Efectis Nederland
P.O. Box 554 | 2665 ZN Bleiswijk
Brandpuntlaan Zuid 16 | 2665 NZ Bleiswijk
The Netherlands
+31 88 3473 723
nederland@efectis.com

REPORT

Determination of the fire resistance according to EN 1634-1:2014 and EN 1364-1:2015 of two doors, five electrical installation parts, a timber panel with wood filler product and an animal flap, mounted in a standard flexible wall construction

Report no.	2017-Efectis-R000741
Sponsor	Intumescent Systems Ltd Envirograf House Barfrestone CT15 7JG DOVER UNITED KINGDOM
Prepared by	Efectis Nederland BV
Notified body no	1234
Author(s)	L. Schimmer – Herder BBE P.G.R. Scholten B.Sc.
Project number	ENL-17-000081
Date of issue	May 2017
Number of pages	49

CONTENTS

1. GENERAL

1.1 REPORT

This report details the method of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in EN 1363-1, and where appropriate EN 1363-2. Any significant deviation with respect to size, constructional details, loads, stresses, edge or end conditions other than those allowed under the field of direct application in the relevant test method is not covered by this report.

1.2 SUBJECT

Subject of the investigation were two doors, five electrical installation parts (electrical boxes, switches), a timber panel with wood filler product and an animal flap. All mounted in a standard flexible wall construction.

1.3 INVESTIGATION

Determination of the fire resistance of two doors, five installation penetrations, an opening for a wood filler product and an animal flap, in a standard flexible wall construction, exposed to the standard fire curve of EN 1363-1.

1.4 SPONSOR AND MANUFACTURER

Sponsors	Manufacturer
Intumescent Systems LTD Envirograf House Barfrestone CT15 7JG DOVER UNITED KINGDOM North Kent Joinery LTD Brunel Sawmill, Churchill Lane The Historic Dock Yard ME4 4TQ CHATHAM, KENT UNITED KINGDOM	Envirograf Envirograf House Barfrestone CT15 7JG DOVER UNITED KINGDOM

1.5 PLACE AND DATA REGARDING THE EXAMINATION

The research was conducted at the laboratory of Efectis Nederland BV in Bleiswijk, the Netherlands.

Assembly of the test specimens	16th of March 2017
Fire resistance test	17th of March 2017

1.6 NORMATIVE REFERENCES

EN 1363-1:2012	Fire resistance tests - Part 1: General Requirements
EN 1634-1:2014	Fire resistance tests for door and shutter assemblies and openable windows.
EN 1364-1:2015	Fire resistance tests for non-loadbearing elements - Part 1:Walls
EN 13501-2:2016	Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services

1.7 REVISION INFORMATION

This is the first issue of the test report.

2. TEST SPECIMENS

2.1 GENERAL

A fire test was carried out on two doors, five electrical installation parts (electrical boxes, switches), a timber panel with wood filler product and an animal flap. All mounted in a standard flexible wall construction.

For the dimensions and specifications of the materials and components of the examined construction, also see the figures in chapter 8. Details of the assembly of the construction are given in the paragraphs below.

2.2 TEST FRAME

The test frame was constructed of steel beams with a fire resistant concrete lining.

Dimensions	
Aperture	4000 mm x 3000 mm (w x h)
Width of frame and concrete lining	250 mm

2.3 SUPPORTING CONSTRUCTION AND FREE EDGES

The doors and the penetration seals were built in a standard flexible supporting construction according to EN 1363-1, being an insulated metal stud gypsum plasterboard wall.

Specifications	
Dimensions wall	3090 x 3000 mm (w x h)
Nominal thickness	100 mm
Material cladding	Standard gypsum board
Manufacturer	Knauf
Type	Type F, EN 520

Dimensions board	1200 x 3000 x 12,5 mm (w x h x t)
Number of layers	2 on both sides
Both layers fixed with screws	Galvanised gypsum board screws
Manufacturer	Knauf
Metal profile frame	CW50, UW50 and UA50 profiles
Dimensions profiles	CW50 and UW50: 50 x 0.6 mm (w x t) UA50: 50 x 2.0 mm (w x t)
Core to core (c.t.c.) distance studs	See figures in chapter 8
Insulation	Rock wool
Manufacturer	Rockwool
Type	Rockwool PROROX SL 970
Thickness	50 mm
Density	115 kg/m^3
Number of free edges	2
Width	25 – 50 mm
Filling free edge	Strips of Rockwool PROROX SL 970

2.3.1 Restraint

The two vertical edges of the supporting construction were unrestrained according to EN 1634-1. At these positions mineral wool insulation was placed with a thickness of 50 mm and a density of 115 kg/m^3.

2.4 ELECTRICAL INSTALLATION

2.4.1 Type of electrical installation parts

Table 2.1: Materials used in the test

Service	Envirograf product	Service	Dimensions (mm)
C	Product 30 Sunken socket firecover	Kumho ABS 750 Plastic	207 x 171 x 50 (w x h x l), back box and facia excluded
D	Product 30 Intumescent gasket	Electrical box A7001-BB 1-level 1-way white SW 2x40 CW	71 x 121 x 50 (w x h x l)
E	Product 30 Intumescent gasket	Electrical box A7401-BB 16A switched socket outlet 4x4 CW	121 x 121 x 50 (w x h x l)

2.4.2 Intumescent materials in electrical installation parts

Table 2.2: Intumescent materials

Service	Product	Dimensions (mm)
C	PU coated glass cloth	40 x 210 x 40 x 110 (d x l x d x w), 1.5 mm thick, 62 g/m³ pigmented PU coated glass cloth
D	G-Mix intumescent	115 x 65 (l x w), 4 mm thick
E	G-Mix intumescent	115 x 115 (l x w), 4 mm thick

2.5 WOOD FILLER PRODUCT

A Sapele timber panel (dimensions 500 x 1075 x 100 mm (w x h x t)), density 675 kg/m^3, was mounted in the flexible supporting construction to create three vertical joints with a width of 15, 10 and 6 mm. The panel was fixed in a hardwood installation frame a with cross dimensions of 100 x 45 mm. Within the vertical joints, product 64 wood filler was applied.

2.6 ANIMAL ACCES DOOR

One pet flap assembly was installed comprising of a zintec sheet with white powder coating and pigmented PU-coated glass cloth, with the external size of 273 mm width x 305 mm height. The door section was constructed from PU-coated cloth 190 mm wide by 200 mm height, rolled around a mild steel rod Ø10 mm. The animal acces door was kept in position with eight screws of type “Long pozidriv pan-head self-tapping”, with dimensions 8 x 50 mm.

2.7 WHITE DOOR

One white door assembly was installed made from Pine soft wood, density 470 kg/m^3. The external size of the door frame was 1002 mm wide by 2140 mm high by 35 mm thick and 100 mm deep. The door construction was a flat panelled door compromising of six panels. Panel sizes were; top 262 x 262 mm, middle 262 x 562 mm and bottom 262 x 562 mm, all panels were 20 mm thick. The door size was 926 x 2095 x 45 mm (w x h x t). Panels and door sections were rebated into stiles and rails at a depth of 20 mm and glued. The door stops are 33 x 15 mm.

The door assembly was finished with the following paint application:

Exposed side	Non exposed side
1x Dulux Primer 1x Dulux Gloss Paint 1x Johnson Primer 1x Johnson Satin Top Coat 1x HWAPWB Clear Primer (12m² per litre) 2x HW01 White Intumescent Coating (8 m² per litre per coat) 1x HW04 White undercoat 1x Johnson White Acrylic Coating (10m² per litre)	1x Dulux Primed Coat 1x Coat Dulux Gloss Paint 1x Johnsons Primer 1x Johnsons Satin Top Coat

Since the door was already coated when it arrived at Efectis, Efectis was not able to check the applied coatings.

Door seals were Envirograf product 69 ES/SDS surface mounted on the frames white. The lock area is protected with Envirograf product 71 hinge, lock and door closer protector, and a set of three hinges Envirograf product 71 self-closing door hinge.

The door included an aluminium lever latch Felan FN42 and a 60 mm tubular latch surface.

2.8 BROWN DOOR

One brown door assembly was installed made from Sapele hard wood, density 675 kg/m^3. The external size of the door frame was 1002 mm wide by 2140 mm high by 35 mm thick and 100 mm deep. The door construction was a flat panelled door compromising of six panels. Panel sizes were; top 262 x 262 mm, middle 262 x 562 mm and bottom 262 x 562 mm, all panels were 20 mm thick. The door size was 926 x 2095 x 45 mm (w x h x t). Panels and door sections were rebated into stiles and rails at a depth of 20 mm and glued. The door stops were 33 x 15 mm.

The door assembly was finished with the following paint application:

Exposed side	**Non exposed side**
1x Sadolin Oak Stain 1x Sikkens Dark Oak Stain 1x Envirograf® HWAP/WB Clear Primer (12m² per litre per coat) 2x HW02/N Clear Intumescent Coating (8m² per litre per coat) 1x Johnsons Jacobean Wood Stain (8m² per litre)	1 Coat Sadolin Oak Stain 1 x Sikkens Dark Oak Stain 1 x Johnsons Jacobean Wood Stain (8m² per litre)

Since the door was already coated when it arrived at Efectis, Efectis was not able to check the applied coatings.

Door seals were Envirograf product 69 ES/SDS surface mounted on the frames brown. The lock area is protected with Envirograf product 71 hinge, lock and door closer protector, and a set of three hinges Envirograf product 71 self-closing door hinge.

The door included an aluminium lever latch Felan FN42 and a 60 mm tubular latch surface.

2.9 METHOD OF ASSEMBLY

- Attaching the steel C edge profiles to the concrete lining of the test frame;
- Attaching the vertical and horizontal steel profiles to the edge profiles with screws;
- Placing the first layer of gypsum on the steel profiles with screws at the non-fire side;
- Placing the second layer of gypsum on the steel profile with screws at the non-fire side;
- Filling up the joints with gypsum plaster;
- Placing the insulation between the steel profiles;
- Placing the first layer of gypsum on the steel profiles with screws at the fire side;
- Placing the second layer of gypsum on the steel profile with screws at the fire side;
- Filling up the joints with gypsum plaster;
- Installation of doors, electrical installation parts, animal flap and panel with vertical joint seals.

3. MANUFACTURING OF THE CONSTRUCTION

Efectis Nederland BV	Supplying test frame Production of the supporting construction
Intumescent Systems Ltd	Production of seals Installation of doors Installation of electrical installation parts Installation of animal flap Installation of panel with vertical joint seals

4. RESEARCH METHOD

4.1 VERIFICATION OF THE SPECIMEN

During the assembly, the materials and parts used were verified on the basis of the data provided. Since the doors were already coated when they arrived at Efectis, Efectis was not able to check the applied coatings.

4.2 CONDITIONING

From the moment of installation until the fire test, the construction was stored in the laboratory of Efectis Nederland BV under the following conditions:

Ambient temperature: 20 ± 5°C.

Relative humidity: 50 ± 10 %.

4.3 DENSITY AND MOISTURE CONTENT

Material	Density [kg/m^3]	Moisture content [%]
Plasterboard	1016	1.1
Rockwool PROROX SL 970	115	0.8
Pine soft wood (White door)	470	-
Sapele hard wood (Brown door)	675	-
Sapele hard wood (panel)	675	-

4.4 FIRE TEST

4.4.1 Test conditions

The fire test was carried out according to EN 1364-1 for the electrical installations and EN 1634-1 for the doors. The doors were opening into the furnace.
The specimens have been exposed to the standard fire curve according to EN 1363-1. The aimed overpressure in the furnace was 0 Pa at 0.5 m from the notional floor level. The pressure set was 17 Pa at 2.5 m from the furnace floor level.

4.4.2 Measurements

During the heating the following data was measured and registered:

Furnace conditions

- The temperatures in the furnace using plate thermocouples, equally spread over the heated surface;
- The pressure in the furnace.

Specimen

- Surface temperatures of the door leafs;
- Surface temperatures of the wood filler product
- Radiation at the centre of the door leafs;

Environment

- The temperature in the laboratory.

5. TEST RESULTS

5.1 OBSERVATIONS DURING HEATING

Table 5.1: Observations during test

Time [min]	Observations
0	Start of the heating
1	Animal flap closed down
7	Dark colouring at top part of the animal flap, plastic facia flap material was melting
9	Front flap dropped of the animal flap
12	Doors stopped to smoke
14	Door handle of the brown door started to smoke
14	Small bulges appeared on the door leaf
32	Top section of plastic facia surround of the animal flap housing started to melt
38	Thermocouple 4 fell off
41	Wooden filler of 15 mm width was deflecting towards the unexposed side
50	Animal flap was chattering
51	Top right panel of the black door was glowing
55	Both top panels of the black door were glowing
56	Flames > 10 seconds on brown door (top right panel), door was closed off at request of the sponsor
61	Bottom right corner of the white door flames appeared < 10 seconds
61	Flames > 10 seconds at panel of wood filler products
64	End of heating after consulting the client

5.2 GRAPHS OF THE FIRE TEST

The test results are shown in graphs in appendix A and B.

5.3 UNCERTAINTY OF MEASUREMENT

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

5.4 PHOTOGRAPHS

The pictures during assembly, before, during and (when applicable) after the fire test are shown in appendix C.

6. SUMMARY OF TEST RESULTS

Table 6.1: Summary of test results

Test results		**Time of reaching a criterion according to EN 1363-1, measured from the start of the test**	
Material	**Service**	**Integrity 'E' (minutes)**	**Radiation 'W' (minutes)**
Sunken Bocket box	A	64	-
Wood filler product 6 mm	B1	61	-
Wood filler product 10 mm	B2	61	-
Wood filler product 15 mm	B3	61	-
Animal flap	C	64	-
Electrical box, unexposed side	D1	64	-
Electrical box, exposed side	D2	64	-
Electrical box, unexposed side	E1	64	-
Electrical box, exposed side	E2	64	-
White door		Gap gauge ∅ 6 mm, 64 Gap gauge ∅ 25 mm, 64 Flames> 10 s, 64 Cotton pad, 64	64
Brown door		Gap gauge ∅ 6 mm, 64	64*

	Gap gauge ∅ 25 mm, 64 Flames> 10 s, 56 Cotton pad, 64	
The heating was terminated after 64 minutes after consulting the client.		

7. FIELD OF DIRECT APPLICATION, ACCORDING TO EN 1634-1

7.1 GENERAL

The field of direct application defines the allowable changes to the test specimen following a successful fire resistance test. These variations can be applied automatically without the need for the sponsor to seek additional evaluation, calculation or approval.

NOTE When extended product size requirements are envisaged, the dimensions of certain components within the test specimen can be less than those intended to be used at full size in order to maximize the extrapolation of the test results by modelling the interaction between components at the same scale.

Where referred to annex B or annex C in this paragraph, the annexes in EN 1634-1 are meant.

7.2 MATERIALS AND CONSTRUCTION

7.2.1 General

Unless otherwise stated in the following text, the materials and construction of the doorset or openable window shall be the same as that tested. The number of leaves and the mode of operation (e.g. sliding, single action or double action) shall not be changed.

7.2.2 Specific restrictions on materials and construction

7.2.2.1 Timber construction

The thickness of the door panel(s) shall not be reduced but may be increased.

The door panel thickness and/or density may be increased provided the total increase in weight is not greater than 25%.

For timber based board products (e.g. particle board, blockboard, etc.), the composition (e.g. type of resin) shall not change from that tested. The density shall not be reduced but may be increased.

The cross-sectional dimensions and/or the density of the timber frames (including rebates) shall not be reduced but may be increased.

7.2.3 Decorative finishes

7.2.3.1 Paint

Where the paint finish contributes to the fire resistance of the door (e.g. intumescent paints) then no change shall be permitted.

7.2.4 Fixings

The number of fixings per unit length used to attach doorsets to supporting constructions may be increased, but shall not be decreased and the distance between fixings may be reduced but shall not be increased.

7.2.5 Building hardware

The number of hinges and dog bolts may be increased but shall not be decreased.

NOTE 1 The number of movement restrictors such as locks and latches is not covered by direct application.

NOTE 2 Interchange of building hardware is not covered by the field of direct application.

7.3 PERMISSIBLE SIZE VARIATIONS

7.3.1 General

Doorsets of sizes different from those of tested specimens are permitted within certain limitations, but the variations are dependent on product type and the length of time that the performance criteria are fulfilled.

The increase and decrease of dimensions permitted by the field of direct application are applicable to the overall size and to each door leaf, each side panel and each over panel independently.

7.3.2 Test periods

The amount of variation of size permitted is dependent on whether the classification time was just reached (Category 'A') or whether an extended time (Category 'B') in accordance with the values shown in Table 1 were fulfilled before the test was concluded.

For category 'B':

Table 1 — Category B overrun requirements

Classification time (min)	All performance criteria fulfilled for at least minutes
15	18
20	24
30	36
45	52
60	-

7.3.3 Size variation related to product type

7.3.3.1 General

The rules to cover increase or decrease of size without additional considerations are applicable only to six main product groups:

a) hinged and pivoted doorsets and openable windows;

No increases in size are permitted for doorsets which are required to satisfy radiation control levels unless the insulation criteria are also satisfied. This is because any increase in size will increase the radiation received at a fixed distance away from the door. There are calculation methods which can be used to determine acceptable size increases for such doors; however, these are beyond the scope of direct application. Doors that satisfy both the radiation control levels and insulation criteria may have their sizes increased as outlined in Annex B of EN 1634-1. This is accepted because the increase in radiation resulting from a size increase allowed

under this section, for an insulated door, will be such that it will still satisfy the required radiation control levels. Size decreases are permitted for both doors which satisfy radiation control levels and those which satisfy insulation criteria and radiation control levels.

7.3.3.2.2 Other changes

For smaller doorset sizes the relative positioning of movement restrictors (e.g. hinges and latches) shall remain the same as tested or any change to the distances between them will be limited to the same percentage reduction as the decrease of test specimen size.

7.3.3.2.4 Timber constructions

The number, size, location and orientation of any joints in the timber framing shall not be changed.

Where decorative veneers of 1,5 mm or greater thickness, or other claddings which themselves provide constructive benefits, are part of the test specimen, they shall not be substituted with alternatives of lesser thickness or strength.

7.3.3.2.5 Gaps

The maximum size of the primary gaps identified in 7.3 of EN 1634-1 is restricted to the following sizes in practice:

$x = (a + b)/2 + 2$ mm

where
x is the maximum permitted gap size;
a is the maximum measured gap size;
b is the mean measured gap size.

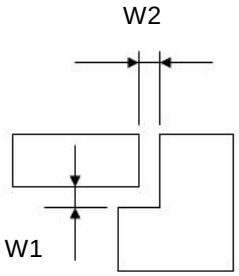

Figure 7.1: position of maximum gap widths

Permitted gap widths brown door		
	Unexposed side (W1)	Exposed side (W2)
Top of door leaf	6.5 mm	8.2 mm
Bottom of door leaf	4.6 mm	4.5 mm
Hinge side of door leaf	3.6 mm	4.1 mm
Latch side of door leaf	7.1 mm	7.4 mm

Permitted gap widths white door		
	Unexposed side (W1)	Exposed side (W2)
Top of door leaf	8.0 mm	9.8 mm
Bottom of door leaf	6.4 mm	6.2 mm
Hinge side of door leaf	3.0 mm	3.9 mm
Latch side of door leaf	9.0 mm	7.2 mm

The minimum size of the primary gaps may be reduced.

The permitted gap size may be different for different parts of the door or window.

7.4 ASYMMETRICAL ASSEMBLIES

7.4.1 General

EN 1363-1 states that for separating elements required to be fire resisting from both sides, two test specimens shall be tested (one from each direction) unless the element is fully symmetrical, i.e. the construction of the door set is identical on both sides of the centre line when viewed in plan (from above). However, in some cases it is possible to develop rules whereby the fire resistance of an asymmetrical door assembly tested in one direction can apply when the fire exposure is from the other direction. The possibility to develop such rules increases if the consideration is limited to certain types of door assembly and on the criteria being applicable (e.g. integrity only doors). The following rules represent the minimum level of common agreement which shall be followed. The rationale behind the rules is given in Annex C of EN 1634-1.

7.4.2 Specific rules

The rules governing the applicability of tests carried out in one direction to other directions are given in Table 2 and are based on the following premises:

- that each of the door leaves are themselves of symmetrical construction with the exception of the edges (e.g. lock/leading edge and hinge edge or double rebated doors);
- that any restraining/supporting elements of building hardware has been included in a test to EN 1634-1 when exposed in both directions so that they will retain their function when exposed to the heat of the test;
- that there is no change in the number of leaves or the mode of operation (e.g. sliding, swinging, single action or double action);
- that side, over and transom panels are excluded from Table 2 unless they are fully symmetrical.

Table 7.1 lists the type of door assembly for which rules can be generated and gives the direction in which it should be tested to cover the opposite direction. The separate columns for the integrity and insulation criteria reflect the different ability to make rules for integrity only doors as opposed to those which satisfy both criteria. A ‘Yes’ means that it is possible to identify the direction of test which covers the opposite direction. A ‘No’ indicates that it is not possible to identify the direction which will cover the opposite direction.

Table 7.1 Type of door set and direction to be tested to cover the opposite direction

Type of doorset	Direction to be tested to cover opposite direction	Integrity	Insulation	Radiation
Hinged or pivoted, timber leaf, timber frame	Opening into the furnace	Yes	Yes	Yes

7.5 SUPPORTING CONSTRUCTIONS

7.5.1 General

The fire resistance of a door assembly tested in one form of standard supporting construction may or may not apply when it is mounted in other types of construction. Generally, the rigid and flexible types are not interchangeable and rules governing the direct application within each group are given in 13.5.2 to 13.5.4 of EN 1634-1. However, in some cases it is possible for the result of a test on a particular type of door assembly tested in one form of standard supporting construction to be applicable to that door assembly when mounted in a different type of standard supporting construction. Specific rules governing the situation for hinged and pivoted door assemblies are given in 13.5.4 of EN 1634-1. The rationale behind the rules is given in Annex C of EN 1634-1.

7.5.2 Flexible standard supporting constructions

The fire resistance of a door tested in one of the flexible standard supporting constructions specified in EN 1363-1 can be applied to a door mounted in the same manner in a wall or partition which is of the board covered type with studs made from metal or timber.

The fire resistance of the door is only applicable to a door mounted in a partition with a fire resistance equal to or greater than the partition in which it was tested.

The fire resistance of the partition shall have been established separately in a previous test.

7.5.3 Specific rules for hinged or pivoted door sets

a) For timber door leaves hung in timber frames, the result of a test in a flexible standard supporting construction is applicable to that door assembly mounted in a rigid construction.

The rules above assume that the fixing methods used in each type of supporting construction are appropriate to that construction.

L. Schimmer – Herder BBE
Project leader resistance to fire

P.G.R. Scholten B.Sc.
Project leader resistance to fire

8. FIGURES

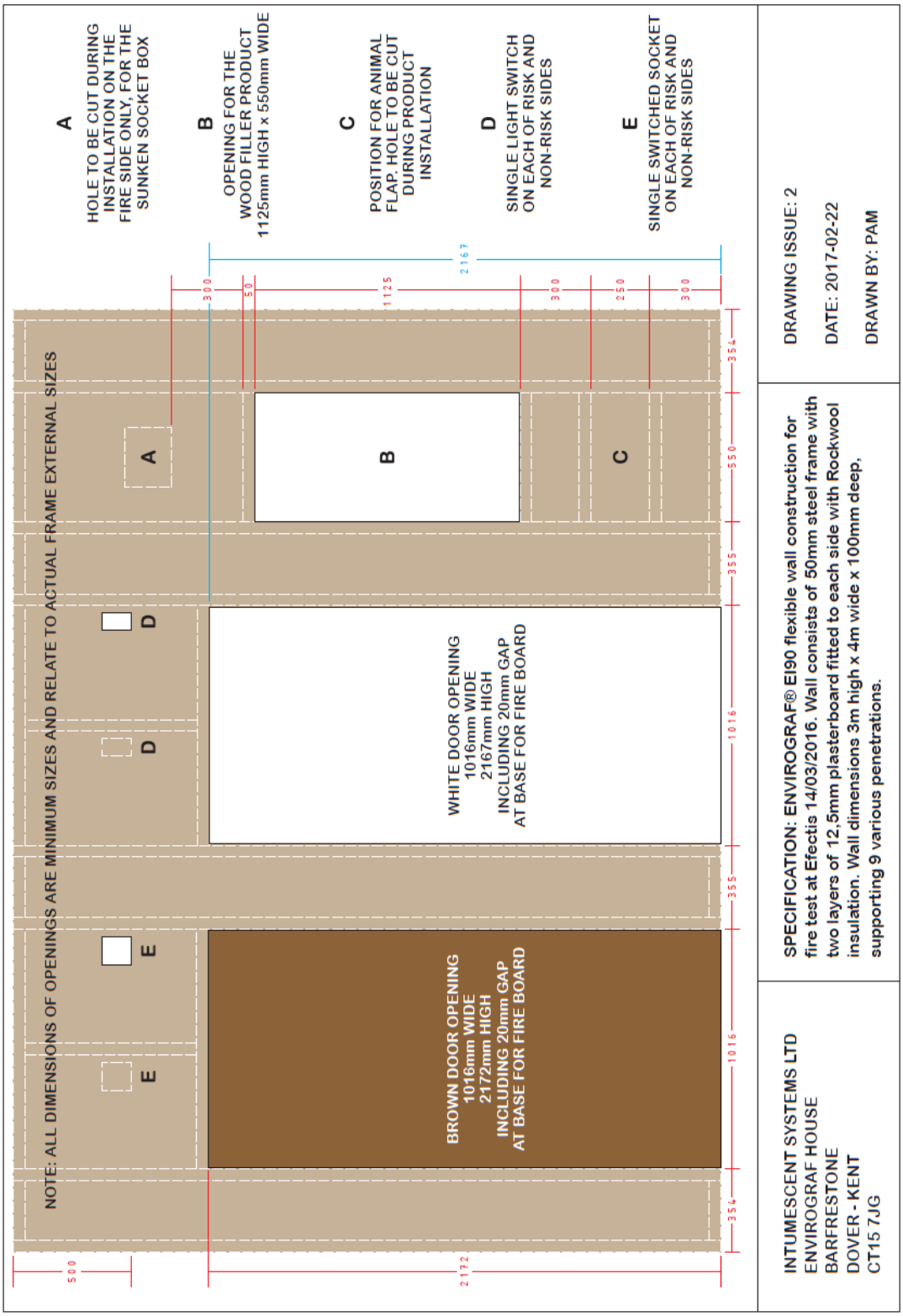

Figure 8.1 Overview of the flexible wall, non-exposed side

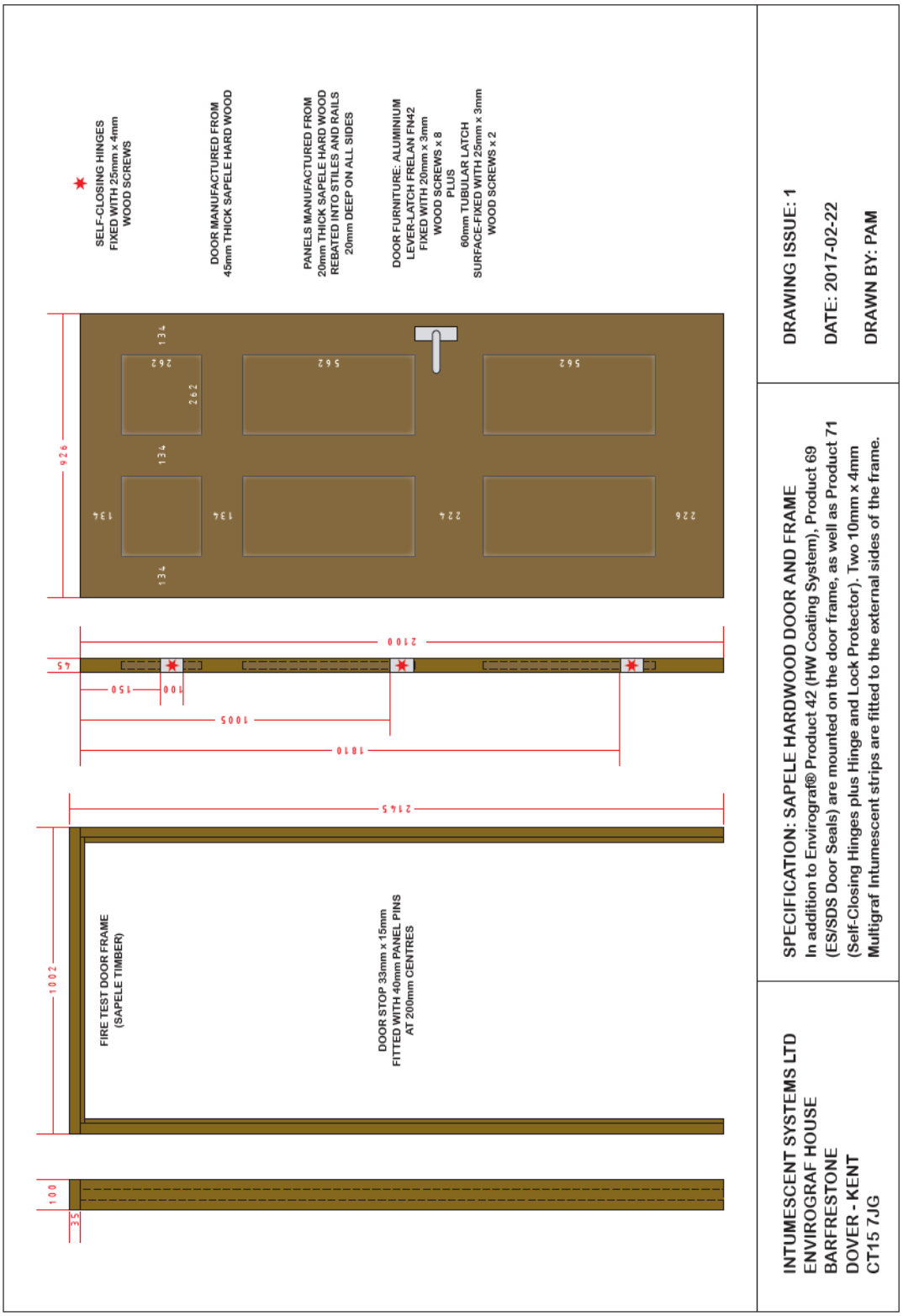

Figure 8.2 Overview hardwood door (brown door)

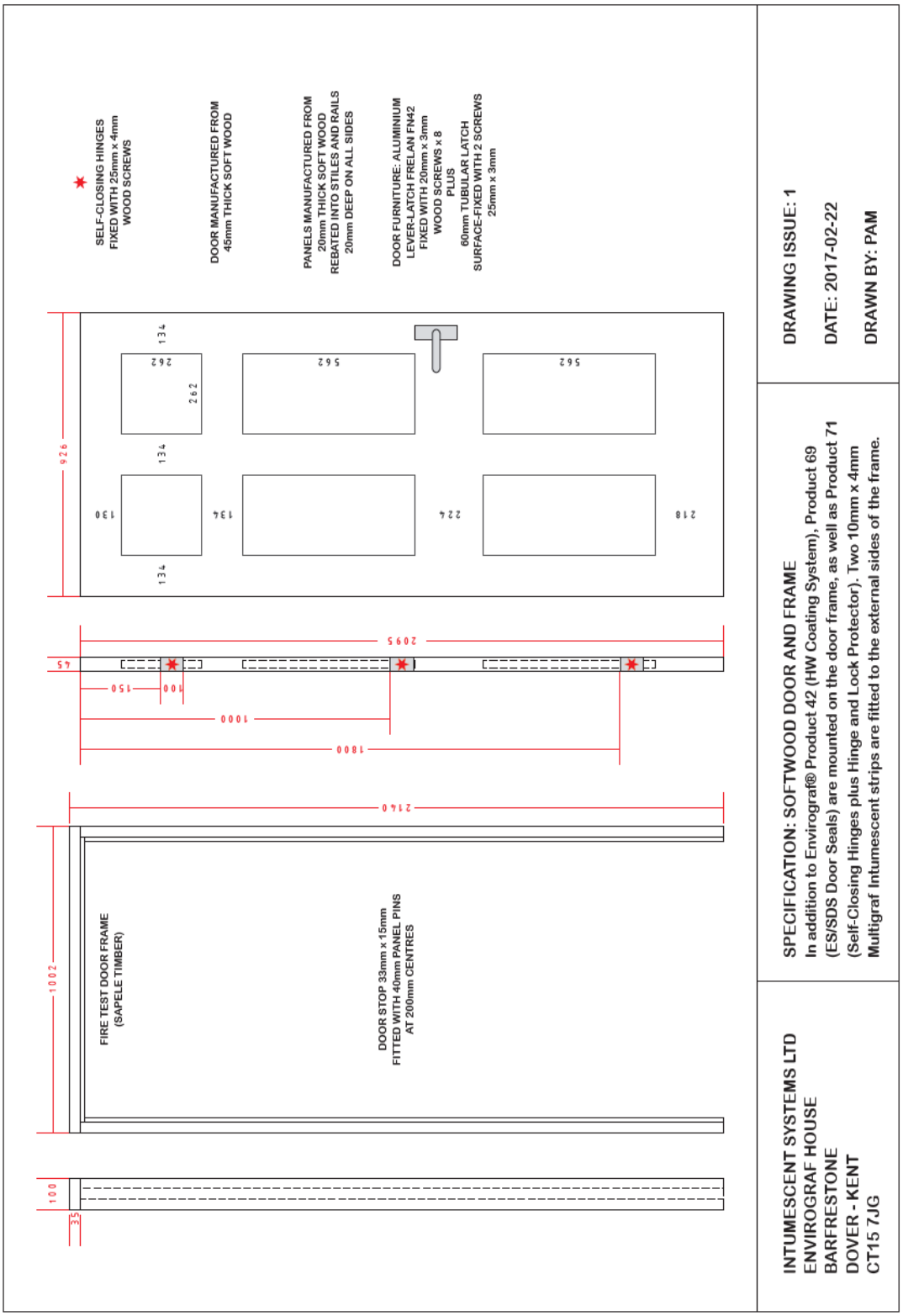

Figure 8.3 Overview softwood door (white door)

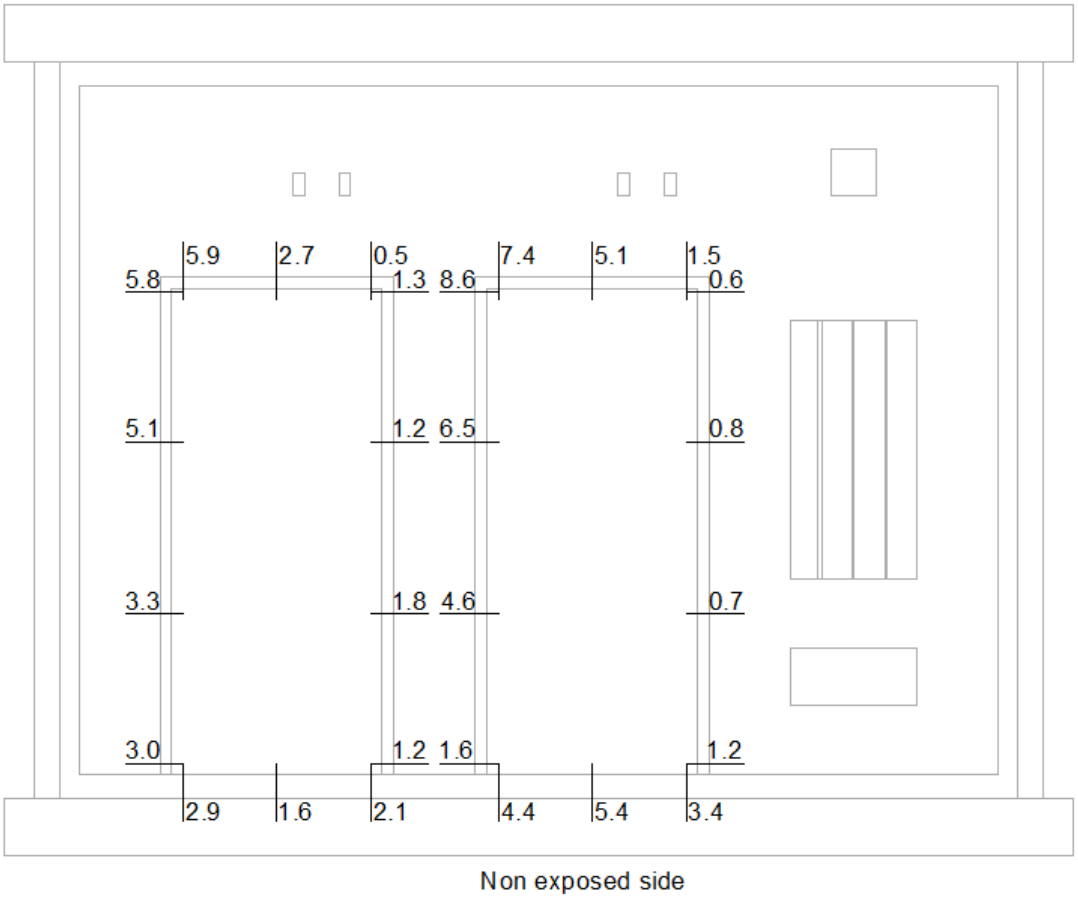

Figure 8.4 Primary gaps (unexposed side)

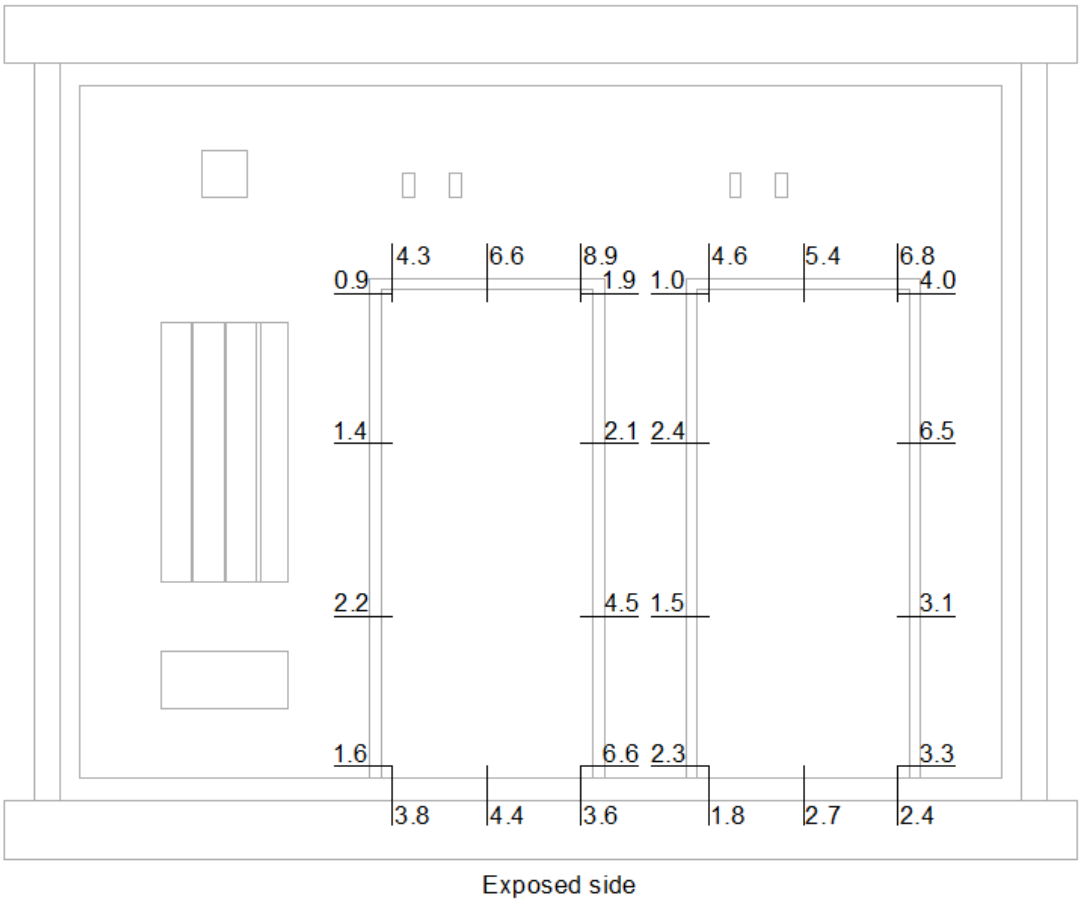

Figure 8.5 Primary gaps (exposed side)

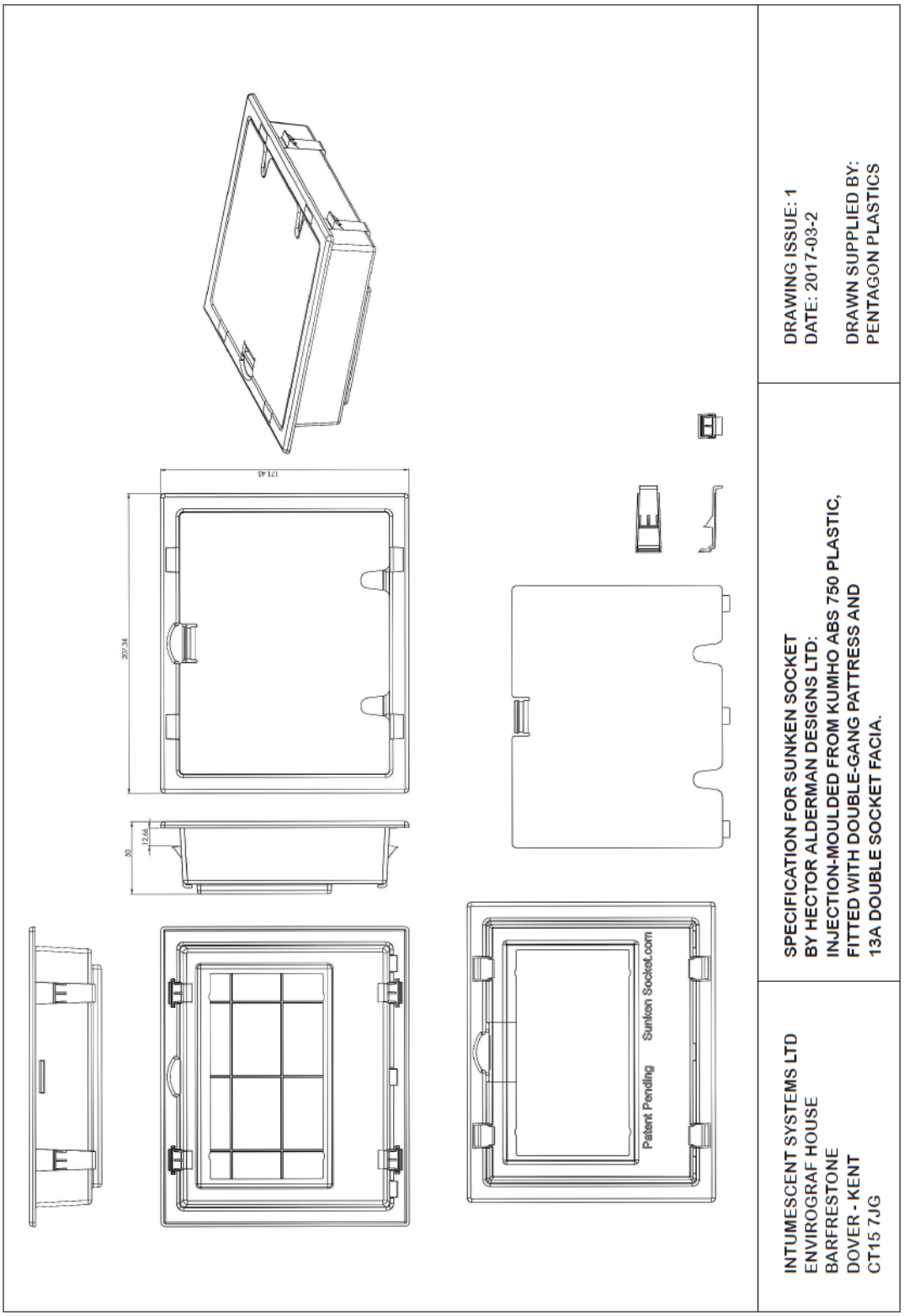

Figure 8.6 Specifications of the Sunken Socket

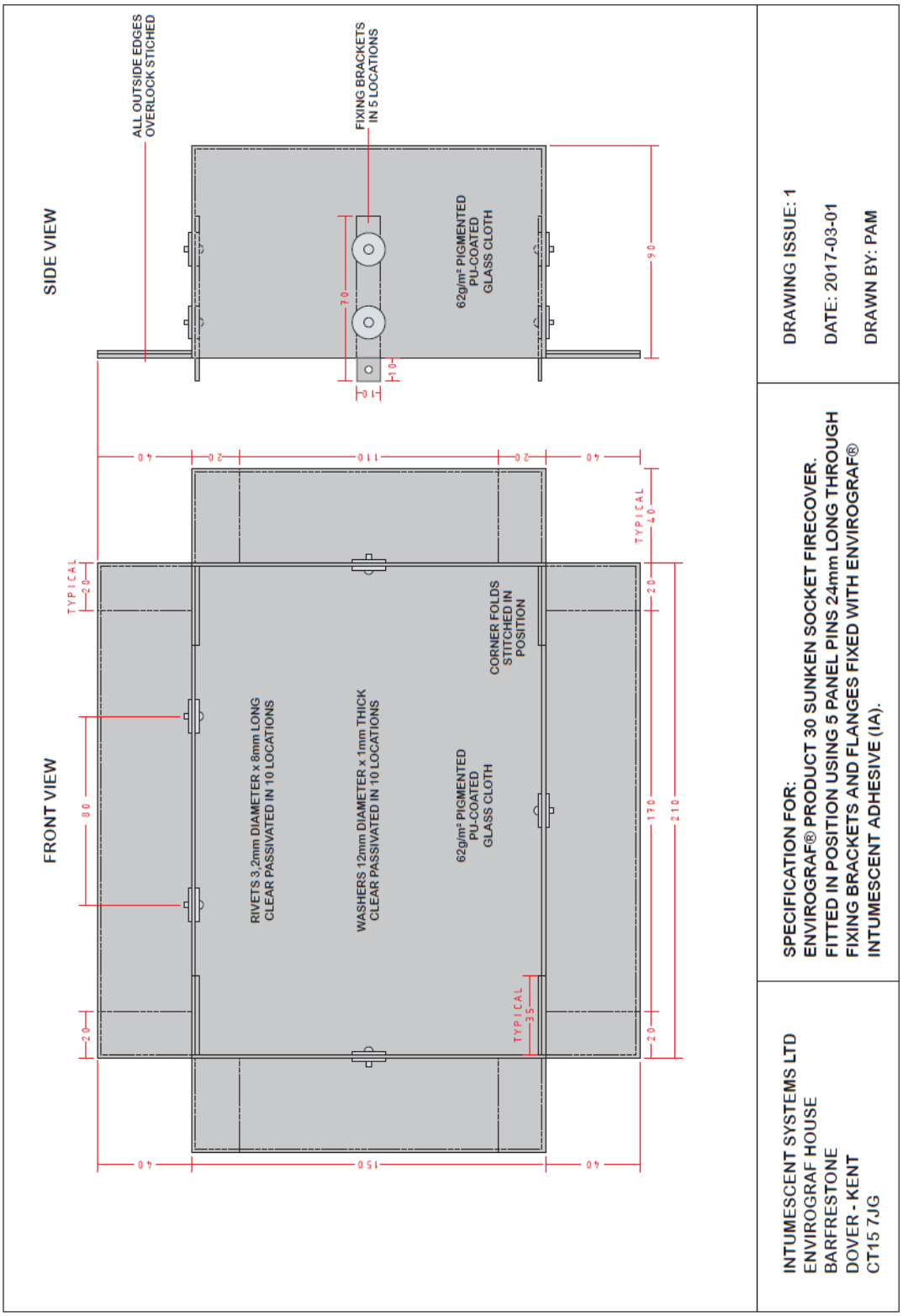

Figure 8.7 Specifications of Envirograf product 30; Sunken Socket firecover

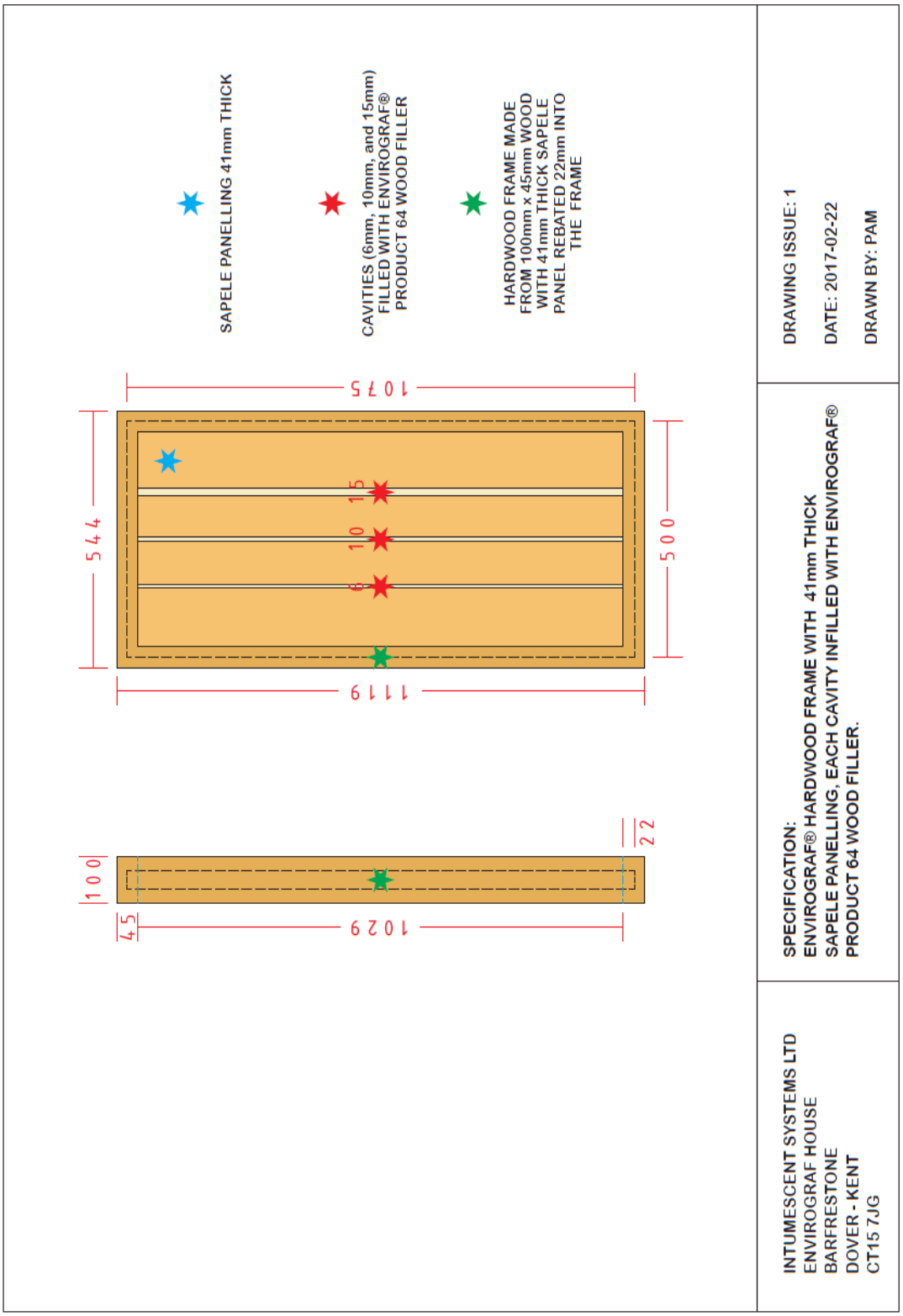

Figure 8.8 Specifications and test setup of Envirograf product 64; woodfiller

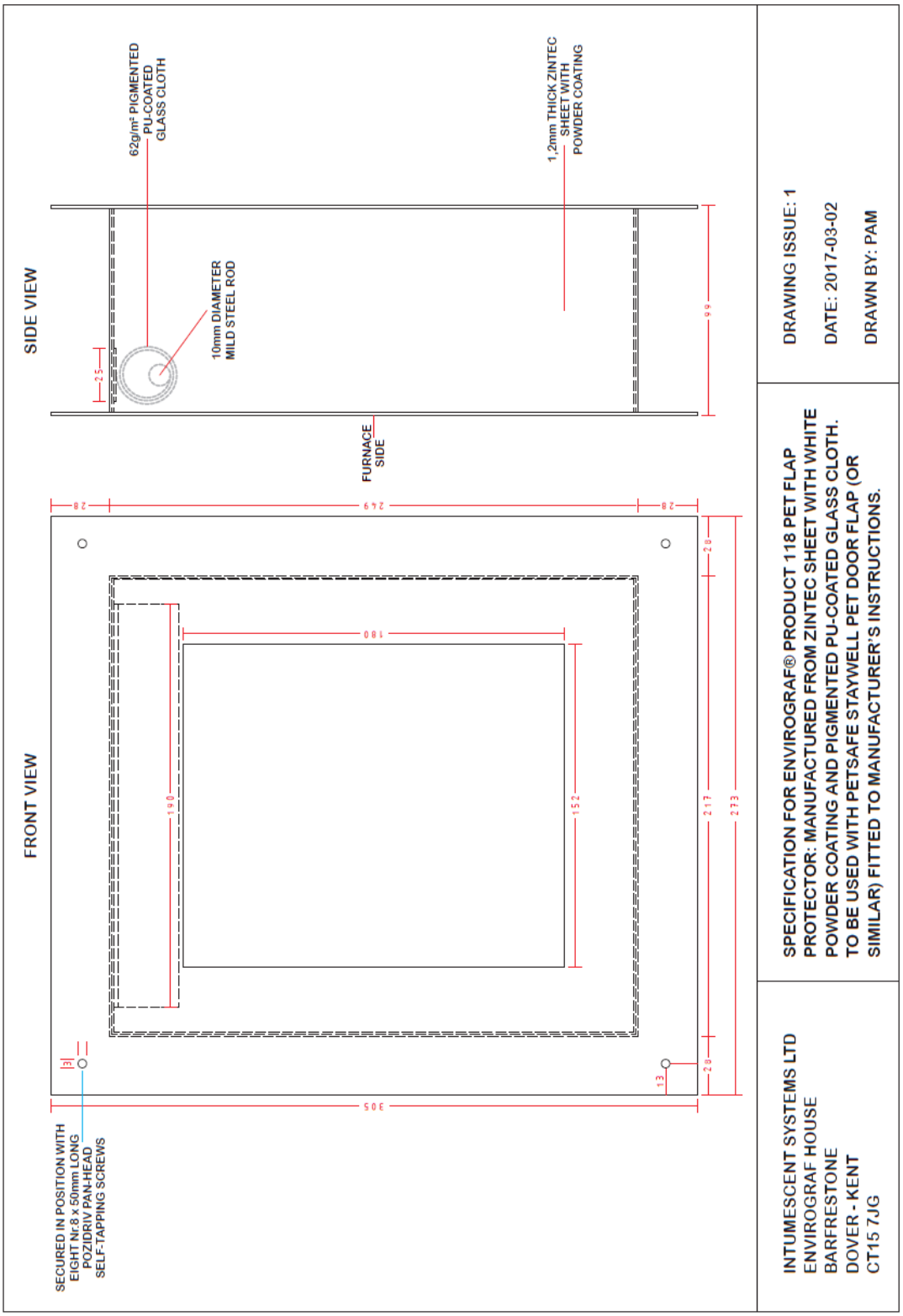

Figure 8.9 Specifications of Envirograf product 118; pet flap

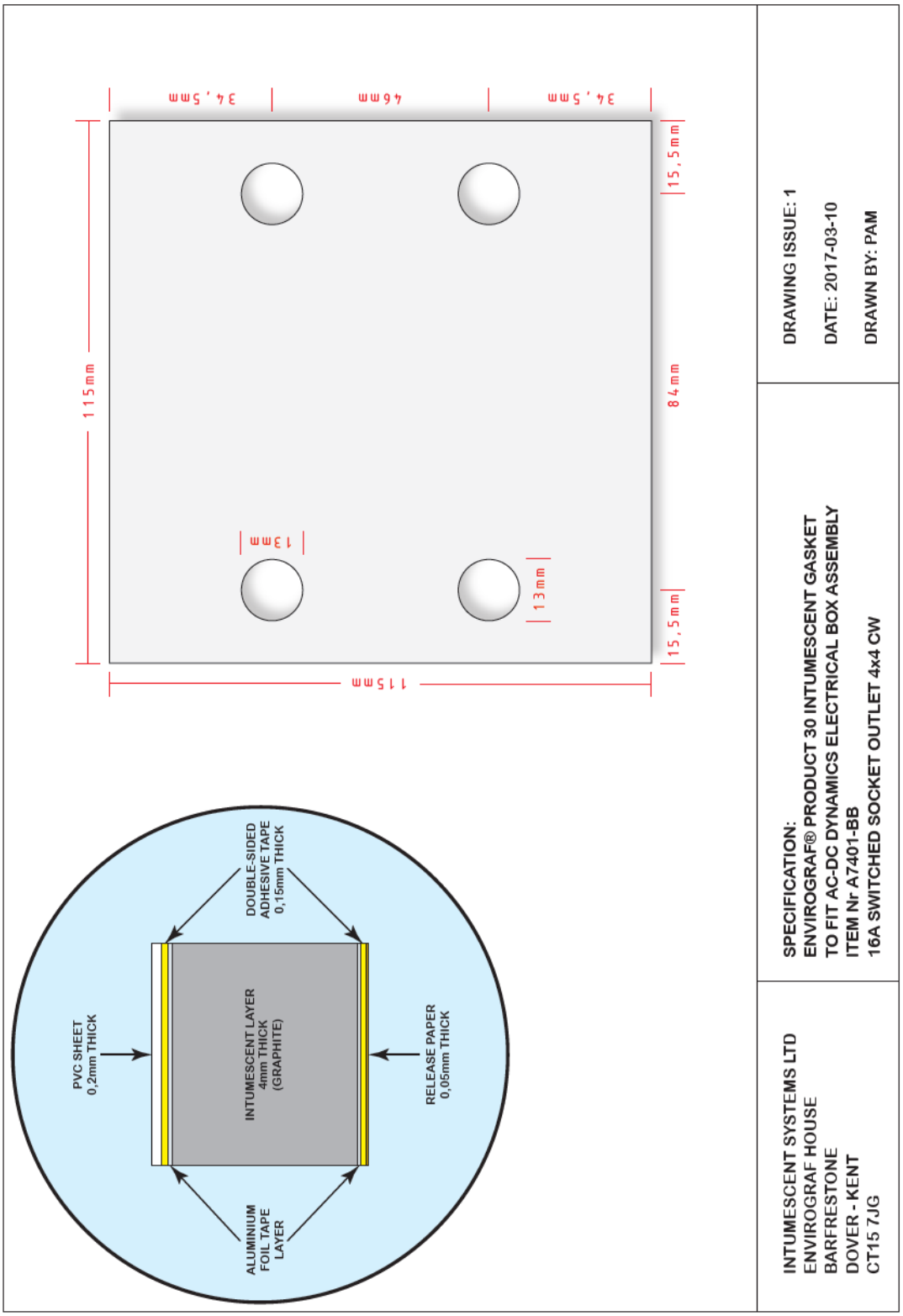

Figure 8.10 Specifications of Envirograf product 30; Intumescent gasket

Figure 8.11 Specifications of electrical box type A7401-BB

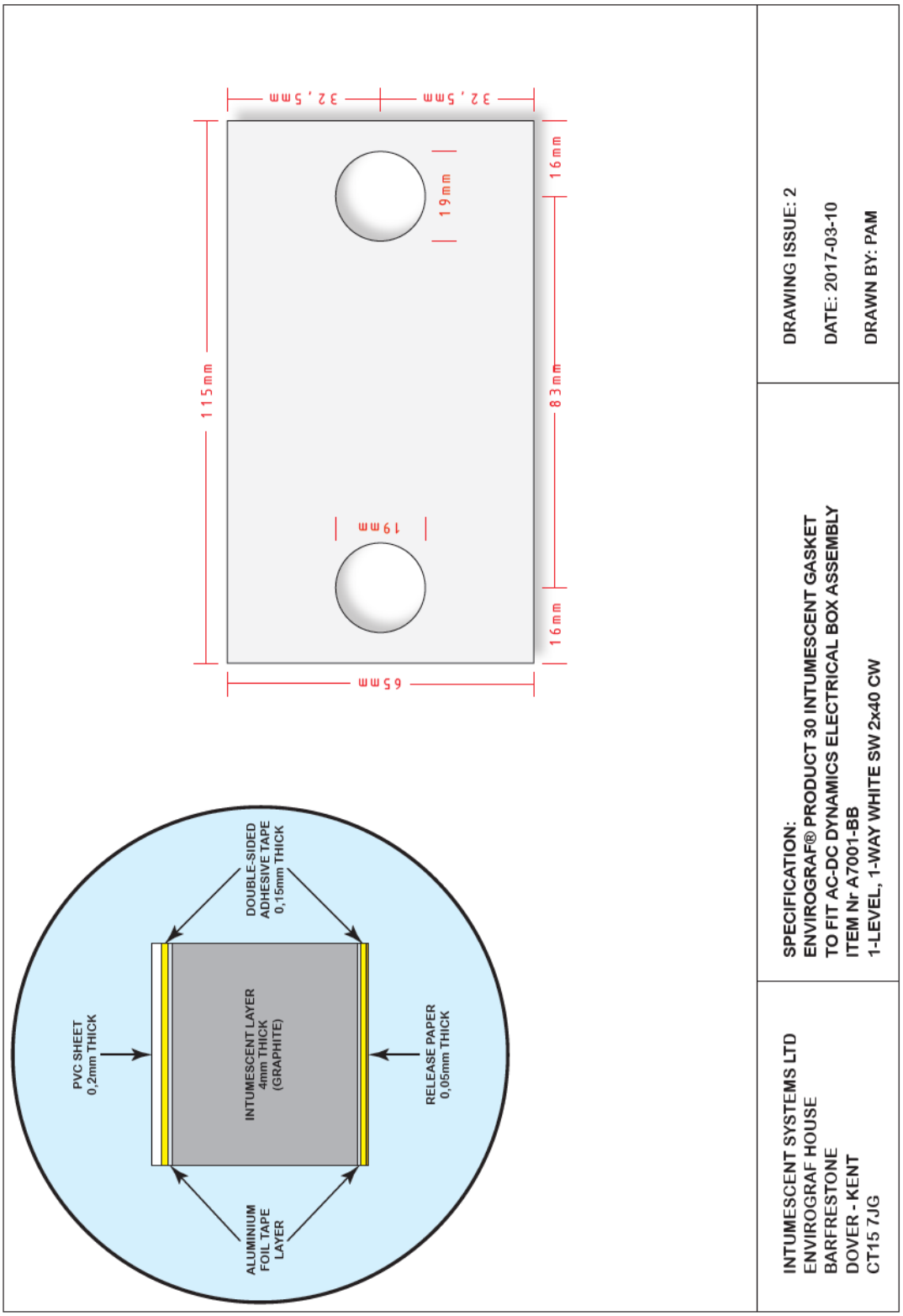

Figure 8.12 Specifications of Envirograf product 30; Intumescent gasket

Figure 8.13 Specifications of electrical box type A7001-BB

APPENDIX A: FURNICE CONDITIONS, PRESSURE AND AMBIENT TEMPERATURE

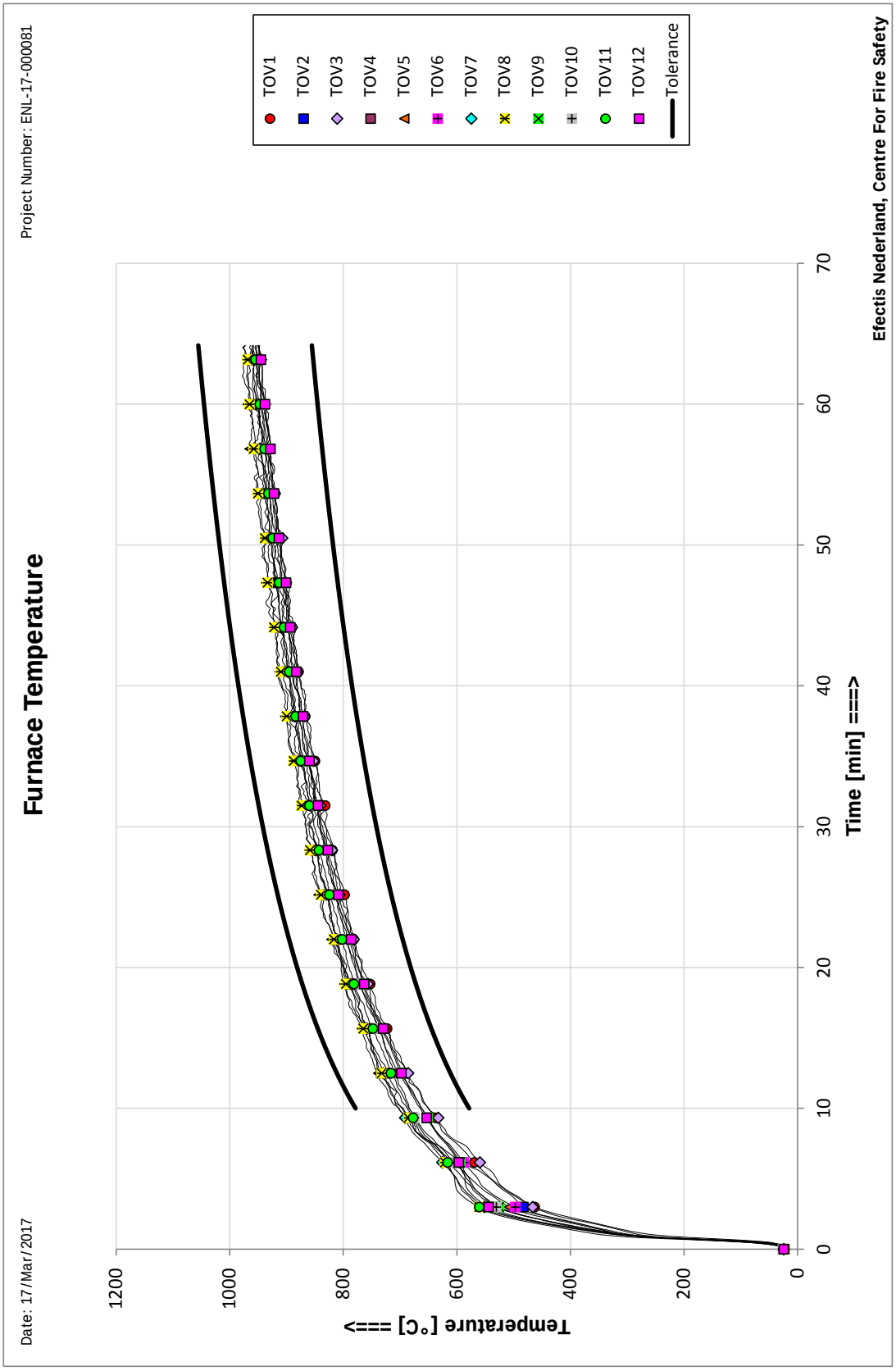

Figure A.1 Furnace temperatures

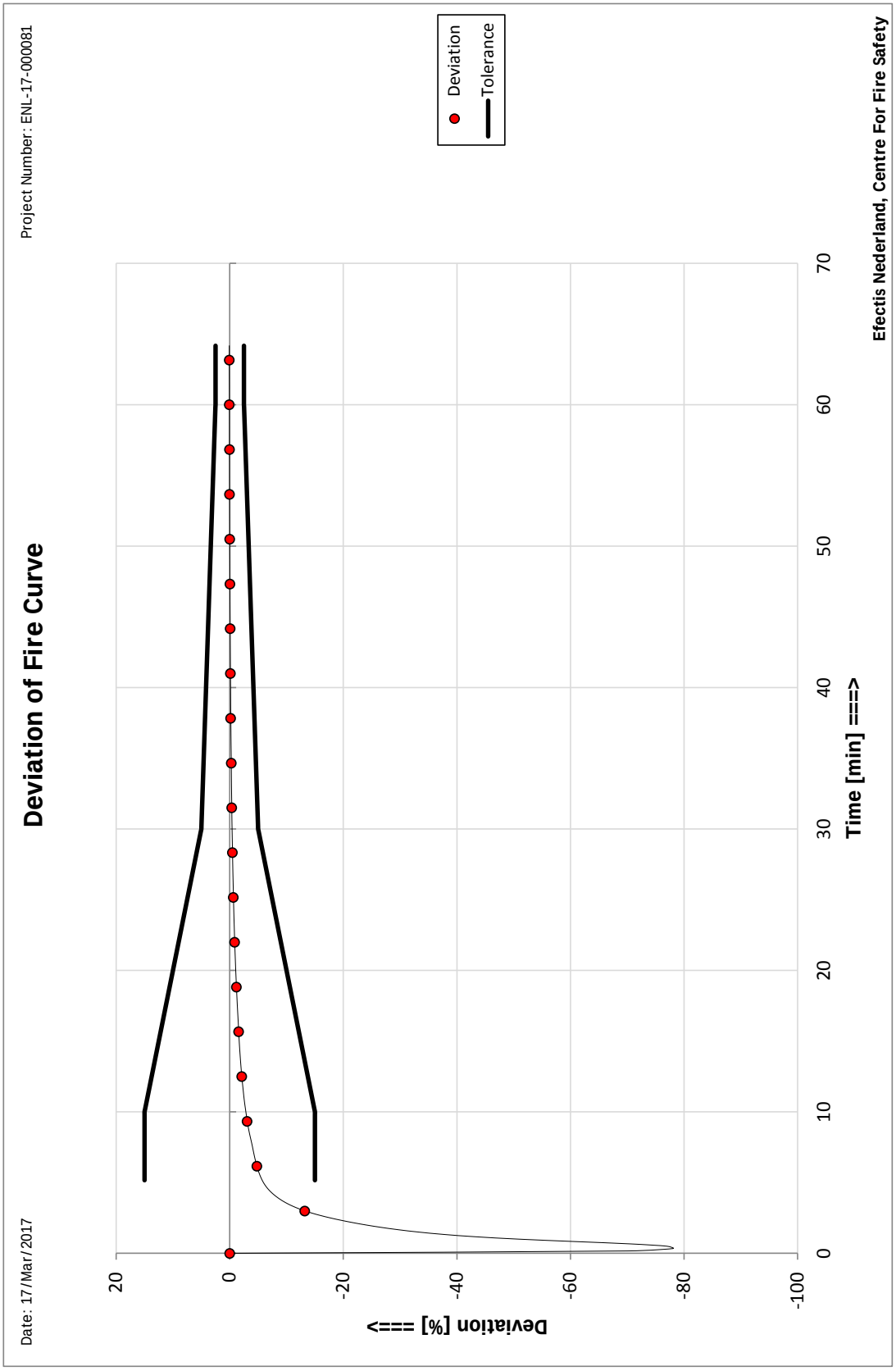

Figure A.2 Deviation fire curve according to EN1363-1

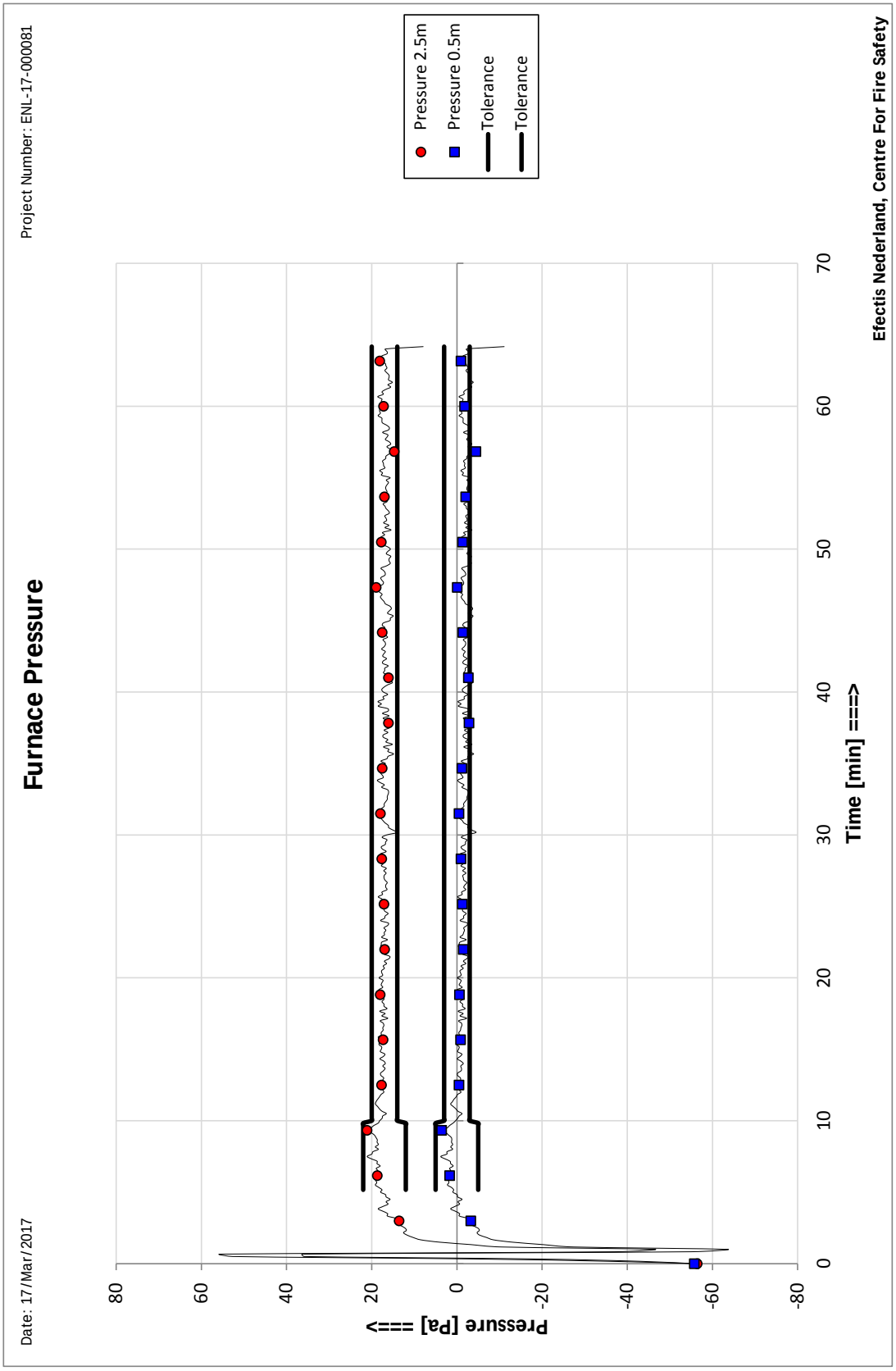

Figure A.3 Furnace pressure at 2.5 m and 0.5 m

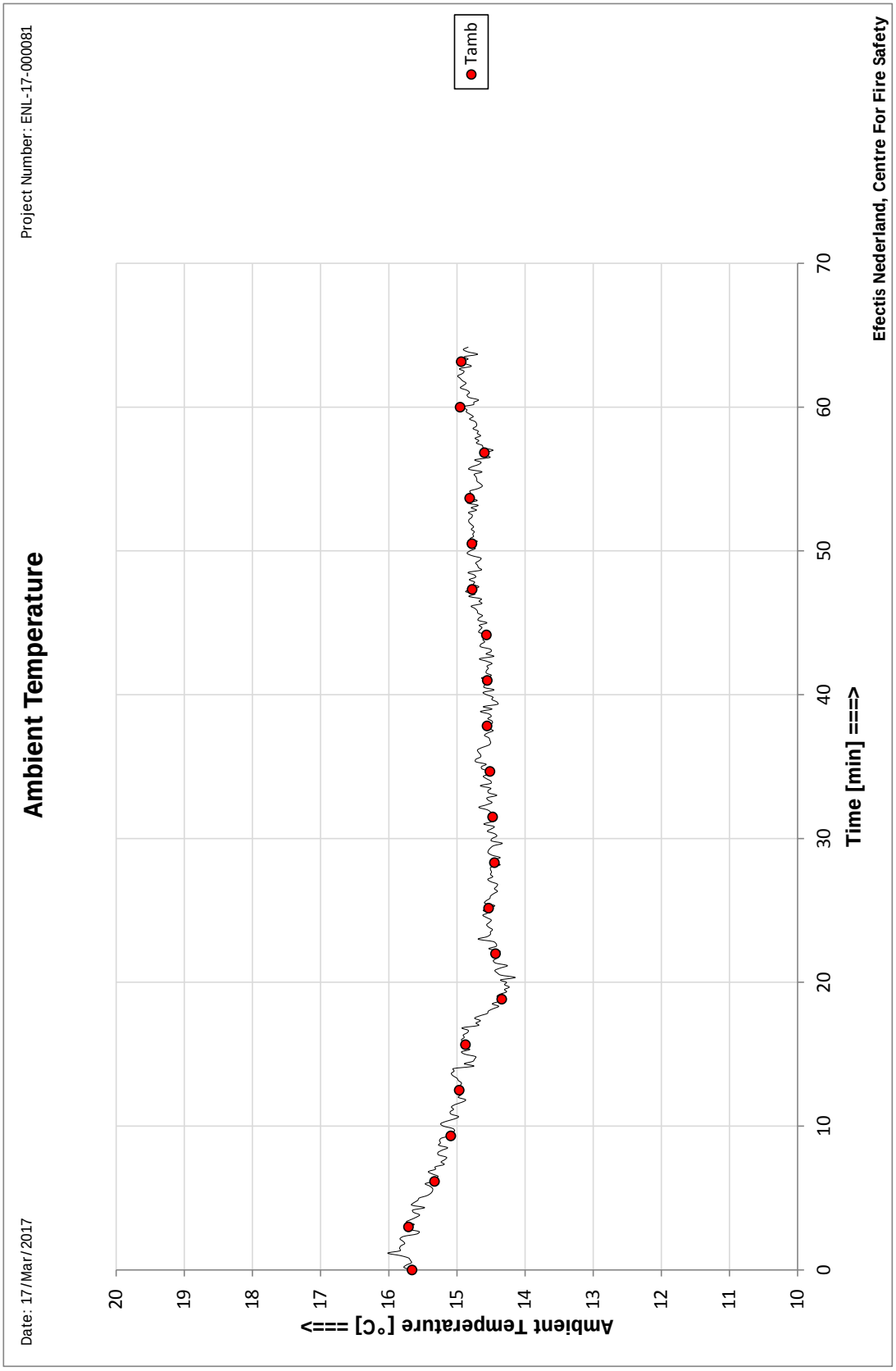

Figure A.4 Ambient temperature

APPENDIX B: MEASUREMENTS ON THE SPECIMEN

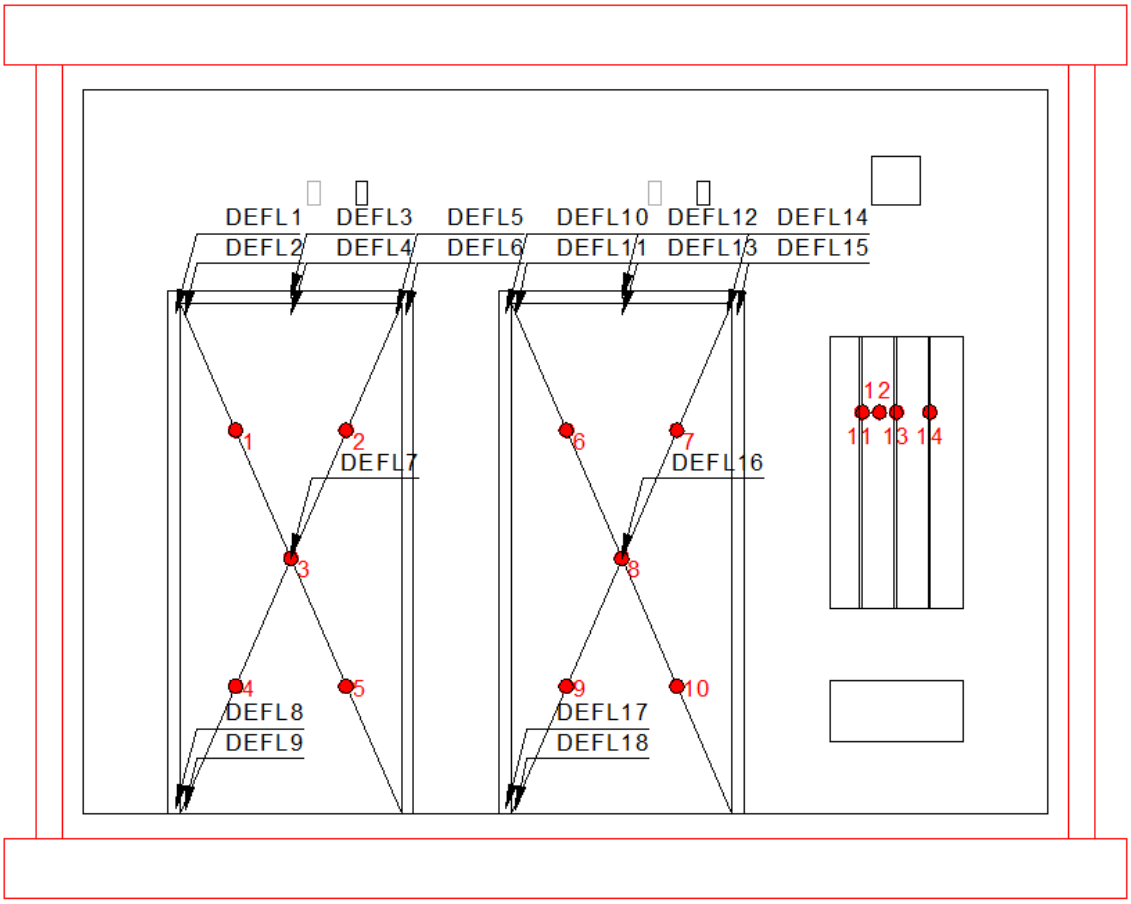

Figure B.1 Positions of thermocouples, radiation and deflection measurements

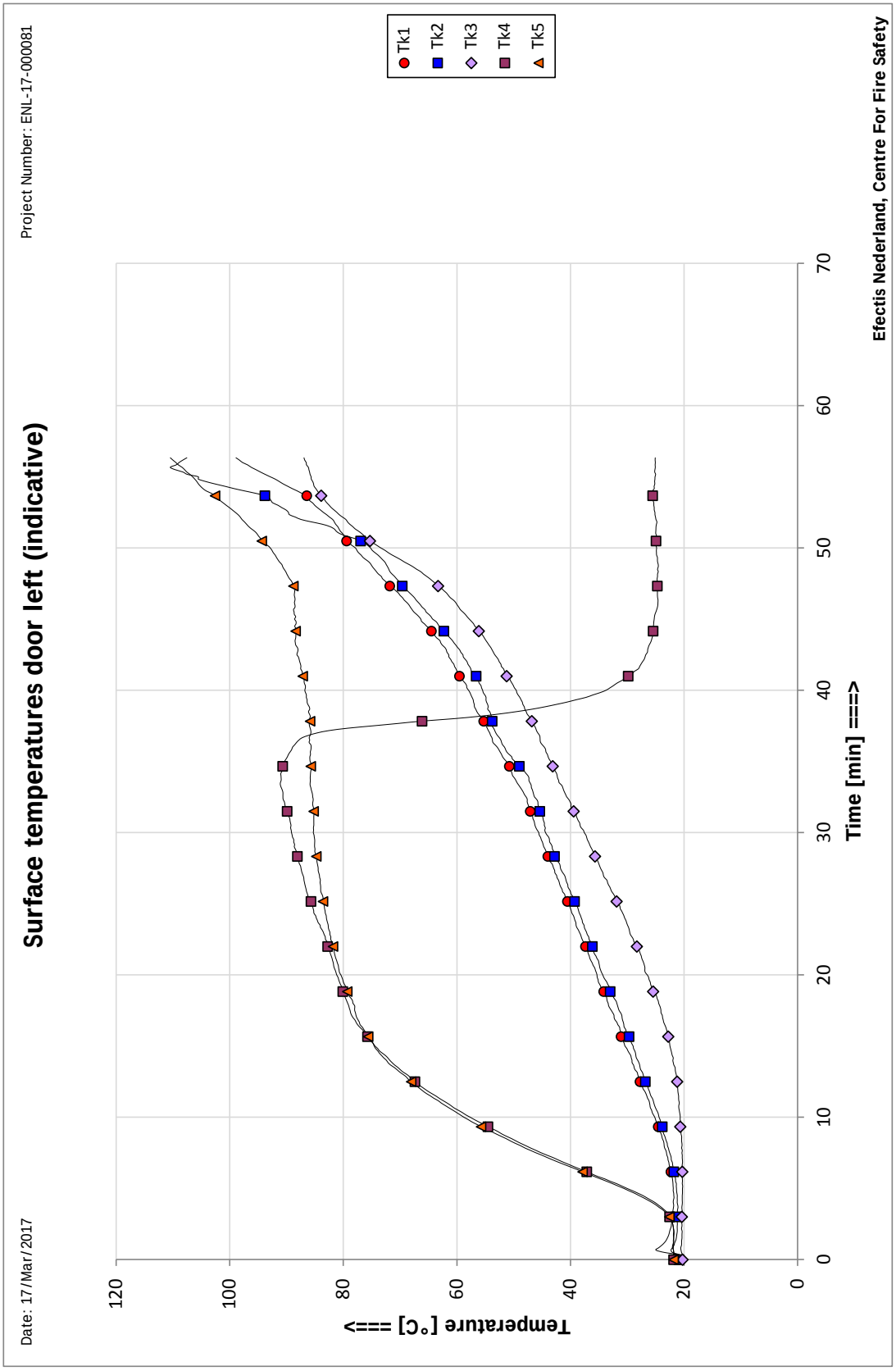

Figure B.2 Surface temperatures left door

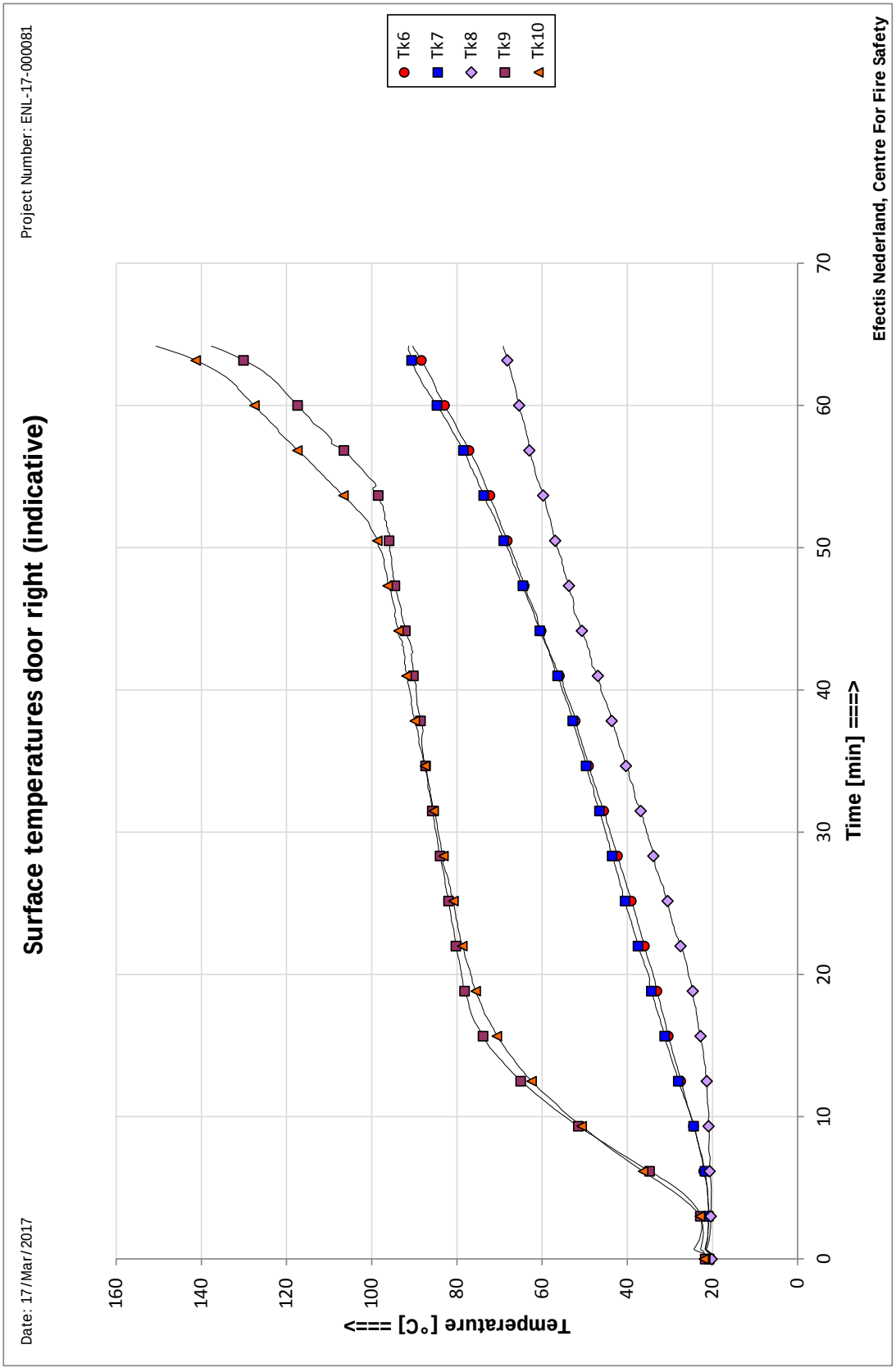

Figure B.3 Surface temperatures right door

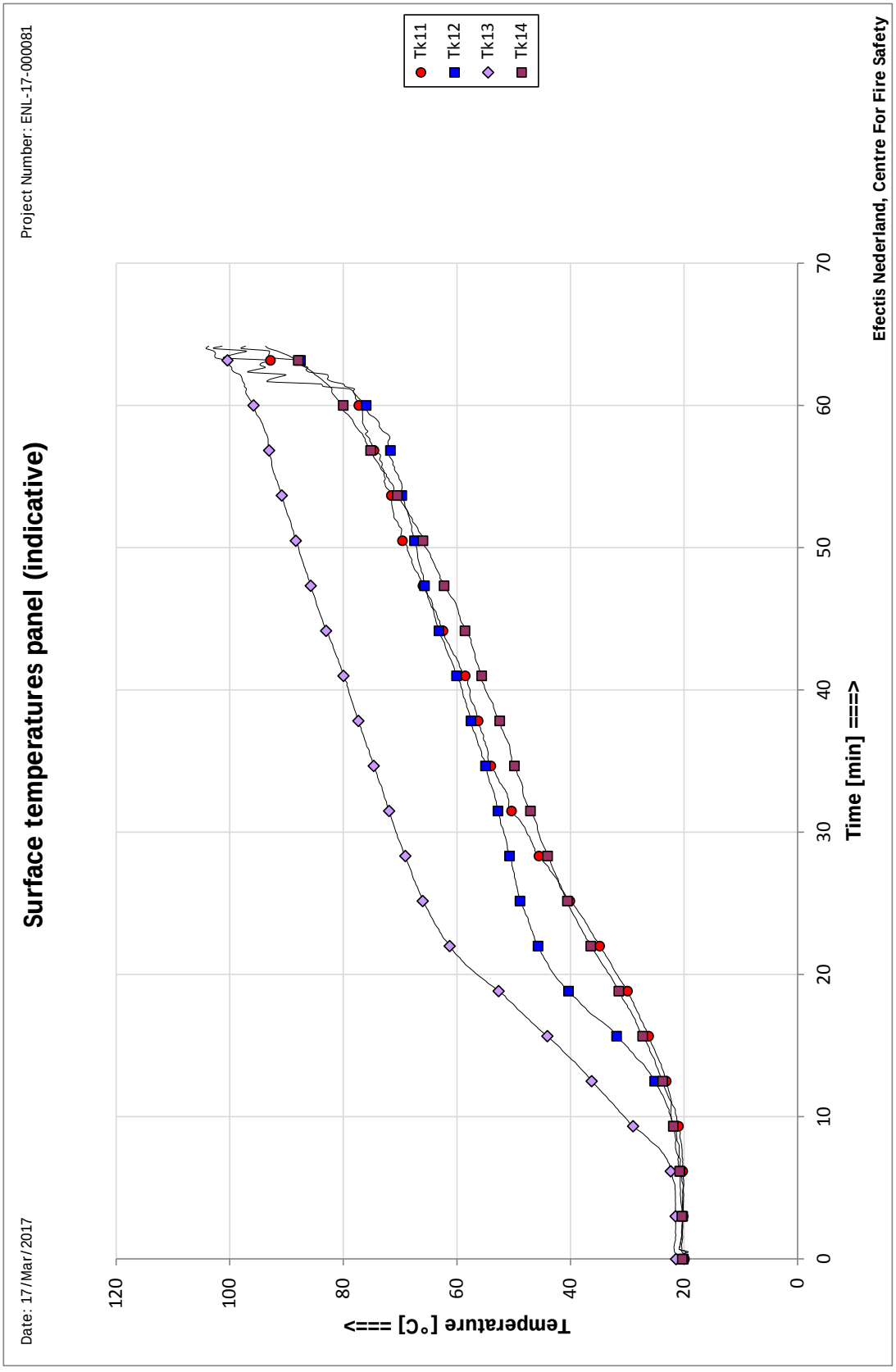

Figure B.4 Surface temperatures wood filler panel

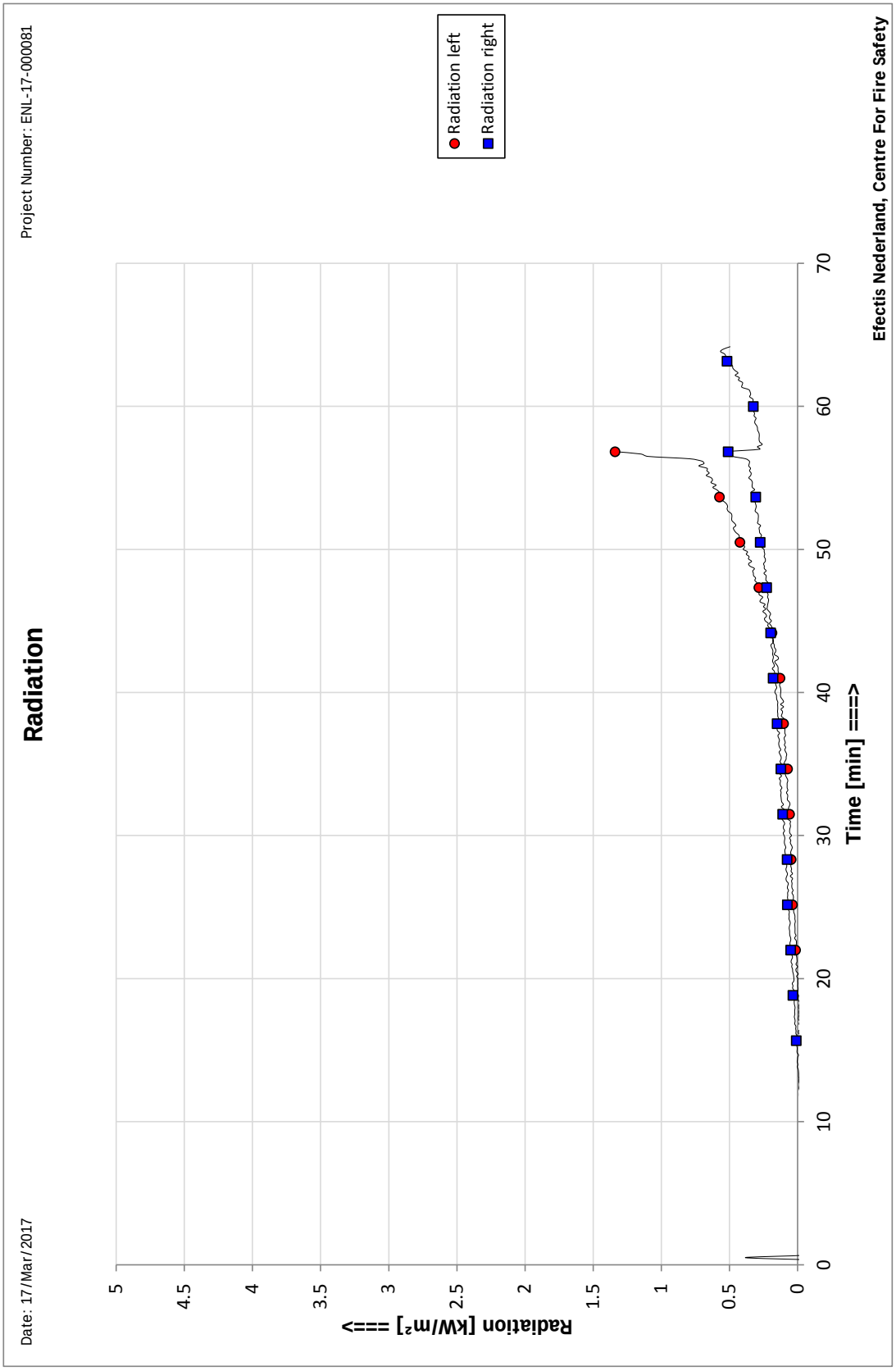

Figure B.5 Radiation

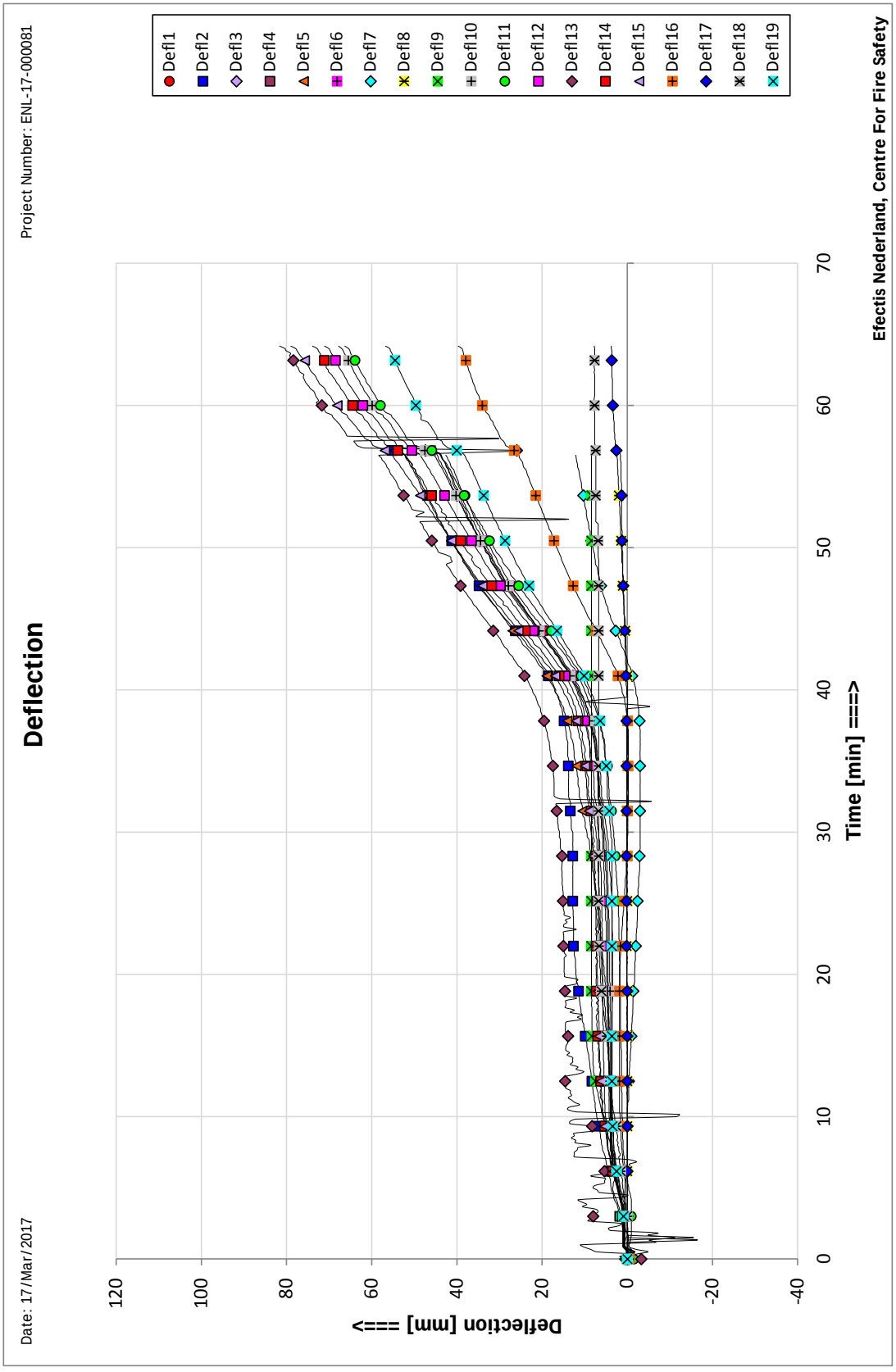

Figure B.6 Deflection

APPENDIX C: PHOTOGRAPHS

Foto C.1 Installation of the white door

Foto C.2 Brown door before installation

Foto C.3 Installation of the panel with the woodfiller product

Foto C.4 Detail of the Sunken Socket and back box with two gang socket facia assembly

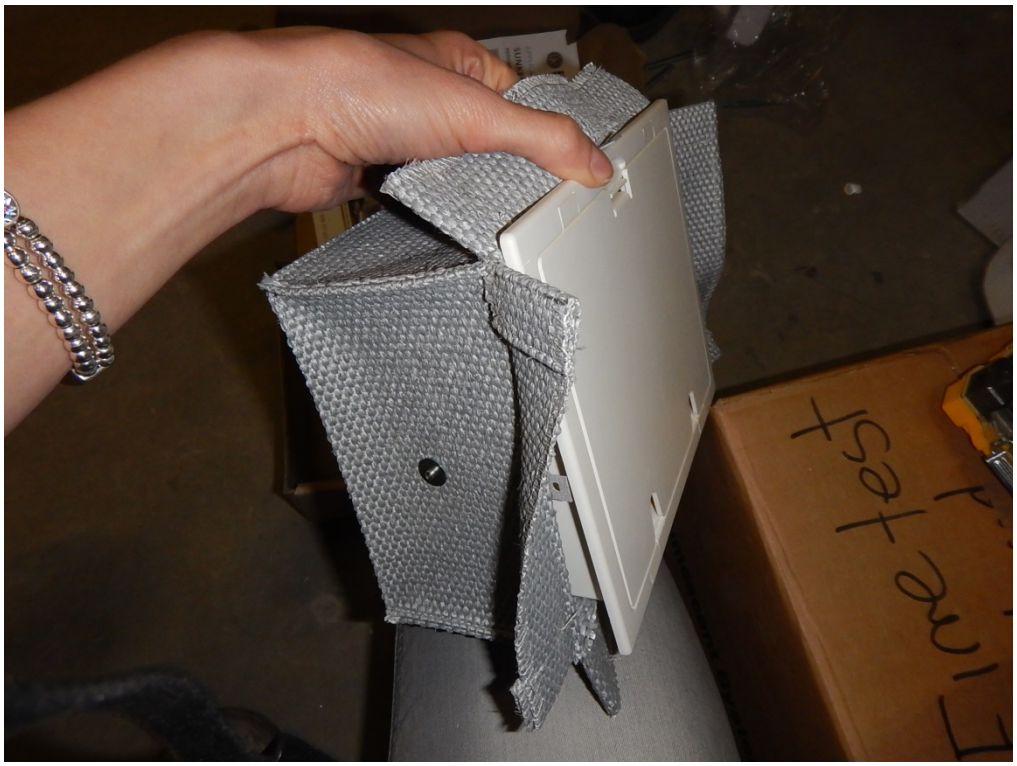

Foto C.5 Detail of the intumescent material around the Sunken Socket

Foto C.6 Detail of the intumescent gasket inside electrical back box

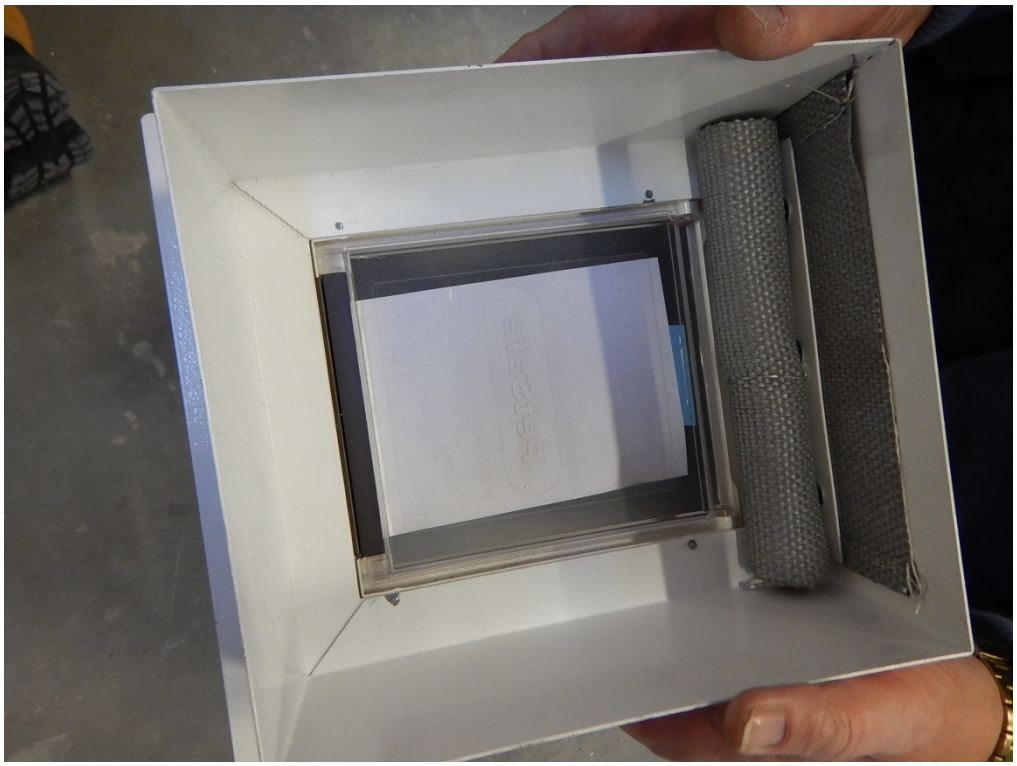

Foto C.7 Detail of the inside of the animal flap

Foto C.8 Front view of the specimen after installation

Foto C.9 Specimens before starting the test

Foto C.10 Specimens after 18 minutes of heating

Foto C.11 Specimens after 32 minutes of heating

Foto C.12 Specimens after 45 minutes of heating

Foto C.13 Specimens after 56 minutes of heating

Foto C.14 Specimens after 61 minutes of heating

Foto C.15 Specimens after 63 minutes of heating, end of heating after consulting the client