Promat

Ventilation &
smoke extraction

PROMINA® 60

Fire resistant cladding ducts

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Introduction

The relative complexity of any ductwork system passing through different fire compartments and the relevance of the system's function in ambient as well as fire conditions can make the selection of a suitable ductwork system difficult.

This chapter aims to give some guidance on the fire performance requirements of ductwork and offers a wide range of solutions for the protection of steel ductwork using PROMINA® 60.

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Fire resistant test standards

To determine the fire resistance of ducts (without the aid of fire dampers) passing through or between compartments, the system should normally be tested or assessed in accordance with BS 476: Part 24.

These standards have been written specifically for ventilation ducts, but guidance is also given in these standards or the performance requirements for “smoke outlet” and “kitchen extract” ducts.

As part of a standard fire test according to BS 476: Parts 20 & 24, duct systems are exposed to external fire (also known as Duct Type A) and one sample to both external and internal fire (also known as Duct Type B). Fans attached create a standard pressure difference and air flow and the duct’s fire performance is assessed in both fan-on and fan-off situations. When testing in BS for a horizontal ducts, a run of at least 3000mm is located within the fire compartment and a further 2500mm outside the fire compartment.

BS 476: Part 24 expresses the fire resistance of ducts without the aid of dampers, in terms of stability, integrity and insulation.

Stability failure occurs when the suspension or fixing devices can no longer retain a duct in its intended position or when sections of the duct collapse. This requirement does not apply to the length of the duct exposed to internal fire (Duct Type B) within the fire compartment.

It should be noted that if a duct suffers extensive deformation, such that it can no longer fulfil its intended purpose, this would be classified as stability failure. For Duct Type A, loss of pressure within the duct during testing is also construed as stability failure.

Integrity failure also occurs when cracks, holes or openings occur in the duct or at any penetrations within walls or floors, through which flames or hot gases can pass. The effects on integrity of the movement and distortion of both restrained and unrestrained ducts are also included in the standard.

Insulation failure occurs when the temperature rise on the outer surface of the duct outside the fire compartment exceeds 140°C (mean) or 180°C (maximum). The guidance in the standard also states that ducts lined with combustible materials or coated internally with fats or greases, e.g. kitchen extracts, should also have this criterion for the inner surface of the duct within the fire compartment when the duct is exposed to external fire (Duct Type A).

For smoke extraction, the guidance in the standard states that the cross sectional area of a duct required to extract smoke in the event of a fire should not be reduced by more than 25% for the duration of the fire exposure. All PROMINA® 60 fire resistant ducts meet this requirement up to 120 minutes performance.

Fire test for Duct Type A and Type B

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Design considerations

The following points are some of the factors which should be considered when determining the correct specification to ensure a ductwork system will provide the required fire performance.

Required fire exposure

Ductwork systems which are located in more than one compartment should always be tested or assessed for their performance when exposed to the heating conditions described within BS 476: Part 20: 1987. Reduced heating curves are generally only acceptable for certain of the systems components, e.g. fans.

The performance of a ductwork system will vary depending on whether or not a fire could have direct access to inside the duct through an unprotected opening. If in doubt, one should assume direct access, i.e. the prescribed Duct Type B scenario. The construction of all PROMINA® 60 fire resistant ducts detailed in this document fulfil both Duct Type A and B requirements.

Required fire performance

It is a general requirement that the ducts must satisfy all the relevant performance criteria of stability, integrity and insulation (and cross sectional area if a smoke extraction duct). However, the approval authority may accept exceptions on occasion. For example, if no combustible materials or personnel are likely to be in contact with the duct, the authority may accept a reduced insulation performance.

Supporting structure

Care should be taken that any structural element from which the duct system is supported, e.g. a beam, floor or wall, must have as a minimum the same fire resistance as the duct system itself and must be able to support the load of the duct under fire conditions.

Hanger support

The supporting steel hanger rods, channels and fixings should be appropriate for the load of the complete ductwork system including any applied insulation material or other services suspended from it.

For example, the length of the hanger support system should not exceed 2500mm unless appropriate insulation is provided to reduce the effect of thermal expansion. If the hanger supports are longer than 2500mm and unprotected, there is a likelihood that excessive expansion of the support system could place undue strain on the duct and lead to premature failure of the smoke extraction and ventilation system.

Steel ductwork

The steel duct must be constructed in accordance with the requirements of DW/144, "Specification for sheet metal ductwork: Low, medium and high pressure/velocity air systems (published by the Heating & Ventilating Contractors' Association UK)" or equivalent specification, e.g. SMACNA. The steel ducts must be constructed with rolled steel angle-flanged cross joints. It is recommended that longitudinal seams be formed using the Pittsburgh lock system.

Penetrations through walls and floors

Care should be taken to ensure that movement of the duct in ambient or in fire conditions does not adversely affect the performance of the wall, partition or floor, or any penetration seal. It should be understood that where a duct passes through any compartment wall or floor or other type of separating element, the aperture between the element and the duct must be sealed in accordance with the system approved for use with the specific duct system. In general this requires the use of a penetration seal constructed from materials and in such a manner to match the system used in the duct test programme. Penetrations seals are part of the tested duct system and the use of untested third party products or systems are not permitted.

Movement joints

Movement joint details may be required for long lengths of duct, particularly where the duct spans across a movement joint in the floor or wall, or passes through floors and roof that may deflect at different rates. Please consult Promat for details of such joints.

Air flow and leakage

The design of some fire resisting duct systems may need modification to mee DW/144 or equivalent specification, e.g. SMACNA performance standards. All duct systems will meet the requirements of DW/144 to the highest levels, provided the correct board thickness is employed and all joints are correctly sealed in accordance with the system recommendations.

Ductwork functions

Most ductwork systems can fall into one or more of the following categories:

- → Ventilation and air conditioning
- → Natural smoke extract
- → Fan assisted smoke extract
- → Pressurisation of escape routes and fire fighting lobbies

In the event of fire, the function of a system can often change. For example, an air conditioning system could switch to become a fan assisted smoke extract duct. It is therefore essential that the performance requirements in both normal conditions and fire conditions are considered.

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Selection of fire protection system

Traditionally all ductworks are fabricated from steel which normally had to be encased in a fire protection system when passing through a compartment wall or floor without the aid of a fire damper.

The stress allowance of the steel hanger rods for a 120 minute fire resistant duct should not exceed 10N/mm² and the centres of the hanger supports should not exceed 2440mm. These figures are based on work carried out by Warrington Fire Research Centre (now Exova Warrington) in the UK and European research projects into the stress and strains of steel members under simulated fire conditions.

It should be noted that the stress levels referred to above apply to the threaded rod hanger supports themselves. The horizontal members have a differing level of applicable stress. The maximum centres refer to the greatest allowable distance between hanger support systems. However it should be noted that in certain locations, bends for instance, additional supports at lesser centres should be considered.

Stress calculation for hangers

To calculate the stress in N/mm² on each hanger, the total weight of the ductwork and fire protection materials being taken by each hanger should be calculated in kilograms, converted to Newtons (N) by multiplying 9.81 and then divided by the cross-sectional area of the hanger in mm². The cross-sectional area of a circular hanger is p x r² where r is the radius of the support rod. It should be noted that the root diameter of the core of the threaded rod should be applied in this calculation, not the outer diameter of the threaded part of the rod.

The method to calculate whether the diameter of the threaded rod is within the permitted stress level is given below.

Nominal outer diameter	Root diameter	Cross sectional area
6mm	5.06mm	20.10mm²
8mm	6.83mm	36.63mm²
10mm	8.60mm	58.08mm²
12mm	10.36mm	84.29mm²
14mm	12.25mm	117.85mm²
16mm	14.14mm	157.03mm²
18mm	15.90mm	198.55mm²
20mm	17.67mm	245.20mm²

The density of steel is approximately 7850kg/m³, therefore the weight of steel (kg) = 7850kg/m³ x Surface area (m²) x Steel thickness (m).

The following example of calculating the stress of the support system is based on the use of PROMINA® 60 boards.

Board thickness = 12mm

Duct height = 1.0m

Duct width = 1.0m

Section length = 1.22m

Area of boards = (Width x 2) + (Height x 2) x Section length

Weight of boards = Area x Thickness x Density (975kg/m³)

Weight of angles = (Centres of hangers x 4) + (Width x 4) + (Height x 4) x 0.63kg/m

Section weight = 68.62kg inclusive of angles

Weight on one hanger = 34.31kg

Total force = 336.58N (weight, kg x 9.81 = N)

Diameter of steel rod = 8mm

Cross section area = 36.63mm²

$$\text{Stress} = \frac{F \text{ where } F = \text{force in Newtons}}{A \text{ where } A = \text{area of rod cross section}}$$

= 9.19N/mm²

Since the stress is less than 10N/mm² (as set in the table here), an 8mm diameter rod is the minimum permissible for the duct of cross section 1000mm x 1000mm x 1220mm length constructed with a single layer of 12mm PROMINA® 60 for up to 120/120/120 fire resistance. If cladding a steel duct, the weight of this has to be included within the total weight supported upon the hangers.

If these stress levels are exceeded then the size of the hanger members must be increased, or the centres of the hangers reduced or the hangers protected. The penetration of the hanger fixings into any concrete soffit should be a minimum depth of 40mm for up to 120 minutes of fire resistance.

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PROMINA® 60

Fire protective construction board

Product description

PROMINA® 60 is a non combustible matrix engineered mineral board reinforced with selected fibres and fillers. It does not contain formaldehyde.

PROMINA® 60 is beige in colour. The front face is smooth and is suitable for any forms of architectural/finishing treatment; the reverse face is sanded. The board can be left undecorated or easily finished with paints, wallpapers or tiles.

PROMINA® 60 is resistant to effects of moisture and will not physically deteriorate in a damp or humid environment. Whilst its performance characteristics are not degraded by moisture or aging, PROMINA® 60 is not designed for application in areas subject to continual damp or high temperatures.

Material properties	
General description	Calcium Silicate board made with Mineral Matrix Engineering technology
Surface condition & appearance	Beige colour Front face: smooth Back face: sanded
Nominal dry density (average)	Nominal 1000kg/m³
Moisture Content	Approx 8.0% (may change depending on ambient Relative Humidity)
Alkalinity	pH 9
Thickness tolerance	-0.5mm, +1mm (standard thickness of boards)
Dimension tolerance	±5mm (standard board dimensions)

Advantages

- → Resistant to the effects of moisture
- → Not physically deteriorate when used in damp or humid conditions
- → Performance characteristics are not degraded by age or moisture

Fire Resistant Applications

- → Partitions & External Walls
- → Ceilings & Floors
- → Ductwork
- → M&E Services Enclosures
- → Cavity & Smoke Barriers
- → Access Panels & Hatches
- → Fire Doors

Static Values (deflection f ≤ l/250, safety factor n ≥ 3)			
Modulus of Elasticity E	**Flexural Strength** F	**Tensile strength** T	**Compressive strength** ⊥
Longitudinal: 4599/mm² Transverse: 3817N/mm²	Longitudinal: 7.52N/mm² Transverse: 5.15N/mm²	Longitudinal: 5.99N/mm² Transverse: 5.17N/mm²	7.76 N/mm²

Reaction to Fire & Thermal Properties		
Combustibility	**Surface burning**	**Thermal conductivity**
A1 Classification: EN 13501-1 Non-combustible: BS 476: Part 4 AS 1530: Part 1	Class 1: BS 476: Part 7 Class 0: AS 1530: Part 3	0.136W/m°K

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PROMINA® 60

Fire protective construction board

Standard thickness	Standard dimension	Number of boards per pallet	Surface area per pallet	Weight of boards per m²	Weight per pallet
6mm	2440mm x 1220mm	90	267m²	Approx. 6kg	Approx. 1,730kg
9mm	2440mm x 1220mm	61	181m²	Approx. 9kg	Approx. 1,760kg
12mm	2440mm x 1220mm	46	137m²	Approx. 12kg	Approx. 1,775kg
15mm	2440mm x 1220mm	36	107.m²	Approx. 15kg	Approx. 1,733kg

All physical and mechanical values are averages based on standard production and tested according to internal procedures. The typical values are given for guidance. The figures can change dependent on the test methods used. If a particular value is of prime importance for a specification, please consult Promat Technical Department.

Manufacturing Certification

PROMINA® 60 is manufactured under a quality management system certified in accordance with ISO 9001:2015. The manufacturing site is also certified to meet the environmental standards of ISO 14001: 2015 and the occupational health & safety requirements of ISO 45001:2018.

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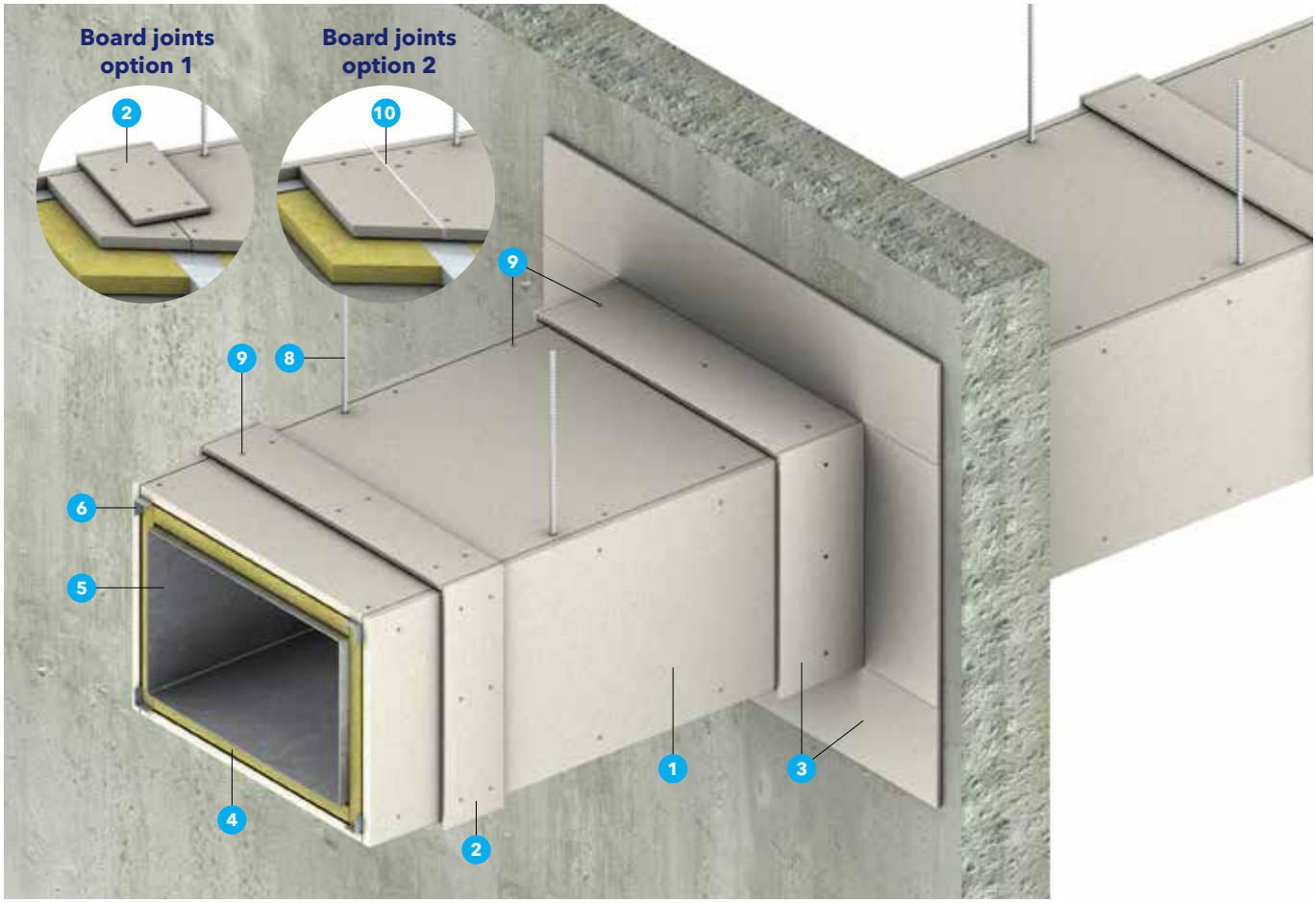
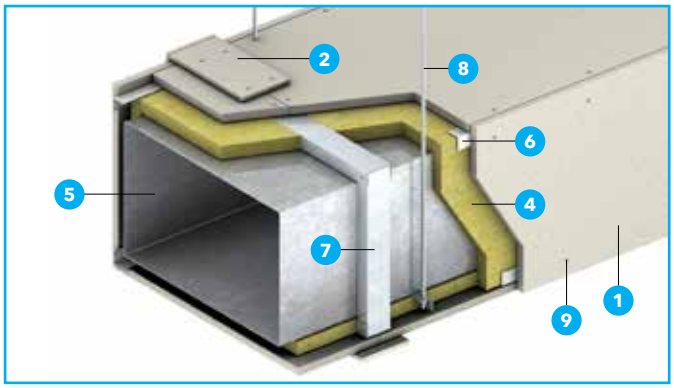
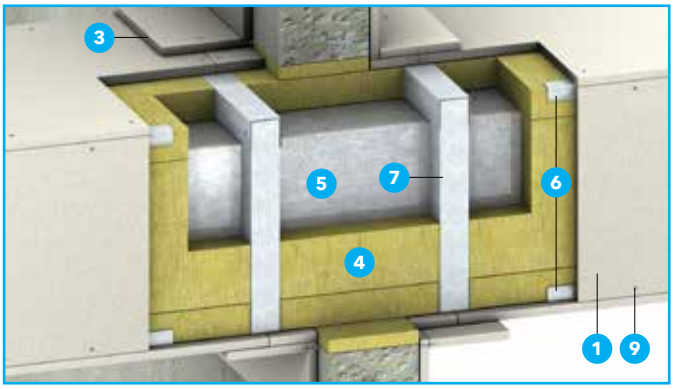
PROMINA® 60 120 minutes Fire Resistant Cladding Ducts

Up to 120/120/120 fire resistance in accordance with the requirements of BS 476: Part 24: 1987 and tested to duct types A and B.





Internal framing detail



Wall penetration detail

1. One layer of PROMINA® 60 12mm thick.
2. PROMINA® 60 cover strips 100mm wide x 9mm thick or PROMASEAL®-A Acrylic Sealant at all butt joints.
3. PROMINA® 60 collar 100mm width x 12mm thick fitted around the duct on both sides of the wall or floor forming an L shape.
4. Mineral wool slab 50mm x 100kg/m^3 density.
5. Sheet metal duct and suitable steel support bracket.
6. Galvanised steel angles 50mm x 50mm x 0.6mm thick.
7. Steel channel collar 50mm x 50mm x 0.6mm thick fill with rock wool and coincides with boards' butt joints.
8. Threaded steel rod hangers at nominal 1200mm intervals and permissible tensile stress not exceeding 10N/mm^2.
9. M4 self-tapping screws at nominal 200mm centres.
10. PROMASEAL®-A Acrylic Sealant or PROMINA® 60 cover strips 100mm wide x 9mm thick at all butt joints.

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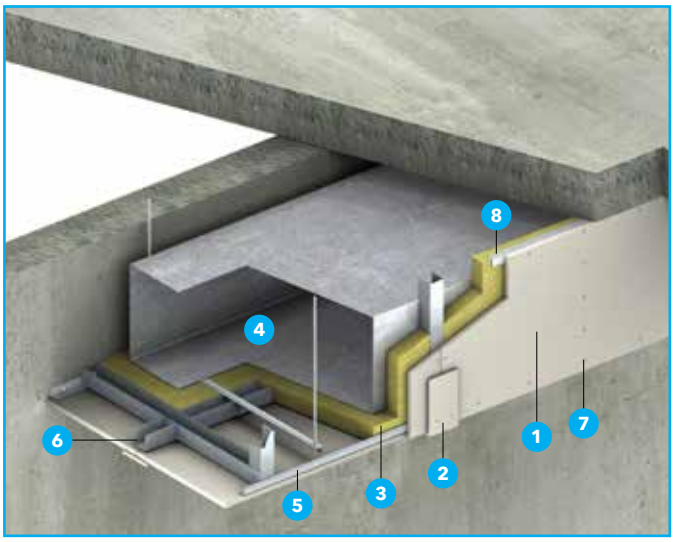
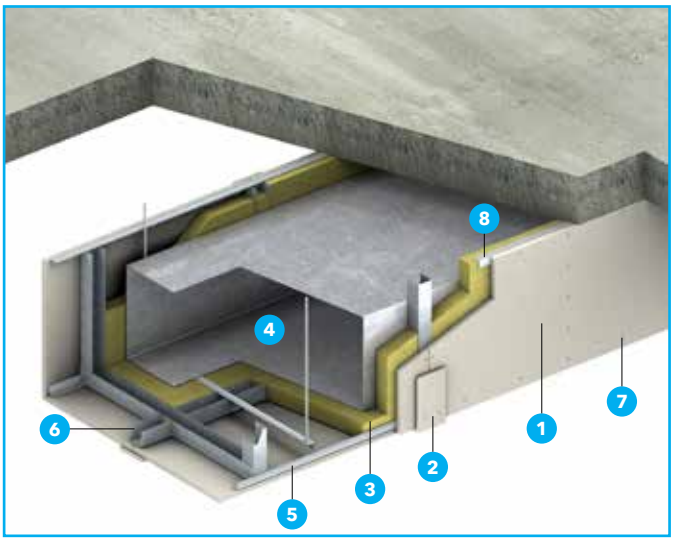
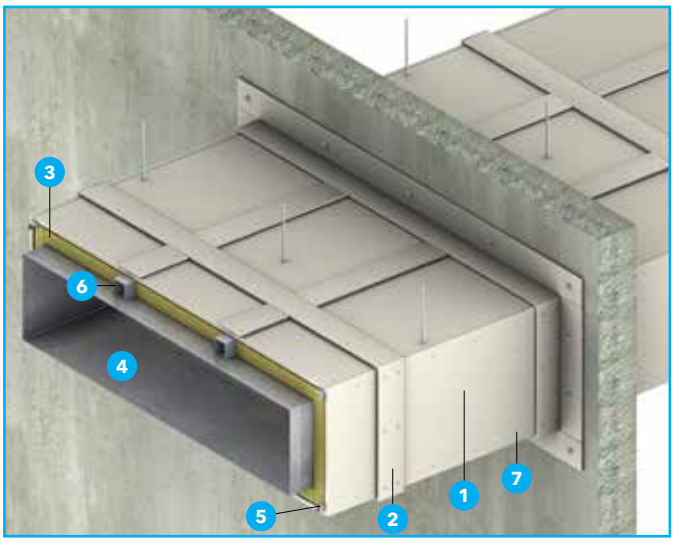
Other typical fixings of cladding to steel ducts



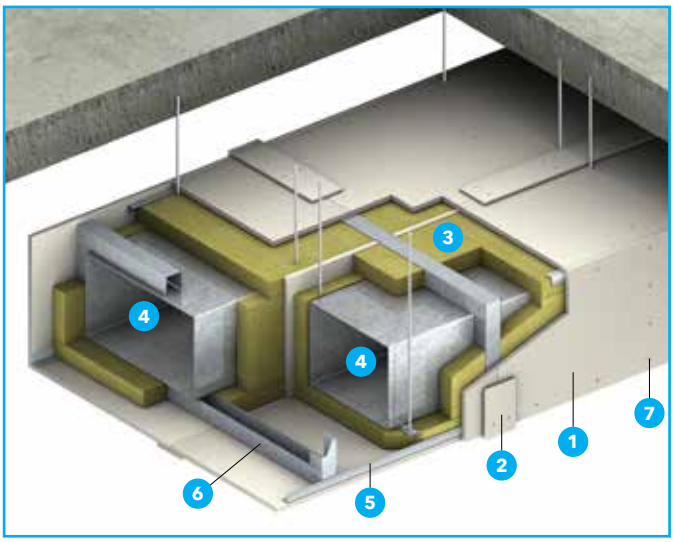
Two sided cladding to steel ducts



Three sided cladding to steel ducts



Internal duct size up to 10m



Multiple duct cladding

1. One layer of PROMINA® 60 12mm thick.
2. PROMINA® 60 cover strips 100mm wide x 9mm thick or PROMASEAL®-A Acrylic Sealant at all butt joints.
3. Mineral wool slab 50mm x 100kg/m^3 density.
4. Sheet metal duct and suitable steel support bracket.
5. Galvanised steel angles 50mm x 50mm x 0.6mm thick.
6. Steel channel collar 50mm x 50mm x 0.6mm thick fill with rock wool and coincides with boards' butt joints.
7. M4 self-tapping screws at nominal 200mm centres.
8. Continuous wall/floor steel angles 40mm x 40mm x 1.5mm thick.

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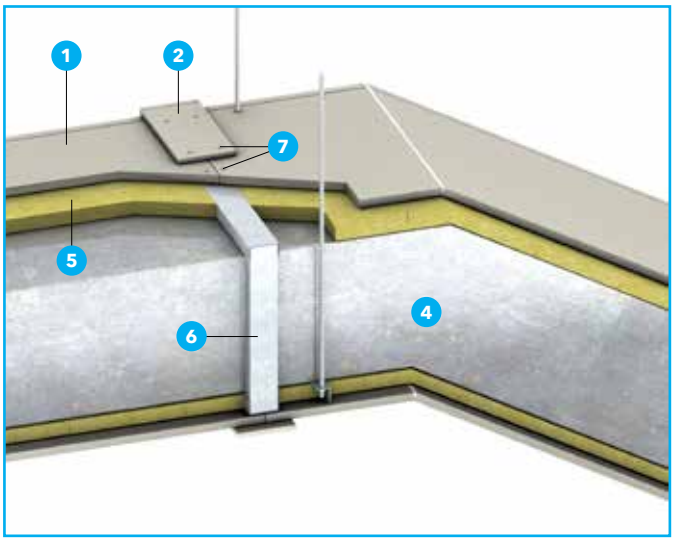
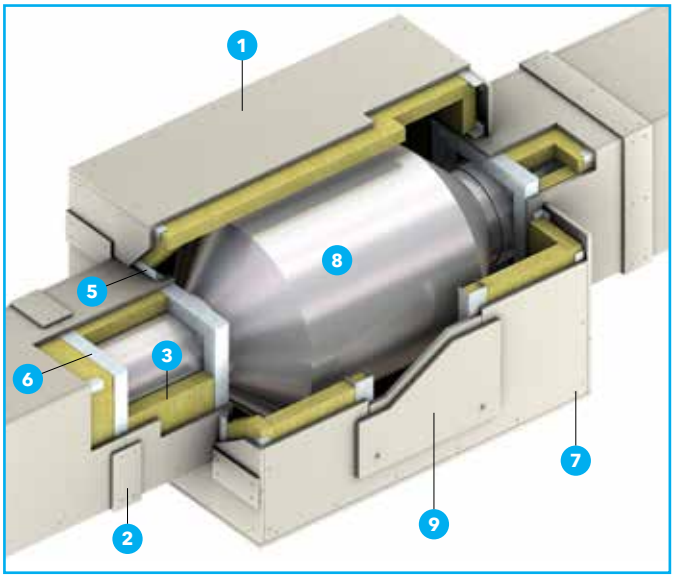
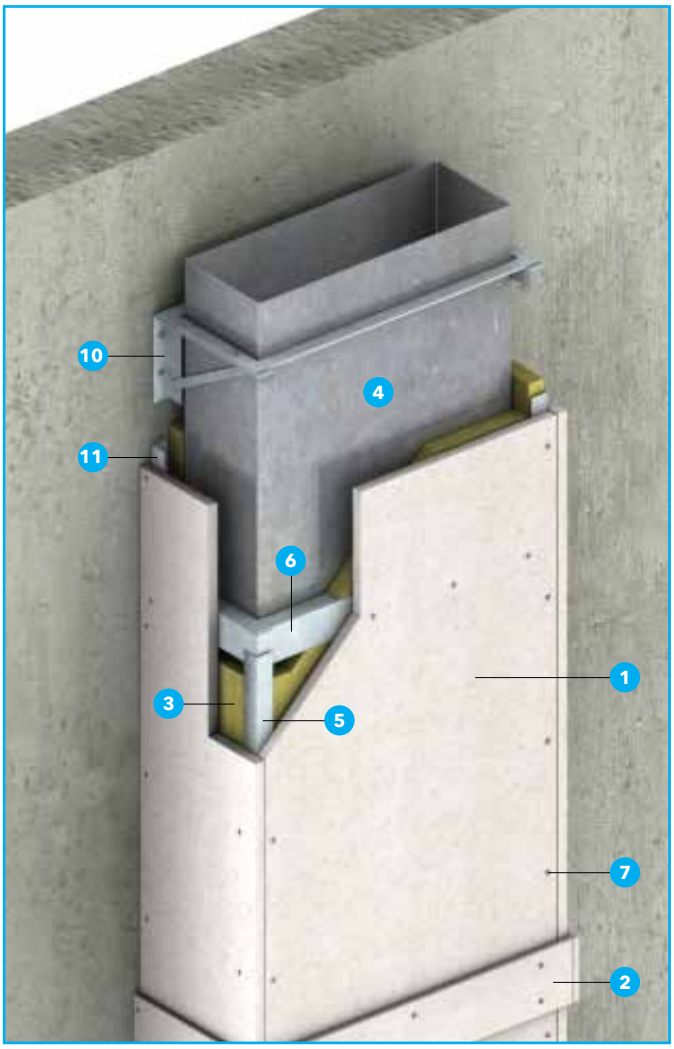
Other typical fixings of cladding to steel ducts



Duct inclining detail



Fan enclosure and access hatch



Typical vertical cladding to steel ducts

1. One layer of PROMINA® 60 12mm thick.
2. PROMINA® 60 cover strips 100mm wide x 9mm thick or PROMASEAL®-A Acrylic Sealant at all butt joints.
3. Mineral wool slab 50mm x 100kg/m^3 density.
4. Sheet metal duct and suitable steel support bracket.
5. Galvanised steel angles 50mm x 50mm x 0.6mm thick.
6. Steel channel collar 50mm x 50mm x 0.6mm thick fill with rock wool and coincides with boards' butt joints.
7. M4 self-tapping screws at nominal 200mm centres.
8. Bifurcation fan.
9. Access panel constructed with PROMINA® 60 board. Contact Promat for assistance.
10. Suitable steel support bracket.
11. Continuous wall/floor steel angles 40mm x 40mm x 1.5mm thick.

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- The technical data provided in this publication is based on mean values prevalent at time of publication and is thus subject to fluctuation. It should not be regarded as a guarantee to system performance.
- All data contained herein conforms to and frequently surpasses generally accepted fire protection standards recognised by most professional fire science practitioners and regulatory authorities worldwide. The same general principle is equally applicable to all Promat products and systems. Promat has access to a considerable body of test authentication data and this can be provided on a complimentary basis upon request. It should be noted however that this publication replaces all previous editions in its entirety.
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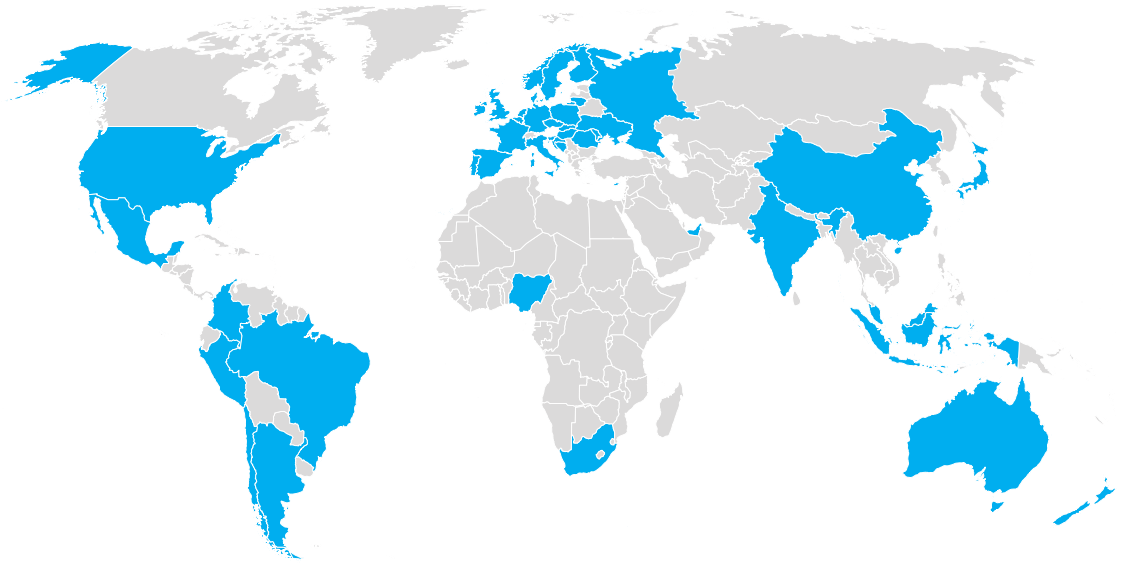

Etex is an international building materials specialist; the company wants to inspire people around the world to build living spaces that are ever more safe, sustainable, smart and beautiful. Founded since 1905 and headquartered in Brussels, Belgium, Etex currently operates in 101 production sites across 42 countries, employs more than 13,000 people and is one of the largest fibre cement producers in the world.

Through its subsidiaries, the group offers an extensive range of products: Plasterboard and passive fire protection systems, fibre cement solutions for cladding, façade and roofing as well as innovative modular systems.