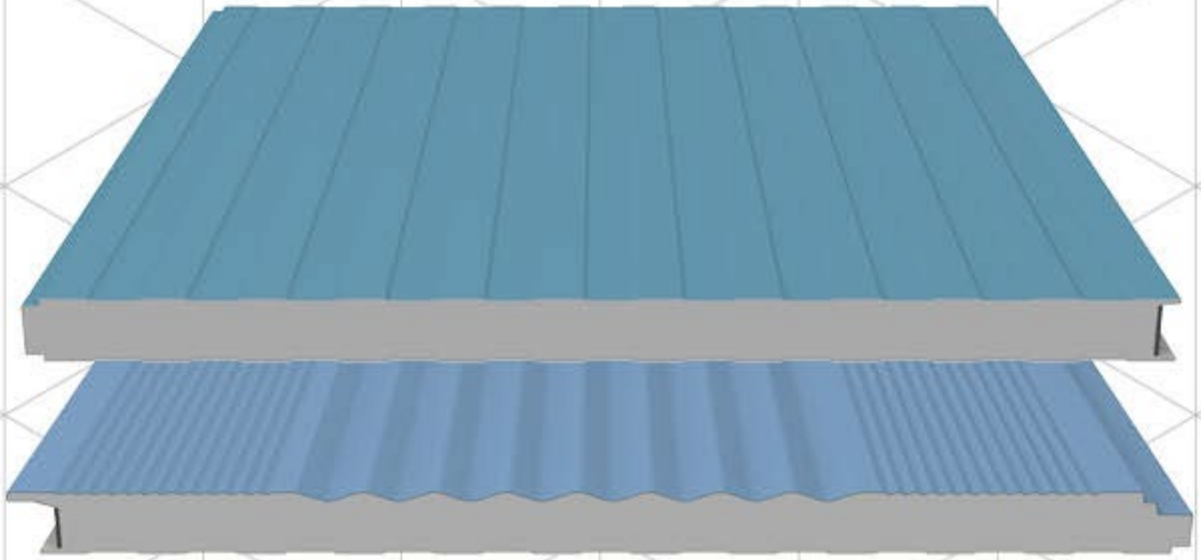
TECHNICAL MANUAL
Wall Panels



PART OF MANNI GROUP

ISOPAN
BUILDING ENVELOPE SOLUTIONS
by Manni Group

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ISOFROZEN	ISOPARETE EVO (Gamma Prodotti)	ISOFIRE WALL FONO	ISOPARETE FIRE EVO
	ISOPARETE PLUS-2 (Gamma Prodotti)		ISOPARETE FIRE
	ISOCLASS		ISOFIRE WALL PLISSè FONO
			ISOPARETE FIRE EVO FONO

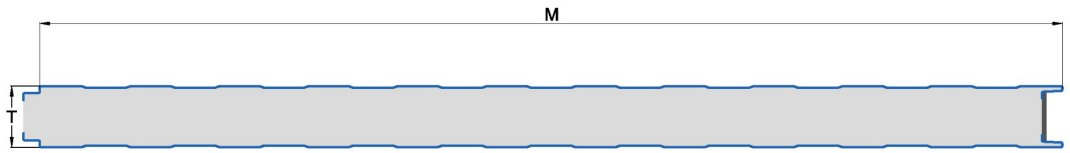
NOTE ON IMAGES

Images are for information purposes only and are not intended as a faithful representation of the product. Each article may differ depending on the reference production plant or the product configuration used (metal profile, nominal thickness, etc.). For more information on the geometry of the products used, please refer to the Technical Drawings available on the website, or alternatively contact Isopan.

PRODUCT FEATURES

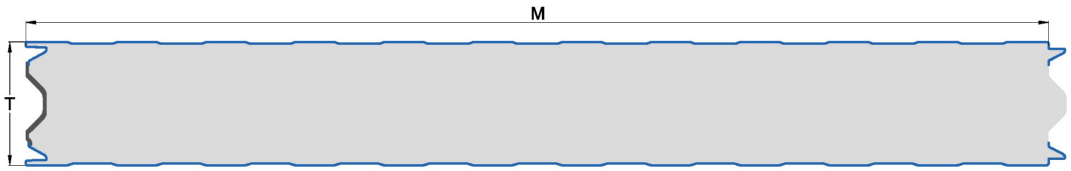
POLYURETHANE INSULATION – VISIBLE FASTENING

ISOBOX (Product Range)



PITCH - MODULE (M)	1000mm (Standard) – 1150mm – 1155mm
EXTERNAL FACING	Pre-painted sheet
INSULATION	Polyurethane foam (PUR) or Polyisocyanurate foam (PIR)
INTERNAL FACING	Pre-painted sheet

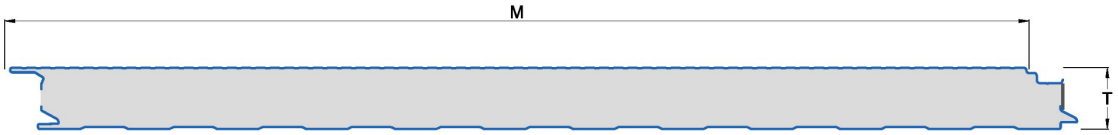
ISOFROZEN – ISOFROZEN HT



PITCH - MODULE (M)	1000mm – 1150mm (standard) – 1155mm
EXTERNAL FACING	Pre-painted sheet
INSULATION	Polyurethane foam (PUR) or Polyisocyanurate foam (PIR)
INTERNAL FACING	Pre-painted sheet

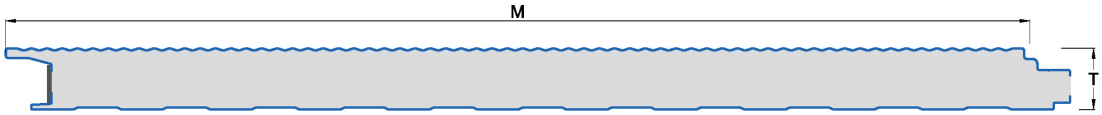
POLYURETHANE INSULATION – CONCEALED FASTENING

ISOPARETE (Product Range)



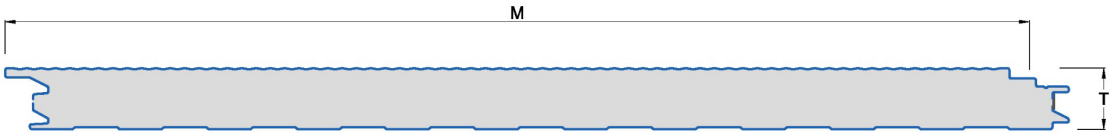
PITCH - MODULE (M)	1000mm
EXTERNAL FACING	Pre-painted sheet
INSULATION	Polyurethane foam (PUR) or Polyisocyanurate foam (PIR)
INTERNAL FACING	Pre-painted sheet

ISOPARETE PLUS-2 (Product Range)



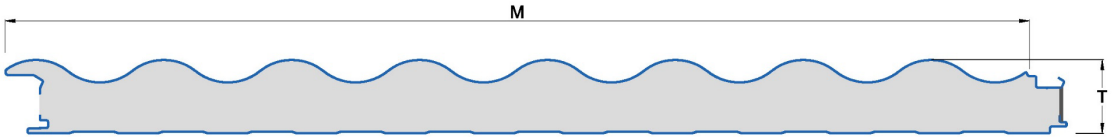
PITCH - MODULE (M)	1000mm
EXTERNAL FACING	Pre-painted sheet
INSULATION	Polyurethane foam (PUR) or Polyisocyanurate foam (PIR)
INTERNAL FACING	Pre-painted sheet

ISOPARETE EVO (Product Range)



PITCH - MODULE (M)	1000mm
EXTERNAL FACING	Pre-painted sheet
INSULATION	Polyurethane foam (PUR) or Polyisocyanurate foam (PIR)
INTERNAL FACING	Pre-painted sheet

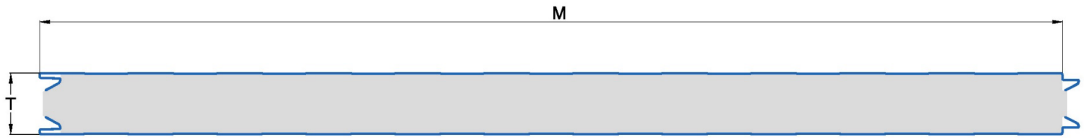
ISOCLASS



PITCH - MODULE (M)	1000mm
EXTERNAL FACING	Pre-painted sheet
INSULATION	Polyurethane foam (PUR) or Polyisocyanurate foam (PIR)
INTERNAL FACING	Pre-painted sheet

MINERAL WOOL INSULATION – VISIBLE FASTENING

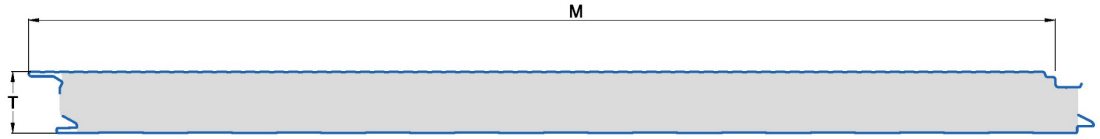
ISOFIRE WALL (Product Range) – ISOFIRE WALL FONO



PANEL	**ISOFIRE WALL**	**ISOFIRE WALL FONO**
PITCH - MODULE (M)	1000mm (standard) – 1150mm	
EXTERNAL FACING	Pre-painted sheet	
INSULATION	Feldspathic rock mineral fibre wool	
INTERNAL FACING	Pre-painted sheet	Pre-painted sheet Microperforated

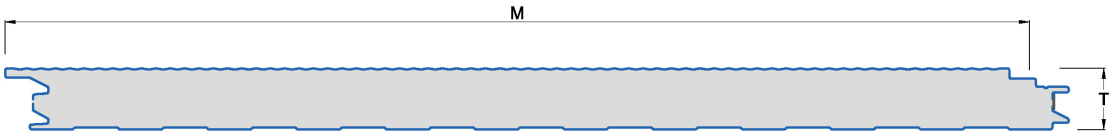
MINERAL WOOL INSULATION – CONCEALED FASTENING

ISOFIRE WALL PLISSè – ISOFIRE WALL PLISSè FONO



PANEL	**ISOFIRE WALL PLISSè**	**ISOFIRE WALL PLISSè FONO**
PITCH - MODULE (M)	1000mm	
EXTERNAL FACING	Pre-painted sheet	
INSULATION	Feldspathic rock mineral fibre wool	
INTERNAL FACING	Pre-painted sheet	Pre-painted sheet Microperforated

ISOPARETE FIRE EVO – ISOPARETE FIRE EVO FONO



PANEL	ISOPARETE EVO FIRE	ISOPARETE EVO FIRE FONO
PITCH - MODULE (M)	1000mm	
EXTERNAL FACING	Pre-painted sheet	
INSULATION	Feldspathic rock mineral fibre wool	
INTERNAL FACING	Pre-painted sheet	Pre-painted sheet microperforated

DIMENSIONAL CHARACTERISTICS AND TOLERANCES

BASE DIMENSIONAL CHARACTERISTICS

USEFUL WIDTH (Module / Step)

The standard useful width of Isopan wall panels is 1000 mm.

For ISOFROZEN and ISOFROZEN HT panels only, the standard working width is 1150 mm.

At some Isopan plants, some articles can be produced with increased (1150 mm or 1155 mm) or reduced width (ISOFROZEN and ISOFROZEN HT with 1000 mm width). To check the actual availability of products with non-standard widths, please contact Isopan.

LENGTH

Isopan products can be produced in a length to customer request.

The maximum length that can be produced varies depending on the product required and the reference factory, so please contact Isopan to find out about production limitations.

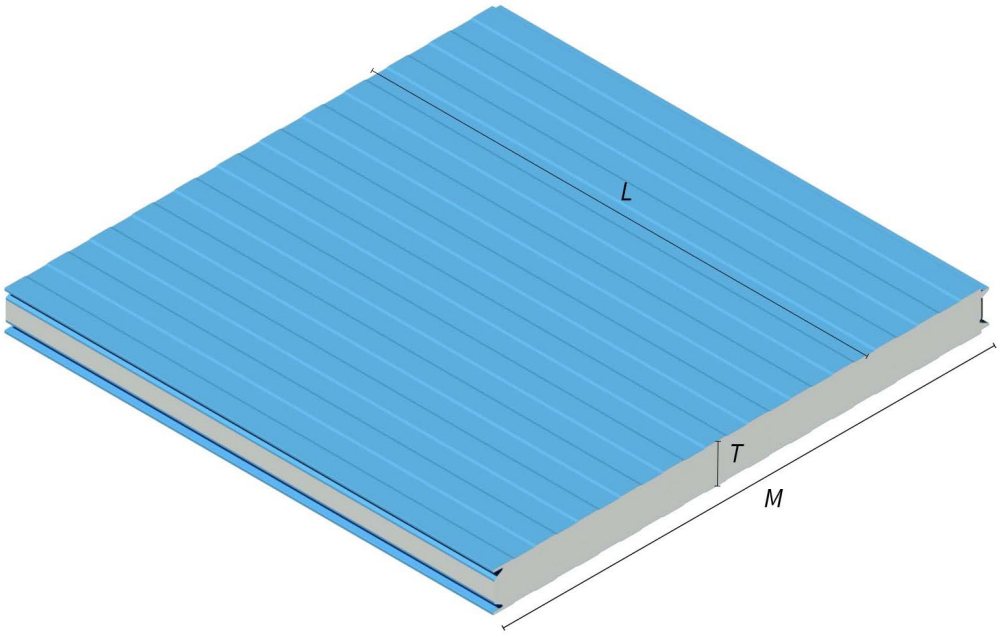
In any case, Isopan recommends not exceeding the maximum size that can be transported by standard vehicle.

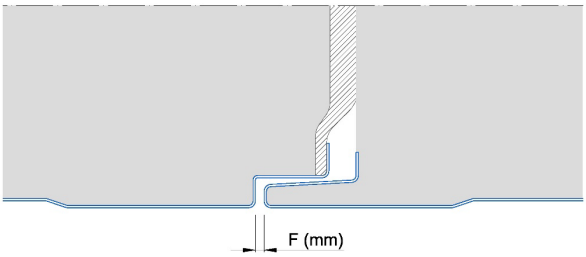
NOMINAL THICKNESS

Each product can be manufactured according to a range of nominal thicknesses. For panels produced at several Plants, the nominal thickness range may vary.

TOLERANCES

Dimensional tolerances are declared in accordance with EN 14509 - Annex D.





- Thickness of metal facings: in accordance with the reference product standards for the types of facings used.
- T: Nominal panel thickness: T ≤ 100mm ± 2 mm ; T > 100mm ± 2%
- L: Panel length: L ≤ 3000 mm ± 5 mm; L > 3000 mm ± 10 mm
- M: useful width/ pitch/ module: ± 2 mm
- F: Coupling of the joint (inner side): 0+3 mm

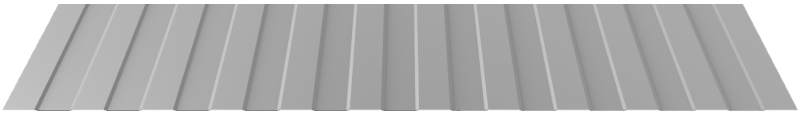
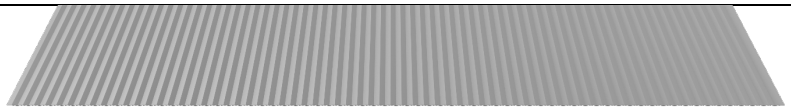
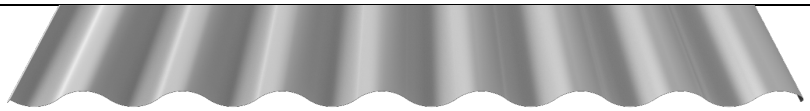
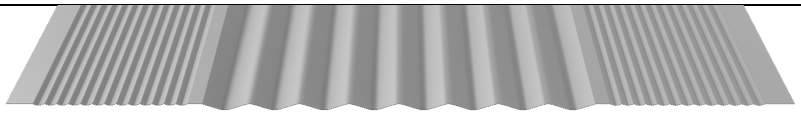
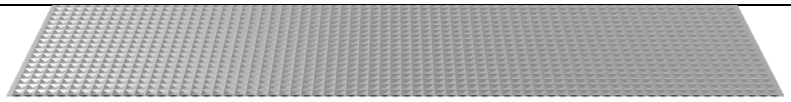
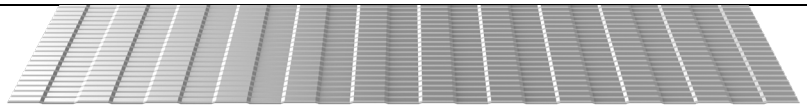
METAL PROFILING

The profiling of the metal cladding of wall panels may vary depending on the type of product used and depending on the production plant.

For more information on the available profiles, please consult the Technical Drawings, which can be downloaded from the website. Please contact Isopan for the actual availability and configurability of the product with the various metal profiles depending on the production site.

In addition to its aesthetic function, profiling helps to improve the stiffness of the sheets.

TYPES OF PROFILING AVAILABLE

BOX Profile	
Pleated Profile Only available on the outer side of the panel	
RIGHE Profile*	
Class Profile* Only available for ISOCLASS product	
Double Profile* Only available on the outer side of the panel	
Flat Profile*	
DT Profile* Only available on the outer side of the panel	
DIAMOND profile* Only available on the outer side of the panel	
EMERALD Profile* Only available on the outer side of the panel	
ATTENTION	Profiles marked with * are only available for products with a useful width of 1000 mm

CHARACTERISTICS OF THE INSULATION LAYER

POLYURETHANE FOAM

The polyurethane foams used by Isopan can be:

- type PUR (Polyurethane)
- type PIR (Polyisocyanurate)

Please refer to Isopan's statements regarding the feasibility of each Product at the relevant Production Facility. Polyurethane foams for panel insulation are resistant to biological attack and do not promote the growth of mould and fungus. They are therefore inert and non-biodegradable materials, and their eventual disposal in landfills is therefore not a possible pollution factor.

Made with rigid polyurethane foam, having the following physical and mechanical features:

Compressive strength	≥ 0.11 MPa (AT 10% DEFORMATION)
Tensile strength	≥ 0.10 MPa
Shear strength	≥ 0.10 MPa
Thermal conductivity coefficient	λ = 0.022 W/mK
Operating temperature:	minimum - 40 °C; maximum + 80 °C
Foaming agent: N-Pentane in accordance with the Montreal protocol	
The 95% closed cells guarantee anhygroscopic structure	

ROCK FIBRE MINERAL WOOL

Isopan uses mineral wool made from feldspathic rock fibres, with an average density of 100 kg/m^3. The use of oriented fibres gives the product physical and mechanical strength.

Made with rock wool with oriented fibres, having the following physical and mechanical features:

Incombustibility	Class A1 according to standard EN 13501
Average density	100 kg/m^3 ± 10%; other density values available on request
Melting temperature	> 1000 °C
Resistance to water/vapour penetration	μ = 1.4
Water absorption (long-term)	Wlp < 3 Kg/m2
Specific heat capacity	cp = 840 J/kgK
Durability	class DUR2 according to standard EN 14509
Thermal conductivity coefficient	λ = 0.04 W/mK
Compressive strength	≥ 0.06 MPa (at 10% deformation)
Shear strength	≥ 0.05 MPa
Tensile Strength	≥ 0.04 MPa
Absence of fumes during insulating material combustion	

METAL FACINGS

Isopan uses metal facings of various types and thicknesses. The main types of metal cladding used in the production of sandwich panels and corrugated sheets are listed below:

- SENDZIMIR system hot dip galvanised steel by continuous process (UNI EN 10346) and pre-painted by means of a coil coating continuous process with different painting cycles based on end use (see: ''Guide to Choosing Pre-painted'') For stainless steel facings, one should take into account the possible appearance of flaws that are highlighted by such reflecting surfaces

- 3000 or 5000 series aluminium alloys with pre-painted finish with the cycles mentioned in the previous point, with a natural or embossed effect. In case of aluminium facings, these must be preferably applied on both sides: in fact, if different materials are used on the two sides, the panel may distort and bend due to the different thermal expansion coefficients of the faces.

- Stainless steel AISI 304, 2B finish, according to EN 10088-1.

Microperforated steel sheets (ISOFIRE WALL FONO and ISOFIRE WALL FG-FV FONO) - FOR INTERNAL USE ONLY

A layer of dustproof black glass fibres is placed between the perforated internal face and insulating core package to protect the inner side.

SPECIAL FACINGS

Depending on the product and the reference production plant, special metal facings may be available to guarantee particular performance in terms of durability, corrosion resistance and UV resistance. Such facings usually consist of a steel base, with special facings in aluminium zinc and magnesium alloys.

PROTECTION OF THE PRE-PAINTED FACES

All pre-painted metal facings are supplied with an adhesive polyethylene protective film that prevents damage to the paint layer. If the material is specifically requested without protective film, Isopan assumes no liability in case of damages to the paint. The protective film that covers the pre-painted panels must be completely removed during assembly and, in any case, within sixty days after the material preparation. It is also recommended not to expose the panels covered by a protective film to direct sunlight.

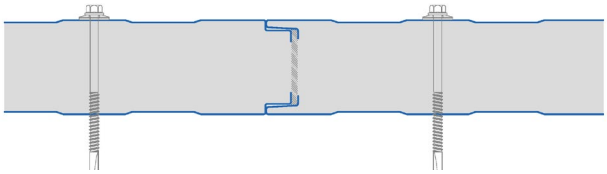
JOINT

The joint is the junction area in the tongue-and-groove combination between two panels; it represents a point where there is therefore discontinuity between two prefabricated elements. During the handling and installation of sandwich panels, care must be taken to safeguard the integrity of the joint on both the male and female sides of the panel to avoid compromising its technical and aesthetic functionality.

The functions of a correctly installed joint, considering the direction of installation and orientation of the outer and inner sides of the panel, are as follows:

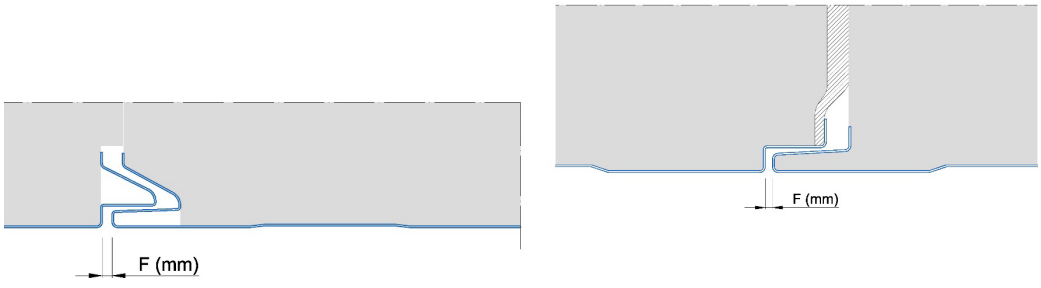
- Ensure the correct consequential installation of sandwich panels;
- Avoid passage of water and air from the external environment to the internal environment, or at least minimise migration of liquids and air from one side of the wall/covering to the other;
- Minimise the risk of condensation forming on the inside of the building, or in any case on the protected side of the wall/covering surface;
- Ensure proper thermal insulation of the rooms enclosed by the panels.

Depending on the type of product, the joint can be made with different geometries and technologies. The joint closure may have factory tolerances, which can be found in the relevant section of this document.



Pictured is an example of a joint in a wall panel.

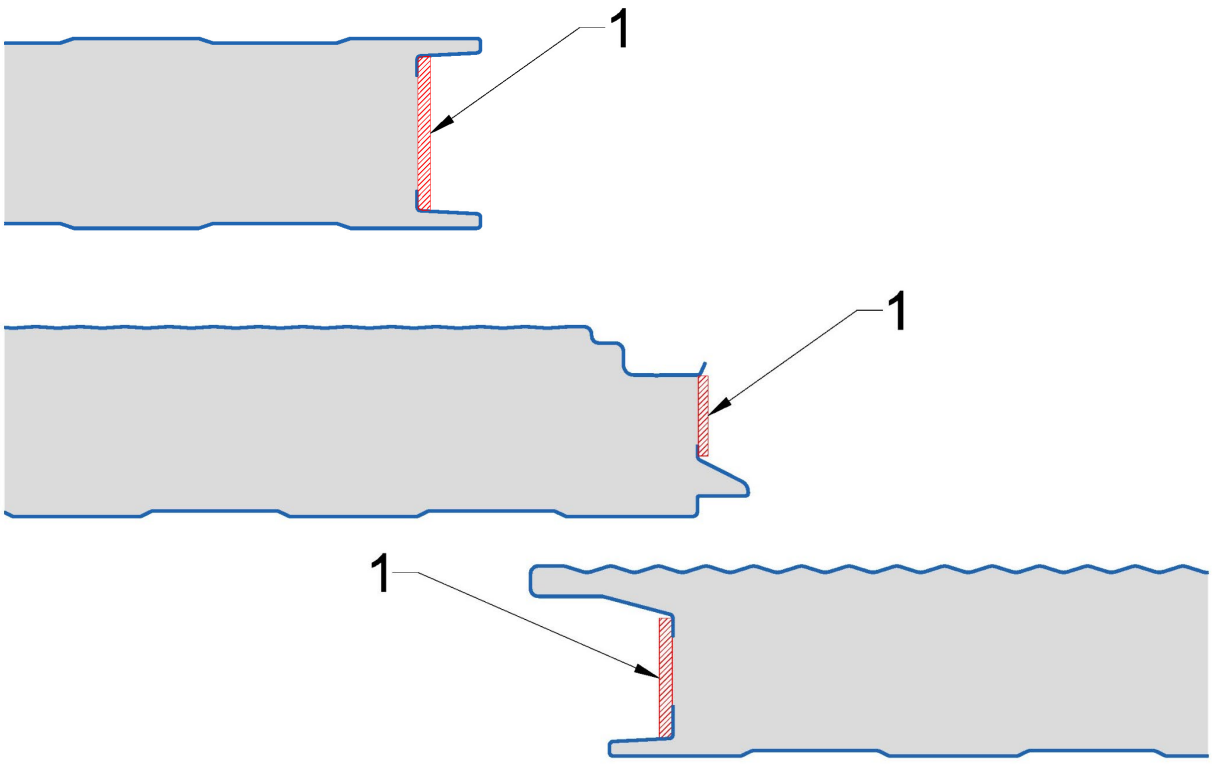
In correctly installed wall panels, a gap between the male-female fins at the joint may be visible on both the inner and outer sides. The presence of this space (called a gap, represented in the following figure by “F”) is not an indication of product faults or incorrect installation. The factory tolerances are designed to favour tightening between the panels in the area of the insulating core and/or sealing gasket, allowing compression of the space between them to prevent water penetration.



The presence and size of the “F” joint are subject to dimensional tolerances, which can be found in the appropriate section of this document.

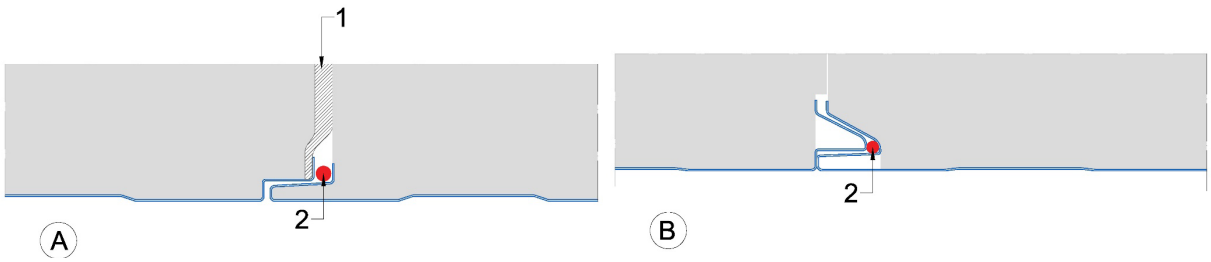
FACTORY STANDARD AND OPTIONAL GASKETS

For panels with polyurethane insulation, there may be a compressible synthetic gasket on one of the two male/female sides. The size and position of the gasket may vary depending on the product.



1: Standard gasket

Under severe conditions, additional gaskets and/or sealants can be installed on site to try to avoid condensation and seepage. The following figures indicate the position where such elements can be installed, depending on the design of the products used.



A: Example of optional gasket/sealant installation with male/female joint

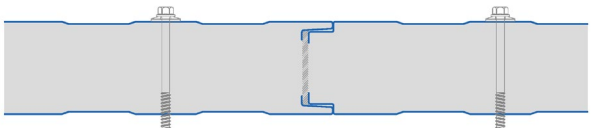
B: Example of optional gasket/sealant installation with labyrinth joint

1: Standard gasket (factory pre-assembled)

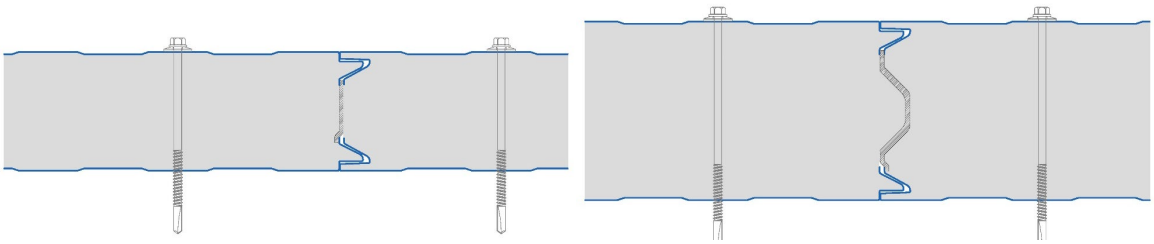
2: Standard gasket/sealant (to be installed on site)

POLYURETHANE INSULATION – VISIBLE FASTENING

ISOBOX – ISOBOX PLISSè – ISOPIANO - ISORIGHE

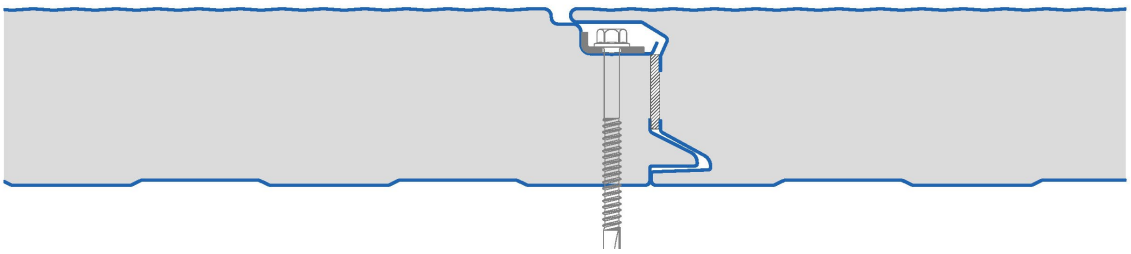


ISOFROZEN

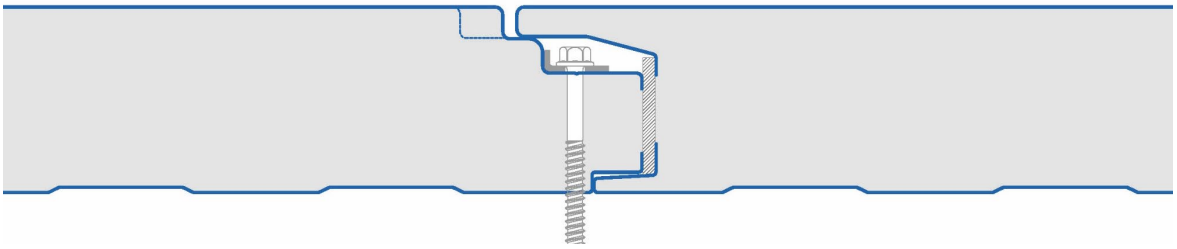


POLYURETHANE INSULATION – CONCEALED FASTENING

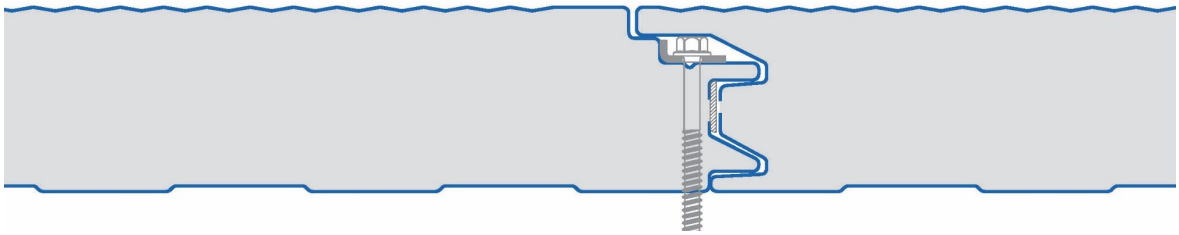
ISOPARETE



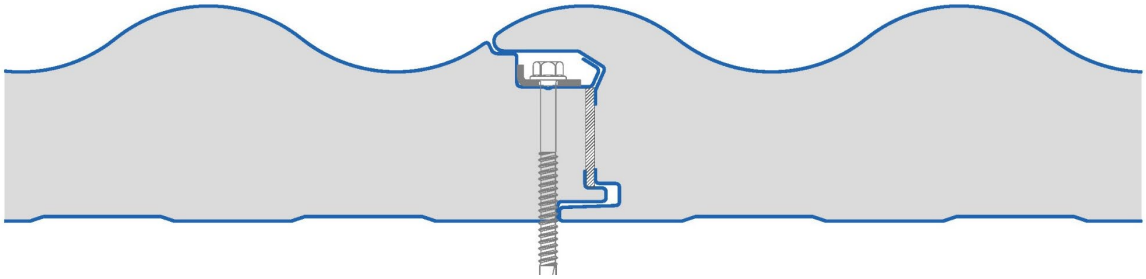
ISOPARETE PLUS-2



ISOPARETE EVO



ISOCLASS

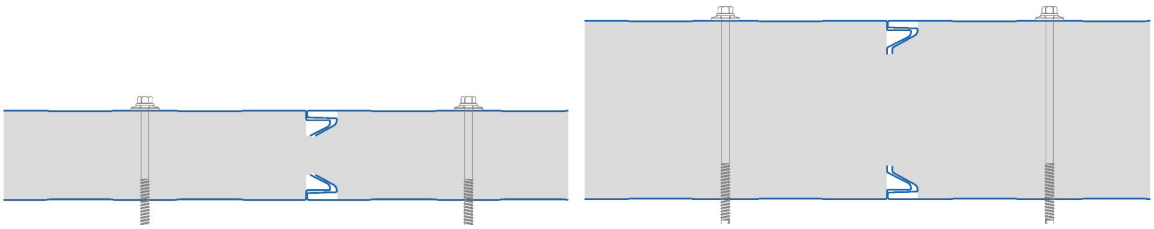


MINERAL WOOL INSULATION – VISIBLE FASTENING

GASKET: Wool panels are produced without standard gaskets, as this could impair safety performance in the event of fire. Closure between adjacent panels during installation is ensured by the compression of the insulation layer, which is normally exerted during the joining of one panel to another.

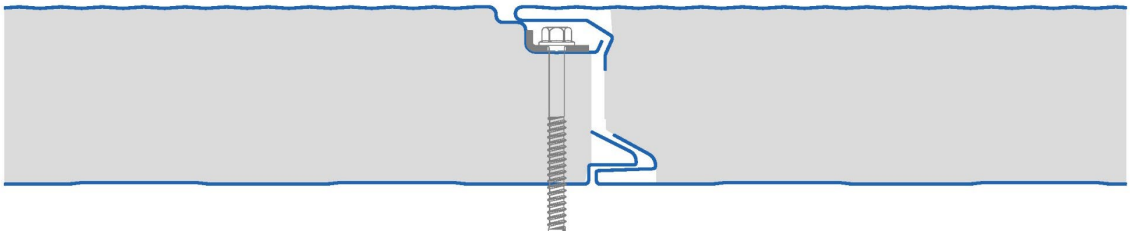
The joint of panels with mineral wool insulation is not fitted with gaskets, so that the non-combustibility characteristics are maintained. The shape of the tongue-and-groove interlock is designed to prevent water infiltration from outside and to reduce the formation of thermal bridges. When installing the panels, it is necessary to manually rotate the second panel so that it can fit properly into the previously installed panel, as shown in the figure.

ISOFIRE WALL – ISOFIRE WALL FONO – ISOFIRE WALL FG-VF – ISOFIRE WALL FG-VF FONO

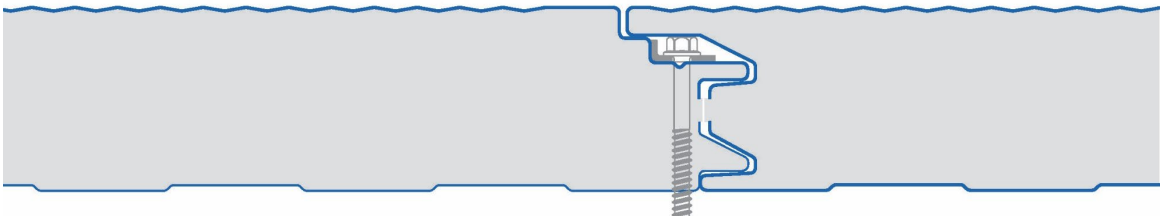


MINERAL WOOL INSULATION – CONCEALED FASTENING

ISOFIRE WALL PLISSè – ISOFIRE WALL FG-HF (F ext = ~ 4-5mm)



ISOPARETE FIRE EVO – ISOPARETE FIRE EVO FONO

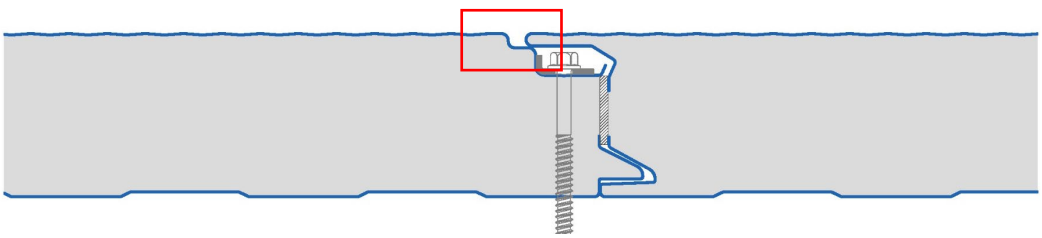


GAP ON THE OUTER SIDE

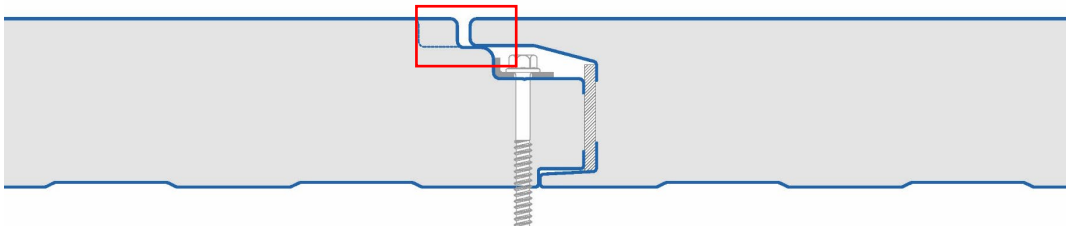
For some products, there is a gap at the joint. This joint remains visible once the products are brought together and installed, and its presence does not result in incorrect installation.

In some products, the joint can be modulated to a standard or optional size, depending on aesthetic and functional requirements. For detailed information, please refer to the Isopan Technical Drawings.

PRODUCT	F Standard (mm)	F Optional (mm)
ISOPARETE	~ 4-5 mm	-
ISOPARETE PLUS-2	~ 4-5 mm	~ 18 mm
ISOPARETE EVO	~ 2 mm (Germany) ~ 4-5 mm (Italy)	-
ISOPARETE FIRE EVO	~ 4-5 mm (Italy)	



Isoparete



Isoparete Plus-2

Isoparete EVO; Isoparete Fire EVO

FASTENING AND INSTALLATION

ASSEMBLY INSTRUCTIONS

PRELIMINARY OPERATIONS

- Verify that the supports are properly aligned. Please refer to the appropriate annex in this document.
- Pay particular attention to the contact points between the supports and the panel support sheets to avoid phenomena linked to electrochemical corrosion if incompatible metals are coupled. For this purpose, elastomer or expanded resin strips may be applied as separators.
- Ensure that the site area has appropriate storage and handling capacity in order to prevent material damage.
- Use suitable tools (toothed circular saw, jigsaw, shears, nibbler) for on-site cutting operations. The use of equipment that produces metallic sparks (e.g. abrasive discs, disc cutter) is strictly not recommended.
- Use suitable handling systems, particularly for long or heavy panels, in order to prevent safety risks on site and damage to the product.

Using acetic silicones is prohibited as they tend to attack the pre-painted galvanised sheet and form incipient oxidation. It is recommended to use single component sealant silicones with neutral curing that tend to harden due to the air humidity and, being free of solvents, do not attack the paint.

ASSEMBLY

- Apply the basic tinwork (when provided) to the foot of the wall, as well as the tinwork that must be installed before the wall, such as drip edges, roof fittings, etc.
- Remove the protective film from the panels, if any.
- Apply the panels starting from the bottom of the wall, or the side end in case of vertical assembly, taking care to join them properly and to ensure they are plumb. *
- Systematically fasten the elements after ensuring they match correctly. The fastening screw must be inserted orthogonally to the panel.
- If the wall height involves the need to assemble panels vertically, the junction is made at the frame and requires appropriate use of shaped fitting tinwork (ridge caps, drip edges, etc.).
- Use ''U''-shaped ridge caps and drip edges for doors and window frames.
- Apply the finishing elements (angle bars, perimeter edgings, fittings).
- Check and clean the walls, with particular attention to metal scraps, fastenings and connections with door and window frames.

SCREWS: TYPES, LENGTH AND INSTALLATION

Isopan wall panels are typically installed using self-drilling screws and a metal washer with gasket. Fastening varies according to the design to be constructed and on the panel application system at the construction site.

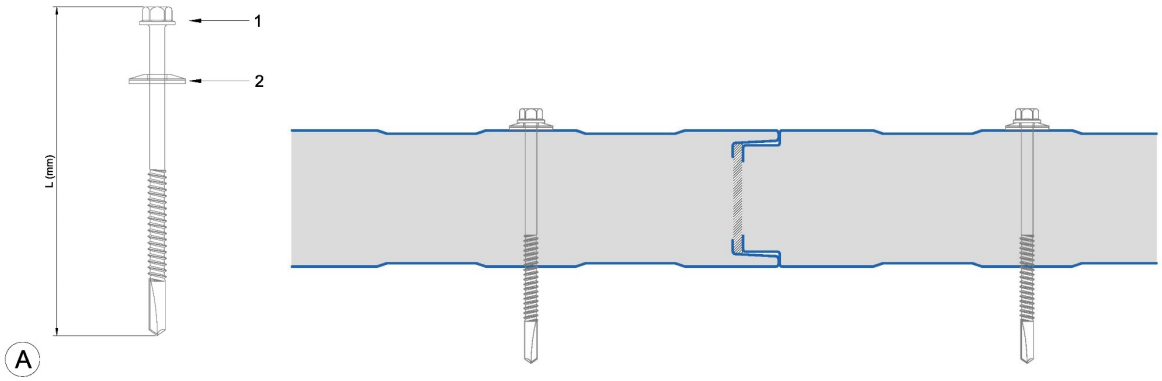
ALUMINIUM PANELS: In the event of Aluminium panel installation, we recommend using stainless steel screws with specific washer.

PANELS WITH VISIBLE FASTENING (A):

SCREW WITH METALLIC WASHER AND GASKET: fastening assembly to be used for panels with exposed fastening, or for additional fastening (outside the standard configuration in the joint) of panels with concealed screw. **Isopan recommends the use of double-threaded screws with a washer and seal with a diameter of not less than 19 mm.**

1: Screw

2: Washer with gasket

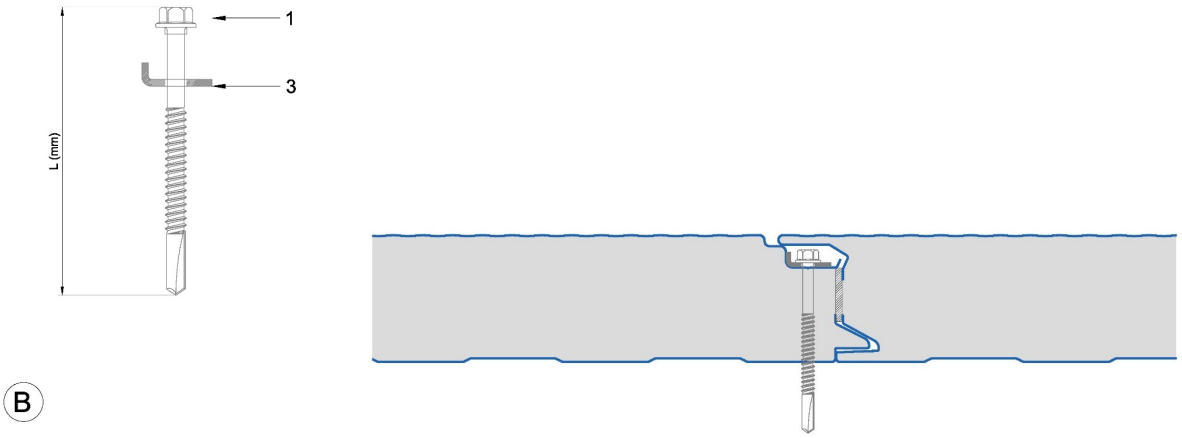


PANELS WITH CONCEALED FASTENING (B):

Screw (without washer and gasket) with metal plate for stress distribution: only to be used for panels with concealed fastening

1: Screw (without washer and gasket)

3: Distribution plate



Correct screw length

The correct length of the screw is chosen mainly based on the panel thickness and on the type of face (steel, wood).

NOTE: The choice of screw length must be made taking into account both the design features and the characteristics of the supports: depending on the morphology, material and size of the supporting elements and supports to which the panel is fixed, the required screw length may vary.

Depending on the country in which the products are installed, the types of screws may vary in accordance with the applicable technical regulations and standards.

INDICATIVE SCREW LENGTH SELECTION GUIDE

The indications below are to be considered indicative. The measurements shown in the table can be considered as minimums, based on Isopan's experience and on the guidelines in the document "Rules for good practice - Wall Cladding and roof coverings with double skin metal-faced insulating panels; Planning installations; Sept. 2020" European Association for Panels and Profiles.

In any case, it is advisable to check with the supplier of the fasteners the actual clamping thickness relative to the type of screw used.

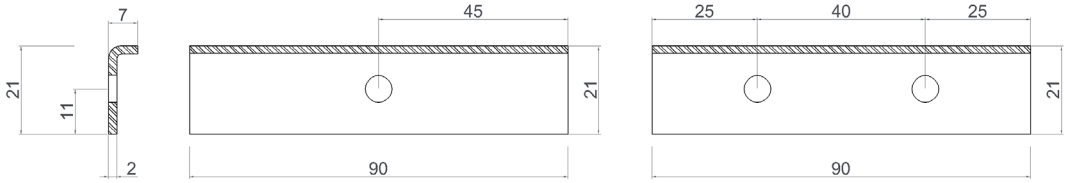
L (mm): Screw length

T (mm): Nominal thickness of the panel

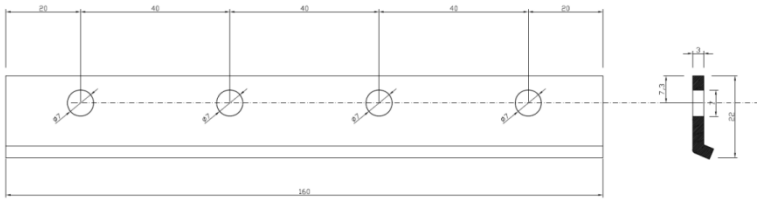
CALCULATION BY SCREW LENGTH	Panels with VISIBLE FASTENING (A)	Panels with HIDDEN FASTENING (B)
	LENGTH OF SCREWS (mm)	
Fastening on METAL structure	L=T+30mm	L=T+15mm
Fastening on WOOD structure	L=T+50mm (1)	L=T+35mm (1)

(1) "Rules for good practice – Wall Cladding and roof coverings with double skin metal-faced insulating panels; Planning installations; Sept. 2020" , European Association for Panels and Profiles

1- OR 2-HOLE EFFORT DISTRIBUTION PLATE (Recommended by Isopan for panels with HIDDEN MOUNTING)



LOAD SPREADING PLATE WITH 4 HOLES (Recommended by Isopan for panels with ZULASSUNG)



INSTALLATION OF FASTENINGS

The purpose of the fastening elements is to efficiently anchor the panel to the load-bearing structure; the type of fastening unit depends on the type of face. The number and position of the fastening elements must guarantee resistance to the stresses induced by dynamic loads, which can also exist in depression.

Appropriately coated carbon steels or austenitic type stainless steels must be chosen as suitable materials to fasten panels. Pay particular attention to the compatibility of the steel and aluminium materials in order to prevent the formation of galvanic currents.

FASTENING METHOD

Before proceeding with the installation of the screws, Isopan recommends carrying out tests in order to correctly adjust the tools (screwdrivers, spanners). Fastening varies depending on the project to be implemented and site application system of the panels. Isopan recommends using double-threaded screws with washer and sealing gasket with 19 mm minimum diameter (in case of panels with visible fastening).

A – EXCESSIVE TIGHTENING TORQUE
Incorrect tightening due to high torque applied to the screw with marked deformations of the metal sheet. In this situation the optimal closure of the interlock is no longer guaranteed, therefore, the aesthetic functionality of the product remains compromised.

B – INSUFFICIENT TIGHTENING TORQUE
Incorrect tightening due to the torque applied to the screw being insufficient to ensure correct fastening of the panel to the structure.

C – CORRECT TIGHTENING TORQUE
Correct tightening obtained by applying sufficient torque to the screw to ensure fastening of the panel to the structure.

PERFORMANCE

FIRE RESISTANCE

The concept of fire resistance is defined, within national legislation, as the ability of a construction element, component, or structure, to retain, according to a predetermined temperature programme and for a set time, in whole or in part, the following requirements:

- The stability or load bearing ability (R): “ability of a structure or a member thereof to withstand the specific actions during the relevant fire exposure” (Eurocodes);
- The seal or integrity (E): “ability of the separation members to prevent the passage of hot gases or ignition beyond the exposed surface, during the relevant fire exposure” (Eurocodes);
- Thermal insulation (I): “ability of a separating member to restrict excessive heat transmission” (Eurocodes).

REACTION TO FIRE (EN 13501–1)

The reaction to fire indicates the degree to which a material participates in the fire which it is subjected to.

The European reference standard to classify the reaction to fire of construction material is EN 13501-1 (Fire classification of construction products and building elements). This standard specifies:

Euroclasses: the standard distinguishes seven classes, with increasing contribution to fire, from A1 (non-combustible product) to F (product not tested/not classified).

Smoke: smoke opacity growth speed

s1 no smoke emission

s2 low smoke emission

s3 strong smoke emission

Burning droplets: fall of burning particles

d0 no burning particles

d1 few burning particles

d2 many burned drops

The fire classification of the panel depends on the type of polyurethane foam used and the thickness of the insulation; for further information, please refer to the Isopan catalogue, the website www.isopan.com or contact the Technical Department.

DESIGN FOR FIRE CRITICAL CONDITIONS (ISOFIRE ROOF)

The panel with MINERAL ROCK WOOL insulation can be used for possible fire exposure on both sides when positioned on the roof and horizontally. Pursuant to the regulations the certified performances refer to and are guaranteed only in conventional test conditions: application of a Standard Fire Curve, as per standard ISO 834, implemented in Italy by regulation UNI EN 1363, used on small-sized structural elements assembled with the specific joint.

It is the designer’s responsibility to justify from an engineering point of view the performance extension at dimensions and under methods other than the laboratory tests, in particular with regards to length and, therefore, the need for intermediate supports, head junction and coupling with other constructive elements, especially structural.

WATER PERMEABILITY (EN 12865)

The resistance of a sandwich panel assembly to driving rain under air pressure must be subjected to testing according to **EN 12865**.

GENERAL DESIGN INSTRUCTIONS

The wall panels generally require, during the design phase, a structure able to absorb the external loading stress that will not submit the panels to excessive and permanent distortions to the detriment of their basic characteristics. When choosing the panel types during the design phase, you should consider some parameters related to environmental actions like:

- **Wind action**: depends on the climatic zone of the building installation; the values vary depending on the wind speed, with consequent greater or lesser load pressure on the exposed surfaces (affects the type and number of panel fastening systems). For this particular panel (with concealed fastening), the action of the vacuum wind on the joint resistance and fastening points must be considered, and the adoption of the specific Isopan stress distribution plate on each screw is prescribed (please consult the ISOPAN Technical Office).
- **Thermal stress**: largely depends on the colour of the external surface of the panel and the building exposure, and can create significant system deformations.
- **Atmospheric corrosion**: depends on the environment where the panels are installed (marine, industrial, urban, rural); mainly affects the degree of corrosiveness on the panel surfaces. In this regard, suitable metallic or organic facings should be chosen (refer to the available documentation or contact the Isopan Technical Department).

In order to make up for possible lack of material due to damages during handling and assembly, Isopan recommends procuring spare panels (quantity equal to approximately 5% of the total).

THERMAL EXPANSIONS

All the materials used to build the roofs, especially metals, are subject to thermal expansion and contraction phenomena, due to temperature changes. The stresses due to metal sheet thermal expansions act on the roofing and can cause functional and structural product anomalies, particularly in case of:

- Significant panel length (L > 8000 mm);
- Solar radiation;
- Medium and dark colours;
- High panel thickness.

VALUES OF LINEAR THERMAL EXPANSION COEFFICIENTS

Material	Thermal expansion coefficient (°C-1)
Aluminium	23.6 x 10-6
Steel	12.0 x 10-6
Stainless steel AISI 304	17.0 x 10-6
Material	Thermal expansion coefficient (°C-1)

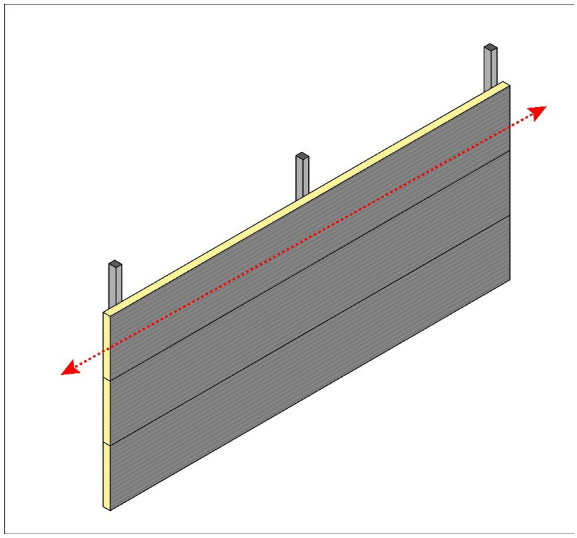
TEMPERATURE RANGE and DILATATION JOINTS

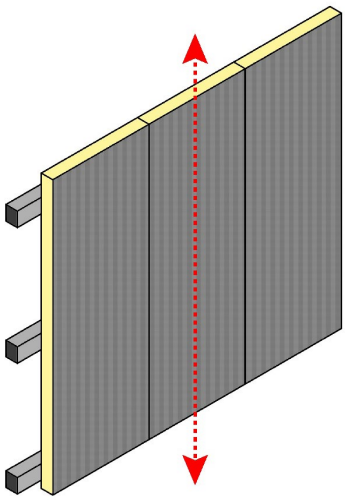
TYPE OF FACING		SURFACE TEMPERATURES (°C)	
		Min.	Max.
Insulated	Light	-20	+60
	Dark	-20	+80
Where "insulated" means that an insulating core is inserted between the external sheet and the structure; "light or dark" means the surface colour of the sheet.			

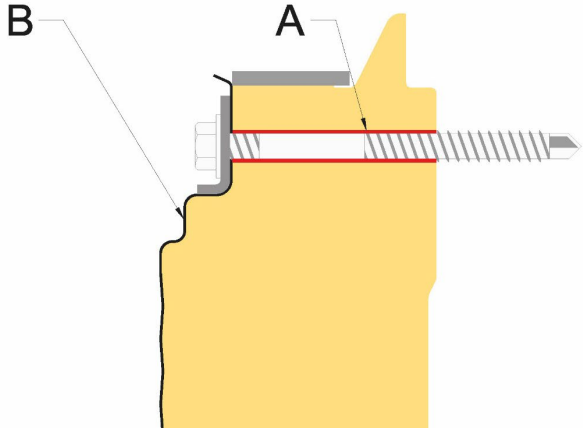
For high surface temperatures, the linear extension of the metal face must be absorbed by the system; cyclic temperature changes related to the day-night or freeze-thaw fluctuations create uncontrollable cyclic stresses that fatigue the support elements. These stresses may cause flaws and undulations in wall panels and, in more severe cases, even wrinkling phenomena. These issues may be overcome by complying with the requirements:

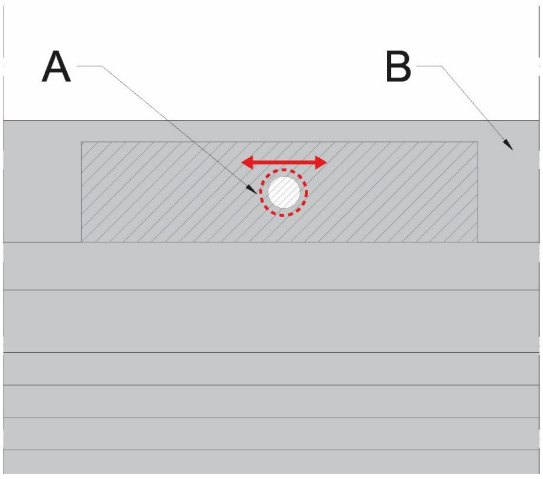
- Calculate in advance the deformation induced on the panel by thermal expansion
- Do not use dark colours on long panels
- Use suitable thickness of the metal supports (minimum 0.6 mm to be assessed based on the design specifics)
- Segment the panels
- Use sliding anchors (see diagram below)

  Attention: the use of any sliding anchor system must be carefully evaluated by the designer on the basis of the design and site conditions in order not to compromise the stability and functionality of the installation.







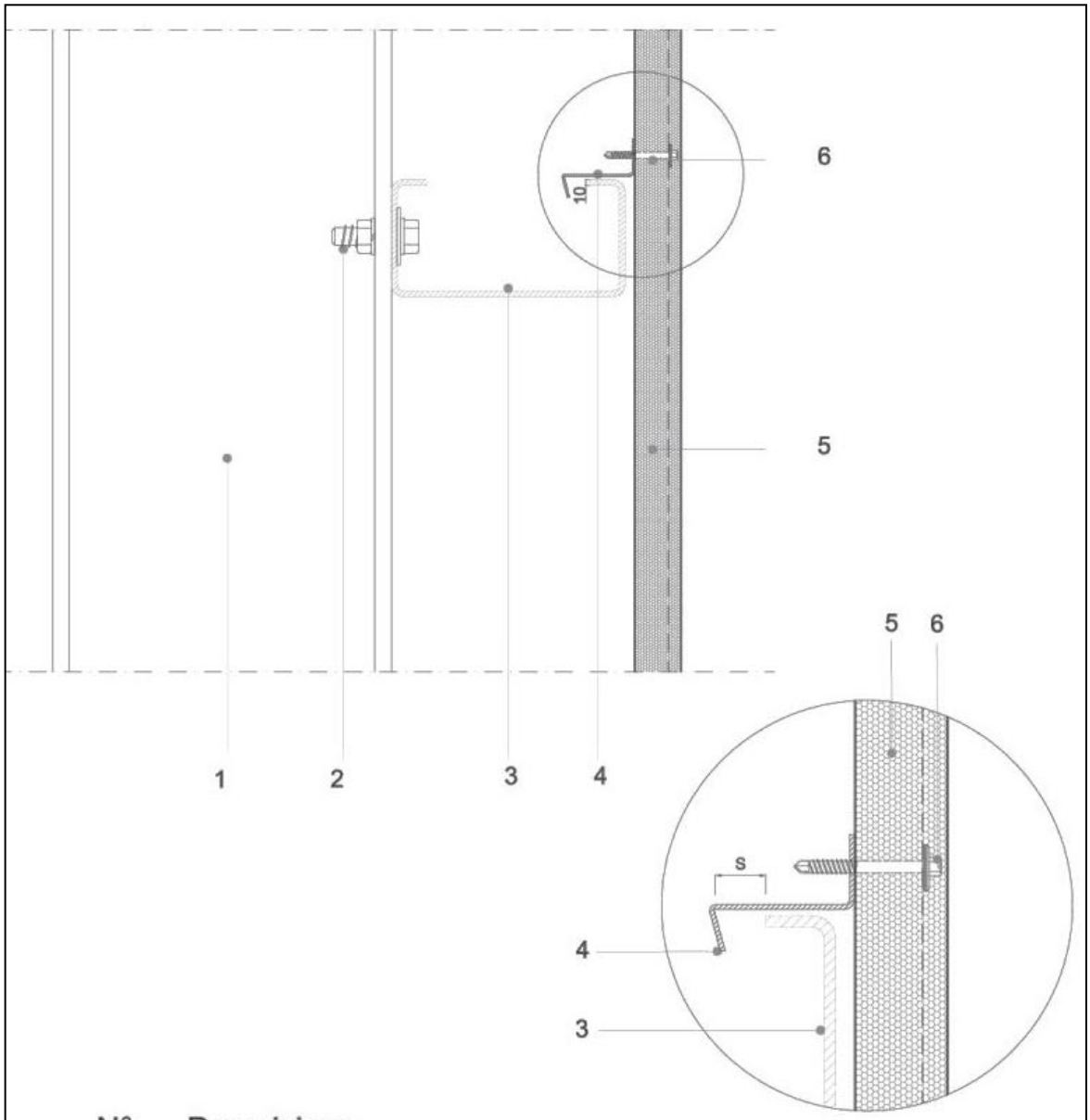


A: slightly increased pre-drilling on the panel to allow for a physiological slight movement of the panel in the event of thermal expansion

B: Isopan Panel

- Use a panel fastening system able to offset the shift caused by the excessive thermal expansions; this solution is particularly important when using panels with aluminium faces (see for example figure below).

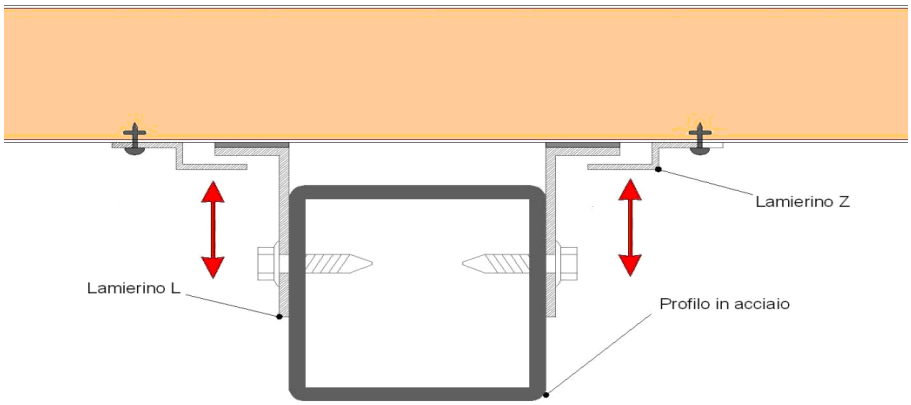
EXPANSION JOINTS – EXAMPLE WITH CONCEALED FASTENING PANEL



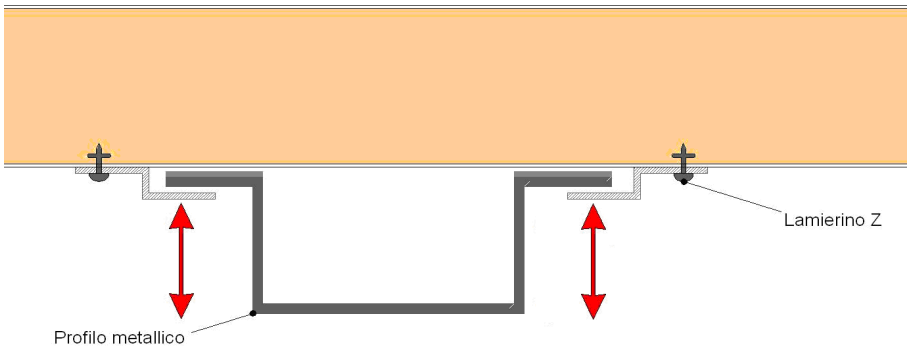
N°	Descrizione
1	Struttura portante in acciaio
2	Bullone
3	Profilo a C in acciaio per appoggio intermedio
4	Profilo di blocco
5	Pannello parete ISOPAN (fissaggio nascosto)
6	Vite di fissaggio
S	Gioco di compensazione per dilatazione termica

WHEN NECESSARY, INTERMEDIATE SUPPORTS ARE TO BE USED:

Solution 1



- Solution 2



Therefore, the assembly stage is critical for the following reasons:

- Due to the very nature of the mechanical joint: the profiles of the tongue-and-groove joints are accurate and, therefore, due to the effect of linear elongation and bowing caused by solar irradiation, the assembly phase can be difficult or compromised;

- Due to the bending stiffness of the panel: panels with high thicknesses have a higher stiffness than those with average-low thicknesses; any abnormalities during assembly due to thermal effects cannot be resolved with "adjustments" during installation, causing jointing difficulties.

NOTE – DARK COLOURS FOR PANELS

Sandwich panels with dark external faces that reach external surface temperatures of around +80°C (as described in UNI EN 14509) are submitted to a deflection perpendicular to the longitudinal axis of the panel. This deflection, which depends on the temperature difference between the external and internal metal sheet, is particularly noticeable for long simple span panels. To limit such deformations that undermine the panel's appearance, Isopan recommends complying with the maximum work spans specified in the following table.

It is important to emphasise that for this type of panel (with concealed fastening), the mechanical action brought about by the sum of thermal loads and wind suck-out loads must be considered significant for proper joint functionality and stability. ISOPAN suggests not to exceed the maximum centre distances between supports shown in the following tables:

Isoparete:

THERMAL LOAD TABLES WITH ΔT = 55°C
DARK EXTERNAL METAL SHEET COLOUR - GROUP III

Concealed fastening with a screw on every support with load spreading plate

Dark steel sheet 0.6 mm - support 120 mm

ΔT = 55°C (dark external sheet colour - Group III)						
	Nominal panel thickness (mm)					
	40	50	60	80	100	120
	Maximum span (cm)					
	130	160	190	275	345	430

Isoparete EVO:

THERMAL LOAD TABLES WITH ΔT = 55°C
DARK EXTERNAL METAL SHEET COLOUR - GROUP III

Concealed fastening with a screw on every support with load spreading plate

Dark steel sheet 0.6 mm - support 120 mm

ΔT = 55°C (dark external sheet colour - Group III)				
	Nominal panel thickness (mm)			
	60	80	100	120
	Maximum span (cm)			
	210	300	380	470

Isoparete Plus:

THERMAL LOAD TABLES WITH ΔT = 55°C
DARK EXTERNAL METAL SHEET COLOUR - GROUP III

Concealed fastening with a screw on every support with load spreading plate

Dark steel sheet 0.6 mm - support 120 mm

ΔT = 55°C (dark external sheet colour - Group III)					
	Nominal panel thickness (mm)				
	40	50	60	80	100
	Maximum span (cm)				
	120	150	180	260	330

(*) The calculation considers a deformation limit equal to 1/300 of the span to limit panel deformation due to thermal loads induced by the dark colour of the external metal sheet

REFLECTANCE OF METAL SURFACES

Reflectance refers to the ratio of the intensity of globally reflected solar radiation to the intensity of incident radiation on a surface expressed in the form of a dimensionless parameter in the [0-1] or [0-100] scale.

High reflectance materials are suggested in order to avoid overheating of the building envelope surfaces, in order to limit the energy needs for summer air conditioning and to contain the internal room temperature. Prepainted metal surfaces in light colours (e.g. similar RAL9002, similar RAL9003, similar RAL9010, and white/grey colours) can positively influence reflectance values.

RESTRICTIONS OF USE

A thermohygrometric check should be performed during the design stage. In certain conditions (e.g. high indoor humidity), condensation can appear on the internal face of the panel with consequent burning droplets inside the building. If these conditions persist long enough, they can accelerate the natural degradation of the organic facing of the support itself.

Due to solar radiation, the external face of the panel can reach relatively high temperatures. In some cases, a temperature of 80÷90 °C can be reached. A high temperature gradient can lead to panel buckling and wrinkling. The problem can be limited with an accurate design, taking into account the environmental conditions, length, colour of the panels and the number of fastening elements. (See the "Thermal expansion" section).

OVERHANGS AND PROJECTIONS

Cantilever assessment and verification must be carefully analysed on a case-by-case basis by the designer, based on product characteristics (product thickness, sheet thickness, type of panel installed) and design characteristics (length of cantilever, size of supports, site conditions, snow load).

In the case of overhangs and projections made with panels (in the absence of a load-bearing structure underneath them in the cantilevered part), it is a good idea to provide an appropriate maintenance plan to prevent accidental loads on the cantilevered part from becoming permanent (snow accumulation).

Mounting, fastening and design instructions according to UNI 10372 apply.

LENGTH OF PANELS

When ordering and dimensioning panels, Isopan recommends considering the length as a parameter directly related to the deflection of the panels both during handling and during service life (see section "Thermal expansion").

Panels with large lengths can lead to difficulties in transport and storage, as well as safe handling, due to deformations that may occur during construction.

Panels produced with considerable lengths (L>8000mm) must be carefully evaluated by the designer during handling and installation, as well as with regard to thermal expansion. It is advisable to provide handling systems that can preserve the integrity of the products, particularly when moving at height.

For more information, please refer to the chapter "Transport, storage, packaging", as well as "Annex A – Loading, unloading, handling, installation and maintenance" and "Annex B – Suction cup lifters".

In any case, Isopan recommends not exceeding the maximum size that can be transported by standard vehicle.

STATIC CHARACTERISTICS: LOADS AND SPANS

The resistance values refer to a panel assembled horizontally and subject to the action of a distributed load; the calculation method used by ISOPAN does not consider the thermal effects, which are verified by the designer. Depending on the weather conditions of the installation site and the colour of the external face, if the designer feels a detailed verification of the stresses caused by thermal actions and long-term effects is necessary, he/she should contact the ISOPAN Technical Office. The designer is still responsible for checking the fastening systems, based on their number and positioning.

The indications contained in the following tables do not take into account the effects due to thermal load. Furthermore, the indicative values provided cannot replace the design calculations drawn up by a skilled technician, who must validate this information under the laws in force in the place of installation of the panels.
Below are some examples of indicative load bearing capacity tables:

PANELS WITH POLYURETHANE INSULATION

Gamma ISOBOX, ISOPARETE, ISOPARETE PLUS2, ISOPARETE EVO, ISOFROZEN – Simple support

STEEL SHEETS 0.5/0.5 mm – SIMPLE support 120 mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	180	200	240
	MAXIMUM SPAN cm											
50	260	320	380	440	550	640	730	800	820	890	920	-
60	240	300	350	410	500	590	680	745	765	780	900	-
80	205	260	310	350	440	520	600	660	675	720	840	-
100	180	230	275	320	395	470	540	590	605	700	760	-
120	165	210	250	290	360	430	490	535	550	640	690	-
140	150	190	230	265	330	395	455	500	510	590	640	-
160	135	175	210	245	310	370	425	465	475	550	600	-
180	125	165	195	230	290	345	400	440	450	510	560	-
200	115	155	185	215	270	325	375	410	420	480	520	-

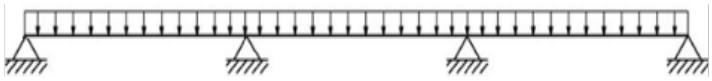
STEEL SHEETS 0.6/0.6 mm – SIMPLE support 120 mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	180	200	240
	MAXIMUM SPAN cm											
50	-	-	-	-	-	650	760	-	850	960	980	-
60	-	-	-	-	-	610	700	-	820	930	950	-
80	-	-	-	-	-	530	610	-	720	820	890	-
100	-	-	-	-	-	470	540	-	640	730	800	-
120	-	-	-	-	-	420	490	-	580	660	730	-
140	-	-	-	-	-	390	450	-	530	620	660	-
160	-	-	-	-	-	360	410	-	500	570	620	-
180	-	-	-	-	-	330	380	-	460	530	580	-
200	-	-	-	-	-	310	360	-	430	500	550	-

ALUMINIUM SHEETS 0.6/0.6 mm – SIMPLE support 120 mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	180	200	240
	MAXIMUM SPAN cm											
50	200	240	290	330	410	480	550	605	615	-	-	-
60	180	230	270	310	380	450	510	560	570	-	-	-
80	160	200	240	270	335	390	450	495	505	-	-	-
100	145	180	215	245	305	360	400	440	450	-	-	-
120	135	165	195	220	280	330	380	415	425	-	-	-
140	125	155	185	210	260	310	355	390	395	-	-	-
160	115	140	170	195	240	285	335	365	375	-	-	-
180	110	135	160	185	230	275	310	340	345	-	-	-
200	100	125	150	175	220	260	300	330	335	-	-	-

Gamma ISOBOX, ISOPARETE, ISOPARETE PLUS2, ISOPARETE EVO, ISOFROZEN – Multiple Support



STEEL SHEETS 0.5/0.5 mm - MULTIPLE support 120mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	180	200	240
	MAXIMUM SPAN cm											
50	300	380	450	520	650	740	800	880	900	930	960	-
60	270	340	410	470	590	660	710	780	795	900	920	-
80	230	290	350	410	500	550	600	660	675	830	850	-
100	200	260	310	360	440	490	510	560	570	710	730	-
120	170	230	280	320	390	430	460	505	515	620	630	-
140	150	200	250	295	360	390	420	460	470	550	560	-
160	130	185	220	265	330	360	385	420	430	490	500	-
180	120	160	200	240	305	340	360	395	405	440	445	-
200	110	145	180	215	285	315	335	365	375	405	410	-

STEEL SHEETS 0.6/0.6 mm - MULTIPLE support 120mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	180	200	240
	MAXIMUM SPAN cm											
50	-	-	-	-	-	760	850	-	920	940	970	-
60	-	-	-	-	-	660	790	-	880	900	925	-
80	-	-	-	-	-	600	660	-	810	850	860	-
100	-	-	-	-	-	530	610	-	710	720	740	-
120	-	-	-	-	-	470	540	-	620	650	660	-
140	-	-	-	-	-	430	500	-	550	560	560	-
160	-	-	-	-	-	390	450	-	490	500	500	-
180	-	-	-	-	-	350	420	-	440	450	450	-
200	-	-	-	-	-	330	390	-	400	400	400	-

ALUMINIUM SHEETS 0.6/0.6 mm - MULTIPLE support 120mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	180	200	240
	MAXIMUM SPAN cm											
50	230	290	350	400	490	580	620	680	695	-	-	-
60	210	270	320	360	450	530	560	635	650	-	-	-
80	185	235	280	320	400	470	540	590	605	-	-	-
100	160	210	250	285	360	420	480	525	540	-	-	-
120	150	190	225	260	330	390	445	485	500	-	-	-
140	135	170	210	240	300	360	410	450	460	-	-	-
160	125	160	190	220	280	330	380	415	425	-	-	-
180	110	150	180	210	265	310	360	395	405	-	-	-
200	100	140	170	195	245	285	335	365	375	-	-	-

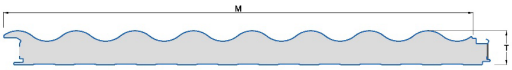
PANELS WITH POLYURETHANE INSULATION - ISOCLASS

ISOCLASS – Simple support

EVENLY DISTRIBUTED LOAD [kg/m2]	STEEL SHEETS 0.5/0.5 mm – SIMPLE support 120 mm			
	NOMINAL PANEL THICKNESS mm			
	72	92	102	122
	MAXIMUM SPAN cm			
50	455	570	610	650
60	420	515	555	600
80	360	455	490	525
100	350	430	465	505
120	310	390	425	455
140	280	350	385	420
160	260	330	360	395
180	260	325	355	385
200	240	305	330	360

EVENLY DISTRIBUTED LOAD [kg/m2]	STEEL SHEETS 0.6/0.6 mm – SIMPLE support 120 mm			
	NOMINAL PANEL THICKNESS mm			
	72	92	102	122
	MAXIMUM SPAN cm			
50	475	600	640	680
60	440	540	580	620
80	380	475	510	545
100	365	450	480	520
120	320	400	435	470
140	290	360	395	425
160	265	335	365	395
180	265	330	360	390
200	240	305	330	360

ISOCLASS – Multiple support



EVENLY DISTRIBUTED LOAD [kg/m2]	STEEL SHEETS 0.5/0.5 mm - MULTIPLE support 120mm			
	NOMINAL PANEL THICKNESS mm			
	72	92	102	122
	MAXIMUM SPAN cm			
50	455	570	605	645
60	410	515	540	570
80	355	435	455	475
100	330	400	425	445
120	290	355	365	385
140	265	320	335	345
160	235	290	305	315
180	225	285	300	315
200	195	265	275	295

EVENLY DISTRIBUTED LOAD [kg/m2]	STEEL SHEETS 0.6/0.6 mm - MULTIPLE support 120mm			
	NOMINAL PANEL THICKNESS mm			
	72	92	102	122
	MAXIMUM SPAN cm			
50	475	600	635	680
60	430	540	565	595
80	370	455	475	495
100	340	420	440	460
120	300	365	380	395
140	270	330	340	355
160	240	295	310	320
180	225	290	305	320
200	195	265	275	295

MINERAL ROCK WOOL INSULATION PANELS

ISOFIRE WALL - ISOFIRE WALL PLISSè - ISOPARETE FIRE EVO – Simple support

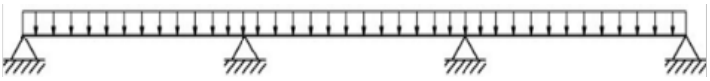
STEEL SHEETS 0.5/0.5 mm – SIMPLE support 120 mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	170	200	240
	MAXIMUM SPAN cm											
50	-	-	440	480	540	610	670	-	755	805	890	960
60	-	-	390	430	495	570	625	-	700	750	825	895
80	-	-	310	355	425	500	550	-	615	650	715	770
100	-	-	250	295	365	440	490	-	550	580	630	680
120	-	-	210	250	315	385	435	-	495	525	565	610
140	-	-	180	210	275	340	390	-	440	475	510	550
160	-	-	160	185	245	300	350	-	400	435	465	500
180	-	-	145	165	220	270	320	-	360	395	425	450
200	-	-	130	150	205	250	295	-	330	360	390	415

STEEL SHEETS 0.6/0.6 mm – SIMPLE support 120 mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	170	200	240
	MAXIMUM SPAN cm											
50	-	-	490	520	600	675	720	-	800	860	935	980
60	-	-	425	470	545	635	685	-	755	810	870	920
80	-	-	335	380	465	550	605	-	670	720	760	820
100	-	-	265	310	385	460	525	-	585	630	665	730
120	-	-	235	270	330	410	470	-	525	560	595	645
140	-	-	200	230	290	360	415	-	470	505	535	570
160	-	-	175	210	260	315	370	-	415	445	480	520
180	-	-	160	190	230	275	335	-	375	405	430	470
200	-	-	140	165	210	255	305	-	335	365	400	430

ISOFIRE WALL - ISOFIRE WALL PLISSè - ISOPARETE FIRE EVO – Multiple support



STEEL SHEETS 0.5/0.5 mm - MULTIPLE support 120mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	170	200	240
	MAXIMUM SPAN cm											
50	-	-	390	420	460	500	540	-	580	630	670	700
60	-	-	345	380	415	450	490	-	520	550	585	620
80	-	-	270	310	345	370	400	-	425	450	485	520
100	-	-	210	250	285	310	335	-	355	375	405	430
120	-	-	180	205	240	265	285	-	305	325	350	370
140	-	-	155	175	210	230	250	-	265	280	300	320
160	-	-	130	155	185	205	220	-	230	245	265	290
180	-	-	120	135	165	180	195	-	205	220	240	260
200	-	-	110	120	150	165	180	-	190	205	220	240

STEEL SHEETS 0.6/0.6 mm - MULTIPLE support 120mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	170	200	240
	MAXIMUM SPAN cm											
50	-	-	430	460	500	540	580	-	610	650	680	710
60	-	-	375	415	455	490	530	-	560	590	615	640
80	-	-	290	330	375	405	440	-	465	495	515	545
100	-	-	220	260	300	330	360	-	380	405	425	455
120	-	-	190	220	250	280	305	-	325	345	365	390
140	-	-	160	190	220	240	265	-	280	300	320	340
160	-	-	140	165	195	215	230	-	245	265	280	300
180	-	-	130	150	175	195	210	-	225	240	255	275
200	-	-	115	135	160	180	195	-	210	225	240	260

MINERAL ROCK WOOL INSULATION PANELS - FONO

ISOFIRE WALL FONO – ISOPARETE FIRE EVO FONO – Simple support

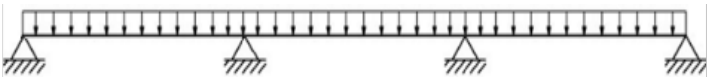
0.5 mm EXTERNAL STEEL SHEET / 0.6 mm MICRO-DRILLED INTERNAL SHEET (FONO) – SIMPLE support 120mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	170	200	240
	MAXIMUM SPAN cm											
50	-	-	370	400	450	510	560		635			
60	-	-	325	360	415	475	525		585			
80	-	-	260	295	355	420	460		515			
100	-	-	210	245	305	370	410		460			
120	-	-	175	210	265	320	365		415			
140	-	-	150	175	230	285	325		370			
160	-	-	130	155	205	250	290		335			
180	-	-	120	135	185	225	265		300			
200	-	-	105	125	170	210	245		275			

INTERNAL EXTERNAL SHEET 0.6 / MICRO-DRILLED INTENAL SHEET (FONO) 0.6 mm – SIMPLE support 120mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	170	200	240
	MAXIMUM SPAN cm											
50	-	-	410	435	505	565	605		670			
60	-	-	355	395	455	535	575		635			
80	-	-	280	320	390	460	505		560			
100	-	-	220	260	320	385	440		490			
120	-	-	195	225	275	345	395		440			
140	-	-	165	190	240	300	345		395			
160	-	-	145	175	215	265	310		345			
180	-	-	130	160	190	230	280		315			
200	-	-	115	135	175	210	255		280			

ISOFIRE WALL FONO – ISOPARETE FIRE EVO FONO – Multiple support



0.5 mm EXTERNAL STEEL SHEET / 0.6 mm MICRO-DRILLED INTERNAL SHEET (FONO) – MULTIPLE support 120mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	170	200	240
	MAXIMUM SPAN cm											
50	-	-	325	350	385	420	455	-	485	-	-	-
60	-	-	290	320	345	375	410	-	435	-	-	-
80	-	-	225	260	290	310	335	-	355	-	-	-
100	-	-	175	210	240	260	280	-	295	-	-	-
120	-	-	150	170	200	220	240	-	255	-	-	-
140	-	-	130	145	175	190	210	-	220	-	-	-
160	-	-	105	130	155	170	185	-	190	-	-	-
180	-	-	100	110	135	150	160	-	170	-	-	-
200	-	-	90	100	125	135	150	-	160	-	-	-

0.5 mm EXTERNAL STEEL SHEET / 0.6 mm MICRO-DRILLED INTERNAL SHEET (FONO) – MULTIPLE support 120mm

EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm											
	30	40	50	60	80	100	120	140	150	170	200	240
	MAXIMUM SPAN cm											
50	-	-	360	385	420	455	485	-	510	-	-	-
60	-	-	315	345	380	410	445	-	470	-	-	-
80	-	-	240	275	315	340	370	-	390	-	-	-
100	-	-	185	215	250	275	300	-	320	-	-	-
120	-	-	160	185	210	235	255	-	270	-	-	-
140	-	-	130	160	185	200	220	-	235	-	-	-
160	-	-	115	135	160	180	190	-	205	-	-	-
180	-	-	105	125	145	160	175	-	185	-	-	-
200	-	-	95	110	130	150	160	-	175	-	-	-

TRANSPORT, STORAGE, PACKAGING

LORRY LOADING

The packages of panels are loaded on lorries, usually two in width and three in height. The packages include polystyrene spacers at the base, which are thick enough to allow for the lifting straps.

The goods are arranged on the vehicles so as to ensure safe transportation and integrity of the material, in accordance with the requirements of the carrier, who is solely responsible for load integrity. Pay special attention to ensure the weight bearing on the bottom package, as well as the pressure exerted in the tying points, do not cause damage and the straps do not distort the shape of the product in any way.

Isopan assumes no liability for loading lorries that are already partially occupied by other materials, or that do not have a suitable loading floor.

Customers who will pick up the material must instruct the drivers accordingly.

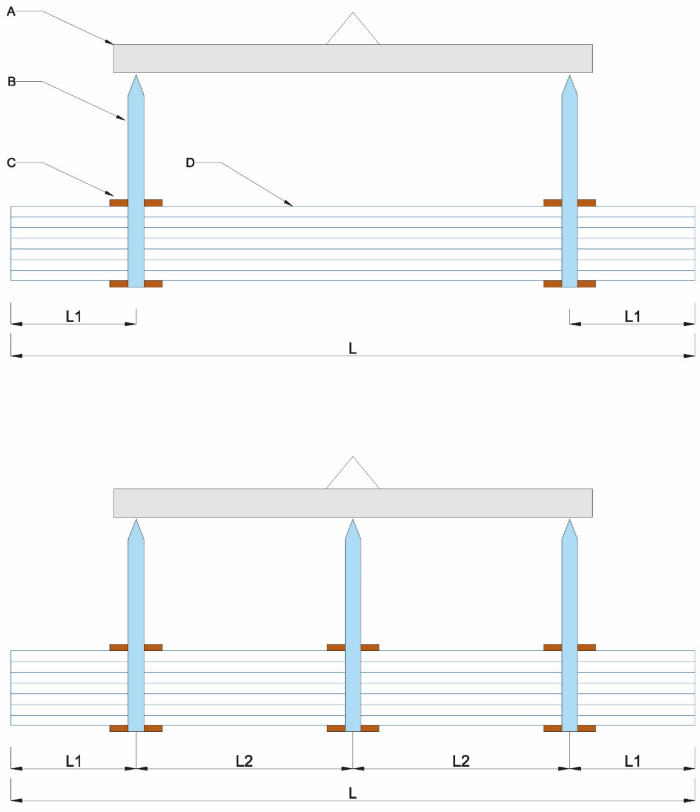
UNLOADING WITH CRANE

Use any type of crane equipped with a spreader beam and equipped straps. Isopan can advise customers on the choice of spreader beams and straps. By using correct lifting systems, the panels will not be damaged.

Never use chains or metal cables for lifting. As a general rule, sling the packages leaving about 1/4 of their length protruding from each end.

For lifting operations at height, Isopan recommends providing at least two support points using suitable straps, crossbars and spacers, in order to minimise panel bending and deformation. In the case of particularly long panels (L>8000mm), it may be useful to consider using 3 or more support points.

Examples of lifting point arrangements are shown in the following image.



A	Lifting crossbeam
B	Lifting belts/straps
C	Spacers/rigid support elements
D	Isopan panels package

The support points must be arranged in such a way that the products can be lifted safely, in order to prevent damage from excessive deformation and falls.

LORRY UNLOADING WITH FORKLIFTS

If the lorries are unloaded using a forklift, the length of the packages and their possible bending should be taken into account in order to prevent damage to the bottom of the package.

The forks must be wide and long enough in order not to damage the product. When possible, protective material against surface abrasion and scratches should be applied between the fork and the package.

Lifting with forklift trucks must be carried out using means equipped with suitably sized gripping forks. In the case of particularly long panels (L>8000mm), it may be necessary to use two forklift trucks in order to increase the support surface of the package during unloading, and thus reduce the deflection due to the products' own weight.

INDOOR STORAGE (ANNEX A)

The materials must be stored in ventilated indoor facilities that are free of dust and humidity and not subject to temperature changes.

Moisture that can penetrate (rain) or form (condensation) between two panels can damage the facings since it is particularly aggressive on metals and facings, with subsequent oxidation.

Pre-painted facings can be more exposed to the negative consequences of combined heat/humidity conditions.

OUTDOOR STORAGE (ANNEX A)

If the packages and accessories are stored outdoors, the surface must absolutely be inclined longitudinally to prevent moisture from accumulating and to allow water run-off and natural air circulation.

If storage is not shortly followed by pick-up for installation, it is advisable to cover the packages with a protective tarp, ensuring impermeability as well as adequate ventilation to prevent condensate from accumulating and puddles of water from forming.

STORAGE TERMS (ANNEX A)

Based on experience, in order to maintain original product performance, continuous indoor storage in closed and ventilated facilities should not exceed six months, while outdoor storage should never exceed sixty days from the date of production. These terms refer to the properly stored product, as instructed in the ''storage'' chapter in Annex A. However, the materials must always be protected against direct sunlight, as it may cause alterations.

In case of transport in containers, the products must be removed from them as soon as possible and, however, no later than 15 days from the loading date, to prevent deterioration of the metal supports and organic facings (e.g. blistering). Moisture inside the container must strictly be avoided. Upon customer request, Isopan can provide special packages that are more suitable for transport in containers.

PACKAGING

Isopan suggests carefully choosing the type of packaging depending on destination, type of transport, conditions and length of storage.

To choose the correct type of packaging, please refer to the "Packaging and Services" document on www.isopan.com.

DURABILITY

Product durability depends on the intrinsic features of the panel used in relation with its final use. The panel, including the features of the metal supports, must be chosen after the roof has been properly designed.

In this regard we recommend, if necessary, using the Isopan documentation, also available on the web (www.isopan.com), and/or the reference standards.

We recommend, especially for roof panels with metal facings in pre-painted galvanised steel, checking the roof pitch slope and other construction details in order to promote normal water drainage and prevent aggressive materials from accumulating, which would lead to premature oxidation.

In the event of roof pitches with longitudinal overlapping (panel overlap), we recommend paying special attention during installation to seal the sheets in order to prevent leaks or stagnation on the end part of the panel.

We recommend using accessories like ridge tinwork, caps and gaskets supplied by Isopan, as they are appropriately designed for the specific use of the manufactured products.

MAINTENANCE

All types of facings, including those made with metal sandwich panels, require maintenance.

The type and frequency of maintenance depend on the product used for the external facing (steel, aluminium); in any case, it is recommended to periodically inspect the building (at least once a year), in order to assess its conditions.

In order to maintain the aesthetic and physical properties of the elements and to extend the efficiency of the protective facing, it is also recommended to regularly clean the roof, paying special attention to the areas that could facilitate rain water stagnation, where substances that are harmful for the durability of the metal support may be concentrated.

If you notice any problems following an on-site inspection, you must act immediately in order to restore the initial general conditions (e.g. restoring the paint where there are local abrasions or scratches).

Upon customer request, Isopan can provide useful information to solve certain problems related to this.

SAFETY AND DISPOSAL

Pursuant to Directive 68/548/EEC the sandwich panel does not require labelling. To meet customer requirements, Isopan has drawn-up a "Technical details for safety" document, to be consulted for any kind of information related to safety.

Conclusion

Caution: all information contained in the product data sheets must be validated by a qualified technician according to the laws in force in the country where the panels are installed.

Technical specifications and features are not binding. Isopan reserves the right to make changes without prior notice; the latest documentation is available on our website www.Isopan.com. For whatever is not explicitly specified herein, please refer to the “General conditions of sale of the corrugated metal sheets, insulated metal panels and accessories”. All the products that fall under the EN 14509 standard field of application are CE marked.

Annex A – Loading, Unloading, Handling, Installation and Maintenance

LORRY UNLOADING WITH CRANE

For lifting, the packages must always be attached in at least two points. The distance between them must be no less than half the length of the packages.

Lifting should be possibly carried out using synthetic fibre straps (Nylon) no thinner than 10 cm, so that the load is distributed on the strap and does not cause distortion.

(see Figure 1)

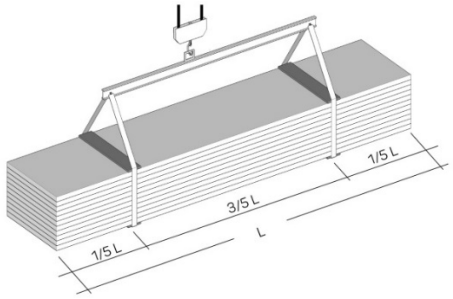


Figure 1

Suitable spacers must be placed under and above the package, made of sturdy solid wood or plastic elements to prevent the strap from coming into direct contact with the package.

These spacers must be at least 4 cm longer than the width of the package and be at least as wide as the strap.

Make sure that the straps and supports cannot move during lifting and that manoeuvres are performed cautiously.

LORRY UNLOADING WITH FORKLIFTS

If the lorries are unloaded with a forklift, take into account the length of the packages and their possible bending in order to avoid damaging the bottom of the package and/or to the extreme failure limit of the panels.

We recommend using forklifts that are suitable for handling panels and similar products.

STORAGE

The packages must always be kept off the ground both in the warehouse and, more so, at the construction site. They must have plastic foam supports with flat surfaces longer than the width of the panels and at a distance adequate to the features of the product.

The packages should preferably be stored in dry facilities to prevent stagnation of condensation water on inner, less ventilated elements, which is particularly aggressive on metals, resulting in the formation of oxidation.

The panels must be stored in dry ventilated facilities; should this not be possible, open the packages and ventilate the panels (spacing them from each other). If the panels remain packaged outdoors, the galvanised facing may oxidise (white rust) even after a few days, due to electrolytic corrosion.

The panels must be stored to facilitate water run-off, especially when it is necessary to temporarily store them outside (see Figure 2).

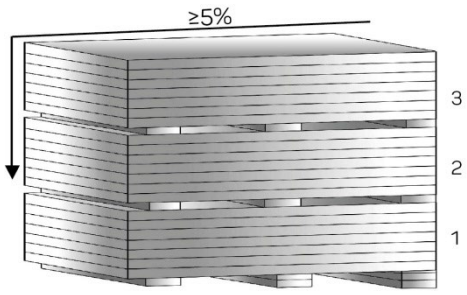


Figure 2

If storage is not shortly followed by pick-up for installation, it is advisable to cover the packages with protective tarps.

To maintain original product performance, continuous indoor storage in ventilated facilities should not exceed 6 months, while outdoor storage should never exceed 60 days.

Packages stored at a height must always be properly bound to the structure.

PRE-PAINTED FACES

In case of prolonged storage, the pre-painted products must be stored indoors or under a canopy. There is the risk that stagnant humidity may attack the paint layer, causing it to detach from the galvanised face. It is not advisable to let more than two weeks elapse from when the products were stored at the site.

In case of container transport, the products must be removed from the container within 15 days from the loading date in order to prevent the metal supports from deteriorating.

PANEL HANDLING

The panels must be handled using adequate protection equipment (accident-prevention shoes, gloves, overalls, etc.) in compliance with current regulations.

The individual element must always be manually handled by lifting the element without dragging it on the ground and turning it sideways beside the package; it must be transported by at least two people according to the length, keeping the element on its side. (see Figure 3)

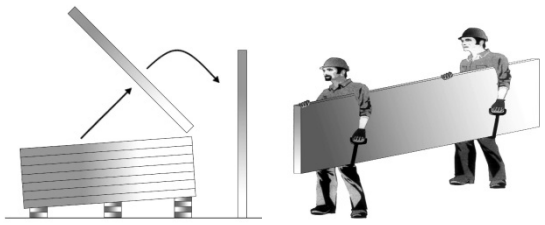


Figure 3

Handling equipment as well as gloves must be clean and such not to damage the items.

INSTALLATION

Panel installation personnel must be qualified and know the correct technique to perform the work in a workmanlike manner. If required, the seller can provide appropriate guidance and instructions.

Installation personnel must be equipped with footwear with soles that do not damage the external facing of the panel.

On-site cutting operations must be done with suitable tools (jigsaw, shears, nibbler, etc.).

We do not recommend using tools with abrasive discs.

To fasten the panels, it is advisable to use devices that can be provided by the seller.

Tighten the screws using a screwdriver with torque limitation.

For roofs with pitch elements without intermediate joints (overlaps), the slope is usually no less than 7%. For smaller slopes, adopt the seller's provisions.

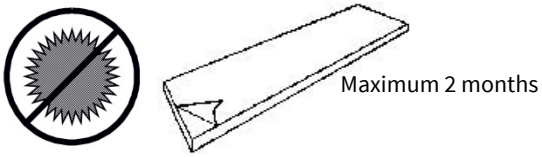
In case of head overlaps, the slope should take into account the type of joint and material used, as well as the specific environmental conditions.

During panel assembly and, in particular, in roofs, it is necessary to immediately remove all residual materials paying special attention to metal ones that may cause early deterioration of the metal supports by oxidising.

PROTECTIVE FILM

The pre-painted metal facings are supplied upon request with adhesive polyethylene protective film that prevents damage to the paint layer.

The protective film covering the pre-painted panels must be completely removed during assembly or, in any case, within 60 days from material preparation. It is also recommended not to expose the panels covered by a protective film to direct sunlight.



For panels expressly requested without protective film, special care is required during on-site handling and installation.

MAINTENANCE

The main routine maintenance operation is cleaning the panels. Panel surfaces that, following visual inspection, are found to be dirty or oxidised can be washed with soap and water using a soft brush. Cleaning water pressure can be applied up to 50 bar, but the jet must not be too close or perpendicular to the surfaces. Near the joints the water must be sprayed at a sufficient angle not to undermine their tightness.

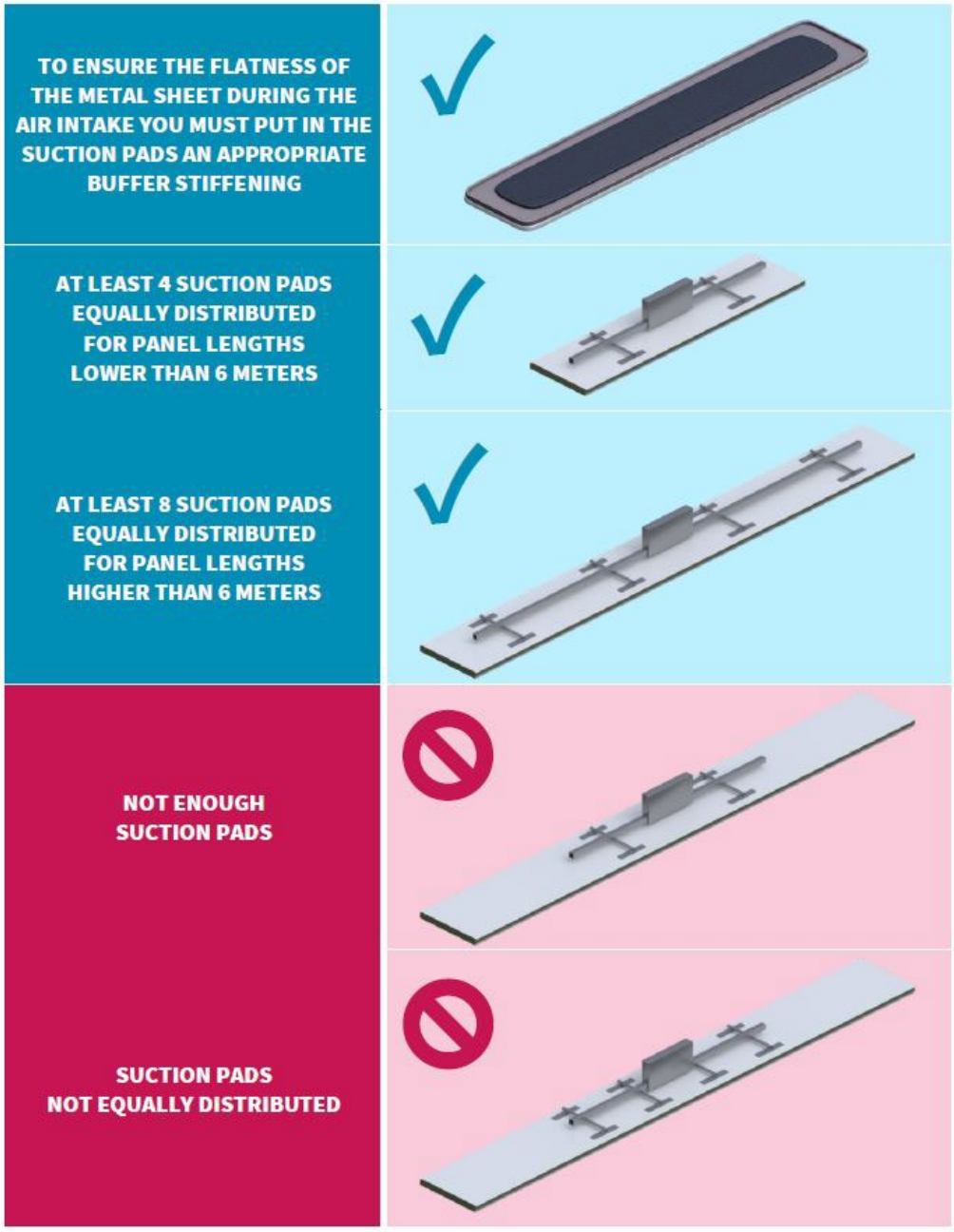
YEARLY CHECKS OF THE ISOPAN PANELS	
WHAT TO INSPECT	**CORRECTIVE ACTIONS**
Conditions of the pre-painted surfaces (cracks and colour unevenness)	Assess the condition of the surfaces Repaint where possible
Scratches and dents	Repaint and repair dents
Fastening screws	Remove a screw and check if oxidised Tighten the screws where necessary
Angular cut-edge parts	Check the state of oxidation Clean and repaint

These provisions are taken from the General Conditions of Sale.

Annex B – Suction cup lifters

In the event the panels are handled using suction cup lifters the operations must be carried out ensuring the panel is not deformed. The action of the suction cup on the sheet during lifting must be adequately redistributed taking into account the panel's length and weight.

To prevent excessive force by the suction cups from causing detachment of the sheet from the insulating core, Isopan recommends complying with the following restrictions:



Annex C – Alignment of metal sub-structures

THE IMPORTANCE OF CORRECT STRUCTURE ALIGNMENT BEFORE THE ASSEMBLY AND FASTENING OF ISOPAN PANELS.

The sandwich panels are a constructive element that represents a sort of second skin that covers the structure and, as such, takes on all the level and/or aesthetic deviations in the metal sheets depending on the irregularities or misalignment of the supports on which they will have to be installed.

The metal elements may undergo static and dynamic stresses during their installation to which the effects of “thermal expansion” must inevitably be added, for example due to solar action on the outer surface of the metal sheet.

Precisely for this reason, installers must strictly check the alignment of the structures before proceeding with fastening: the supports on which the panels are fixed must be aligned, flat and free from obstructions, such as welding points, bolts and screws, as any variations may affect performance, the installation and final aesthetics.

All elements required to construct a structure are carefully designed by taking into account the production processes, the subsequent assembly operations and the technical requirements for the safety of the works.

The contractor must draw up an appropriate Assembly Method for each structure to ensure that the activities are carried out in complete safety, taking the requirements of the design documents into account. This document must be approved by the Site Manager and the Designer in order to certify that the Assembly Method does not decrease the quality level established for the structure. All structure assembly activities cannot be started before this document is viewed by the aforementioned designated people.

The following points must be included in this document, if relevant:

- position and type of connections of the structures to be carried out on site;
- maximum weights and dimensions of the elements to be assembled;
- assembly sequences;
- stability of the structure during assembly;
- conditions to remove temporary assembly braces;
- causes of risk during assembly;
- methods required to align the structures and their grouting;
- results from any pre-assembly activities;
- temporary constraints to be set to ensure stability before the welding operation on site, and to control any local deformations;
- identification of any overturning caused by the wind during assembly and indication of the method to counter them;

An integral part of the Assembly Method are the drawings that contain the plans, sections and elevations in adequate scale, the axes of the structures, the position of the supports and the assembly of the components, in addition to the permitted assembly tolerances.

The assembly of a metal structure follows rules of good practice, which are derived from the specific reference standard; first of all Eurocode 3 (EN 1993-1) - Design of steel structures , which is to be used alongside EN 1990 “Basis of structural design”, EN 1991 “Actions on structures”, EN 1090 “Execution of steel structures and aluminium structures- part 2 Technical requirement of steel structures” and lastly, in the Italian context, the Technical Standards for buildings updated to 2018.

During the construction process, it is good practice to ensure that each part of the structure is aligned immediately after assembly and that the final assembly is completed in the shortest time possible.

Permanent connections between components should not be made until the structure is aligned, levelled, plumb and subjected to temporary connections to ensure that the components do not move during subsequent construction or the subsequent alignment of the rest of the structure.

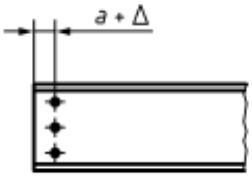
The basic operations to carry out an adequate vertical and horizontal alignment of all parts of the assembled structure involve the use of positioning templates, accurate three-dimensional surveys and partial or total pre-assembly. They can also be supported by the use of specific tools such as the laser spirit level.

Particular attention must be paid to which parts of the structure are not permanently distorted. Adjustments to the structure and the presence of gaps in connections can be resolved by the use of shims, which must be secured if they are in danger of loosening. Unless otherwise specified, they must be in flat steel and have a durability similar to that of the structure.

If the misalignment between the built components cannot be corrected with the use of shims, the components of the structure must be modified locally in accordance with the methods specified in the European standards, however the changes must not compromise the performance of the structure. This work can be performed on site.

To align the connections, the use of broaches is allowed as long as the hole elongation for the bolts does not exceed the values indicated in the tolerance tables of EN standard 1090.

Table B.8 Manufacturing tolerances- Holes for connecting elements, notches and cutting edges

No.	Criteria	Parameter	Essential Tolerances Deviation allowed Δ	Functional Tolerances Deviation allowed Δ	
2	Position of the holes for the connecting elements: 	Deviation Δ in the distance a between a single hole with diameter d_0 and a cut end: if at < 3 d_0 if at ≥3 d_0	Class 1 and 2	Class 1	Class 2
			-Δ= 0 (note the negative direction) Δ=±3 mm	-Δ= 0 +Δ= 3 mm Δ= ±3 mm	-Δ= 0 +Δ= 2 mm Δ= ±2 mm

In any case, it is preferable to correct the misalignment via reaming, mechanical machining to slightly correct the axiality and diameter of the holes.

Steel shims can be used to correctly align the structure on the foundations. If levelling is carried out by means of levelling nuts, they must be chosen based on the fact that they keep the structure stable without affecting the performance of the anchor bolts.

The grouting of the base of the columns must not be carried out until a sufficient part of the structure has been aligned, levelled and braced.

The holes of the base plates of the columns for the anchor rods can have a larger diameter for adjustments, and it is required to use thick washers to be placed between the nuts and the base plate.

Each part of the structure must be aligned as soon as possible, without making permanent connections between the different components until enough parts of the structure have been levelled and connected temporarily.

ASSEMBLY TOLERANCES

EN 1090-2 covers some tolerances that should be complied with and not exceeded during assembly in order not to compromise the stability, resistance and alignment of the structure.

These tolerances are classified as “essential” which, if not complied with, may compromise the stability of the structure, and “functional”, which, on the other hand, refer to the installation and aesthetics of the latter.

The latter are divided into two classes, 1 and 2, with more restrictive requirements switching from the first to the second. The contractor or designer must choose the most appropriate class for the type of structure for these tolerances.

These tolerances are provided in the following tables.

In a purely Italian context, there is an additional document to refer to regarding the design and construction of metal structures, the UX94 “Guide to the standard specifications for metal structures”. This document, provided by UNICMI (National Union of Industries operating in the Metal, Envelope and Door and Window industry) is a contractual document that describes the object of the supply and the services to be requested in order to obtain a good quality product. It also provides technical provisions that comply with the regulations and standards in force, and the procedures and methods to control the implementation activities in order to ensure achievement of the optimal level required;

The UX94 has been drawn up in compliance with the current Italian legislation but also with the technical reference standards, first of all EN 1090-2. However, as can be seen in the following examples, the document sometimes revises it in a more precautionary manner.

Standard EN 1090-2 for single-storey buildings, with reference to the global inclination on height (h), reports as tolerance in class 1, h/300, and in class 2, h/500, while UX94 defines them as not poorly precautionary as in the version compatible with the English standards, it indicates 5 mm, or h/600, as long as it is not higher than 25 mm.

An additional difference between the standard and this document concerns the positioning tolerance of the columns in the plan:

In this regard, *EN 1090-2* defines the tolerances in the table based on the centre distance of the columns and the reference class, while the UNICMI *UX94* defines this tolerance by setting it to 0.002% of the centre distance of the columns, a rule of good practice that is frequently inferred from company specifications, and more restrictive.

Regarding the functional tolerances on the verticality of columns in multi-storey buildings, on the other hand, both *EN 1090-2* and the *document* provided by UNICMI require a maximum of 50 mm on 10 floors, considering 4.5 m floors on the first floor and 3.5 m to the next floors.

The analyses carried out show that the requirements for correct structure alignment are supported by standardised criteria, such as for example what is provided in standard EN 1090-2. Should these rules be too permissive, it is good practice to follow the contents indicated in UX94 provided by UNICMI that revises it in a more cautionary manner, and aims to provide a dynamic guiding tool for professionals in light of standards of good practice, of European technology and C.E. marking.

In any case, both documents agree on the fundamental rules for the alignment of steel structures, functional for the subsequent fastening of the insulating panels, that is:

- Preliminary drafting of an appropriate Assembly Method, containing the assembly stages, the axiality of the structures and any assembly tolerances;
- During construction, do not perform permanent connections between components until the structure is aligned, level and plumb;
- Check verticality through the use of positioning templates, accurate three-dimensional surveys and partial or total pre-assembly, using specific tools such as the laser spirit level;
- Correctly align the structure on the foundations through steel shims and levelling nuts, keeping the holes in the base plates of the columns for the anchor rods with an increased diameter for any adjustments;
- Correct any adjustments to the structure and gaps in connections through the use of shims, or local changes such as the use of broaches or reaming;
- Do not exceed the assembly tolerances set by EN 1090-2;

- Check that the supports on which the panels will be fixed are flat and free from obstructions, such as welding points, bolts and screws, as any variations may affect the performance, installation and final aesthetics of the product.

Table B.15 Construction Tolerances- Buildings

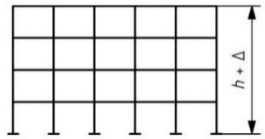
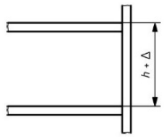
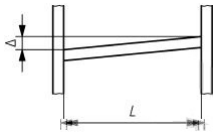
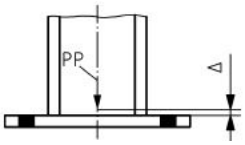
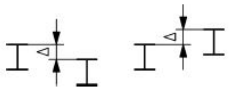
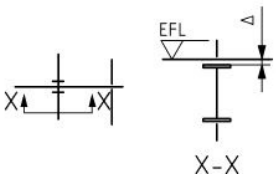
No.	Criteria	Parameter	Functional Tolerances Deviation allowed Δ	
			Class 1	Class 2
1	Height 	Overall height with respect to the base level. $h \leq 20$ [m] 20 [m] < h < 100 [m] $h \geq 100$ [m]	Δ = ± 20 mm Δ= ± 0.5 (h +20) mm Δ= ± 0.2 + (h +200 mm)	Δ = ± 10 mm Δ= ± 0.25 (h +20) mm Δ= ± 0.1 + (h +200 mm)
2	Floor height 	Height with respect to adjacent levels	Δ = ± 10 mm	Δ = ± 5 mm
3	Slope 	Height with respect to the other end of the beam.	Δ = ± L/500 |ma| Δ ≤ 10 mm	Δ = ± L/1000 |ma| Δ ≤ 5 mm
4	Section of the column 	Eccentricity not foreseen and around one of the two axes	5 mm	3 mm
5	Base of the column 	Level of the bottom of the column well, relative to the specified level of its position point (PP).	Δ = ± 5 mm	Δ = ± 5 mm
6	Relevant levels 	Level of adjacent beams, measured at the corresponding ends.	Δ = ±10 mm	Δ = ± 5 mm
7	Connection levels 	Beam level in a beam-to-column connection, measured against the established floor level (EFL)	Δ = ± 10 mm	Δ = ± 5 mm

Table B.16 Construction Tolerances- Beams in buildings

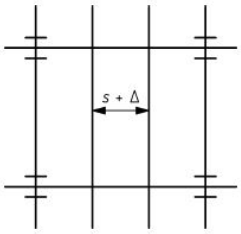
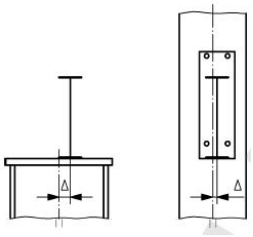
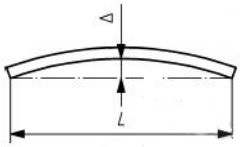
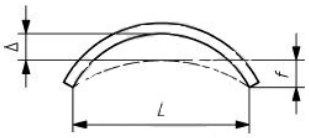
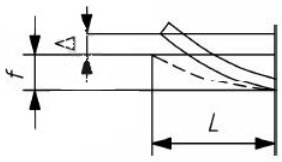
No.	Criteria	Parameter	Functional Tolerances Deviation allowed Δ	
			Class 1	Class 2
1	Spacing between the centre lines of the beam 	Deviation Δ of the predicted distance (s) between adjacent constructed beams, measured at each end.	Δ = ± 10 mm	Δ = ± 5 mm
2	Position on the columns 	Deviation Δ of the required distance of a measured beam-to-column connection with respect to the column.	Δ = ± 5 mm	Δ = ± 3 mm
3	Linearity in the plan 	Deviation Δ of the linearity of a constructed beam or of a length cantilever L	Δ = ± *L*/500	Δ = ± *L*/1000
4	Centring 	Mid-span deviation Δ with respect to the planned centring f of a constructed beam or of a truss element of length L	Δ = ± *L*/300	Δ = ± *L*/500
5	Cantilever presetting 	Deviation Δ of the presetting required at the end of a built cantilever of length L.	Δ = ± *L*/200	Δ = ± *L*/300

Table B.17 Construction Tolerances- Columns of single storey buildings

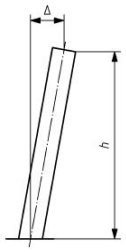
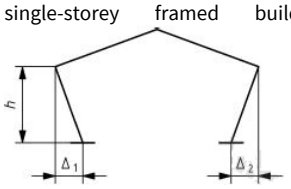
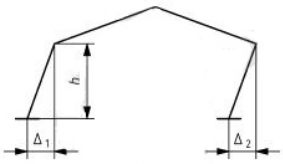
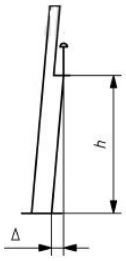
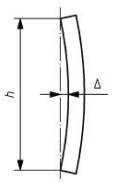
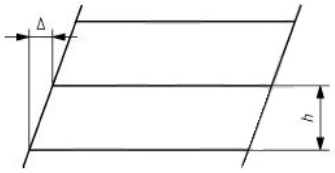
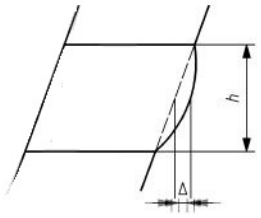
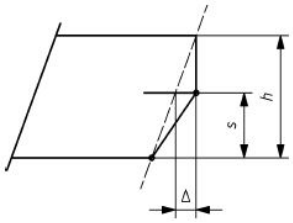
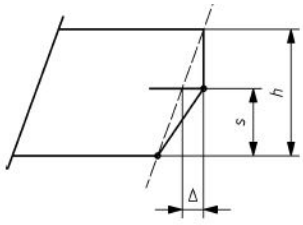
No.	Criteria	Parameter	Functional Tolerances Deviation allowed Δ	
			Class 1	Class 2
1	Inclination of columns of single storey buildings 	Overall inclination in height *h*	Δ = ± *h*/300	Δ = ± *h*/500
2	Inclination of individual columns in single-storey framed buildings 	Inclination Δ of each column: Δ= Δ1 or Δ2	Δ = ± *h*/150	Δ = ± *h*/300
3	Inclination of in single-storey framed buildings 	Average inclination of all columns of the same structure. For two columns, the average is: Δ= (Δ1 + Δ2)/2	Δ = ± *h*/500	Δ = ± *h*/500
4	Inclination of any column supporting a crane stand 	Inclination of the level of the floor to support the crane beam.	Δ = ± 25 mm	Δ = ± 15 mm
5	Linearity of a single-storey column 	Position of the column in the plan, in relation to a straight line between the top and bottom position points.	No requirement	No requirement

Table B.18 Construction Tolerances- Buildings with multiple floors

No.	Criteria	Parameter	Functional tolerances Deviation allowed Δ	
			Class 1	Class 2
1	Position at floor level, no. of levels above the base, with respect to that of the base 	Position of the column in the plan, with respect to a vertical line that crosses its centre at the lowest level.	$\Delta=\pm\sum h/(300\sqrt{n})$	$\Delta=\pm\sum h/(500\sqrt{n})$
2	Inclination of the column between levels of adjacent floors 	Position of the column in the plan with respect to a vertical line that crosses its centre at the next lower level.	$\Delta = \pm h/300$	$\Delta = \pm h/500$
3	Linearity of a continuous column between levels of adjacent floors 	Position of the column in the plan in the joint, with respect to a straight line between the position points at adjacent storey levels	$\Delta = \pm h/1000$	$\Delta = \pm h/1000$
4	Inclination of any column supporting a crane stand 	Position of the column in the plan in the joint, with respect to a straight line between the position points at adjacent story levels	$\Delta= \pm s/1000$ with $s \leq h/2$	$\Delta= \pm s/1000$ with $s \leq h/2$

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