








# Fire protection



LF range

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## Fire safety, an important ongoing issue

Fire causes hundreds of deaths (occupants and fire-fighters alike) and major material damage in industry every year.

New legislation has been passed to define appropriate construction regulations and insurers have imposed new coverage restrictions.

From start to finish, buildings must meet basic safety concepts:

- compartmentalisation
- detection and fire-fighting systems
- automatic extinguishing equipment
- prevention of hot spots.

The materials used must meet fire performance standards and be non-combustible whenever possible.

## New fire regulations

The behaviour of materials in the event of fire is usually qualified according to two different criteria:

reaction to fire performance and resistance to fire performance (see pp 18 to 20).

To harmonise the classification of reaction to fire performance for the free circulation of goods in the European Union, an international system based on fire test classification procedures, known as Euroclasses, has been set up to determine parameters such as combustibility, ignitability, toxicity of smoke and fumes and the formation of flaming droplets and debris (see pp 18 to 20).

To determine the real behaviour of buildings and thus protect the occupants and fire-fighters, various organisations have developed half-scale and full-scale tests (at the request of the insurance companies) to highlight sensitive points in buildings such as joins between walls and ceilings, fixings, etc. (see pp 18 to 20).

## HIGH-PERFORMANCE PANELS

Dagard has been present on the fire protection market for more than 10 years with its LP panel.

The new range of LF sandwich panels with their high density rock wool core and steel-to-steel tongue and groove interlock panel joints completes its "fire protection" offering. These high quality, high performance panels meet the latest safety and hygiene requirements.

Like the FP panels, the LF panels are non-combustible.

Two manufacturing processes are possible:

- continuous: an industrial process with a large production capacity. The panels are made and sold in the required lengths. The edges are straight.
- discontinuous gluing: used to manufacture panels for premises with special requirements in terms of fixings, finishings and the incorporation of accessories (Clean Rooms, catering kitchens, etc.)



The steel-faced panels are joined by overlapping interlock joints to prevent flames from directly attacking the insulating material in the event of a fire.

The groove is designed to reinforce the rigidity of the panel.

Assembly is very simple. The panels are automatically aligned after interlocking without being forced and the resulting partition is perfectly flat.

Different joint sealing and finishing solutions are available depending on the atmosphere in the room.



Rock wool is a natural, incombustible material which does not contribute to fire development and does not ignite. Its melting point is above 1000°C. It does not release toxic fumes.

It does not absorb water and its technical and performance characteristics remain stable in the course of time.

Its acoustic and thermal performance is excellent.

Since it contains neither gases nor organic components, it is environment-friendly.

It is not dangerous for human health. In accordance with European directive EC/97/69, rock wool used throughout the insulation and mineral wool manufacturing industries is classified non-carcinogenic.



LF panels have all the advantages of a sandwich panel over traditional construction. They are easy and quick to erect, adapt easily to the existing architecture and facilitate subsequent extensions and conversions.

They can be used indoors for walls and ceilings in workshops, laboratories, corridors, offices, etc. and outside as an insulating cladding

They are the perfect solution for high-risk areas in new buildings or new installations in existing premises.

Rounded reflex angles and flush finishings with invisible screws make them attractive, hygienic and easy to clean.



The 40 mm version (LF40) is used as a lining panel on walls and ceilings to upgrade run-down premises to new sanitary standards or to line walls, posts and pipework.

The 60, 80, 100, 120 and 160 mm panels are used to make heat-insulated walls or load-bearing ceilings in chillrooms.

Numerous accessories (hinged doors, sliding doors, flush doors, etc.) complete the LF panel range.

Different types of glazing can also be incorporated into the wall panels.



Fire doors can be made using FP panels. Assembly is by heat-insulated key and special gaskets and seals. Fire resistant doors and glazing complete the range.



## TECHNICAL FEATURES

Type	LF 40	LF 60	LF 80	LF 100	LF 120	LF 160
Thickness (mm)	40	60	80	100	120	160
Weight per m <sup>2</sup> (kg/m <sup>2</sup> )	18	21	23	26	29	33
Uniformity coefficient <b>Uc</b> (W/m.°C)	0,91	0,64	0,49	0,39	0,33	0,25

*Width :*

- 1160 mm

*Length :*

- on request in 1 cm increments

To facilitate transport and erection, the maximum length is usually 4 m for 40 mm thick panels and 8 m for the other thicknesses (possibility of greater lengths).

*Facings :*

En standard

- Pebble White (near RAL 9002) 25 micron **polyester** powder-coated on a 0.53 mm thick galvanised sheet steel, **slightly ribbed** (0.6 mm depth))

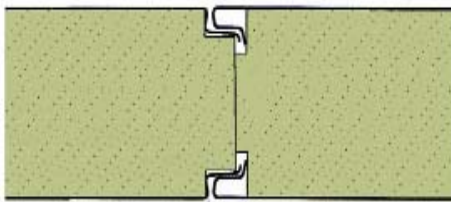
Optional

- Pebble White (near RAL 9002) 25 micron polyester powder-coated on a 0.63 mm thick galvanised sheet steel, **smooth finish** or slightly ribbed (0.6 mm depth)
- Pebble White (near RAL 9002) 25 micron **polyester** powder-coated on a 0.75 mm thick galvanised sheet steel, smooth finish or slightly ribbed (0.6 mm depth)
- 0.63 mm thick **304** stainless steel, slightly ribbed
- 0.63 mm thick **304** or **316** stainless steel + white (near RAL 9010) 35 micron PVDF coating, smooth or slightly ribbed finish
- 0.75 mm thick **304** stainless steel, smooth finish
- 0.63 mm thick galvanised sheet steel + Pebble White (near RAL 9002) 35 micron **PVDF coating**
- 0.63 mm thick galvanised sheet steel + **PET coating** (polyester coating + anti-scratch, anti-corrosion PET film), 55 microns or 150 microns thick, smooth or slightly ribbed finish

The facings can be either the same or different on the two sides of the panel. All facings surface material are food safe (FDA)



*Interlock panel joints :*  
 - steel-to-steel overlapping interlock joints



*Core :*  
 - high density (100 kg/m<sup>3</sup> to 135 kg/m<sup>3</sup> depending on the thickness and process) adhesive bonded between the facings using a pressure polymerised two-part polyurethane adhesive

*Thermal conductivity: k-value = 0.039W/m.°C*

*Heat transmission coefficient :*

panel thickness in mm	U value in W/m <sup>2</sup> .K
40	0.91
60	0.64
80	0.49
100	0.39
120	0.33
160	0.25

## TIGHTNESS AND FINISHINGS

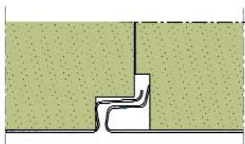
Panel joints must be treated to meet two criteria:

**Watertightness:** The transfer of water vapour must be limited and moisture must be prevented from getting inside the joint. The solution used depends on the location of the partition and the atmosphere on either side.

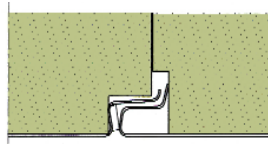
**Finishing:** the type of finishing is determined by the cleaning and hygiene requirements and the industrial design.

**Assembly:** depending on the specifications and accessibility on each side of the panel, the following solutions can be adopted or combined:

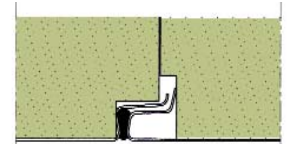
- Application of a gasket or sealant on the edge of the steel facings (position 1)



no joint

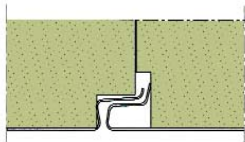


PVC gasket

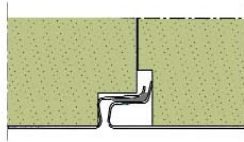


silicone

- Application of mastic at the bottom of the interlock groove (position 2)



no mastic



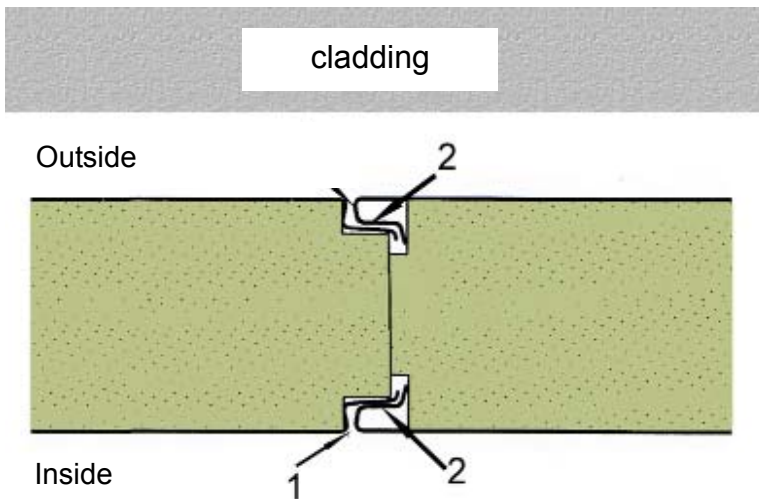
butyl or silicone mastic

### Classification of room atmosphere

Relative humidity	Temperature (°C)								
	<0	1 < 5	6 < 10	11 < 15	16 < 20	21 < 25	26 < 30	31 < 35	36 < 40
5 %	<div style="display: flex; justify-content: space-between;"> <div style="width: 30%; background-color: #f4a460; padding: 5px;">Atmosphere A</div> <div style="width: 40%; background-color: #c8e6c9; padding: 5px;">Atmosphere B</div> <div style="width: 30%; background-color: #f8bbd0; padding: 5px;">Atmosphere C</div> </div>								
10 %									
15 %									
20 %									
25 %									
30 %									
35 %									
40 %									
45 %									
50 %									
55 %									
60 %									
65 %									
70 %									
75 %									
80 %									
85 %									
90 %									
95 %									
100 %									



**Case N°1** : Partition against cladding



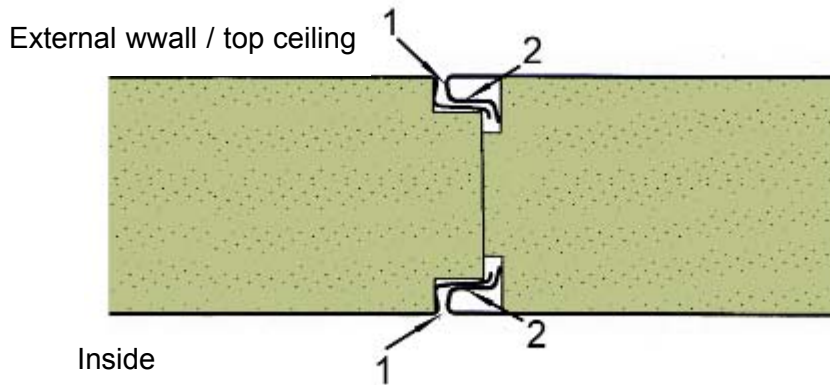
Position 1 : at edge of sheet steel  
Position 2 : at bottom of groove

Sealing and finishing solutions

Atmosphere	Inside sealing joint		outside joint
	no cleaning	pressurised and/or frequent cleaning	
A	soft PVC gasket (in position 1)	Silicone (in position 1)	Butyl (in position 2)
B	Silicone (in position 1)	Silicone (in position 1)	Butyl (in position 2)
C	Butyl (in position 2)+Silicone(in position 1)	Butyl (in position 2)+Silicone (in position 1)	Silicone (in position 2)



**Case N°2** : Outside wall exposed to weather or ceiling

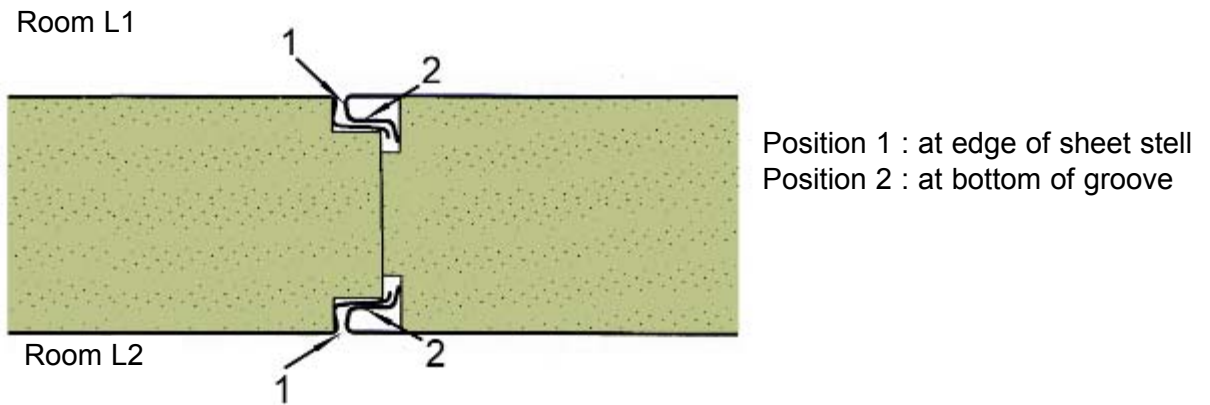


Position 1 : at edge of sheet steel  
Position 2 : at bottom of groove

Sealing en finishing solutions

Inside atmosphere	inside		outside	
	no cleaning	pressurised and/or frequent cleaning	sealing	finishing solution
A	soft PVC gasket (in position 1)	Silicone (in position 1)	Butyl (in position 2)	selection as per customer's requirement (in position 1) - no joint - PVC gasket - silicone
B	Silicone (in position 1)	Silicone (in position 1)	Butyl (in position 2)	
C	Butyl (in position 2)+ Silicone (in position 1)	Butyl (in position 2)+ Silicone (in position 1)	Silicone (in position 1)	

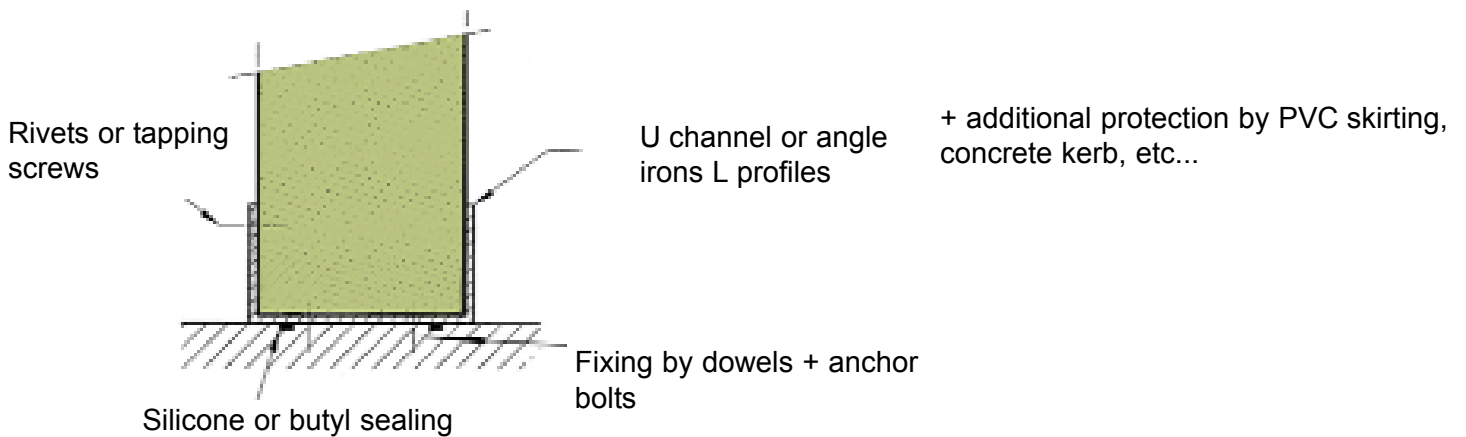
**Case N°3** : internal partition



Sealing and finishing solutions

Atmosphere		Room L2		
		A	B	C
Room L1	A	L1 : silicone (in position 1) L2: silicone (in position 1) *	L1 : silicone (in position 1) L2: silicone (in position 1)	L1 : silicone (in position 1) L2: butyl (in position 2) + silicone (in position 1)
	B	L1 : silicone (in position 1) L2: silicone (in position 1)	L1 : silicone (in position 1) L2: silicone (in position 1)	L1 : silicone (in position 1) L2: butyl (in position 2) + silicone (in position 1)
	C	L1 : butyl (in position 2) L2: silicone (in position 1)	L1 : butyl (in position 2) L2: silicone (in position 1)	L1 : butyl (in position 2) + silicone (in position 1) L2: butyl (in position 2) + silicone (in position 1)

\*If there is no cleaning, possibility of using PVC gaskets if the atmosphere is dry on either side

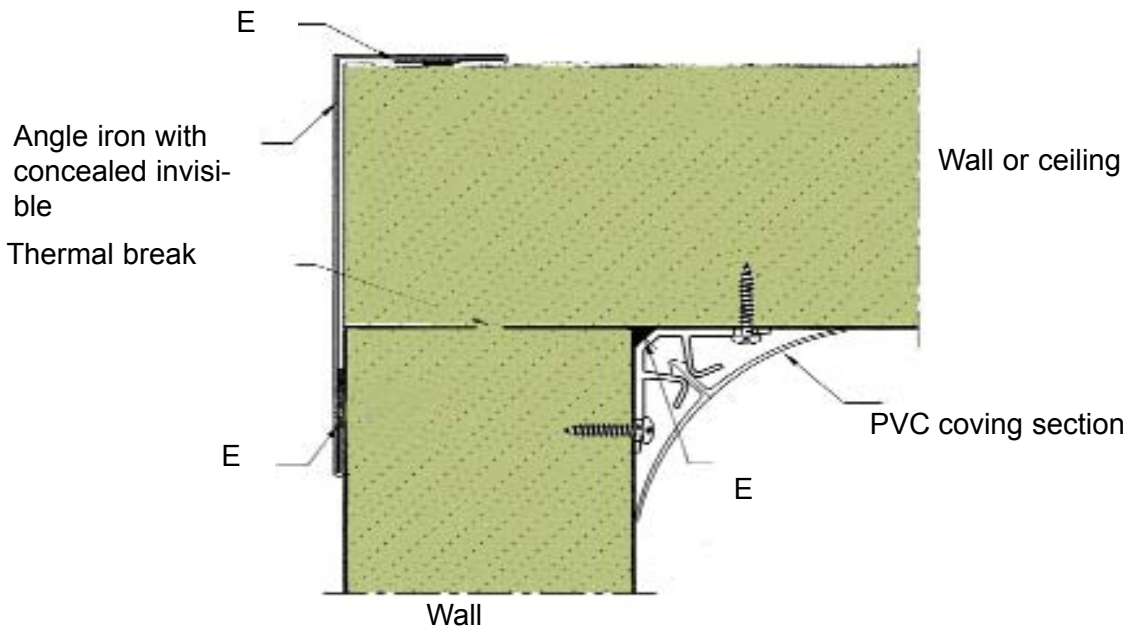
**ERECTION****Floor to wall connection**

NB : Wedging may be necessary to make up for the difference in level either in the channel (maximum height 20 mm) or under the channel.

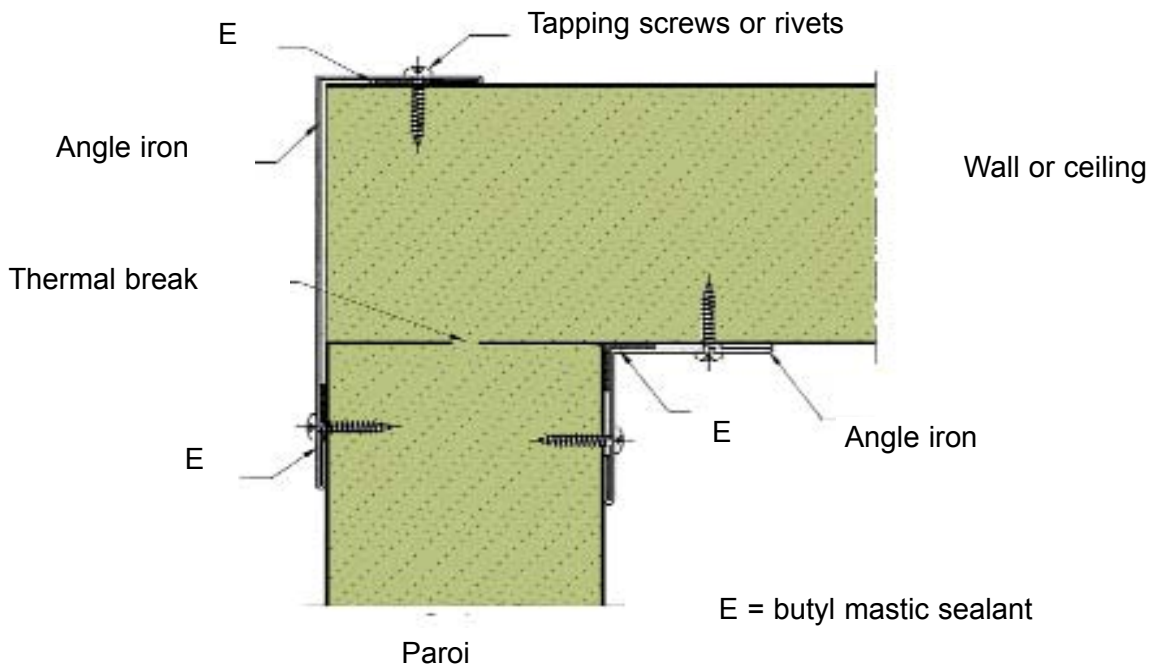


## Wall to wall ou wall to ceiling connection

using coving sections



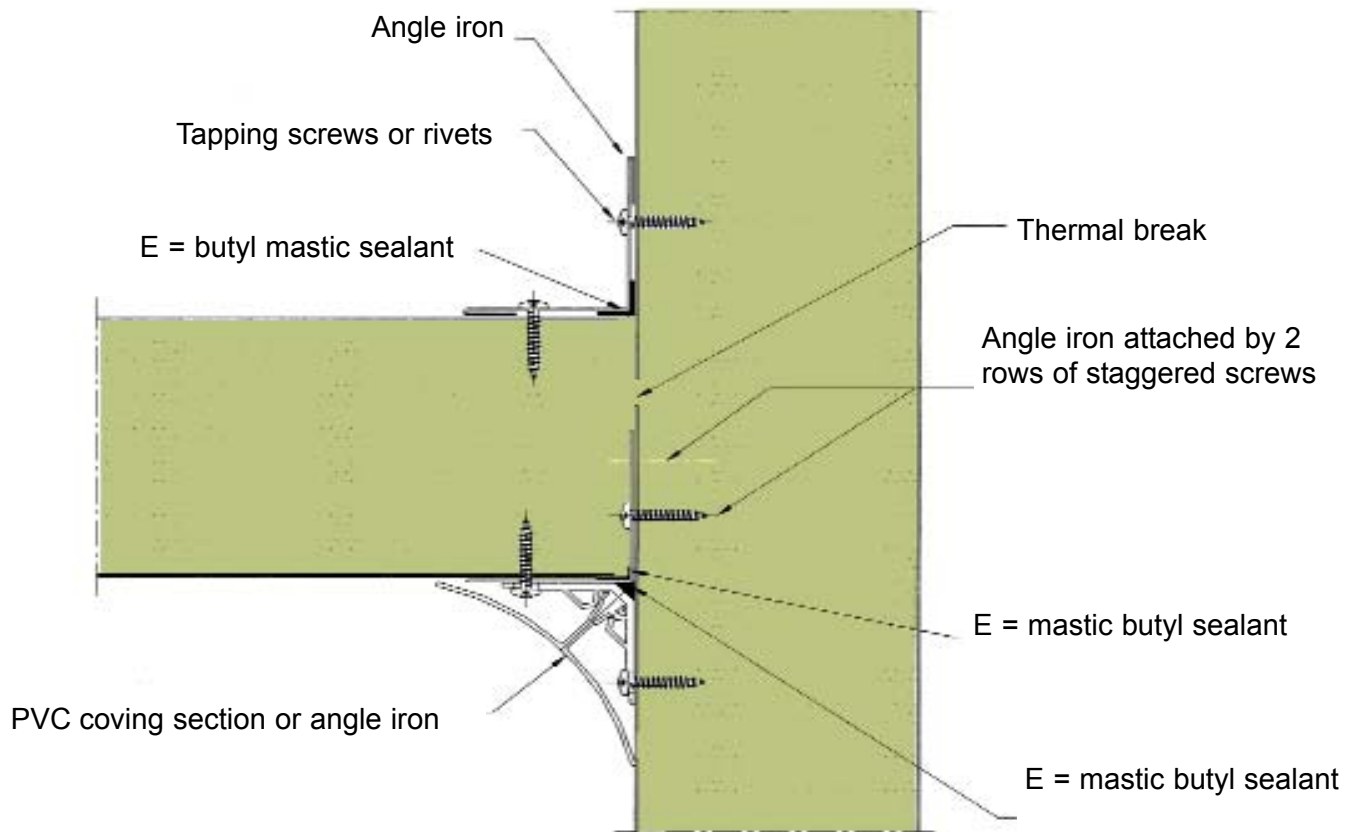
using angle iron



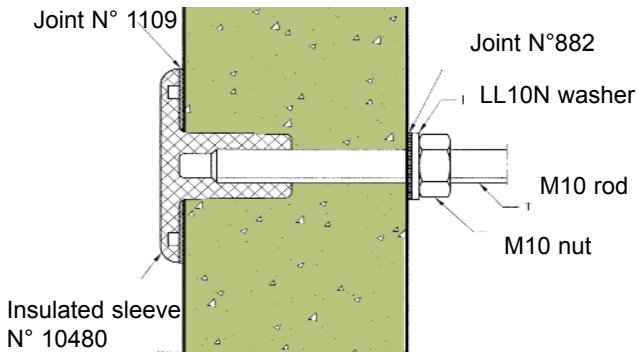


## Ceiling connection in the middle of the wall

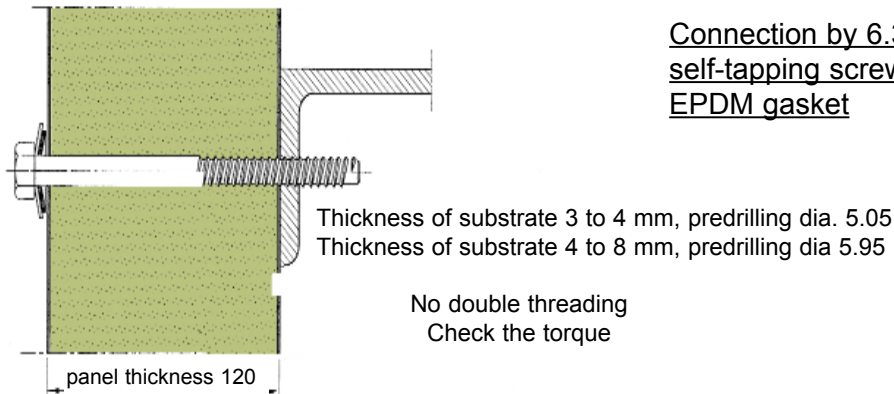
by coving section or angle iron



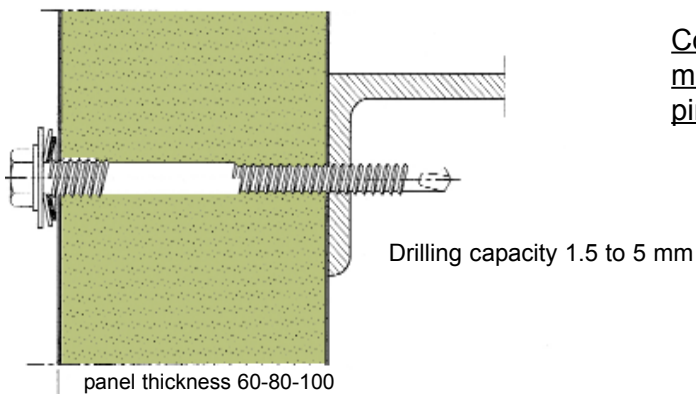
## Connection of wall to beam clamp



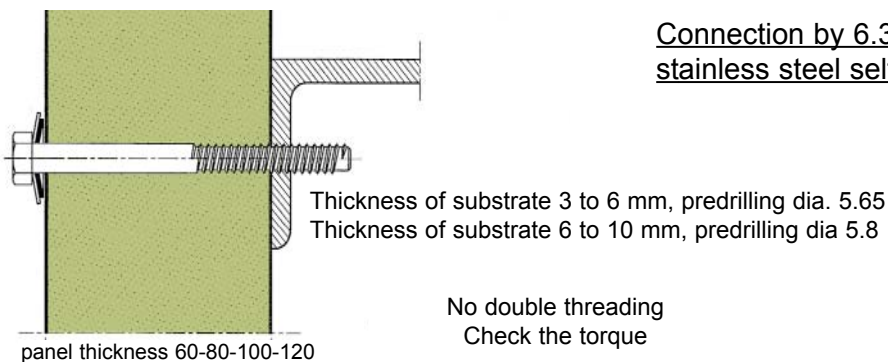
Connection by through-hole insulator



Connection by 6.3 x 150 mm zinc-plated self-tapping screws with metal washer and EPDM gasket



Connection by RAL 9010 5.5 x 100 to 125 mm duplicate-moulded zinc-plated self-tapping screws and EPDM gasket



Connection by 6.3 x 100, 130 and 150 mm stainless steel self-tapping screws

## Fixing of cladding panels

In the case of cladding panels, the choice of fixing depends on the atmosphere inside the room.

atmosphère	Type de fixing
<b>A</b>	All types of through fixings
<b>B</b>	All types of through fixings
<b>C</b>	Insulation sleeves or stainless steel through screws

### Additional precautions

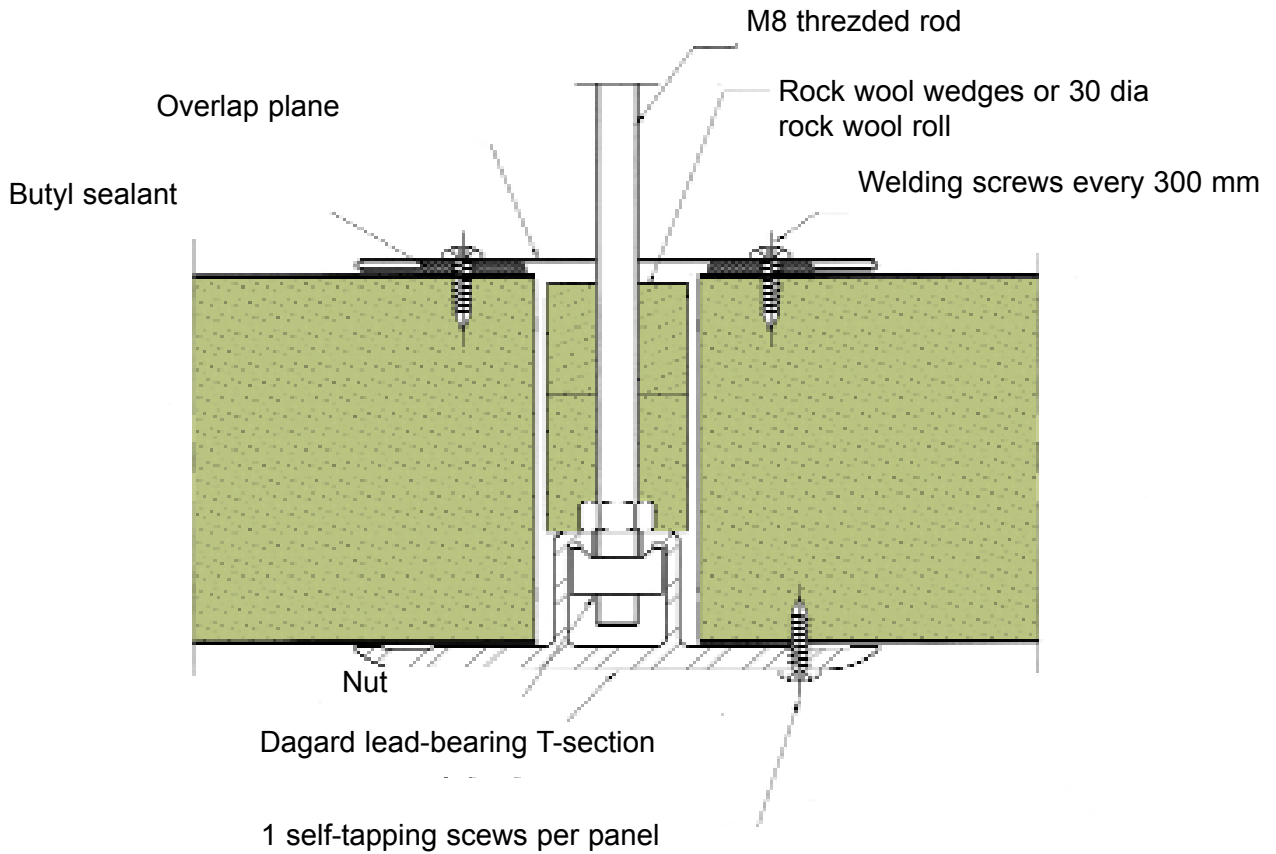
Since the building frame is outside, the fixings must be protected against the weather (upper cladding, weather bar above runner, etc.)

If no precautions have been taken against the rain, the following must be used:

- either stainless steel tapping screws
- or N° 1048 sleeves with stainless steel threaded rods



### Ceilings : intermediate suspension by load-bearing T-section



## MECHANICAL PROPERTIES

### Bending strength of panels

#### Walls panels

##### *Inside partition*

Maximum admissible height without intermediate suspension

thickness	maximum admissible height without intermediate suspension
60	4.00 m
80	6.00 m
100	8.00 m
120	8.00 m
160	8.00 m

##### *Outside partitions*

The walls must be stabilised in relation to the building frame.

The following data are examples of the maximum distance between panel supports required to meet the safety regulations and determine the number and position of stabilizing runners.

Maximum admissible distances between supports on an outside wall

épaisseur	portée maxi admissible entre appuis en paroi extérieure
60	2.50 m
80	3.00 m
100	3.50 m
120	4.00 m
160	4.00 m



**Ceilings**

Ceilings are considered to be accessible for maintenance only. An occasional point load of 150 daN is allowed.  
 Heavy traffic areas must be protected if necessary, particularly during initial construction.

Maximum admissible distance between bearings,  
 centre-to-centre distance between suspension frames

thickness	maximum admissble distance between bearears
60	2.50 m
80	3.00 m
100	3.00 m
120	3.50 m
160	3.50 m

**These values are only given by way of information. A detailed study must be carried out in each case, taking into account the region (loads due to wind) and including the mechanical strength of fixings (see detail CSTB technical documents).**

## A FEW REMINDERS OF STANDARDS, TESTS AND CLASSIFICATIONS

### Flame spread rating

Characterises the facility with which a material catches alight (flashover) and propagates fire. Each country uses its own set of test standards. Tests are carried out on test specimens. There is no simple correspondence between the different classifications.

French regulations, which are based on the combustible mass and the length and lifetime of flames produced during testing, uses the following classification system:

- M0 non-combustible
- M1 non-flammable
- M2 low flame spread
- M3 easy flame spread
- M4 very easy flame spread

### Resistance to fire performance

Characterises the fitness of a building component to fulfil its function, even in a fire.

The international standard ISO 834 defines classifications based on three criteria expressed in terms of time

- Fire stability: mechanical strength of a component
- Flame retardance: mechanical strength + propensity to flashover
- Fire resistance: mechanical strength + propensity to flashover + thermal insulation (the temperature must not exceed 140°C on average, and 180° at any point on the surface opposite the fire).

### Position of insurers: mock-up tests

To limit risks, Insurance Companies and their representatives (APSAD, FM, etc.) recommend that non-combustible materials be used whenever possible.

Half or full-scale mock-up tests are carried out in conjunction with test laboratories.

Tests carried out at the CNPP resulting in APSAD "Pa" classifications:

1st test: ignitability test on a test specimen

2nd test: full-scale test "Direct attack of flames on a full-scale mock-up".

These tests led to Pa2 classification.

## Euroclasses

In order to harmonise reaction-to-fire classifications and test methods within the European Union, a European Directive has been published to coordinate the systems of member countries (94/611/EC of January 2001).

In the long term, Euroclasses will replace the classification system used by each individual country (Uno in Italy, M in France, 0 and 1 in Great Britain, etc.).

Seven classes have been defined, from A to F:

- Classes A1 and A2 are reserved for non-combustible materials
- Class B: very limited contribution to fire development
- Class C: limited contribution to fire
- Class D: acceptable contribution to fire and satisfies the SBI test
- Class E: acceptable contribution to fire and satisfies the small flame test
- Class F: no test, or materials not admitted to class E.

Five test methods are recommended:

- The non-combustibility furnace test (draft EN ISO 1182)

This test identifies products that do not contribute to fire development and covers Euroclasses 1 and 2.

- The bomb calorimeter test (draft EN ISO 1716)

This test is used to measure the gross calorific value of a material in an atmosphere of oxygen. It covers Euroclasses A1 and A2.

- The SBI or Single Burning Item test (EN ISO 9705)

This test is used to determine the contribution of a product to fire development in a scenario that simulates the combustion of an isolated object in the corner of a room.

The fire can be fully developed. This test covers Euroclasses B, C and D.

- The small flame ignitability test (draft EN ISO 11925-2)

This ignitability test is carried out before all the others. If it fails, the product is classified in Euroclass F.

Three results are calculated at the end of the test:

- FIGRA (fire growth rate index expressed in kW/s)
- SMOGRA (smoke growth rate index in m/s)
- THR (total heat release)

The Euroclass for the tested materials is determined according to the values obtained.

Euroclasses are combined with a smoke index of s1, s2 or s3 and a drop index of d0, d1 or d2.

N.B. The French classification system (M classification) and the Euroclass system will coexist up until 2006.

## Correspondence table for French M classes and Euroclasses

An order signed by the Minister of the Interior on 21st November 2002 defines the new reaction to fire test methods and classifications for building products.

requirement	Classes	Smoke indice	Drip indice
No-combustible	A1		
M0	A2	s1	d0
M1	A2	s1	d1
		s2	d0
		s3	d1
	B	s1	d0 ou d1
		s2	
		s3	
M2	C	s1	d0 ou d1
		s2	
		s3	
M3 M4 (non gouttant)	D	s1	d0 ou d1
s2			
s3			
M4	All classes other than e-d25 et F		

Classes as per NF EN 13 501-1

The above table defines the admissible Euroclasses for construction products other than flooring, in relation to the m categories stipulated in the French fire safety regulations.

N.B. The fire regulations for sandwich panels have not yet been completed. Work is being carried out on a European level. The CE marking system currently being developed should enable the specific properties of these products to be defined.



Route du Stade - 23600 Boussac - France - Tél :+33(0)555.82.40.00 - Fax :+33(0)555.65.10.00  
mail : [info@dagard.com](mailto:info@dagard.com) - site web :[dagard.com](http://dagard.com)