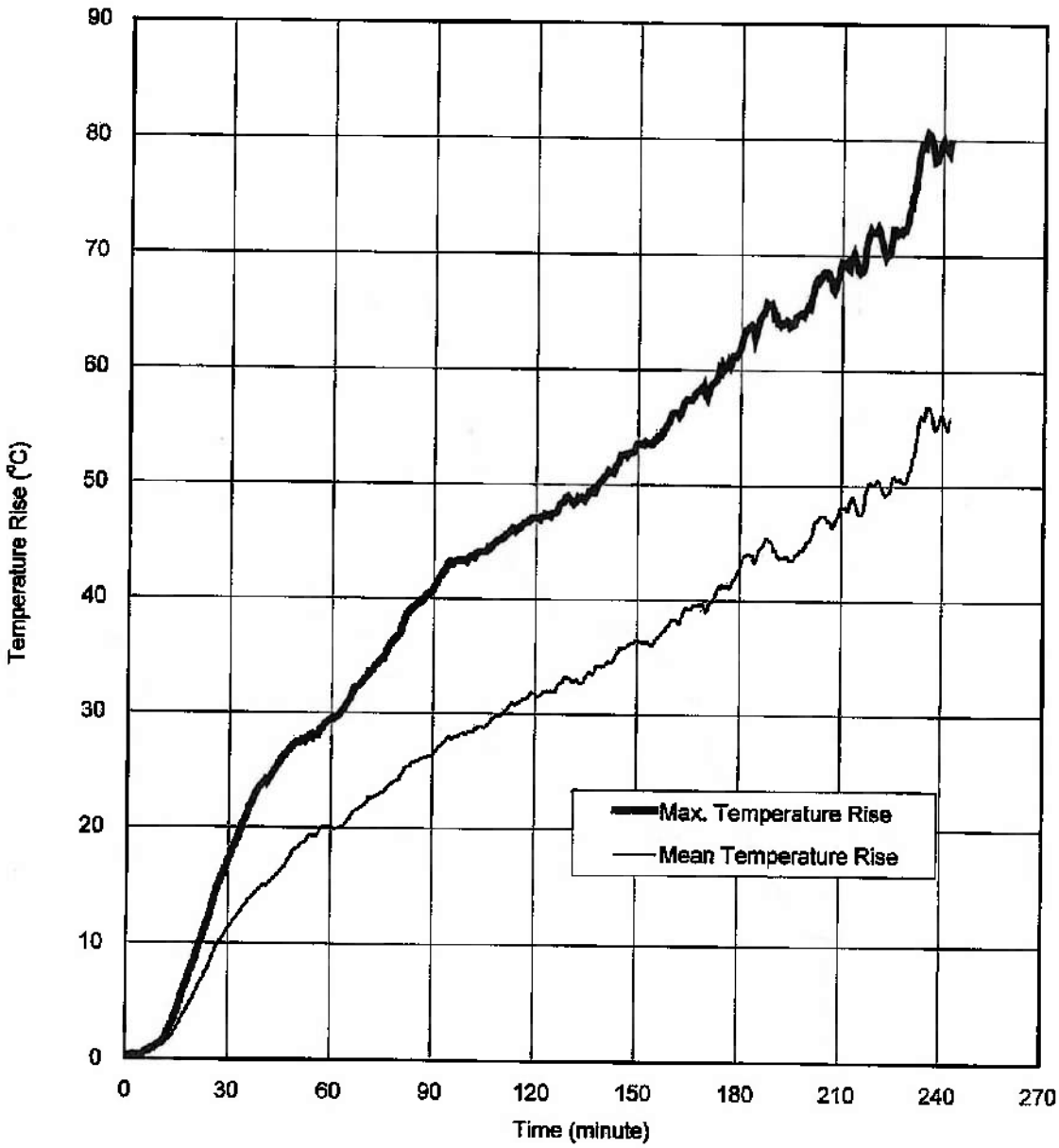


Figure 10 – Temperature rises of unexposed surface of specimen '18'.

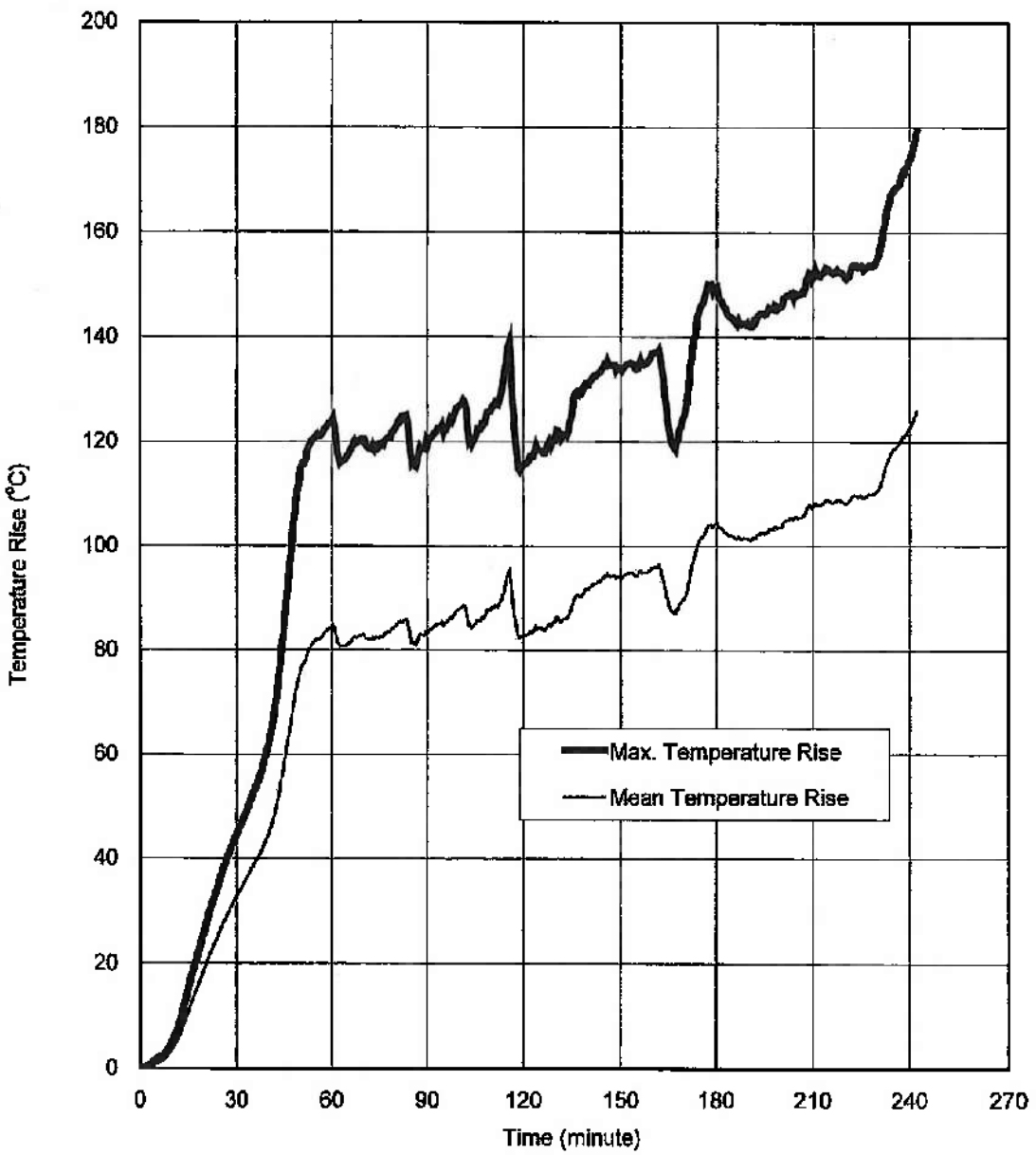


Figure 11 – Temperature rises of unexposed surface of specimen '19'.

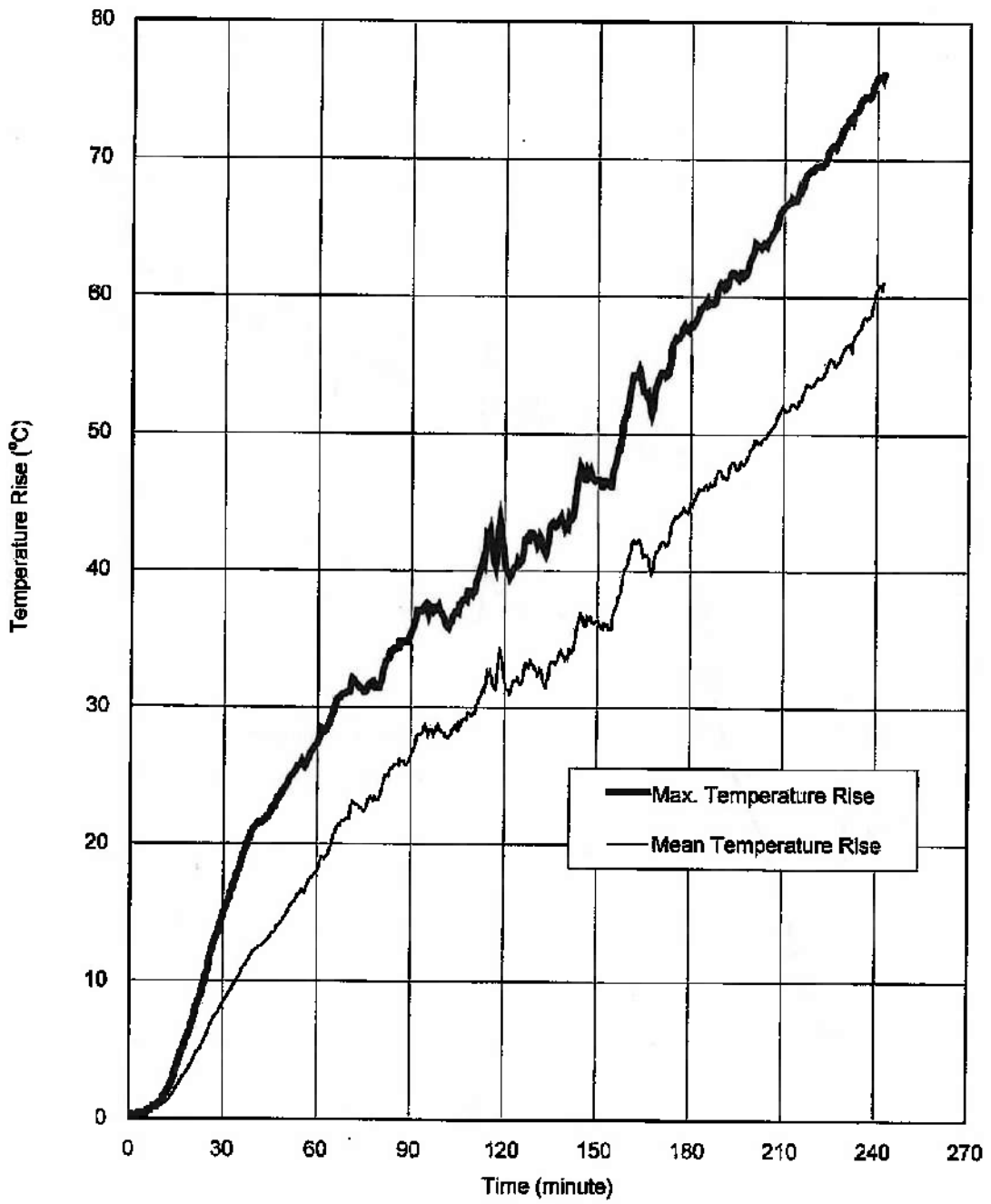


Figure 12 – Temperature rises of unexposed surface of specimen '20'.

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

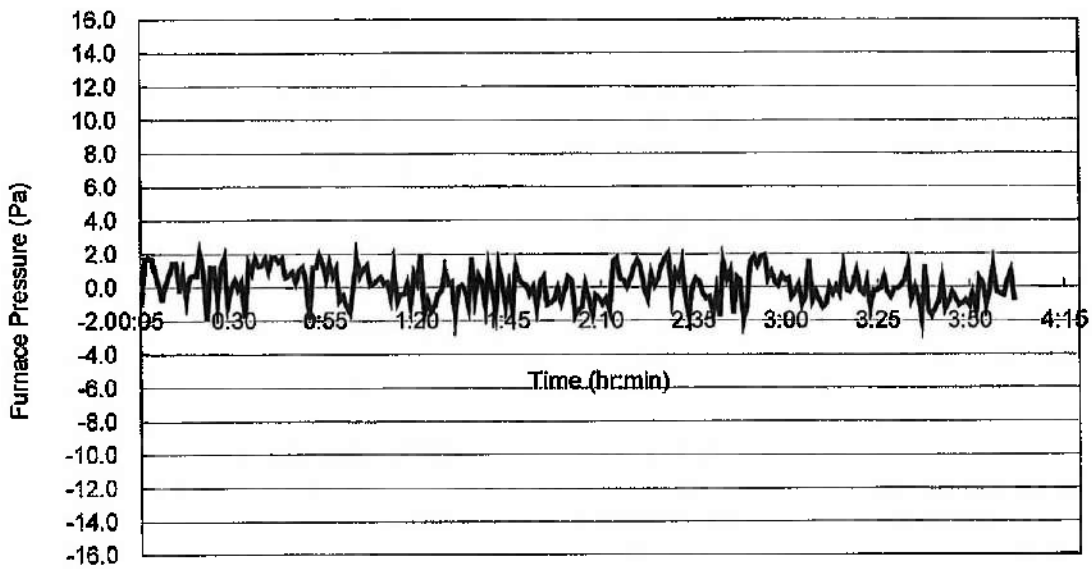


Figure 13 – Furnace pressure.

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

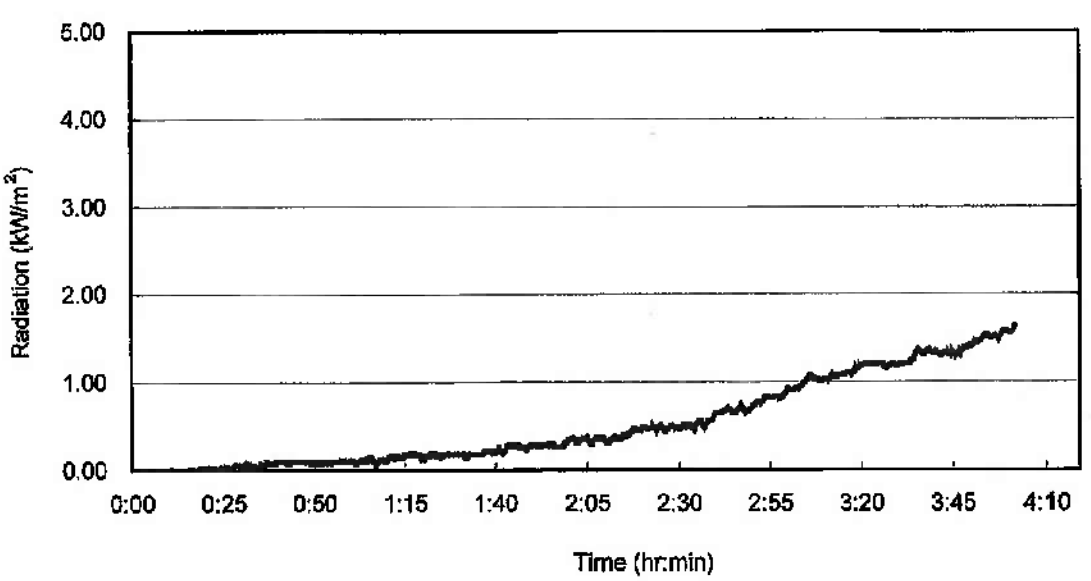


Figure 14 – Radiation.

APPENDIX B – Observation

Time (min.sec)	Exposed (E) or Unexposed (U)	Observation
00.00	-	Test started.
01.30	U	Smoke started releasing from specimen '18'.
01.49	U	Smoke started releasing from specimens '17' & '20'
02.21	U	Bubbles was observed from specimen '12'.
03.16	U	The pipe of specimen '14' deformed.
03.30	U	Smoke started releasing from specimens '13' & '14'
03.45	U	Specimen '12' deformed and moved away from the furnace.
09.37	U	Intumescent materials of specimens '12' & '13' reacted.
21.00	U	Specimen '12' turned dark.
21.34	U	Specimen '13' turned brown.
21.53	U	Water mark was observed at specimen '15'.
25.31	U	Smoke release increased from specimen '16'.
52.54	U	Joint of firestop composite sheet of specimens '12' & '13' turned red.
53.52	U	Cotton pad test applied at top of specimen '17' and the test passed.
54.13	U	Cotton pad test applied at top of specimen '20' and the test passed.
54.32	U	Cotton pad test applied at top of specimen '16' and the test passed.
54.51	U	Cotton pad test applied at top of specimen '19' and the test passed.
55.11	U	Cotton pad test applied at top of specimen '18' and the test passed.
55.25	U	Cotton pad test applied at top of specimen '15' and the test passed.
60.00	U	Specimens '12', '13' & '14' satisfied the integrity performance requirements. Specimens '15', '16', '17', '18', '19' & '20' satisfied the integrity and insulation performance requirements.
88.00	U	The sealant of specimen '18' turned brown.
102.00	U	Area above the socket box of specimen '15' turned yellow.
104.50	U	Intermitted flaming was observed at top of specimen '12'.
116.11	U	Cotton pad test applied at top of specimen '17' and the test passed.
116.28	U	Cotton pad test applied at top of specimen '20' and the test passed.
116.58	U	Cotton pad test applied at top of specimen '16' and the test passed.
117.14	U	Cotton pad test applied at top of specimen '19' and the test passed.
117.32	U	Cotton pad test applied at top of specimen '18' and the test passed.
117.50	U	Cotton pad test applied at top of specimen '15' and the test passed.

(To be continued)

Appendix B – Observation (Con't)

Time (min.sec)	Exposed (E) or Unexposed (U)	Observation
120.00	U	Specimens '12', '13' & '14' satisfied the integrity performance requirements. Specimens '15', '16', '17', '18', '19' & '20' satisfied the integrity and insulation performance requirements.
150.00	U	No significant change was observed from all specimens.
179.00	U	Specimens '12' & '13' turned red.
180.00	U	No significant change was observed from specimens '14' to '20'. Specimens '12', '13' & '14' satisfied the integrity performance requirements. Specimens '15', '16', '17', '18', '19' & '20' satisfied the integrity and insulation performance requirements.
200.00	U	Sealant of specimens '18' & '19' turned dark.
205.00	U	Putty pad of specimen '15' reacted.
211.00	U	All copper pipes turned dark.
233.45	U	Cotton pad test applied at top of specimen '20' and the test passed.
234.10	U	Cotton pad test applied at top of specimen '17' and the test passed.
234.25	U	Cotton pad test applied at top of specimen '16' and the test passed.
234.50	U	Cotton pad test applied at top of specimen '19' and the test passed.
235.10	U	Cotton pad test applied at top of specimen '18' and the test passed.
235.30	U	Cotton pad test applied at top of specimen '15' and the test passed.
238.17	U	No significant change was observed from specimens '12' to '14'.
240.00	U	Specimens '12', '13' & '14' satisfied the integrity performance requirements. Specimens '15', '16', '17', '18', '19' & '20' satisfied the integrity and insulation performance requirements.
242.05	–	Test was terminated as requested by test sponsor.

APPENDIX C – Data Recorded During the Test

Table 1 - Mean furnace temperature.

Time (minute)	BS 476: Part 20 Standard Curve (°C)	Actual Mean Furnace Temp. (°C)
0	20	49
5	576	541
10	678	680
15	739	747
20	781	778
25	815	804
30	842	852
35	865	883
40	885	903
45	902	920
50	918	906
55	932	939
60	945	950
65	957	964
70	968	963
75	979	982
80	988	990
85	997	1007
90	1006	1013
95	1014	1004
100	1022	1011
105	1029	1040
110	1036	1043
115	1043	1049
120	1049	1056
125	1055	1061
130	1061	1066
135	1067	1069

(To be continued)

Table 1 - Mean furnace temperature (con't).

Time (minute)	BS 476: Part 20 Standard Curve (°C)	Actual Mean Furnace Temp. (°C)
140	1072	1073
145	1077	1082
150	1082	1082
155	1087	1085
160	1092	1098
165	1097	1103
170	1101	1109
175	1106	1112
180	1110	1120
185	1114	1128
190	1118	1130
195	1122	1124
200	1126	1131
205	1129	1134
210	1133	1133
215	1136	1135
220	1140	1136
225	1143	1136
230	1146	1138
235	1150	1153
240	1153	1160
242	1154	1162

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 242 minutes.

Table 2 - Time and related temperature rises measured by thermocouples S1 – S14.

Time (min)	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	77	74	83	119	84	78	25	10	8	15	4	1	0	0
10	155	143	188	215	240	218	94	34	21	48	20	1	0	0
15	204	187	–	271	318	299	144	71	45	89	29	42	1	12
20	313	238	–	318	364	353	169	99	66	118	37	58	22	41
25	478	360	–	356	398	377	185	140	93	152	47	42	66	61
30	445	420	–	382	428	403	194	173	101	173	55	37	68	64
35	363	421	–	387	436	413	199	186	107	178	62	34	68	63
40	344	327	–	402	458	428	207	196	113	173	71	25	67	62
45	353	325	–	412	468	439	211	201	118	178	77	22	67	54
50	350	333	–	421	479	447	214	208	120	183	82	16	67	40
55	332	325	–	417	479	445	213	211	124	185	94	18	66	24
60	343	344	–	427	494	455	216	215	128	194	101	21	66	23
65	339	376	–	436	506	462	218	219	132	199	110	22	66	22
70	347	470	–	446	515	475	219	222	137	204	115	24	65	22
75	369	521	–	452	522	486	219	224	141	207	114	24	64	22
80	409	548	–	461	533	494	222	228	146	212	116	24	63	23
85	477	542	–	472	547	506	225	232	160	220	118	26	62	23
90	525	512	–	478	557	516	229	238	163	225	118	26	61	23
95	526	533	–	484	564	526	230	243	176	230	123	24	60	22
100	545	548	–	502	579	542	231	247	176	234	123	24	59	23
105	606	578	–	516	590	570	236	254	178	239	124	25	58	23
110	–	583	–	534	605	589	241	265	180	247	128	27	57	23
115	–	–	–	552	619	608	247	273	184	258	133	29	57	24
120	–	–	–	567	628	622	247	281	188	263	132	28	56	24
125	–	–	–	583	636	637	248	288	181	274	137	28	55	23
130	–	–	–	608	653	645	251	296	185	281	140	29	54	24
135	–	–	–	633	675	659	254	301	186	291	146	30	53	24
140	–	–	–	655	690	680	254	306	185	292	149	32	51	24
145	–	–	–	673	703	693	260	311	181	297	148	35	49	24

(To be continued)

Table 2 - Time and related temperature rises measured by thermocouples S1 – S14 (con't).

Time (min)	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
150	--	--	--	690	765	711	259	314	183	299	152	80	52	49
155	--	--	--	705	727	727	258	315	185	300	154	59	51	50
160	--	--	--	740	779	744	270	320	191	307	156	56	50	50
165	--	--	--	761	774	760	272	326	175	311	155	55	49	50
170	--	--	--	779	792	769	272	332	175	315	154	54	48	50
175	--	--	--	798	760	775	282	336	176	320	159	56	47	50
180	--	--	--	829	726	794	286	340	176	321	163	59	48	50
185	--	--	--	--	--	--	--	344	178	326	164	56	47	50
190	--	--	--	--	--	--	--	348	180	331	166	58	46	51
195	--	--	--	--	--	--	--	352	182	331	164	60	44	51
200	--	--	--	--	--	--	--	355	182	335	165	58	41	52
205	--	--	--	--	--	--	--	358	183	337	167	56	40	51
210	--	--	--	--	--	--	--	360	184	339	166	64	39	52
215	--	--	--	--	--	--	--	362	185	340	167	63	38	51
220	--	--	--	--	--	--	--	363	186	338	168	66	36	52
225	--	--	--	--	--	--	--	365	185	341	167	72	36	51
230	--	--	--	--	--	--	--	367	183	339	169	71	35	49
235	--	--	--	--	--	--	--	369	184	339	174	75	35	43
240	--	--	--	--	--	--	--	374	185	342	175	73	34	41
242	--	--	--	--	--	--	--	375	186	344	178	78	36	39

Notes: Locations of thermocouples S1 – S14 are shown in Figure 2.

Thermocouples S1, S2 & S3 malfunctioned after heating periods of 107, 111 and 12 minutes respectively.

Thermocouples S4, S5, S6 & S7 malfunctioned after a heating period 181 minutes.

The test was terminated as requested by the test sponsor after a heating period of 242 minutes.

Table 3 - Time and related temperature rises measured by thermocouples S15 – S28.

Time (min)	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24	S25	S26	S27	S28
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	1	1	1	1	1	0	0	0	0	1	0	0	0
10	0	1	1	1	1	2	0	0	1	1	5	2	1	1
15	1	53	1	1	3	3	1	0	4	1	15	6	3	1
20	6	67	1	1	6	5	1	0	8	2	26	12	7	1
25	18	67	2	2	10	8	3	1	13	4	37	17	11	2
30	31	67	5	5	13	10	4	1	17	5	45	21	15	2
35	44	67	8	8	17	11	22	2	21	6	52	25	18	3
40	52	67	9	9	20	13	31	3	24	6	62	28	21	3
45	55	66	11	11	21	13	34	4	26	7	85	31	22	4
50	56	66	12	12	23	14	44	6	28	9	114	38	24	5
55	56	66	13	13	26	15	46	9	28	11	121	43	26	7
60	55	65	14	14	25	15	51	27	30	11	124	45	27	9
65	55	65	16	15	27	16	55	52	31	10	117	45	30	11
70	55	64	17	16	28	17	58	57	33	11	121	45	31	13
75	54	64	17	17	29	17	59	59	35	11	119	46	31	14
80	54	66	18	17	30	20	60	57	37	12	123	46	32	15
85	54	75	19	18	32	22	60	57	40	12	116	47	34	17
90	54	64	19	18	33	23	61	58	41	12	119	47	36	18
95	54	53	20	18	36	24	63	59	43	13	122	48	37	19
100	54	53	20	19	36	23	65	55	43	13	127	49	37	20
105	54	57	22	21	39	22	67	53	44	14	121	49	37	20
110	54	66	22	22	42	24	71	52	45	14	126	49	39	21
115	53	72	24	23	51	25	80	51	46	16	138	51	43	22
120	53	75	24	24	50	24	88	53	47	16	116	50	40	23
125	52	80	25	24	53	25	98	52	48	16	118	50	41	23
130	46	86	26	24	55	26	107	52	49	18	122	51	42	23
135	44	92	26	24	59	29	116	50	49	18	126	51	43	23
140	43	96	27	25	62	27	128	50	51	18	131	53	43	24
145	41	102	27	23	67	38	140	49	53	19	135	54	47	26

(To be continued)

Table 3 - Time and related temperature rises measured by thermocouples S15 – S28 (con't).

Time (min)	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24	S25	S26	S27	S28
150	51	124	27	24	71	31	147	53	54	19	134	54	47	26
155	50	133	27	24	77	29	150	53	54	19	134	55	47	26
160	47	136	28	23	80	41	153	53	56	20	137	55	53	30
165	42	138	28	24	73	32	150	53	57	21	122	55	53	29
170	39	138	29	23	64	41	143	54	58	20	126	55	54	30
175	35	141	28	23	83	45	146	61	60	22	146	57	57	31
180	37	152	27	23	76	47	151	75	62	24	150	59	58	32
185	36	153	27	21	66	48	151	84	64	24	144	60	60	33
190	37	162	27	20	64	46	150	88	65	24	142	61	61	33
195	37	171	26	19	57	49	149	91	64	23	144	61	61	34
200	37	181	26	19	59	47	149	94	66	25	146	61	63	35
205	39	192	26	19	59	47	150	99	69	26	148	63	64	36
210	42	197	24	19	56	50	151	101	69	27	152	64	67	37
215	48	202	25	19	58	50	153	105	69	27	153	65	68	37
220	54	203	25	19	57	48	156	107	72	28	151	65	70	38
225	62	195	24	19	54	48	157	108	72	29	153	66	71	40
230	73	191	24	19	57	45	160	107	74	29	155	66	73	40
235	89	191	26	20	66	49	165	119	80	33	168	69	74	41
240	104	196	27	19	64	52	169	128	80	33	174	71	76	45
242	111	196	26	19	62	57	170	131	80	32	179	72	76	46

Notes: Locations of thermocouples S15 - S28 are shown in Figure 2.

Thermocouple S16 was for additional information only.

The test was terminated as requested by the test sponsor after a heating period of 242 minutes.

APPENDIX D – Information from Test Sponsor

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

Specimen '12'

Item	Description		
1	**Firestop Composite Sheets**		
	Brand	:	Hilti.#
	Model	:	CFS-COS.#
	Material	:	Intumescent stainless steel composite sheet.
	Overall sizes	:	910 mm wide by 910 mm high by 3.8 mm thick.*
	Exposed area	:	910 mm wide by 910 mm high.*
	Fixing method	:	The Firestop Composite Sheets were joined together with M5 by 25 mm long screws at 250 mm nominal centres and fixed to L-angles with sizes of 50 mm by 50 mm by 3 mm thick at four sides. The L-angles was fixed the concrete with M6 by 54 mm long anchor bolts at 250 mm nominal centres..#
	Direction	:	Stainless steel facing was faced at fire exposed side.#

*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 is not verified by RED or unless specified.)

Specimen '13'

Item	Description		
1	**Firestop Composite Sheets**		
	Brand	:	Hilti.#
	Model	:	CFS-COS.#
	Material	:	Intumescent stainless steel composite sheet.
	Overall sizes	:	910 mm wide by 1,200 mm high by 3.8 mm thick.*
	Exposed area	:	810 mm wide by 1,110 mm high.*
	Fixing method	:	The Firestop Composite Sheets were joined together with M5 by 25 mm long screws at 250 mm nominal centres and fixed to L-angles with sizes of 50 mm by 50 mm by 5 mm thick at four sides. The L-angles was fixed the concrete with M6 by 54 mm long anchor bolts at 250 mm nominal centres..#
	Direction	:	Stainless steel facing was faced at unexposed side.#
2	**Rockwool**		
	Brand	:	ROCKWOOL.#
	Thickness	:	50 mm.*
	Density	:	160 kg/m^3.*
	Applied location	:	Cover opening of metal sleeve.#
3	**G.I. Pipe**		
	Sizes	:	250 mm by 250 mm by 1 mm thick.*
	Materials	:	Galvanized steel.#
	Fixing method	:	The pipes were supported by fixed to 40 mm by 20 mm by 3 mm thick steel L-angles, located at 120 mm from the concrete wall on both sides. The steel angles were supported by 2 nos. of M10 steel rods to the concrete lining.

*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 is not verified by RED or unless specified.)

Specimen '14'

Item	Description		
1	**Firestop Composite Sheets**		
	Brand	:	Hilti.#
	Model	:	CFS-COS 36x36.#
	Material	:	2 layers intumescent stainless steel composite sheet.
	Overall sizes	:	1,010 mm wide by 910 mm high by 3.8 mm thick.*
	Exposed area	:	900 mm wide by 810 mm high.*
	Fixing method	:	The Firestop Composite Sheets were joined together with M5 by 25 mm long screws at 250 mm nominal centres and fixed to L-angles with sizes of 50 mm by 50 mm by 5 mm thick at four sides. The L-angles was fixed the concrete with M6 by 54 mm long anchor bolts at 250 mm nominal centres..#
	Direction	:	Stainless steel facing was faced at both sides.#
2	**Rockwool**		
	Brand	:	ROCKWOOL.#
	Thickness	:	40 mm.*
	Density	:	160 kg/m^3.*
	Applied location	:	Covered the opening.#
3	**G.I. Pipe**		
	Sizes	:	500 mm by 200 mm by 1 mm thick.*
	Materials	:	Galvanized steel.#
	Fixing method	:	The pipes were supported by fixed to 40 mm by 20 mm by 3 mm thick steel L-angles, located at 120 mm from the concrete wall on both sides. The steel angles were supported by 2 nos. of M10 steel rods to the concrete lining.

*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 is not verified by RED or unless specified.)

Specimen '15'

Item	Description		
1	**Lightweight Blocks**		
	Brand	:	Ytong.#
	Material	:	Lightweight concrete.
	Overall sizes of wall	:	600 mm wide by 300 mm high by 81 mm thick.*
	Sizes for each block	:	600 mm wide by 300 mm high by 75 mm thick.*
	Density of block	:	750 kg/m^3.
	Thickness of plaster	:	3 mm thick on both sides of block.*
2	**Socket Boxes**		
	Sizes	:	2 nos. of 70 mm by 70 mm by 50 mm deep by 3.5 mm thick.*
	Materials	:	PVC.#
	Applied location	:	Embedded in both fire side and non-fire side of blockwall.#
3	**Firestop Putty Pad**		
	Brand	:	Hilti.#
	Model	:	CP617.#
	Materials	:	firestop putty pad.
	Applied location	:	Inner side of PVC socket box.#

*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 is not verified by RED or unless specified.)

Specimen '16'

Item	Description		
1	**PVC Pipe**		
	Material	:	PVC.#
	Overall sizes	:	48 mm outer diameter by 4 mm thick by 1,200 mm long.*
	Fixing method	:	The pipe was supported by fixed to 40 mm by 20 mm by 3 mm thick steel L-angles, located at 120 mm from the concrete wall on both sides. The steel angles ware supported by 2 nos. of M10 steel rods to the concrete lining.
2	**Rockwool**		
	Brand	:	ROCKWOOL.#
	Thickness	:	50 mm.*
	Density	:	160 kg/m^3.*
	Applied location	:	Covered the opening of pipes.#
3	**Insulation**		
	Brand & Model	:	Armacell Classo Armaflex.
	Sizes	:	25 mm thick by 750 mm long.*
	Applied location	:	Wrapped outside the PVC pipe.#
4	**Bandage**		
	Brand & Model	:	Hilti CFS-B.#
	Quantity	:	2 layers in the middle of wall.
	Applied location	:	Wrapped around insulated pipe.#
5	**Sealant**		
	Brand & Model	:	Hilti CP606.#
	Applied location	:	Filled the gaps between the pipe and concrete lining.

*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 is not verified by RED or unless specified.)

Specimen '17'

Item	Description		
1a	**PVC Pipe**		
	Material	:	PVC.#
	Overall sizes	:	1 no. of 25 mm outer diameter by 2 mm thick by 1,200 mm long.*
	Fixing method	:	The pipe was supported by fixed to 40 mm by 20 mm by 3 mm thick steel L-angles, located at 120 mm from the concrete wall on both sides. The steel angles were supported by 2 nos. of M10 steel rods to the concrete lining.
1b	**Copper Pipes**		
	Material	:	Copper.#
	Overall sizes	:	3 pairs of 12.7 mm outer diameter by 1 mm thick and 6.4 mm outer diameter by 1 mm thick 48 mm outer diameter by 4 mm thick by 1,200 mm long.*
	Fixing method	:	The pipes were supported by fixed to 40 mm by 20 mm by 3 mm thick steel L-angles, located at 120 mm from the concrete wall on both sides. The steel angles were supported by 2 nos. of M10 steel rods to the concrete lining.
2	**Rockwool**		
	Brand	:	ROCKWOOL.#
	Thickness	:	50 mm.*
	Density	:	160 kg/m^3.*
	Applied location	:	Covered the opening.#
3	**Insulation**		
	Brand & Model	:	Armacell Classo Armaflex.
	Sizes	:	25 mm thick by 750 mm long.*
	Applied location	:	Wrapped outside the pipes individually.#
4	**Collar**		
	Brand & Model	:	Hilti CFS-C EL.#
	Applied location	:	Wrapped around insulated pipes at both opening ends.#
5	**Foam**		
	Brand & Model	:	Hilti CFS-F FX.#
	Applied location	:	Filled the gaps between the pipe and concrete lining.

*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 is not verified by RED or unless specified.)

Specimen '18'

Item	Description		
1a	**PVC Pipe**		
	Material	:	PVC.#
	Overall sizes	:	1 no. of 25 mm outer diameter by 2 mm thick by 1,200 mm long.*
	Fixing method	:	The pipe was supported by fixed to 40 mm by 20 mm by 3 mm thick steel L-angles, located at 120 mm from the concrete wall on both sides. The steel angles were supported by 2 nos. of M10 steel rods to the concrete lining.
1b	**Copper Pipes**		
	Material	:	Copper.#
	Overall sizes	:	3 pairs of 12.7 mm outer diameter by 1 mm thick and 6.4 mm outer diameter by 1 mm thick 48 mm outer diameter by 4 mm thick by 1,200 mm long.*
	Fixing method	:	The pipes were supported by fixed to 40 mm by 20 mm by 3 mm thick steel L-angles, located at 120 mm from the concrete wall on both sides. The steel angles were supported by 2 nos. of M10 steel rods to the concrete lining.
2	**Rockwool**		
	Brand	:	ROCKWOOL.#
	Thickness	:	50 mm.*
	Density	:	160 kg/m^3.*
	Applied location	:	Covered the opening.#
3	**Insulation**		
	Brand & Model	:	Armacell Classo Armaflex.
	Sizes	:	25 mm thick by 750 mm long.*
	Applied location	:	Wrapped outside the pipes individually.#
4	**Bandage**		
	Brand & Model	:	Hilti CFS-B.#
	Quantity	:	2 layers in the middle of wall.
	Applied location	:	Wrapped around insulated pipes. Three pairs of insulated copper pipes were wrapped together by the bandage and the insulated PVC pipe was wrapped individually.#
5	**Sealant**		
	Brand & Model	:	Hilti CP606.#
	Applied location	:	Filled the gaps between the pipe and concrete lining.

*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 is not verified by RED or unless specified.)

Specimen '19'

Item	Description		
1	**Pipe**		
	Material	:	Galvanized steel.#
	Overall sizes	:	138 mm inner diameter by 1.5 mm thick by 1,200 mm long.*
	Fixing method	:	The pipe was supported by fixed to 40 mm by 20 mm by 3 mm thick steel L-angles, located at 120 mm from the concrete wall on both sides. The steel angles were supported by 2 nos. of M10 steel rods to the concrete lining.
2	**Rockwool**		
	Brand	:	ROCKWOOL.#
	Thickness	:	50 mm.*
	Density	:	160 kg/m^3.*
	Applied location	:	Covered the opening.#
3	**Filling Foam**		
	Brand & Model	:	Hilti CF-F 750.
	Applied location	:	Filled the gaps between the pipe and concrete lining.
4	**Sealant**		
	Brand & Model	:	Hilti CP606.#
	Applied location	:	Filled the gaps between the pipe and concrete lining at both opening ends with 10 mm depth CP606.

*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 is not verified by RED or unless specified.)

Specimen '20'

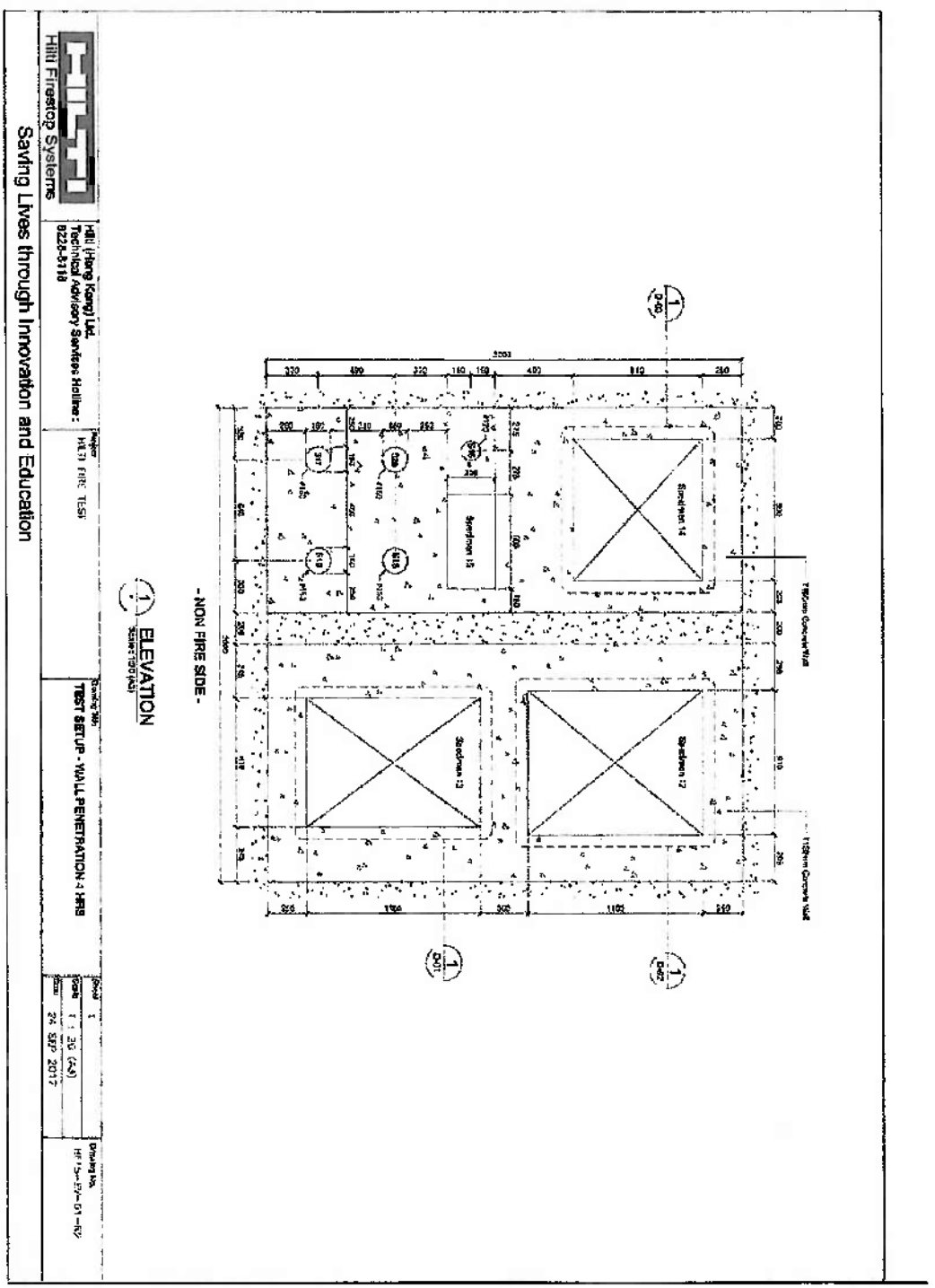
Item	Description		
1a	**PVC Pipe**		
	Material	:	PVC.#
	Overall sizes	:	1 no. of 25 mm outer diameter by 2 mm thick by 1,200 mm long.*
	Fixing method	:	The pipe was supported by fixed to 40 mm by 20 mm by 3 mm thick steel L-angles, located at 120 mm from the concrete wall on both sides. The steel angles were supported by 2 nos. of M10 steel rods to the concrete lining.
1b	**Copper Pipes**		
	Material	:	Copper.#
	Overall sizes	:	3 pairs of 12.7 mm outer diameter by 1 mm thick and 6.4 mm outer diameter by 1 mm thick 48 mm outer diameter by 4 mm thick by 1,200 mm long.*
	Fixing method	:	The pipes were supported by fixed to 40 mm by 20 mm by 3 mm thick steel L-angles, located at 120 mm from the concrete wall on both sides. The steel angles were supported by 2 nos. of M10 steel rods to the concrete lining.
2	**Rockwool**		
	Brand	:	ROCKWOOL.#
	Thickness	:	50 mm.*
	Density	:	160 kg/m^3.*
	Applied location	:	Covered the opening.#
3	**Insulation**		
	Brand & Model	:	Armacell Classo Armaflex.
	Sizes	:	25 mm thick by 750 mm long.*
	Applied location	:	Wrapped outside the pipes individually.#
4	**Bandage**		
	Brand & Model	:	Hilti CFS-B.#
	Quantity	:	2 layers in the middle of wall.
	Applied location	:	Wrapped around insulated pipes. All insulated pipes were wrapped together.#
5	**Sealant**		
	Brand & Model	:	Hilti CP606.#
	Applied location	:	Filled the gaps between the pipe and concrete lining.

*Notes: * Verified on site by RED.*

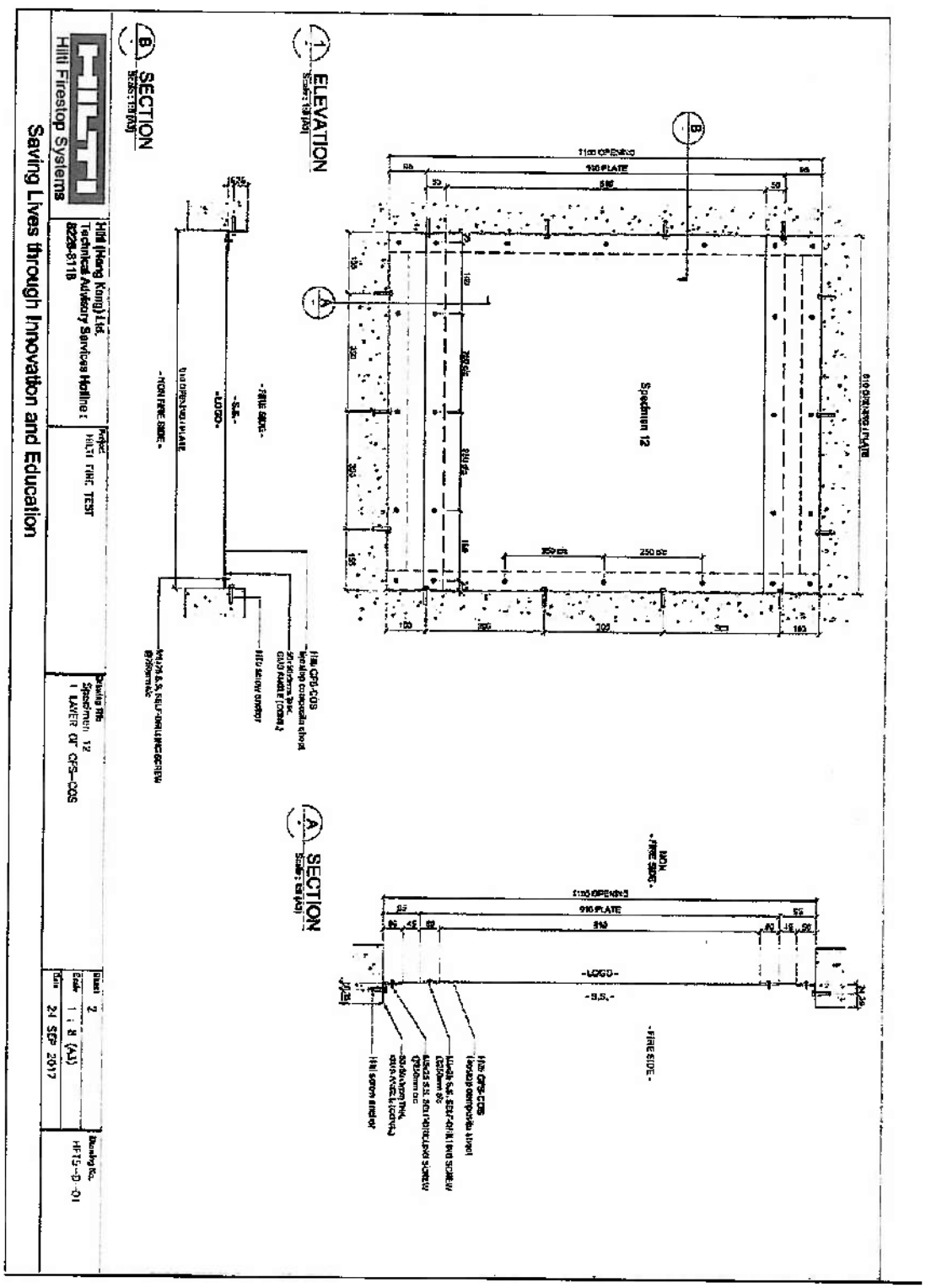
 # As shown on the test construction

Drawings from Test Sponsor

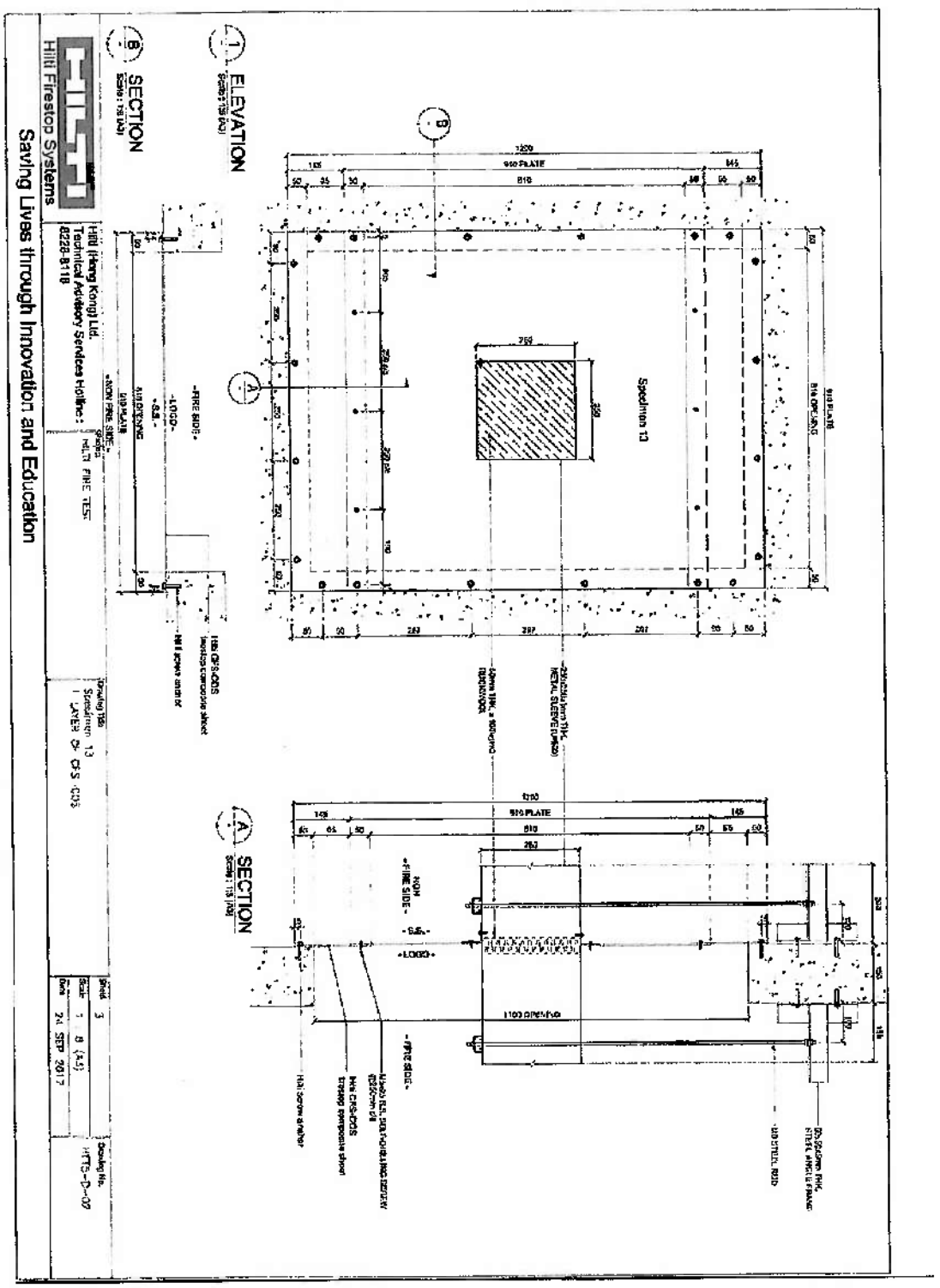
(The drawings provided by test sponsor, which was not verified by RED, except those specified and described in 'information from test sponsor'.)



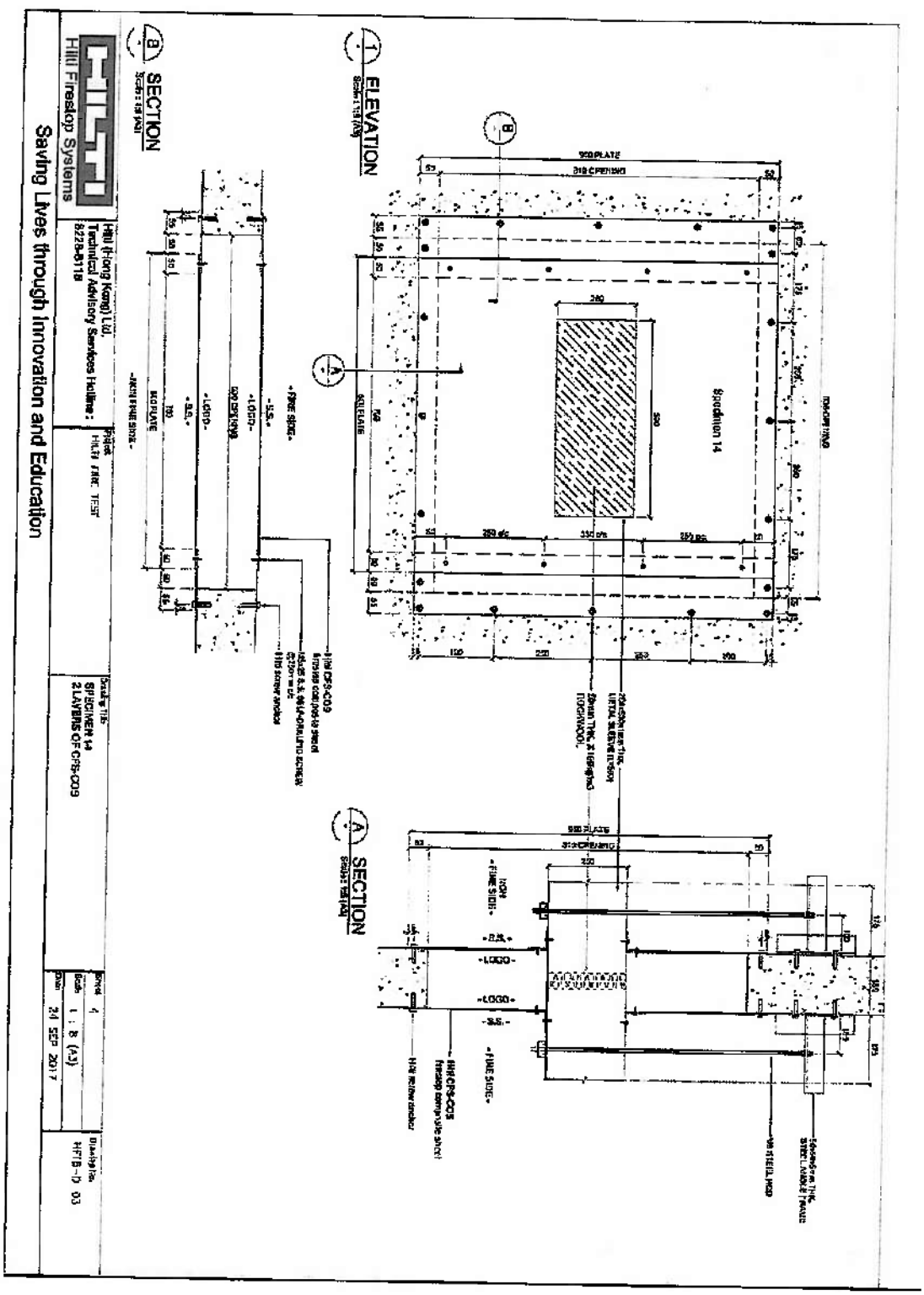
Specimen '12'


Hilti Firestop Systems
Saving Lives through Innovation and Education
Hilti (Hong Kong) Ltd.
Technical Advisory Services Hotline :
2228-6118
Project
HILTI FIRE TEST
Drawing Title
Specimen 12
1 LAYER OF CFS-COS
Scale
1 : 8 (A3)
Date
24 SEP 2017
Sheet
2
Drawing No.
HFTS-D-01
ELEVATION
SECTION
SECTION
Specimen 12
910 PLATE
- FIRE SIDE -
- LOCO -
- S.S. -
- NON FIRE SIDE -

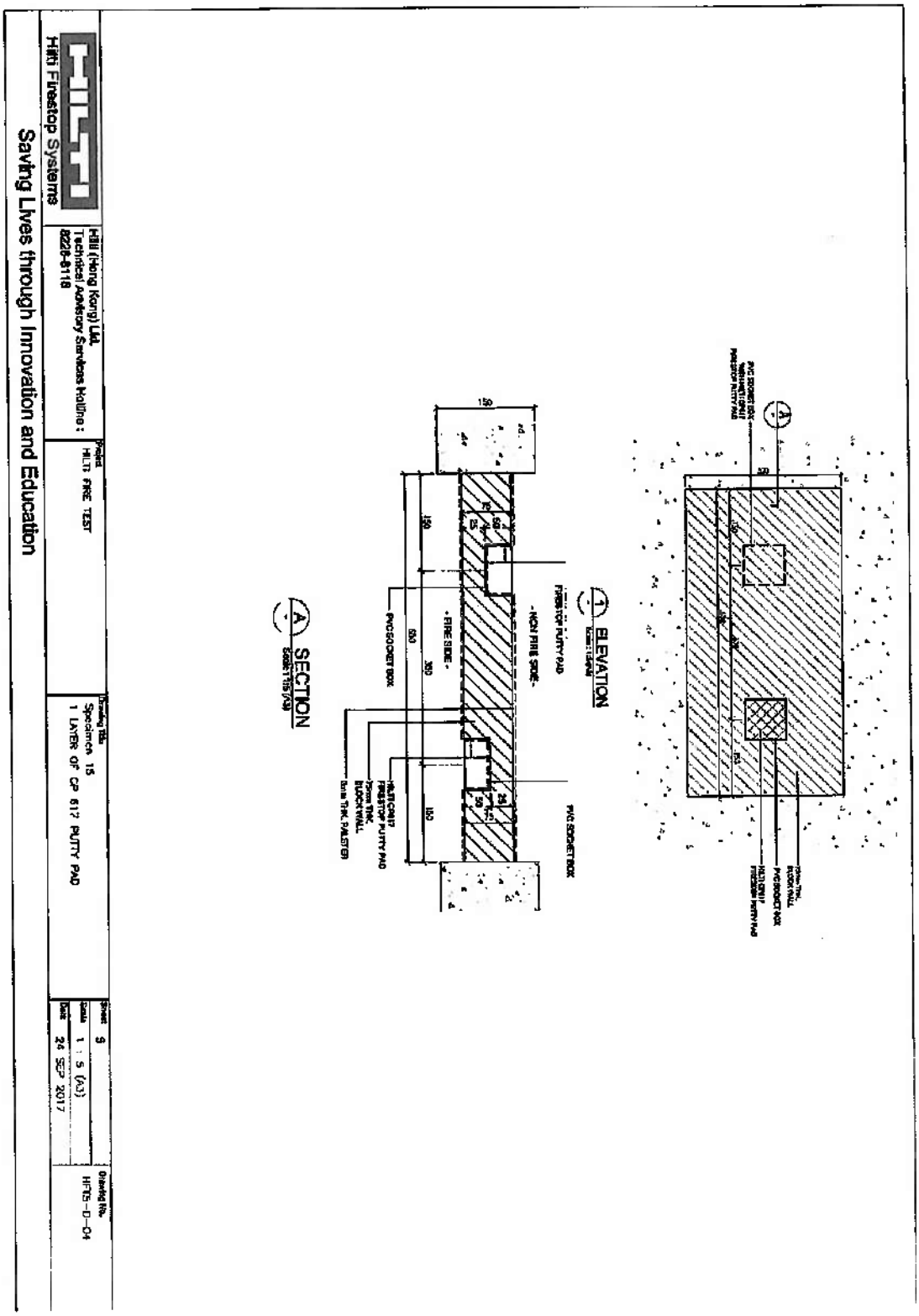
Specimen '13'


Hilti Firestop Systems
Saving Lives through Innovation and Education
SECTION
ELEVATION
SECTION
Specimen 13
950 PLATE
-FIRE SIDE-
-LOAD-
-NON FIRE SIDE-
-fire side-

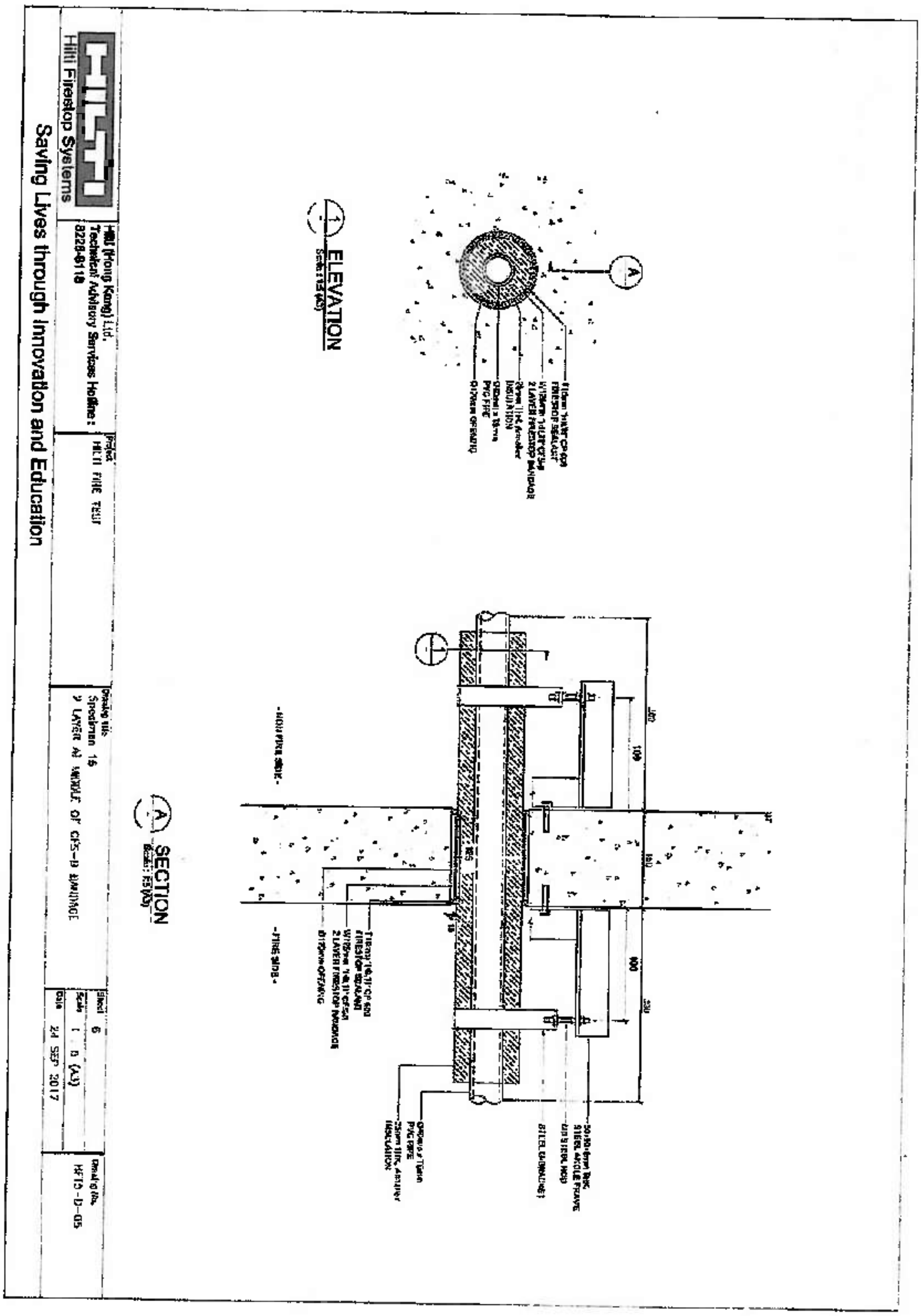
Specimen '14'


Hilti Firestop Systems
Saving Lives through Innovation and Education
SECTION
ELEVATION
SECTION
Specimen 14
FIRE SIDE
NON FIRE SIDE
LOGO
SPECIMEN 14
2 LAYERS OF CFS-COS
21 SEP 2017
HFTB-D 03

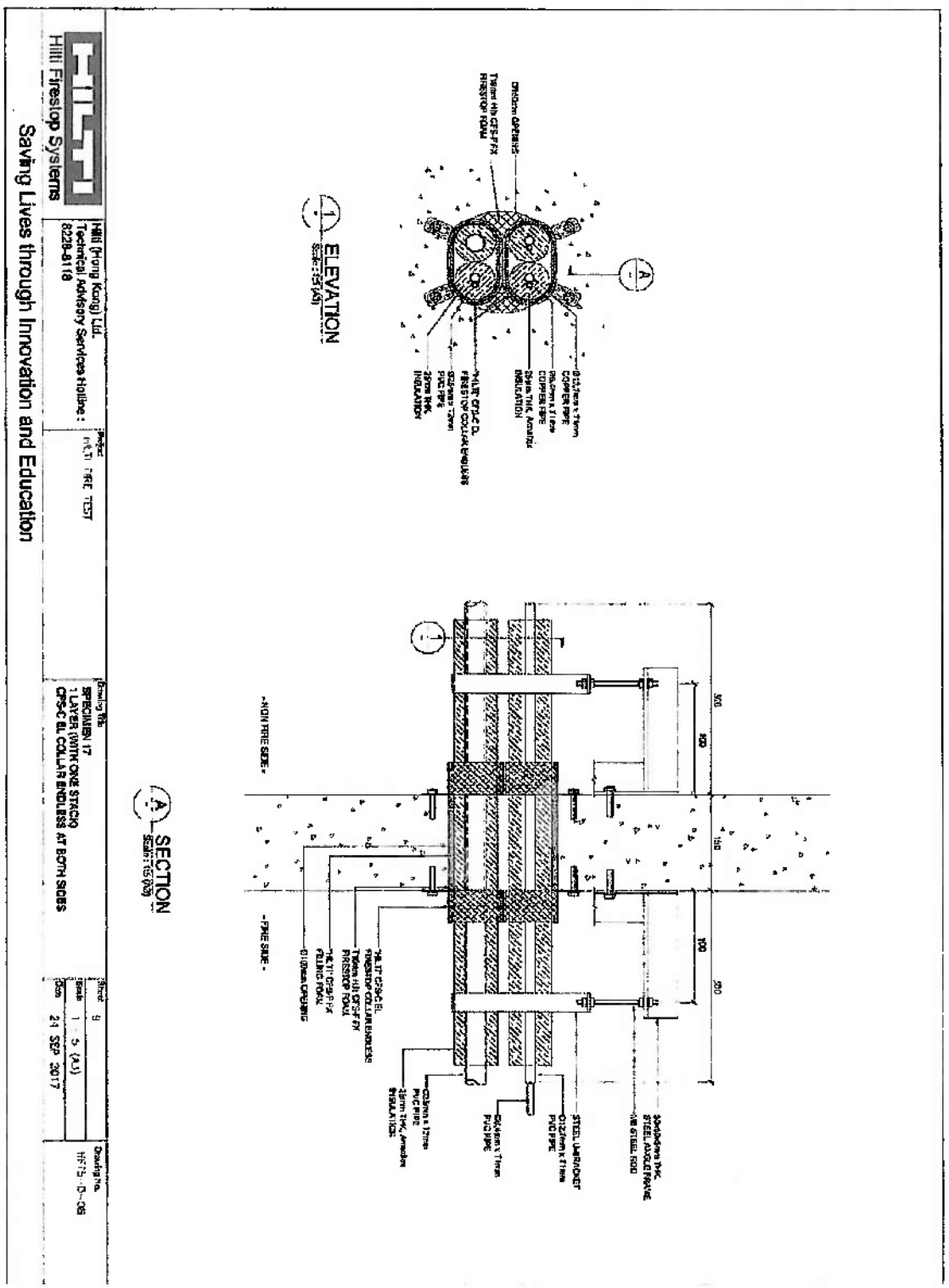
Specimen '15'


Hilti Firestop Systems
Saving Lives through Innovation and Education
Hilti (Hong Kong) Ltd.
Technical Advisory Services Hotline :
8228-6118
Project
HILTI FIRE TEST
Drawing Title
Specimen 15
1 LAYER OF CP 617 PUTTY PAD
Sheet
S
Scale
1 : 5 (A3)
Date
26 SEP 2017
Drawing No.
HFTS-D-04
SECTION
ELEVATION
- NON FIRE SIDE -
- FIRE SIDE -
PVC SOCKET BOX
HILTI CP617 FIRESTOP PUTTY PAD
75mm THK. BLOCK WALL
5mm THK. PLASTER

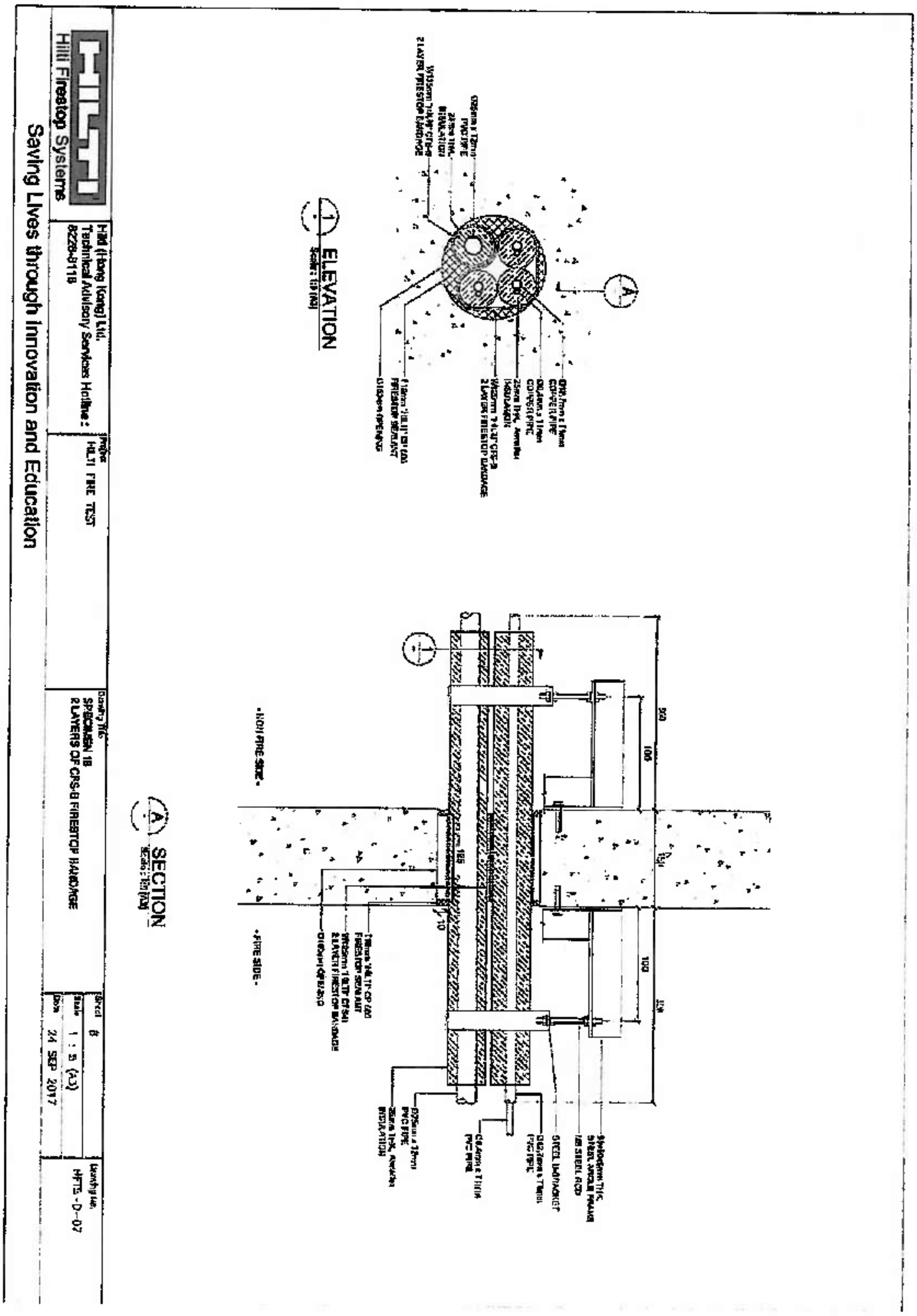
Specimen '16'


Hilti Firestop Systems
Saving Lives through Innovation and Education
ELEVATION
SECTION
Specimen 16
HILTI FIRE TEST
24 SEP 2017

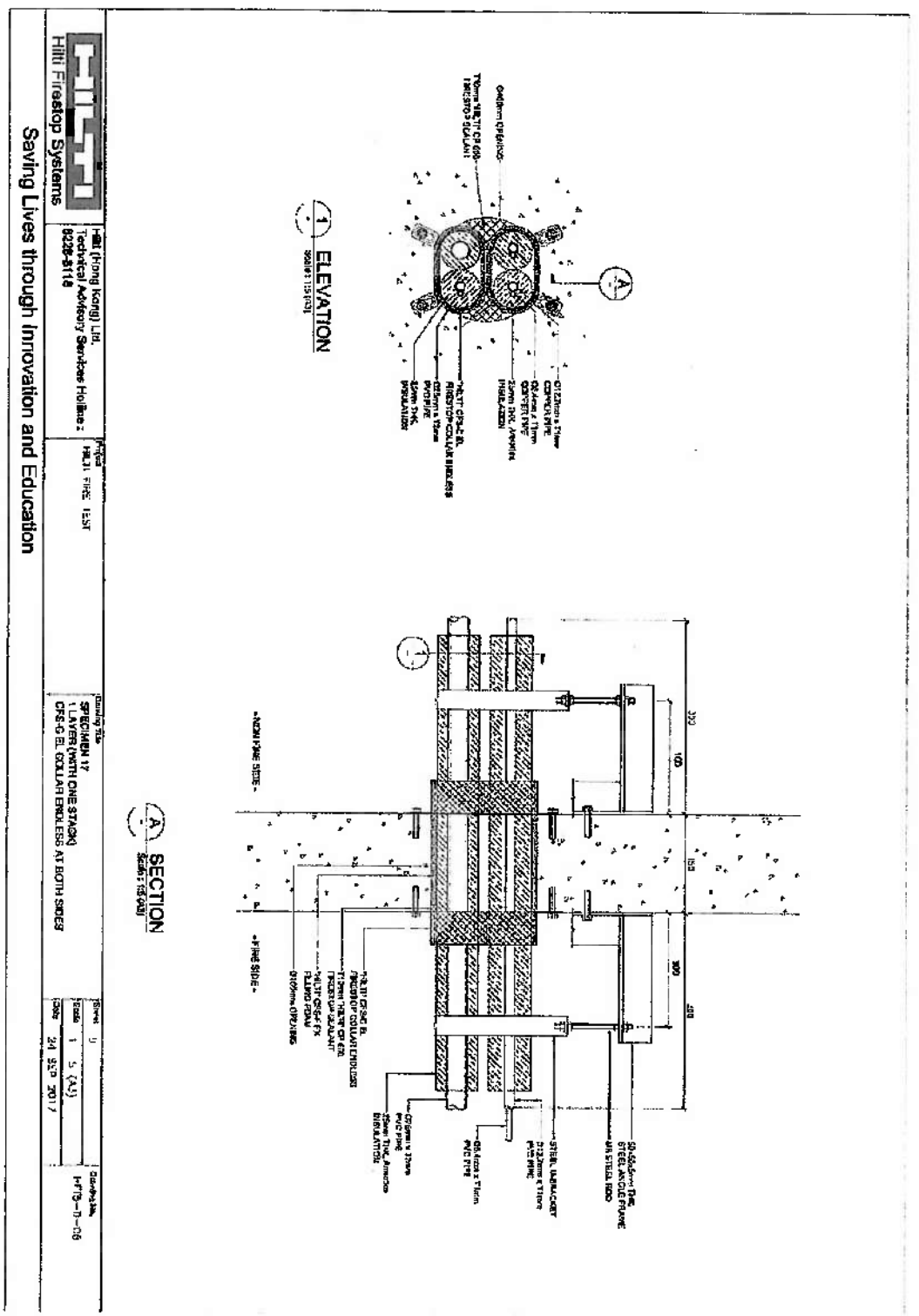
Specimen '17'


Hilti Firestop Systems
Saving Lives through Innovation and Education
Hilti (Hong Kong) Ltd.
Technical Advisory Services Hotline : 2233-3113
Project
HILTI FIRE TEST
Drawing No.
SPECIMEN 17
1 LAYER (WITH ONE STACK)
CFS-C EL COLLAR ENDLESS AT BOTH SIDES
Sheet 9
Scale 1 : 5 (A3)
Date 21 SEP 2017
Drawing no.
HFTS-D-C05
1 ELEVATION
Scale : 1:5(A3)
A SECTION
Scale : 1:5(A3)
- HOT FIRE SIDE -
- FIRE SIDE -
100
150
100
150
100
250

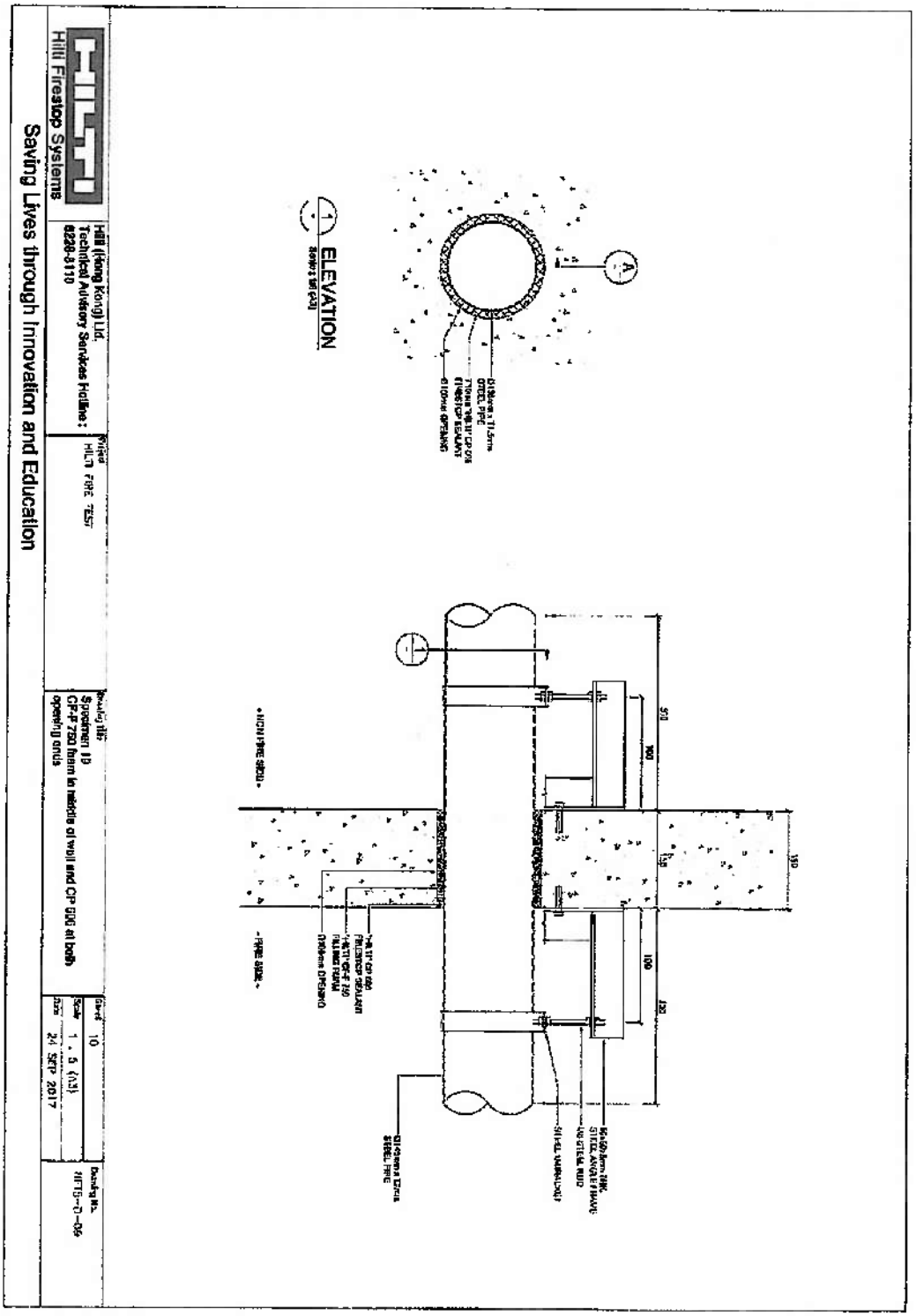
Specimen '18'


Hilti Firestop Systems
Saving Lives through Innovation and Education
HILTI FIRE TEST
SPECIMEN 18
2 LAYERS OF CFS-B FIRESTOP BANDAGE
1 : 5 (A3)
24 SEP 2017
HFTS-D-07
ELEVATION
SECTION
NON FIRE SIDE
FIRE SIDE

Specimen '19'


Hilti Firestop Systems
Saving Lives through Innovation and Education
SPECIMEN 17
1 LAYER (WIDTH ONE STAGE)
CFS-C EL COLLAR ENGLESS AT BOTH SIDES
ELEVATION
SECTION
- NON-FIRE SIDE -
- FIRE SIDE -

Specimen '20'



- End of report -

ASSESSMENT REPORT

The use of Hilti 'CFS-COS' FireStop Composite Sheet for Wall and Floor Penetration

Report No.: R18M03-1A

Issue Date: 22 March 2019

Date of Review: 21 March 2021

Report Sponsor

Hilti (Hong Kong) Limited
701-704 & 708B, Tower A Manualife Finance Centre,
223 Wai Yip Street, Kwun Tong, Kowloon, HK

CONTENT

REVISION HISTORY

Issue date (DD/MM/YYYY)	Issue number	Remark
22/03/2019	0	Initial version

FIRE RESISTANCE PERFORMANCE OF HILTI 'CFS-COS'
FIRESTOP COMPOSITE SHEET

1 INTRODUCTION

This assessment report presents an appraisal for the use of the Hilti 'CFS-COS' firestop composite sheet for protecting the openings on the wall or flooring. The appraisal will be based on the test evidences of R18G14-1A and R18G14-2A issued by Research Engineering Development Façade Consultants Limited. The report is prepared for Hilti (Hong Kong) Limited of 701-704 & 708B, Tower A, Manualife Finance Centre, 223 Wai Yip Street, Kwun Tong, Kowloon, HK.

The proposed opening protection systems are required to provide a fire resistance performance of up to 240 minutes integrity and up to 30 minutes insulation with respect to BS 476: Part 20: 1987, depends on the design.

2 ASSUMPTIONS

The proposed systems are assumed to be installed in a similar manner to that of the previously tested system by competent installers. It is assumed that the modified systems will be constructed in a similar manner from materials and components of the same manufacture and equivalent quality as tested with supporting test evidence or otherwise appraised by RED. Further assumptions related to the specific modifications will be stated in the report.

It is also assumed that the supporting structures to which the perimeter of the systems will be fixed are capable of supporting the proposed structure effectively.

Assuming that the issue of the original test report is valid, the current testing standard or testing experience has not been changed and the procedures adopted for the original report have been re-examined and reviewed that there have been no changes to the specification of the construction considered in the original report. If contradictory data or any related evidence becomes available to RED, the assessment will be unconditionally withdrawn and the sponsor will be notified. This report is based on the given information, in which is declared by report sponsor that no contradictory data has become available.

3 SUPPORTING DATA

3.1 Summary of Supporting Test Evidences

Report no.	Sections	Description
Primary Test Evidence		
RED Test report no. R18G14-1A	4.1	Supporting test evidence for the use of the Hilti 'CFS-COS' for opening protection on slab up to 240 minutes integrity and up to 30 minutes insulation performance with respect to BS 476: Part 20: 1987
RED test report no. R18G14-2A	4.1	Supporting test evidence for the use of the Hilti 'CFS-COS' for protection of wall opening for 240 minutes integrity only fire resistance performance with respect to BS 476: Part 20: 1987

3.2 *Primary Test Evidences*

3.2.1 *RED Test Report No. R18G14-1A*

A fire resistance test in accordance with BS 476: Part 20: 1987 on a total of four specimens of firestop composite sheets, namely specimens 'A', 'B', 'C' and 'D' was conducted at the Research Engineering Development Façade Consultants Limited (RED) Laboratory on 18 July 2018. The test sponsor was Hilti (Hong Kong) Limited.

As requested by the test sponsor, the specimens were mounted within concrete line specimen holder. The specimens were asymmetrical and only one side of specimens was tested, in which the fire side was determined by the test sponsor.

Specimen 'A' was comprised of Firestop Composite Sheets and Rockwool. The overall sizes of the Firestop Composite Sheets were 1,300 mm long by 1,100 mm wide by 3.8 mm thick. The Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Rockwool was installed at the bottom of Firestop Composite Sheets and had the thickness of 50 mm and density of 160 kg/m^3. The Rockwool was supported by C-channel with sizes of 50 mm wide by 125 mm high by 1 mm thick at one side and L-angles with sizes of 50 mm by 50 mm by 3 mm thick at three sides. Both the C-channel and L-angles were fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The separation distance between the Firestop Composite Sheets and Rockwool was 70 mm.

Specimen 'B' was comprised of 2 layers of Firestop Composite Sheets and Rockwool. The overall sizes of the first layer of Firestop Composite Sheets were 1,300 mm long by 1,100 mm wide by 3.8 mm thick. The first layer of Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Rockwool was installed at the bottom of first layer of Firestop Composite Sheets and had the thickness of 50 mm and density of 160 kg/m^3. The second layer of Firestop Composite Sheets with the same construction as the first layer was placed at the bottom of the Rockwool. The Rockwool and second layer of Firestop Composite Sheets were supported by C-channel with sizes of 50 mm wide by 125 mm high by 1 mm thick at one side and L-angles with sizes of 50 mm by 50 mm by 3 mm thick at three sides. Both the C-channel and L-angles were fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The separation distance between the first layer of Firestop Composite Sheets and Rockwool was 100 mm.

Specimen 'C' was comprised of Firestop Composite Sheets. The overall sizes of the Firestop Composite Sheets were 1,750 mm long by 1,100 mm wide by 3.8 mm thick. The Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Firestop Composite Sheets were supported by L-angle with sizes of 50 mm by 50 mm by 3 mm thick which was fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres at one side.

Specimen 'D' was comprised of Firestop Composite Sheets. The overall sizes of the Firestop Composite Sheets were 1,600 mm long by 1,100 mm wide by 3.8 mm thick. An opening with sizes of 300 mm diameter by 200 mm deep by 0.7 mm thick was created at the surface of Firestop Composite Sheets. The Firestop Composite Sheets were joined together with M5 by 30 mm long screws at 300 mm nominal centres and fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres. The Firestop Composite Sheets were supported by L-angle with sizes of 50 mm by 50 mm by 3 mm thick which was fixed to the concrete with M6 by 45 mm long anchor bolts at 300 mm nominal centres at one side. The Rockwool with thickness of 50 mm and density of 160 kg/m^3 was used to cover the opening.

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

	Integrity	**Insulation**
Specimen 'A'	**219** Minutes	**36** Minutes
Specimen 'B'	**288** Minutes (No failure)	**69** Minutes
Specimen 'C'	**199** Minutes	N/A
Specimen 'D'	**209** Minutes	N/A

The test was discontinued after a heating period of 288 minutes (See R18G14-1A for full details).

3.2.2 *RED Test Report No. R18G14-2A*

A fire resistance test in accordance with BS 476: Part 20: 1987 on a total of nine specimens of penetration / or opening protection systems was conducted at the Research Engineering Development Façade Consultants Limited (RED) Laboratory on 28 September 2018. The test sponsor was Hilti (Hong Kong) Limited.

As requested by the test sponsor, the specimens were mounted within concrete line specimen holder. The specimens were asymmetrical and only one side of specimens was tested, in which the fire side was determined by the test sponsor.

Specimen '12' was comprised of Firestop Composite Sheets. The overall and exposed sizes of the Firestop Composite Sheets were 910 mm wide by 910 mm high by 3.8 mm thick. The Firestop Composite Sheets were joined together with M5 by 25 mm long screws at 250 mm nominal centres and fixed to L-angles with sizes of 50 mm by 50 mm by 5 mm thick at four sides. The L-angles was fixed the concrete with M6 by 54 mm long anchor bolts at 250 mm nominal centres. Stainless steel facing was faced at exposed side.

Specimen '13' had overall dimensions 910 mm wide by 1,200 mm high by 3.8 mm thick with exposed area 810 mm wide by 1,100 mm high. It was comprised of Firestop Composite Sheets and a G.I. squared pipe. The G.I. squared pipe with sizes of 250 mm wide by 250 mm high by 1 mm thick was penetrated in the centre of specimen. The Firestop Composite Sheets were joined together with M5 by 25 mm long screws at 250 mm nominal centres and fixed to the concrete with M6 by 54 mm long anchor bolts at 250 mm nominal centres. Stainless steel facing was faced at unexposed side.

Specimen '14' had overall dimensions of 1,010 mm wide by 910 mm high by 3.8 mm thick with clear opening area 900 mm wide by 810 mm high. It was comprised of two layers of Firestop Composite Sheets and a G.I. pipe. The G.I. pipe with sizes of 500 mm wide by 200 mm high by 1 mm thick was penetrated in the centre of specimen. The Firestop Composite Sheets were joined together with M5 by 25 mm long screws at 250 mm nominal centres and fixed to the concrete with M6 by 54 mm long anchor bolts at 250 mm nominal centres. Stainless steel facing was faced at both sides.

Specimen '15' had overall dimensions of 600 mm wide by 300 mm high by 81 mm thick. It was comprised of two nos. of socket boxes with 'Hilti CP617' firestop putty pad incorporated with 75 mm thick 'Ytong' lightweight block wall with nominal 3 mm thick plaster on both sides. Each socket box with cover with sizes of 70 mm by 70 mm by 50 mm deep by 3.5 mm thick was incorporated in each side of block wall. 'Hilti CP617' firestop putty pad was placed inside the socket boxes (refer to test sponsor's drawings).

Specimen '16' had overall dimensions of 90 mm diameter by 1,200 mm long. It was comprised of a PVC pipe with sizes of 48 mm outer diameter by 4 mm thick, wrapped with a layer of nominal 25 mm thick by 750 mm long 'Armaflex' foam. The gaps between the pipe and concrete wall were applied with two layers of 'CFS-B' bandage and 'CP606' sealant.

Specimen '17' had overall dimensions of 160 mm diameter by 1,200 mm long. It was comprised of a PVC pipe with sizes of 25 mm outer diameter by 2 mm thick, and 3 pairs of copper pipes with sizes of 12.7 mm outer diameter by 1 mm thick and 6.4 mm outer diameter by 1 mm thick. All pipes wrapped with a layer of nominal 25 mm thick by 750 mm long 'Armaflex' foam individually. The gaps between all the pipes and concrete wall were applied with 'CFS-F FX' foam and with 'Hilti CFS-C EL' collar endless at both opening ends.

Specimen '18' had overall dimensions of 160 mm diameter by 1,200 mm long. It was comprised of a PVC pipe with sizes of 25 mm outer diameter by 2 mm thick, and 3 pairs of copper pipes with sizes of 12.7 mm outer diameter by 1 mm thick and 6.4 mm outer diameter by 1 mm thick. All pipes wrapped with a layer of nominal 25 mm thick by 750 mm long 'Armaflex' foam individually. The gaps between all the pipes and concrete wall were applied with two layers of 'CFS-B' bandage and 'Hilti CP606' sealant. Three pairs of copper pipes were wrapped together by the bandage and the PVC pipe was wrapped individually.

Specimen '19' had overall dimensions of 160 mm diameter by 1,200 mm long. It was comprised of a G.M.S. pipe with sizes of 138 mm inner diameter by 1.5 mm thick. The gaps between the pipe and concrete wall were applied with 'Hilti CP606' sealant and 'Hilti CF-F 750' filling foam.

Specimen '20' had overall dimensions of 160 mm diameter by 1,200 mm long. It was comprised of a PVC pipe with sizes of 25 mm outer diameter by 2 mm thick, and 3 pairs of copper pipes with sizes of 12.7 mm outer diameter by 1 mm thick and 6.4 mm outer diameter by 1 mm thick. All pipes wrapped with a layer of nominal 25 mm thick by 750 mm long 'Armaflex' foam individually. The gaps between all the pipe and concrete wall were applied with two layers of 'CFS-B' bandage and 'Hilti CP606' sealant. All pipes were wrapped together by the bandage.

All penetrated pipes were supported by fixed to 40 mm by 20 mm by 3 mm thick steel L-angles, located at 100 mm from the concrete wall on both sides. The steel angles were supported by 2 nos. of M10 steel rods to the concrete lining. The opening was covered by nominal 40 mm thick rockwool with density 160 kg/m^3.

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

	Integrity	Insulation
Specimen '12'	**242** Minutes (No failure)	**8** Minutes
Specimen '13'	**242** Minutes (No failure)	**6** Minutes
Specimen '14'	**242** Minutes (No failure)	**27** Minutes
Specimen '15'	**242** Minutes (No failure)	**242** Minutes
Specimen '16'	**242** Minutes (No failure)	**242** Minutes
Specimen '17'	**242** Minutes (No failure)	**242** Minutes
Specimen '18'	**242** Minutes (No failure)	**242** Minutes
Specimen '19'	**242** Minutes (No failure)	**242** Minutes
Specimen '20'	**242** Minutes (No failure)	**242** Minutes

The test was discontinued after a heating period of 242 minutes (See R18G14-2A for details).

4 PROPOSAL & DISCUSSION

4.1 The use of Hilti 'CFS-COS' firestop Composite sheet for opening protection on slabs

Proposal

It is proposed that Hilti 'CFS-COS' firestop composite sheet may be used to protect the openings on slab application similar to that tested under R18G14-1A.

In the protection of floor opening, the 'CFS-COS' may be modified as below:

(a) In case of system required 240 minutes integrity and 60 minutes insulation, the "CFS-COS" shall be composed of a top layer and bottom layer with the minimum separation distance of 150 mm, a layer of 50 mm thick by 160 kg/m^3 mineral wall will be placed above the bottom layer of "CFS-COS". The air gap in between the bottom surface of the top layer of "CFS-COS" and the top surface of the mineral wool shall be at least 100 mm, unless occupied by extra thickness of mineral wool. The protected opening sizes may be up to 2,630 mm by 1,770 mm;

(b) In case of system required 180 minutes integrity, one layer of "CFS-COS" shall be applied. The protected opening sizes may be up to 2,630 mm by 1,770 mm;

(c) In both cases, the fixing of the "CFS-COS" at the edge may be

  i. directly to the top of the slab using M6 by 45 mm long anchor bolts at not less than 300 mm nominal centres; and

  ii. within the slab aperture supporting fixed to the 50 mm by 50 mm by 3 mm thick L-angles by M5 by 39 mm long screws at 300 mm c/c. and the L-angles are fixed to the slab by M6 by 45 mm long anchor bolts at 300 mm c/c to the slab.

(d) In the case for integrity only, opening for service penetration on the on the "CFS-COS" of square or rectangular shape with the length/width not exceeding 300 mm and area within 0.071 m^2 is considered acceptable; and

(e) In case if adequate rigid supporting is presented as the intermediate support to the product, the system may be further increase in either doubled width or doubled length.

Discussion

The test evidence R18G14-1A, described the test of 4 nos. of specimens, each with different fixing methods tested to BS 476: Part 20: 1987. Specimen 'A' is a system with an aperture opening sizes of 1,050 mm wide by 1,200 mm long, consisted of top layer of "CFS-COS" on top and there was a layer of 50 mm thick by 160 kg/m^3 mineral wool at a distance 70 mm underneath the bottom face of the "CFS-COS". The mineral wool was supported by the L-steel angles. The one layer of "CFS-COS" is composed of four nos. of original 910 mm by 910 mm cut into sizes and joint together. The joint between the "CFS-COS" are 50 mm overlapping with screw fixings using M5 by 30 mm long screws at maximum 300 mm c/c. The system achieved 219 minutes integrity and 30 minutes insulation.

Specimen 'B' is a system with an aperture opening sizes of 1,050 mm wide by 1,200 mm long, consisted of top and bottom layers of "CFS-COS" separated by 120 mm from each other. A layer of 50 mm thick by

160 kg/m^3 mineral wool was sat on the bottom layer of CFS-COS. The system achieved 288 minutes integrity and 69 minutes insulation. The one layer of "CFS-COS" is composed of four nos. of original 910 mm by 910 mm cut into sizes and joint together. The joint between the "CFS-COS" are 50 mm overlapping with screw fixings using M5 by 30 mm long screws at maximum 300 mm c/c.

The specimen 'C' was a single layer of "CFS-COS" protecting the aperture opening sizes of 1,050 mm wide by 1,650 mm long, composed of four nos. of original 910 mm by 910 mm cut into sizes and joint together. The joint between the "CFS-COS" are 50 mm overlapping with screw fixings using M5 by 30 mm long screws at maximum 300 mm c/c. The system achieved 199 minutes integrity.

The specimen 'D' is a single layer of "CFS-COS" protecting the opening sizes of 1,050 mm wide by 1,500 mm long, composed of six nos. of original 910 mm by 910 mm cut into sizes and joint together. The joint between the "CFS-COS" are 50 mm overlapping with screw fixings using M5 by 30 mm long screws at maximum 300 mm c/c. A circular opening with 300 mm diameter was present at the corner of the system. The opening is sealed with mineral wool. The system achieved 209 minutes integrity.

(a) The proposed construction of the system is basically reference to the specimen 'B' that tested under R18G14-1A. The necessary thickness of air spacing and mineral wool thickness is the same as that tested. Since the specimens 'A' to 'D' had demonstrated the necessary jointing details between the "CFS-COS" it is reasonable to believe that even the opening sizes is larger, the CFS-COS shall still be capable to provide the same protection. The increase in sizes may associate with the increase in sizes of mineral wool as well. The mineral wool shall have a 25 mm by 25 mm staggered meeting edge to prevent the present of a through gap. With the above provision and based on the discussion in (b) below, it is believed that the system shall be able to protect the opening up to 2,630 mm long by 1,770 mm wide and achieve at least 240 minutes integrity and 60 minutes insulation.

(b) For the system requires integrity performance only up to 180 minutes, it is directly supported by the specimens 'C' and 'D' as tested. From the test, both case had demonstrated the "CFS-COS" with joints that had up to 6 panels joined together, although some panels are not in their full sizes. However, based on the two specimens that tested, it is reasonable to believe that the tested jointing methods with the "CFS-COS" overlapping each other by 50 mm and screw fixed with M5 screws at maximum 300 mm c/c can provide the adequate engagement between. Provided that all six panels are in their full sizes, the maximum opening sizes that can be protected would be 2,630 mm long by 1,770 mm wide as proposed.

(c) The proposed fixing method in (i) and (ii) are just the tested fixing method in the test. Although, only some edges are proposed but it is already reasonable to tell that the fixing method is adequate to provide the necessary holding force at the edges. The fixing with the "CFS-COS" on the slab aperture requires the overlapping of 50 mm on the slab edge and fixed by M6 screws at 300 mm c/c which was the same as the tested fixing. While in case if the "CFS-COS" is fixed within the aperture, a steel

L-angles with sizes of 25 mm by 25 mm by 3 mm thick is needed as the supporting to the "CFS-COS" and fix to the slab. Those are the fixing methods that already tested.

(d) In the same test evidence, it is demonstrated that a hole of 300 mm diameter opened on the "CFS-COS" is possible, provided that this hole is connecting to a piping with adequate sealing method. However, as only the integrity only case had demonstrated this situation, and it is therefore confined that the opening can only present in the integrity only case. The proposed opening sizes is within the tested sizes and is allowable for modify this circular opening to rectangular shapes, provided that the length is not exceeding the tested 300 mm and the area is also within the tested area of 0.071 m^2. This opening in case if some other penetration system is penetrating through "CFS-COS", it should have its own independent supporting to surrounding supporting construction.

(e) In the test, the system was proven to be possible to self-support up to the sizes of 2,630 mm long by 1,770 mm wide within a concrete aperture as discussed in (a) above. In case if intermediate support, that have adequate rigidity and providing the required fire resistance performance of up to 240 minutes with insignificant deflection, is provided, the sizes of the overall system may be doubled in either length or width such that the maximum self-support span will keep equal or smaller than 2,630 mm long by 1,770 mm wide per aperture.

4.2 *The use of Hilti 'CFS-COS' firestop Composite sheet for opening protection on walls*

Proposal

It is proposed that Hilti 'CFS-COS' firestop composite sheet may be used to protect the openings on walls application similar to that tested under R18G14-2A.

In the protection of wall opening, the 'CFS-COS' may be modified as below:

(a) one layer of "CFS-COS" for the protected opening sizes up to 2,630 mm by 1,770 mm;

(b) either face of the "CFS-COS" can be the exposure side to fire;

(c) the fixing of the "CFS-COS may be

  i. On the wall openings with an overlapping of 50 mm at the edges and fixed by M6 by 300 mm long anchor bolts at maximum 300 mm c/c; and

  ii. Within the aperture of the wall openings fixed by a 50 mm by 50 mm by 3 mm thick steel L-angles. The fixing of the "CFS-COS" to the L-angles will be M6 by 45 mm screws at maximum 300 mm c/c. While the fixing of the L-angles to the wall openings are M6 by 300 mm long anchors bolts at max 300 mm c/c.

(d) opening on the "CFS-COS" of square or rectangular shape with the length/width not exceeding 500 mm and area within 0.1 m^2 is considered acceptable; and

(e) In case if adequate rigid supporting is presented as the intermediate support to the product, the system may be further increase in either doubled width or doubled length.

The system may provide up to 240 minutes integrity performance with respect to BS 476: Part 22: 1987.

Discussion

The test evidence R18G14-2A, described the test of 3 nos. of specimens (specimen nos. 12, 13, 14) that related to the application of "CFS-COS" tested to BS 476: Part 20: 1987. Specimens 12 and 13 are general the same configuration that composed of 1 layer of "CFS-COS" demonstrated the upper and lower joints. The "CFS-COS" actually was not symmetrical for the front face (with logo side) and the back face (stainless steel side). In specimen 12, the "CFS-COS" is fixed with the back face exposed to fire and fixed within the opening, while in specimens 13, the "CFS-COS" is fixed on the opening with the front face exposed to fire. In this specimen, a opening of 250 mm by 250 mm is left.

Specimen 14 is fixed with a layer of "CFS-COS" on each side of the opening, the single-layer of "CFS-COS" is installed with vertical joints combined with 3 nos. of "CFS-COS". An opening of 500 mm wide by 200 mm long is left on one of the "CFS-COS"

(a) The proposal is directly supported by the specimens '12' and '13' as tested. From the test, both cases had demonstrated the "CFS-COS" with joints that had up to 3 panels joined together, although some panels are not in their full sizes. And as similar case has been tested in horizontal configuration with up to six panels joint together as discussed in section 4.1. Based on this, it is reasonable to believe that

the tested jointing methods with the "CFS-COS" overlapping each other by 50 mm and screw fixed with M5 screws at maximum 300 mm c/c can provide the adequate engagement between. Provided that all six panels are in their full sizes, the maximum opening sizes that can be protected would be 2,630 mm long by 1,770 mm wide as proposed.

(b) The proposal with either face of the "CFS-COS" exposed to fire had been demonstrated in specimen 12 and 13 and same performance of 240 minutes integrity performance had been achieved.

(c) The proposed fixing method in (i) and (ii) are just the tested fixing method in the test. The fixing with the "CFS-COS" on the slab aperture requires the overlapping of 50 mm on the wall aperture edges and fixed by M6 screws at 300 mm c/c which was the same as the tested fixing. While in case if the "CFS-COS" is fixed within the aperture, a steel L-angles with sizes of 25 mm by 25 mm by 3 mm thick is needed as the supporting to the "CFS-COS" and fix to the wall. Those are the fixing methods that already tested.

(d) In the same test evidence, it is demonstrated that a hole of 500 mm wide by 200 mm long opened on the "CFS-COS" is possible. Although this opening sizes is tested under specimen 14, it had already been proved that the single-layer shall achieve the same integrity performance, therefore, it is reasonable to tell that this opening sizes shall also accepted in single-layer case. Provided that this hole is connecting to a piping with adequate sealing method. However, as only the integrity only case had demonstrated this situation, and it is therefore confined that the opening can only present in the integrity only case. The proposed opening sizes is within the tested sizes and is allowable for modify this circular opening to rectangular shapes, provided that the length is not exceeding the tested 500 mm and the area is also within the tested area of 0.1 m^2. This opening in case if some other penetration system is penetrating through "CFS-COS", it should have its own independent supporting to surrounding supporting construction.

(e) In the test, the system was proven to be possible to self-support up to the sizes of 2,630 mm long by 1,770 mm wide within a concrete aperture as discussed in (a) above. In case if intermediate support, that have adequate rigidity and providing the required fire resistance performance of up to 240 minutes with insignificant deflection, is provided, the sizes of the overall system may be doubled in either length or width such that the maximum self-support span will keep equal or smaller than 2,630 mm long by 1,770 mm wide per aperture.

5 CONCLUSION

The proposed use of Hilti "CFSCOS' firestop composite sheet for protecting openings on wall or floor is capable to maintain the fire resistance performance of up to 240 minutes integrity performance and in some case up to 30 minutes insulation with respect to BS 476: Part 20: 1987.

6 DECLARATION BY APPLICANT

We, Hilti (Hong Kong) Limited, confirm that the material, component or element of structure, which is the subject of the test report being reviewed, has not to our knowledge been subjected to another test to the standard against which the assessment is being made.

We agree to withdraw this assessment from circulation should the component or element of structure be the subject of another test to the standard against which the assessment is being made.

We are not aware of any information that could affect the conclusions of this assessment.

If we subsequently become aware of any such information we agree to ask the assessing authority to withdraw the assessment.

7 VALIDITY

This assessment is based on test data, experience and the information supplied. The assessment will be invalidated if the assessed construction is subsequently tested since actual test data is deemed to take precedence over an expressed opinion. Any changes in the specification of product will invalidate this assessment. This assessment relates only to the specimen assessed and does not by itself infer that the product is approved under any other endorsements, approval or certification scheme. Since the appraisal method is under development, the laboratory reserved the right to supersede this assessment in case the appraisal method had been changed.

This report only relates to the specimen(s) tested and may only be reproduced by the sponsor in full, without comment, abridgement and modifications.

8 SIGNATORIES

Assessment by:

Dr. SZE Lip-kit
Test Consultant
Research Engineering Development
Façade Consultants Limited

Reviewed by:

Ir Dr. YUEN Sai-wing, MHKIE (Fire)
Authorized Signature
Research Engineering Development
Façade Consultants Limited

- End of Report -

Hilti (Hong Kong) Ltd

701-704 & 708B, Tower A Manulife Finance Centre,

223 Wai Yip Street, Kwun Tong, Kowloon, HK

Date: 11 December 2020 Our Ref: R20M11-1A

TO WHOM IT MAY CONCERN

Re: Assessment Report no. R18M03-1A – Fire Resistance Performance of 'Hilti, CFS-COS' Firestop Composite Sheet for Wall and Floor Penetration up to 240 Minutes Integrity and up to 30 Minutes Insulation with respect to BS 476: Part 20: 1987, depending on design

The RED assessment report no. R18M03-1A was issued on 22 March 2019 and expired on 21 March 2021. The specification and interpretation of test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. Whilst RED has conducted a review of the procedures adopted for the supporting data to ensure they are consistent with current practices, the assessment report no. R18M03-1A has been reviewed and found satisfactory.

It has been confirmed by Hilti (Hong Kong) Limited that there have been no changes to the material specifications and methods of construction considered in the original appraisal of assessment report no. R18M03-1A.

Therefore, it is recommended that the assessment report no. R18M03-1A is valid until 21 March 2024 and another review shall be undertaken by 20 March 2024.

Assessment by:

Dr. SZE Lip-kit
Authorized Signature
Research Engineering Development
Façade Consultants Limited

Reviewed by:

Ir Dr. YUEN Sai-wing, MHKIE (Fire)
Authorized Signature
Research Engineering Development
Façade Consultants Limited

LEGEND
Technical Services, Inc.
www.legend-group.com
88 Empire Drive • St. Paul, Minnesota • 55103
(651) 642-1150 • fax (651) 642-1239

VOC Content Test Certificate

May 6, 2016

Supplier: Hilti Entwicklungsgesellschaft mbH
BU Chemicals
Hiltistrasse 6
86916 Kaufering
GERMANY

Sample Description: Hilti Firestop Composite Sheet

Date Tested: April 20, 2016

Test Method: SCAQMD method 304-91 “Determination of Volatile Organic Compounds (VOC) in Various Materials” as referenced by South Coast Air Quality Management District (SCAQMD) Rule 1168. The values also comply with the requirements of EPA test method #24.

Test Data:

Specification	Product
LEED 2009 (LEED 3.0) **LEED 2.2** IEQ-4.1: Low-Emitting Materials – Adhesives and Sealants	**Hilti Firestop Composite Sheet**
Green Building Council of Australia Green Star Office Design 3.0, IEQ-13 Green Star Office Design 2.0, IEQ-13 Green Star Office Interiors 1.1, IEQ-11	
Architectural Sealant; **VOC Limit: 250 g/L**	**Product contains: 1.0 g/L of VOC**

Tom Barrett
Vice President/Strategic Analytical Services

Buildings Department ⟶

屋宇署

Our Ref. 本署檔號：(24) BD GR/BM/2(185)
Your Ref. 來函檔號：
Tel. No. 電　話：848 2838
Fax No. 圖文傳真：840 0451

Hilti (Hong Kong) Ltd.
Unit 3 5/F Harbour Centre Tower 2
8 Hok Cheung Street Hung Hom
Kowloon

26 May 1994

Dear Sirs,

Fire Resisting Penetration Sealing System
As Supplied By Hilti (GB) Ltd.

Thank you for your letters dated 4.3.94 and 27.4.94 and the accompanying test/assessment reports on the above. You are asking for comments on the acceptability of the fire resisting product in the context of relevant provisions of the Buildings Ordinance, Chapter 123 of the Law of Hong Kong and its subsidiary legislation.

Under the Buildings Ordinance, "authorized persons" (i.e. architects, engineers or surveyors registered with the Building Authority) are required to supervise building works including the selection and installation of fire resisting products and to certify compliance with the Buildings Ordinance upon completion of works. Authorized persons are therefore responsible for ensuring the safety requirements inter alia of fire resisting products in the building projects which they have been appointed by the developer to coordinate and supervise.

In establishing the acceptability of fire resisting products, reference may be made to the performance standards laid down in Building (Construction) Regulation 90, the current Code of Practice for Fire Resisting Construction issued by the Building Authority and British Standard 476: Parts 20 to 24. Reliance may also be placed on the test/assessment report prepared by a recognized laboratory or an equivalent establishment.

The Buildings Department has a list of recognized laboratories. This is available for reference at our office :

Technical Administration (Building) Unit
Buildings Department
11/F Murray Building
Garden Road Hong Kong

Before fire resisting products are installed in a building project, the authorized person appointed for the project should be approached for advice and guidance.

Your test/assessment reports are returned herewith. In this respect, please note that paragraph 3 of my letter dated 25 January 1994 is no longer applicable. The delay in replying is regretted.

Yours faithfully,

(Patrick H. Tsui)
Technical Secretary/Building
for Director of Buildings

PT/rcy/ac

4/F-12/F, Murray Building, Garden Road, Hong Kong 香港花園道美利大廈四樓至十二樓

消 防 處
防 火 組
香港九龍尖沙咀東部廣華道1號
消防總部大廈

FIRE SERVICES DEPARTMENT,
FIRE PROTECTION BUREAU,
FIRE SERVICES HEADQUARTERS BUILDING,
No. 1 Hong Chong Road,
Tsim Sha Tsui, East, Kowloon,
Hong Kong.

本處檔號 Our Ref.: FPB 207/0005
來函檔號 Your Ref.: L026/92HK
電訊掣號 Telex: 39607 HKFSD HX (24 小時 Hours)
圖文傳真 Fax: 852-3110066
852-3689744
電話 Tel. No.: 733 7596

29 April 1992

Hilti (Hong Kong) Ltd.,
Unit 3, 5/F, Harbour Centre,
Tower 2,
8 Hok Cheung Street,
Hunghom, Kowloon.

Dear Sirs,

"HILTI" Fire Prevention System

I refer to your letter of 30.3.92 and the enclosures attached thereto.

Based on the information contained in your letter under reference and the given test report, I understand that the captioned product is a building material which should be approved by the Director of Buildings and Lands. As such, I am not in a position to process your application and you are advised to refer your enquiry to the Director of Buildings and Lands, whose address is listed hereunder :-

The Director of Buildings and Lands,
(Attn.: Technical Secretary/Building, B.O.O.)
Murray Building,
Garden Road,
Central,
Hong Kong.

Please feel free to contact us should you have any other question in this matter.

Yours faithfully,

(TSE Yu-hing)
for Director of Fire Services

TYH/jt

ARCHITECTURAL SERVICES DEPARTMENT 建築署
QUEENSWAY GOVERNMENT OFFICES, 66 QUEENSWAY, HONG KONG. 香港金鐘道六十六號金鐘道政府合署
FAX 852-2869 0289

Our Ref : ASD 16/92101/AML/APP 06 June 1997
Your Ref. : --------
Tel. No. : 2867 3631
Fax No. : 2877 0594

Hilti (HK) Ltd
17/F, Tower 6, China HK City,
33 Canton Rd,. TST

Dear Sirs,

Architectural Services Department
List of Acceptable Materials
Hilti Firestop Products
Ref. no. 0001P

I am pleased to inform you that approval has been given to include the above product/material in this Department's List of Acceptable Materials. Initially, this listing is for a probationary status and this will be reviewed after the submission of satisfactory performance reports on completion of projects undertaken by this Department where your product has been used.

The Architectural Services Department List of Acceptable Materials is a restricted internal document. This letter should not be used for commercial or marketing purposes and failure to comply with this may result in the removal of the product from the List.

Yours faithfully,

WM Tang

(W.M. TANG)
Technical Secretary/2
for Chief Architect/ Central Management Branch
Architectural Services Department

Filecode : 95202 - LIST_LE.DOC
WMT/WHY/by

Attn. : To whom it may concern

Date : 26 September 2023
Ref. : 098/FP/DY/23

Subject : Country of Origin- Hilti CFS-COS Firestop Composite Sheet

Dear Sir / Madam,

Enclosed please find the information of Hilti CFS-COS Firestop Composite Sheet.

Brand Name : Hilti

Model Name : Hilti CFS-COS Firestop Composite Sheet

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 : USA

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

Hilti (Hong Kong) Ltd.
701-704 | Tower A | Manulife Financial Centre
223 Wai Yip Street | Kwun Tong
Kowloon | Hong Kong
P +852-8228 8118 I **F** +852-2954 1751
www.hilti.com.hk

To whom it may concern

Date:14th Sept 2018

Dear Sir / Madam,

Subject: Hilti Firestop Products non-CFC and Ozone Confirmation

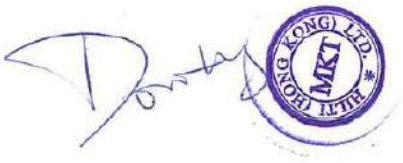
Referring to your enquiry about the captioned subject, please be advised that:

Hilti firestop products, CFS-COS Firestop Composiste Sheet 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 or Customer Service Hotline at 8228-8118.

Yours sincerely,



Dorothy Wai
Product Manager

Hilti (Hong Kong) Ltd.
701-704 & 708A&B | Tower A | Manulife Financial Centre
223 Wai Yip Street | Kwun Tong
Kowloon | Hong Kong
P +852-8228 8118 I F +852-2954 1751
www.hilti.com.hk

Material Information Statement

Articles

According to Regulation (EC) 1907/2006, Article 32
Revision: 07.04.2020 Version: 18

1 Identification of the articles and of the company undertaking

1.1 Product identifier

Trade name:

- Firestop Bandage CFS-B / CP 646
- Firestop Back Pan Strip CFS-BPS
- Firestop Block CFS-BL / CFS-BL P
- Firestop Board CP 675
- Firestop Boot CFS-BO
- Firestop Box Insert
- Firestop Cable Collar CFS-CC / CFS-RCC / CFS-RCC EXT
- Firestop Cable Module CFS-T
- Firestop Cast-in device CP 680 / CP 681 / CFS-CID /
- CFS-CID MD P/M
- Firestop Coated Board CFS-CT B / CP670 / CP673 / CP676
- Firestop Collar CFS-C / CFS-C P
- Firestop Collar CP 643 / CP 644
- Firestop Composite Sheet CFS-COS
- Firestop Cord CFS-CO
- Firestop Cushion CP 651N
- Firestop Drop-In Device CFS-DID
- Firestop Edge of Slab QuickSeal CFS-EOS QS
- Firestop Endless Collar CFS-C EL
- Firestop Filler Module CFS-T FB
- Firestop Gangplate CFS-SL GP
- Firestop Module Box CFS-MB / CP 657
- Firestop Plug CFS-PL / CP 658
- Firestop Plug Seal CFS-T RR / CFS-T RRS
- Firestop Retrofit Sleeve CFS-SL RK
- Firestop Sleeve CP 645
- Firestop Sleeve Kit CFS-SL SK
- Firestop Speed Sleeve CFS-SL / CFS-SL GA / CP 653
- Firestop Top Track Seal CFS-TTS
- Firestop Top Track Seal CFS-TTS MD
- Firestop Top Track Cover CFS-TTS MD
- Firestop Top Track Plug CFS-TTS MD
- Firestop Top Track Seal CFS-TTS 212
- Firestop Top Track Seal CFS-TTS R
- Firestop Wedge Seal CFS-T WD120
- Firestop Wrap Strip CFS-W EL / SG / P / CP 648
- Foil Tapes CS-FT
- Intumescent façade cavity closer CP674
- Joint Sealing Tapes CS-JST
- Mineral Wool
- Mineral Wool Boards
- Multifunctional Tapes CS-MFT
- Pre-coated Mineral Wool Boards
- Smoke & Acoustic Track Seal CS-TTS SA
- Speed Plug CP 777
- Speed Strip CP 767

1.2 Application of the listed articles

Construction industry.

Refer to Hilti product literature, technical data sheets, 3rd party published listings and national approvals for specific application information. For more details, please contact your local Hilti organization through http://www.hilti.group

1.3 Manufacturer / Supplier

Hilti AG
Feldkircherstr. 100
FL-9494 Schaan
Liechtenstein

Customer Service
Phone +423 (0)844 84 84 85
Fax +423 (0)844 84 84 86

2 Other information

A Safety Data Sheet is not required due to the classification of these products as “articles” according to Regulation (EC) No. 1907/2006 of 18 December 2006 (EU) / 29CFR 1910.1200 (U.S.A.). Consequently, these products are exempted from CLP / OSHA Labeling and SDS requirements.

These data are based on our present knowledge. However, they shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

Informing department:
chemicals.hse@hilti.com

Hilti CFS-COS Firestop Composite Sheet Job Reference

Year	Project Name	Customer Name	Project type
2020	New - Hospitality - 302 Jockey Club Road, Fanling	SHUI ON CONSTRUCTION	Hospitality
2021	TAI WAI STATION NW RES	SCHINDLER LIFTS (HONG KONG) LTD	Residential
2022	CHUN YAT ST & CHUN CHEONG ST AMC	GAMMON E&M LIMITED	Office