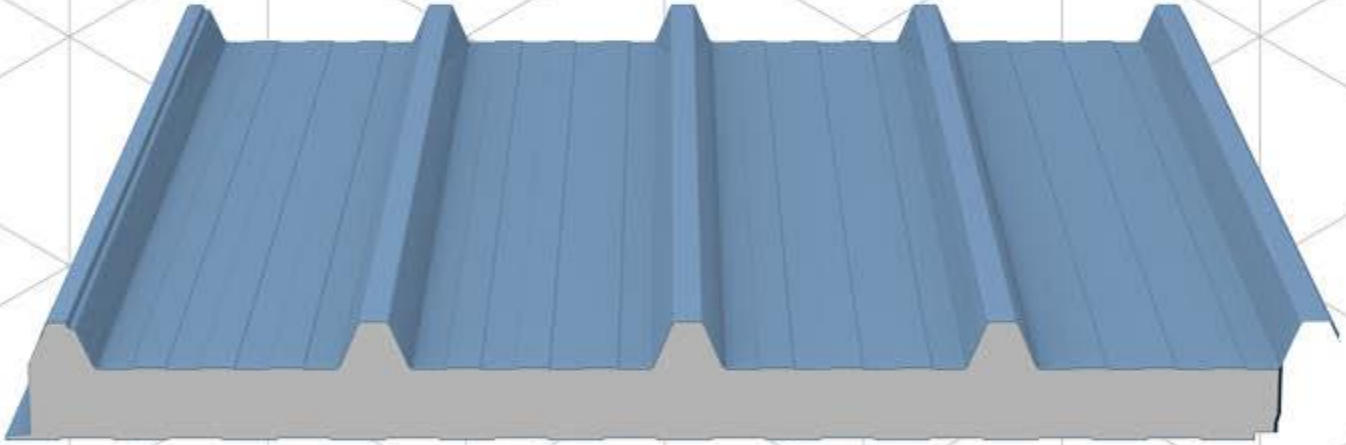
TECHNICAL MANUAL
Ribbed Roof Panels

Product Series: ISOCOP – ISOTEGO – ISOTAP - ISOSMART – ISOFIRE ROOF



PART OF MANNI GROUP

ISOPAN
BUILDING ENVELOPE SOLUTIONS
by Manni Group

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ISOSMART	ISODECK	ISOFIRE ROOF FONO
ISOTEGO	ISOVETRO	ISOFIRE ROOF FG
ISOTAP	SG20 / SG40	ISOFIRE ROOF FG FONO

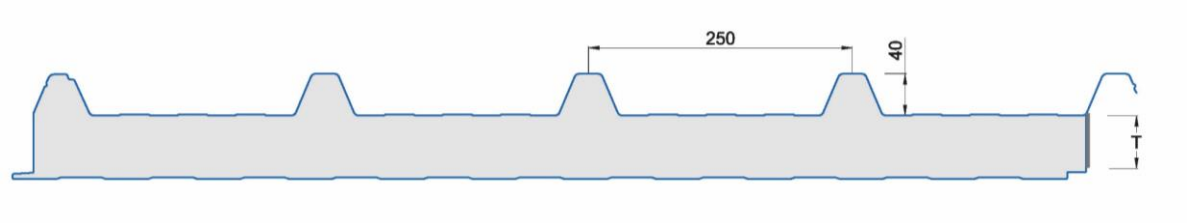
NOTE ON IMAGES

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

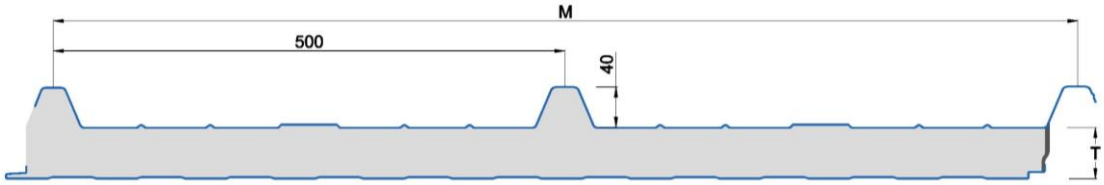
POLYURETHANE INSULATION - DOUBLE SHEET METAL

ISOCOP – ISOCOP TOP CLASS – ISOCOP FARM COAT



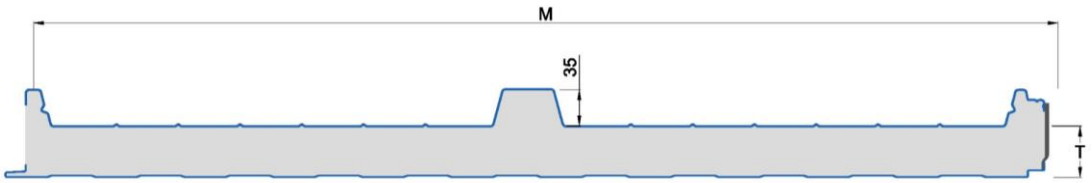
PITCH - MODULE (M)	1000mm
CORRUGATED PROFILE	Profile 5 ribs, height 40 mm
EXTERNAL FACING	Pre-painted sheet
INSULATION	Polyurethane foam (PUR) or Polyisocyanurate foam (PIR)
INTERNAL FACING	Pre-painted sheet

ISOTEGO



PITCH - MODULE (M)	1000mm
CORRUGATED PROFILE	Profile 3 ribs, height 40 mm
EXTERNAL FACING	Pre-painted sheet
INSULATION	Polyurethane foam (PUR) or Polyisocyanurate foam (PIR)
INTERNAL FACING	Pre-painted sheet

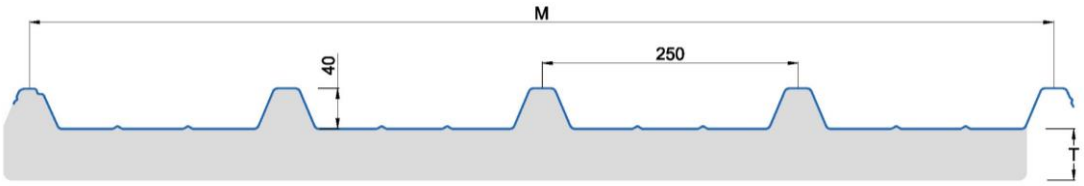
ISOTAP



PITCH - MODULE (M)	1000mm
CORRUGATED PROFILE	3 ribs profile, 35mm rib height
EXTERNAL FACING	Pre-painted sheet
INSULATION	Polyurethane foam (PUR) or Polyisocyanurate foam (PIR)
INTERNAL FACING	Pre-painted sheet

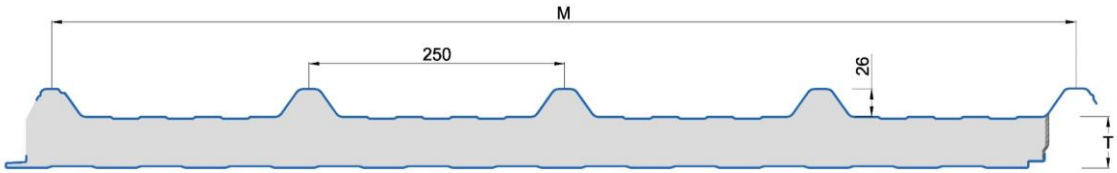
POLYURETHANE INSULATION – SINGLE SHEET METAL

ISOGRECATA – ISODECK – ISOVETRO – GR10 – DK10



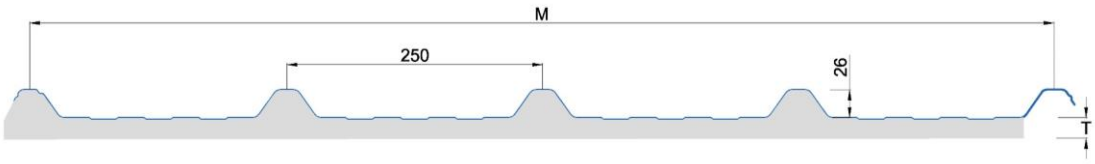
PANEL	ISOGRECATA ; GR10	ISODECK ; DK10	ISOVETRO
PITCH - MODULE (M)	1000mm		
CORRUGATED PROFILE	Profile 5 ribs, height 40 mm		
EXTERNAL FACING	Pre-painted sheet		
INSULATION	Polyurethane foam (PUR) or Polyisocyanurate foam (PIR)		
INTERNAL FACING	Embossed centesimal aluminium sheet	Bituminous felt sheet	Fibreglass laminate

ISOSMART



PITCH - MODULE (M)	1000mm
CORRUGATED PROFILE	Profile 5 ribs, height 26 mm
EXTERNAL FACING	Pre-painted sheet
INSULATION	Polyurethane foam (PUR) or Polyisocyanurate foam (PIR)
INTERNAL FACING	Pre-painted sheet

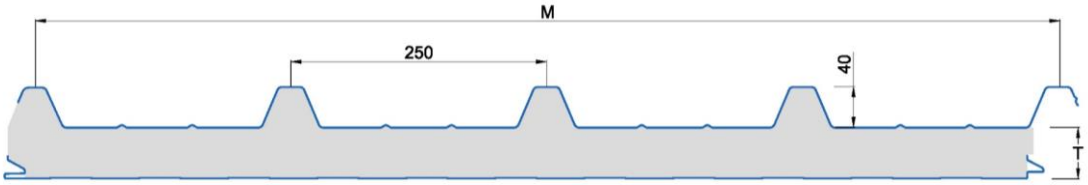
SG20 – SG40



PITCH - MODULE (M)	1000mm
CORRUGATED PROFILE	Profile 5 ribs, height 26 mm
EXTERNAL FACING	Pre-painted sheet
INSULATION	Polyurethane foam (PUR) or Polyisocyanurate foam (PIR)
INTERNAL FACING	Embossed centesimal aluminium sheet

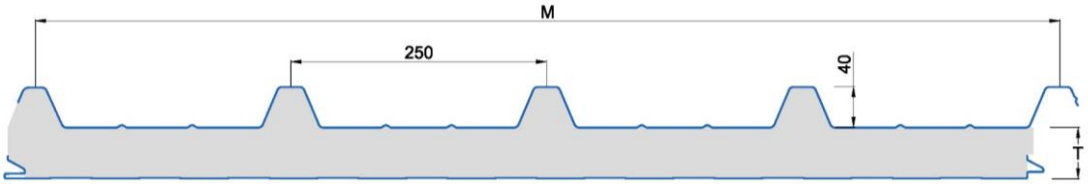
MINERAL WOOL INSULATION – DOUBLE SHEET METAL

ISOFIRE ROOF – ISOFIRE ROOF FONO



PANEL	ISOFIRE ROOF	ISOFIRE ROOF FONO
PITCH - MODULE (M)	1000mm	
CORRUGATED PROFILE	Profile 5 ribs, height 40 mm	
EXTERNAL FACING	Pre-painted sheet	
INSULATION	Feldspathic rock mineral fibre wool	
INTERNAL FACING	Pre-painted sheet	Pre-painted sheet Microperforated

ISOFIRE ROOF FG – ISOFIRE ROOF FG



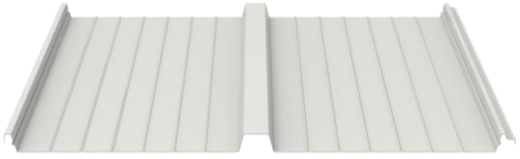
PANEL	ISOFIRE ROOF	ISOFIRE ROOF FONO
PITCH - MODULE (M)	1000mm	
CORRUGATED PROFILE	Profile 5 ribs, height 40 mm	
EXTERNAL FACING	Pre-painted sheet	
INSULATION	Glass mineral fibre wool	
INTERNAL FACING	Pre-painted sheet	Pre-painted sheet Microperforated

METAL PROFILING

The profiling of the metal cladding of some of the ribbed roofing 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.

TYPES OF PROFILING AVAILABLE

Profile 5 RIBS With micro-slatting H 40mm	
Profile 5 RIBS With micro-ribbing H 40mm	
Profile 5 RIBS H 26mm	
Profile 3 RIBS With micro-slatting H 40mm	
Profile 3 RIBS H 35mm ISOTAP MODEL	

DIMENSIONAL CHARACTERISTICS AND TOLERANCES

BASE DIMENSIONAL CHARACTERISTICS

USEFUL WIDTH (Module / Pitch)

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

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.

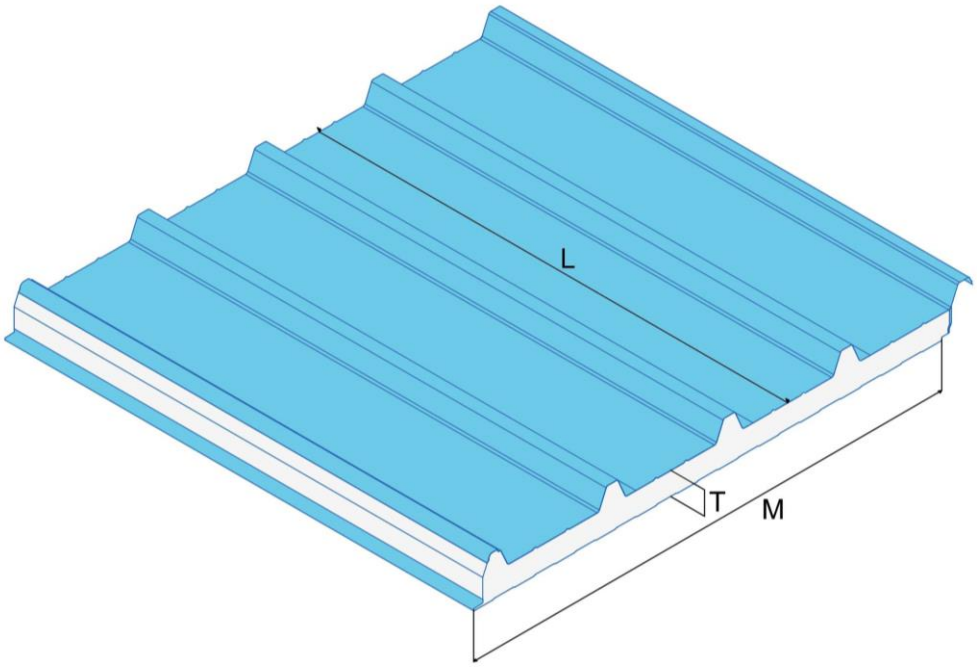
In any case, Isopan recommends not exceeding the maximum size that can be transported by standard vehicle.

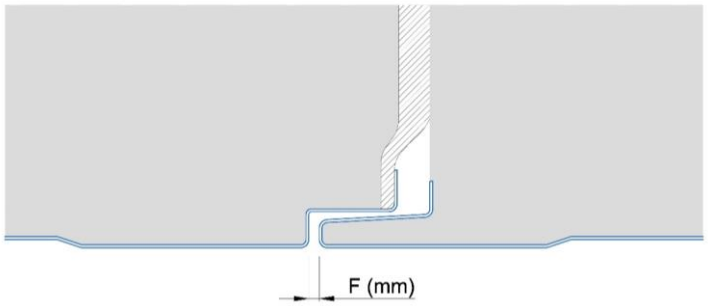
NOMINAL THICKNESS

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

DIMENSIONAL 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

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	

GLASS FIBRE MINERAL WOOL

Isopan uses mineral wool made from glass fibres, with an average density of 55 kg/m^3. The use of oriented fibres gives the product physical and mechanical strength.

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

Incombustibility	Class A2 according to standard EN 13501
Average density	55 kg/m^3 ± 10%
Melting temperature	> 1000 °C
Resistance to water/vapour penetration	MU1 (μ = 1)
Water absorption (short-term)	WS (W_p < 1 kg/m^2)
Specific heat capacity	cp = 1030 J/kgK
Durability	class DUR2 according to standard EN 14509
Thermal conductivity coefficient	λ = 0.039 W/mK
Compressive strength	≥ 0.06 MPa (at 10% of deformation)
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 ROOF FONO AND ISOFIRE ROOF FG FONO) – FOR INTERNAL USE ONLY

A layer of dustproof black glass fibres is placed between the perforated internal face and ISOLAMENTO 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.

OTHER FACINGS (Interior only)

Some panels have rigid or semi-rigid interior cladding types suitable only for exposure to the building's interior environment. Isopan advises against using panels with such facings exposed to the outside environment.

EMBOSSED CENTESIMAL ALUMINIUM (ISOGRECATA)

Embossed centred aluminium sheet, available for lining the inside of Isogrecata, GR10, SG20, and SG40. Due to the fragility of the aluminium face, Isopan gives no guarantee for aesthetic flaws on the internal side of the panel, including the perfection of the joint. Any imperfections on the internal side like, for example, creases on the face and the lack of flatness are to be considered normal and accepted for the uses recommended by Isopan.

BITUMINOUS FELT (ISODECK)

Bituminous felt, available as an inner coating for Isodeck and DK10 products.

- Upper surface layer: bitumen
- Main intermediate layer (reinforcement): wool paper
- Bottom surface layer: bitumen

CLEAN FARM (ISOGRECATA CLEAN FARM)

Polymer material, available with different surface finishes and colours.

The Clean Farm coating has the following characteristics:

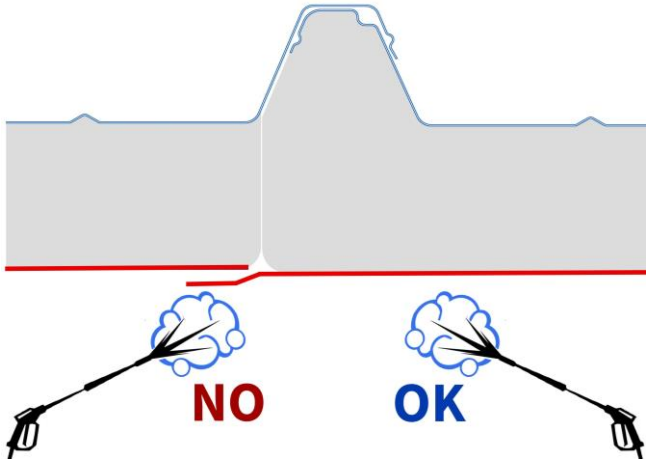
- Water-repellent and washable
- Mould/parasite resistant
- UV-resistant
- Resistant to chemical agents
- Resistant to water vapour diffusion

FIBREGLASS LAMINATE (ISOVETRO, ISOVETRO PLUS, FARMAFARM, FAMALUM, ISOBOX FARM PLUS)

- Flat laminate on reels, manufactured with orthopthalic polyester resin, UV stabilised, reinforced with textile glass fibres, laminated and hot-catalysed.
- Standard colour: matte white (colour consistency is not guaranteed).
- Temperature range: -40 °C to +120 °C.
- Fire behaviour: classified "non-drip".
- Ageing: using UV ray stabilised polyester resin slows yellowing of the material, which will still be greater and faster when used outdoors with solar radiation. Surface migration of glass fibres mostly occurs when used outdoors and, in any case, does not undermine the laminate's mechanical resistance features.
- Resistance to chemical agents: acids/ excellent, alcohols/ excellent, alkali/ good, solvents/ good. More detailed information requires knowing the nature and concentration of the chemical agent and the environmental conditions of use. Excellent resistance to mould.
- Due to the fragility of the fibreglass support, ISOPAN gives no guarantee for aesthetic flaws on the internal side including the perfection of the joint.

Cleaning fibreglass laminate

N.B. The following indications apply to any product in the Isopan range that uses one or both fibreglass substrates (e.g. Isovetro, Isovetro Plus, Farmafarm, Famalum, Isobox Farm Plus). The fibreglass laminate can be cleaned using normal cleaning products (degreasers, etc.); should more thorough cleaning be required, acetone or mild solvents can be used. Power washing is allowed at a distance of at least 80 cm and at moderate spray pressure, in order to avoid damaging the laminate. We recommend testing initially on a limited, hidden area of the roof to make sure the operation is feasible, obviously with the spray pointed so as not to open the joint.



A representation of the direction of the hydro-cleaning jets is provided in the figure. The jet must be directed so as not to damage the laminate, as this could cause water seepage.

The indications in the table are reliable to the best of common knowledge and the values shown are to be considered a helpful guide for use. They must not, in any case, be held as direct and indirect guarantees.

Fibreglass resistance to main chemical agents

Product	Concentration %	Temperature
Acetone	10%	80 °C
Acetic acid	10%	90 °C
Acetic acid	25%	70 °C
Acetic acid	75%	65 °C
Hydrogen cyanide	10%	70 °C
Hydrochloric acid (gas)	10%	150 °C
Hydrochloric acid (gas)	35%	70 °C
Hydrochloric acid (gas)	100%	25 °C
Hydrochloric acid (solution)	10%	90 °C
Hydrochloric acid (solution)	37%	65 °C
Phosphoric acid	80%	90 °C
Lactic acid	100%	90 °C
Nitric acid	5%	65 °C
Nitric acid	60%	room t.
Nitric acid	fumes	80 °C
Hydrogen sulphide	all	90 °C

Sulfuric acid	10%	90 °C
Sulfuric acid	50%	80 °C
Sulfuric acid	70%	70 °C
Chlorine acid	saturated	40 °C
Distilled water	-	100 °C
Ammonia	30%	40 °C
Sodium carbonate	30%	65 °C
Formaldehyde	44%	65 °C
Calcium hydroxide	25%	70 °C
Potassium hydroxide	25%	70 °C
Sodium hydroxide	25%	70 °C
Sodium hydroxide	50%	room t.
Sodium hypochlorite	10%	65 °C
Copper nitrate	all	90 °C
Mineral oils	100%	100 °C
Olive oil	100%	100 °C
Ferric sulphate	all	90 °C
Ferrous sulphate	all	90 °C

*Values obtained from supplier data sheets or technical literature.

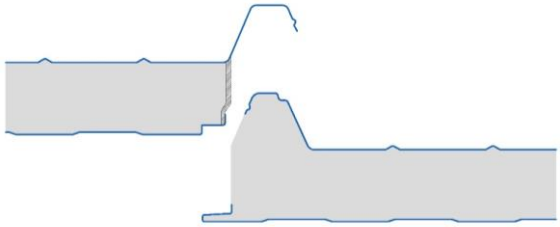
JOINT

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:

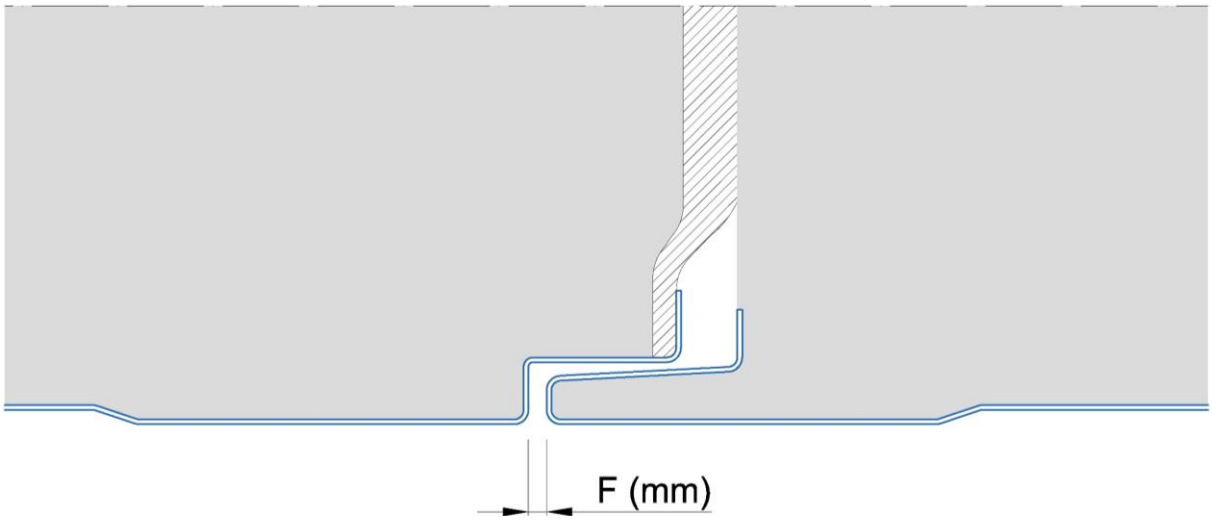
- Ensure the correct consequential installation of sandwich panels;
- Avoid passage of water and air from the external environment to the internal environment, or at least minimise migration of liquids and air from one side of the wall/covering to the other;
- Minimise the risk of condensation forming 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 roof panel.

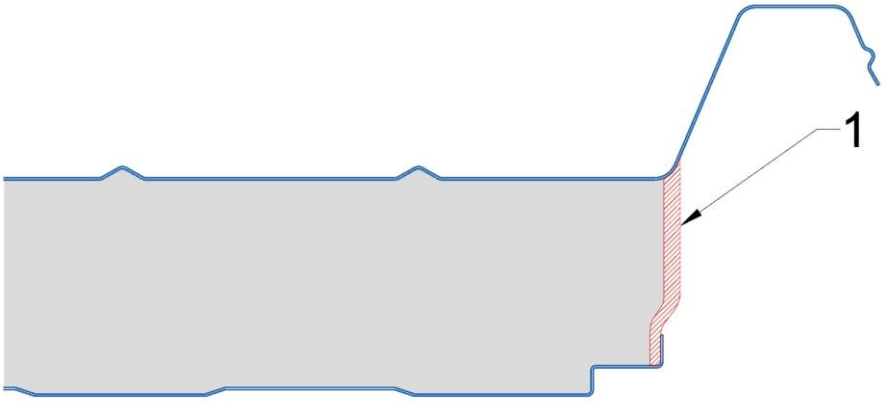
At the joint, a gap between the male-female fins of the inner metal profile may be visible in correctly installed roof panels. The presence of this space (called a gap, represented in the following figure by “F”) is not an indication of product faults or incorrect installation. The factory tolerances 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.

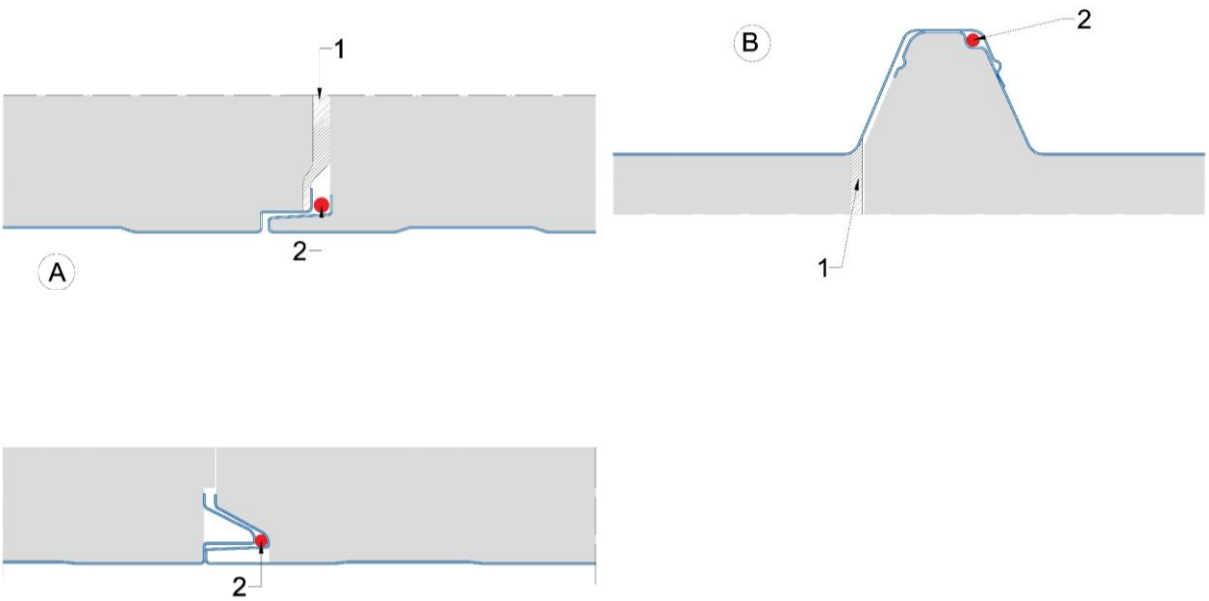
FACTORY STANDARD AND OPTIONAL GASKETS

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: Installation on the internal side

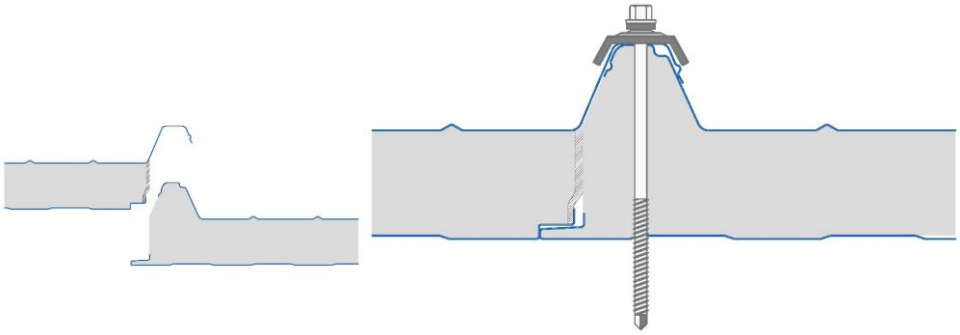
B: Installation on external side

1: Standard gasket (factory pre-assembled)

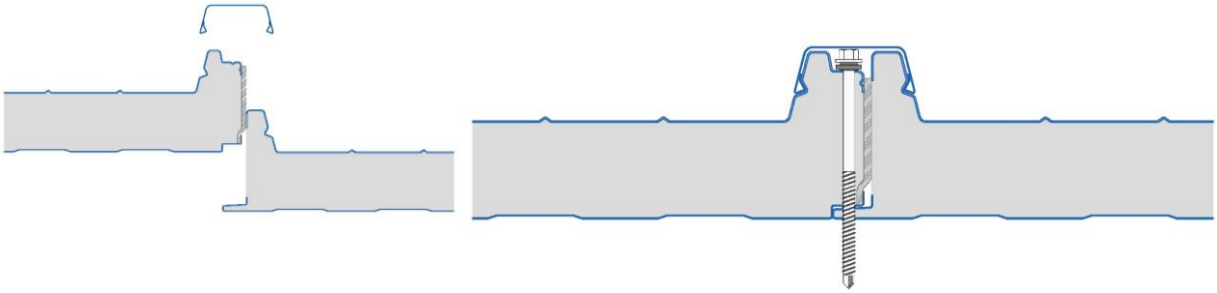
2: Standard gasket/sealant (to be installed on site)

POLYURETHANE INSULATION – DOUBLE-SHEET METAL PANELS

ISOCOP – ISOCOP TOP CLASS – ISOCOP FARM COAT - ISOTEGO



ISOTAP



POLYURETHANE INSULATION – SINGLE-SHEET METAL PANELS

The internal face coupling cannot reach the perfection typical of a double skin metal faced panel (like ISOCOP); considering the field of application and the limited performance features required of single skin metal faced panels, no sealing gaskets are inserted in the joint. It is recommended for the designer to carry out a thorough thermo-hygrometric assessment of the application.

ISOGRECATA – ISODECK – ISOVETRO

ROCK WOOL INSULATION – DOUBLE SHEET METAL

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.

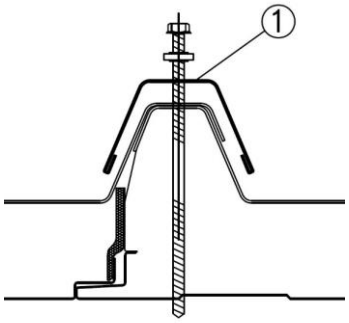
ISOFIRE ROOF – ISOFIRE ROOF FONO – ISOFIRE ROOF FG – ISOFIRE ROOF FG FONO

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 required to manually rotate the second panel so that it can fit properly into the previously installed panel, as shown in the figure.

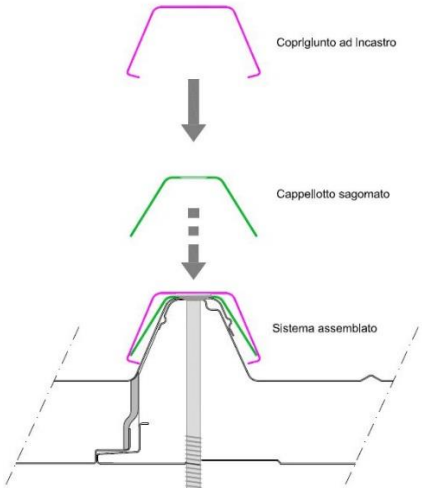
USEFUL ACCESSORIES

Optional Joint Cover

For roof pitches with slopes of less than 7%, Isopan recommends the installation of joint cover accessories, which are available in different types. The function of these accessories is to protect against the infiltration of rainwater, which can occur during particularly intense weather events. In the presence of low slopes, rainwater tends to remain on the roof for longer and can accumulate in larger quantities before being effectively drained by the slope and the eaves.



Joint cover consisting of pre-painted sheet metal



Snap-on joint cover, consisting of sheet metal and shaped cap (countersunk screws required)

For information on joint cover systems, please contact Isopan.

Auxiliary manual device for closing panel joints

To ensure correct installation of the roofing panels, it is essential that, during the installation of the fasteners, the panels are correctly joined and interlocked, exerting appropriate pressure between them to ensure that the joint is correctly closed without leaving gaps and without deforming the sheets.

This can be carried out by manual operations by the operators, in compliance with safety regulations and good practice. Isopan offers the use of auxiliary devices for joining two roofing panels, manually operated by operators during assembly.

Representative operating diagram of the auxiliary device for closing joints. For detailed information please contact Isopan

FASTENING AND INSTALLATION

ASSEMBLY INSTRUCTIONS

PRELIMINARY OPERATIONS

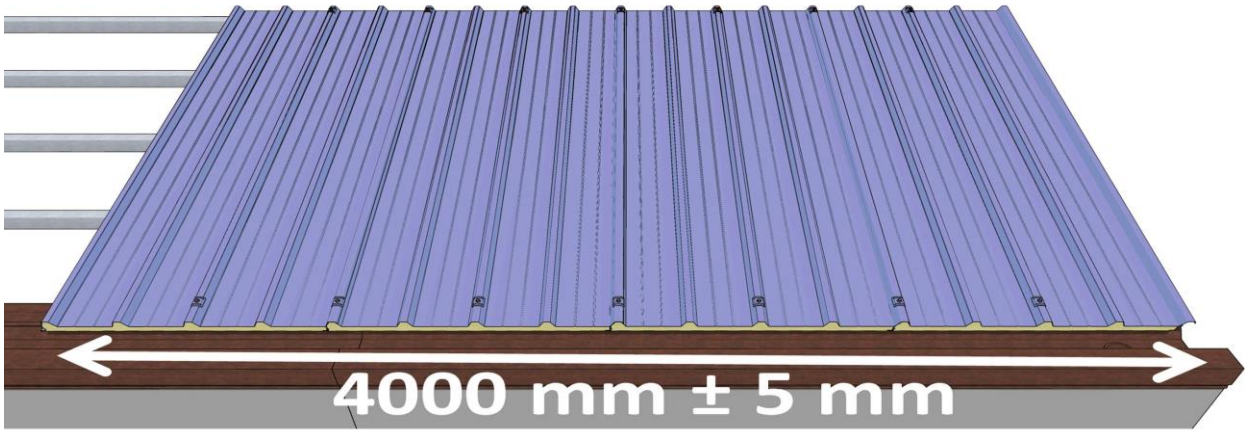
- Verify that the supports are properly aligned. Please refer to the appropriate annex in this document.
- Pay particular attention to the contact points between the supports and the panel support sheets to avoid phenomena linked to electrochemical corrosion if incompatible metals are coupled. For this 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

- Install gutters and any sub-ridges and connection ridge caps.
- Remove the protective film from the panels, if any.
- Installing the panels starting from the gutter and from an end side of the building, taking care to correctly overlap and align the elements and check for perfect orthogonality to the underlying structure.
- Systematically fasten the elements after ensuring they match correctly. All the residual materials must be quickly removed, with special attention to metallic residues.
- Install the subsequent row of elements overlapping the gutter row (when there are roof pitches in two or more elements). The insulating core in the overlapping area must first be removed.
- Fasten the elements on all the ribs on the ridge, gutter, valley and head overlap lines.
- Install finishing elements (ridges, ridge caps, and tinwork in general) and any related insulating elements.
- Check and clean the roof, with particular attention to metal scraps, fastenings and fittings with door and window frames. After completing panel and tinwork element assembly, make sure no foreign material or processing scraps are left on the roof, as these may trigger corrosion phenomena, prevent proper rainwater draining or create a build-up of aggressive, undesired substances.

The panels must be installed opposite the direction of the prevailing winds, frequently checking to make sure they are parallel and aligned. The holes must have a smaller diameter than the fastening elements. The number of fastenings depends on the local climatic condition. The normal fastening density entails one on every other rib on central beams and one on every rib on terminal beams.

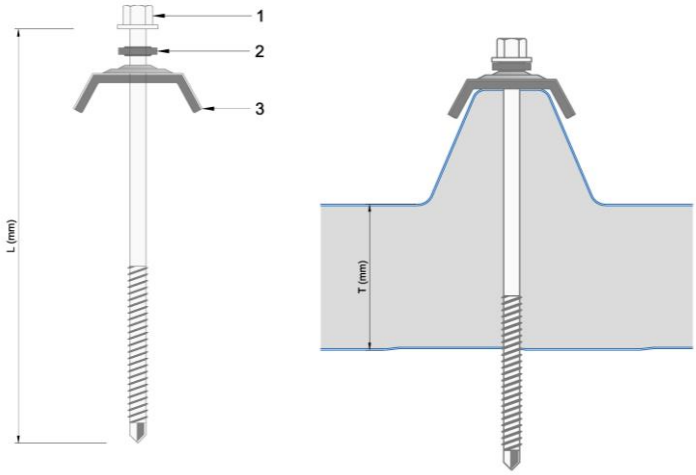


Note: take care to properly place the panels during the assembly step (4 panels = 4000 mm ± 5 mm) in order to prevent problems during the next ridge installation step, as shown in the figure.

SCREWS: TYPES, LENGTH AND INSTALLATION

Isopan roofing panels are typically installed using self-drilling screws and gaskets or caps.

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



1. Screw
2. Washer/gasket
3. Metal cap with gasket

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. When installing roofing panels, the use of a cap is mandatory.

L (mm): Screw length

T (mm): Nominal thickness of the panel

CALCULATION BY SCREW LENGTH	Panels with 40mm ribbed profile *	Panels with 26mm ribbed profile **
	LENGTH OF SCREWS (mm)	
Fastening on METAL structure	L=T+30mm	L=T+15mm
Fastening on WOOD structure	L=T+90mm (1)	L=T+75/80mm (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

* ISOCOP, ISOVETRO, ISOGRECATA, ISODECK, ISOTEGO, ISOTAP, ISOFIRE ROOF, ISOFIRE ROOF FONO, ISOFIRE ROOF FG, ISOFIRE ROOF FG FONO

** ISOSMART, SG20, SG40

INSTALLATION OF FASTENINGS

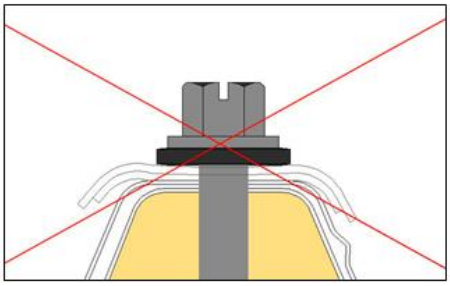
The purpose of the fastening elements is to efficiently anchor the panel to the load-bearing structure; the type of fastening unit depends on the type of face. The number and position of the fastening elements must guarantee resistance to the stresses induced by the dynamic loads, which can also exist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

Isopan recommends fastening at the top of the ribs; the possibility of fastening at the bottom of the rib is not to be ruled out, provided the system ensures water tightness.

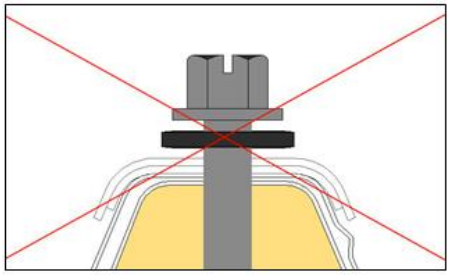
Appropriately coated carbon steels or austenitic type stainless steels must be chosen as suitable materials to fasten panels. Pay particular attention to the compatibility of the steel and aluminium materials in order to prevent the formation of galvanic currents.

FASTENING METHOD

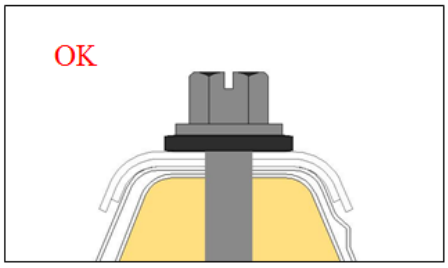
Before proceeding with the installation of the screws, Isopan recommends carrying out tests in order to correctly adjust the tools (screwdrivers, spanners). The type of suitable screws must be chosen on the basis of the design and site characteristics.



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.



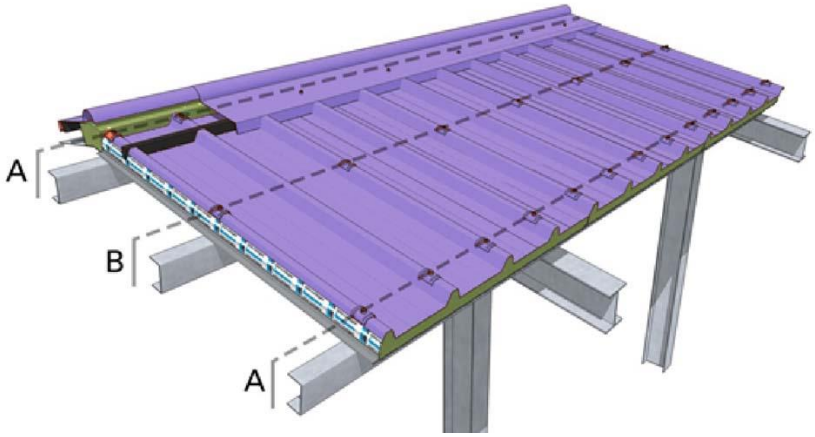
B – INSUFFICIENT TIGHTENING TORQUE
Incorrect tightening due to the torque applied to the screw being insufficient to ensure correct fastening of the panel to the structure.



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

ROOF PANEL FASTENING

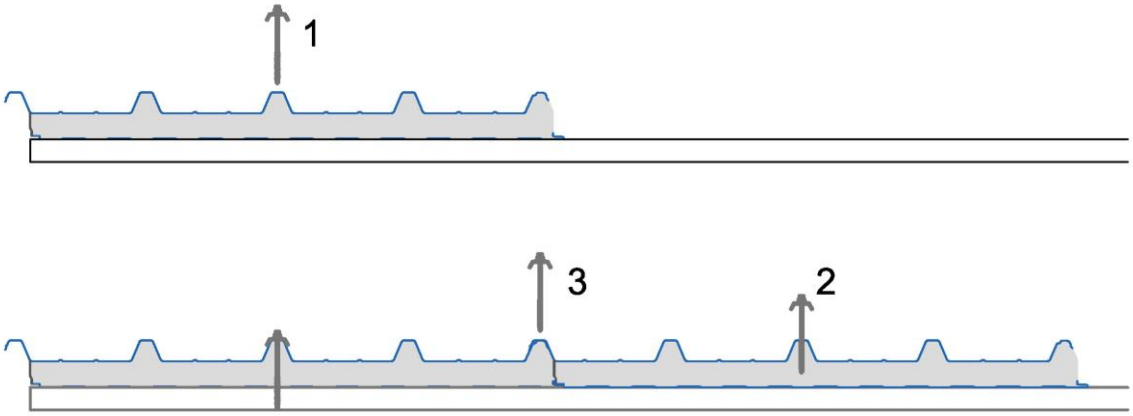
The panels must be installed opposite the direction of the prevailing winds, frequently checking to make sure they are parallel and aligned. The holes must have a smaller diameter than the fastening elements. The number of fastenings depends on the local climatic condition. The normal fastening density entails one on every other rib on central beams and one on every rib on terminal beams.



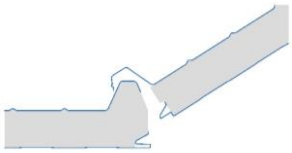
A: Beams/supports/end supports

B: Beams/supports/central supports

ASSEMBLY SEQUENCE

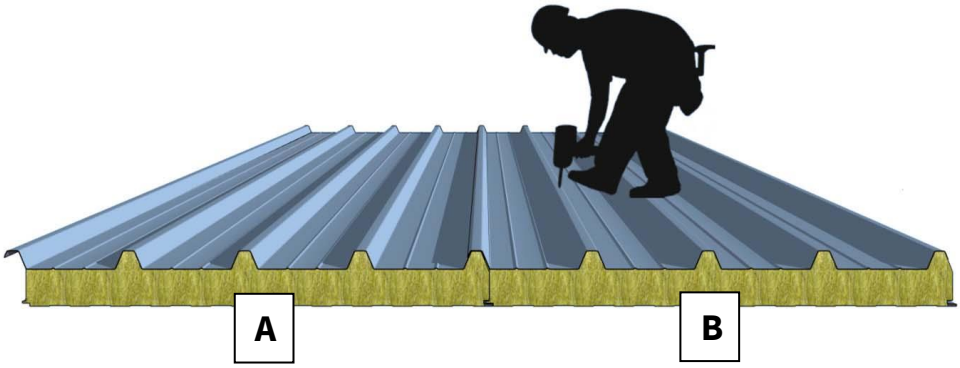


1. Lay the first panel, fitting the fastener at one of the central ribs (screw no. 1)
2. Lay the second panel and attach it to the previously laid panel. Fasten the second panel just laid using one of the central ribs (screw no. 2), exerting adequate pressure to ensure correct coupling/locking between the two panels.



ATTENTION: For MINERAL WOOL panels, it is required to fit the panels by rotating them so that the tongue and groove joints fit together correctly, as shown in the figure.

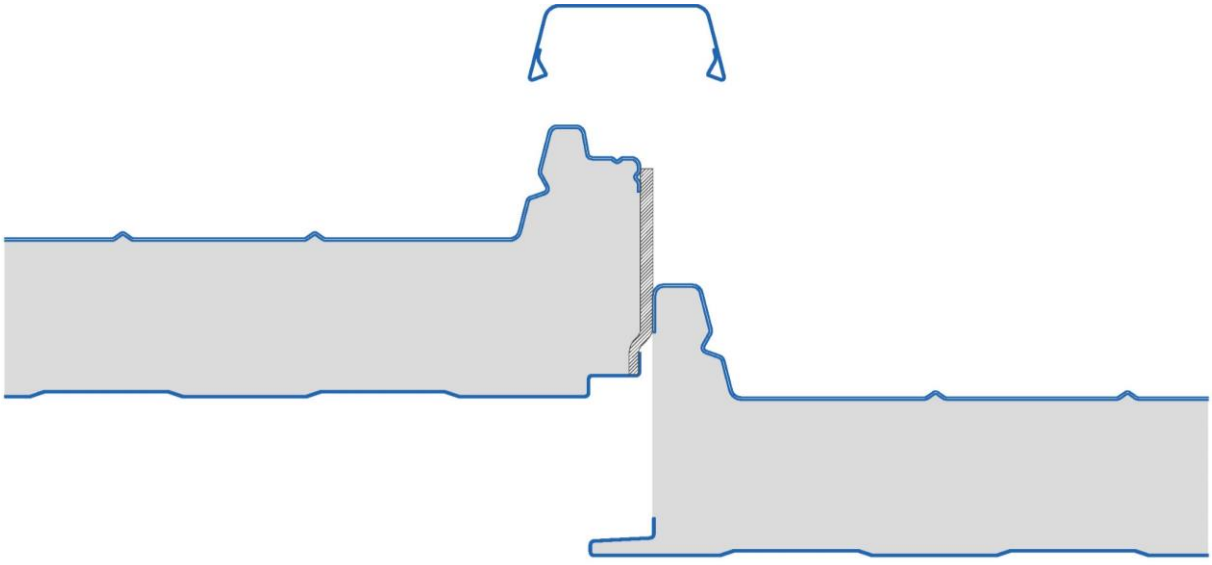
During STEP 2, the Operators must not overload the previously laid panels (panel A in the figure) with their own weight, to avoid deformations forming and making it difficult to fit them together correctly.



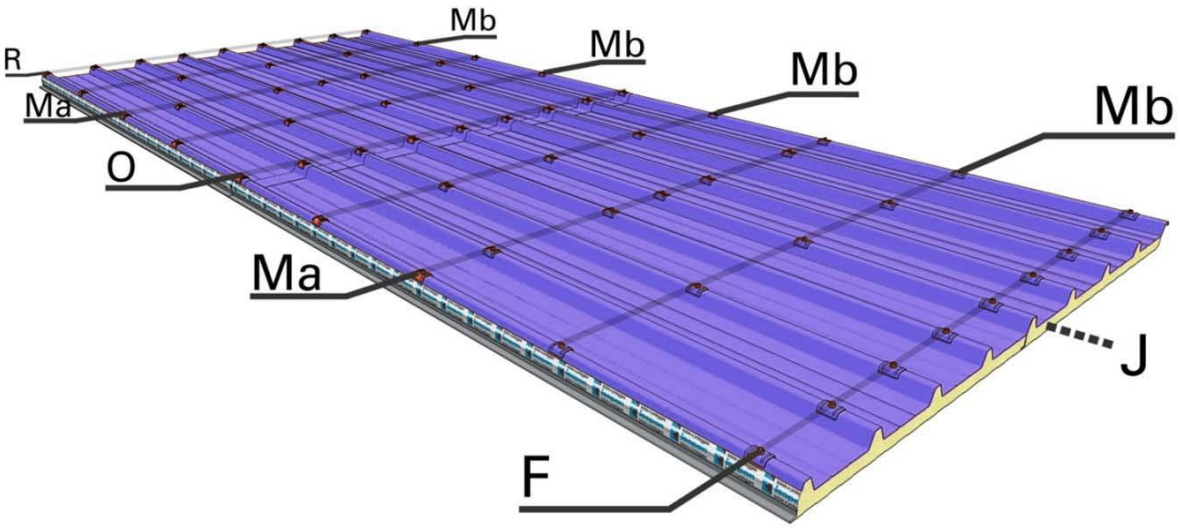
3. Install the fastener at the coupling between the two panels, on the overlap flap (screw No. 3).

ISOTAP: Joint cover installation

The installation of the joint plate must only be carried out under pressure, at the joint, after the panels have been fastened to the structure with the appropriate screws.



ISOPAN PROPOSAL FOR FASTENING TEXTURE



R: terminal support (ridge)

F: terminal support (gutter)

Ma-Mb: intermediate supports

O: support at the head junction

J: longitudinal joint

This fastening texture system is not a specific indication, but represents an indicative diagram on the typical distribution of fasteners, useful to prevent instability and blemishes on installed products.

ATTENTION

Due to external factors, such as thermal expansion and forces acting on the building and building envelope (snow load, wind, etc.), the installation of sandwich panels with an incorrect fastening texture can lead to the development of blemishes and deformations over time.

The length of sandwich panels is a highly relevant factor, as very long panels (>8000mm) can be subject to large thermal expansion.

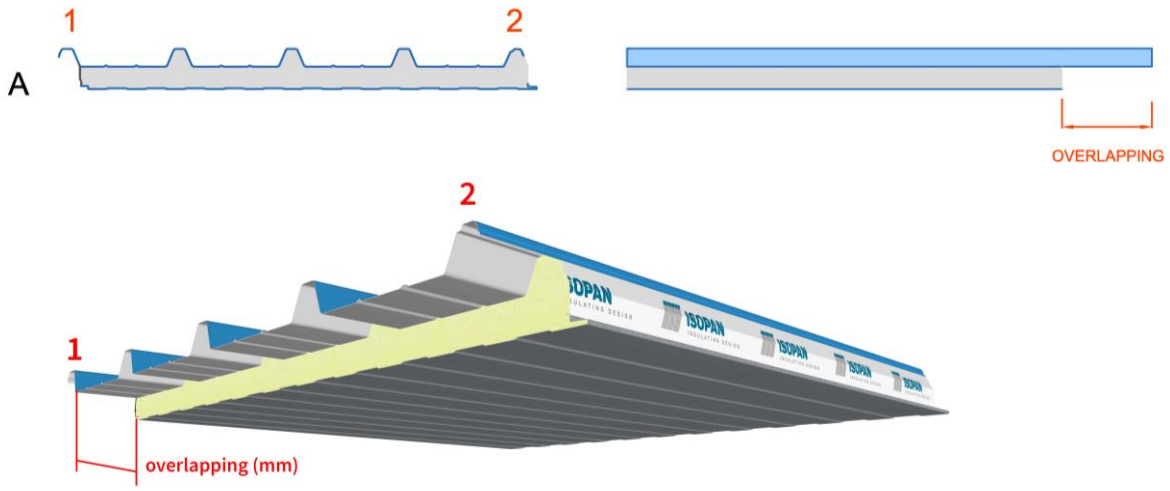
For information on thermal expansion, please refer to the appropriate section on this document.

OVERLAPPING AND HEAD-TO-HEAD JOINING

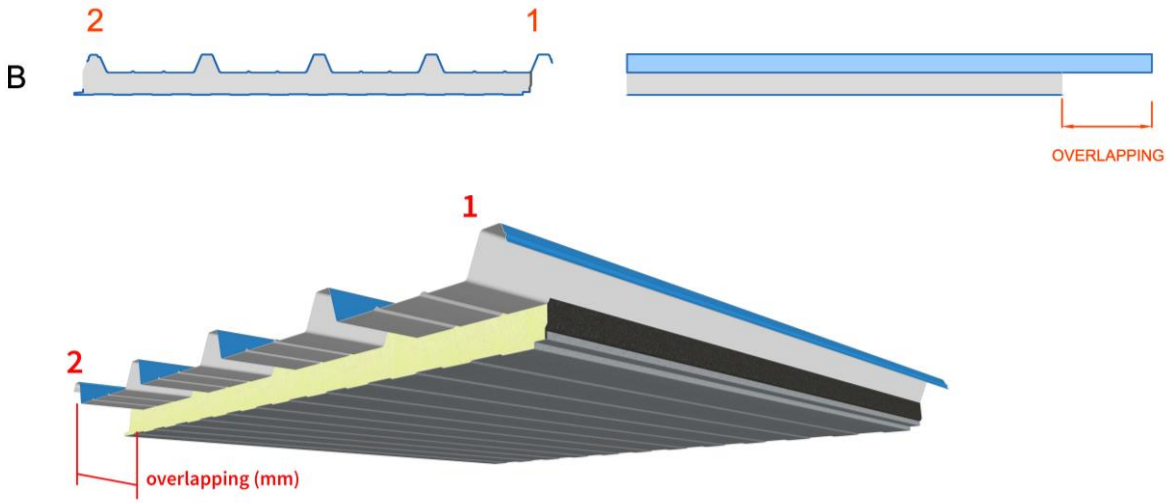
Very long panels can present difficulties in safe handling, as well as being more susceptible to significant deformation due to thermal expansion. For this reason, in the case of particularly long roofs in the slope direction, Isopan recommends using panels with a shorter length. In order to prevent water infiltration and to allow the panels to be connected in the transverse direction, OVERLAPPING can be provided.

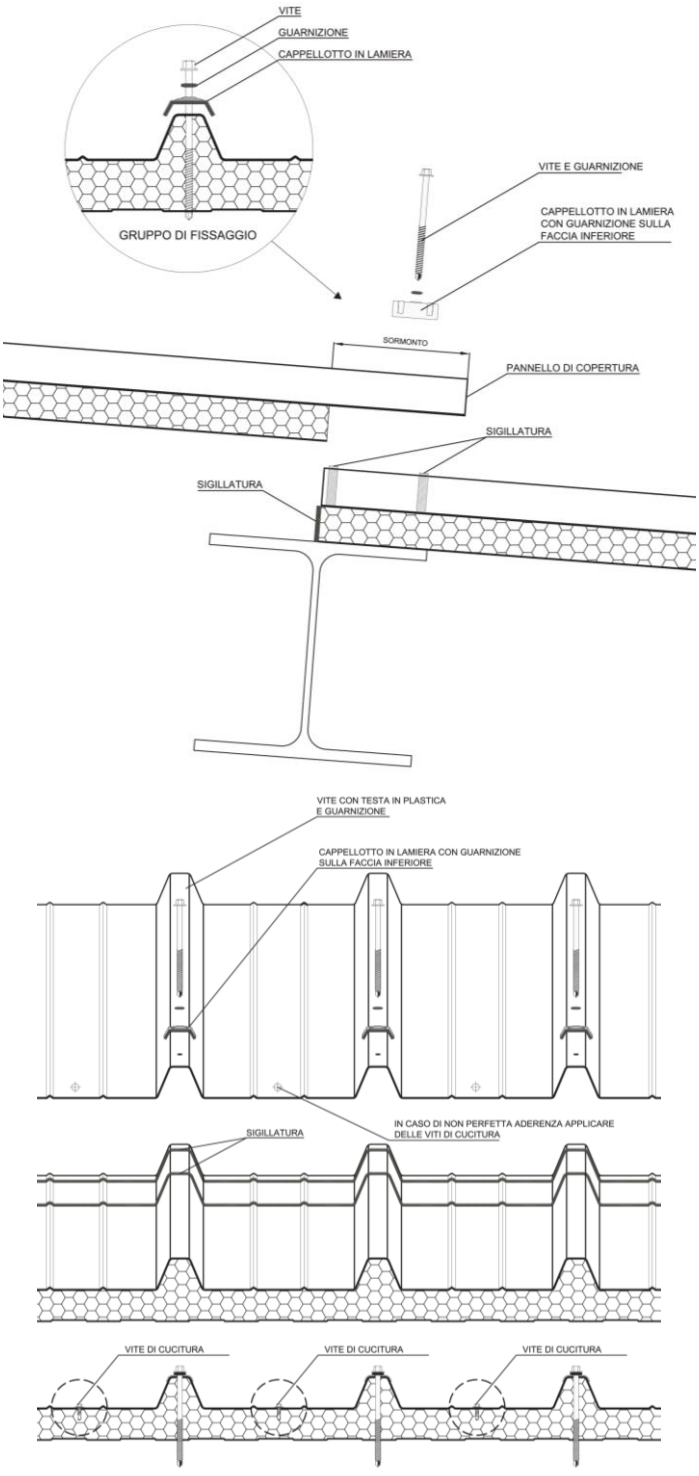
It consists of removing part of the inner sheet metal and insulation, in order to leave only the upper outer sheet metal. In this way, one panel can be placed on top of another without any discontinuity in the waterproofing layer. The size of the overlapping cut may vary depending on the slope of the roof. This is an operation carried out at the factory. The overlapping cut is also useful for making a drip line in the case of an end panel in a pitch. The following are Isopan's conventions for naming cut-overlapping.

A: OVERLAPPING WITH LEFT OVERLAP: Assembly direction from left to right.



B: OVERLAPPING WITH RIGHT OVERLAP: Assembly direction from right to left





The images in the “HEAD-TO-HEAD JOINT” section are indicative and represent ISOCOP products. In the case of single-sheet panels (e.g. Isogrecate, Isoglass) there is no micro-slatted inner sheet. The information depicted also applies to the other products contained in this document.

If the sheets do not adhere perfectly to each other at the overlap, Isopan recommends applying seam screws as shown in the figure.

Please note: the information given here must necessarily be evaluated on the basis of the design conditions. Any consideration of the position, number and type of fastenings must be evaluated by the designer.

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.

EXTERIOR FIRE RESISTANCE CLASSIFICATION (Broof)

The external fire resistance classification system for roofing (Broof) is based on four test levels that simulate different fire triggering and development conditions:

t1 burning brand alone

t2 burning brand and wind

t3 burning brand, wind and solar radiation

t4 burning brand, wind and supplementary radiant heat

The panels can be Broof certified; please contact the Isopan Technical Department to check what classifications have been obtained based on the type of insulating material and metal support.

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.

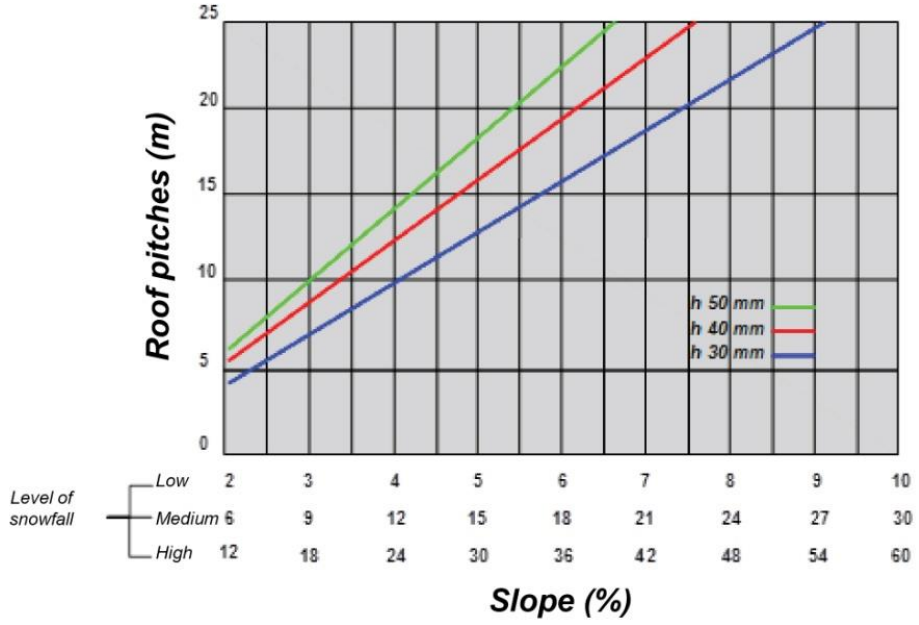
WATER PERMEABILITY (EN 12865)

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 roof panels generally require, during the design phase, a load-bearing structure able to absorb the external loading stress that will not submit the metal supports of the panels to excessive and permanent distortions to the detriment of their basic characteristics. When choosing panel types during the design stage, some parameters related to the environmental actions should be considered, such as:

- 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).
- Snow load: depends on the elevation above sea level compared to the one at the building construction site. The formation of water puddles resulting from snowmelt must be taken into account, which can expose the overlapping joints to being pressed under a load of water and possibly create infiltrations. It is recommended to implement appropriate tinwork systems (or suitable constructive measures) to ensure normal water run-off.
- 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: depending 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 (it is advisable to refer to the available documentation or contact the Isopan Technical Department).
- Rainfall: the degree of rainfall affects the slope angle of the roof pitch; in order to ensure normal water run-off and to prevent the metal supports from oxidising, the slope angle of the panels must be chosen on the basis of two types of construction:
- Roof without intermediate overlapping joints;
- Roof with intermediate overlapping joints.



In the former case, the minimum slope, in relation to the climatic area and the rib height, can be taken from the Slope diagram. We recommend (in the event of low or average level of snowfall) a slope no less than 7%.

In the event of roofs built with intermediate overlapping joints, the slope can be taken from the Slope diagram, increasing it (for roof pitches with slope <25%) by a value equal to 0.2*L, with L = length of the roof pitch (expressed in metres). The presence of intermediate overlapping joints depends on the slope, the level of snowfall and exposure to wind. Under normal weather conditions, the overlap values generally used are:

Slope (%)	Overlapping (mm)
7 < P ≤ 10	250
10 < P ≤ 15	200
P > 15	150

Gutter drip edge: Isopan, in consideration of the rules of best practice, recommends requesting the gutter arrangement in order to make a drip edge and prevent any leaks into the insulating material or inside the building.

This solution is required to prevent premature panel head decay since, if exposed to stagnating water, the metal might oxidise and the faces might detach from the insulating mass in places.

After the drip edge, it is recommended to protect the heads (insulation and faces) with Isopan liquid sheath that can be applied on-site.

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).

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 expansions").

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.

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.

These stresses are exerted on the head of the fastening element, with bend and shear stress in the event of fastening on rib. These are important parallel to the ribbing, as transversally, they are cancelled out by the flexibility of the metal sheet profile itself.

VALUES OF LINEAR THERMAL EXPANSION COEFFICIENTS

Material	Thermal expansion coefficient ($°C^{-1}$)
Aluminium	23.6×10^{-6}
Steel	12.0×10^{-6}
Stainless steel AISI 304	17.0×10^{-6}
Fibreglass laminate	32.0×10^{-6}

TEMPERATURE RANGE

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 temperature values, linear extension of the metal support must be absorbed by the system. If this is not so, tensions occur that discharge near the sheet section changes by effect of the shape variation. Furthermore, cyclical temperature changes associated to day-night or freeze-thaw differences cause uncontrollable cyclical stresses that fatigue the support elements. These stresses can exceed the material yield point (formation of bubbles) or the failure limit. The effect of this phenomenon is the formation of fatigue cracks, initially not visible, that cause cracking on the face, undermining the product's structural features and water tightness. This problem can be overcome by adopting 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
- Suitable fastening texture (see proposed Isopan fastening in the "Roofing panel fastening" section in this manual)
- In the event of Aluminium panel installation, we recommend using stainless steel screws with cap and specific washer.
- If the pitch length requires the use of several panels, the heads of the panels must be spaced by about 5-10 mm (minimum distance in the hotter season, maximum distance in the colder season), taking care to put a flexible gasket between the heads to prevent condensate from forming.

For anything that is not expressly indicated, refer to the Isopan General Sales Conditions and annexes.

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 level) condensation can appear on the internal face of the panel with consequent dripping inside the building. If these conditions persist long enough, they can accelerate the natural degradation of the organic facing of the face 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).

In view of the low aesthetic qualities of Isogrecata, Isovetro and Isodeck single skin metal faced panels, concealing them or using them in conditions with low aesthetic requirements is recommended.

WALKABILITY OF PANELS

The walkability of panels 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 (distance between supports, size of supports, site conditions).

According to Standard EN 14509, walkability means: resistance to concentrated loads, i.e. the ability of a sandwich panel to withstand non-permanent concentrated loads and occasional pedestrian access loads of operators for laying and fastening operations or maintenance (e.g. visual inspection of the state of the roof), as stated in point 5.2.3.2 of UNI EN 14509 and in accordance with test A.9.1 (Test of resistance to point concentrated loads) of the aforementioned standard. A panel is walkable if it is capable of bearing a concentrated load of 1.2KN placed in the centre of the panel as per standard UNI EN 14509:2007.

Some general notes regarding the walkability of the panels:

- If used for regular foot traffic or in work areas during installation, panels should be protected (e.g. with wooden boards); however, prolonged standing in the centre of the work area should be avoided.
- Only one person at a time must be allowed to walk on a panel during maintenance;
- The above does not exempt from the obligation to carry out a proper risk assessment of access to the suspended ceiling and from the adoption of all consequently identified prevention and protection measures.

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.

CENTRING ON SITE

On-site centring must be carefully assessed on the basis of product characteristics (panel type, nominal product thickness and sheet thickness) and design characteristics (radius of curvature, distance of supports, size of supports).

As a rule, single-panel panels can be centred in place over large radii of curvature, provided that the appropriate evaluations are made by the designer or Works Management.

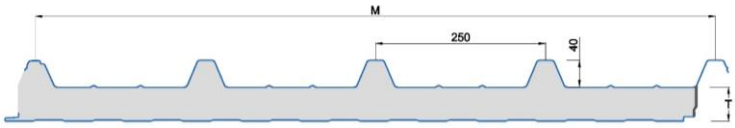
During installation, special care must be taken to preserve the integrity of the panel, both of the insulating layer (avoid breaking the insulating layer, as this could seriously affect the stability and functionality of the product) and of the metal sheets or flexible coverings.

STATIC CHARACTERISTICS: LOADS AND SPANS

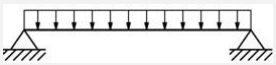
The resistance values refer to a panel assembled horizontally and subject to the action of a distributed load; the calculation method used by ISOPAN does not consider the thermal effects, which are verified by the designer. Depending on the weather conditions of the installation site and the colour of 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:

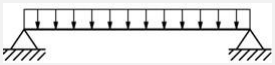
ISOCOP – ISOCOP TOP CLASS – ISOCOP FARM COAT



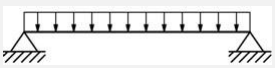
A panel with double metal facing is self-supporting according to the UNI EN 14509 definition. "…panel capable of supporting, by virtue of its materials and shape, its own weight and in case of panel fastened to spaced structural supports, all applied loads (snow, wind, air pressure), and transmitting these loads to the supports.", depending on the type of metal supports, their thickness and the thickness of the thermal insulating core.



STEEL SHEETS 0.4/0.4 mm - Simple support 120 mm								
EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm							
	30	40	50	60	80	100	120	150
	MAXIMUM SPAN cm							
80	270	290	310	340	390	440	470	500
100	250	260	280	300	350	390	440	480
120	230	245	260	280	320	360	400	460
140	210	230	255	260	290	330	370	420
160	200	220	230	255	285	310	340	390
180	185	215	220	230	270	290	320	370
200	160	200	210	220	260	270	300	340
220	140	190	200	210	230	260	280	320
250	115	170	190	200	220	240	260	300

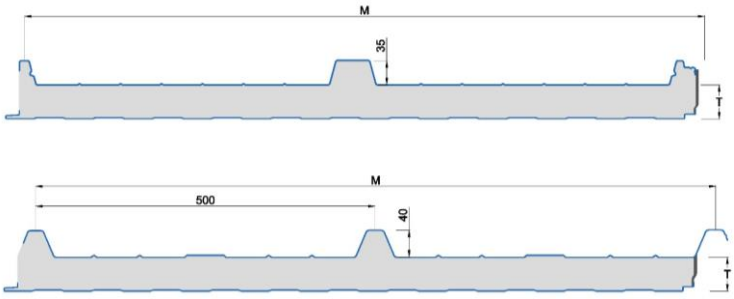


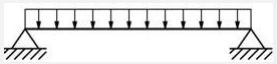
STEEL SHEETS 0.5/0.5 mm - Simple support 120 mm								
EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm							
	30	40	50	60	80	100	120	150
	MAXIMUM SPAN cm							
80	320	350	390	420	500	570	630	730
100	295	320	360	390	450	510	580	670
120	270	300	330	360	420	480	540	620
140	235	280	315	340	390	450	500	580
160	210	260	300	320	370	420	480	550
180	185	235	280	300	355	400	450	520
200	170	210	250	290	330	380	430	500
220	150	190	230	270	320	360	410	470
250	130	170	205	240	300	340	385	445



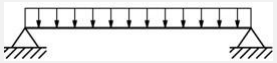
ALUMINIUM SHEETS 0.6 / 0.6 mm - Simple support 120 mm								
EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm							
	30	40	50	60	80	100	120	150
	MAXIMUM SPAN cm							
80	255	290	325	370	435	505	565	605
100	225	255	290	315	385	455	510	590
120	205	230	255	285	340	400	460	540
140	190	210	230	255	315	370	420	495
160	170	190	215	230	285	335	385	455
180	155	170	200	215	265	310	360	420
200	145	160	180	200	240	285	335	395
220	130	155	170	190	225	255	310	355
250	110	145	155	165	200	230	275	335

ISOTEGO – ISOTAP

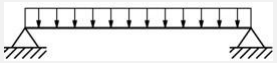




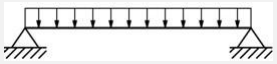
STEEL SHEETS 0.6 / 0.6 mm – Simple support 120 mm							
EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm						
	30	40	50	60	80	100	120
	MAXIMUM SPAN cm						
80	310	340	380	420	500	560	640
120	250	290	320	360	420	480	540
150	200	255	290	325	380	440	490
200	160	195	230	280	335	380	430
250	125	160	190	235	290	340	385



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
	MAXIMUM SPAN cm						
80	295	330	365	400	470	530	600
120	230	280	310	340	400	450	500
150	190	240	280	310	365	410	460
200	145	180	220	260	320	360	400
250	115	150	180	220	275	320	360



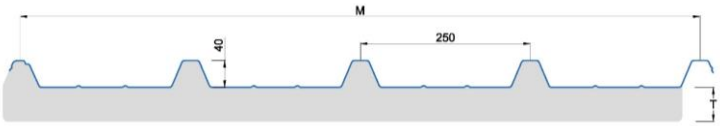
STEEL SHEETS 0.5 / 0.4 mm – Simple support 120 mm					
EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm				
	30	40	50	60	80
	MAXIMUM SPAN cm				
80	290	320	355	400	460
120	230	280	310	340	390
150	190	240	280	300	360
200	145	180	220	260	310
250	115	150	180	215	275



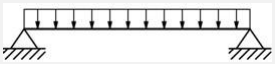
STEEL SHEETS 0.4 / 0.4 mm – Simple support 120 mm					
EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm				
	30	40	50	60	80
	MAXIMUM SPAN cm				
80	250	285	315	350	405
120	210	240	265	295	350
150	175	210	240	265	315
200	135	165	195	220	265
250	110	140	165	195	230

ISOGRECATA – ISODECK – ISOVETRO

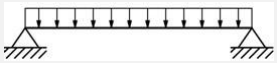
NOTE: The single skin metal faced panel can withstand its own weight by virtue of its materials and shape, and in case of a panel fastened to spaced structural supports, all applied loads (snow, wind, air pressure), and to transmit these loads to the supports, depending on the type of metal supports and their thickness. According to EN 14509, in single-sheet panels the insulation layer does not contribute to the static properties of the product; the stated data only take into account the static contribution of the metal sheet.



- PANEL ON TWO SUPPORTS: *Stress-limited values.



SIMPLE STEEL SHEET SUPPORT					
EVENLY DISTRIBUTED LOAD [kg/m²]	NOMINAL SHEET THICKNESS mm				
	0.5	0.6	0.7	0.8	1.0
	MAXIMUM SPAN cm				
80	220*	235	250	265	285
100	200*	220*	235	245	265
120	180*	200*	215*	230	250
140	165*	185*	200*	215*	235
160	155*	170*	185*	200*	225



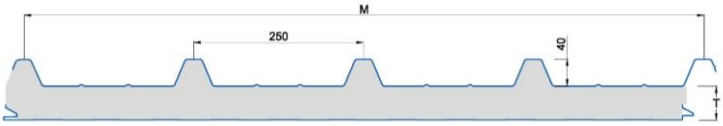
SIMPLE ALUMINIUM SHEET SUPPORT				
EVENLY DISTRIBUTED LOAD [kg/m²]	NOMINAL SHEET THICKNESS mm			
	0.6	0.7	0.8	1.0
	MAXIMUM SPAN cm			
80	160*	170	180	190
100	140*	155*	165	180
120	130*	140*	155	170
140	120*	130*	140*	160
160	110*	120*	130*	150

- PANEL ON MULTIPLE SUPPORTS: *Stress-limited values.

MULTI-SUPPORT STEEL SHEET					
EVENLY DISTRIBUTED LOAD [kg/m²]	NOMINAL SHEET THICKNESS mm				
	0.5	0.6	0.7	0.8	1.0
	MAXIMUM SPAN cm				
80	250*	270	285	295	320
100	200*	245*	260	275	295
120	200*	225*	240*	260	280
140	185*	205*	225*	240*	265
160	175*	195*	210*	225*	255

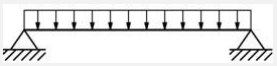
MULTI-SUPPORT ALUMINIUM SHEET				
EVENLY DISTRIBUTED LOAD [kg/m²]	NOMINAL SHEET THICKNESS mm			
	0.6	0.7	0.8	1.0
	MAXIMUM SPAN cm			
80	180*	190	200	220
100	160*	175*	190	205
120	145*	160*	185	190
140	135*	150*	160*	180
160	125*	140*	150*	170

ISOFIRE ROOF

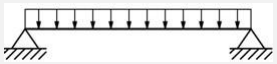


Self-supporting panels according to the UNI EN 14509 definition. "…panel capable of supporting, by virtue of its materials and shape, its own weight and in case of panel fastened to spaced structural supports, all applied loads (snow, wind, air pressure), and transmitting these loads to the supports.", depending on the type of metal supports, their thickness and the thickness of the thermal insulating core. Below are some examples of indicative load bearing capacity tables:

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. The values for the thicknesses 170 and 200mm *(in italic BLUE)* are obtained considering a support width of 150mm.

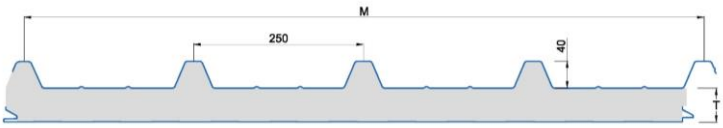


STEEL SHEETS 0.5/0.5 mm - Simple support 120 mm								
EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm							
	50	170	200	100	120	150	170	200
	MAXIMUM SPAN cm							
80	330	360	420	475	525	550	*560*	*570*
100	305	330	375	425	480	495	*500*	*510*
120	270	300	345	390	435	475	*480*	*490*
140	255	270	315	360	405	420	*425*	*435*
160	235	255	290	320	365	390	*395*	*405*
180	210	235	270	305	340	360	*365*	*370*
200	195	210	255	290	320	340	*345*	*350*
220	185	200	240	265	295	325	*330*	*335*
250	165	185	215	250	275	290	*295*	*300*

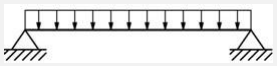


STEEL SHEETS 0.6 / 0.6 mm – Simple support 120 mm								
EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm							
	50	60	80	100	120	150	170	200
	MAXIMUM SPAN cm							
80	350	375	430	495	545	595	*605*	*615*
100	315	340	395	445	495	540	*550*	*560*
120	280	310	355	405	450	485	*490*	*495*
140	260	290	325	370	415	440	*445*	*450*
160	245	260	300	340	375	405	*410*	*415*
180	230	245	280	315	345	380	*385*	*390*
200	210	230	265	300	330	350	*355*	*360*
220	195	220	250	280	310	330	*335*	*340*
250	170	195	230	260	290	300	*305*	*310*

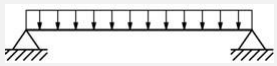
ISOFIRE ROOF FONO



Self-supporting panels according to the UNI EN 14509 definition. "…panel capable of supporting, by virtue of its materials and shape, its own weight and in case of panel fastened to spaced structural supports, all applied loads (snow, wind, air pressure), and transmitting these loads to the supports.", depending on the type of metal supports, their thickness and the thickness of the thermal insulating core. Below are some examples of indicative load bearing capacity tables:



STEEL SHEET 0.5/0.5 mm (MICRO-PERFORATED inner sheet) Simple support 120mm						
EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm					
	50	60	80	100	120	150
	MAXIMUM SPAN cm					
80	285	310	365	410	455	475
100	265	285	325	365	415	430
120	230	260	300	335	375	410
140	220	230	270	310	350	365
160	200	220	250	275	315	335
180	180	200	230	265	295	310
200	165	180	220	250	275	295
220	160	170	205	230	255	280
250	140	160	185	215	235	250



STEEL SHEET 0.6 / 0.6 mm (MICRO-PERFORATED inner sheet) Simple support 120mm						
EVENLY DISTRIBUTED LOAD [kg/m2]	NOMINAL PANEL THICKNESS mm					
	50	60	80	100	120	150
	MAXIMUM SPAN cm					
80	300	325	370	430	470	515
100	270	295	340	385	430	465
120	240	265	305	350	390	420
140	225	250	280	320	360	380
160	210	225	260	295	325	350
180	200	210	240	270	300	330
200	180	200	230	260	285	300
220	165	190	215	240	265	285
250	145	165	200	225	250	260

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.

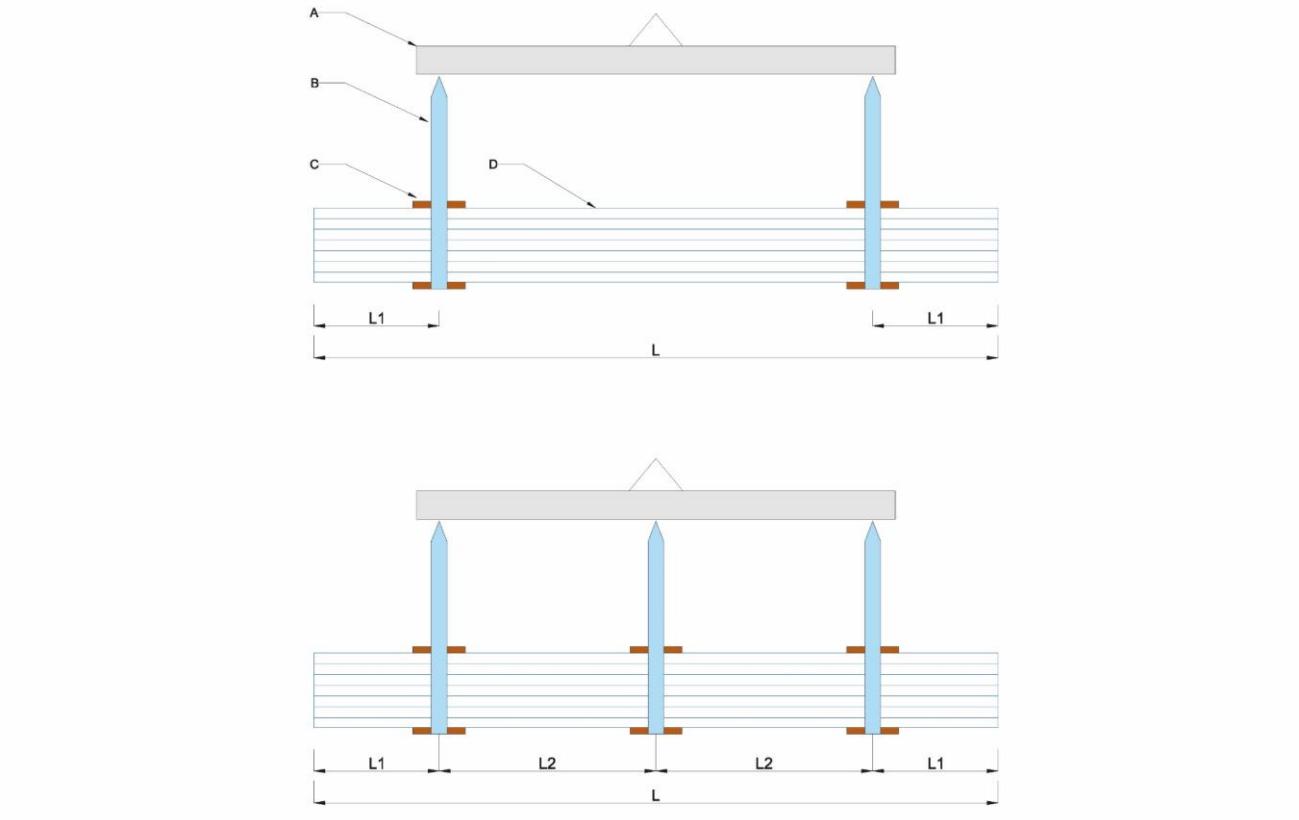
UNLOADING WITH A CRANE

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), 3 or more support points must be used.

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 A FORKLIFT

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, assuring 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)

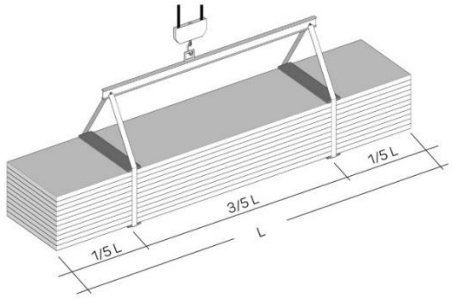


Figure 1

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).

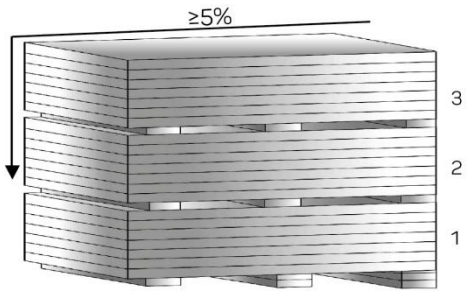


Figure 2

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)

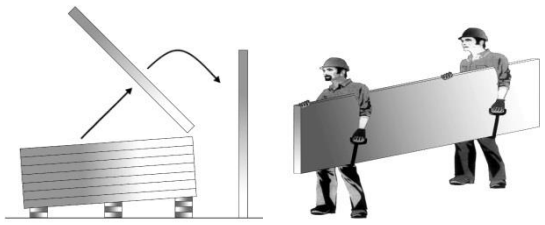


Figure 3

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.

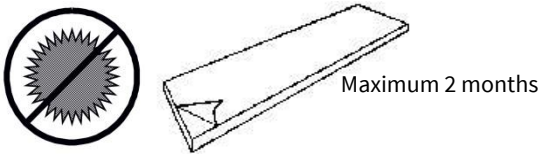
In case of head overlaps, the slope should take into account the type of joint and material used, as well as the specific environmental conditions.

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.

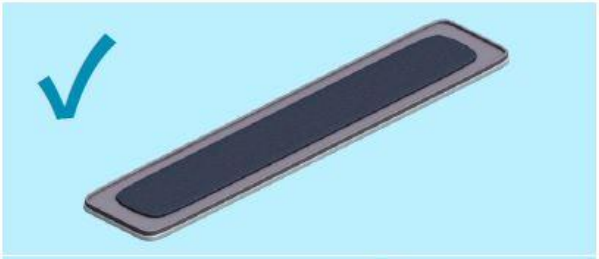
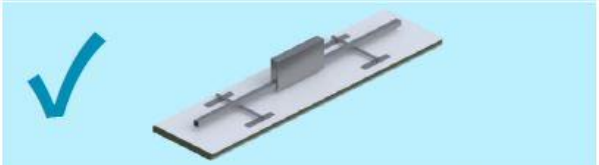
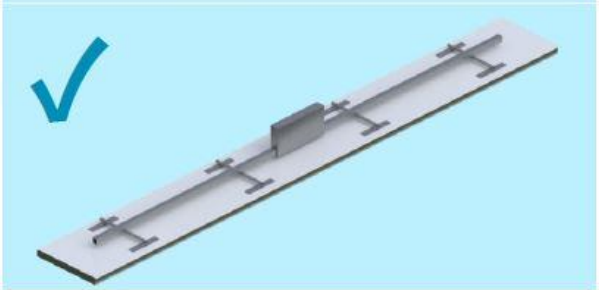
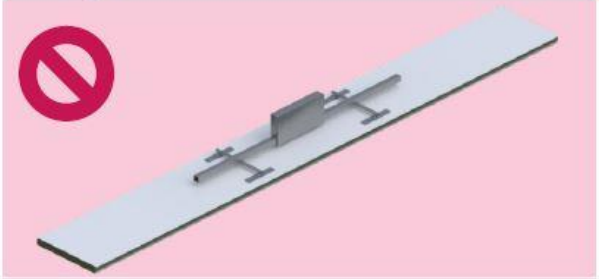
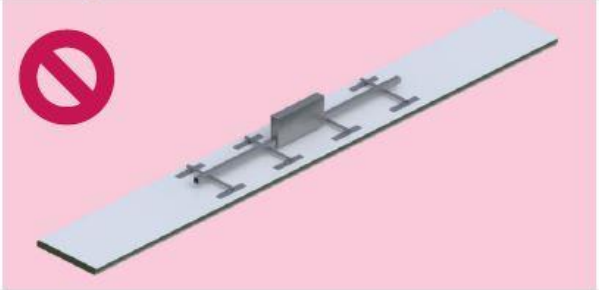
YEARLY CHECKS OF THE ISOPAN PANELS	
WHAT TO INSPECT	**CORRECTIVE ACTIONS**
Conditions of the pre-painted surfaces (cracks and colour unevenness)	Assess the condition of the surfaces Repaint where possible
Scratches and dents	Repaint and repair dents
Fastening screws	Remove a screw and check if oxidised 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:

TO ENSURE THE FLATNESS OF THE METAL SHEET DURING THE AIR INTAKE YOU MUST PUT IN THE SUCTION PADS AN APPROPRIATE BUFFER STIFFENING	
AT LEAST 4 SUCTION PADS EQUALLY DISTRIBUTED FOR PANEL LENGTHS LOWER THAN 6 METERS	
AT LEAST 8 SUCTION PADS EQUALLY DISTRIBUTED FOR PANEL LENGTHS HIGHER THAN 6 METERS	
NOT ENOUGH SUCTION PADS	
SUCTION PADS NOT EQUALLY DISTRIBUTED	

Annex C – Alignment of metal substructures

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.

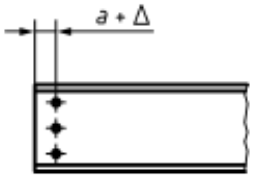
The basic operations to carry out an adequate vertical and horizontal alignment of all parts of the assembled structure involve the use of positioning templates, accurate three-dimensional surveys and partial or total pre-assembly. They can also be supported by the use of specific tools such as the laser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

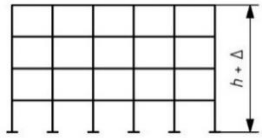
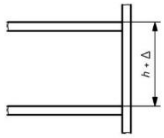
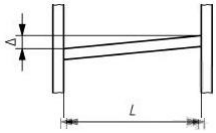
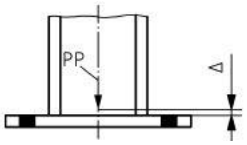
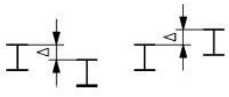
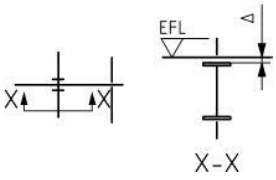
No.	Criteria	Parameter	Functional Tolerances Deviation allowed Δ	
			Class 1	Class 2
1	Height 	Overall height with respect to the base level. $h \leq 20$ [m] 20 [m] < h < 100 [m] $h \geq 100$ [m]	Δ = ± 20 mm Δ= ± 0.5 (h +20) mm Δ= ± 0.2 + (h +200 mm)	Δ = ± 10 mm Δ= ± 0.25 (h +20) mm Δ= ± 0.1 + (h +200 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

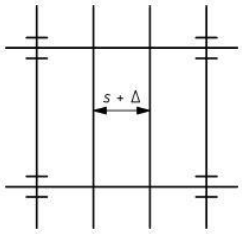
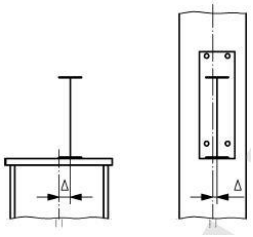
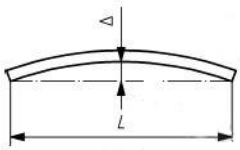
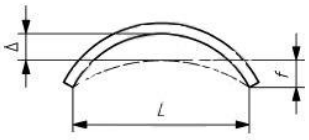
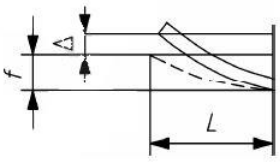
No.	Criteria	Parameter	Functional Tolerances Deviation allowed Δ	
			Class 1	Class 2
1	Spacing between the centre lines of the beam 	Deviation Δ of the predicted distance (s) between adjacent constructed beams, measured at each end.	Δ = ± 10 mm	Δ = ± 5 mm
2	Position on the columns 	Deviation Δ of the 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

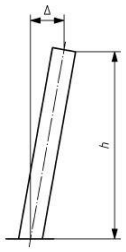
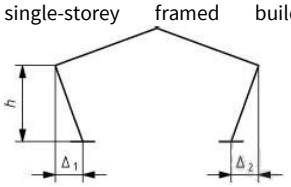
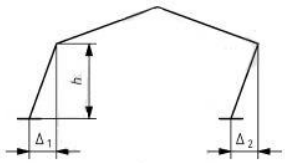
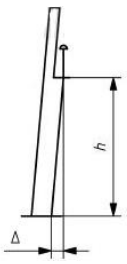
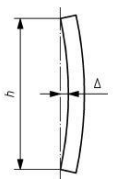
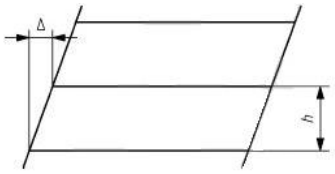
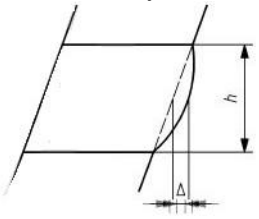
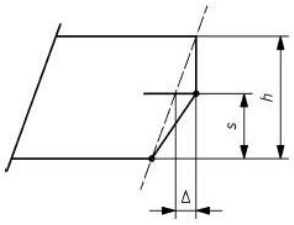
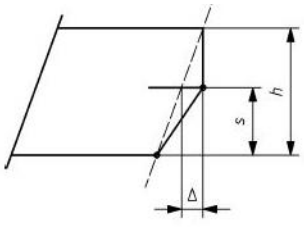
No.	Criteria	Parameter	Functional Tolerances Deviation allowed Δ	
			Class 1	Class 2
1	Inclination of columns of single storey buildings 	Overall inclination in height *h*	Δ = ± *h*/300	Δ = ± *h*/500
2	Inclination of individual columns in single-storey framed buildings 	Inclination Δ of each column: 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

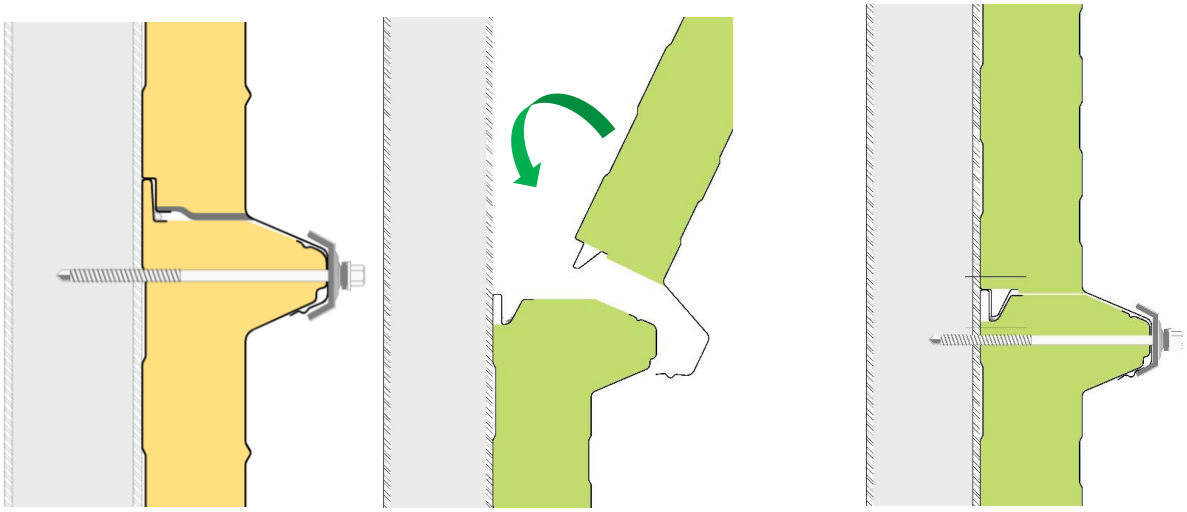
No.	Criteria	Parameter	Functional tolerances Deviation allowed Δ	
			Class 1	Class 2
1	Position at floor level, no. of levels above the base, with respect to that of the base 	Position of the column in the plan, with respect to a vertical line that crosses its centre at the lowest level.	$\Delta=\pm\sum h/(300\sqrt{n})$	$\Delta=\pm\sum h/(500\sqrt{n})$
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 $s \leq h/2$

Annex Z - Wall installation

Corrugated Roof Panels can be installed for wall application, with horizontal or vertical installing configuration. In this kind of application, instruction contained in previous chapter of this document can be considered valid.

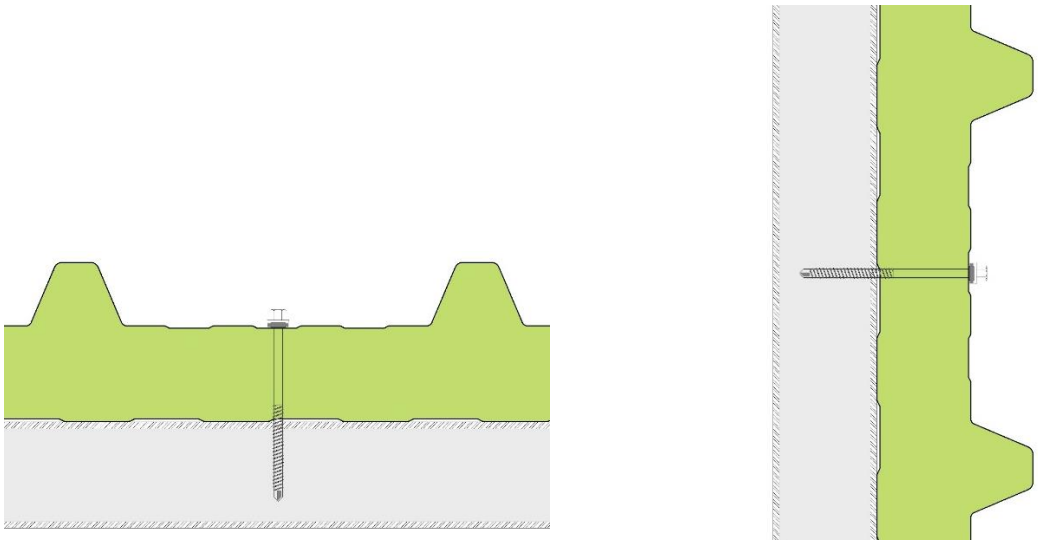
Panel installation (specially with horizontal panel configuration) must be done in such a way as to allow the rain water outflow, to prevent stagnation and infiltrations.

Regarding to fastenings installation and assembly instructions, please refer to JOINT chapter in this document.



Mineral rock wool insulated panels

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 required to manually rotate the second panel so that it can fit properly into the previously installed panel, as shown in the figure.

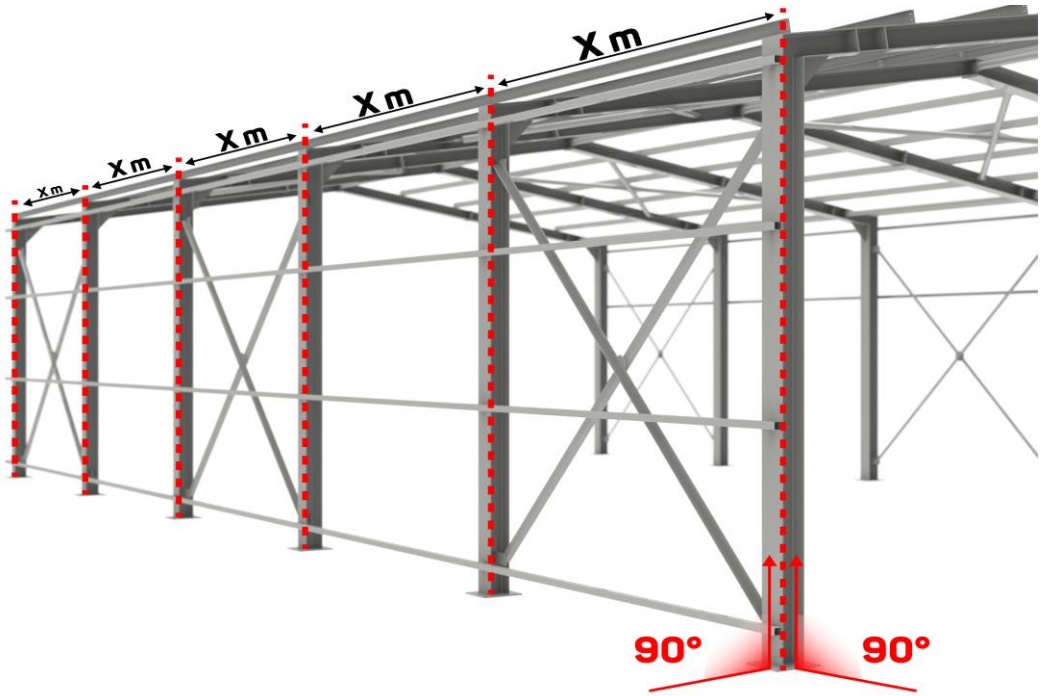


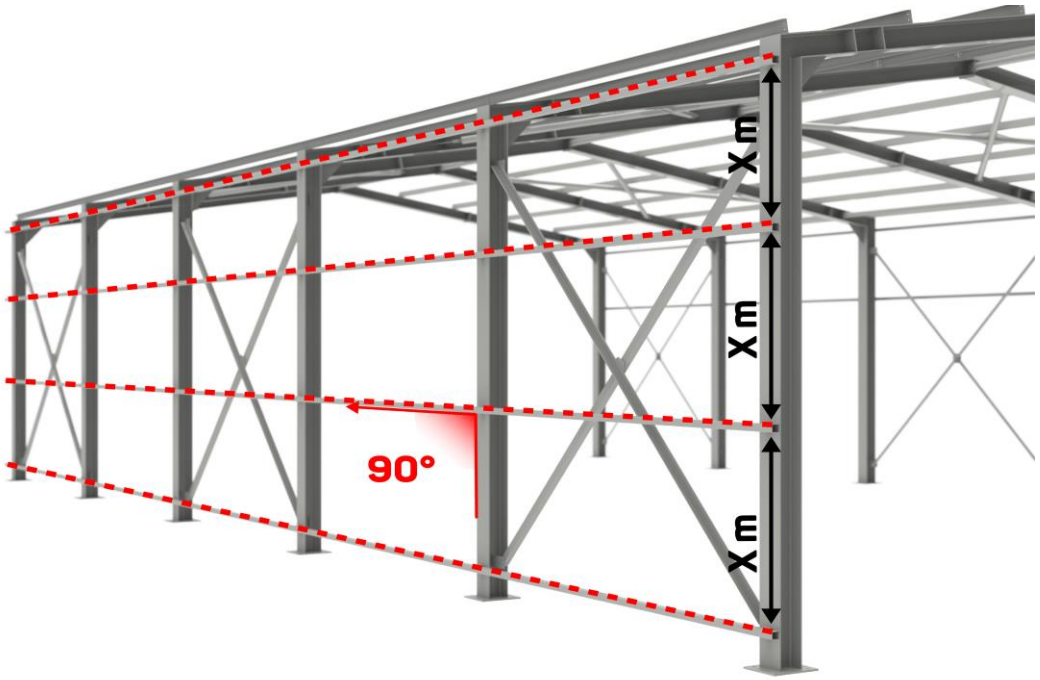
If design conditions require an increase in the number of fixings, it is possible to place additional fixing screws even on the non-corrugated part of the metal profile.

Wall structures alignment

The installation of the corrugated roof panels on the wall is subject to the correct alignment of the supporting substructures.

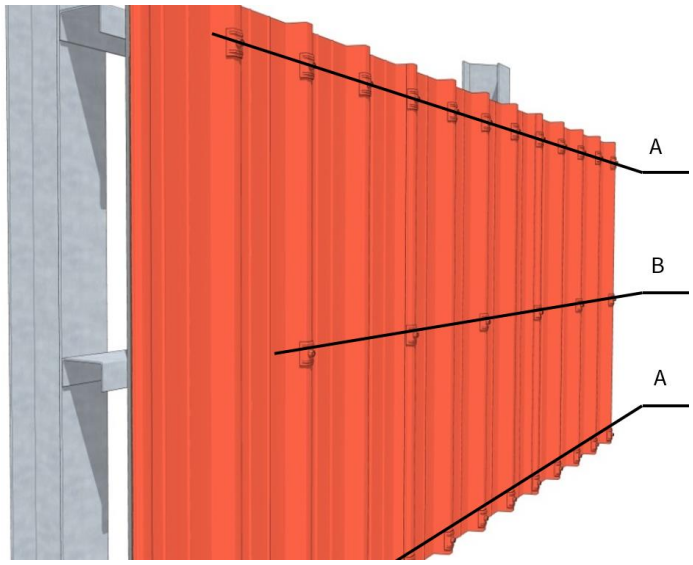
In order to ensure correct installation, and to avoid damage and imperfections to the products, Isopan recommends carrying out a check on the perpendicularity and alignment of the structural frame.





Fastenings for ROOF CORRUGATED PANELS in wall application

The panels are installed with the direction of installation opposite to that of the prevailing winds, frequently checking their parallelism and alignment. The holes must be smaller in diameter than the fasteners. The number of fasteners depends on the local climatic situation. The normal fixing density is that which foresees one on alternate ribs on the central joists and one on each rib on the terminal joists.



A: Terminal joists

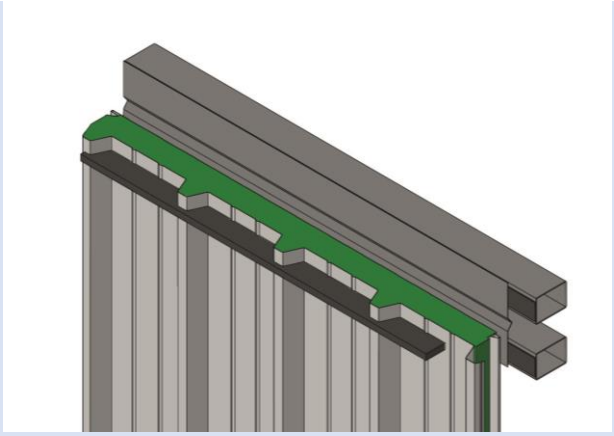
B: Central joist

Fastenings installation

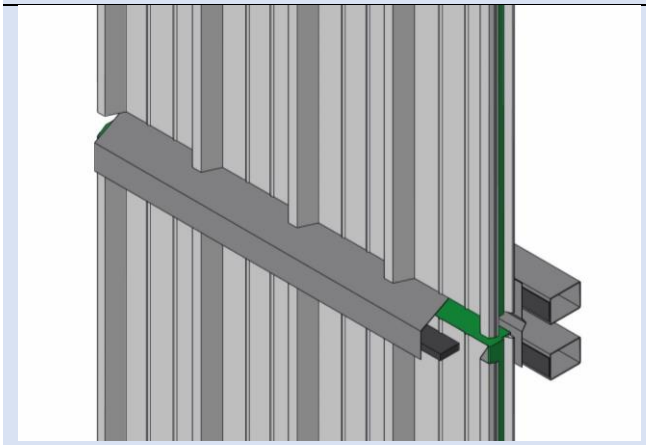
Regarding to fastenings installation and assembly instructions, please refer to JOINT and FASTENING AND INSTALLATION chapters in this document.

Note: it is necessary to pay attention to the correct juxtaposition of the panels during assembly (4 panels = 4000 mm ± 5 mm) in order to avoid problems during the subsequent installation of the ridge, as shown in the figure.

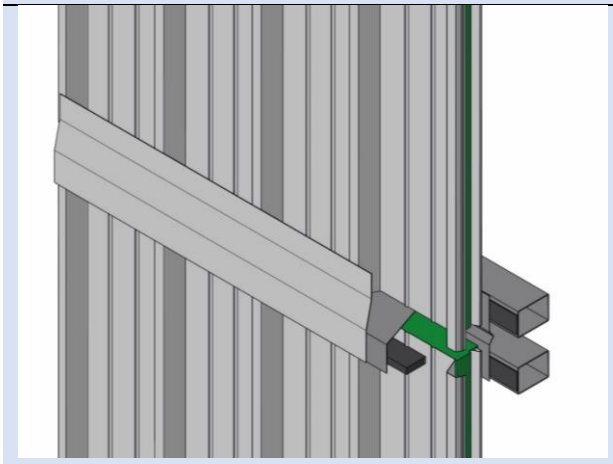
Panel-to-panel joint – Vertical configuration panels, with dripping and joint-cover flashing



1. At the joint between the upper and lower panels, install an internal joint cover sheet metal.
2. Then install the lower panel, and place the Giuntoplast shaped gasket.

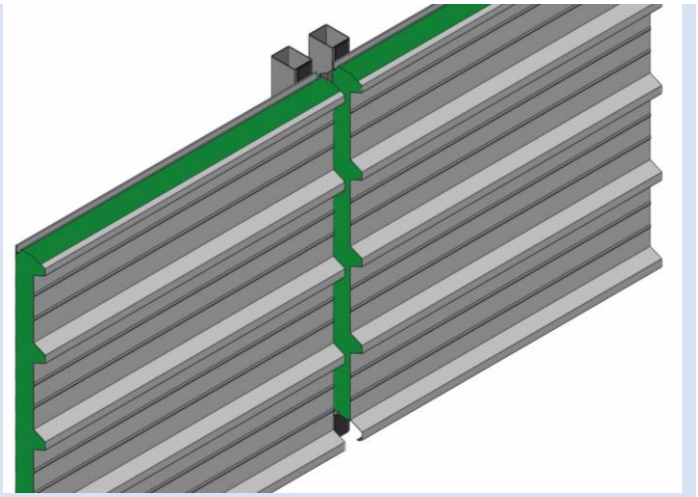


3. **The space between the panel and the drip sheet metal must be filled with on-site insulation.**
4. Install a drip sheet metal above the lower panel, so that it covers the Giuntoplast gasket.
5. Then place the upper panel, taking care to align it correctly with the lower panel.

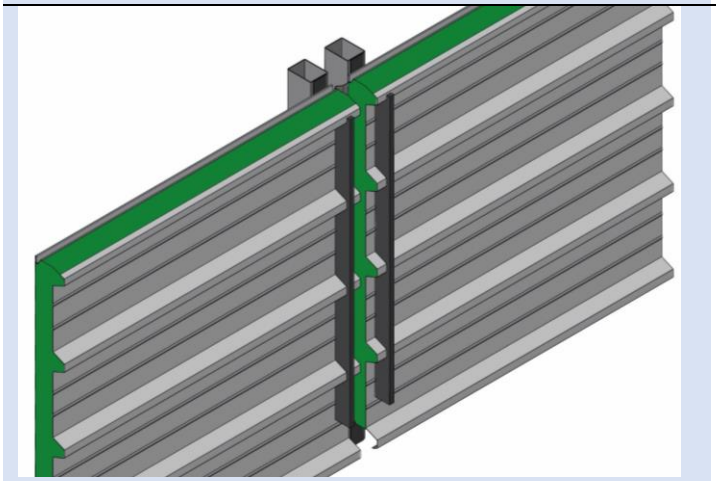


6. Install the joint cover sheet metal so that it covers the drip cover sheet metal.

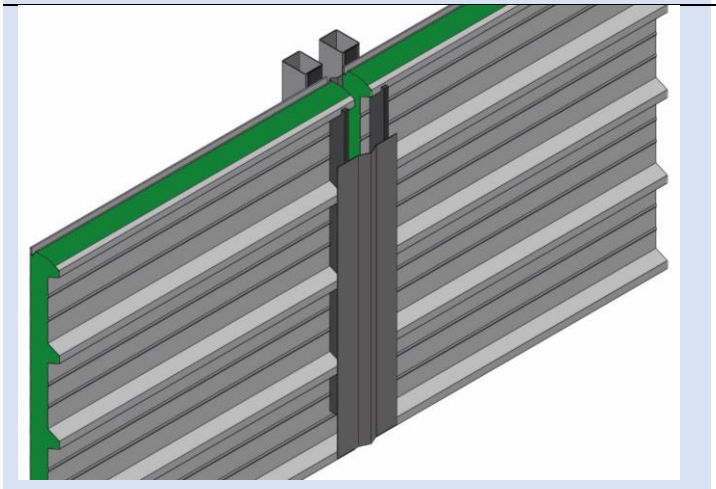
Panel-to-panel joint – Horizontal configuration panels, with joint-cover flashing



1. The panels must be correctly installed, so that the profiles are aligned with each other.
2. **The space between the panel and the drip sheet metal must be filled with on-site insulation.**



3. Position the Giuntoplast gaskets on both panels.



4. Install the joint cover sheet metal so that it covers the jointplast gaskets.

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