

## Fire Assessment Report

AR23108

**Likely fire resistance performance of  
FIRESTOP DUCTWRAP-38 for internal and  
external fire protection of a rectangular or  
circular duct**

Issued to: Firestop Centre Ltd

Report Date: 22/05/2024

Revision: 2

Valid till: 09/08/2028



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## 1.1 Document Revision Schedule

Revision #	Date	Description
1	14/05/2024	Initial issue for Client review
2	22/05/2024	Typographical errors amended

## 1.2 Signatories

Report	Name	Signature	Date
Prepared by:	Daniel De Jong		22/05/2024
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## 2. Introduction

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The objective of the report is to assess the likely fire resistance performance of FIRESTOP DUCT WRAP-38 for external and internal fire exposure of rectangular and circular ducts if tested to AS1530.4-2014 in conjunction with AS4072.1-2005 for the protection of penetrations through vertical and horizontal fire-rated separations.

The following variations were considered in the assessment:

- Different orientations and types of fire separations (walls and floors)
- Penetration details of ducts penetrating through various separating elements
- Size of ducts, rectangular and circular
- Required wrap thickness and fixing details for internally exposed ducts
- Performance of externally exposed ducts
- Additional access panels
- 2 and 3 – side exposure of ducts

## 3. Test Reports

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The following test reports were considered in the assessment:

**Table 1: Relevant Test Reports**

Test report #	Duct size	Shape	Duct Orientation	Exposure
PF23004	800x800mm	Square	Horizontal	Internal
PF23082	1800x400mm	Rectangular	Horizontal	Internal
PF23083	1000x500mm	Rectangular	Horizontal	Internal
PF23095	800x800mm	Square	Vertical	Internal
PF23110	800mm	Circular	Horizontal	Internal
PF23111	300mm	Circular	Vertical	Internal
PF24048	1800x400m	Rectangular	Vertical	Internal
PF24010-1	1000x500mm	Rectangular	Both	External
PF24010-2	800mm	Circular	Both	External

All tests were conducted as per AS1530.4-2014.

## 4. Assessment Summary

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### 4.1 Duct Specification and Installation

The duct shall be constructed in accordance with AS4254.2-2012 Pressure class 500 or higher.

The duct support system shall use minimum M10 threaded rods and minimum 40 x 40 x 2.4mm trapeze angles, spaced no more than 1500mm apart. The loads associated with the support system shall not exceed the following:

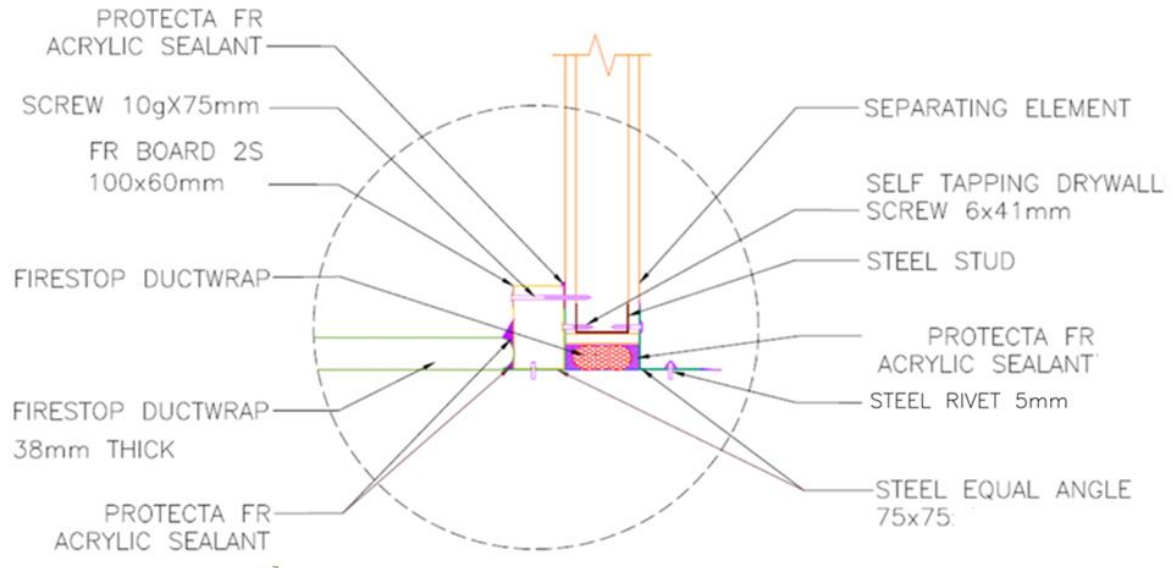
Type of Load	Maximum Stresses for up to 120 minutes (N/mm <sup>2</sup> )
Tensile stress in all vertical components	6
Bending stress in trapeze angle	6.5
Shearing stress in screws	10

Support systems for ducts larger than 1000x500mm or 800mm diameter shall use a higher specification in accordance with AS4254.2-2012.

Where the duct penetrates the vertical or horizontal separation, the duct shall not provide any structural support to the separation.

## 4.2 Duct Penetration Details

### 4.2.1 Rectangular Duct – Penetration Detail A



**Fig. 1 – Penetration detail A**

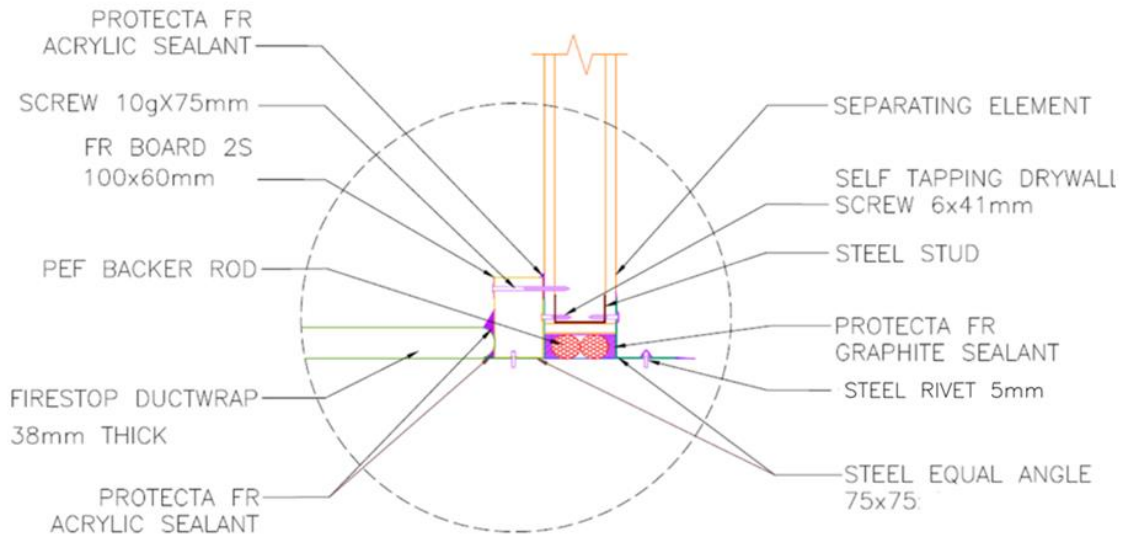
**Table 2: Penetration detail A Characteristics**

Characteristic	Description
Aperture	<p>Annular gap 10 – 30mm</p> <p>For plasterboard framed walls, the aperture shall be lined with:</p> <p>Up to -/60/60 – one layer of 13mm FR plasterboard</p> <p>Up to -/120/120 – two layers of 13mm FR plasterboard</p>
Application	<p>Horizontal ducts up to -/120/120</p> <p>Vertical ducts up to -/120/120</p> <p>The annular gap shall be sealed with 20mm deep Protecta FR Acrylic Sealant on both sides of the wall. FIRESTOP WRAP with foil removed shall be used as backing for the remaining depth of the wall. Minimum 75mmx75mmx1.2mm steel angles shall be installed on both sides of the wall.</p> <p>For a one-way system – 100mm high by 60mm thick collar made of Protecta FR Board 2S collar to be installed on non-fire side only. All joints shall be treated with Protecta FR Acrylic sealant and unpainted surfaces shall be protected with a thin layer of Protecta FR Coating or Protecta FR Acrylic.</p>

	<p>For a two-way system – 100mm high by 60mm thick collar made of Protecta FR Board 2S collar to be installed on both sides. All joints shall be treated with Protecta FR Acrylic sealant and unpainted surfaces shall be protected with a thin layer of Protecta FR Coating or Protecta FR Acrylic.</p>
<p>Separating element</p>	<p>Up to 60/60/60*:</p> <ul style="list-style-type: none"> <li>- minimum 64mm steel or timber stud with a minimum of one layer of min 13mm thick FR plasterboard on each side</li> <li>- minimum 90mm thick concrete wall.</li> <li>- Minimum 90mm timber joist floor with minimum one layer of 16mm FR plasterboard underneath and 19mm plywood board on the top.</li> </ul> <p>Up to 120/120/120*:</p> <ul style="list-style-type: none"> <li>- minimum 90mm steel or timber stud with a minimum of two layers of min 13mm thick FR plasterboard on each side</li> <li>- minimum 140mm thick concrete wall</li> </ul> <p>* - refer to the manufacturer-stated fire resistance performance of separating element</p>



## 4.2.2 Rectangular Duct – Penetration Detail B



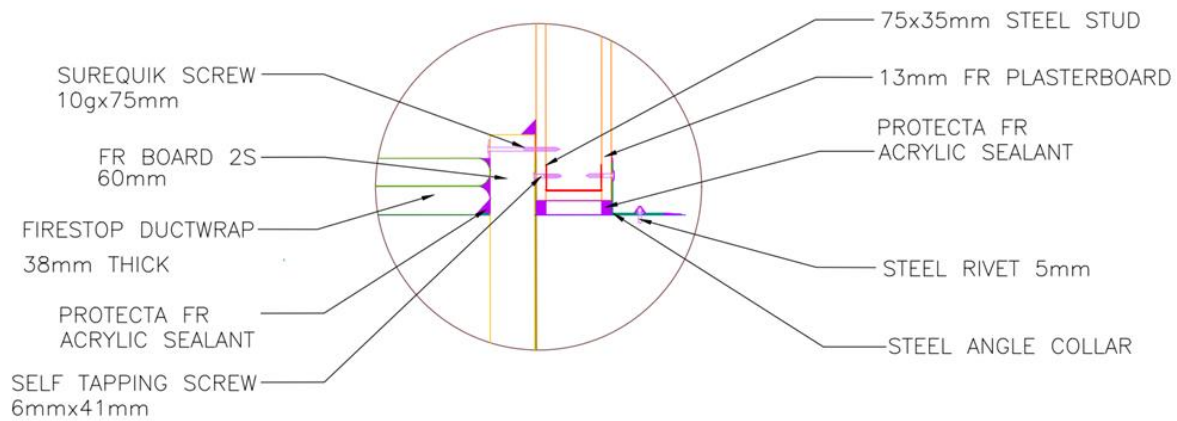
**Fig. 2 – Penetration detail B**

**Table 3: Penetration detail B Characteristics**

Characteristic	Description
Aperture	<p>Annular gap 10 – 30mm</p> <p>For plasterboard frame walls, the aperture shall be lined with:</p> <p>Up to -/60/30 – one layer of 13mm FR plasterboard</p> <p>Up to -/90/60 – two layers of 13mm FR plasterboard</p>
Application	<p>Horizontal ducts only</p> <p>The annular gap shall be sealed with 20mm deep Protecta FR Graphite Sealant on both sides of the wall. Minimum 75mmx75mmx1.2mm steel angles shall be installed on both sides of the wall.</p> <p>For a one-way system – 100mm high by 60mm thick collar made of Protecta FR Board 2S collar to be installed on non-fire side only. All joints shall be treated with Protecta FR Acrylic sealant and unpainted surfaces shall be protected with a thin layer of Protecta FR Coating or Protecta FR Acrylic.</p> <p>For a two-way system – 100mm high by 60mm thick collar made of Protecta FR Board 2S collar to be installed on both sides. All joints shall be treated with Protecta FR Acrylic sealant and unpainted surfaces shall be protected with a thin layer of Protecta FR Coating or Protecta FR Acrylic.</p>

<p>Separating element</p>	<p>Up to 60/60/30*</p> <ul style="list-style-type: none"> <li>- minimum 64mm steel or timber stud with a minimum of one layer of min 13mm thick FR plasterboard on each side</li> <li>- minimum 90mm thick concrete wall</li> </ul> <p>Up to 90/90/60*</p> <ul style="list-style-type: none"> <li>- minimum 90mm steel or timber stud with a minimum of two layers of min 13mm thick FR plasterboard on each side</li> <li>- minimum 140mm thick concrete wall</li> </ul> <p>* - refer to the manufacturer-stated fire resistance performance of separating element</p>
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### 4.2.3 Circular Duct – Penetration Detail C



**Fig. 3 – Penetration detail C**

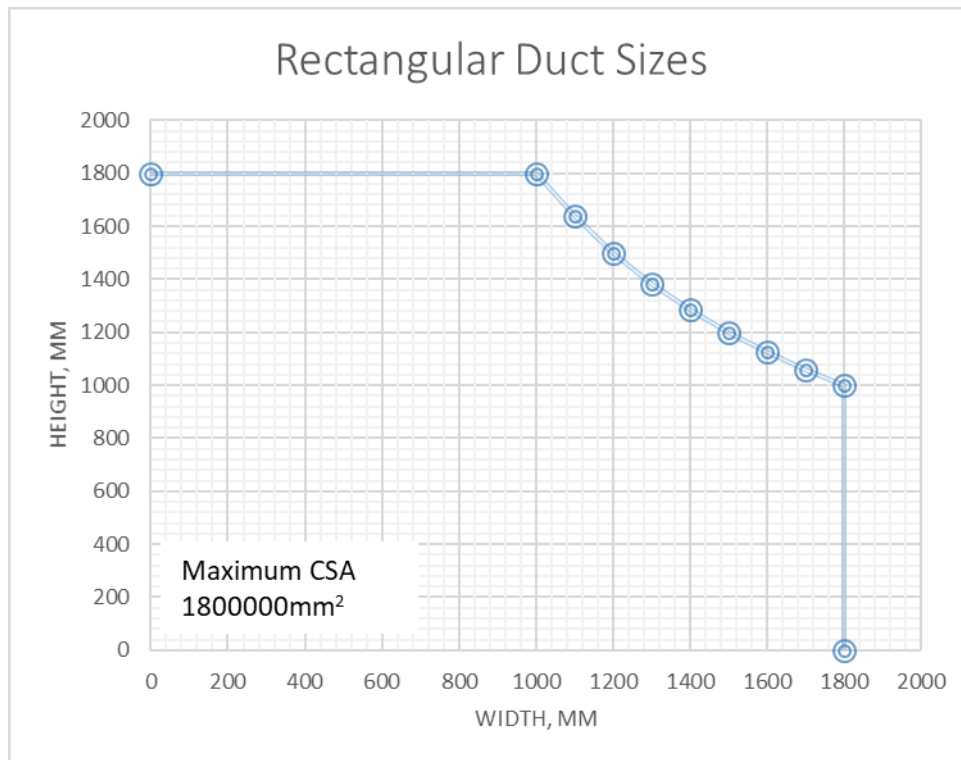
**Table 4: Penetration detail C Characteristics**

Characteristic	Description
Aperture	Annular gap 10 – 30mm For plasterboard framed walls – no internal lining required
Application	Horizontal ducts up to -/120/120 Vertical ducts up to -/120/120 The annular gap shall be sealed with <ul style="list-style-type: none"> <li>- For Plasterboard lined walls – Protecta FR Acrylic Sealant to the depth of plasterboard lining</li> <li>- For concrete walls or floors - 20mm deep Protecta FR Acrylic Sealant on both sides of the separating element. FIRESTOP WRAP-38 content shall be used as backing for the remaining depth of the separating element.</li> </ul> Minimum 75mmx75mmx0.8mm steel angles (slotted or prefabricated) shall be installed on both sides of the wall or the top of the concrete slab.  For a one-way system – 100mm high by 60mm thick collar made of Protecta FR Board 2S collar to be installed on non-fire side only. All joints shall be treated with Protecta FR Acrylic sealant and unpainted surfaces shall be protected with a thin layer of Protecta FR Coating or Protecta FR Acrylic.  For a two-way system – 100mm high by 60mm thick collar made of Protecta FR Board 2S collar to be installed on both sides only. All joints shall be treated with Protecta FR Acrylic

	<p>sealant and unpainted surfaces shall be protected with a thin layer of Protecta FR Coating or Protecta FR Acrylic.</p> <p>For concrete floors – steel and board collars are required on the top of the separating element.</p>
<p>Separating element</p>	<p>Up to 60/60/60*:</p> <ul style="list-style-type: none"> <li>- minimum 76mm steel or timber stud with a minimum of one layer of min 13mm thick FR plasterboard on each side of the wall</li> <li>- minimum 90mm thick concrete wall or minimum 90mm thick concrete floor.</li> </ul> <p>Up to 120/120/120*:</p> <ul style="list-style-type: none"> <li>- minimum 120mm thick concrete wall or floor</li> </ul> <p>* - refer to the manufacturer-stated fire resistance performance of separating element</p>

### 4.3 Duct Dimensions

Rectangular duct sizes, limited by a maximum cross-sectional area of up to 1800000mm<sup>2</sup> have been positively assessed for both internal and external exposure to fire. Ducts with dimensions within the plotted area may be used, provided the duct has been constructed in accordance with AS4254.2 Pressure class 500 or higher.



**Fig. 4 – Positively assessed rectangular duct sizes**

Circular duct sizes, limited by a maximum diameter of up to 1000mm have been positively assessed for both internal and external exposure to fire, provided the duct has been constructed in accordance with AS4254.2 Pressure class 500 or higher.

## 4.4 Internal Duct Protection

### 4.4.1 30 Minutes Protection – Rectangular Duct

**Table 5: Rectangular Duct Characteristics for 30-minute protection**

Characteristic	Description	
	30/30/-	30/30/30
Separating element	<p>Framed wall – minimum 64mm steel or timber stud with one layer of fire-rated plasterboard on both sides</p> <p>Concrete/masonry wall – minimum 90mm thick</p> <p>Framed floor/ceiling - minimum 90mm timber joist floor with minimum one layer of 16mm FR plasterboard underneath and 19mm plywood board on the top.</p> <p>Concrete floor – Minimum 90mm thick</p>	
Penetration	A or B (B for horizontal only)	A or B (B for horizontal only)
Wrap cut-off tape	Class 1, 2, or 3	Class 1 or 2
Joints tape	Class 1, 2, or 3	Class 1, 2, or 3
Maximum vertical duct size	1800000mm <sup>2</sup> CSA	1800000mm <sup>2</sup> CSA
Maximum horizontal duct size	1800000mm <sup>2</sup> CSA	1800000mm <sup>2</sup> CSA
Protection from internal fire	<p>Horizontal duct: 1 layer</p> <p>Vertical duct: 1 layer</p>	<p>Horizontal duct: 1 layer</p> <p>Vertical duct <math>\leq</math> 640000mm<sup>2</sup> perimeter: 1 layer + 600mm 2<sup>nd</sup> layer</p> <p>Vertical duct <math>&gt;</math> 640000mm<sup>2</sup> perimeter: 1 layer + 900mm 2<sup>nd</sup> layer</p>

## 4.4.2 30 Minutes Protection – Circular Duct

**Table 6: Circular Duct Characteristics for 30-minute protection**

Characteristic	Description	
	30/30/-	30/30/30
Separating element	Framed wall – minimum 76mm steel or timber stud with one layer of fire-rated plasterboard on both sides Concrete/masonry wall – minimum 90mm thick Framed floor/ceiling - minimum 90mm timber joist floor with minimum one layer of 16mm FR plasterboard underneath and 19mm plywood board on the top. Concrete floor – Minimum 90mm thick	
Penetration	C	C
Wrap cut-off edge tape	Class 1, 2, or 3	Class 1 or 2
Joints tape	Class 1, 2, or 3	Class 1, 2, or 3
Maximum vertical duct size	300mm	300mm
Maximum horizontal duct size	1000mm	1000mm
Protection from internal fire	Horizontal duct: 1 layer Vertical duct: 1 layer*	Horizontal duct: 1 layer Vertical duct: 1 layer*

\* - For Vertical ducts up to 300mm diameter – 25mm thick wrap may be used, provided 1 layer for 30/30/- rating and minimum 550mm of the 2 layers for 30/30/30 rating.

### 4.4.3 60 Minutes Protection – Rectangular Duct

**Table 7: Rectangular Duct Characteristics for 60-minute protection**

Characteristic	Description		
	60/60/-	60/60/30	60/60/60
Separating element	Framed wall – minimum 64mm steel or timber stud with one layer of fire-rated plasterboard on both sides Concrete/masonry wall – minimum 90mm thick Framed floor/ceiling - minimum 90mm timber joist floor with minimum one layer of 16mm FR plasterboard underneath and 19mm plywood board on the top. Concrete floor – Minimum 90mm thick		
Penetration	A or B (B for horizontal only)	A or B (B for horizontal only)	A or B (B for horizontal only)
Wrap cut-off tape	Class 1, 2, or 3	Class 1 or 2	Class 1 or 2
Joints tape	Class 1, 2, or 3	Class 1, 2, or 3	Class 1 or 2
Maximum vertical duct size	1800000mm <sup>2</sup> CSA	1800000mm <sup>2</sup> CSA	1800000mm <sup>2</sup> CSA
Maximum horizontal duct size	1800000mm <sup>2</sup> CSA	1800000mm <sup>2</sup> CSA	1800000mm <sup>2</sup> CSA
Protection from internal fire	Horizontal duct: 1 layer Vertical duct: 1 layer	Horizontal duct: 1 layer Vertical duct ≤ 640000mm <sup>2</sup> perimeter: 1 layer + 600mm 2 <sup>nd</sup> layer Vertical duct > 640000mm <sup>2</sup> perimeter: 1 layer + 900mm 2 <sup>nd</sup> layer	Horizontal duct: 1 layer + 1400mm 2 <sup>nd</sup> layer Vertical duct ≤ 640000mm <sup>2</sup> perimeter: 1 layer + 1900mm 2 <sup>nd</sup> layer Vertical duct > 640000mm <sup>2</sup> perimeter: 1 layer + 1780mm 2 <sup>nd</sup> layer, 860mm 3 <sup>rd</sup> layer



#### 4.4.4 60 Minutes Protection – Circular Duct

**Table 8: Circular Duct Characteristics for 60-minute protection**

Characteristic	Description		
	60/60/-	60/60/30	60/60/60
Separating element	Framed wall – minimum 76mm steel or timber stud with one layer of fire-rated plasterboard on both sides Concrete/masonry wall – minimum 90mm thick Framed floor/ceiling - minimum 90mm timber joist floor with minimum one layer of 16mm FR plasterboard underneath and 19mm plywood board on the top. Concrete floor – Minimum 90mm thick		
Penetration	C	C	C
Wrap cut-off tape	Class 1, 2, or 3	Class 1 or 2	Class 1 or 2
Joints tape	Class 1, 2, or 3	Class 1, 2, or 3	Class 1 or 2
Maximum vertical duct size	300mm	300mm	N/A
Maximum horizontal duct size	1000mm	1000mm	1000mm
Protection from internal fire	Horizontal duct: 1 layer Vertical duct: 1 layer*	Horizontal duct: 1 layer Vertical duct: 1 layer*	Horizontal duct: 1 layer + 1900mm 2 <sup>nd</sup> layer Vertical duct: N/A

\* - For Vertical ducts up to 300mm diameter – 25mm thick wrap may be used, provided 1 layer for 60/60/- rating and minimum 550mm of the 2 layers for 60/60/30 rating.

#### 4.4.5 120 Minutes Protection – Rectangular Duct

**Table 9: Rectangular Duct Characteristics for up to 120-minute protection**

Characteristic	Description				
	120/120/-	120/120/30	120/120/60	120/120/90	120/120/120
Separating element	Framed wall – minimum 92mm steel or timber stud with two layers of fire-rated plasterboard on both sides Concrete/masonry wall – minimum 120mm thick Concrete floor – Minimum 150mm thick				
Penetration	A or B (for horizontal only)	A or B (for horizontal only)	A or B (for horizontal only)	A or B (for horizontal only)	A
Wrap cut-off tape	Class 1, 2, or 3	Class 1 or 2	Class 1 or 2	Class 1	Class 1
Joints tape	Class 1, 2, or 3	Class 1, 2, or 3	Class 1 or 2	Class 1	Class 1
Maximum vertical duct size	1800000 mm <sup>2</sup> CSA	1800000mm <sup>2</sup> CSA	1800000mm <sup>2</sup> CSA	1800000m <sup>2</sup> CSA	1800000mm <sup>2</sup> CSA
Maximum horizontal duct size	1800000 mm <sup>2</sup> CSA	1800000mm <sup>2</sup> CSA	1800000mm <sup>2</sup> CSA	1800000m <sup>2</sup> CSA	1800000mm <sup>2</sup> CSA
Protection from internal fire	Horizontal duct: 1 layer Vertical duct: 1 layer	Horizontal duct: 1 layer Vertical duct ≤ 640000mm <sup>2</sup> perimeter: 1 layer + 600mm 2 <sup>nd</sup> layer Vertical duct > 640000mm <sup>2</sup> perimeter: 1 layer + 900mm 2 <sup>nd</sup> layer	Horizontal duct: 1 layer + 1400mm 2 <sup>nd</sup> layer Vertical duct ≤ 640000mm <sup>2</sup> perimeter: 1 layer + 1900mm 2 <sup>nd</sup> layer Vertical duct > 640000mm <sup>2</sup> perimeter: 1 layer + 1780mm 2 <sup>nd</sup> layer, 860mm 3 <sup>rd</sup> layer	Horizontal duct: 1 layer + 1900mm 2 <sup>nd</sup> layer Vertical duct: 1 layer + 2040mm 2 <sup>nd</sup> layer, 1660mm 3 <sup>rd</sup> layer	Horizontal duct: 1 layer + 1900mm 2 <sup>nd</sup> layer Vertical duct: 1 layer + 2040mm 2 <sup>nd</sup> layer, 1660mm 3 <sup>rd</sup> layer



#### 4.4.6 120 Minutes Protection – Circular Duct

**Table 10: Circular Duct Characteristics for up to 120-minute protection**

Characteristic	Description				
	120/120/-	120/120/30	120/120/60	120/120/90	120/120/120
Separating element	Framed wall – minimum 92mm steel or timber stud with two layers of fire-rated plasterboard on both sides Concrete/masonry wall – minimum 120mm thick Concrete floor – Minimum 150mm thick				
Penetration	C	C	C	C	C
Wrap cut-off tape	Class 1, 2, or 3	Class 1 or 2	Class 1 or 2	Class 1	Class 1
Joints tape	Class 1, 2, or 3	Class 1, 2, or 3	Class 1 or 2	Class 1	Class 1
Maximum vertical duct size	300mm	300mm	N/A	N/A	N/A
Maximum horizontal duct size	1000mm	1000mm	1000mm	1000mm	1000mm
Protection from internal fire	Horizontal duct: 1 layer Vertical duct: 1 layer*	Horizontal duct: 1 layer Vertical duct: 1 layer*	Horizontal duct: 1 layer + 1900mm 2 <sup>nd</sup> layer	Horizontal duct: 1 layer + 4300mm 2 <sup>nd</sup> layer	Horizontal duct: 1 layer + 4300mm 2 <sup>nd</sup> layer

\* - For Vertical ducts up to 300mm diameter – 25mm thick wrap may be used, provided 1 layer for 120/120/- rating and minimum 550mm of the 2 layers for 120/120/30 rating.

## 4.5 External Duct Protection

**Table 11: Rectangular and Circular Duct Characteristics for up to 120-minute protection**

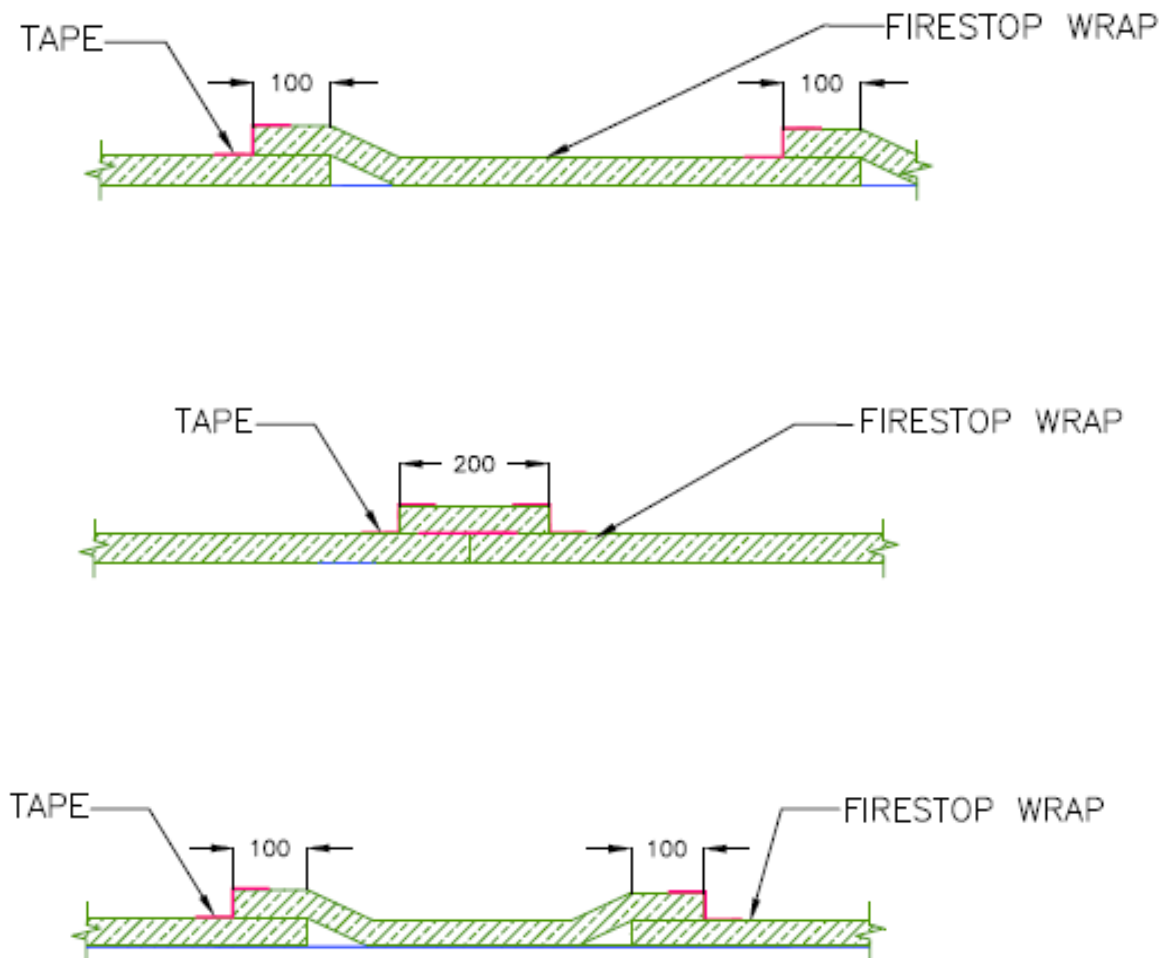
Characteristic	Description	
	Rectangular Duct 120/120/120	Circular Duct 120/120/90
Separating element	<p>Framed wall – minimum 64mm steel or timber stud with one layer of fire-rated plasterboard on both sides</p> <p>Concrete/masonry wall – minimum 90mm thick</p> <p>Framed floor/ceiling - minimum 90mm timber joist floor with minimum one layer of 16mm FR plasterboard underneath and 19mm plywood board on the top.</p> <p>Concrete floor – Minimum 90mm thick</p>	<p>Framed wall – minimum 76mm steel or timber stud with one layer of fire-rated plasterboard on both sides</p> <p>Concrete/masonry wall – minimum 90mm thick</p> <p>Framed floor/ceiling - minimum 90mm timber joist floor with minimum one layer of 16mm FR plasterboard underneath and 19mm plywood board on the top.</p> <p>Concrete floor – Minimum 90mm thick</p>
Penetration	A - installed both sides of separating element	C - installed both sides of separating element
Wrap cut-off tape	Class 1	Class 1
Joints tape	Class 1	Class 1
Maximum duct size	1800x1000mm or 1800000mm <sup>2</sup>	1000mm
Protection from external fire	2 layers	2 layers

For installations into separating elements with a rating less than 120/120/120, the rating of the duct shall be reduced to match that of the separating element.

## 4.6 Wrap Fixings, Overlap and Joint Treatment

### 4.6.1 Wrap Overlap

The following overlapping methods are permitted for duct wrap protection application. A minimum of 100mm from the ends of the wrap shall be maintained.



**Fig. 5 – Permissible wrap overlap methods**

## 4.6.2 Wrap Fixing

The following wrap fixing methods may be used to secure the duct wrap protection to the duct for internal fire systems. For external fire systems, welded pins shall be used.

Horizontal orientation:

Up to 800 x 800mm - steel straps and/or welded pins

Up to 300mm diameter - steel straps and/or welded pins

Vertical orientation:

Up to 300 x 300mm - steel straps and/or welded pins

Up to 300mm diameter - steel straps and/or welded pins

For ducts exceeding the above dimensions, welded pins shall only be used

Where steel straps are to be used, the straps shall be minimum 12mm wide and 0.15mm thick. The steel straps shall be installed at 300mm centres, as well as 50mm from the ends of all layers of wrap.

Where welded pins are to be used, steel or copper-plated steel pins with a diameter of 2.5mm – 3.2mm shall be used. Different lengths of pins shall be used depending on the thickness of the wrap, in accordance with the table below. Pins shall be fixed at maximum 200mm centres along the width and length of the duct and shall be fixed 50mm from the ends of all layers of wrap.

**Table 12: Required welded pin lengths**

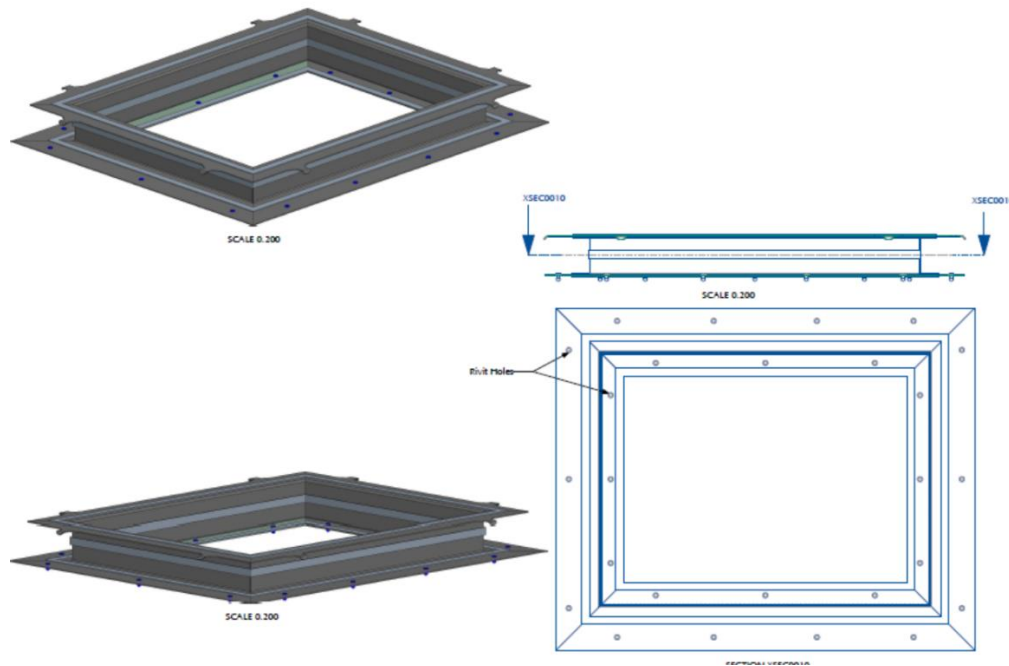
Thickness of Ductwrap used	Pin length (minimum)	Pin length (maximum)
1 x 38mm	25mm	34mm
2 x 38mm	63mm	72mm
3 x 38mm	95mm	110mm

### 4.6.3 Tape for Joints and Cut-off Ends

Three types of tape may be used, depending on the required insulation rating:

- Class 1: Minimum 50µm thick Aluminium tape with minimum 120°C heat-resistant adhesive. No reinforced aluminium tape is allowed.
- Class 2: Minimum 50µm thick Aluminium tape with minimum 60°C heat-resistant adhesive. No reinforced aluminium tape is allowed.
- Class 3: No tape or any reinforced aluminium tape

## 4.7 Access Panels



**Fig. 6 – FIRESTOP Duct Hatch Details**

The FIRESTOP Duct Hatch as per the drawings above will to achieve the performance described below, provided the following conditions are met:

**Table 13: Access panel Ratings and location**

Duct Orientation	Hatch cut-out dimensions	Minimum distance from Separating Element	Rating
Horizontal	600mm x 450mm	1800mm	-/120/120
Vertical	600mm x 450mm	1075mm	-/60/60
Vertical	440mm x 320mm	1330mm	-/120/60

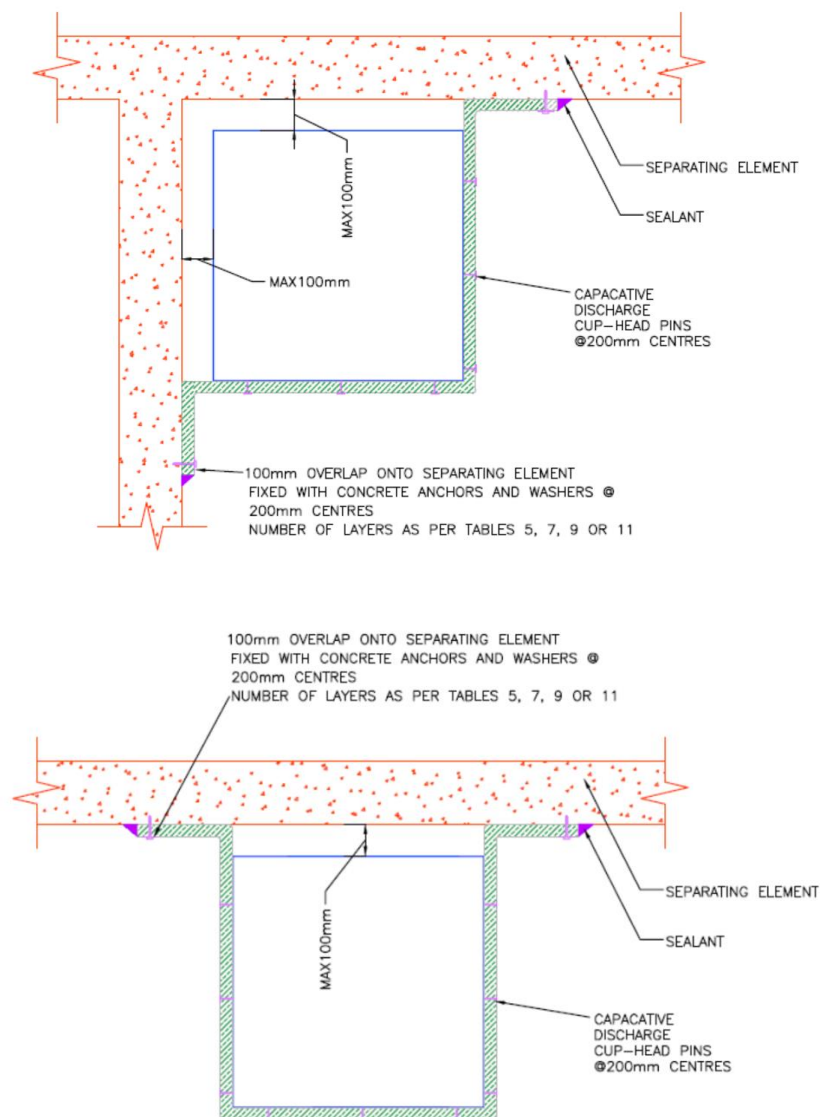
- The dimensions of the opening shall not exceed 650mm x 450mm and the hatch frame shall be fixed to the duct on four sides
- The width and length of the hatch may be reduced, but not the thickness of the hatch or part thereof
- Individual components shall not be removed or reduced in size
- The hatch flanges shall overlap and be fixed on all edges around the cut-out
- The opening in the duct shall be located not less than 100mm from any edge of the duct
- The fixing centres shall not be increased



## 4.8 Optional Detail – 2 and 3-Side Exposure

The following 2 and 3 side exposure cases may be implemented for both internal and external fire conditions, provided the following conditions are met:

- Penetration detail A or B shall be used
- The wrap protection characteristics shall be consistent with requirements of Tables 5, 7, 9 or 11 coinciding with the desired FRL
- The spacing between the duct and separating element shall be no more than 100mm at any point
- The wrap shall be fixed to the concrete separating element with minimum 100mm overlap. The wrap shall be fixed using concrete anchors and washers (OD > 25mm) at 200mm centres



**Fig. 7 – 2 and 3 side duct exposure layouts**

## 5. Validity of the Assessment

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The assessment report is valid till 09/08/2028.

Any further variations with regards to size, construction details, stresses, edge or end conditions other than those identified in this report, may invalidate the conclusions drawn in this report.

This Assessment does not provide an endorsement by Fire TS Lab of the actual data provided.

The conclusions of this report may be used to directly assess the fire resistance performance under such conditions, but it should be acknowledged that a single test method will not provide a full assessment of the product under all fire conditions.

Because of the nature of fire resistance testing and the consequential difficulty in quantifying the uncertainty of measurement, it is not possible to provide a stated degree of accuracy. The inherent variability in testing procedures, materials and methods of construction and installation may lead to variations in performance between elements of similar construction.

This Assessment can only, therefore, relate to the actual prototype test specimens, testing conditions and methodology provided in the supporting data and does not imply any performance abilities of constructions of subsequent manufacture.

This Assessment is based on the information provided and experience available at the time of writing. The published procedures for the conduct of tests and the assessment of test results are subject to constant review and improvement and it is recommended that this document be reviewed on or before the stated expiry date. If contradictory evidence becomes available to the assessing authority, the assessment will be unconditionally withdrawn and the report sponsor will be notified in writing. Similarly, the assessment should be re-evaluated, if the assessed construction is subsequently tested since actual test data is deemed to take precedence.

The information contained in this document shall not be used for the assessment of variations other than those in the conclusions above. This document is valid providing no modifications are made to the systems described in this document.

All details of construction should be consistent with the requirements stated in the relevant test reports and all referenced documents.

## 6. Authority

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By using this document as evidence of compliance of performance, the applicant(s) confirms that;

- to their knowledge the component or element of structure which is the subject of this assessment has not been subjected to a fire test to the standard against which this assessment is being made, and;
- they agree to withdraw this assessment from circulation should the component or element of the structure be subject to a fire test by a recognized test authority in accordance with the standard against which this assessment is being made and the results are not in agreement with this assessment and;
- they are not aware of any information that could adversely affect the conclusions of this assessment and if they subsequently become aware of any such information agree to ask the testing authority to withdraw the assessment.

This assessment may only be reproduced in full without modifications by the sponsor. Copies, extracts or abridgements of this report in any form shall not be published by other organisations or individuals without the permission of Fire TS Laboratory.

## Appendix A – Discussion

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### Penetration details A and C

Tests PF23004, PF23083, PF23095, PF24048 and PF24010-1 comprised of both vertically and horizontally orientated, circular and rectangular ducts passing through various separating elements, including plasterboard-steel stud, plasterboard-timber stud and concrete separating elements.

Throughout the range of tests, the penetration detail was installed using the same methods and materials and tested for up to 120 minutes as described in Appendix B.

Test PF23004 included an 800mm x 800mm horizontally orientated duct, penetrating through a timber stud and 2 x 13mm FR plasterboard wall. No structural adequacy, integrity or insulation failures were observed at either the separating element or on the penetration detail collar during the 127-minute test.

Test PF23083 included a 1000mm x 500mm horizontally orientated duct, penetrating through a steel stud and 1 x 13mm FR plasterboard wall. No structural adequacy or integrity failures were observed at either the separating element or on the penetration detail collar during the 124-minute test. Thermocouples attached to the separating element and the penetration detail collar exceeded the insulation criteria at approximately 70 minutes, which occurred after the published -/60/60 fire resistance level of the separating element.

Test PF23110 included an 800mm diameter horizontally orientated duct, penetrating through a timber stud and 1 x 13mm FR plasterboard wall. No structural adequacy or integrity failures were observed at either the separating element or on the penetration detail collar during the 124-minute test. Thermocouples attached to the separating element and the penetration detail collar exceeded the insulation criteria at approximately 60 minutes, which occurred after the published -/60/60 fire resistance level of the separating element.

Test PF24048 included an 1800mm x 400mm vertically orientated duct, penetrating through a 150mm concrete slab. No structural adequacy, integrity or insulation failures were observed at either the separating element or on the penetration detail collar during the 126-minute test.

The penetration detail demonstrated its ability to achieve an FRL of up to 120 minutes in both horizontal and vertical orientations for a range of duct sizes and separating elements. It was observed that the only instances of insulation failure of the penetration detail occurred after the published FRL of the separating element. It is considered reasonable and conservative that the fire resistance of proposed penetration details A (Fig.1) and C (Fig.3) is likely to achieve at least the rating stated for the respective separating element if tested in accordance with AS1530.4-2014 in conjunction with AS4072.1-2005.

## **Penetration detail B**

In the fire resistance test, PF23082 the duct was tested passing through a 64mm steel stud wall with one layer of fire-rated plasterboard on each side. The temperature recorded by the thermocouple located on the plasterboard wall exceeded the limiting temperature at 58 minutes while the thermocouple located on the board collar exceeded the limiting temperature at 70 minutes. The insulation failure was determined by the performance of the wall. There was no integrity failure recorded at the conclusion of the test at 91 minutes.

Based on the above discussion, it is considered reasonable and conservative that the fire resistance of proposed penetration detail B (Fig.2) is likely to achieve at least -/60/30 FRL if tested in accordance with AS1530.4-2014 in the separating elements, having higher fire resistance performance, such as steel stud wall with higher profile of the stud, timber stud framed walls with stud profile not less than 64mm or minimum 90mm concrete walls.

It is considered reasonable and conservative that the fire resistance of proposed penetration detail B (Fig.2) is likely to achieve at least -/90/60 FRL if tested in accordance with AS1530.4-2014 in conjunction with AS4072.1-2005 in the separating elements, having higher fire resistance performance, such as steel or timber stud framed walls with minimum 64mm stud and at least two layers of 13mm fire rated plasterboard each side or minimum 140mm concrete walls.

It is considered conservative, that penetration detail will demonstrate the same or better performance if tested in the concrete separating element, provided the thickness of the concrete is the same or greater thickness than the equivalent plasterboard wall.

## Wrap protection

In the fire resistance tests PF23004, PF23082, PF23095, PF23110, PF23111, PF24048, PF24010-1 and PF24010-2 the duct was tested using single and double layers of 25mm and 38mm thick FIRESTOP WRAP. The tests were conducted for 60, 90 and 120 minutes as described in Appendix B. All ducts were designed in accordance with AS4254.2 Pressure class 500. AS1530.4 section 9 states that the structural adequacy failure of the duct shall be deemed to have occurred when the duct collapses in such a manner that the duct no longer fulfils its intended function. AS1530.4 section 9 states that the Integrity of the duct shall be deemed to be lost for internal fire testing, when hot gases can pass to the unexposed side, except for the open end; and for external and internal fire testing, under the criteria given in Section 10 for service penetrations.

During the range of tests, no failures were observed in terms of structural adequacy or integrity, displaying the ability of the 500 Pressure class duct to withstand internal fire exposure for up to 120 minutes. Although unlikely, structural adequacy could be compromised if the supporting system of the internal duct were to be affected by the temperature of the wrap. The maximum temperature recorded at any point on a single layer of wrap was below 400 °C, which is not likely to significantly influence the supporting system of the duct. Based on this, it is considered reasonable and conservative that the fire resistance performance of the tested duct sizes for the internal fire will achieve 120 minutes of structural adequacy and integrity if protected with 1 layer of duct wrap if tested to AS1530.4-2014.

In the fire resistance test PF23083, a 1000 x 500mm horizontally oriented duct was tested for a duration of 124 minutes. The duct had one layer of 38mm thick wrap installed along the entire length of the duct, with a 600mm wide second layer wrap installed butted against the separating element. A reinforced aluminium tape was used for all joints, overlaps and cut ends. The thermocouple located at a wrap overlap, 700mm from the separating element exceeded the insulation failure criteria of 180K at 33 minutes. The structural adequacy and integrity failure criteria were not exceeded at the conclusion of the test. It was observed that the tape became detached from the wrap prior to the insulation failure of the wrap, which likely allowed hot air generated on the outer surface of the duct through convection to escape from the wrap joints.

There was no observation of internal duct hot gasses penetrating through the duct, therefore the integrity of the duct was not compromised. It is however, likely that the specimen thermocouples were significantly influenced by the hot air, which resulted in higher temperatures along the entire length of the duct compared to other similar tests. In the opinion of the laboratory, the use of reinforced tape negatively influenced the performance of the test, and the results shall not be used to further examine the insulation performance of the wrap protection.

In the fire resistance tests PF23004 and PF23082, various sizes of horizontally oriented ducts were tested. The ducts had one layer of the wrap applied to the entire length of the duct, with additional sections of wrap for assessment of the second layer's performance.

It was observed, that the single layer of 38mm thick wrap achieved up to 30 minutes insulation criteria, while two layers of 38mm wrap achieved up to 120 minutes insulation criteria. The exception to this is where thermocouples were located in the proximity of the separating element and the duration of the test exceeded the stated performance of the separating element, resulting in the thermocouples being affected by the hot gases passing through the separating element. AS 1530.4 clause 2.2.3.1 states that if the unexposed face thermocouples become heated by hot gases passing through the specimen then data from that thermocouple shall be excluded – therefore results were disregarded.

For the range of tests, the single layer of the wrap demonstrated its ability to maintain a temperature rise not higher than 180K for 60 minutes at a distance of 1400mm and 90 minutes at a distance of 1800mm from the separating element. Based on analysis of the performance of single and double layers of the wrap, it is likely, that the tested ducts will achieve a minimum of 60 minutes insulation criteria with a second layer of wrap extending 1400mm from the separating element and a minimum of 90 minutes insulation criteria with a second layer of wrap extending 1900mm from the separating element – provided the following criteria are met:

- The penetrated separating element shall have an FRL equal to or greater than that of the duct system
- The duct size shall be limited to a maximum CSA of 1800000mm<sup>2</sup>
- All wrap joints must overlap by a minimum of 100mm

In the fire resistance test PF23095, an 800 x 800mm vertical duct was tested for a duration of 66 minutes. The duct had one layer of 38mm thick wrap installed along the entire length of the duct, with a 600mm wide second layer wrap installed butted against the separating element. An additional layer of the wrap was installed along the length of one side of the duct to evaluate the performance of the double layer.

The thermocouple located at a transverse joint, 1200mm from the separating element exceeded the insulation failure criteria of 180K at 21 minutes. It was determined that the failure occurred due to the absence of the required wrap overlap of 100mm between the layers and was therefore influenced by hot gasses passing through the gap. The thermocouples located 200mm above and below the stated location were not influenced by hot gasses and did not exceed the insulation failure criteria prior to 30 minutes, therefore results were disregarded.

Apart from the localised insulation failure, it was observed that the single layer of 38mm thick wrap achieved up to 30 minutes insulation criteria, while two layers of 38mm wrap achieved up to 60 minutes insulation criteria.



The single layer of the wrap demonstrated its ability to maintain a temperature rise not higher than 180K for 60 minutes at the distance of 1900mm from the separating element. Based on analysis of the performance of single and double layers of the wrap, it is likely, that the tested ducts will achieve a minimum of 30 minutes insulation criteria with a second layer of wrap extending 600mm from the separating element and a minimum of 60 minutes insulation criteria with a second layer of wrap extending 1900mm from the separating element - provided the following criteria are met:

- The penetrated separating element shall have an FRL equal to or greater than that of the duct system
- The duct size shall be limited to a maximum CSA of 640000mm<sup>2</sup>
- All wrap joints must overlap by a minimum of 100mm

In the fire resistance test PF23110 an 800mm diameter, horizontally oriented circular duct was tested. The duct had one layer of the wrap installed along the entire length of the duct. An additional layer of the wrap was installed along the length of one side of the duct to evaluate the performance of a double layer.

It was observed, that the single layer of 38mm thick wrap achieved up to 30 minutes insulation criteria, while two layers of 38mm wrap achieved up to 120 minutes insulation criteria.

The single layer of the wrap demonstrated its ability to maintain a temperature rise not higher than 180K for 60 minutes at the distance of 1900mm from the separating element and 90 minutes at the distance of 4300mm from the separating element. Based on analysis of the performance of single and double layers of the wrap, it is likely, that the tested duct will achieve a minimum of 60 minutes insulation criteria with a second layer extending 1900mm from the separating element and 90 minutes insulation criteria, having at least 4300mm of the second layer of wrap - provided the following criteria are met:

- The penetrated separating element shall have an FRL equal to or greater than that of the duct system
- The duct size shall be limited to a maximum diameter of 800mm
- All wrap joints must overlap by a minimum of 100mm

In the fire resistance test, PF23111 a 300mm diameter, vertically oriented circular duct was tested passing through a composite floor with profiled decking with 60mm minimum thickness. The duct had one layer of the wrap installed along the entire length of the duct. An additional layer of the wrap was installed along the length of one side of the duct to evaluate the performance of a double layer.

It was observed, that the single layer of 25mm thick wrap achieved a minimum of 22 minutes insulation criteria, while two layers of 25mm wrap achieved a minimum of 30 minutes insulation criteria.



The single layer of the wrap demonstrated its ability to maintain a temperature rise not higher than 180K for 30 minutes at the distance of 550mm from the separating element. Based on analysis of the performance of single and double layers of the wrap, it is likely, that the tested duct will achieve a minimum of 30 minutes insulation criteria, with a second layer extending 550mm from the separating element - provided the following criteria are met:

- The penetrated separating element shall have an FRL equal to or greater than that of the duct system
- The duct size shall be limited to a maximum diameter of 300mm
- All wrap joints must overlap by a minimum of 100mm

In the fire resistance test PF24048, an 1800 x 400mm vertical duct was tested for the duration of 1266 minutes. The duct had one layer of 38mm thick wrap installed along the entire length of the duct. An additional second layer with a 1000mm width was installed on top of the first layer along the entire length of the duct, butted against the FR Board. An additional third layer with a 200mm width and 1000mm length was installed on top of the second layer, butted against the FR Board

It was observed, that the single layer of 38mm thick wrap achieved a minimum of 22 minutes insulation criteria, while two and three layers of 38mm wrap achieved a minimum of 120 minutes insulation criteria.

The single layer of the wrap demonstrated its ability to maintain a temperature rise not higher than 180K for 30 minutes at the distance of 1200mm from the separating element.

While a thermocouple was not present at the location, it is considered reasonable that the wrap would maintain a temperature rise not higher than 180K at 30 minutes at a distance of 900mm, provided that 1000mm widths of wrap were used. This is due to the overlap beginning at 900mm, which is likely to provide a temperature similar to that recorded by the thermocouple at 980mm. Based on analysis of the performance of single, double and triple layers of the wrap, it is likely, that the tested duct will achieve a minimum of 30 minutes insulation criteria, with a second layer extending 900mm from the separating element. The tested duct will likely achieve a minimum of 60 minutes insulation criteria with a second layer of wrap extending 1780mm from the separating element and a third layer of wrap extending 860mm from the separating element. The tested duct will likely achieve a minimum of 120 minutes insulation criteria with a second layer of wrap extending 2040mm from the separating element and a third layer of wrap extending 1660mm from the separating element - provided the following criteria are met:

- The penetrated separating element shall have an FRL equal to or greater than that of the duct system
- The duct size shall be limited to a maximum CSA of 1800000mm<sup>2</sup>
- All wrap joints must overlap by a minimum of 100mm

## Duct Suspension

During tests PF24010-1 and PF24010-2, the duct systems were supported by M10 threaded rods and 40 x 40 x 2.4mm trapeze angles, in accordance with AS 4254.2. A pair of supports was fixed to the furnace enclosure above the ducts, spaced approximately 1500mm apart. At the conclusion of the test, the support systems remained in place and the structural adequacy and integrity of the duct were not compromised. This demonstrated the suspension system's ability to withstand 120 minutes of exposure to fire while supporting a 1000mm x 500mm rectangular duct and an 800mm diameter circular duct. AS4254.2 Appendix C includes trapeze load calculations for a given duct size. The bending stress of the trapeze member was calculated to be 6.5N/mm<sup>2</sup>. Neither AS1530.4 or AS4254.2 provide further guidance on the support system under fire conditions, therefore the field of application in EN 1366-1:2014 was considered. EN 1366-1:2014 states that as the test configuration does not allow an assessment of the load bearing capacity, the suspension devices shall be made and sized such that the calculated stresses do not exceed the values given below:

Type of Load	Maximum Stresses (N/mm <sup>2</sup> ) 60 < T ≤ 120 min
Tensile stress in all vertically orientated components	6
Shearing stress in screws of property class 4.6	10

The horizontal load bearing component of the suspension device shall be of the same profile as in the test. It shall be sized in such a way that the bending stress does not exceed that applied to the equivalent member in the test.

In the opinion of the laboratory the support system of the duct is likely to provide structural adequacy for up to 120 minutes provided the vertical components of the suspension system shall not exceed 6 N/mm<sup>2</sup>, shear stress in screws shall not exceed 10 N/mm<sup>2</sup>, and the bending stress of the trapeze member shall not exceed 6.5 N/mm<sup>2</sup>

## Maximum Duct Dimensions

AS 1530.4 states that test results obtained for the largest air duct in the range may be applied to all air ducts of the same type (including any aspect ratio), provided the maximum dimensions do not exceed those tested and that the components remain in the same orientation as that tested. This would allow for a duct size up to 1800mm x 1800mm, however due to the unpredictable nature of fire resistance tests and lack of evidence to support an increase of this size, the more conservative field of direct application highlighted in EN 1366-1:2014 was considered.

EN 1366-1:2014 describes standard sizes in a standard configuration for ducts to be tested, in which the field of direct application may be applied to. Standard configuration "Duct B" describes either a 1000mm wide, 250mm high rectangular duct or a 630mm diameter circular duct which is exposed to fire internally through two openings on each side of the duct, measuring a total area of 50% of the internal cross section of the duct. Although differences between standards are evident, the internal fire exposure highlighted in AS1530.4 is considered to be more onerous than that of EN1366-1, and therefore the field of application is likely to be applicable to ducts tested in accordance with AS1530.4.

The field of applications allows a test result obtained for the standard sizes of duct A and duct B is applicable up to the maximum nominal internal sizes given below.

	Rectangular Width mm	Rectangular Height mm	Circular Diameter mm
Duct Size	1250	1000	1000

For ducts tested at a size other than those specified above, no extrapolation to larger sizes allowed, however smaller sizes are covered. For ducts larger than the allowable upper limits for extrapolation, no extrapolation to larger sizes is allowed.

In tests PF23082 and PF24048, an 1800 x 400mm rectangular duct was tested, and demonstrated the ability to maintain structural adequacy and integrity for up to 120 minutes. As the width of the duct is larger than the allowable upper limits for extrapolation it shall not be increased. The height however is smaller than the maximum height specified above.

In tests PF23110, a 800mm diameter circular duct was tested, and demonstrated the ability to maintain structural adequacy and integrity for up to 120 minutes. The diameter is smaller than the maximum diameter specified above.

Therefore, in the opinion of the laboratory, an increase of duct dimensions of up to 1800mm x 1000mm for rectangular ducts and up to 1000mm diameter for circular ducts is not likely to negatively influence the performance of the duct for up to 120 minutes.



In the opinion of the laboratory, the performance of the duct may be applied to all air ducts of the same type (including any aspect ratio), provided the area of the duct does not exceed the limits described above and that the components remain in the same orientation as that tested. Therefore, rectangular duct sizes, limited by a maximum cross-sectional area of 1800000mm<sup>2</sup> have been positively assessed. Ducts with dimensions within the plotted area of Figure 4 above, provided the duct has been constructed in accordance with AS4254.2 Pressure class 500 or higher. Similarly, circular ducts, limited by a maximum diameter of 1000mm have been positively assessed, provided the duct has been constructed in accordance with AS4254.2 Pressure class 500 or higher.

In test PF24010-1, a rectangular duct measuring 1000 x 500mm was installed using penetration detail A in a concrete separating element and was tested for 120 minutes, protected by 2 layers of wrap. During the test, there was no evidence of structural adequacy, integrity or insulation failure. The maximum temperature recorded within the duct was recorded to be 152°C, and the temperatures on the unexposed side of the test were significantly lower than the same duct tested in an internal fire environment. For this reason, the internal fire conditions are considered more onerous. In the opinion of the laboratory, if the duct size was increased to a maximum CSA of 1800000mm, it is likely that the performance of the duct would not be negatively influenced and would achieve an FRL of 120/120/120, provided the following conditions are met:

- An airflow of 1m/s shall be maintained
- Penetration Detail A shall be used
- 2 layers of wrap shall protect the external fire section of the duct
- If an internal fire section exists, it shall be protected in accordance with the tables above.
- The duct shall be constructed in accordance with AS4254.2
- The support system shall be in accordance with the maximum allowable stresses listed above.

In test PF24010-2, a circular duct measuring 800mm diameter was installed using penetration detail C in a concrete separating element and was tested for 120 minutes, protected by 2 layers of wrap. During the test, there was no evidence of structural adequacy or integrity failure. Insulation failure inside the duct occurred at 93 minutes, however the temperatures on the unexposed side of the test were significantly lower than the same duct tested in an internal fire environment. For this reason, the internal fire conditions are considered more onerous. In the opinion of the laboratory, if the duct size was increased to a diameter of 1000mm, it is likely that the performance of the duct would not be negatively influenced and would achieve an FRL of 120/120/90, provided the following conditions are met:

- An airflow of 1m/s shall be maintained
- Penetration Detail C shall be used
- 2 layers of wrap shall protect the external fire section of the duct

- If an internal fire section exists, it shall be protected in accordance with the tables above.
- The duct shall be constructed in accordance with AS4254.2
- The support system shall be in accordance with the maximum allowable stresses listed above.

### **Wrap fixings, overlap and joint treatment**

In the fire resistance tests PF23004, PF23082, PF23083, PF23095, PF23110 and PF23111 the ducts were tested using various methods of wrap fixings, overlaps and joints.

Throughout the range of tests, different wrap joining methods were used between layers of wraps. It was observed that regardless of the type of joint (except for butt joint with no overlap), the joint did not influence the structural adequacy, integrity or insulation. Therefore, it was confirmed that the joints with at least 100mm overlap will not negatively influence the overall performance of the duct wrap protection and are likely to achieve at least the performance stated in this assessment. The allowable wrap overlaps are detailed in section 4.4.1

Throughout the range of tests, different joint tapes were applied to the cut ends of the wrap and applied between wrap joints. It was observed that regardless of the type of tape, the joint tape did not influence the structural adequacy or integrity of the system. The joint tape did however significantly influence the insulation performance of the systems. In test 23083, reinforced aluminium tape was used for all joints, overlaps and cut ends. It was observed that the tape became detached from the wrap prior to insulation failure of the wrap, likely due to the reinforcing fibres within the tape contracting. Due to this, different joint tapes used in the test were grouped into three classes:

- Class 1: Minimum 50µm thick Aluminium tape with minimum 120°C heat-resistant adhesive. No reinforced aluminium tape is allowed.
- Class 2: Minimum 50µm thick Aluminium tape with minimum 60°C heat-resistant adhesive. No reinforced aluminium tape is allowed.
- Class 3: No tape or any reinforced aluminium tape

It was observed that 30 minutes insulation can be achieved using class 1 or 2 solid aluminium foil tape for the treatment of cut edges and any foil tape (class 1, 2 or 3) may be used for wrap joints.

It was observed that 60 minutes insulation can be achieved using class 1 or 2 solid aluminium foil tape for the treatment of cut edges and wrap joints.

It was observed that 90- and 120-minute insulation can be achieved using class 1 solid aluminium foil tape for the treatment of cut edges and wrap joints.

In the fire resistance test PF23004 an 800x800mm horizontally orientated duct was tested. The wrap was secured to the duct using 12mm wide stainless-steel straps. The straps were located at 300mm centres and each overlap, 50mm from the ends of the wrap. At the conclusion of the test, there was no structural adequacy or integrity failure of the system. It was observed that there was minor sagging at the bottom of the wrap, but no dislocation of the wrap between layers at 120 minutes.

In fire resistance test PF23111 a 300mm diameter vertical circular duct was tested. The wrap was secured to the duct using 12mm wide stainless-steel straps. The straps were located at 300mm centres and each overlap, 50mm from the ends of the wrap. At the conclusion of the test, there was no structural adequacy or integrity failure of the system. There was no significant sagging or dislocation between wraps observed. In the opinion of the laboratory, if the 300mm diameter circular duct was tested in the horizontal orientation, the stainless-steel straps would likely achieve the same performance as the vertically orientated duct.

In fire resistance test PF23082 a 1800x400mm horizontally orientated duct was tested. The wrap was secured to the duct using 12mm wide stainless-steel straps, as well as glued stainless-steel pins. The straps were located at 300mm centres and each overlap, 50mm from the ends of the wrap. At the conclusion of the test, there was no structural adequacy or integrity failure of the system. It was observed that the pins had become detached from the duct at 5 minutes, and there was sagging at the bottom of the wrap, but no dislocation of the wrap between layers at 90 minutes. The use of the pins did not affect the performance of the system and may be omitted.

In the fire resistance tests PF23083, PF23095 and PF23110, the wrap was installed to the ducts using capacitive discharge welded pins. The pins were installed at 200mm centres around the width and length of the duct, 50mm from the ends of the wrap. A range of pin lengths were tested, depending on how many layers of wrap were in the required location. The wrap shall be compressed by the pin. If too long of a pin is used, the pins do not secure the wrap to the duct sufficiently near the corners. If too short of a pin is used, the wrap foil becomes damaged during the welding process. The minimum and maximum lengths for pins can be seen in the table below. The standard wrap thickness and pin lengths are advertised in inches and have been conservatively converted for the purpose of this assessment.

Thickness of Ductwrap used	Pin length (minimum)	Pin length (maximum)
1 x 38mm	25mm	34mm
2 x 38mm	63mm	72mm
3 x 38mm	95mm	110mm



At the conclusion of the test, there was no structural adequacy or integrity failure of the system. There was no sagging or dislocation between wraps observed.

Based on the above discussion it is considered reasonable that the wrap protection will achieve a similar or better rating for internal fire protection if tested in accordance with AS1530.4-2014 and fixed using the following methods:

Horizontal orientation:

Up to 800 x 800mm - steel straps and/or welded pins

Up to 300mm diameter - steel straps and/or welded pins

Vertical orientation:

Up to 300 x 300mm - steel straps and/or welded pins

Up to 300mm diameter - steel straps and/or welded pins

For ducts exceeding the above dimensions, welded pins shall only be used

Where steel straps are to be used, the straps shall be minimum 12mm wide and 0.15mm thick. The steel straps shall be installed at 300mm centres, as well as 50mm from the ends of all layers of wrap.

Where welded pins are to be used, steel or copper-plated steel pins with a diameter of 2.5mm – 3.2mm shall be used. Different lengths of pins shall be used depending on the thickness of the wrap, in accordance with the table below. Pins shall be fixed at maximum 200mm centres along the width and length of the duct and shall be fixed 50mm from the ends of all layers of wrap.

### **Access hatch**

In the fire resistance test PF23004 an 800 x 800mm horizontally orientated duct was tested, which included a FIRESTOP Access hatch installed over a 600x450mm opening. During the test, no integrity or insulation failure was observed. The hatch demonstrated the ability to achieve an FRL of up to -/120/120 when located at a distance of 1800mm from the separating element and installed in accordance with Appendix B.

In the fire resistance test PF23004 an 800 x 800mm the vertically orientated duct was tested, which included a FIRESTOP Access hatch installed over a 600x450mm opening. During the test, no integrity or insulation failure was observed. The hatch demonstrated the ability to achieve an FRL of up to -/60/60 when located at a distance of 1075mm from the separating element and installed in accordance with Appendix B.

In the fire resistance test PF24048, an 1800 x 400mm vertically orientated duct was tested, which included a reduced size FIRESTOP Access hatch installed over a 440x320mm opening. During the test, no integrity or insulation failure was observed. The hatch demonstrated the ability to achieve an FRL of up to -/60/60 when located at a distance of 1330mm from the separating element and installed in accordance with Appendix B.



In the opinion of the laboratory, it is likely that the installation of access hatches to horizontally orientated ducts, located a minimum of 1800mm from the separating element will not negatively influence the performance of the system, and is likely to achieve an FRL of up to -/120/120. It is likely that the installation of access hatches to vertically orientated ducts, located a minimum of 1075mm from the separating element will not negatively influence the performance of the system, and is likely to achieve an FRL of up to -/60/60. It is likely that a reduction in aspect ratio of the access hatch will not negatively influence the performance of the hatch, provided the following criteria are met:

- The dimensions of the hatch shall not exceed 650mm x 450mm
- The width and length of the hatch may be reduced, but not the thickness of the hatch or part thereof
- Individual components shall not be removed or reduced in size
- The hatch flanges shall overlap and be fixed to on all edges around the cut-out
- The hatch shall be located not less than 100mm from any edge of the duct
- The fixing centres shall not be increased

## **2 and 3 Side Exposure**

During the range of tests, the ability of the duct protection to achieve an FRL of up to 120/120/120 was displayed. In some cases, the installation of the wrap protection on all 4 sides may not be possible due to clearances between the separating element and duct. For this reason, 2-side and 3-side exposure for rectangular ducts installed parallel to concrete separating elements were considered. In the opinion of the laboratory, the use of wrap protection 2 or 3 side exposure is not likely to negatively influence the performance of the system for both internal and external flaming conditions, provided the following conditions are met:

- Penetration detail A or B shall be used
- The wrap protection characteristics shall be consistent with requirements of Tables 5, 7, 9 or 11 coinciding with the desired FRL
- The spacing between the duct and separating element shall be no more than 100mm at any point
- The wrap shall be fixed to the concrete separating element with minimum 100mm overlap. The wrap shall be fixed using concrete anchors and washers (OD > 25mm) at 200mm centres



## Appendix B – Supporting Data

### Test PF23004

The test was conducted as per AS 1530.4-2014 Section 9 Air ducts – Internal fire and AS 1530.4-2014 Section 10 Service penetrations and control joints on 10/05/2023.

An 800mm x 800mm (W/H) air duct was installed, penetrating through a 90x45mm timber stud wall, with 2 x layers of FR plasterboard on each side. The supporting construction aperture was protected using a combination of acrylic sealant, ceramic fibre, steel brackets, and FR board. The duct was protected using 38mm thick FIRESTOP Duct Wrap-38, fixed using steel cable ties. The first layer of wrap was installed to the entire length of the duct. The second layer of wrap extended approximately 1100mm from the separating element protection. All joints were overlapped by minimum 100mm.

The duct included a FIRESTOP Access hatch installed over a 600x450mm opening, located 1800mm from the separating element. The hatch was fixed directly to the duct using rivets around the perimeter in the corresponding mounting holes, at 150mm centres. One layer of 38mm duct wrap was installed around the hatch butting into the hatch webbing. All joints on the first layer of wrap were butt joints. An additional layer of wrap was installed around the perimeter of the hatch, extending 100mm from all edges of the hatch.

The test was terminated at 127 minutes. No structural adequacy or integrity failure was observed during the test. The duct failed insulation criteria at 62 minutes on the 1st layer of wrap at 1400mm distance from the separating element. The thermocouples associated with the hatch did not reach failure criteria during the test.

The following temperature measurements were recorded for the determination of the effective thickness of protection:

Layers of wrap	From the wall, mm	Maximum temperature rise, deg C			
		30 min	60 min	90 min	120 min
1	1200	82	177	228	240
	1200	64	161	189	197
2	25	37	120	166	180
	25	17	69	170	178
	400	30	105	152	155
	400	16	66	129	133
	1900	59	119	141	157
	1900	59	132	150	149

## Test PF23082

The test was conducted as per AS 1530.4-2014 Section 9 Air ducts – Internal fire and AS 1530.4-2014 Section 10 Service penetrations and control joints on 10/05/2023.

An 1800mm x 400mm (W/H) duct was installed, penetrating through a 64mm steel stud wall, with 1 x layer of 13mm fire-rated plasterboard on each side. The supporting construction aperture was protected using a combination of intumescent sealant, steel brackets, FR board and acrylic sealant. The duct was protected using 38mm thick FIRESTOP Duct Wrap-38, fixed using steel cable ties and glued steel pins. One layer of wrap was installed to the entire length of the duct. All joints were overlapped by minimum 100mm. Additional thermocouples were installed on the overlaps, resulting in the measurement of 2 layers of wrap in some locations.

The test was terminated at 91 minutes. No structural adequacy or integrity failure was observed during the test. The duct failed insulation criteria at 33 minutes on the 1 layer of the wrap at a 1200mm distance from the separating element.

The following temperature measurements were recorded for the determination of the effective thickness of protection:

Layers of wrap	From the wall, mm	Maximum temperature rise, deg C			
		30 min	60 min	90 min	120 min
1	100	92	215	302	N/A
	500	134	238	270	N/A
	1200	79	185	209	N/A
	1400	69	172	195	N/A
	1800	40	110	131	N/A
2	600	42	101	143	N/A
	1300	7	50	79	N/A

## Test PF23083

The test was conducted as per AS 1530.4-2014 Section 9 Air ducts – Internal fire and AS 1530.4-2014 Section 10 Service penetrations and control joints on 24/11/2023.

A 1000mm x 500mm (W/H) air duct was installed, penetrating through a 64mm steel stud wall, with 1 x layer of FR plasterboard on each side and around the aperture. The supporting construction aperture was protected using a combination of steel brackets, ceramic fibre, FR board and acrylic sealant. The duct was protected using 38mm thick FIRESTOP Duct Wrap-38, fixed using welded steel pins. A reinforced aluminium foil tape was used to seal all exposed ends of the duct wrap, as well as all overlaps and joints. The first layer of wrap was installed to the entire length of the duct. The second layer of wrap extended approximately 600mm from the separating element protection. The first joint of the first layer was a butt joint and remaining joints were overlapped by minimum 100mm.

The test was terminated at 124 minutes. No structural adequacy or integrity failure was observed during the test. The duct failed insulation criteria at 33 minutes on the 1 layer of the wrap at a 600mm distance from the separating element at the location of the transverse joint of the wrap. It was observed that the reinforced aluminium tape became detached prior to insulation failure, and smoke was coming from multiple overlaps and joints.

The following temperature measurements were recorded for the determination of the effective thickness of protection:

Layers of wrap	From the wall, mm	Maximum temperature rise, deg C			
		30 min	60 min	90 min*	120 min*
1	700	117	332	346	362
	1000	97	247	276	289
	1600	111	200	220	242
	1900	29	166	213	235
2	100	50	142	204	236
	400	39	163	187	203
	1500	38	106	125	135

\* - The duct was tested in the separating element having FRL -/60/60, therefore the FRL of the duct was reduced to 60/60/30.

## Test PF23095

The test was conducted as per AS 1530.4-2014 Section 9 Air ducts – Internal fire and AS 1530.4-2014 Section 10 Service penetrations and control joints on 01/12/2023.

An 800mm x 800mm (W/H) air duct was installed vertically, penetrating through a timber joists floor, with 1 x 16mm FR Plasterboard on the exposed face, 1 x 19mm Structural Chipboard on the unexposed face and 13mm FR Plasterboard was installed around the aperture. The supporting construction aperture was protected using a combination of steel brackets, ceramic fibre, FR board and acrylic sealant. The duct was protected using 38mm thick FIRESTOP Duct Wrap-38, fixed using welded steel pins. The first layer of wrap was installed to the entire length of the duct. The second layer of wrap extended approximately 600mm from the separating element protection. All joints were overlapped by minimum 100mm – To confirm an additional layer of wrap was butt-joined to the second layer on one side, extending the second layer of wrap.

The duct included a FIRESTOP Access hatch installed over a 600x450mm opening, located 1075mm from the separating element. The hatch was fixed directly to the duct using rivets around the perimeter in the corresponding mounting holes, at 150mm centres. One layer of 38mm duct wrap was installed around the hatch butting into the hatch webbing. All joints on the first layer of wrap were butt joints. An additional layer of wrap was installed around the perimeter of the hatch, extending 100mm from all edges of the hatch.

The test was terminated at 66 minutes. No structural adequacy or integrity failure was observed during the test. The duct failed insulation criteria at 21 minutes on the 1 layer of the wrap at 1200mm distance from the separating element at the location of the transverse joint of the wrap. The thermocouples associated with the hatch did not reach failure criteria during the test.

The following temperature measurements were recorded for the determination of the effective thickness of protection:

Layers of wrap	From the floor, mm	Maximum temperature rise, deg C			
		30 min	60 min	90 min	120 min
1	1000	150	241	N/A	N/A
	1400	156	242	N/A	N/A
	1900	126	175	N/A	N/A
	1900	87	138	N/A	N/A
2	100	61	165	N/A	N/A
	400	32	119	N/A	N/A
	700	19	107	N/A	N/A
	1600	17	78	N/A	N/A



## Test PF23110

The test was conducted as per AS 1530.4-2014 Section 9 Air ducts – Internal fire and AS 1530.4-2014 Section 10 Service penetrations and control joints on 19/12/2023.

An 800mm diameter circular air duct was installed, penetrating through a 76mm steel stud wall with 1 x layer of FR plasterboard on each side. The supporting construction aperture was protected using a combination of steel collars, FR board and acrylic sealant. The duct was protected using 38mm thick FIRESTOP Duct Wrap-38, fixed using foil tape and welded steel pins. The first layer of wrap was installed to the entire length of the duct. An additional layer of wrap was installed on the left side of the duct, along the entire length of the duct. All joints were overlapped by minimum 100mm

The test was terminated at 125 minutes. No structural adequacy or integrity failure was observed during the test. The duct failed insulation criteria at 31 minutes on the 1 layer of the wrap at 400mm distance from the separating element.

The following temperature measurements were recorded for the determination of the effective thickness of protection

Layers of wrap	From the board, mm	Maximum temperature rise, deg C			
		30 min	60 min	90 min	120 min
1	25	176	364	331	373
	400	176	300	304	313
	850	110	214	233	254
	1100	131	228	244	253
	1750	112	186	203	215
	1900	87	174	208	226
	2500	90	163	194	209
	3400	142	176	189	201
	4300	81	147	169	184
	4550	30	104	133	145
2	50	41	109	121*	132*
	400	37	78	108*	110*
	800	18	94	105*	115*
	1700	28	125	166	167
	3150	11	71	108	118
	4200	7	46	82	93
	4550	4	26	57	71



\* - Temperature recorded using roving thermocouple applied for 90 seconds

## Test PF23111

The test was conducted as per AS 1530.4-2014 Section 9 Air ducts – Internal fire and AS 1530.4-2014 Section 10 Service penetrations and control joints on 22/12/2023.

A 300mm diameter circular air duct was installed vertically, penetrating through a composite concrete slab with profiled decking - 60mm trapezoidal profile and 60mm thick topping. The slab aperture was protected using a combination of slotted steel angle brackets, ceramic fibre, FR board, duct wrap and acrylic sealant. The duct was protected using 25mm thick FIRESTOP Duct Wrap-25, fixed using steel cable ties. The first layer of wrap was installed to the entire length of the duct. An additional layer of 300mm wide wrap was installed on the left side of the duct, extending 1200mm from the board. All joints were overlapped by minimum 100mm

The test was terminated at 123 minutes. No structural adequacy or integrity failure was observed during the test. The duct failed insulation criteria at 22 minutes on the 1 layer of the wrap at 400mm distance from the separating element.

The following temperature measurements were recorded for the determination of the effective thickness of protection:

Layers of wrap	From the board, mm	Maximum temperature rise, deg C			
		30 min	60 min	90 min	120 min
1	25	135	284	334	351
	400	227	308	337	361
	550	166	233	247	259
	1050	122	190	206	213
	1650	98	159	191	205
	1900	104	172	192	202
2	50	109	210	242	268
	400	93	191	216	235
	650	68	173	193	211
	925	61	153	175	189

## Test PF24048

The test was conducted as per AS 1530.4-2014 Section 9 Air ducts – Internal fire and AS 1530.4-2014 Section 10 Service penetrations and control joints on 10/04/2023.

An 1800 x 400mm rectangular air duct was installed vertically, penetrating through a 150mm reinforced concrete slab. The slab aperture was protected using a combination of steel angle brackets, ceramic fibre, FR board, duct wrap, FR Coating and acrylic sealant. The duct was protected using 38mm thick FIRESTOP Duct Wrap-38, fixed using foil tape and welded steel pins. The first layer of wrap was installed to the entire length of the duct. An additional layer of wrap measuring 1000mm in width was installed along the entire length of the duct on one of the faces, aligned with the edge of the duct to gather data for 2 layers of wrap. An additional layer of wrap measuring 200mm in width, and 1000mm in length was installed on top of the second layer, aligned with the edge of the duct to gather data for 3 layers of wrap. All joints were overlapped by minimum 100mm

The duct included a FIRESTOP Access hatch installed over a 440x320mm opening, located approximately 1330mm from the separating element. The hatch was fixed directly to the duct using rivets around the perimeter in the corresponding mounting holes, at 150mm centres. One layer of 38mm duct wrap was installed around the hatch butting into the hatch webbing. All joints on the first layer of wrap were butt joints. An additional layer of wrap was installed around the perimeter of the hatch, extending 200mm from all edges of the hatch.

The test was terminated at 126 minutes. No structural adequacy or integrity failure was observed during the test. The duct failed insulation criteria at 24 minutes on the first layer of the wrap at 400mm distance from the separating element.

The following temperature measurements were recorded for the determination of the effective thickness of protection:

Layers of wrap	From the floor, mm	Maximum temperature rise, deg C			
		30 min	60 min	90 min	120 min
1	25	157	265	320	356
	400	245	281	318	344
	660	252	316	334	367
	860	239	313	346	374
	980	89	175	200	218
	1200	176	246	285	300
	1440	165	235	249	259
	1660	171	231	272	289



	1780	68	157	175	181
	2040	112	167	190	206
2	25	35	101	147	193
	400	37	184	228	259
	660	31	163	202	231
	860	47	190	236	273
	980	22	120	164	186
	1200	48	165	202	230
	1440	49	175	211	237
	1660	33	128	154	168
	1780	22	122	162	176
	2040	25	84	110	123
3	25	12	61	97	128
	400	7	76	133	154
	860	7	81	148	174



## Test PF24010-1

The test was conducted as per AS 1530.4-2014 Section 9 Air ducts – External fire and AS 1530.4-2014 Section 10 Service penetrations and control joints on 16/02/2024.

A rectangular 1000mm x 500mm (W/H) air duct, comprising of a 2100mm horizontal section, two 90-degree angles and two 1800mm vertical sections. The vertical sections penetrated through two corresponding apertures in a 150mm reinforced concrete slab. The slab apertures were protected using a combination of steel angle brackets, ceramic fibre, FR board and acrylic sealant. The duct was protected using 38mm thick FIRESTOP Duct Wrap-38, fixed using welded steel pins. Two layers of wrap were installed on the exposed side of the duct, with all joints overlapping by minimum 100mm.

The test was terminated at 124 minutes. No structural adequacy, integrity failure or insulation failure was observed during the test.

The following temperature measurements were recorded for the determination of the effective thickness of protection:

Location	Maximum temperature rise, deg C			
	30 min	60 min	90 min	120 min
Thermocouple inside the duct, attached to the surface of the duct in the furnace	37	86	121	152
External thermocouples at seal and wrap (non-fire side)	1	7	32	101

## Test PF24010-2

The test was conducted as per AS 1530.4-2014 Section 9 Air ducts – External fire and AS 1530.4-2014 Section 10 Service penetrations and control joints on 16/02/2024.

A circular 800mm air duct which included horizontal and vertical sections and two 90-degree angles. The vertical sections penetrated through two corresponding square apertures in a 150mm reinforced concrete slab. The slab apertures were protected using a combination of slotted steel angle collars, FR board and acrylic sealant. The duct was protected using 38mm thick FIRESTOP Duct Wrap-38, fixed using welded steel pins. Two layers of wrap were installed on the exposed side of the duct, with all joints overlapping by minimum 100mm.

The test was terminated at 124 minutes. No structural adequacy or integrity failure was observed during the test. Insulation failure occurred at 93 minutes, located inside the duct, within the furnace.

The following temperature measurements were recorded for the determination of the effective thickness of protection:

Location	Maximum temperature rise, deg C			
	30 min	60 min	90 min	120 min
Thermocouple inside the duct, attached to the surface of the duct in the furnace	37	140	174	298
External thermocouples at seal and wrap (non-fire side)	1	12	31	41