

Classification of the fire resistance according to EN 13501-2:2007+A1:2009 of Fernocollar HH and Fernocryl penetration seals

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1. INTRODUCTION

1.1 SUBJECT

This report defines the resistance to fire classification, assigned to Bloem Sealants penetration seals Fernocollar HH and Fernocryl, in accordance with the procedures defined in EN 13501-2.

1.2 SPONSOR AND MANUFACTURER

Sponsor	Manufacturer
Bloem Sealants BV P.O. Box 24058 2490 AB DEN HAAG The Netherlands	Confidential, known to Efectis

1.3 NORMATIVE REFERENCES

EN 1363-1:2012	Fire resistance tests - Part 1: General Requirements
EN 1366-3:2009	Fire resistance tests for service installations - Part 3: Penetration seals
EN 13501-2:2007 +A1:2009	Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services

1.4 REVISION INFORMATION

This is the first version of the classification report.

2. DETAILS OF CLASSIFIED PRODUCT

2.1 GENERAL

The element; Bloem Sealants penetration seals Fernocollar HH and Fernocryl, mounted in walls and floors.

2.2 DESCRIPTION

The element, Fernocollar HH and Fernocryl penetration seals, are fully described in the test reports in support of classification listed in 3.1.

3. REPORT(S) AND TEST RESULT(S) IN SUPPORT OF THE CLASSIFICATION

3.1 REPORTS

Name of laboratory	Name of sponsor	Report ref. no.	Test method
Exova Warrington Fire	Confidential, known to Efectis	348262 iss. 3	EN 1366-3:2009
		350177	
		350704	
BM Trada	Confidential, known to Efectis	BMT/FEI/F15009 Revision A	
		BMT/FEI/F14135	
		BMT/FEI/F15008	

3.2 DESCRIPTION

Name of laboratory	Report ref. no.	Description
Exova Warrington Fire	348262 iss. 3	Standard flexible wall construction
	350177	Standard aerated concrete floor construction
	350704	Standard aerated concrete floor construction
BM Trada	BMT/FEI/F15009 Revision A	Standard aerated concrete wall construction
	BMT/FEI/F14135	Standard aerated concrete floor construction
	BMT/FEI/F15008	Standard aerated concrete floor construction

3.3 TEST RESULTS EXOVA WARRINGTON FIRE REPORT 348262 ISS. 3

A standard flexible wall construction; two layers of 12.5 mm type F plasterboard, 50 mm studs, total thickness of 100 mm. The wall insulated with 100 kg/m³ mineral wool.

The wall was penetrated by eighteen plastic pipes, capped at the unexposed side (U/C).

At all specimens the 10 mm wide annular space between the pipe and the aperture was sealed with Fernocryl, nominally 12.5 mm deep. At both sides of the wall a single Fernocollar HH was applied.

The plasterboard fixing is a 6.0 mm diameter x 65 mm long Fisher HM 6x65 S, steel toggle anchor.

The services were supported by the service supporting construction at a distance of max. 400 mm at both sides of the wall.

3.3.1 Summary of test results

Test results		Classification criterion reached, measured from the start of the test	
Specimen	Material (dimensions)	Integrity 'E' (minutes)	Insulation 'I' (minutes)
A	PE (60x2.9)	150	150
B	PP (50x2.9)	150	120
C	PP (110x10)	150	150
D	PVC (50x1.8)	150	142
E	PP (110x4.2)	150	150
F	PE (110x10)	150	150
G	PE (110x2.7)	150	150
H	PP (110x2.7)	150	150
I	PVC (110x7.4)	150	146
J	PVC (125x6)	150	150
K	PE (125x3.1)	150	150
L	PE (160x9.5)	150	150
M	PP (125x3.1)	150	150
N	PVC (160x9.5)	150	150
O	PVC (160x6.2)	150	150
P	PE (160x4.9)	150	150
Q	PP (160x14.6)	150	150
R	PP (160x4)	150	150

3.4 TEST RESULTS EXOVA WARRINGTON FIRE REPORT 350177

A standard aerated concrete floor construction with a thickness of 150 mm.

The floor was provided with nine circular apertures, each penetrated by a range of plastic pipes which were capped on the unexposed side (U/C). Each specimen was protected with a single pipe collar fitted to the underside of the floor assembly. Each specimen was positioned within an aperture which was cut to give a nominal 10 mm annular gap. The annular gap was filled to a depth of 5 mm with Fernocryl sealant to both sides of the floor assembly.

The concrete fixing is an 8.0 mm diameter x 60 mm long Fisher FSA 8x60/15S, steel sleeve anchor with a M6 hexagon head bolt.

The services were supported by the service supporting construction at a distance of max. 400 mm from the floor surface, only at the not exposed side.

3.4.1 Summary of test results

Test results		Classification criterion reached, measured from the start of the test	
Description	Material (dimensions)	Integrity 'E' (minutes)	Insulation 'I' (minutes)
A	PVC (50x1.8)	250	250
B	PVC (160x6.2)	250	250
C	PVC (160x9.5)	250	250
D	PP (160x4)	250	250
E	PP (50x2.9)	250	250
F	PP (160x14.6)	250	250
G	PE (160x4.9)	250	250
H	PE (50x2.9)	250	250
I	PE (160x9.5)	250	250

3.5 TEST RESULTS EXOVA WARRINGTON FIRE REPORT 350704

A standard aerated concrete floor construction with a thickness of 150 mm.

The floor was provided with nine circular apertures, each penetrated by a range of plastic pipes which were capped on the unexposed side (U/C). Each specimen was protected with a single pipe collar fitted to the underside of the floor assembly. Each specimen was positioned within an aperture which was cut to give a nominal 10 mm annular gap. The annular gap was filled to a depth of 5 mm with Fernocryl sealant to both sides of the floor assembly.

The concrete fixing is an Ø 8 mm x 60 mm long Fisher FSA 8x60/15S, steel sleeve anchor with a M6 hexagon head bolt.

The services were supported by the service supporting construction at a distance of max. 400 mm from the floor surface, only at the not exposed side.

3.5.1 Summary of test results

Test results		Classification criterion reached, measured from the start of the test	
Description	Material (dimensions)	Integrity 'E' (minutes)	Insulation 'I' (minutes)
A	PP (110x10)	264	264
B	PVC (110x7.3)	264	264
C	PVC (110x4.2)	264	264
D	PP (110x2.7)	264	264
E	PE (110x10)	264	264
F	PE (110x2.7)	264	264
G	PVC (125x6)	264	264
H	PE (125x3.1)	264	264
I	PP (125x3.1)	264	264

3.6 TEST RESULTS BM TRADA REPORT BMT/FEI/F15009 REV. A

A standard aerated concrete wall construction with a thickness of 100 mm.

The wall was provided with seven circular apertures, only specimens referenced A and G were included in the classification report.

The pipes were capped on the unexposed side (U/C). At both sides of the wall a single Fernocollar was applied. Each specimen was positioned within an aperture which was cut to give a nominal 10 mm annular gap. The annular gap was filled to a depth of 10 mm with Fernocryl sealant at both sides of the wall.

The collars were fixed with three Ø 4 x 70 mm wood screws and penny washers.

The services were supported by the service supporting construction at a distance of max. 230 mm at both sides of the wall.

3.6.1 Summary of test results

Test results		Classification criterion reached, measured from the start of the test	
Description	Material (dimensions)	Integrity 'E' (minutes)	Insulation 'I' (minutes)
A	PP (160x4)	150	150
G	PP (250x6.2)	150	150

3.7 TEST RESULTS BM TRADA REPORT BMT/FEI/F14315

A standard aerated concrete wall construction with a thickness of 100 mm.

The wall was provided with eight circular apertures, only specimen referenced D is included in the classification report.

The pipe was uncapped at both sides (U/U). At both sides of the wall a single Fernocollar HH was applied. The specimen was positioned within an aperture which was cut to give a nominal 10 mm annular gap. The annular gap was filled to a depth of 10 mm with Fernocryl sealant at both sides of the wall.

The collars were fixed with three Fisher pins.

The service was supported by the service supporting construction at a distance of max. 400 mm at both sides of the wall.

3.7.1 Summary of test results

Test results		Classification criterion reached, measured from the start of the test	
Description	Material (dimensions)	Integrity 'E' (minutes)	Insulation 'I' (minutes)
D	PP (110x2.7)	140	140

3.8 TEST RESULTS BM TRADA REPORT BMT/FEI/F15008

A standard aerated concrete floor construction with a thickness of 150 mm.

The floor was provided with seven circular apertures, only specimens referenced A and I are included in the classification report.

Pipe A was uncapped (U/U), pipe I was capped on the exposed side (C/U). At both sides of the floor a single Fernocollar HH was applied. The specimen was positioned within an aperture which was cut to give a nominal 10 mm annular gap. The annular gap was filled to a depth of 10 mm with Fernocryl sealant at both sides of the floor.

The collars were fixed with three Fisher FSA Ø 8 x 60 mm long M6 hex head.

The services were supported by the service supporting construction at a distance of max. 230 mm from the floor surface, only at the not exposed side.

3.8.1 Summary of test results

Test results		Classification criterion reached, measured from the start of the test	
Description	Material (dimensions)	Integrity 'E' (minutes)	Insulation 'I' (minutes)
A	PP (110x2.7)	132	132
I	PP (160x4)	132	132

4. CLASSIFICATION AND FIELD OF APPLICATION

4.1 REFERENCE OF CLASSIFICATION

This classification has been carried out in accordance with clause 7 of EN 13501-2.

4.2 CLASSIFICATION

The classification of Bloem Sealants penetration seals Fernocollar HH and Fernocryl.

4.3 FIELD OF DIRECT APPLICATION

The results of the fire test are directly applicable to similar constructions, where one or more of the changes listed below are made and the construction continues to comply with the appropriate design code for its stiffness and stability. A reference given in the text below refers to EN 1366-3:2009.

4.3.1 Orientation

Test results are only applicable to the orientation in which the penetration seals were tested, i.e. in a wall or floor.

4.3.2 Supporting construction

4.3.2.1 Rigid floor and wall constructions

Test results obtained with rigid standard supporting constructions may be applied to concrete or masonry separating elements of a thickness and density equal to or greater than that of the supporting construction used in the test. This rule does not apply to pipe closure devices positioned within the supporting construction in case of higher thickness of the supporting construction unless the length of the seal is increased by an equal amount and the distance from the surface of the supporting construction remains the same on both sides.

4.3.2.2 Flexible wall

- The test results are valid for all flexible wall constructions, as mentioned in the EN 1366-3: 2009, of the same fire resistance classification provided:
 - The construction is classified in accordance with EN 13501-2;
 - The construction has an overall thickness not less than the minimum thickness of the range given in Table 3 of EN 1366-3 for the standard flexible wall used in the test.
 - The insulation was not removed around the penetrations.
 - The number of board layers and the overall board layer thickness is equal or greater than that tested;
 - Flexible wall constructions with timber studs are constructed with at least the same number of layers as given in Table 3, no part of the penetration seal is closer than 100 mm to a stud, the cavity is closed between the penetration seal and the stud, and minimum 100 mm of insulation of class A1 or A2 according to EN 13501-1 is provided within the cavity between the penetration seal and the stud.
- The standard flexible wall construction does not cover sandwich panel constructions and flexible walls where the lining does not cover the studs on both sides. Penetrations in such constructions shall be tested on a case by case basis.
- The test results apply to concrete or masonry elements of an overall thickness equal to or greater than that of the element used in the test. This does not apply to pipe closure devices positioned within the supporting construction in case of higher thickness of the supporting construction unless the length of the seal is increased by an equal amount and the distance from the surface of the supporting construction remains the same on both

sides.

4.3.3 Service support construction

The standard cable ladders/trays as defined in Annex A cover metal trays with a melting point higher than the furnace temperature at the classification time, e.g. stainless steel, galvanised steel. For all other ladders/trays (e.g. plastic, aluminium) separate evidence is necessary.

Steel ladder/trays with organic coatings are covered by the standard ladders/trays if their overall classification is minimum A2 according to EN 13501-1.

The distance from the surface of the separating element to the nearest support position for services shall be as tested or less.

4.3.4 Seal size and distances

The test results obtained using standard wall and floor configurations for penetration seals are valid for any penetration seal size (in terms of linear dimensions) equal to or smaller than that tested, provided the total amount of cross sections of the services (including insulation) does not exceed 60 % of the penetration area, the working clearances are not smaller than the minimum working clearances (as defined in Annexes A, B, E and F) used in the test and a blank penetration seal of the maximum seal size desired was tested in addition.

The distance between a single service and the seal edge (annular space, e.g. a_1 according to Figures B.7 and E.2) shall remain within the tested range.

Annular space a_1 shall be maximum 10 mm.

4.4 FIELD OF DIRECT APPLICATION FOR PLASTIC PIPES

4.4.1 General

Results from a multiple penetration seal may be extended to a single penetration seal of the same type but not vice versa.

4.4.2 Seal size

4.4.2.1 Pipe closure devices

The maximum pipe closure device size within a design group determined according to E.2.2.1 covers smaller sizes of this design group.

If the thickness of the active component of the pipe closure device is changed (length remains constant) the maximum pipe closure device sizes from the design groups comprising the smallest and the largest pipe closure device sizes cover the size range/design groups in between provided the thickness of their active components is higher than the calculated value from the straight line that connects the maximum and minimum size in a thickness - pipe diameter diagram (see Figure E.8). This interpolation is only permissible if the inner diameter of the smallest pipe closure device included in the test is greater than or equal to 40 mm.

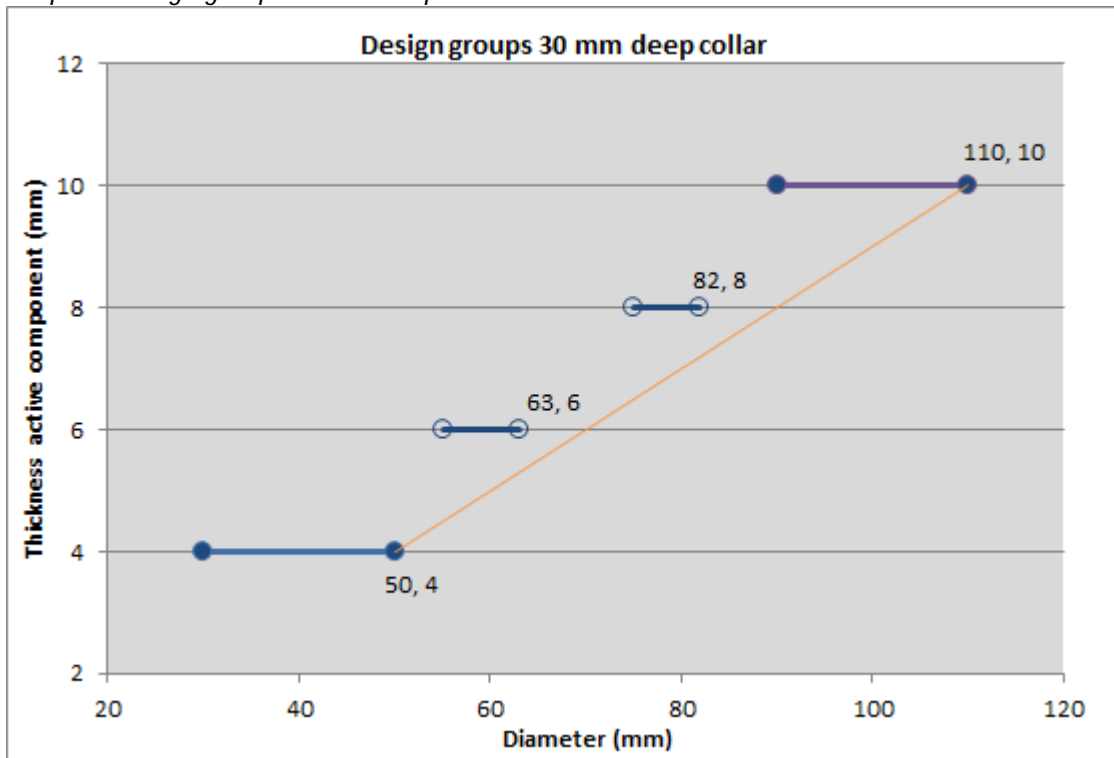
NOTE For further details see H.4.7.2

Table 1: Specifications Fernocollar HH

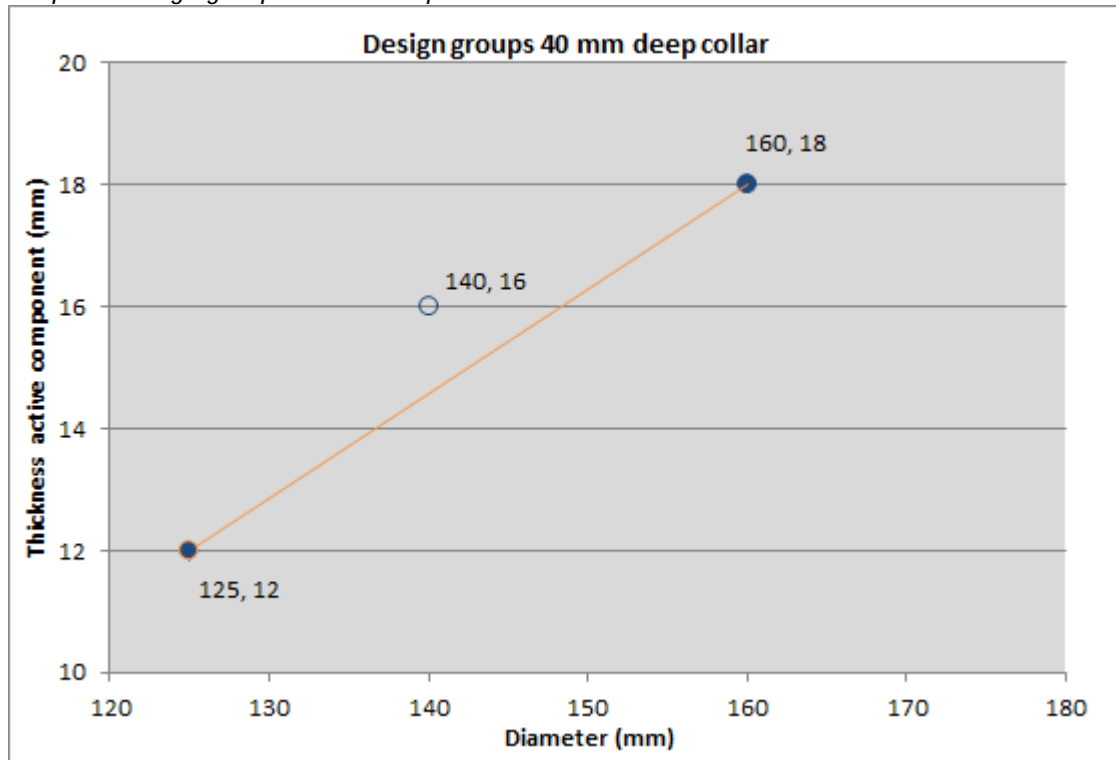
Diameter (mm)	Depth intumescent (mm)	Layers of intumescent (2 mm/layer)	Total thickness intumescent (mm)
32-50	30	2*	4
55-63	30	3*	6
75-82	30	4	8
90-110	30	5*	10
125	40	6*	12
140	40	8	16
160	40	10*	20
250	40	12*	24

* Collars used in the tests

Graph 1: Design groups 30 mm deep collar



Graph 2: Design groups 40 mm deep collar



4.4.2.2 PVC-U pipes, applied in a rigid floor

PVC-U pipes provided with Fernocollar HH fixed on the underside of a rigid floor (min. 150 mm) with 3 Fisher FSA Ø8x60 mm hexagon head bolts. The 10 mm annular gap was filled to a depth of 5 mm with Fernocryl sealant to both sides of the floor assembly.

Table 2

Material	Dimensions pipe (mm)	Collar	Intumescent material depth/thickness (mm)	Classification
PVC-U	Ø32 x 1.8	Ø32 mm	30 x 4	EI 240-U/C
	Ø40 x 1.8	Ø40 mm		
	Ø50 x 1.8	Ø50 mm		
	Ø55 x 2.3 - 3	Ø55 mm	30 x 6	
	Ø63 x 2.3 - 3	Ø63 mm		
	Ø75 x 3.1 - 4.8	Ø75 mm	30 x 8	
	Ø82 x 3.1 - 4.8	Ø82 mm		
	Ø90 x 4.2 - 7.3	Ø90 mm	30 x 10	
	Ø100 x 4.2 - 7.3	Ø100 mm		
	Ø110 x 4.2 - 7.3	Ø110 mm		
	Ø125 x 6	Ø125 mm	40 x 12	
	Ø140 x 6.1 - 7.5	Ø140 mm	40 x 16	
	Ø160 x 6.2 - 9.5	Ø160 mm	40 x 18	

4.4.2.3 PP pipes, applied in a rigid floor

PP pipes provided with Fernocollar HH fixed on the underside of a rigid floor (min. 150 mm) with 3 Fisher FSA Ø8x60 mm hexagon head bolts. The 10 mm annular gap was filled to a depth of 5 mm with Fernocryl sealant to both sides of the floor assembly.

Table 3

Material	Dimensions pipe (mm)	Collar	Intumescent material depth/thickness (mm)	Classification
PP	Ø32 x 2.9	Ø32 mm	30 x 4	EI 240-U/C
	Ø40 x 2.9	Ø40 mm		
	Ø50 x 2.9	Ø50 mm		
	Ø55 x 2.9 - 4.4	Ø55 mm	30 x 6	
	Ø63 x 2.9 - 4.4	Ø63 mm		
	Ø75 x 2.8 - 6.7	Ø75 mm	30 x 8	
	Ø82 x 2.8 - 6.7	Ø82 mm		
	Ø90 x 2.7 - 10	Ø90 mm	30 x 10	
	Ø100 x 2.7 - 10	Ø100 mm		
	Ø110 x 2.7 - 10	Ø110 mm		
	Ø125 x 3.1	Ø125 mm		
	Ø140 x 3.5 - 8	Ø140 mm	40 x 16	
	Ø160 x 4 - 14.6	Ø160 mm	40 x 18	

4.4.2.4 PP pipes, applied in a rigid floor

PP pipes provided with Fernocollar HH fixed on both faces of a rigid floor (min. 150 mm) with 3 Fisher FSA Ø8x60 mm hexagon head bolts. The 10 mm annular gap was filled to a depth of 5 mm with Fernocryl sealant to both sides of the floor assembly.

Table 4

Material	Dimensions pipe (mm)	Collar	Intumescent material depth/thickness (mm)	Classification
PP	Ø110 x 2.7	Ø110 mm	30 x 10	EI 120-U/U
	Ø160 x 4	Ø160 mm	40 x 16	EI 120-C/U

4.4.2.5 PE pipes, applied in a rigid floor

PE pipes provided with Fernocollar HH fixed on the underside of a rigid floor (min. 150 mm) with 3 Fisher FSA Ø8x60 mm hexagon head bolts. The 10 mm annular gap was filled to a depth of 5 mm with Fernocryl sealant to both sides of the floor assembly.

Table 5

Material	Dimensions pipe (mm)	Collar	Intumescent material depth/thickness (mm)	Classification
PE	Ø32 x 2.9	Ø32 mm	30 x 4	EI 240-U/C
	Ø40 x 2.9	Ø40 mm		
	Ø50 x 2.9	Ø50 mm		
	Ø55 x 2.9 - 4.4	Ø55 mm	30 x 6	
	Ø63 x 2.9 - 4.4	Ø63 mm		
	Ø75 x 2.8 - 6.7	Ø75 mm	30 x 8	
	Ø82 x 2.8 - 6.7	Ø82 mm		
	Ø90 x 2.7 - 10	Ø90 mm	30 x 10	
	Ø100 x 2.7 - 10	Ø100 mm		
	Ø110 x 2.7 - 10	Ø110 mm		
	Ø125 x 3.1	Ø125 mm	40 x 12	
	Ø140 x 3.9 - 5.8	Ø140 mm	40 x 16	
	Ø160 x 4.9 - 9.5	Ø160 mm	40 x 18	

4.4.2.6 PVC-U pipes, applied in a flexible or rigid wall

PVC-U pipes provided with Fernocollar HH fixed on both sides of the wall (min. 100 mm) with Fisher HM 6x65 S steel toggle anchor. The 10 mm annular gap was filled to a depth of 12.5 mm with Fernocryl sealant to both sides of the wall assembly.

Table 6

Material	Dimensions pipe (mm)	Collar	Intumescent material depth/thickness (mm)	Classification
PVC-U	Ø32 x 1.8	Ø32 mm	30 x 4	EI 120-U/C
	Ø40 x 1.8	Ø40 mm		
	Ø50 x 1.8	Ø50 mm		
	Ø55 x 2.3 - 3	Ø55 mm	30 x 6	
	Ø63 x 2.3 - 3	Ø63 mm		
	Ø75 x 3.1 - 4.8	Ø75 mm	30 x 8	
	Ø82 x 3.1 - 4.8	Ø82 mm		
	Ø90 x 4.2 - 7.4	Ø90 mm	30 x 10	
	Ø100 x 4.2 - 7.4	Ø100 mm		
	Ø110 x 4.2 - 7.4	Ø110 mm		
	Ø125 x 6	Ø125 mm		
	Ø140 x 6.1 - 7.5	Ø140 mm	40 x 16	
	Ø160 x 6.2 - 9.5	Ø160 mm	40 x 18	

4.4.2.7 PP pipes, applied in a rigid wall

PP pipes provided with Fernocollar HH fixed on both faces of a rigid wall (min. 100 mm) with three 40 mm Fisher pins (110 mm diameter) and three Ø4 x 70 mm wood screws (160 and 250 mm diameter). The 10 mm annular gap was filled to a depth of 5 mm with Fernocryl sealant to both sides of the wall assembly.

Table 7

Material	Dimensions pipe (mm)	Collar	Intumescent material depth/thickness (mm)	Classification
PP	Ø110 x 2.7	110 mm	30 x 10	FI 120-U/U
	Ø160 x 4	160 mm	40 x 18	EI 120-U/U
	Ø250 x 6.2	250 mm	40 x 24	FI 120-U/C

4.4.2.8 PE pipes, applied in a flexible or rigid wall

PE pipes provided with Fernocollar HH fixed on both sides of the wall (min. 100 mm) with Fisher HM 6x65 S steel toggle anchor. The 10 mm annular gap was filled to a depth of 5 mm with Fernocryl sealant to both sides of the wall assembly.

Table 8

Material	Dimensions pipe (mm)	Collar	Intumescent material depth/thickness (mm)	Classification
PE	Ø32 x 2.9	Ø32 mm	30 x 4	EI 120-U/C
	Ø40 x 2.9	Ø40 mm		
	Ø50 x 2.9	Ø50 mm		
	Ø55 x 2.9 - 4.4	Ø55 mm	30 x 6	
	Ø63 x 2.9 - 4.4	Ø63 mm		
	Ø75 x 2.8 - 6.7	Ø75 mm	30 x 8	
	Ø82 x 2.8 - 6.7	Ø82 mm		
	Ø90 x 2.7 - 10	Ø90 mm	30 x 10	
	Ø100 x 2.7 - 10	Ø100 mm		
	Ø110 x 2.7 - 10	Ø110 mm		
	Ø125 x 3.1	Ø125 mm	40 x 12	
	Ø140 x 3.9 - 5.8	Ø140 mm	40 x 16	
	Ø160 x 4.9 - 9.5	Ø160 mm	40 x 18	

4.4.3 Pipe end configuration

Test results obtained from tests with “plastic pipes” having both ends uncapped (see Table 9, test condition “U/U”) are valid for all other test conditions of Table 2. Test results obtained from tests where a flue gas recovery system was used are valid for pipe end conditions U/C and C/C.

Table 9 - Field of application rules for pipe end configuration

	Tested				
		U/U	C/U	U/C	C/C
Covered	U/U	Y	N	N	N
	C/U	Y	Y	N	N
	U/C	Y	Y	Y	N
	C/C	Y	Y	Y	Y

Y = acceptable, N = not acceptable

4.4.4 Pipe and insulation material

The pipe and/or insulation material range permitted is the range covered by the test including the critical pipe approach results where applicable.

Test results on pipes made from PVC-U according to EN 1329-1, EN 1453-1 or EN 1452-1 are valid for pipes made from PVC-U according to EN 1329-1, EN 1453-1 and EN 1452-1 as well as pipes made from PVC-C according to EN 1566-1.

Test results on pipes made from PE-HD according to EN 1519-1 or EN 12666-1 are valid for pipes made from PE according to EN 12201-2, EN 1519-1 and EN 12666-1, for pipes made from ABS according to EN 1455-1 and pipes made from SAN+PVC according to EN 1565-1.

4.4.5 Pipe wall thickness

4.4.5.1 Pipe closure devices for pipes without insulation

The range between that tested is covered for a particular size of the pipe closure device. The maximum thickness tested with the maximum size within a design group (see E.2.2.1) of pipe closure device sizes is valid for smaller sizes within the design group. For a design group not included in the test, either a linear interpolation between the corner points tested or a step approach as illustrated in Figure E.9 may be used. Where the minimum wall thickness remains the same over several design groups, the design groups representing the maximum and minimum sizes cover the intermediate ones.

4.4.6 Pipe orientation

If a pipe was tested perpendicular to the seal as well as oblique, the result is valid for each angle between a right-angle and the angle tested.

4.4.7 Separations

For multiple penetrations the separations a_1 to a_3 from a test conducted as specified in the standard configurations may be increased without limitation (see Figure E.1).

Where single pipes penetrate directly through the structural associated construction (masonry walls, flexible walls, concrete floors, etc.) the annular space between the pipe and the supporting construction shall remain within the tested range. Separation a_2 may be increased.

For seals other than pipe closure devices the results of a test conducted as specified in Option 1 of the standard configurations does not cover 'clusters' of pipes, unless the distances a_3 (Figure E.1) or a_2 (Figure E.2) are > 100 mm in practice. The results of a test conducted as specified in Option 2 of the standard configurations covers pipes with linear separation.

5. LIMITATIONS

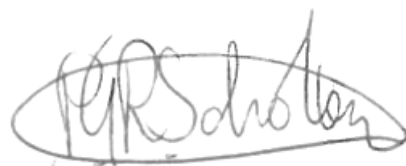
This classification document does not represent type approval or certification of the product.

Signed



W. Scheffer BBE
Project leader fire resistance

Approved



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

6. FIGURES

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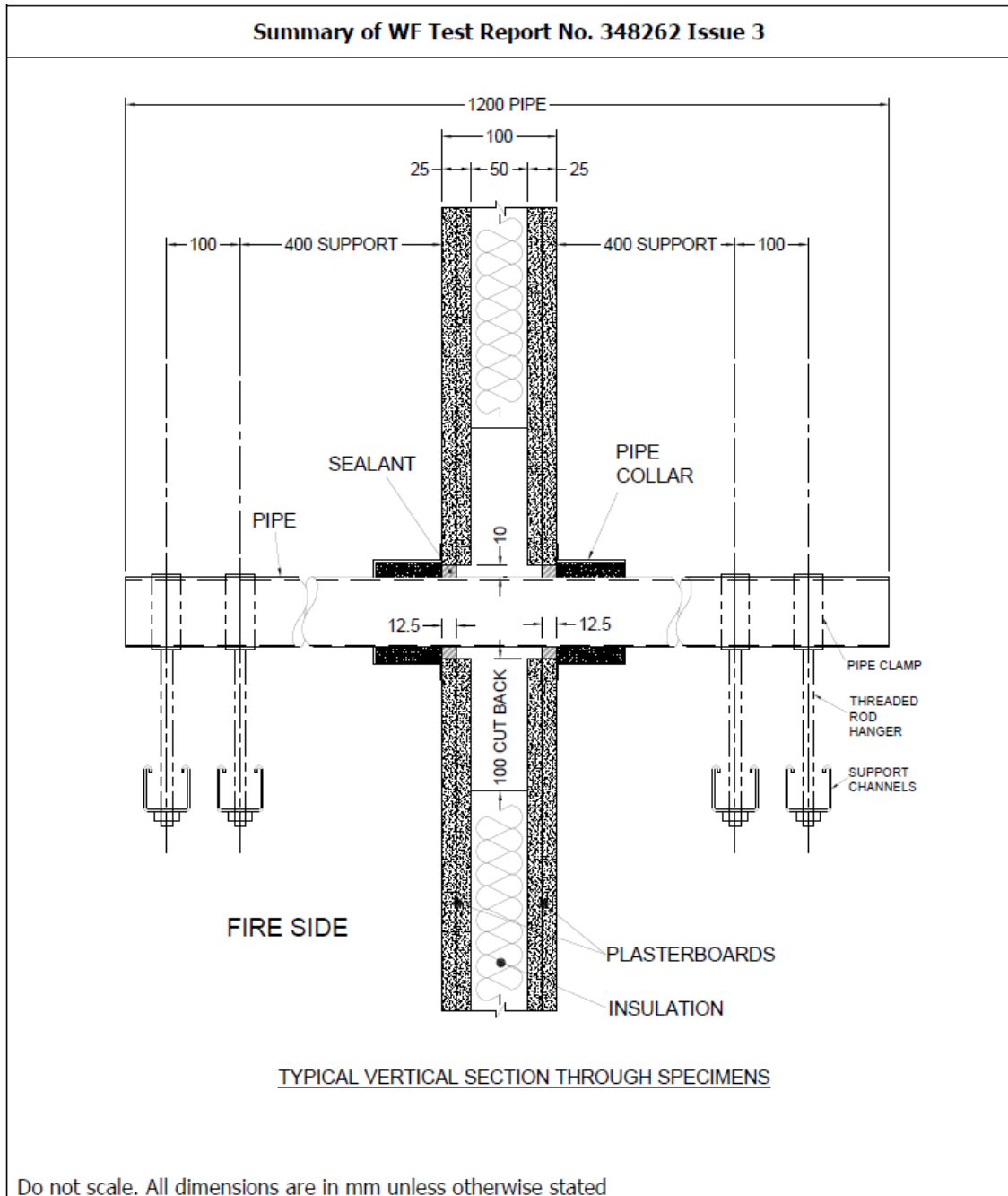


Figure 6.1 Exova Warrington Fire 348262 iss.3

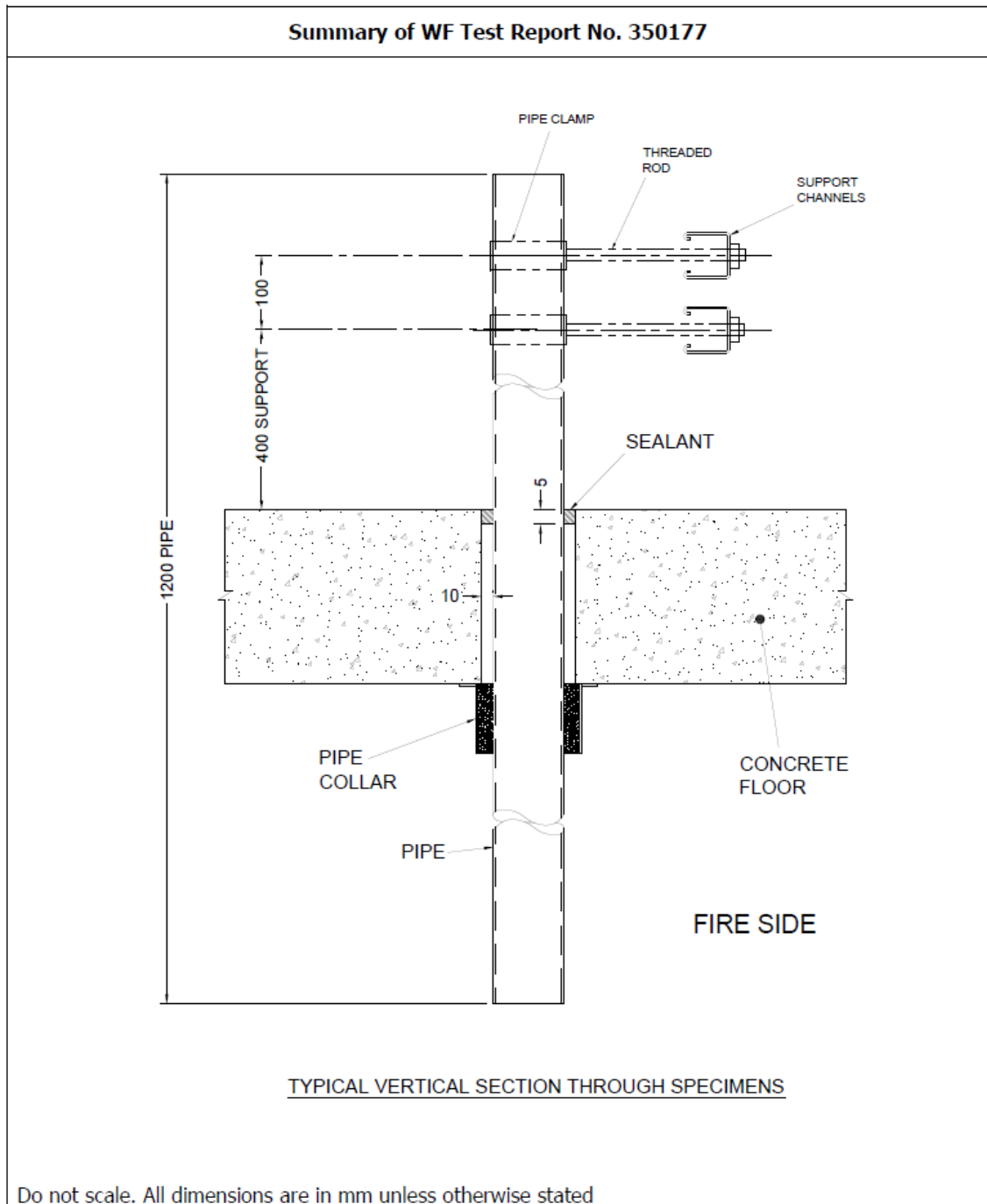


Figure 6.2 Exova Warrington Fire 350177

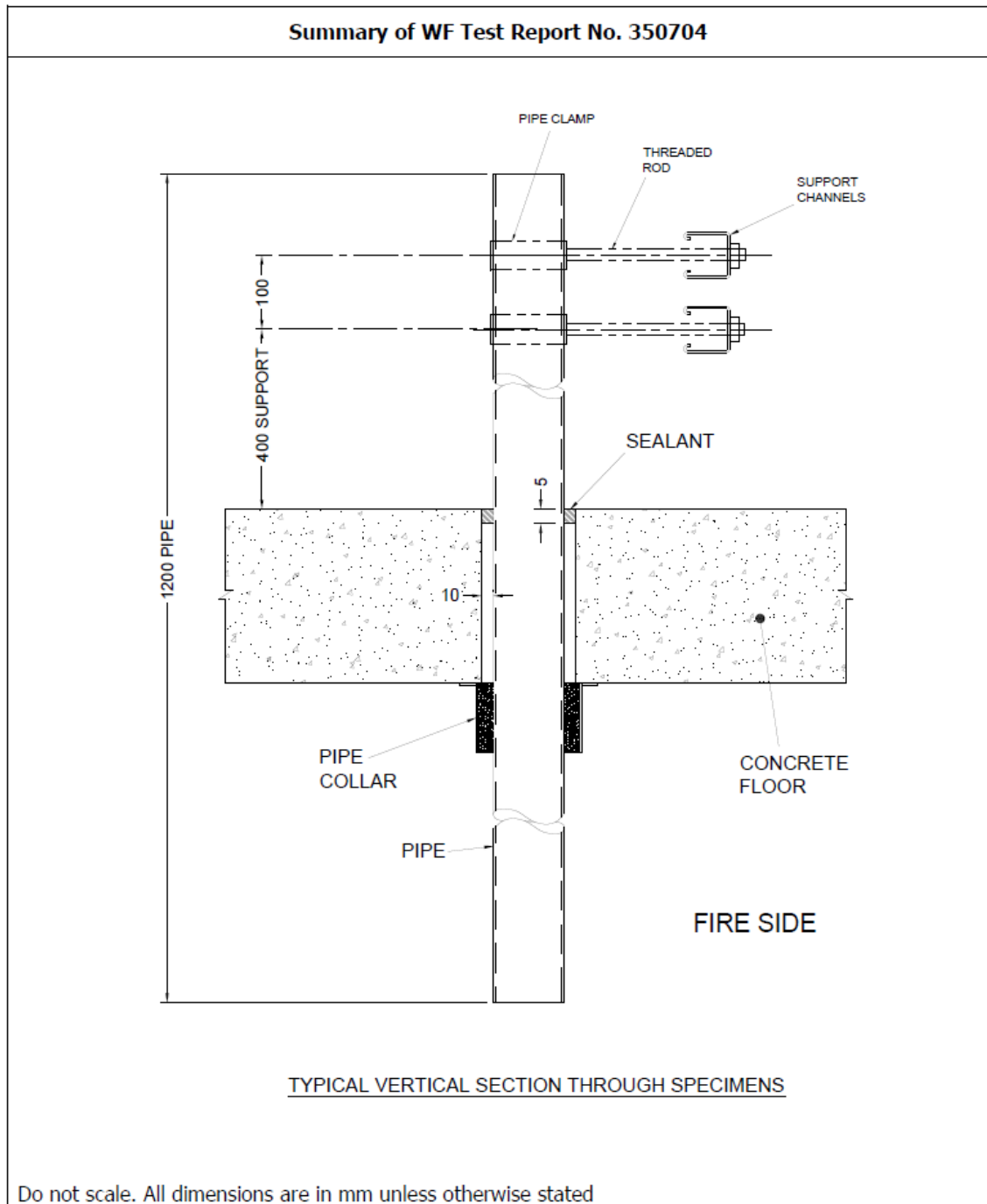


Figure 6.3 Exova Warrington Fire 350704

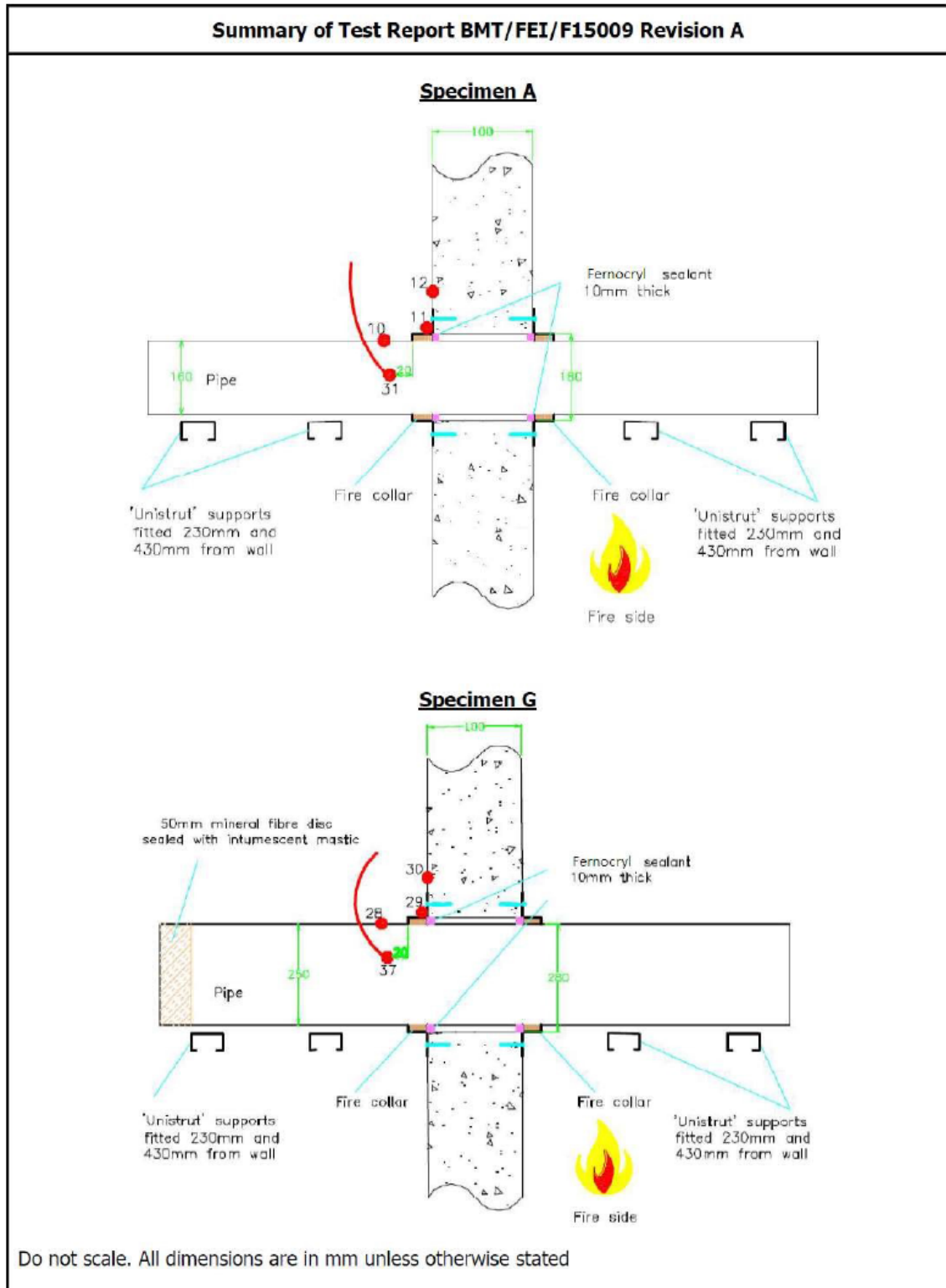


Figure 6.4 BM Trada BMT/FEI/F15009 Revision A

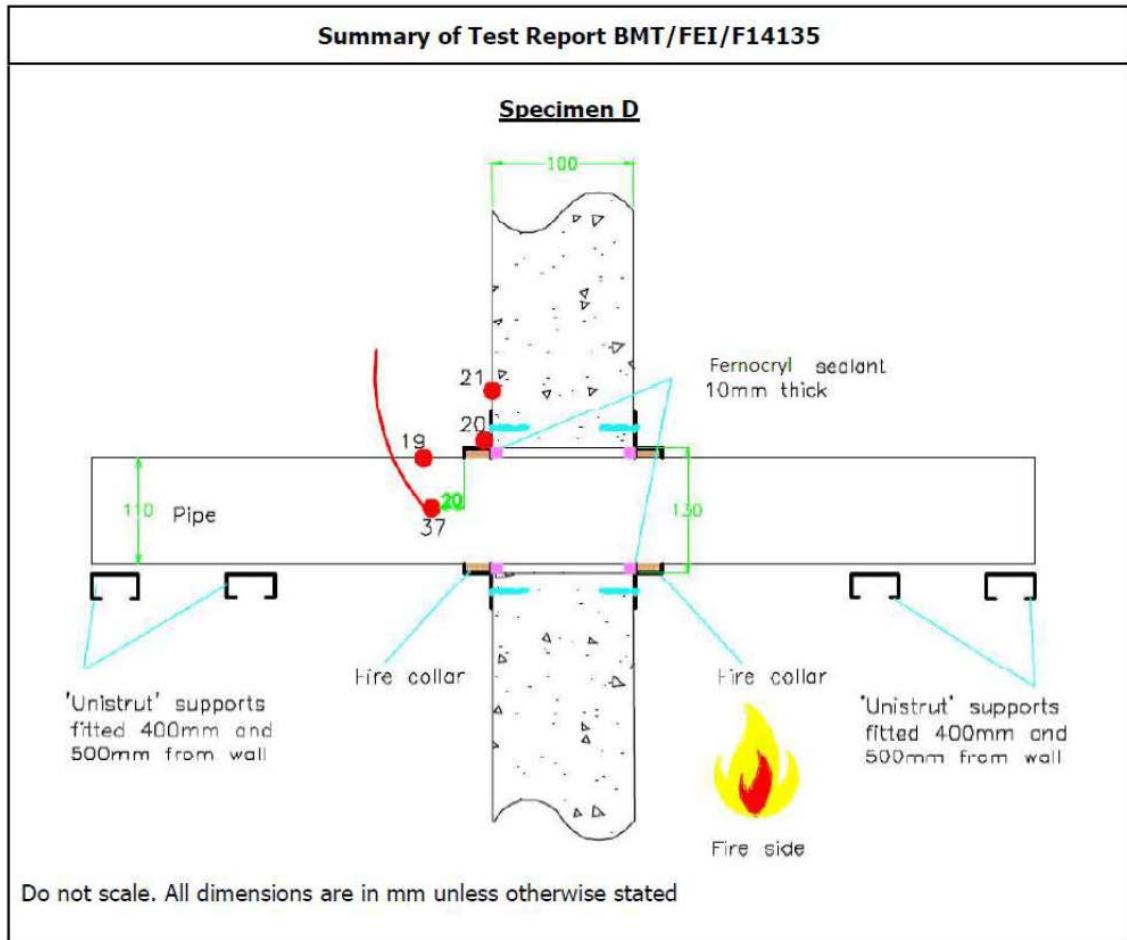


Figure 6.5 BM Trada BMT/FEI/F14135

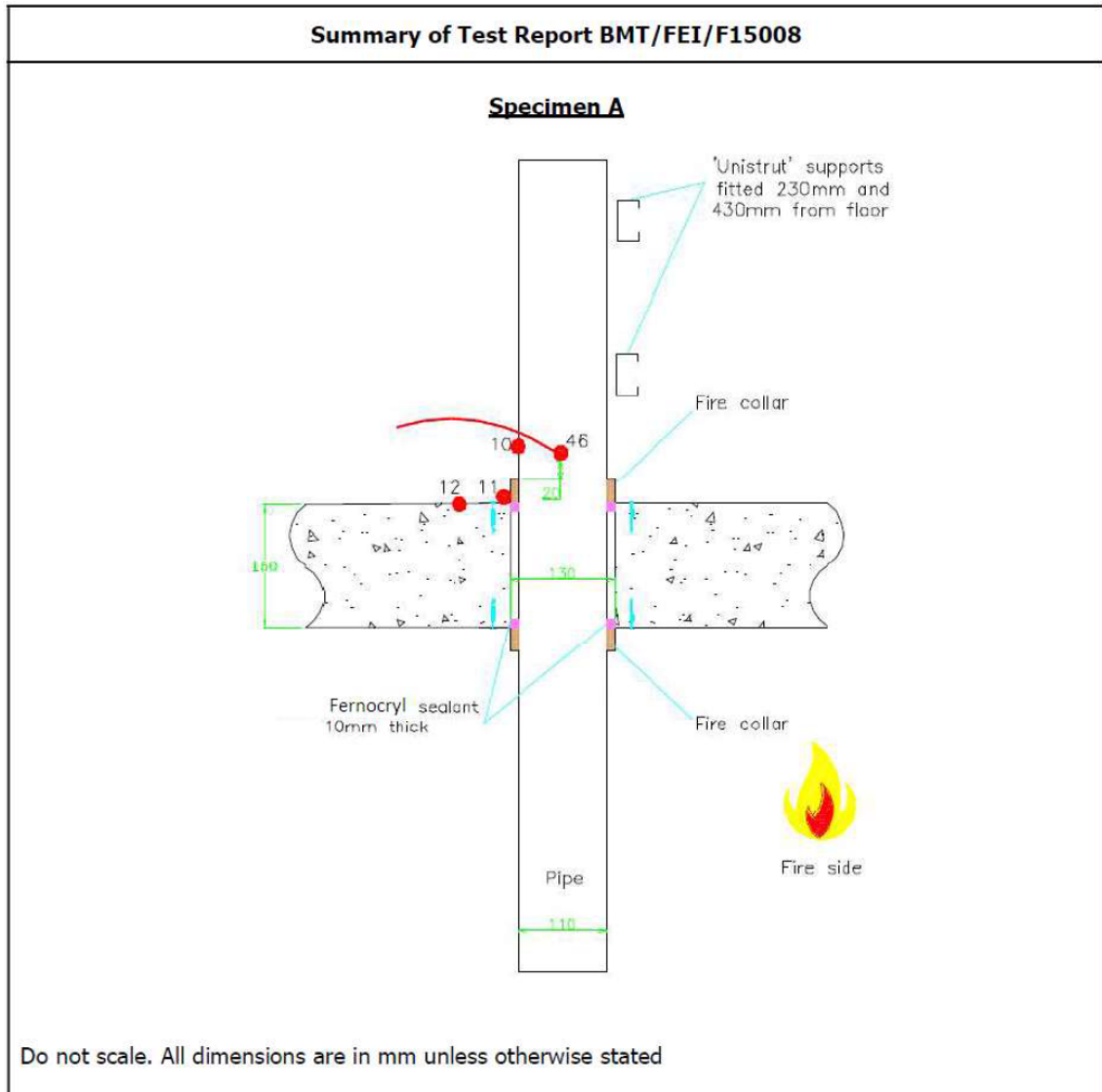


Figure 6.6 BM Trada BMT/FEI/F15008 (1/2)

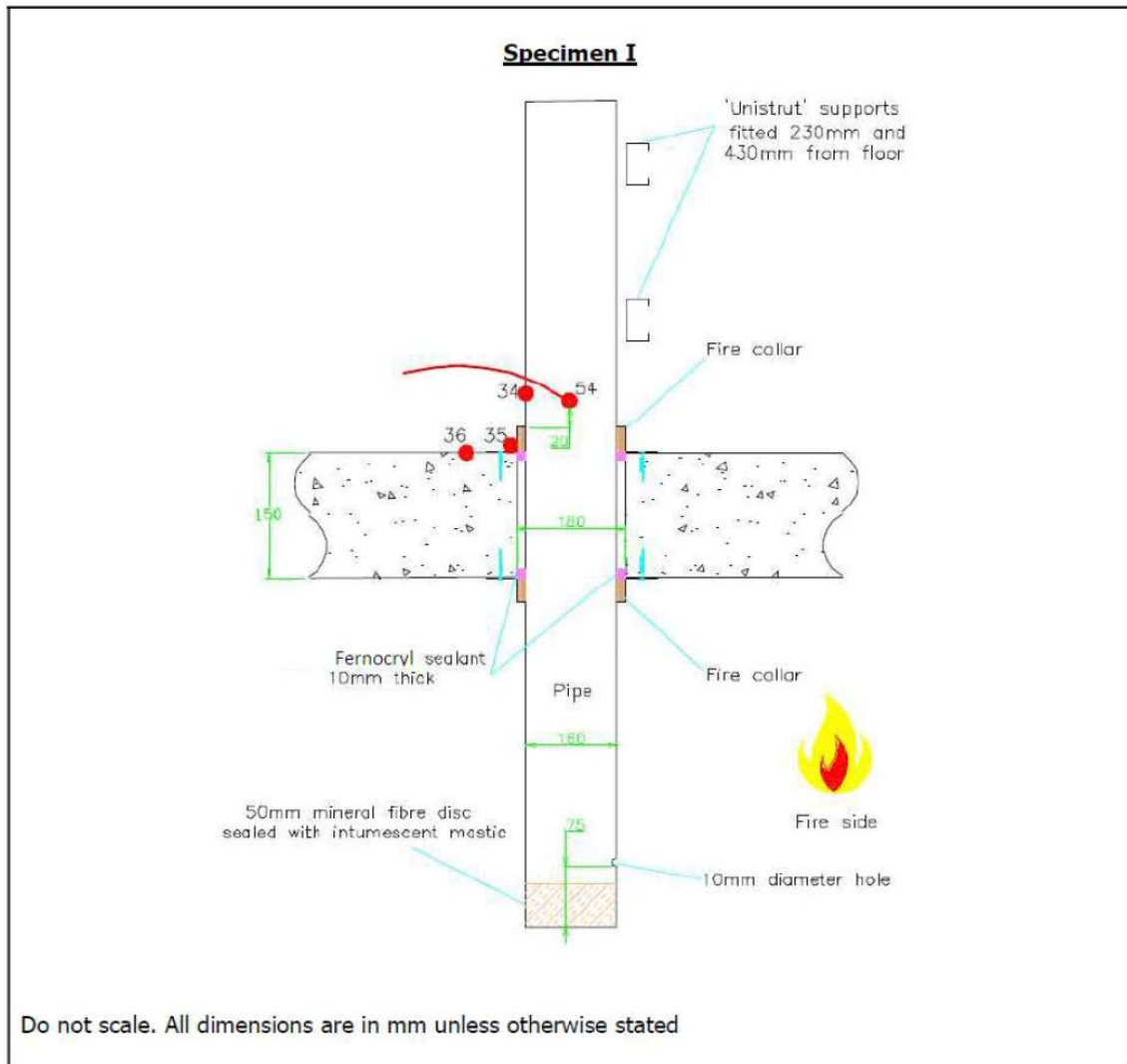


Figure 6.7 BM Trada BMT/FEI/F15008 (2/2)