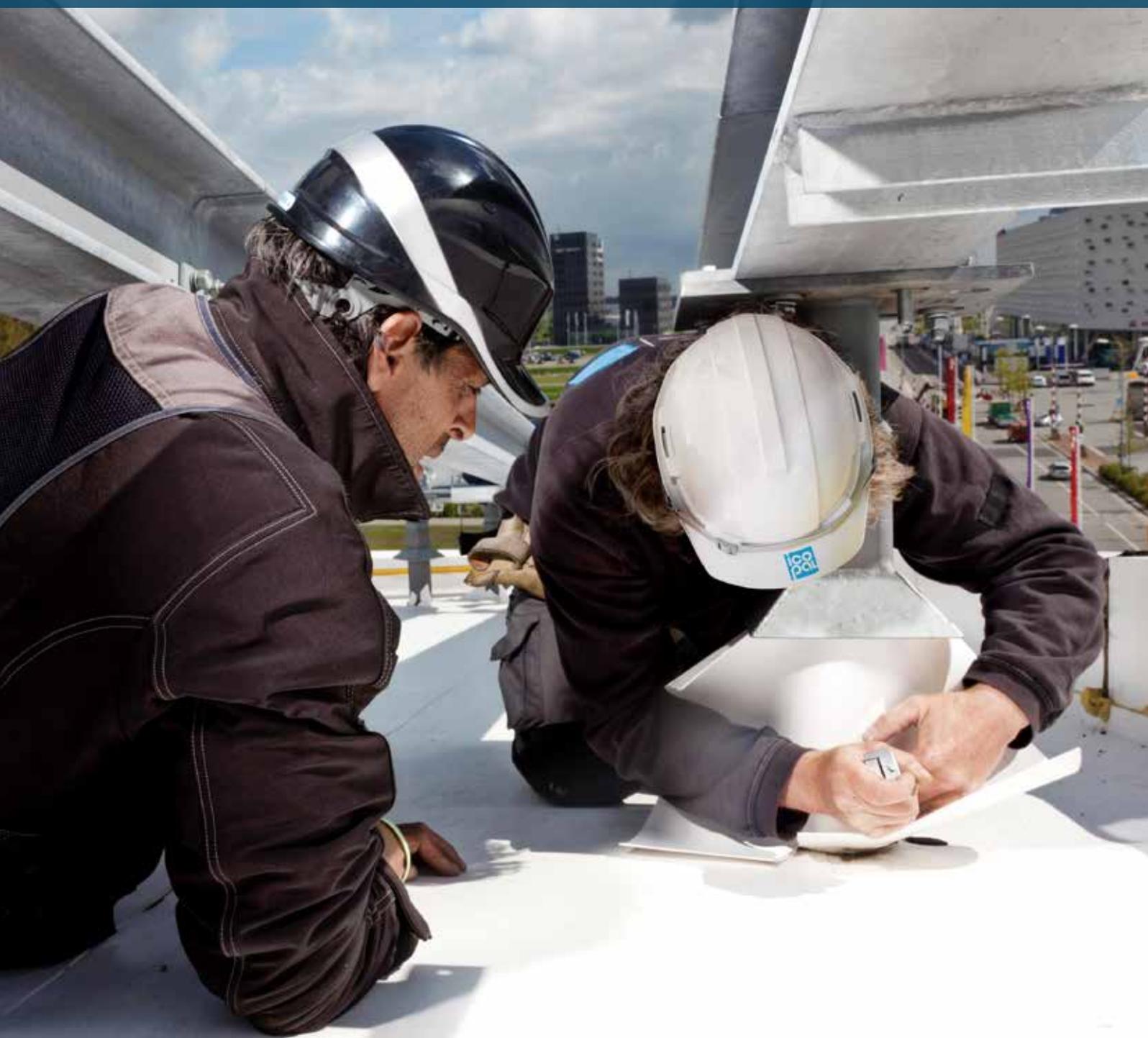




Monarplan® Installation Manual



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1 Subject and range of application

This application manual contains basic rules and serves as a guideline for roof waterproofing with Monarplan® waterproofing membranes for new buildings and refurbishment. They are the manufacturer's instructions and guidelines for roofers and construction site managers. They are the result of decades of practical experience in the laying of Icopal waterproofing membranes on millions of square metres of roof areas.

Adherence to the relevant technical rules, as published in standards and regulations, as well as to the workers protection and safety regulations is obligatory. The handling instructions and notes on can labels and safety data sheets for Icopal adhesives and accessory materials are to be observed. Drawings included in these instructions are not true to scale and are schematic.

Please take notice of the local winduplift regulation. The way of installing is also dependant on the specific construction of the building.

2 Icopal Synthetic Membranes

Product range at a glance

Monarplan® is a range of thermoplastic heat weldable waterproofing membranes suitable for flat, curved and pitched roofs.

PVC membranes from Icopal have been in use for over 50 years, covering roofs of all types and forms. Whether it's domestic or commercial, public or private; Monarplan® membranes offer a flexible and lightweight waterproofing solution with a proven track record. Monarplan® is a flexible PVC (polyvinyl chloride) single ply membrane offering excellent characteristics of strength, elongation and weathering, making it ideal for new build or refurbishment projects

2.1 System Components

2.1.1 Monarplan® Membranes

All roofing materials are subjected to environmental conditions that can alter the physical and chemical properties of the material. These conditions include ozone, heat, solar radiation, thermal cycling, freeze/thaw, pollution, biological growth and ponding rainwater. Waterproofing properties must be maintained during exposure to the roof environment or the roof will not perform as expected. The inherent performance benefits of Monarplan® ensure both the specifier and building owner of a versatile, durable and stable roofing option.

- **Monarplan® FM**

is a polyester reinforced membrane designed specifically for use within mechanically fastened applications. The polyester fabric gives the membrane inherent tensile strength which is required to facilitate the use of fasteners to restrain the system against wind uplift. Mechanically fixed systems can be cost effective solutions, and are ideal where lightweight constructions are considered.

- **Monarplan® G**

incorporates a glass reinforcement encapsulated between two layers of extruded PVC. The membrane is specifically designed for use within ballasted inverted, ballasted warm roof or green roof constructions where the membrane is buried.

- **Monarplan® GF**

is the same glass reinforced PVC membrane as Monarplan® G, but incorporating a polyester fleece backing. The factory laminated polyester backing allows the membrane to be applied in a part mechanically fixed/part adhered system or alternatively fully adhered to the underlying substrate using a compatible cold applied adhesive and can be the ideal solution on curved, steep or undulating roof designs that prove challenging for other systems.

- **Monarplan® D**

unreinforced flashing is intended to be used in the formation of internal/external corners, field fabricated pipe flashings, sealant pockets and scuppers, when the use of injection moulded accessories are not feasible.

Durability

Monarplan® provides exceptional weather resistance and protection against usually expected temperatures. Monarplan® is UV resistant and remains virtually unchanged throughout its serviceable life. Accelerated age testing completed on the Monarplan® membranes provide an anticipated life expectancy in excess of 30 years in middle Europe demonstrating superior durability and system service life performance.

Compatibility

Monarplan® roof membranes can be installed on all major roof deck types such as plywood, timber boards, profiled metal, concrete and cementitious screeds. However, PVC membranes can be adversely affected by contact with bituminous or coal tar products. In this situation or when used over polystyrene and unfaced polyurethane insulations a separation layer will be required.

Product range

Monarplan® waterproofing membranes are high-quality synthetic membranes which come in 4 different types, complete with preformed details, coated metal sheets and accessory materials.

	Type of membrane			
Membranes	Monarplan® FM	Monarplan® G	Monarplan® GF	Monarplan® D
Type of reinforcing	polyester reinforcing	glass fleece reinforcing	glass fleece reinforcing and polyester fleece backing (250 g/m ²)	unreinforced (homogeneous)
Effective thickness [mm]	1.2/1.5/1.8/2.0	1.5/1.8/2.0	1.5/1.8/2.0	1.5
Membrane width [m]	1.06/1.50/1.60/2.12 ³⁾	2.12	2.12	0.7/1.4
Standard length [m] ¹⁾	20/15/15	20/15/15	20/15/15	15
Standard colour ²⁾	grey, anthracite	grey, anthracite	grey, anthracite	grey, anthracite
Accessories				
Monarplan® internal/external/universal corners	+	+	+	+
Monarplan® coated metal sheet	+	+	+	+
Adhesives & other liquids				
Icopal Fleeceback Adhesive Partly Bonded (TK 400)			+	
Icopal Fleeceback Adhesive Fully Bonded (TK 3958)			+	
Monarplan® Contact Adhesive (TK 914)	+	+		+
Monarplan® liquid PVC	+	+	+	+
Monarplan® membrane cleaner	+	+	+	+

1) specified lengths on request

2) special colours on request

3) New widths soon available:

ISM SK (SKS): 1,06 / 1,65 / 2,12

ISM NL (NLS): 1,09 / 1,54 / 2,18

2.1.2 Accessories

All Monarplan® single ply roof systems are complimented by a comprehensive range of ancillary products to ensure maximum compatibility and single source responsibility for the roofing system.

- 1 **Monarplan® Coated Metal sheet** is a 0.6 mm hot dipped galvanised steel sheet coated with a layer of 0.6 mm non-reinforced PVC film for an overall thickness of 1.2 mm. The sheet is cut into appropriate widths and used to fabricate metal drip edges or other roof perimeter edging profiles. The coated metal can also be used to provide mechanical restraint at any changes in level, abutments or roof area perimeters.
- 2 **Monarplan® D** Unreinforced Flashing is intended to be used in the formation of internal/external corners, field fabricated pipe flashings, sealant pockets and scuppers, when the use of pre-moulded accessories are not feasible. Monarplan® D Strips are also used to achieve a watertight detail where end laps of the Monarplan® GF membrane are butt jointed. they are also used in conjunction with coated metal drips and upstands.
- 3 **Monarplan® W Walkway Membrane** is a weather resistant PVC membrane which is anthracite in colour and incorporates an aggressive, non-slip, interlocking herringbone tread pattern.
- 4 **Monarplan® inside, outside & universal Corners** aid speed of installation on site.
- 5 **Monarplan® Pipe Fittings** are moulded preformed PVC pipe flashings (pipe boots) designed to suit a range of pipe diameters, achieving a watertight seal.
- 6 **Monarplan® Standing Seam Profiles** are used to replicate the appearance of lead standing seam or metal profiles.



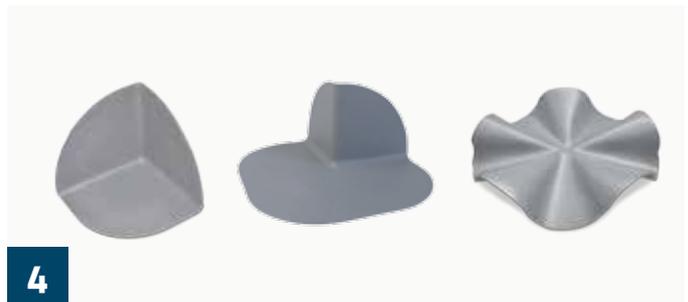
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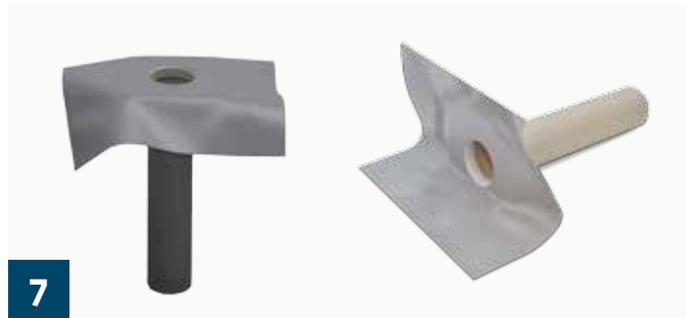


5



6

7 Monarplan® Outlets are manufactured from rigid PVC incorporating a Monarplan® flange for easy welding to the roof membrane. Connection is made with the plumbing using a rubber gasket. The Monarplan® Outlet rang is completed with leaf guards where required. Outlets are available in standard and refurbishment versions. Also available is a Monarplan® Horizontal Outlet. Please consult product information sheet for further information.



7

8 Icopal EPDM sealents can be combined with the Monarplan® outlet to construct a waterproof solution.



8

9 Icopal fixation bar is a 3 m galvanised steel bar with pre-drilled holes at specified centres to facilitate the mechanical restraint of Monarplan® membranes at the base of upstands or angle changes (**Remark: Monarplan® Coated Metal sheet is preferred**). It should be fastened to the more stable substrate, ie fixed vertically to the structural deck or horizontally to masonry or concrete upstands.



9

10 Icopal universal leaf grate is a rigid plastic leaf grate with expanding clamps.



10

2.1.3 Adhesives, Solutions and Compounds

Icopal Fleeceback Adhesive for fully bonded application:

Teroson AD 3958 is a high strength, single component moisture curing polyurethane adhesive that has been formulated for bonding fleece-backed single ply roofing membranes to various substrates including suitable roof insulation panels. The cured adhesive film has very good resistance to heat and hydrolysis, and is blue/ green in appearance.



Icopal PVC Contact Adhesive: Teroson AD 914 is a high

strength solvent based contact adhesive that allows the bonding of Monarplan® non-fleeceback membrane to various porous and non-porous substrates. The adhesive provides instant contact adhesion and is particularly useful at details such as upstands and abutments.



Icopal Fleeceback Adhesive for partly bonded application:

Terokal TK 400 is specially developed I-component foam adhesive for adhering of roofing membranes used for partly bonded application. Can be applied until - 5°C under normal building moisture conditions.



Icopal Insulation Adhesive: Terokal TK 395 is a high strength I-component foam adhesive for bonding thermal insulation products on flat roofs.



3 Packaging, delivery, storage and disposal of materials

3.1 Packaging, delivery and storage of membranes and accessory materials

Handle all materials to prevent damage. At the factory, the waterproofing membrane rolls are laid horizontally on pallets for transportation. The pallets are covered with PE foil.

Leave the material in its original packing until used and protect from moisture. Unsealed packing units must be carefully closed, if stored in the open for a longer period. After long-term storage, small buckles may show at the roof sealing after laying.

The membrane rolls must be stored horizontally on a clean flat and dry level surface. The rolls must be stored in a weather-sheltered place avoided to direct sunlight, or covered with a clean tarpaulin. Moisture on the membranes may impair weldability.

Pallets should not be stapled.

Temporary storage on roofs should be in rolls and with an even spread over the roof deck, on lightweight steel decking only in bearing areas.

The accessory materials are packed weatherproof in synthetic / tin containers or cans.

Please note the storage conditions and shelf life indications on

the container labels!

Adhesives must be stored at temperatures around 20 °C depending upon the product (consult the individual product technical datasheet for specific storage instructions). All flammable materials shall be stored in a cool, dry area away from sources of heat, sparks and open flame. Follow the precautions outlined on the label of the container.

Materials from open containers can be processed only for a short time.

3.2 Disposal of construction site waste and packaging material

The National Regulations must be noted.

Icopal supports the Pan-European ROOFCOLLECT® to collect and recycle PVC roofing membranes.

The aim of ROOFCOLLECT®, a program set-up by the leading manufacturers of plastic roofing and underlays, is the cost-effective and environmentally compatible collection and recycling of PVC roofing underlays. Icopal actively supports the pan-European program.



4 Roof types

4.1 General

There are generally three types of flat roof construction:

Warm Roof

The thermal insulation is positioned above the roof deck immediately below the waterproofing, resulting in the structural deck and ceiling being at a temperature close to that of the interior of the building. A vapour control layer is placed between the roof deck and the insulation to minimise the risk of condensation. Ventilation of the roof void is not required. However due consideration must be given to providing a minimum upstand requirement of 150 mm above the finished roof level for all details.

Ventilated Roof ("cold roof")

This type of roof must be carefully designed to avoid premature failure and should be avoided wherever possible.

Thermal Insulation is positioned beneath the structural deck resulting in the roof covering and structural deck being substantially colder in winter than the interior of the building. The structural deck therefore becomes a potential point for condensation, and so it is important to provide a minimum 50 mm void between the top of the insulation and the roof deck. This void must be ventilated and cross ventilation must be provided with a minimum 25 mm continuous opening at eaves on opposing sides of the roof. A suitable sealed air-leakage barrier, or vapour control layer installed at ceiling level is good practice, as this will help restrict the passage of warm moisture laden air into the roof structure.

Inverted Roof

Sometimes referred to as an 'upside down' roof, the thermal insulation is positioned above the roof covering, resulting in the roof covering, structural deck and ceiling being at a temperature close to that of the interior of the building.

Since the insulation is above the waterproofing system the insulation must be water-resistant and it must be ballasted to prevent floatation of the insulation boards and to protect against wind uplift. Therefore, the roof deck must be capable of withstanding the additional loading of a ballasted roof.

4.2 Method of Attachment

The roof system must be secured to the roof structure to protect against wind uplift. The components of the roof system can be secured in a number of ways.

Mechanically Fastened

The membranes and insulation are secured using screw fasteners which are fixed directly to the structural deck.

Adhered

The layers can be adhered using adhesive compounds to attach the membranes or insulation to the substrate beneath.

Ballasted

The membranes and insulation can be secured using a selected material, such as river-washed pebble or concrete paving slabs to weight the layers down to protect against wind uplift or floatation. A separation layer (PE foil) is required and an additional protection layer may be required beneath the ballast material to protect the underlying layers from damage.

Depending on project requirements and scheduling it is possible to use a combination of methods, eg mechanical fastening of insulation, and adhering of the waterproofing layers.

4.3 Choosing of membrane

The choice of membrane will depend on the application and substrate.

Step 1: Type of Roof	Warm / Cold / Inverted / Refurbishment
Step 2: Type of Substrate	Plywood / OSB / Metal / Concrete / Timber boards
Step 3: Method of Application	Mechanically Fastened / partially or fully Adhered / Ballasted / Combination

The following tables are intended to offer a simple summary. Please consult with Icopal Technical Services on project specific situations.

		Type of membrane			
		Monarplan® FM	Monarplan® G	Monarplan® GF	
Application of membrane to Insulation Substrates (warm roofs)					
Warm roofs	Method of Application	Mechanically Fastened	Ballasted	Adhered	Ballasted
	Insulation Type				
	Mineral Wool				
	Plain/tissue	Yes	Yes	Maybe ⁶⁾	Yes
	Bitumen faced	Yes ²⁾	Yes	Maybe ⁶⁾	Yes
	Expanded PS				
	Bitumen faced	Yes ²⁾	Yes ⁵⁾	Maybe ⁶⁾	Yes
	Glass Fleece	Yes	Yes ⁵⁾	Maybe ⁶⁾	Yes
	PIR/PUR				
	Glass Tissue Face	Yes	Yes	Yes ¹⁾	Yes
	Foil Faced	Yes	Yes	Maybe ⁵⁾	Yes
	Bitumen faced	Yes ²⁾	Yes ²⁾	Yes ¹⁾	Yes
	Naked	Yes ²⁾	Yes ²⁾	Yes ¹⁾	Yes
	Composite Board				
	Perlite	Yes	Yes	Maybe ⁶⁾	No
Cork	Yes	Yes	Maybe ⁶⁾	No	

Application Direct to Common Substrates (cold or inverted roof situations)

		Mechanically Fastened	Ballasted	Adhered	Ballasted
Cold or inverted roof situations	Method of Application				
	Substrate Type				
	Concrete				
	Cellular/Rough	Yes	Yes	Maybe ⁶⁾	Yes
	Cast	Yes	Yes ²⁾	Maybe ⁶⁾	Yes
	Ply/OSB	Yes ^{2) 3)}	Yes ²⁾	Yes ¹⁾	Yes
	Profiled Metal	Maybe ⁶⁾	Maybe ⁶⁾	Maybe ⁶⁾	Maybe ⁶⁾
	Timber Boards	Yes ²⁾	Yes ²⁾	Yes ⁶⁾	Yes
	Asphalt/Bitumen	Yes ²⁾	Yes ²⁾	No ⁴⁾	Yes

1) Icopal Single-Ply Fleeceback Adhesive.

2) Requires separation/protection layer beneath.

3) Monarplan® Contact Adhesive. Please note, coverage rates are adversely affected, to be used for upstands

4) Direct contact not possible. Use thickness of suitable insulation board, or similar.

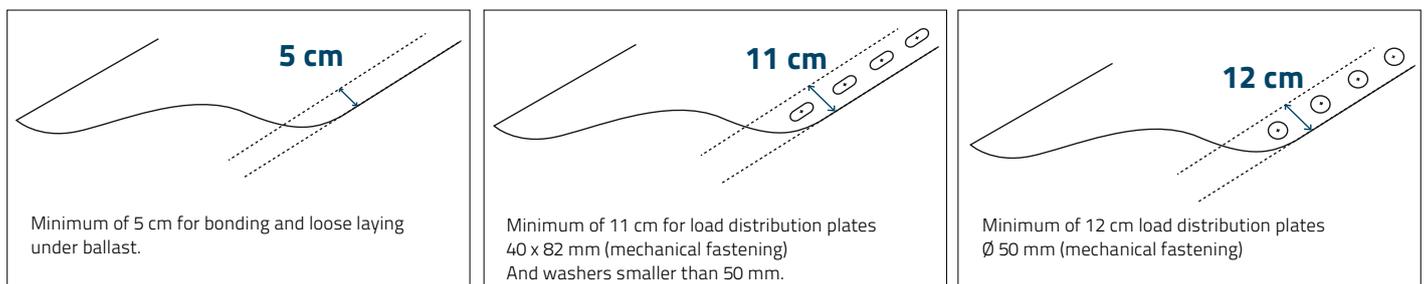
5) For insulation boards, consult insulation manufacturer for guidance.

6) Consult Icopal Technical Services for guidance.

5 Installation principles

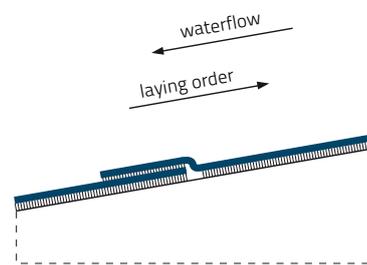
5.1 Seam overlap

Monarplan® waterproofing membranes are marked with several dashed lines along one longitudinal edge. These markings can be used as guiding lines for the corresponding lap width.



5.2 Laying order

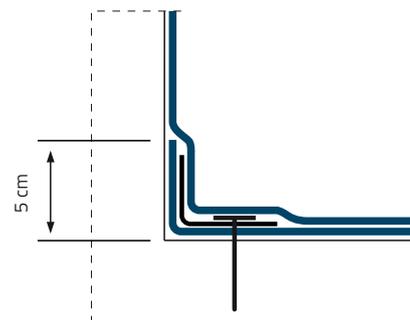
Regardless of the type and the laying method of the membranes, the seam laps can be arranged with or against the "water flow", due to the homogenous seam welding without foreign matter. When arranging with the "water flow", water may ingress under already laid membranes if it rains while waterproofing works are still in progress.



5.3 "Separation" of the roof sealing

The field sealing is always "separated" from the sealing of parapet and upstand flashings.

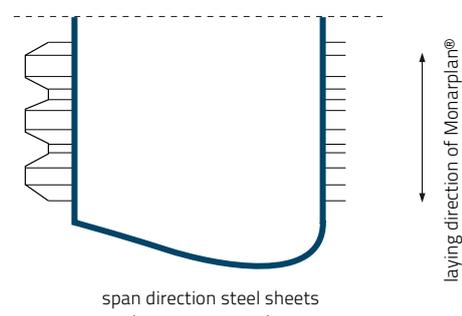
However, membranes of the field area are principally raised approx. 5 cm to parapets and upstands. Timber or insulation fillets are not required.



5.4 Laying direction

Generally, the Monarplan® waterproofing membranes can be laid parallel or perpendicular to the roof slope.

If using mechanical seam fastening of the waterproofing membranes on corrugated steel or timber decks, the membranes have to be laid perpendicularly to the span direction of the steel sheets or the boarding.



5.5 Position of butt joints

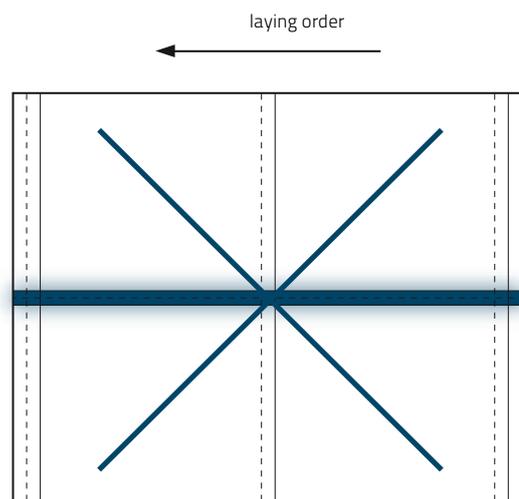
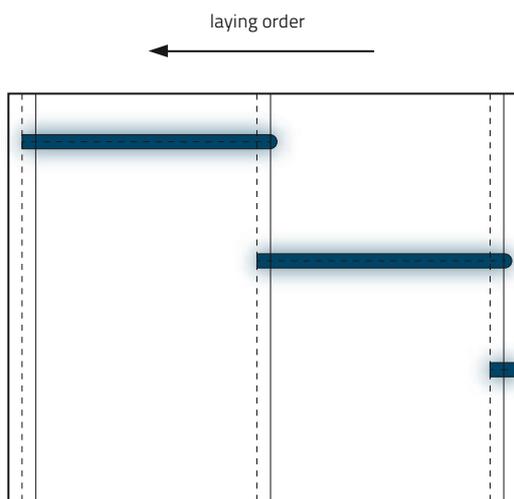
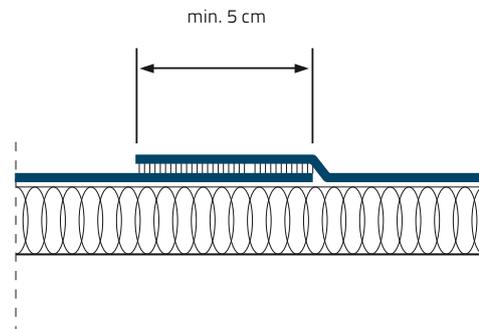
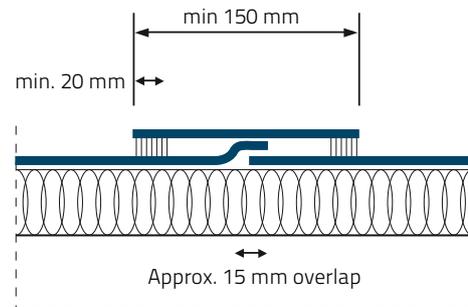
At the end of the membrane, i. e. normally after 15 m, the backed Monarplan® GF waterproofing membranes can be butt-jointed or hot-air welded at an overlap of approx. 1 cm and covered with an unbacked strip of at least 15 cm width.

Unbacked membranes, however, are laid, analogue to the longitudinal edge, with an overlap of at least 5 cm at the end of the membrane.

Double T-joints are forbidden!

Double T-joints are avoided by a staggered arrangement of the membrane ends.

If membrane ends are arranged without stagger, the end joints are to be covered with an unbacked tape of at least 15 cm width.



NOT ALLOWED

5.6 Tips for installation

In case of low ambient temperatures, small ripples may show on the waterproofing membrane after laying (especially in warm weather).

5.7 Formation of expansion joints

Expansion joints has especially to be planned by the architects and are project specific. Contact the Icopal technical service for guidance and advice.

6 Membrane Application

6.1 Tools and Equipment

The following is intended as a basic list of tools and equipment and their operation necessary to install a Monarplan® Roof System. Depending on the project, other tools and equipment may be required.

Additionally, these instructions are provided as recommended guidelines to follow to ensure proper performance of the equipment and successful installation of the Monarplan® membrane. Icopal does not endorse or recommend any particular brand of equipment.

Welding Machine

This is a self-propelled, electrically powered machine with attached air blower and heating unit. There are several models available, and proper operating instruction in the use of each model is the responsibility of the manufacturer/supplier of the machine.

Always read and/or ask the manufacturer of the equipment for the operating procedure. The following should be either checked or the routine followed daily to ensure proper splicing.

Alignment - Check the machine set-up to ensure proper alignment of the heating nozzle and pressure wheels or moving parts to see they move properly or are free-spinning.

Air Intake - Make sure the air intake is open. Clean out the air intake for the blower unit regularly.

Repair - Check the machine for worn or broken parts which need to be replaced. Take care to protect the pressure wheel from notches or cuts to prevent incomplete sealing of the welded splice.

Power-up - Before the machine is connected to the power source, make sure it is switched off to prevent a power surge that could damage the unit. Turn on the unit and allow the blower/heater unit to reach the necessary welding temperature. Always carry out a test weld on a sample piece of membrane each morning prior to welding.

Cleaning - Occasionally clean the heat nozzle with a wire brush to remove any build-up of membrane material.

Hand Welder

These tools are used for detailing and making welds not accessible by welding machines. The hand welder should be set to the appropriate welding temperature. Many of the care and operating notes for the welding machines apply to the hand welders as well.

Tool Kit

A typical tool kit should include the following:

- A 40 mm seam roller
- A penny roller
- A seam probe
- Hot-air Handheld Welder
- A 40 mm flat nozzle
- A 20mm flat nozzle
- A 20mm angled nozzle
- A pair of scissors
- A wire brush



6.2 Hot-Air Welding

6.2.1 General

Monarplan® roofing membranes are hot air welded to each other and the compatible range of PVC ancillaries in a homogeneous manner. The welding zone must be clean (free from dust) and dry. All welds shall be a minimum continuous width of 20 mm. Hot-air welding is possible without further measures at ambient temperatures of at least +5 °C.

The roofing membrane must be unrolled without tension and free of wrinkles. The endlap area between sheets is 50 mm minimum.

To achieve a good weld, the following criteria should be considered:

- The ambient temperature and possible wind
- The temperature of the substrate and
- The temperature of the roofing membranes
- Welding speed / traction of the welding machine
- Volume and temperature of hot-air
- Humidity (water absorption)

All joints in the Monarplan® Roofing System are hot air welded. It is recommended that welding machines are used for all field joints. Manual hand held welders should be used for details and inaccessible areas only. The welding machines should be well maintained and yearly calibrated.

Welding temperatures will vary dependent upon the weather conditions of the day. Test welds should always be carried out before commencing work, adjusting the temperature settings as necessary to achieve the proper weld.

Deficiencies

Wrinkles, capillaries and fish-mouths are to be avoided. When these deficiencies occur they shall be repaired immediately.

Notice

Complete all roofing work and flashing each day to prevent water from getting under completed roof sections. Any areas where water has penetrated the completed roof must have any moisture and wet insulation removed. Temporary sealing of the edge of the roofing membrane is the responsibility of the contractor. The tie-off must be higher than the drain, and slope to the drain.

6.2.2 Hot-air welding with welding machines



Position the automatic hot air welding machine with the pressure wheel approximately 3 mm over the weld edge to ensure a sealed edge. Lift the overlapping membrane sheet and insert the blower nozzle between the overlap. Immediately begin moving the machine along the lap to prevent scorching of the membrane. The seams are welded in one operation usually at a speed of 2.0 to 3.0 m/min. At the end of the run, remove the nozzle first and then stop the machine's forward motion.

When the welding machine moves over an insulation plate, insulation step off, lap crossover, etc., these areas should immediately be hand-rolled to ensure a complete weld.

Metal tracks may be used over the deck membrane and under the welding machine to minimize or eliminate wrinkles.

6.2.3 Manual Hot-air welding



Use a hand-held welder and silicone covered roller to complete welds and details where the welding machine is inappropriate. All hand-held welders, which produce the necessary hot air temperature of approx. 400 - 450 °C and the necessary air volume can be used. Hot-air tools with closed loop controlled temperature (compensation of voltage fluctuations) with display are recommended.

The hand-held welder is to be inserted at an angle of

- approx. 45° to the membrane edge and
- approx. 30° to the roof area

into the seam overlap.

When the welding parameters are adjusted correctly, there is a certain development of smoke and the surface of the lower sheet turns shiny-brilliant when heated correctly. A change of colour, scorching or the formation of ashes on the nozzle or the welding zone indicates that the welding temperature is too high.

Membranes are seal-welded in one operation by moving backwards, whereas small tapes (up to 30 cm) are first tacked and then seal-welded. When seal-welding, the nozzle must be inserted between the membranes in a way that the top membrane edge will also be heated and plastified.

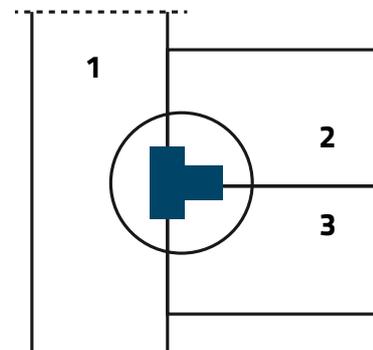
The plastified lap areas will be fused by applying moderate pressure with a silicone pressure roller, following parallel to the opening of the nozzle. Due to the backwards movement, the

nozzle always blows against already seal-welded areas of the seam. The weld must have a constant width as possible and a minimum width of 20 mm.

6.3 Welding of T-joints

T-joints are created when 3 membranes meet and must be formed very carefully, in order to prevent capillary action. T-joints must be thoroughly manual hot-air welded.

When planning the layout of the sheets cross-joints should be avoided. When the roof is long or when this should prove to be too arduous a membrane strip of min. 300 mm width shall be centered and welded over the overlap. Treatment is similar to that of T-joints.



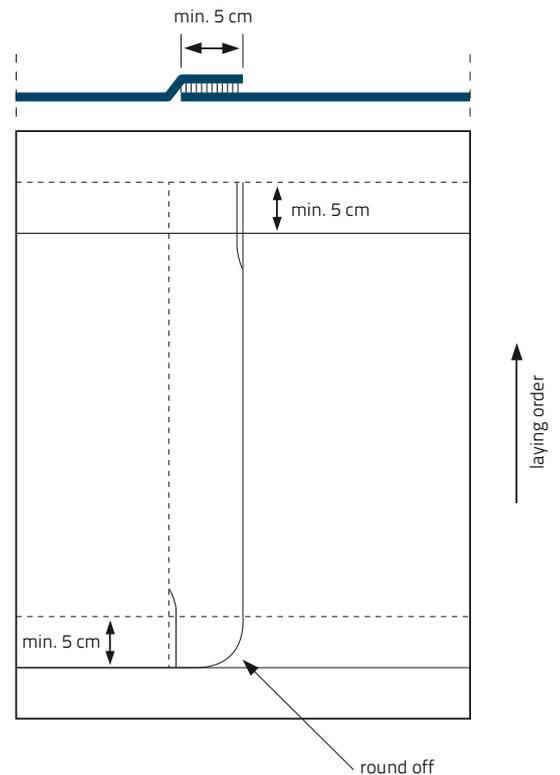
6.3.1 Butt joints of unbacked membranes

Unbacked membranes are laid, analogue to the longitudinal edge, with an overlap of at least 5 cm at the end of the membrane.

The top corner of the membrane must be rounded off!

Before welding the T-joint, the respective inner (middle) membrane end must be chamfered over the whole lap width (min. 4 cm)! This can be done with the hot nozzle of a hand-held welder, if necessary, with a metal plate serving as an underlay.

Note: Be aware that the temperature of the hot air welder is not too high and overheat/burning the membrane!



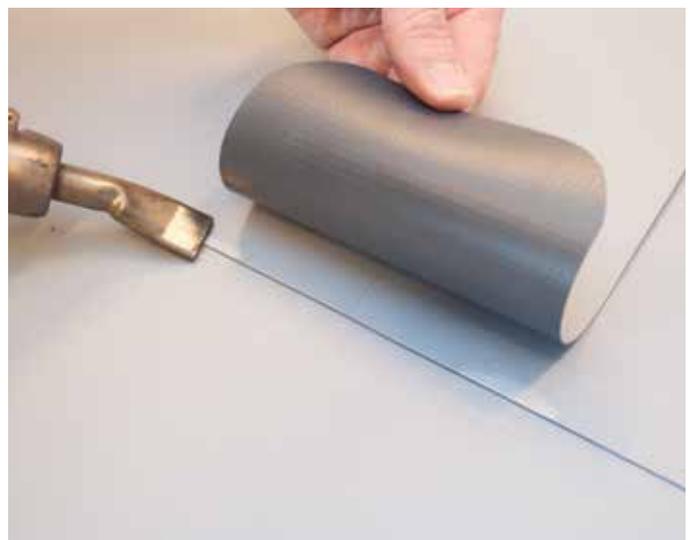
6.3.2 Butt joints of backed membranes

Backed membranes (Monarplan® GF), at the end of the membrane, are butt-jointed or, if appropriate, tacked with hot air with an overlap of approx. 1 cm (advantageous at low temperatures) and covered with an unbacked tape (15 cm tape width for mechanically fastened waterproofing membranes, e. g. if fasteners are placed at the butt joint) of at least 15 cm width.

The length of the tape: membrane width + approx. 5 cm.

At one end of the tape, both corners have to be rounded off.

Place the tape at the centre of the joint with the rounded-off end extending approx. 5 cm onto the previously laid membrane, which is through at the joint. The other side of the strip should end level



with the membranes to be joined. Tack the strip in this position, in the middle, with hot air and seal it all around the perimeter.

The longitudinal seam edges of the membranes to be joined, which are under the rounded-off end of the tape, must be chamfered at a width of approx. 5 cm or 10 cm each. As must the longitudinal seam edges at the other end of the tape itself, at the width of the lap. After chamfering, the strip will be welded at its longitudinal edges and at the rounded-off end.

Be especially careful when welding the chamfered areas with hot air.

The welding edge of the following membrane overlaps another longitudinal edge of the joined membranes and the tape in the chamfered area by at least 5 cm.

Again, be especially careful when welding the chamfered areas with hot air.

6.4 Weld tests

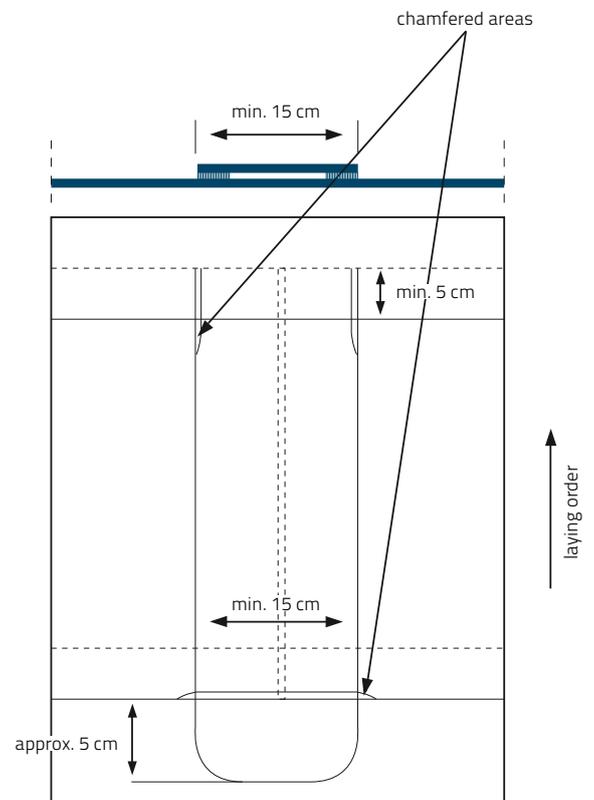
6.4.1 Non-destructive weld test

After the seam has cooled down to the ambient temperature, the sealing layer from the seam edge (min. 2 cm) must be cohesive without any foreign matter over the complete welding width, and the seam has to be permanently waterproof and highly resistant. The performance of the roof sealing depends to a great extent on the quality of the seam.

In order to detect possible voids, the welding seams must be tested over the complete length, paying special attention to the T-joints.

Seams welded with hot air can be tested immediately after cooling down to the ambient temperature.

A non-destructive test along the seam edges can be done by the roofer using a seam probe. The tool shall slide along the seam with little pressure continuously. When a deficient weld is detected (the seam probe penetrates into the overlap), it should be immediately visibly marked and repaired as soon as possible.



Always use a patch of 150 x 150 mm minimum with rounded edges. When the deficiencies are 'long', cut the patch to the size of the problem zone plus a 50 mm perimeter overlap. Circular patches shall have a minimum diameter of 150 mm.

6.4.2 Destructive weld test (Peel test)

Before starting work on site (morning and afternoon) and whenever there has been a change in the weather conditions, the welding parameters have to be verified and adjusted accordingly by carrying out a welding test. This is a site test and samples are torn by hand in the absence of a calibrated peel tester in the lab.

Width of the sample: >20 mm

The requirement for a good weld is that the peel resistance is greater than the required inter-laminar adhesion between the top and bottom PVC layers.



The peel test (by hand) shall not be carried out before the sample has cooled down to ambient temperature. Prior to performing the peel test, cut the sample material into strips 20 mm wide. The samples shall be torn by hand in lengthwise and crosswise direction respectively. When there is a delamination of either the top or bottom sheet the requirement is fulfilled and the welding parameters are set correctly. The delamination means a controlled destruction of the product.

When the seam peels off without a delamination of the membrane layers, it is indicated that the welding parameters were insufficient. A visual check can give a lead to whether:

- The air temperature was too low
- The traction of the machine was too great
- The pressure was not big enough
- The material itself was too cold or damp.

New tests must be carried on cooled samples until the correct parameters can be set for the next period of work.

The peel test can also be performed directly on the construction site using an electrical tensiometer. The advantage is to determine the welding strength and/or the peel force as well as the corresponding elongation data.

6.5 Sealing of seams

Seam edges of Monarplan® waterproofing membranes, whether backed, unbacked or reinforced, do not require sealing. The sealing gives however additional protection for the seam edge. After seam testing, the seam edges can be sealed with approx. 20 g (25 ml) Monarplan® liquid PVC per meter welded seam; i.e. approx. 100 m of seam edges with 2.5 l Monarplan® liquid PVC. The seam edges have to be dry and clean.

6.6 Welding of aged (weathered) membranes

Generally, weathered membranes may be fused with new material on site after years. Necessary technological changes (closing of roof penetrations, flashing of new penetrations to the existing roof sealing) and repairs of damage resulting from inexpert handling, can be carried out with the same material.



Where it is to overlap with the new material, the weathered surface must be thoroughly cleaned with low-surface-tension water (water with dish-washing liquid), if necessary, after drying, with Monarplan® cleaner for waterproofing membranes.

The overlapping surfaces must be absolutely dry and clean and can be welded with hot air.

Test welds are obligatory!

Weathered unbacked membranes - if the underneath is clean - can also be welded to underlying new material. Humidity and moisture trapped under the membranes may impair weldability. The described pretreatment, particularly the drying, is essential for the welding area.

7 Methods of upstands application

7.1 Introduction

With today's construction trends of highly intricate and complex structures and the requirement for higher thermal insulation values, only membranes which aspire to the highest quality standards and possess unquestionable technical properties, will be considered in the design process. The versatility of Monarplan® ensures the designer total freedom and security when specifying the roof waterproofing system.

The Monarplan® roofing system can be applied in a number of ways depending upon the requirements for the specific project.

Mechanically Fastened Membrane

Mechanically fixed systems are often favoured above timber or metal decks where the exposure of the fastener on the underside of the structure is not a consideration. This method of application involves the use of thermally broken fasteners fixed at pre-determined centres and is a fast and cost effective method of installing the single ply membrane which is less dependent upon amicable weather conditions.

Ballasted Membrane

The Monarplan® membrane is loose-laid and welded together at the overlaps prior to the application of a ballast which holds the membrane in place. This method offers maximum restraint to wind uplift and fast application times, while providing protection from mechanical and solar /UV damage. This method can be used in both inverted and warm roof situations. For inverted roofs the membrane is applied directly to the deck and so the suitability of this method will be dependent upon the condition and nature of the substrate.

Adhered Membrane

Adhered membranes are only possible if the functional layers are stationary, and on substrates, which are suitable for the corresponding adhesive. Adhered membranes can also provide a superior surface finish.

Adhered systems are reliant upon suitable weather conditions (which should be considered) however, complex geometries and pitched surfaces can be accommodated with great success.

Monarplan® adhesive 3958 fleeceback is used in fully adhered systems.

Moisture-curing single-component PUR adhesive (Monarplan fleeceback adhesive TK 400), poured in lines (beads), are used in partly adhered systems.

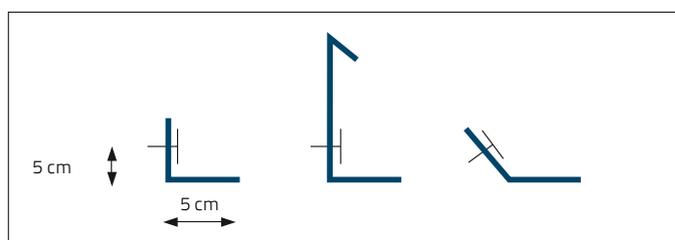
7.2 Perimeter Fastening

Regardless of the type of membrane attachment, mechanical fastening of the field membrane is always required at the roof perimeters, angle changes and any details, for example rooflights and penetrations. This ensures that any tensions generated in the field membrane are not transferred to other areas.

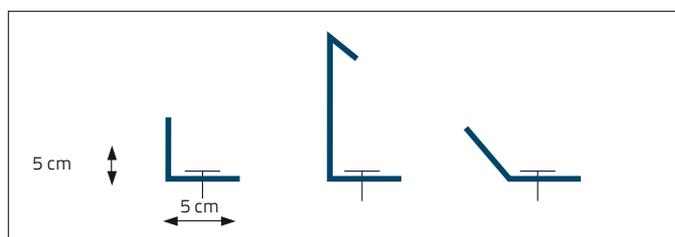
At the foot of upstands the single-ply membrane on the field area should be installed vertically a minimum of 50 mm. It should then be mechanically fastened as close as possible to the foot of the upstand. It should be fastened to the more stable substrate, ie fixed vertically to the structural deck or horizontally to masonry or concrete upstands.

The field membrane can be fastened with screw fasteners in conjunction with

- a 90° angle of Monarplan® Coated Metal Sheet (preferable)
- the Monarplan® Fixation Bar (with peel stop)
- using Tube Washers or Pressure Plates



Angle fillets for fastening at vertical or sloped surfaces.



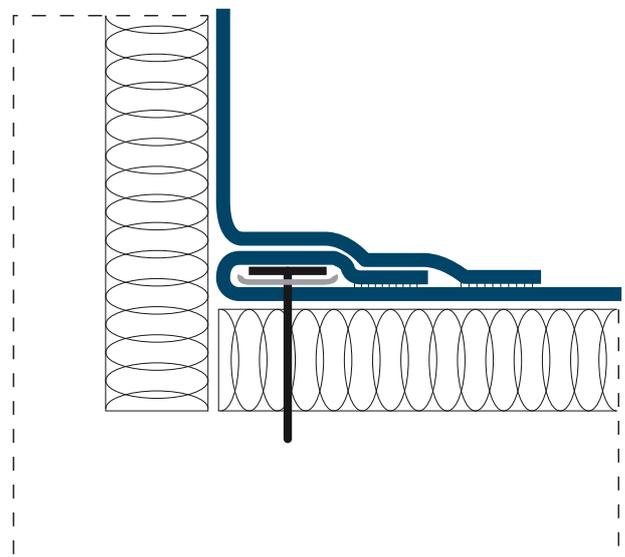
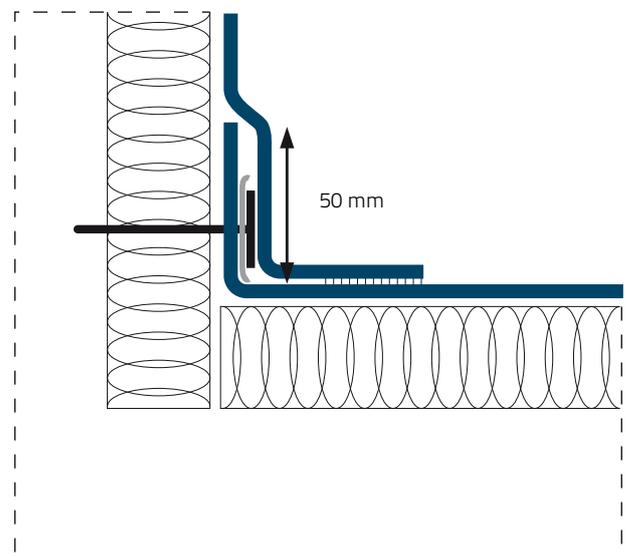
Strips or angle fillets for fastening at horizontal surfaces

7.2.1 Icopal Fixation Bar

The horizontal field membrane is secured at the foot of the upstand using an Icopal Fixation Bar fixed back to the more stable substrate, ie fixed vertically to the structural deck or horizontally to masonry or concrete upstands.

The angle is then waterproofed with the flashing sheet.

In some situations, the field membrane may be turned over the angle, tightly folded, and hot-air welded back onto itself. It should be secured at a rate of 5 fixings per meter.



7.2.2 Monarplan® Coated Metal

7.2.2.1 Complete profile solution

Non-Fleecebacked membrane

The perimeter of the Monarplan® G or FM reinforced membrane on the field area is welded continuously to the horizontal flange of a mechanically fastened 90° membrane-coated metal angle.

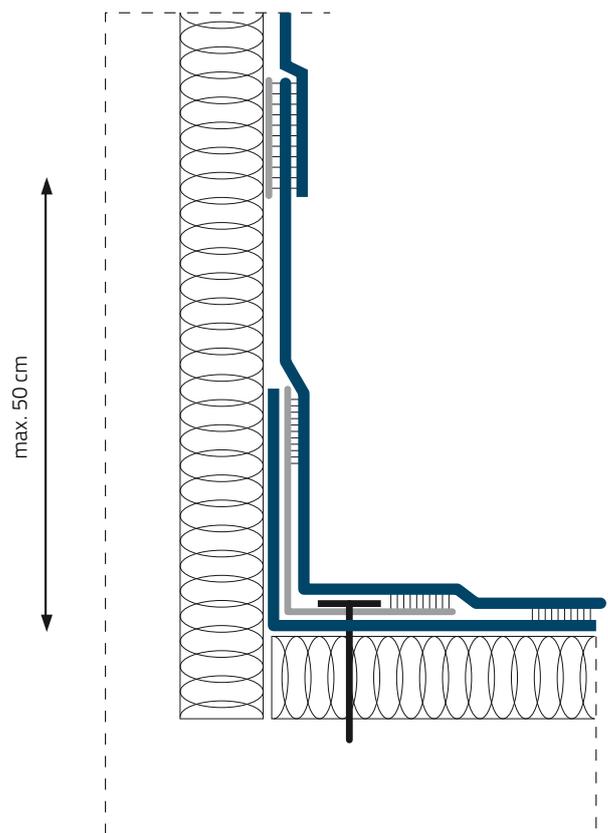
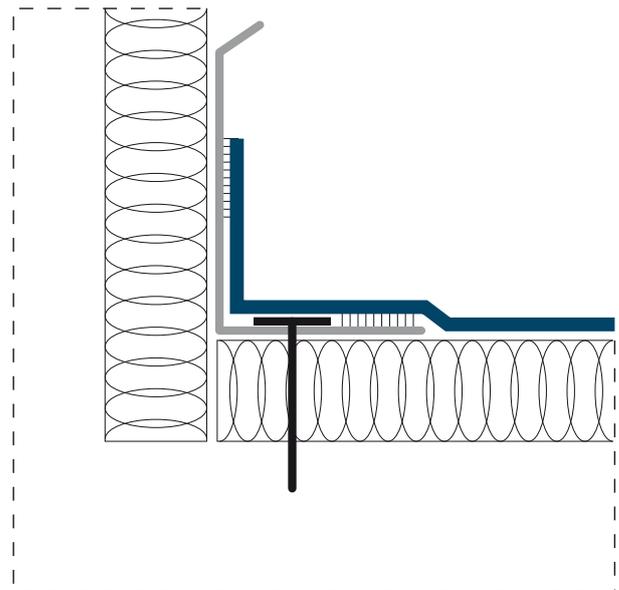
Fleecebacked Membrane

The perimeter of the Monarplan® GF Fleeceback field membrane is secured by mechanically fastening a membrane-coated metal angle to the foot of the upstand. This is then waterproofed using the Monarplan® (G or FM) non-fleeceback membrane dressed to the upstand, welding to the field sheet and at least the horizontal flange of the coated metal angle.

For further clarification regarding the method of perimeter restraint, refer to the range of Monarplan® Standard Drawings.

7.2.2.2 Angle solution

Where the roof shape changes from a horizontal plane to an angled or vertical plane, a section of Monarplan® metal profile must always be used to facilitate this change of direction. The Monarplan® roofing membrane is cut to fit the horizontal metalsheet plane and welded to it in the normal way. The metalsheet follows the change of direction and Monarplan® membrane is cut to fit the vertical leg of the metalsheet section and welded to it. When a right angled section of metalsheet is installed, it must only be fastened to the substrate, in the horizontal plane.



7.3 Membrane Termination

The waterproofing system must be suitably terminated to the surrounding construction to prevent water penetration 'behind' the new waterproofing system.

Depending upon the nature of the installation and construction, the membrane should be protected with a 'Cover Flashing'. Alternatively, the membrane may be secured with a 'Termination Bar' which is then weatherproofed by pointing a suitable mastic sealant along the top edge between the construction and the Termination Bar.

The waterproofing should finish on the vertical a minimum 150 mm from the finished roof level or in accordance with national regulations.

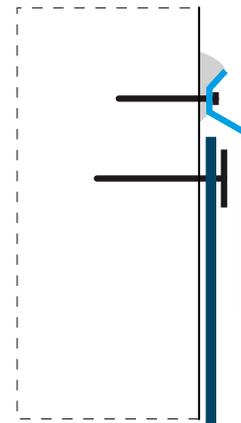
In the case of roofs with paving or other coverings such as a green roof, the 150 mm should be from the uppermost finished level, and not the level of the waterproofing.

Flashings

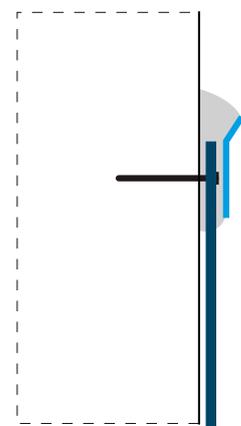
The flashing should provide sufficient coverage of the waterproofing, extending down a minimum 75 mm over the waterproofing system.

Termination Bar

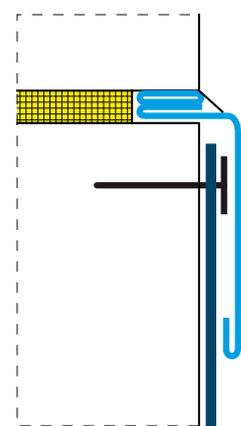
Depending on the method of installation and the type of termination bar used, the waterproofing membrane may first require mechanical restraint using the Icopal Fixation Bar. The termination bar is mechanically fastened to the wall at regular fixing centers. A suitable mastic sealant is applied behind the lip of the termination bar just prior to the final tightening of the fasteners. This provides a compression to the sealant ensuring that the detail is sufficiently weatherproof. The sealant has to be checked regularly.



Termination Bar Arrangement - Membrane secured with Termination Bar



Termination Bar Arrangement - Membrane secured with the Termination bar itself



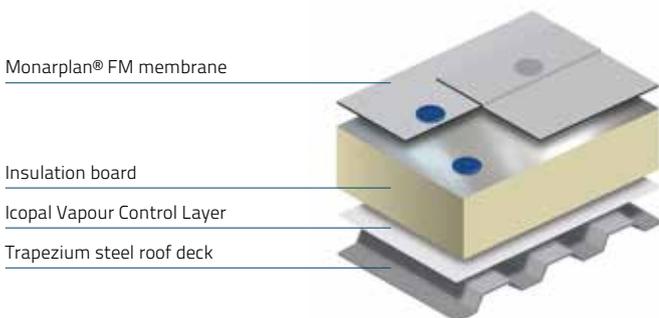
Cover Flashing Arrangement - Membrane secured with Termination Bar

7.4 Mechanically Fastened System

Membrane Used: Monarplan® FM

7.4.1 Introduction

In mechanically fastened systems the Monarplan® FM reinforced membrane is fastened in the overlap seam along one edge of the membrane and secured directly to the structural deck. The adjacent sheets of membrane are then hot-air welded to provide the continuous waterproof covering.



The membrane is protected from mechanical damage by using a tubular washer or pressure plate in conjunction with the appropriate screw fastener.

For confirmation of the appropriate size of washers and fasteners to use, refer to the Icopal Fastener product datasheet.

Prior to application of the Monarplan® FM reinforced membrane, a wind uplift calculation must be carried out in accordance with EN 1991-1 to -4 or to the corresponding national regulations to determine the correct fixing centers specific to the project.

In case of refurbishment, an individual calculation should be done, if necessary based on pullout tests of the fastener manufacturer.

On non-ventilated roofs, fastening of the membrane at the same time provides fastening of the thermal insulation.

If the insulation boards are not sufficiently secured in this way (min. 2 fasteners/m²), they must be additionally fixed prior to installing the membrane.

Where the substrate comprises profiled metal sheet, the waterproof membrane should be fixed at right angles to the longitudinal rib of the metal profile.

7.4.2 Methodology

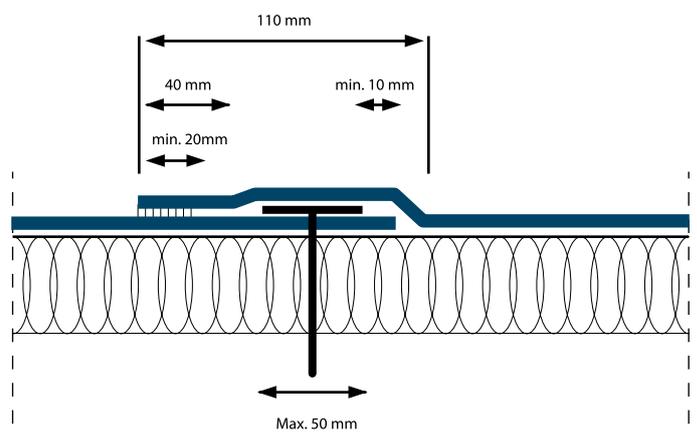
Prior to and during membrane installation, inspect and correct the substrate; (i.e. voids or gaps, uneven conditions, and any other surface irregularities that can cause voids in the weld).

Side Laps

Position sheets so they run square and with sufficient overlap to the adjacent sheet. In the case of the mechanically fastened system the side lap should extend a minimum 50 mm past the fastening plates / washer. The weld must have a compulsory minimum width of 20 mm.

Checking the seams is a compulsory action at the end of any area of work. The welded seams have to cool down to ambient temperature before probing.

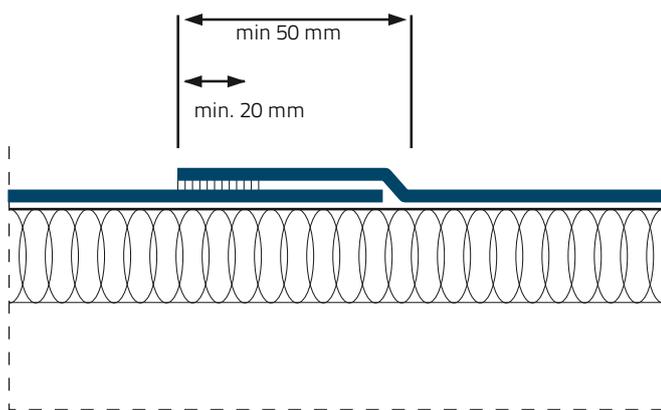
When the sheets are fastened mechanically, a minimum 10 mm free zone between the fasteners edge and the edge of the membrane must be observed. The minimum overlap should be 110 mm (if the width / diameter of the washers is not more than 40 mm). If washers are wider, the overlap is increased accordingly. The overlap is calculated in following manner: 10 mm free edge + width of washer (45mm for a Tube Washer) + 50 mm welding zone.



End Laps

End laps should be a minimum of 50 mm and wherever possible should be staggered to the adjacent sheet.

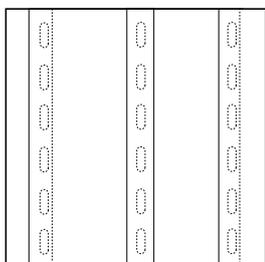
The weld must have a compulsory minimum width of 20 mm. Checking the seams is a compulsory action at the end of any area of work. The welded seams have to cool down to ambient temperature before probing.



Outside seam overlap

Mid-sheet fixings may be required dependent upon the results of the wind uplift calculation, especially in corner areas.

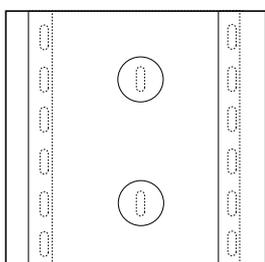
The fasteners outside the overlap area are covered by welding



either

in a row with a section of unbacked membrane (Monarplan® D, 15 cm wide)

or



individually with round unbacked preformed details, (Monarplan® D plates) 15 cm in diameter.

7.4.3 Fastening plan

If required, project-related individual calculations will be produced on request, as a service of the fastener manufacturer, including installation instructions, material requirements and fastening plan.

The fastening plan contains

- the dimensions of the field, perimeter and corner areas, as well as
- the required quantity of fastening elements per roof area.

With mechanical in-lap fastening, the membrane width(s), the corrugation width (top corrugation spacing) of the metal sheets and the position of movement joints and large roof penetrations (arcade and single rooflights, natural smoke vents) are taken into consideration. In order to draw up an individual calculation and a fastening plan, a "**Data Sheet**" confirmed by the roofing contractor will be necessary.

7.4.4 Fasteners

Prior to any application, fastening systems must be tested and certified according ETA-06. The selection of the fasteners (type, length) technologically depends on:

- the thickness of the build-up structure
- the material of the supporting substructure (profiled steel decking, timber deck, derived timber product, cement or lightweight concrete)
- the strength of the substrate
- the corrosion impact from the build-up structure (especially in the case of refurbishment)

The instructions of the fastener manufacturer must be strictly adhered and only tread fast fastening systems must be used.

7.4.5 Installation scheme

- Line out the exact position of the (row of) membranes (repeat after 4-5 membranes)
- Roll out the membrane, allow relaxing and, if necessary, cut to length

Note the position of the butt joints!

- Align the membrane along the line-out with an overlap of min. 11 cm to the edge of the adjacent membrane
- Set fasteners at the free longitudinal edge of the membrane. Observe spacing!
- weld the overlapping longitudinal edge and form the butt joint

7.5 Ballasted System

Membrane Used: Monarplan® G or GF

7.5.1 Types of ballast and ballast calculation

In ballasted systems the Monarplan® G or GF membranes are loose-laid and welded prior to the application of a ballast which holds the membrane in place.

Generally a separation foil (0,20 - 0,25 mm PE) between Monarplan® G or GF and ballast has to be used.

The following ballast forms are used:

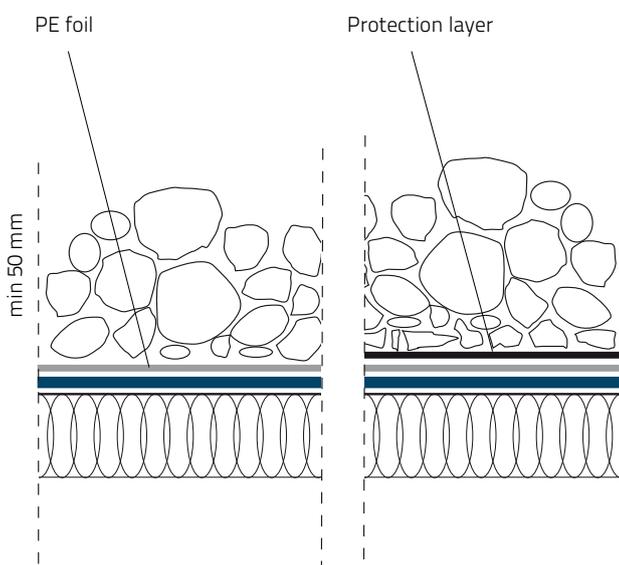
▪ Gravel

consisting of washed round pebbles (16/32 mm) with max. 15 % broken stones can be applied as ballast on Monarplan® waterproofing membranes, without a protection layer. For higher percentages of broken stones and for pneumatic gravel feeding, a protection layer must be installed.

The thickness of the gravel layer must be at least 5 cm.

The weight of gravel (16/32mm) is approx. 18 kg/m^2 ($\approx 0,18 \text{ kN/m}^2$) per 1 cm fill height.

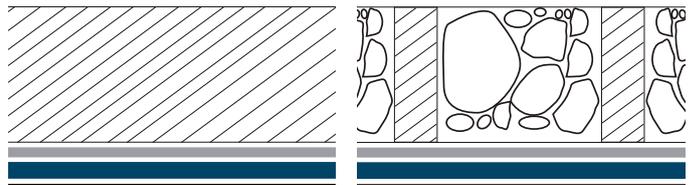
In perimeter and corner areas as well as on sloped surfaces the gravel layer can be consolidated with a suitable adhesive to prevent whirling up.



▪ Concrete slabs / hollow grid tiles

A loose laid protection layer e. g. rot-proof fleece, building-protection mat (e.g. "Regupol" or similar), must be placed between the roof sealing and the concrete slabs or hollow grid tiles! Concrete slabs laid closely together, (e.g. $100 \times 25 \times 5 \text{ cm}$) have a weight of approx. $22\text{-}24 \text{ kg/m}^2$ ($\approx 0,22 - 0,24 \text{ kN/m}^2$) per 1 cm thickness and hollow grid tiles ($60 \times 40 \times 8/10 \text{ cm}$), filled with gravel (16/32 mm), a weight of approx. 20 kg/m^2 ($\approx 0,2 \text{ kN/m}^2$) per 1 cm thickness.

The longer edge of rectangular slabs must be laid parallel to the roof edge.

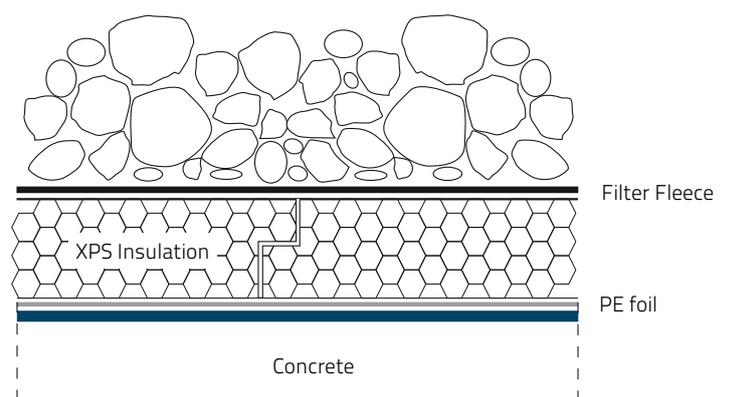


▪ Inverted Roof

The thermal insulation, made of extruded polystyrene boards with a rebated edge, is laid in a single layer onto the Monarplan® waterproofing membranes with a separation layer.

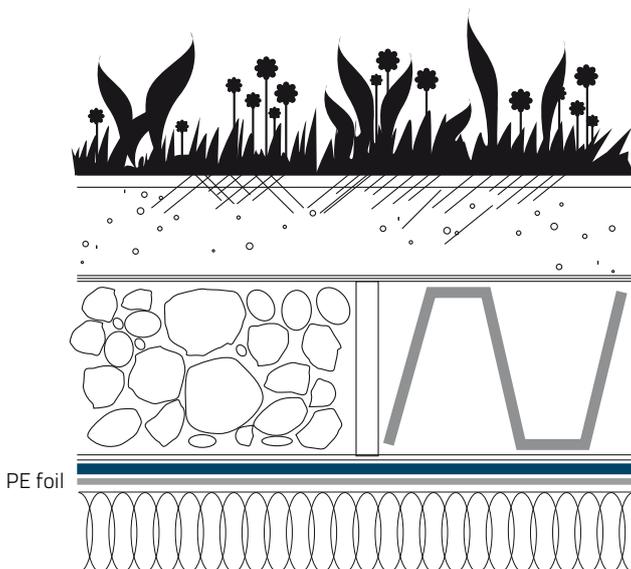
Between the thermal insulation boards and the ballast, a filter layer made of synthetic fleece (min. 140 g/m^2), or a draining fleece layer, must be placed. The required thickness of the ballast with loose laid waterproofing membranes is calculated for wind loads according to EN 1991-1 to -4, or in an individual calculation.

If gravel is used as ballast, the gravel layer must have a thickness of at least 5 cm.



▪ Paving Flags

Paving flags can be installed on paving slab supports, in an underlayer of gravel or chalkfree grit, or in a bed of mortar (on a drainage layer). Between the paving slab supports or the gravel or grit underlayer and the Monarplan® waterproofing membranes, a protection layer of building-protection mat or similar should be installed. Screed or mortar layers are to be separated from the roof sealing with a double-ply PE foil as a "sliding layer".



7.5.2 Installation of loose-laid membranes with ballast

Protection against wind uplift with ballast is permissible only if the bearing capacity of the roof construction and, if necessary, the maximum deflexion for these loads has been proven.

Installation scheme:

- Line out the exact position of the (row of) membranes (repeat after 4-5 membranes)
- Roll out the membrane, allow relaxing and, if necessary, cut to length

Note the position of the butt joints !

- Align the membrane without buckles and wrinkles along the line-out or with an overlap of approx. 4 cm or 6 cm to the edge of the adjacent membrane
- Weld the overlapping parallel edge and form the butt joint

The ballast, including protective layer, must be applied immediately after laying the water-proofing membranes (seam testing), if necessary in sections.

▪ Roof Gardens

Between the roof garden build-up and the Monarplan® waterproofing membranes, a protection layer or a membrane combination (protection / drainage / filter layer) must be installed.

The load from the garden layers depends on the material, the thickness and the moisture content of the draining, filter and vegetation mat. For calculating wind uplift, the load of the dry roof is to be taken.

7.6 Adhered System

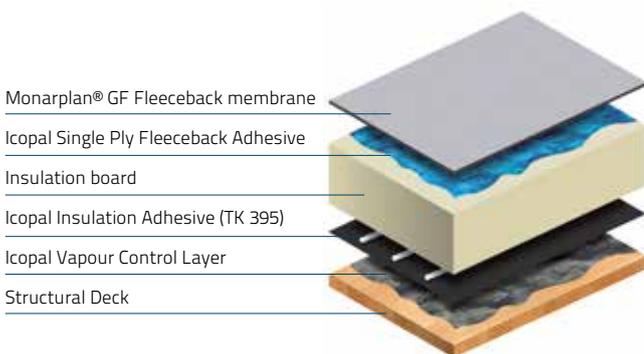
Membrane Used: Monarplan® GF

Adhesive: Icopal Fleeceback Adhesive Fully Bonded (TK 3958)
Icopal Fleeceback Adhesive Partly Bonded (TK 400)

For detailing:

Membrane Used: Monarplan® FM or D

Adhesive: Monarplan® Contact Adhesive TK 914



7.6.1 Introduction

In adhered systems the Monarplan® membrane is attached to the substrate using an adhesive. The adjacent sheets of membrane are then welded.

Icopal offers four types of adhesives depending on the membrane used, and the type of substrate.

The Monarplan® GF Fleeceback membranes are fully adhered using Icopal Single-ply Fleeceback adhesive, 3958 to the pre-secured insulation board. For partly adhered systems (line bonding) TK 400 is used.

The insulation boards are secured to the structural roof deck by either mechanical fasteners, insulation adhesive (TK 395) or hot bitumen, etc.

7.6.2 Preparing the substrate for refurbishment

The scope of the work necessary to prepare surfaces for refurbishment – analysis of the roof built-up provided – depends on the existing layers or plies.

- **Existing bitumen covering with compressed gravel ballast**
Cut open or completely scrape off blisters. Remove compressed gravel ballast with appropriate tools and level the substrate. Apply a compensation layer, e. g. a bituminous felt.
- **Existing bitumen covering under loose gravel ballast**
Remove gravel ballast and bonded, tightly adhered pebbles with appropriate tools, e. g. water-proofing plane. If necessary, even the substrate by additionally torching the surface. Level any depression (e.g. removal of blisters or folds) by applying welding tapes.
- **Existing bitumen covering with a sand/grit coating**
Cut open or completely scrape off blisters. Level any depression (e.g. removal of blisters or folds) by applying welding tapes.

7.6.3 Icopal Single-Ply Fleeceback Adhesive

Monarplan® GF Fleeceback Membrane is fully bonded to insulation board using Single-Ply Fleeceback Adhesive.

Set out the roll to ensure proper alignment, and roll the membrane back up again. The fleeceback membrane has a fleece-free selvedge in the overlap area, to enable the side lap to be hot-air welded. Ensure no adhesive contaminates the weld zone.

The adhesive should be poured onto the insulation board and manipulated using a rubber squeegee and perlon roller to achieve uniform distribution avoiding puddles.



Immediately apply the Monarplan® GF Fleeceback membrane into the adhesive by unrolling, ensuring no wrinkles or air pockets are present.



Once applied, roller the surface of the membrane using a weighted roller to encourage adhesion.

Note: Please use the technical documentation provided with the product for more detailed information. Adhesive and substrate should be at 15 °C or higher for best results. Also, ensure that surfaces are dry and free from dirt, grease, oils and any other solvents.

7.6.4 Icopal Fleeceback Adhesive Fully Bonded: Terokal TK 3958

Stir well before use!

The adhesive is suitable for one-sided bonding and is applied using an airless spray device, adhesive roller or paint brush.

The adhesive is applied over the entire substrate surface. Use a net-like pattern for plastic and rubber sheeting. After a short flash-off time (depending both on air and substrate temperature and air humidity), Monarplan® GF is placed into the semiwet or wet adhesive bed. It can be re-positioned for a short time. A safer method to determine the proper flash-off time is the finger test. The adhesive film must stick to the finger over its entire contact area.

Make sure to entrap as little volatile matter as possible underneath the roofing membrane. Temporary blisters in the membranes will disappear as soon as the volatile substances have escaped.

Apply the adhesive onto the substrate, place the insulation material into the semi-wet or still wet adhesive bed, re-position it, briefly lift it off the surface and then briefly but firmly press it down. Bonding on unlaminated rigid polystyrene boards is not permissible.

7.6.5 Icopal TK 400; Fleeceback Adhesive Partly Bonded

The application temperatures have to be between +10 °C and +45 °C (air/substrate temperature), ideally at +20 °C. Low temperatures delay the curing process. When exceeding the open time, skin formation sets in and this will affect the bond between adhesive and roofing membrane.

Vigorously shake the can before use and then screw it onto the Icopal foam gun. Icopal foam gun XL, equipped with a 60 cm lance, ensures easy and comfortable application. To ensure a reliable bond to the substrate, apply at least three uniform strands of adhesive (min. strand diameter: 30 mm) per m² to be covered.

Please refer to the table on page 3 of the Data Sheet for the proper number and positioning of adhesive strands.

Immediately after applying TK 400, roll the fleece-backed roofing membrane into the adhesive bed and firmly press it down, e.g. with a soft broom. If the adhesive tends to foam after application (post-expansion), press the roofing membrane down again.

When working at low air humidity), the bond strength can be increased and adhesive curing be accelerated by slightly moistening the lamination or the absorbent substrate with water (do not produce a water film).

Replace the emptied can immediately by a new can. Never remove the can forcibly from the gun. If the gun is not used for a longer time, clean it thoroughly with PU Cleaner.

7.6.6 Icopal TK 914; PVC Contact Adhesive

The Monarplan® FM and Monarplan® G reinforced membranes can be adhered using Monarplan® Contact Adhesive.

Icopal TK 914 PVC Contact Adhesive is a solvent based adhesive. This method is typically employed at details such as upstands, rooflights, etc.

The surface, on or against which adhesive is to be applied, shall be clean, smooth, dry, free of fins, sharp edges, loose and foreign

materials, oil and grease. Depressions greater than 6 mm should be feathered, using epoxy, mortar or other approved patching material. All sharp projections should be removed by sweeping, blowing or vacuum cleaning.

After thorough stirring (minimum 5 minutes), apply Icopal TK 914 PVC Contact Adhesive to both substrate and membrane using a 25 mm medium nap roller. Application shall be continuous and uniform avoiding globs or puddles.



An open time of 5 to 50 minutes, based on drying conditions is recommended before assembly. Icopal TK 914 PVC Contact Adhesive must be allowed to dry until it does not string or stick to a dry finger touch.

Any coated area which has been exposed to rain should be allowed to dry and then recoated. Do not apply adhesive to areas to be hot air welded.



Roll the membrane onto the adhesive coated substrate while avoiding wrinkles. Immediately brush down the bonded portion of the sheet with a soft bristle push broom or a clean dry roller applicator to achieve maximum contact, without air pockets or wrinkles.

Always check the adhesiveness.

7.6.7 Suitability of cold-bonding adhesives

With cold-bonding adhesives, pay special attention to their suitability for contact with the substrate. On substrates which have a top separation layer, e. g. a PE foil or a talcum coating, you cannot use cold-bonding adhesives.

Such separation layers may be applied to bituminous felts and on membrane-shaped backings or bituminous adhesive layers of thermal insulation boards to avoid sticking of the material on the roll or transport piles.

Bonding is not possible on unbacked polystyrene boards or polystyrene boards with glass fleece backing.

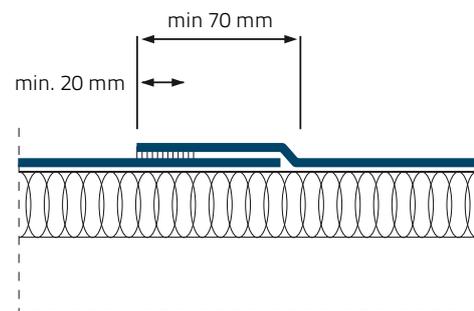
Note: Bituminous felts / backings with a sanded surface are particularly suitable for cold bonding.

7.6.8 Methodology

Side Laps

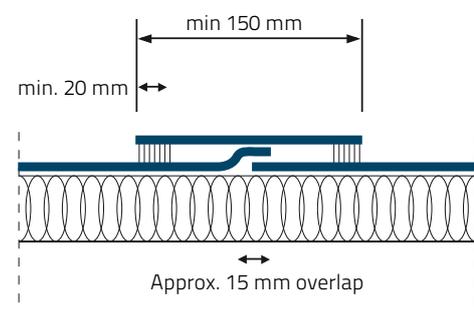
Monarplan® GF Membranes are manufactured with a 70 mm fleece free selvage. Position the adjoining sheet allowing for a 50 mm side lap bond in place as above. The weld must have a compulsory minimum width of 20 mm.

Where possible, position laps so that water runs across or parallel to the laps. Checking the seams is a compulsory action at the end of any area of work. The welded seams have to cool down to ambient temperature before probing.



End Laps

At end laps, or where there is no fleece free selvage (thus a hot-air weld cannot be made) the membranes should be butt jointed. Overlay the butt joint with a 150 mm strip of Monarplan® Reinforced Strip membrane centred over the joint and weld along both edges. End laps should wherever possible be staggered to the adjacent sheet. The weld must be a compulsory minimum width of 20 mm. Checking the seams is a compulsory action at the end of any area of work. The welded seams are to then be allowed to cool down to ambient temperature before probing.



7.7 General Information on Flashings and Trims

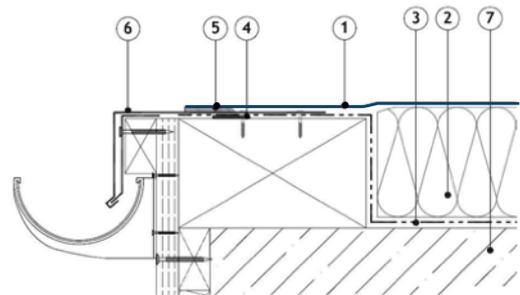
7.7.1 Roof Edges / Drips / Trims – Mechanically Fastened System

Whenever possible, external roof edges shall be constructed using Monarplan® Coated Metal.

Separate lengths of the Monarplan® Coated Metal drip trim are butt jointed. The sheets should be fastened with two rows of fasteners, typically screws, at 150 mm staggered centers. A 5 mm gap should be left to allow for expansion of the metal.

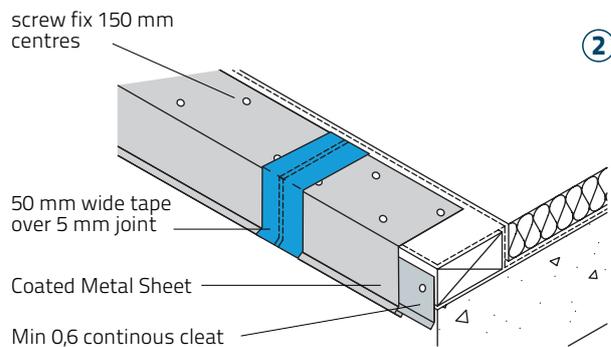
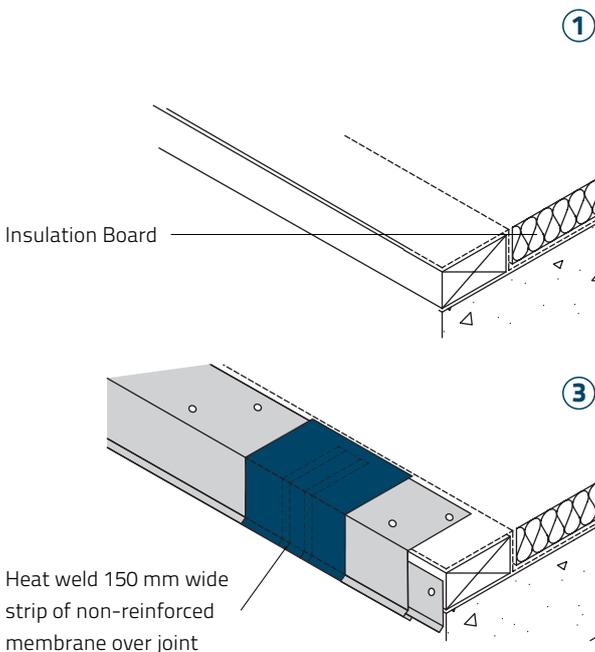
The joints should then be taped with a 50 mm wide duct or crepe tape.

The joint should then be strapped with 150 mm wide Monarplan® D Unreinforced Flashing, hot-air welded to the coated metal with a 20 mm weld.



Mechanically fastened System

- (1) Monarplan® FM reinforced membrane
- (2) Insulation Board
- (3) Vapour Control Layer
- (4) Air-tight Sealant strip
- (5) Hot-air weld, min 20 mm
- (6) Monarplan® Coated Metal Sheet
- (7) Substrate.



Depending on the construction detail, the edge of the roof should be made air-tight. A strip of suitable sealant should be installed along the edge beneath the coated metal. If a compatible vapour control layer is specified, then the vcl can dress

up onto the timber edge batten, and again, be terminated with a strip of sealant. Consult Icopal's standard drawings for further information on www.icopal-synthetic.eu/download/cad-library.

7.7.2 Roof Edges / Drips / Trims - Adhered System

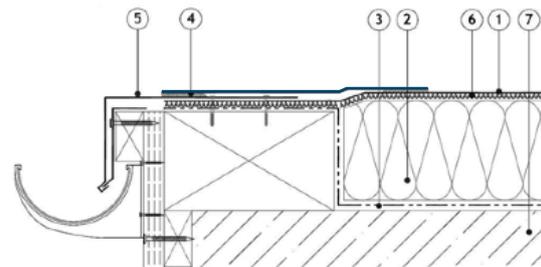
Whenever possible, external roof edges shall be constructed using Monarplan® Coated Metal.

Separate lengths of the Monarplan® Coated Metal drip trim are butt jointed. The sheets should be fastened with two rows of fasteners, typically screws, at 150 mm staggered centres. A 5 mm gap should be left to allow for expansion of the metal.

The joints should then be taped with a 50 mm wide duct or crepe tape.

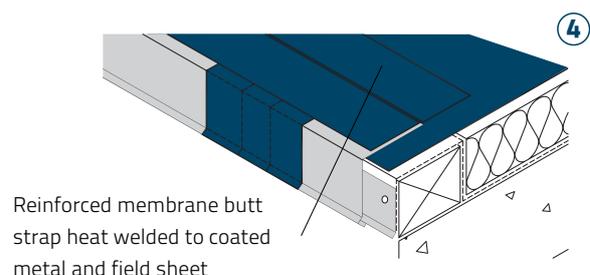
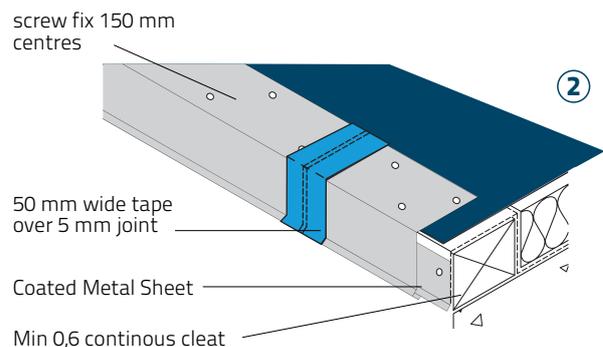
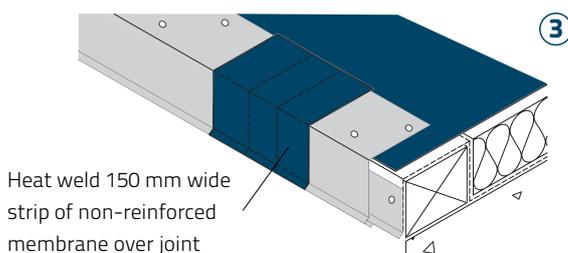
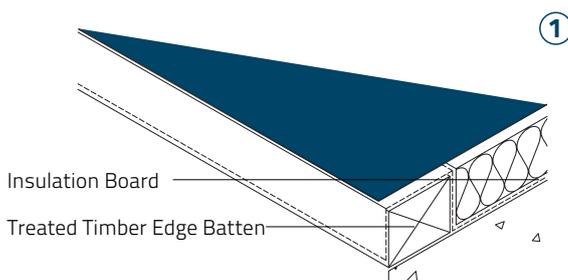
The joint should then be strapped with 150 mm wide Monarplan® D Unreinforced Flashing, hot-air welded to the coated metal with a 20 mm weld.

The edge of the coated metal and field sheet should then be strapped with Monarplan® Reinforced Strip and hot-air welded with a min 20 mm weld to finish the seal.



Adhered System

- (1) Monarplan® GF Fleeceback membrane
- (2) Insulation Board
- (3) Vapour Control Layer
- (4) Hot-air weld, min 20 mm
- (5) Monarplan® Coated Metal Sheet
- (6) Monarplan® Fleeceback Adhesive
- (7) Substrate.



Depending on the construction detail, the edge of the roof should be made air-tight. A strip of suitable sealant should be installed along the edge beneath the coated metal. If a compatible vapour control layer is specified, then the vcl can dress

up onto the timber edge batten, and again, be terminated with a strip of sealant. Consult Icopal's standard drawings for further information.

8 General Information on Substrates

8.1 Introduction

The load bearing structure must comply with all associated national standards and regulations, ensuring that the load bearing capacity is sufficient for any additional loads imposed upon the construction. It is important to consider the possibility of future deflection of the construction when designing roof drainage.

Substrates must be strong enough to permit the penetration of fixings whilst maintaining suitable pull out strength. It is recommended that pull out tests are conducted prior to the application of the Monarplan® system (see below).

8.2 Acceptable Substrates

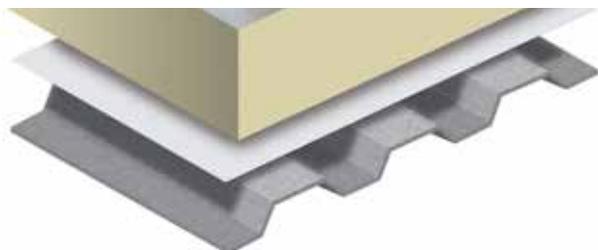
The Monarplan® Roofing System can be installed on new construction or over existing roofs, when the existing roofing assembly is dry or the wet areas have been removed and replaced; or when the existing roof is completely removed to the deck. The roofing contractor has the final responsibility of acceptance of the surface to receive the roofing system.

The following structural substrates are acceptable for the Monarplan® Roofing System:

8.2.1 Profiled metal

Minimum 0.7 mm galvanised steel according to EN 10147. The profiled deck must be overboarded to support the Monarplan® membrane.

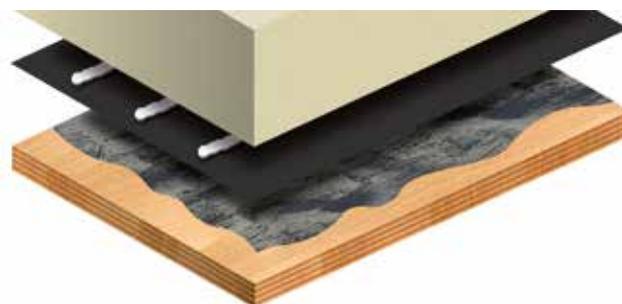
In mechanically fixed roof build-ups, it is crucial ensure that the rows of fasteners are installed in a perpendicular direction to the metal deck's corrugations in order to avoid a concentration of uplift forces on any one single element.



Aluminium decks shall be a minimum 0.9 mm acc. to EN 485-2 AA3004 H34. Reference should also be made to EN 1396 as appropriate. For mechanically fastened systems, refer to Icopal's Technical Department for confirmation of suitability of fastener.

8.2.2 Plywood or Oriented Strand Board

New 22 mm exterior grade plywood (to EN 636-2003: Clause 8) or OSB/3 (to EN 300:1997) fixed according to the national regulations ensuring it is of adequate rigidity for the joist spans involved and fixed with corrosion resistant ring shanked nails or screws at 150 mm centers to the perimeter of the panels and 300 mm along the intermediate supports. Fixings should be well driven to avoid damage to the membrane.



8.2.3 Timber Boarding

New timber boarded roof deck is advised. Boarding should not be less than 22 mm nominal thickness, planed and clamped together with tongued and grooved joints or closely butted and secured by ring shanked nails or screws at a rate of 2 per board width at both ends and at every intermediate support. Fixings should be well driven to avoid damage to the membrane.



In mechanically fixed roof build-ups, it is crucial ensure that the rows of fasteners are installed in a perpendicular direction to the individual timber planks in order to avoid a concentration of uplift forces on any one single element.

8.2.4 Structural Concrete

The reinforced concrete roof slab surface should be finished to provide an even surface free from ridges and hollows. New in-situ cast concrete should be given adequate time to dry out, prior to installing the waterproofing system.

8.3 Fastener Withdrawal Resistance Criteria

Fastener withdrawal resistance tests are recommended on certain refurbishment projects to determine the suitability of the roof deck. The withdrawal resistance test may be conducted by an independent laboratory or the fastener manufacturer or their designated representative. The results of the pullout tests must be designated on a roof plan to indicate the areas at which the tests were conducted and forwarded to Icopal for review.

On refurbishment projects, a core cutter should be used to remove existing roofing material prior to conducting the withdrawal resistance test (even if the existing roofing membrane is specified to remain). Existing roofing materials will contribute to a higher, misleading pullout value.

The withdrawal resistance tests should be carried out in various locations of the roof deck, such as:

- at roof corners;
- at perimeter areas (minimum of 3 each).
- in field of the roof (with at least 2 tests conducted at the low areas of the roof deck

9 Roofing Details

9.1 Parapets

For the single ply waterproofing of parapets, unbacked Monarplan® D membranes or tapes of the required width (girth + min. 10 cm) are used. For full surface bonding backed Monarplan® GF can be used.

The waterproofing of parapets is always carried out "separately" from the water proofing of the field area. The sealing of the field area should be raised approx. 5 cm up the parapet.

Protection against wind uplift:

The edge of the waterproofing at the top of the parapet must be sealed so as to be **wind-proof**.

The installation method and direction of the waterproofing membranes are to be determined depending on the characteristics of the building (height of the parapet, width of parapet top, building material, if necessary perimeter fastening).

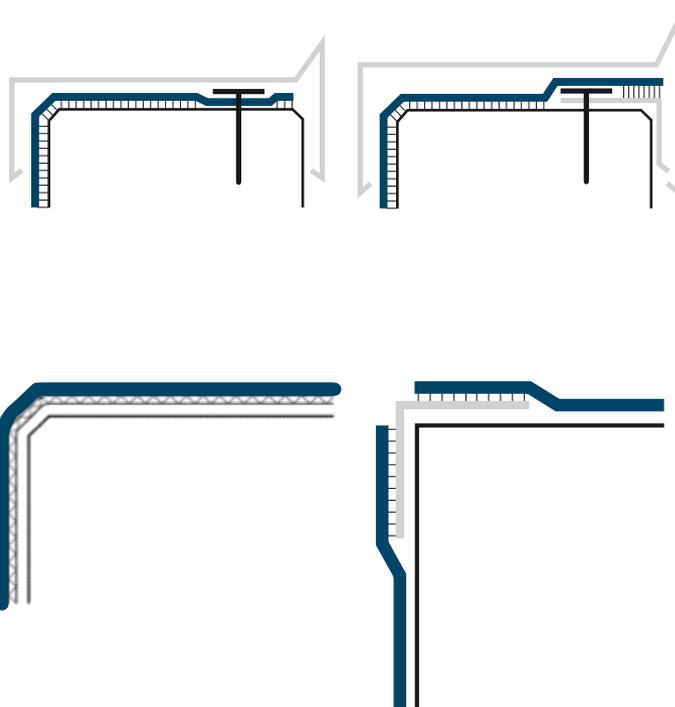
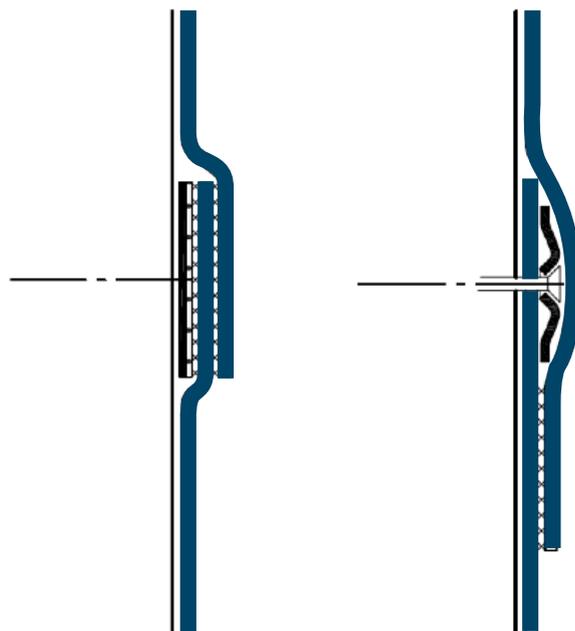
For parapets up to 50 cm height, membranes can be loose laid without fixing on the wall. For parapets over 50 cm height, the membranes must be either fully bonded (Icopal® Contact Adhesive 914), or secured intermediately with Monarplan® coated metal sheets.

9.2 Protection against wind uplift

The edge of the roof sealing at the parapet must be sealed so as to be wind-proof. With loosely laid membranes, this is accomplished by wind-proof, mechanically fastened Monarplan® coated metal sheet angles (e. g. by underlaying a strip of permanently elastic materials, especially at uneven substrates), whereas fully bonded membranes, depending on the building height and edge details (edge trim, capping), may be additionally mechanically fastened in line.

9.3 Edge Protection

Inner edges of the parapet must be shaped in such a way that the roof sealing can be applied without damage. Monarplan® GF membranes can be applied directly around cut-off edges. Non cut-off, sharp edges can be covered with a mechanically fastened Monarplan® coated metal sheet angle.



9.4 Corners

The membranes must be laid so as to have as little covering layers lying on top of each other as possible at the parapet corners. Membranes laid parallel to the parapet are butt together at the corner areas or laid around corners. The lap width at the butt joint should be approx. 10 cm.

If corners are formed with Monarplan® preformed details, they are to be welded with hand-held hot-air gun with a recommended nozzle width of 20 mm.

9.4.1 Internal Corners

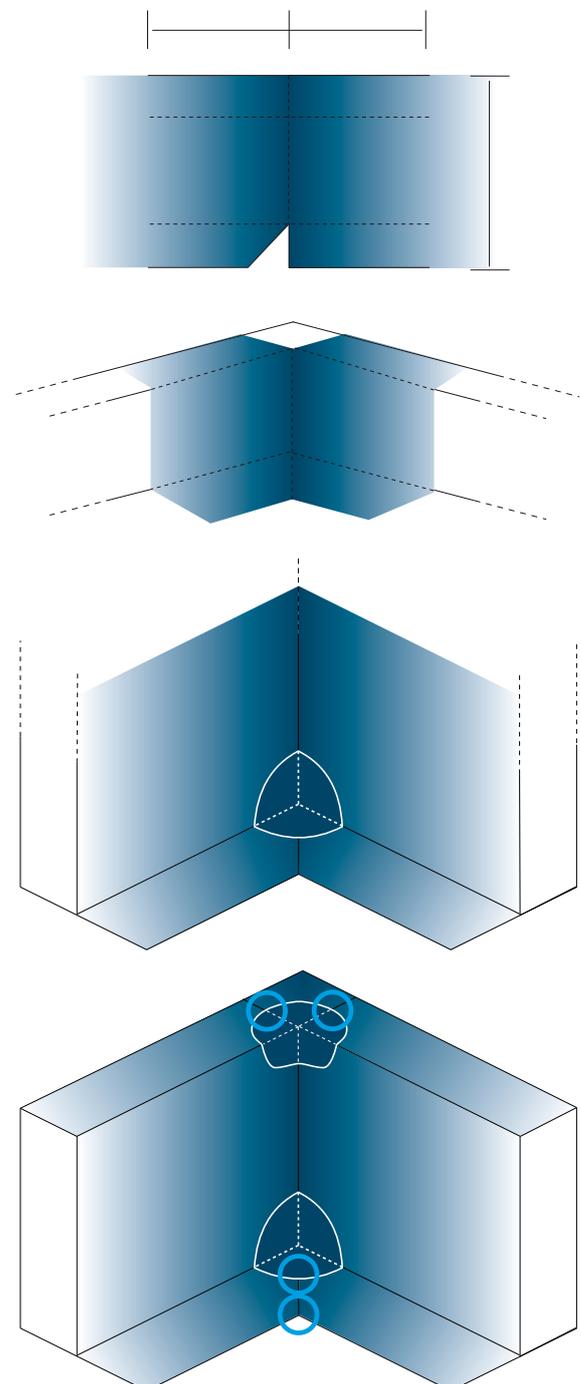
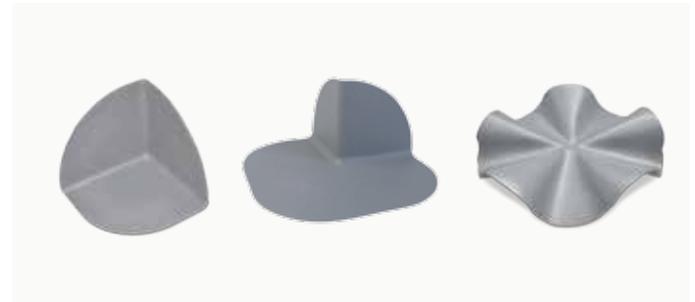
- Cut the trim strip Monarplan® at right angles and cut off the overlap to the corner.

- Weld the seams.

- Weld in the internal corners

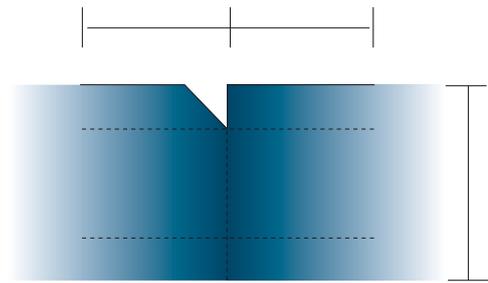
- Upper trim of the parapet completed with cut-to-size Monarplan® and 90° external corner.

- Check all seams and chamfer T-joints (blue circles on sketch)



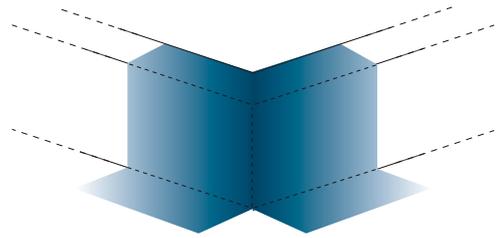
9.4.2 External Corners

- Cut the Monarplan® trim strip to size.

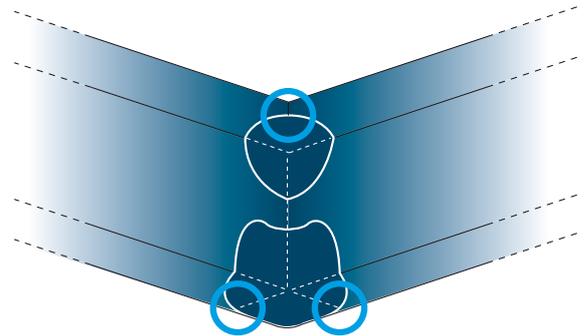


- Weld all seams

- Weld in external corner.



- Upper trim of the parapet completed with prefabricated internal corner, reversed.



- Check all seams and chamfer T- joints (blue circles on sketch)

10 Materials from other Manufacturers

The use of other manufacturers' materials and accessories which become an integral part of the water proofing system shall be avoided. As an exception to this rule Icopal can individually approve other materials for a single project.

Examples:

- Rainwater outlets
- Ready-made accessories
- Adhesives

This clause also refers to membranes and fleeces which are attached to the Monarplan® roofing membranes by bonding or weight of ballast or roof plant.

Examples:

- Walkway sheets or pads,
- Anti-slip sheets,
- protection mats placed beneath roof plant & equipment,
- mats of granulated rubber or
- other anti-vibration materials.

Prior to installation, the chemical compatibility must be proven and the product must be approved by Icopal or supplied by them.

11 Examples for System Components

This chapter is taken up to give some examples of system components. For further information about Icopal system approvals please contact Icopal technical services.

11.1 Vapour Control Layers (vcl)

The presence of a vapour control layer helps to maintain the airtightness of the roof.

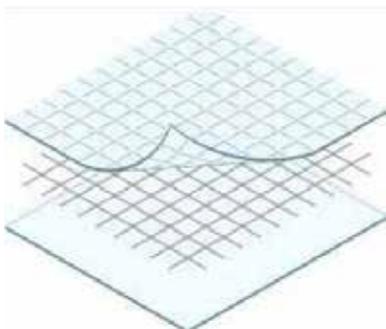
The specification of the vapour control layer is dependent upon a number of factors, such as deck type, method of attachment of vcl and method of attachment of the insulation and waterproofing.

Icopal supplies a range of high performance polyethylene and bituminous vapour control layers for use with its single-ply roofing systems.

11.1.1 Polyethylene Membranes

For mechanically fastened situations, the Monarflex range of reinforced polyethylene vcls provide a quick and cost effective method of vapour control.

These membranes are loose-laid with laps sealed with Monobond LT tape, and are secured to the roof deck through the mechanical fastening of the insulation board.



Monarflex multi-layer VCL's are manufactured from virgin polyethylene with built-in reinforcement grids of HDPE making them highly resistant to tears and damage. Some also have a layer of aluminium foil for higher water vapour resistance performance.

For further guidance and product information contact Icopal Technical Services.

Installation of Loose Laid Polyethylene Membranes

- Lay Monarflex vapour control layer without folds or wrinkles allowing for minimum 100mm side and end laps. Seal all laps with Monobond LT double-sided sealant tape. Turn the vapour control layer up at all upstands, kerbs and penetrations etc. to maintain an air tight barrier.

11.1.2 Bituminous Membranes

Icopal heat-activated self-adhesive vapour control layers are manufactured from SBS-modified bitumen and reinforced with an extra strong glass fibre fleece with a PET aluminium foil.

Some examples:

- Micoral SK has a blue SYNTAN resin upper surface allowing the appropriate insulation board to be adhered using Icopal Insulation Adhesive.



- VillaselfSK is a self adhesive vapour barrier with excellent characteristics.

- Micoral NB is finished with a polyethylene film, and is suitable for use in mechanically fastened applications only.

These membranes are suitable for direct use on metal, timber and concrete deck types only.

- Also available are Total Torch VCL, and Micotherm SK. Please see individual product literature for further information.



Since these membranes are adhered, they can provide a weatherproof temporary finish to the roof structure prior to the application of the insulation and final waterproofing system.

Installation of Self-Adhesive/Heat-Activated Membranes

- Prepare substrate surface using Xtra-Seal SF Primer. Install Micoral SK layer ensuring minimum 100 mm overlaps.

Where external temperatures dictate (ie. cold temperatures) the use of a gas torch may be required to facilitate adhesion by gently warming the underside of the membrane during application. Seal all laps and turn the vapour control layer up all upstands, kerbs and penetrations etc. while making consideration to the compatibility of the membranes with each other.

11.2 Insulation

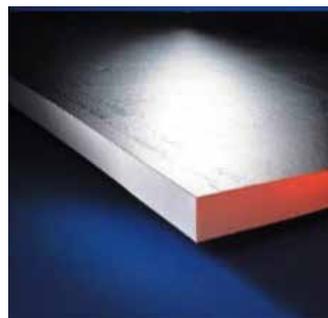
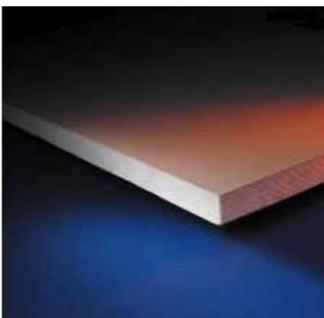
Install only as much insulation as can be covered by the completed roofing system by the end of the day. Surfaces shall be smooth, clean, dry and free from contaminants.

Fit insulation neatly at all perimeters and penetrations with gaps and steps not to exceed 6 mm. Voids greater than 6 mm must be filled with insulation.

Stagger end joints between boards. When installing multiple layers, offset joints between layers.

Fasten the insulation where required with acceptable fastener assemblies.

On metal decks, boards shall be laid with long edges at 90° to the deck troughs with end joints fully supported on the crowns.



11.3 Separation, Protection and Levelling Layers

In many roof applications, the roofing membrane has to be separated from other incompatible elements or protected against mechanical damage. In some cases free movement between layers has to be allowed for (in-situ [reinforced] concrete or ceramic tiles in mortar bed). Where this is the case, a geotextile separation or protection fleece should be installed as part of the roof build up.

11.3.1 Separation Layers

Separation layers are often used with single-ply membranes when applied onto non compatible substrates.

Geotextiles such as non-woven's made of polyester, polypropylene (PP) or a mix of PES and PP can function as separation layers. Polyester shall not be used when an alkaline environment is likely (eg. freshly poured concrete or concrete washed out).

11.3.2 Protection Layers

Protection layers are required for the mechanical protection of the roofing sheet prior to the application of roof ballast or green roofs. A polyester geotextile (eg. SLP 300 Protection Fleece) approximately 300 g/m² will protect the Monarplan® membrane whilst also acting as a filtration layer. Overlaps shall be with the fall of the roof and in excess of 200 mm.

As a fire protection layer, 120gr glass fleece on EPS is advised (Icopal Glass Fleece separation layer).



11.3.3 Levelling Layers

Levelling layers are installed between rough and /or uneven substrates and the water proofing layer (generally above tamped concrete surfaces).

The geotextiles shall have a minimum weight of 200 g/m² depending on the actual situation on the roof (eg. SLP 300 Protection Fleece). A sufficient resistance against perforation and compression is required.

12 Quality Assurance

Please note; the validity and the extent of the Icopal product warranty will only apply where Monarplan® membranes and accessories (or products made by others approved by Icopal prior to commencement of works) have been used. Any alterations to agreed system specifications shall render any warranty offer null and void.

Furthermore, should the Monarplan® system fail to be installed in accordance with the current guidelines (unless otherwise agreed), the warranty offer shall be rendered null and void.

Maintenance

The following care and maintenance requirements are for Monarplan® membrane roofing systems. Icopal recommend that maintenance staff and/or maintenance contractor inspect the roof periodically or at least twice a year ideally before and after the winter period. This ensures that dirt and debris is removed before it can cause damage and that signs of any failure can be reported and remedial action taken at an early stage. Maintenance items, including flashings and sealants, are the responsibility of the building owner.

Item	Action
Internally	Check internal surfaces visually for signs of moisture, leakage or condensation (e.g damp patches, staining etc)
General	Remove any unnecessary debris from the roof area particularly objects, which could cause damage to the membrane. Do not use the roof as a working platform for adjoining buildings or further works. If access is required adequate protection must be provided so as not to damage the membrane.
Drainage	Keep the roof surface clean at drain areas to avoid clogging. Clear leaves, silt or other debris, which may cause blockage of outlets or otherwise impede drainage. Check that ponding water is drained from the roof within 48 hours following rain.
Laps	Visually check the membrane laps for securement.
Petroleum Products	Keep all petroleum products (solvents, greases, paints, oils, or any liquids containing petroleum products) off the membrane to avoid degradation.
Animal Fats	Do not exhaust kitchen wastes (vegetable oils) or other animal fats directly onto the roof surface. They could degrade the membrane.
Chemicals	Contact Icopal if any chemicals come in contact with the roofing membrane. Some chemicals could degrade the membrane or cause swelling.
Foot Traffic	Walkways must be provided if regular traffic is required or if rooftop equipment has a regular thirty (30) day or less maintenance schedule. Exercise caution when not walking on walkways, especially on white membranes since ice or frost build-up may not be visible. Membranes are slippery when wet.
Roof Alterations	Check with Icopal that the proposed alteration will not invalidate the warranty. Work must be carried out by the approved roofing contractor who carried out the original installation. Do not allow other trades to fix through the waterproofing membrane without proper advice. This is especially important when having aerials, heating & ventilation equipment or telephone cables fitted.
Cleaning	Handprints, footprints, general traffic grime, industrial pollutants and environmental dirt may be cleaned from the surface of the membrane using regular household dish washing liquid, then rinsing with clean water. To maximize reflectivity, white membrane(s) should be cleaned once every two years.
Metal Work	Keep roof maintenance items, such as counterflashing, metal curbs and metal ducts sealed watertight at all times
Leaks	Report leaks immediately to Icopal. Try to determine if it is a roof membrane leak or a wall, curb, skylight, metal ductwork or plumbing leak. A water leak may be indicated by soft or warped insulation or the presence of water under the membrane. Physical damage to the membrane or flashing is not covered by the warranty. The building owner is liable to the cost of investigation and repair.

Item	Action
Temporary Repairs	Use a good grade sealant to make temporary repairs. Notify Icopal of this action in writing.
Rooftop Maintenance	When it is necessary for workers to be on the roof to service rooftop equipment, e.g., HVAC units, antennas, etc., workers should be cautioned to use walkways and to exercise care with their tools and equipment to avoid puncturing the roofing membrane.
Roof Cement	DO NOT USE ROOF CEMENT to repair or install membrane. Roof cement contains petroleum products, which may degrade the membrane.

The inspection should concentrate on high-risk areas such as roof hatches, drains and around all rooftop equipment as well as general inspection of the entire roof. The inspector should be looking for membrane damage (cuts and tears), oil or refrigerant leaks, chemical spills from any roof plant machinery, or water infiltration into the roofing system.

Compliance with the above listed care and maintenance requirements will aid in assuring a durable, watertight membrane roofing system.



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