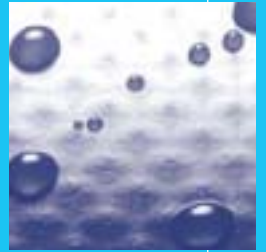
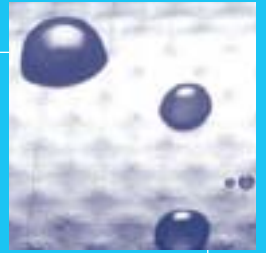


FLAGON TPO ROOFING



YOUR ROOFING AND WATERPROOFING PARTNER

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TPO ROOF SYSTEMS



INTRODUCTION

This section of the technical manual includes sectional diagrams, construction details and laying instructions for waterproofing with FLAGON TPO membranes. Careful design and correct laying are the prerequisites for long, functional life of the waterproofing package. For optimal waterproofing performance, carefully read this technical manual, the product data sheets and the information contained on the website www.flag.it or on the Flag CD-ROM attached to the documents. Drawings and technical details can be downloaded from the site in Autocad format. Due to space limitations, the details and drawings reproduced on the following pages are only a few examples of those that can be found on the Website or CD-ROM.

Flag engineers will be happy to develop specific technical solutions not included in our documentation.

FLAGON TPO LINERS

FLAGON TPO is a new generation synthetic liner made using an innovative formulation: EPR (ethylene propylene rubber) modified polyolefin.

FLAGON TPO development has been based on experience, synergy, co-operation and manufacturing technologies:

- *experience* gained by Flag who, since 1963, have developed and manufactured synthetic waterproofing liners for use in the roofing, civil engineering and hydraulic sectors.
- *synergy* with industry-leading manufacturers of polyolefins, who have developed and introduced these new materials to the field of waterproofing.
- *co-operation* with the most qualified designers, general contractors and installation companies.
- *innovative manufacturing technologies* for synthetic waterproofing materials.

MAIN CHARACTERISTICS

The exclusive manufacturing system designed for this type of liner and its unique formulation have resulted in:

- Excellent weldability
- Softness and flexibility
- Excellent dimensional stability
- High weather and UV rays resistance.
- Non-toxicity

- Resistance to a wide range of chemical attacks
- Compatibility with most insulation panels, including expanded/extruded polystyrene
- Compatibility with oxidised bitumen
- High resistance to puncturing
- Resistance to roots and micro-organisms.
- Adaptability to structural movements
- Environment and user friendly
- Life expectancy in excess of 25 years
- Proven installation history

FLAGON EP/PV, FLAGON EP/PR liners are manufactured in UNI EN ISO 9001 certified plants and fully comply with the performance standards CEN European Standard, UNI 8629/6 – SIA 280 – DIN 16726.

LIFE EXPECTANCY

FLAGON TPO liners have a life expectancy of over 25 years.

Existing waterproofing systems, more than ten years old, do not show any signs of deterioration.

Laboratory tests (Flag S.p.A. & Montell Polyolefins) confirm a life expectancy of over 25 years.

The British Board of Agreement (BBA) Certificate No. 00/3750 states, durability/life expectancy for our FLAGON TPO products (FLAGON EP/PR type) to be in excess of 20 years.

BACKGROUND

Flag introduced polyolefin (polyethylene and polypropylene) to their range of waterproofing systems **during the 70's**, and successfully applied hundreds of thousands of square metres in the field of ecology and hydraulics.

At the end of the 80's, new flexible polyolefins were introduced containing elastomers that improved the flexibility of the finished product making it easier to detail and weld.

Since 1990, in co-operation with their raw material suppliers, Flag have developed, manufactured and tested the "forerunner" of FLAGON TPO, analysing its behaviour in various waterproofing applications.

In 2000 Flag launched the new revolutionary production line for FLAGON TPO.





THE RAW MATERIAL

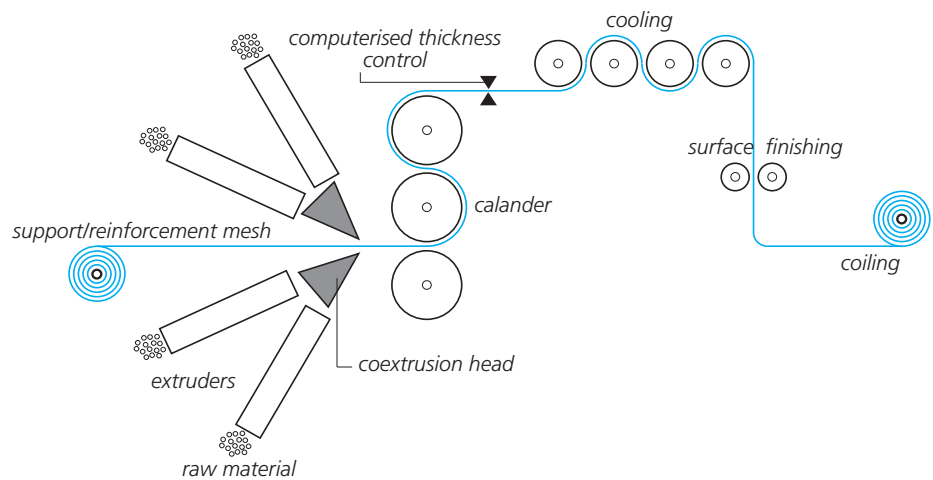
The raw material used to produce FLAGON TPO membranes is created by blending a mix of synthetic polyolefins and softening agents (EPR) with various additives that, through a catalytic procedure, are transformed into a moulded mass and then into granules.

This combines:

- resistance to ageing, weathering and micro-biological attack
- the EPR compound gives softness and flexibility with a high resistance to mechanical and chemical influences in conjunction with the strong welding capacity of polypropylene

THE PRODUCTION PROCESS

The unique manufacturing process designed and developed by Flag combines a tri-extrusion process in a single pass encapsulating a reinforcement mesh



NOTE: This diagram merely gives an idea of the process and is not indicative of the actual lay-out and methods used at the FLAG S.p.A.'s proprietary plant.

that produces a complete homogeneous product with stability and high tensile strength and an effective dual light/dark colour signal layer.

The particular property of FLAGON TPO synthetic liners is the reinforcement insert embedded in the body of the liner.

This reinforcement may be a non-woven glass mesh or polyester mesh, according to application needs, ensuring an efficient and aesthetically flawless end result.

FLAGON TPO liners are produced by co-extrusion in two-colours, known as a "signal layer" system.

The upper sand-grey colour, which provides lower heat absorption, increased longevity and aesthetic qualities, represents 10-15% of the membrane thickness and the black underside, which protects against UV damage, 85-90%. The major benefit of the system becomes apparent during installation; should the membrane become damaged, the black underside is immediately detected by the contractor and simply repaired.

THE PRODUCTS

FLAGON EP/PV

Co-extruded homogeneous liner, dimensionally stabilised by a non-woven glass mesh (ballasted roofing)



FLAGON EP/PR

Co-extruded homogeneous liner, with reinforced polyester mesh (mechanically fastened exposed roofing).



ELEMENTS AND FUNCTIONAL LAYERS OF THE ROOF

An overview of the characteristics and specific functions of the “layers” of the various types of roofing may be useful to clarify the terms used, define the technical requirements of the materials and to better illustrate the graphic examples provided in the following pages.



1 - SUPPORTING ELEMENT OR SUBSTRATE (with or without falls)

This is the structural surface of the works to be waterproofed, onto which the most appropriate combination of sectional layers is applied. The structural element may be constructed using a variety of techniques, such as: traditional reinforced concrete or brick and cement floor, pre-cast concrete, corrugated sheet metal, etc.

The surface of the structural element must be smooth and free from debris or irregularities that may puncture the waterproof stratification layers.



2 - ADJUSTMENT LAYER – COMPENSATION

The purpose of this layer is to take up any surface irregularities of the substrate, in order to avoid any imperfections or foreign particles damaging the vapour barrier or waterproof layers.

It can be made up of one of the following materials:

- a) Flag geotextile, a non-woven felt, minimum weight 500 g/m², dry laid with edge overlap of 10/15 cm.
- b) ISOLFLAG rigid polystyrene panels (or equivalent compensation layer), 10/20 mm thick with a density ranging between 15 and 25 kg/m³, laid in dry conditions, flush with membrane edges.

3 - VAPOUR SHIELD OR BARRIER LAYER

The purpose of this layer is to prevent any moisture working its way up from underlying structures and finding its way into the insulating layer, thus avoiding condensation within the roof covering. It is essential to incorporate a vapour retarder or barrier below the insulation when it is known that particular combinations of temperature and humidity may occur.

The location of the dew point fall in temperature will decide whether or not a retarder or barrier is necessary.

A vapour retarder may consist of:

- a) A layer of VAPOR FLAG polyethylene film, 0.30 to 0.40 mm thick, dry-laid with 10 cm edge overlap and secured using double-sided adhesive tape;
- b) Bituminous polymer membrane laid in hot bitumen, with 5 cm edge overlap, welded by flame tempering.

4 - INSULATION LAYER

The purpose of this layer is to bring the thermal resistance of the roof system to a specified value, limiting heat loss to the extent required by insulation regulations and ensuring that temperature and humidity levels, provided for by the regulations on energy conservation in buildings, are maintained in the premises underlying the roof covering. The insulating layer must consist of rigid, high-density material. It is normally composed of expanded or extruded polystyrene, polyurethane, rock wool, etc. The insulation boards should provide the necessary density and rigidity to support the roof design and loadings.



5 - SEPARATING LAYER

The function of this layer is to physically separate two adjacent, chemically incompatible elements of the waterproofing package.

The separating layer is normally made of Flag geotextile in non-woven felt, with minimum weight of 200 g/m².



6 - WATERPROOF LAYER OR SEALING SYSTEM

The purpose of the waterproof membrane is to ensure complete and durable waterproofing of the roof area. In the context of this waterproofing system we shall clearly consider the various FLAGON TPO synthetic membranes.

Each FLAGON TPO covering is characterised by an identification code.

In the sectional diagrams given, only the FLAGON TPO membranes that correspond to the requirements of the waterproofing project are indicated, and specifically:

- Flagon EP/PV for ballasted roofing;
- Flagon EP/PR for mechanically fastened exposed roofing.



7 - FILTRATION LAYER

The purpose of this layer is to allow the passage of rainwater, whilst preventing by filtration, sand, soil, dirt and other elements from being washed down between the insulation joints. Such elements could cause damage to the membrane through abrasion. The filtering layer is normally composed of FLAG geotextile in non-woven felt, minimum weight 200 g/m².



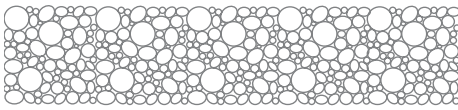
8 - DIVIDING AND SLIPPAGE LAYER (ballasted roofs subject to pedestrian traffic)

This physically separates the protective paving from the waterproof layer in order to prevent any surface tension in the paving, due to thermal expansion or settling, from being transmitted to the remaining layers, thereby damaging it. It also prevents the thinnest part of any concrete from clogging the underlying layers.



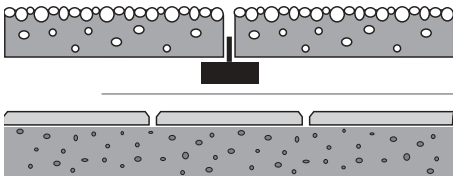
It can be made of the following materials:

- a) Film of VAPOR FLAG polyethylene, with thickness ranging from 0.30 to 0.40 mm, dry-laid with 10 cm edge overlap, and secured with double-sided adhesive tape;
- b) A layer of 0.8 to 1.0 mm FLAGON PeSL polyethylene sheet, dry-laid with 10 cm edge overlap, and secured with double-sided adhesive tape;
- c) Silicone paper (paraffin paper) dry laid with 25/30 cm edge overlap;
- d) FLAGON TS liner, loose laid, the edges of the sheets butted together.



9 - BALLASTING LAYER (ballasted roofs not subject to pedestrian traffic)

This prevents wind from uplifting or moving the dry laid stratification package. The ballasting layer generally consists of round, river-washed gravel, 10/30 mm, loose-laid to a minimum depth of 30/40 mm.

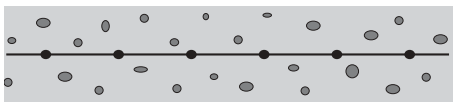


10 - BALLASTING AND PROTECTION LAYER (ballasted roofs for pedestrian traffic)

This prevents wind from uplifting the waterproofing membrane and provides the protection required to allow pedestrian traffic without damage to the waterproofing system.

Ballasting may be effected using the following materials and laying methods:

- a) Dry-laid pre-cast slabs laid on circular polyethylene supports;
- b) Dry-laid pre-cast and/or interlocking square paving slabs on a sand bed with minimum 60 mm thickness;
- c) Traditional paving covered with tiles laid on a bed of cement mortar.



11 - RIGIDITY AND WEIGHT DISTRIBUTION LAYER (ballasted roofs subject to vehicular traffic)

This layer accommodates any changes resulting from mechanical, physical and chemical stress caused by vehicular traffic. The rigidity layer is normally made from cement capping, 60 mm thick, reinforced with an electro-welded steel mesh.



12 - VEHICULAR CARRIAGEWAY LAYER (ballasted roofs subject to vehicular traffic)

This can be effected using the following materials and laying methods:

- a) Reinforced concrete slabs cast with appropriate joints;
- b) Traditional asphalt (binder);
- c) Interlocking paving laid on rolled sand. Please check the laying procedures provided by the paving manufacturer.

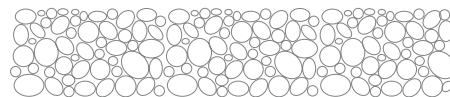


13 - DRAINAGE LAYER (ballasted roofs for roof gardens)

The function of this layer is to ensure drainage outside the waterproof layer.

It may consist principally of the following:

- Round, river-washed gravel, 10/30 mm, laid loose to a depth of 50/60 mm;
- Composite draining structures, with various typologies.



14 - VEGETATION LAYER (ballasted roofs for roof gardens)

The function of this layer is to ballast the waterproofing system, while affording a pleasant architectural feature.

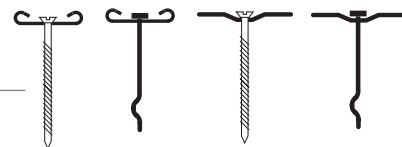


15 - FIXING DEVICES (mechanically fixed and fully adhered roofs)

The purpose of the fixing devices is to prevent wind uplift from affecting the waterproofing system. The following fixing devices can be used:

- Plugs for prefabricated roofing tiles in concrete;
- Self-tapping screws for corrugated sheet metal;
- Pre-drilled bars in galvanised steel;
- Pressure plates for screws or plugs.

The type and number of fixings required will be determined by calculation of the size and zones of influence of wind loading upon each individual roof, in accordance with applicable regulations.



FLAGON TPO ROOFING SYSTEMS

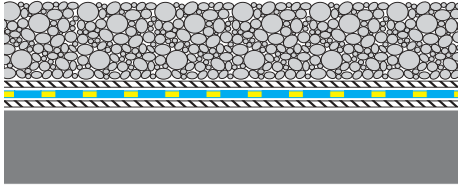
FLAGON TPO waterproofing membranes can be used for both newly built roof systems and for renovating existing roofs.

FLAGON TPO membranes have been designed both for ballasted roof systems (protected) and for exposed roof systems (unprotected), according to the following definitions:

A – BALLASTED ROOF SYSTEM NOT FOR PEDESTRIAN TRAFFIC

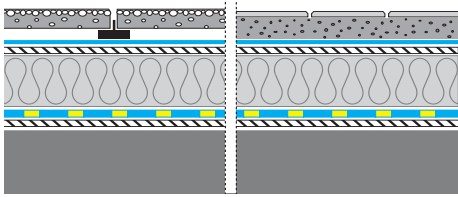
Flat or inverted roofs (with up to 5% gradient) in which the layers that form the waterproof system are dry-laid and ballasted:

- with gravel to prevent wind from lifting, moving or damaging them;
- with other materials to make them suitable for pedestrian or vehicular traffic (see detailed laying instructions).



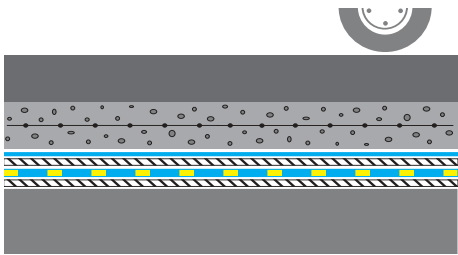
A.1 Ballasted roof system not for pedestrian traffic

Typically, these are ballasted with gravel and are intended for pedestrian transit for maintenance operations only (see structural elements and layers of roof point 9).



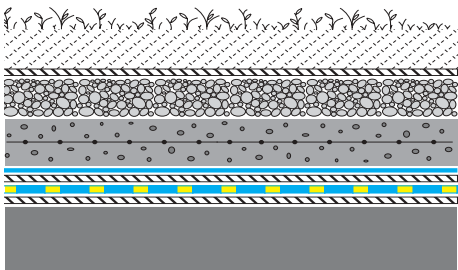
A.2 Ballasted roof system for pedestrian traffic

These are characterized by possible or frequent transit of people. Floors, decks, sidewalks, ramps, for public or private use, where the waterproofing system must be protected against damage caused by pedestrian traffic (see functional elements and layers of roof point 10).



A.3 Ballasted roof system for vehicular traffic

Roof systems and ramps, characterized by possible or frequent transit of vehicles. Car parks, garages, parking decks, floors for vehicular traffic, ramps, for public or private use, where the waterproofing system must be protected against damage caused by vehicular traffic and by contact with aggressive liquids (hydrocarbons), which may be released from the vehicles (see functional elements and layers of the roof point 11-12).



A.4 Ballasted roof system with roof garden

Ballasted roof systems made with the roof garden or green roof system. Traditionally cast floors or pre-cast floors in which the waterproofing system must be protected against root perforation, against the attack of microorganisms living in the soil and against any accidental damage during system laying and/or maintenance phases (see functional elements and layers of the roof point 13-14).

B- EXPOSED ROOFING (UNPROTECTED)

Flat or sloping roofing which cannot accommodate a ballasting layer. The waterproofing system should, therefore, be firmly fastened to the substrate to prevent the wind from lifting or moving it. Pedestrian traffic is possible for maintenance operations.

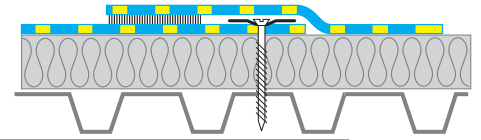
MECHANICALLY FASTENED ROOFING

Flat or sloping roofing, made of traditionally cast or pre-cast floors in concrete or with profiled metal.

Decks, buildings, etc., in which the waterproofing system is mechanically fastened to the substrate to prevent the wind from lifting or moving it.

The system will be weather resistant (rain, snow, hail, UV rays, etc.) and may be moderately accessible to pedestrian traffic for maintenance operations.

Two different mechanical fixing systems are possible: fixing by washers and screws or linear fixing with a bar (see detailed laying instructions).



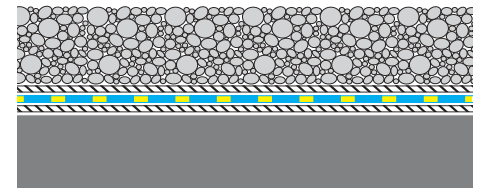
FUNCTIONAL SOLUTIONS

Waterproofing solutions are diverse and depend upon the problems to be solved and the performance to be achieved.

Based on the presence of an insulation element, they can be classified as follows:

A – NON-INSULATED ROOF SYSTEM (cold roof)

This refers to those roofs that do not require the inclusion of thermal insulation. Either ballasted or exposed roof systems can be used.



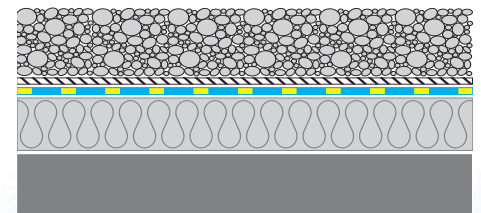
B – INSULATED ROOF SYSTEM

This refers to those roofs that require thermal insulation to be included in the stratification scheme below the waterproof covering (see functional elements and layers of the roof point 4).

Depending on the position of the insulation element in the roof build-up we can distinguish:

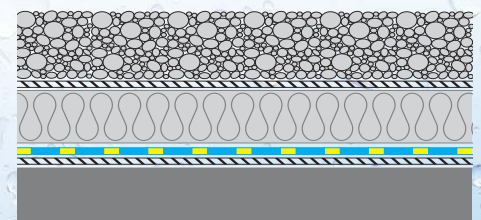
B.1 Warm roof systems (with or without vapour shield or barrier)

Roof build-up with the insulation element placed underneath the waterproof layer. Either ballasted or exposed waterproof systems can be used.



B.2 Inverted roof systems

Roof build-up with the insulation element placed above the waterproof layer. The inverted roof solution provides the following advantages compared to the warm roof solution:



- a) the waterproof layer is protected from thermal shocks and maintains an optimum and virtually constant surface temperature throughout the year. This extends the useful life of the waterproof layer;
 - b) the roof build up does not need a vapour shield or barrier layer because the theoretical dew point is always above the waterproof layer;
 - c) the waterproof membrane remains well protected against accidental mechanical damage, both during the laying of the ballasting layer and during maintenance operations.
- Only the ballasted type of roof system can be used.

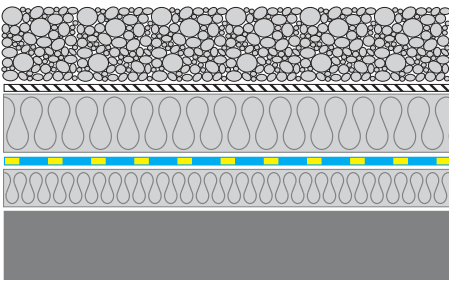
B.3 Sandwich roof systems (with or without vapour shield or barrier)

This refers to those coverings that require the inclusion of thermal insulation in the roof build up specification, both above and below the waterproof layer.

The sandwich roof system is particularly suitable when the substrate decking is not perfectly smooth and even, e.g. prefabricated roof tiles, and where it would, therefore, be ineffective to use a single adjustment layer of geotextile.

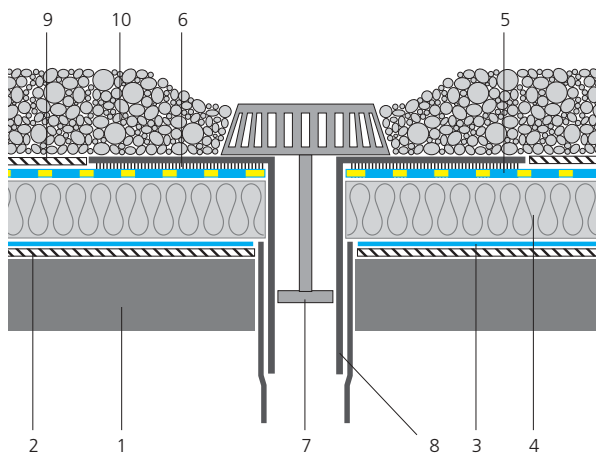
The advantages of the sandwich roof system, as opposed to the traditional warm roof solution, are the same as those of the inverted roof.

Only the ballasted type of roof system can be used.

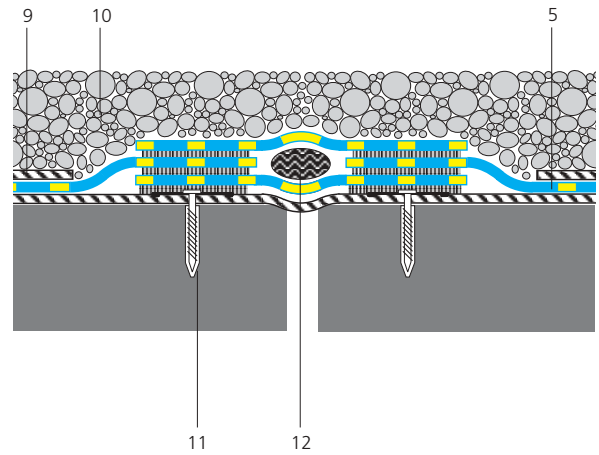


DETAILS AND PARTICULARS

Good design of the finishing details and particulars of a waterproofing system is essential for optimal results. In the following pages we reproduce only a few examples of the many available.



RAINWATER DRAIN UNION
HOT ROOF SYSTEM WITH VAPOUR BARRIER
BALLASTED NOT FOR VEHICULAR TRAFFIC

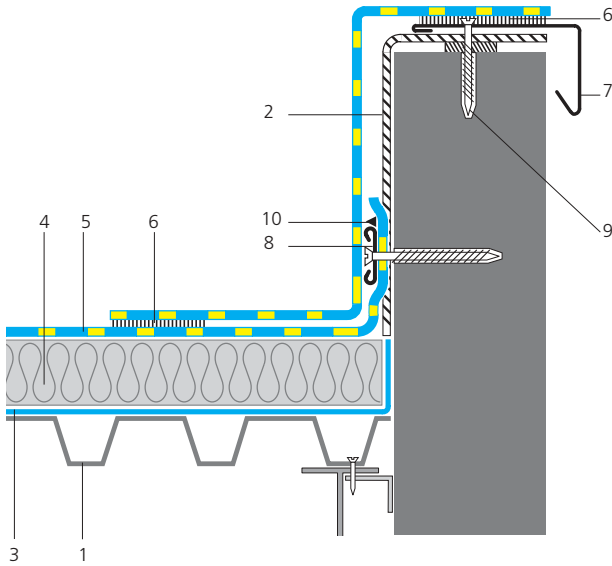


EXPANSION JOINT
NON-INSULATED ROOFING
BALLASTED NOT FOR PEDESTRIAN TRAFFIC

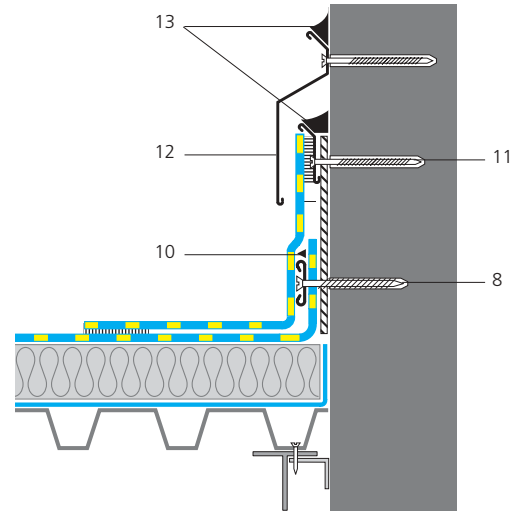
LEGEND

Layer	Function/Material	Contract specification item*
1	Supporting element	1.A
2	Adjustment layer	2.B
3	Vapour shield	3.A / 3.B
4	Thermal insulation element	5.E
5	FLAGON EPIPV waterproof liner	7.V2/7.V5
6	Manual welding	
7	Gravel guard	
8	FLAGON union	
9	Filtering layer	9.A / 9.B
10	Ballasting layer	12.A
11	Fixing element	15.B
12	Compressible element in neoprene	

* Please refer to the Contract Specification Items folder in the CD-ROM attached to the documents



ROOF EDGE JUNCTION WITH FLASHING
HOT ROOF SYSTEM WITH VAPOUR BARRIER
MECHANICALLY FASTENED

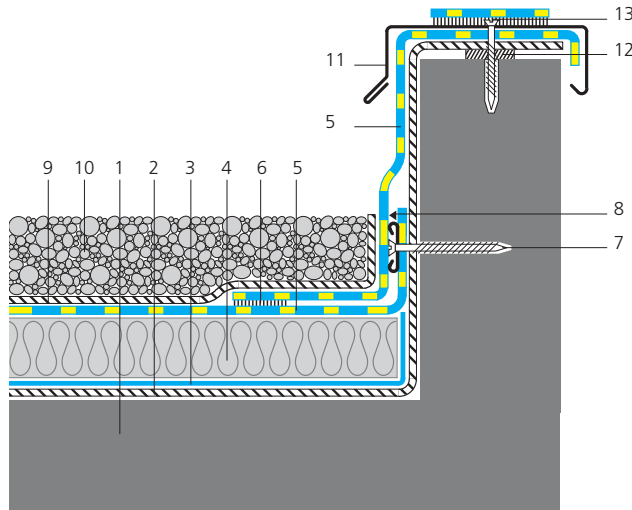


ROOF EDGE JUNCTION WITH COUNTER-PROFILE
HOT ROOF SYSTEM WITH VAPOUR BARRIER
MECHANICALLY FASTENED

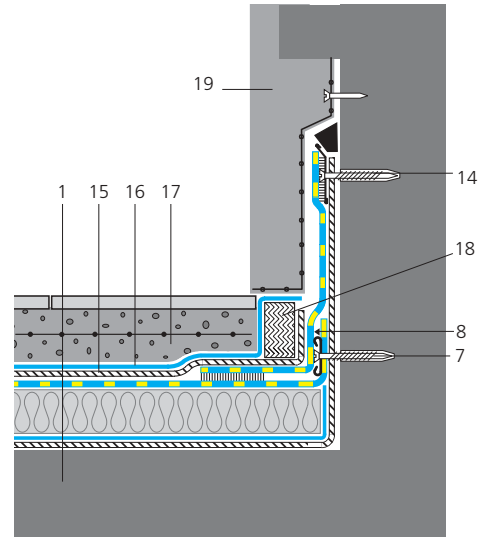
LEGEND

Layer	Function/Material	Contract specification item •
1	Supporting element	1.C
2	Adjustment layer	2.B
3	Vapour shield	3.A / 3.B
4	Thermal insulation element	5.E
5	FLAGON EP/IPR waterproof liner	7.W1/7.W4
6	Manual welding	
7	Finishing element	15.D
8	Fixing element	15.A
9	Fixing element	
10	FLAGONFIL TPO seam	15.T
11	Fixing element	15.C
12	Finishing counter-profile	
13	Sealing	

• Please refer to the Contract Specification Items folder in the CD-ROM attached to the documents



ROOF-EDGE JUNCTION WITH CAP
HOT ROOF SYSTEM WITH VAPOUR BARRIER
BALLASTED NOT FOR VEHICULAR TRAFFIC

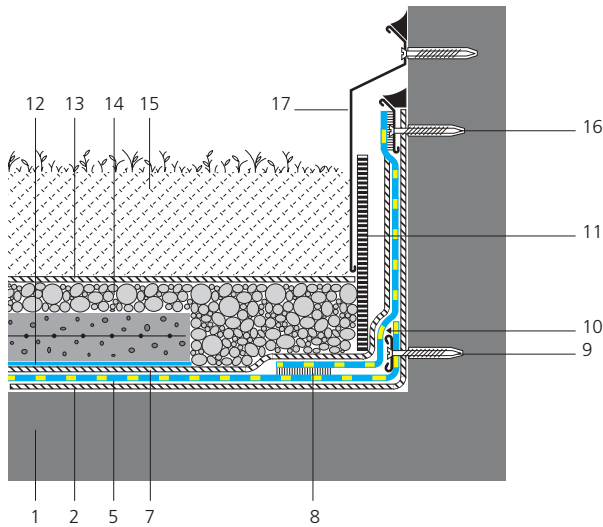


WALL JUNCTION PROTECTED BY PLASTER
HOT ROOF SYSTEM WITH VAPOUR BARRIER
BALLASTED FOR PEDESTRIAN TRAFFIC

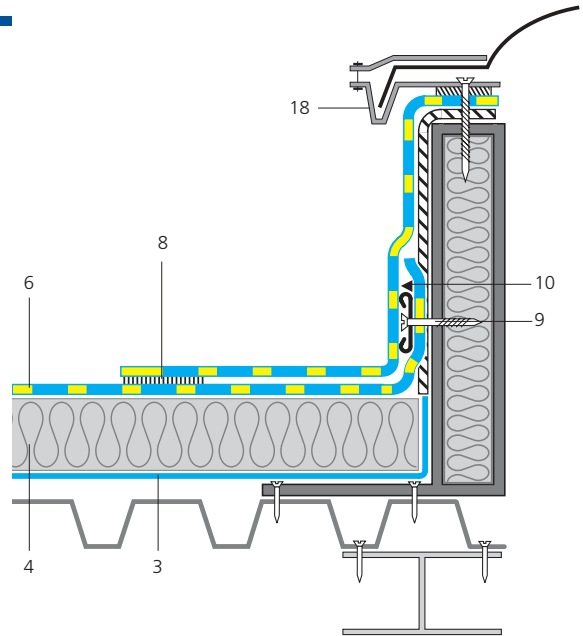
LEGEND

Layer	Function/Material	Contract specification item •
1	Supporting element	1.A
2	Adjustment layer	2.B
3	Vapour shield	3.A / 3.B
4	Thermal insulation element	5.E
5	FLAGON EP/PV waterproof liner	7.V2/7.V5
6	Manual welding	
7	Fixing element	15.R
8	FLAGOFIL TPO seam	15.T
9	Filtering layer	9.A / 9.B
10	Ballasting layer	12.A
11	Finishing element	15.M
12	Wind seal	16.H
13	Fixing element	
14	Fixing element	15.C
15	Separating layer	6.B / 6.E
16	Anti-soaking layer	10.A / 10.C
17	Ballasting-protecting layer	12.C
18	Compressible element	
19	Finishing element with plaster mesh	

• Please refer to the Contract Specification Items folder in the CD-ROM attached to the documents



WALL JUNCTION
NON-INSULATED ROOFING SYSTEM
BALLASTED WITH ROOF GARDEN



FLOOR LIGHT JUNCTION
HOT ROOF SYSTEM WITH VAPOUR BARRIER
MECHANICALLY FASTENED

LEGEND

Layer	Function/Material	Contract specification item •
1	Supporting element	1.A/1.C
2	Adjustment layer	2.B
3	Vapour shield	3.A / 3.B
4	Thermal insulation element	5.E
5	FLAGON EPIPВ waterproof liner	7.V2/7.V5
6	FLAGON EPIPВ waterproof liner	7.W1/7.W4
7	Separating layer	
8	Manual welding	15.C
9	Fixing element	
10	FLAGOFIL TPO seam	15.T
11	Vertical protection element	
12	Anti-soaking layer	10.D
13	Filtering layer	9.A/9.B
14	Draining layer	8.A
15	Vegetable layer	
16	Fixing element	15.C
17	Finishing counter-profile	
18	Floor light	

• Please refer to the Contract Specification Items folder in the CD-ROM attached to the documents

HOW TO CREATE CONTRACT SPECIFICATIONS

To draw up detailed, customized specifications, proceed as follows:

a) Log on to www.flag.it or use the Flag CD-ROM attached to the documentation.
a.1) enter the RPA (Roof Project Assistant) section to use the "dynamic database query system", a navigation path that determines the solution that best suits your project.

Now, by choosing the "specifications" option, you can view the selected stratification package, which has an interactive legend, notes and list of the complete specification items (the solution can be exported to your computer and can be modified and printed).

You can also download the selected sectional drawing in AUTOCAD format, can customise it and incorporate it into the design drawings.

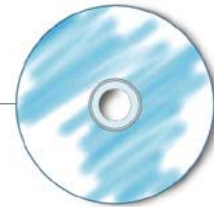
By selecting the "details" option, you can view the construction details and finishing particulars relating to selected solutions.

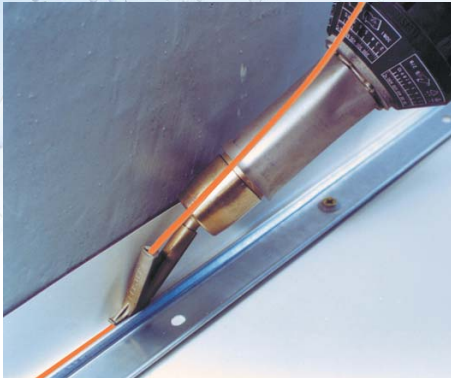
a.2) if the design solution has already been defined, it can be promptly selected in the "application fields" section by entering "TPO liners" and then choosing the "specifications" option to view the selected stratification package and following the same procedure described above.

b) Use the Flag CD-ROM attached to the documentation, opening the specification items folder and selecting, item by item, those relating to the design solution.

Note: All contract specification items are identified both by a name and by an alphanumeric code (e.g. 7.G2).

c) Contact the Flag S.p.A. offices (phone +39.035.4940949 fax +39.035.4940649) or send an e-mail to: info@flag.it to obtain further detailed information concerning the characteristics of the items relevant to your application.





GENERAL LAYING INSTRUCTIONS

1. STORAGE

FLAGON TPO liners are delivered on site in rolls, on flat, ventilated pallets. They should be stored in a dry place or, if this is impossible, they should be protected against dampness, rain and snow using waterproof sheets.

2. PERIMETER FIXING

FLAGON TPO roofing systems must be fixed at all upstands, perimeters and protrusions with a Flagon pre-drilled galvanised steel bar.

The fixing can be made horizontally or vertically depending upon the substrate and design constraints. In each situation the introduction of the FLAGOFIL TPO cord (N.B. details and particulars on the previous page) is necessary.

Using the special nozzle the cord is hot air welded above the fixing bar (in the case of vertical fixing) or between the bar and the brickwork (in the case of horizontal fixing).

3. SHEET OVERLAP

This is the arrangement of the individual sheets of membrane material laid on the surface to be covered in such a way as to allow each sheet to be welded together.

3.a) Membranes for ballasted roof system, FLAGON EP/PV membrane, minimum standard overlap 8 cm.

3.b) Membranes for mechanically fixed exposed roof system: the overlap is determined according to the fixing system selected but, in any case, the minimum standard overlap is 11 cm.

4. CLEANING THE WELDING LINES

The surface of TPO liners can easily become electrostatically charged.

This considerably increases build-up of dust and impurities on welding seams; it is therefore necessary to clean them with a cloth soaked in FLAGON TPO CLEANER before welding.

This cleaning operation can be omitted only when roll laying and welding are carried out simultaneously.

5. WELDING THE SHEETS

Two types of welding system can be used:

- manual hot air guns
- automatic equipment

These welding systems are not mutually exclusive, but can be used together according to the specific requirements and characteristics of each waterproofing job. Regardless of the welding system chosen, the sheet overlaps must be clean and dry.

5.a Hot air manual welding

The layers must be overlapped by 8 cm and fixed by welding spots every 40 cm (spot welding). The following phase is pre-welding.

Usually the welding temperature is about 320°C (+/-20°C) according to the environmental conditions on the building site. The same procedures must be followed when performing the final weld.

Please refer to the "Flag welding documentation" for more information.

5.b Welding by automatic equipment

Automatic welding can be performed by hot wedge welders (e.g. Saldamax Mille) or hot air welders.

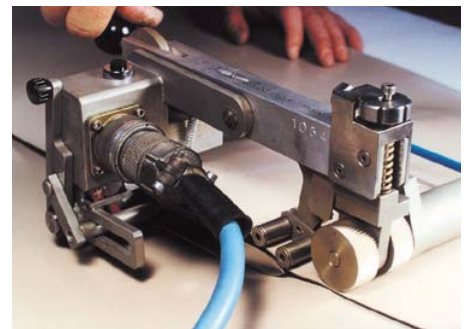
The Saldamax Mille welding machine can be used only if the laying of the waterproof membrane is totally independent of the substrate, i.e. in case of ballasted roofing.

For further information on Saldamax Mille welding machines, please refer to the relevant technical sheets and instructions for use.

If the laying of the membrane is semi-independent, i.e. in case of mechanically fastened exposed roofing, you need to use hot air automatic equipment.

In this case, hot air creates the weld for each seam, at a temperature of approx. 450°C +/- 10°C, depending on the external temperature, with speed of 250 cm/min.

Before laying the waterproofing system, it is advisable to adjust the automatic welding equipment on site, making a sample welding strip.

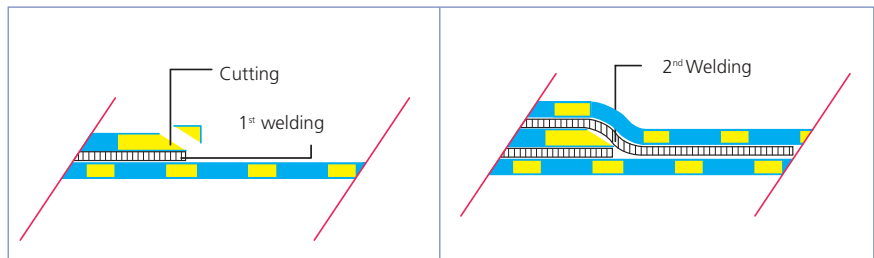




6 - PREPARING THE WELD OVERLAP

When overlapping more than two layer of membrane (T joints) the leading edge of the welding seam should be chamfered or milled.

This also applies to the laying of prefabricated elements in FLAGON TPO.

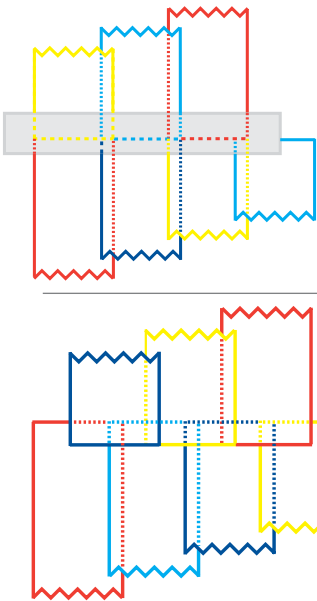


7 - USE OF ACCESSORIES

To ensure perfect compatibility, use only prefabricated corners, fittings and unions from the FLAGON TPO range which are made of the same compound as the waterproof liner. Use a manual hot air gun to weld these to the FLAGON TPO waterproof liner.

8 - FLAGMETAL LAMINATE

Flagon sheet metal laminated sections are easily fixed using expansion plugs (at least 3 per linear metre) and allow the covering to be directly welded to the section. In the case of flashings or cappings, expansion gaps should always be provided at joints to avoid the covering from tearing due to linear expansion of the sections.



9 - OVERLAPPING THE SHEETS

It is strongly recommended that the number of membrane layers be limited to a maximum of three. If more than two, you need to chamfer the leading edge, as per diagrams at point 6.

If the sheet heads create 4-edge crossings, in addition to this chamfering you need to apply a round safety patch on the welding point.

Avoid multiple welding with more than three sheets. For this purpose:

- a) lay a transverse sheet or strip (minimum width 20 cm) across the bottom of two or more perfectly aligned and parallel sheets to provide a connection to the subsequent set;
- b) offset each set of sheets transversally.

CHECKS

CHECKING LAID SURFACES (SIGNALLING EFFECT)

The contrasting colours of the upper and lower surfaces of most FLAGON TPO membranes allow the integrity of laid membranes to be checked.

If, during installation, the waterproof membrane has been in any way damaged or abraded, this will be readily apparent as the darker inner layer of the membrane will be exposed. This can then be easily remedied by welding a piece of the same material over the damaged area.

CHECKING OF THE MANUAL AND AUTOMATIC WELDING

Integrity of welding can be checked by mechanical, pneumatic or destructive testing.

a) Mechanical test (weld made by manual hot air gun or automatic equipment)

This is carried out by passing the rounded tip of a seam probe along the welding line, exerting an adequate pressure to identify any defect in the welded seam.

This operation is absolutely necessary to check the integrity of the welding and should be performed when the material is cold.

Defective areas should be cleaned with seam cleaner and re-welded or overlaid with FLAGON TPO strip.

b) Pneumatic test (weld made by automatic equipment, i.e. Saldamax Mille)

This method ensures an absolutely objective check of the welding seams.

With special calipers, seal the ends of the welding seams to be tested.

Insert a needle connected to a pressure gauge into the groove between the two welding seams made by the Saldamax Mille.

Introduce pressurised air by means of a foot pump at approximately 2 bar. Wait 1 minute to ensure the complete expansion of the inside groove and then start the actual test taking the pressure back to 2 bar.

After a 10 minute interval, again check the air pressure. A 20% pressure decrease (due to the membrane itself expanding) is acceptable.

Where FLAGON transparent liners have been used, the pneumatic test can be carried out also using contrasting liquid under pressure. Any imperfectly welded spots are shown by the appearance of colour stains.

This pneumatic test guarantees the integrity of the weld.



c) Destructive testing (hot air welded seams)

A destructive tensile test is carried out by peel testing a sample of the weld.

To do this, take out a 1 cm wide section of the previously welded seam.

Under test, the weld should not separate, nor should the covering tear.

Note: The test, although manually performed on site, is based on the provisions set forth by the UEAtc Directive.

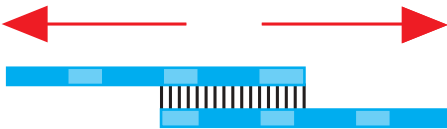
DETAILED LAYING INSTRUCTIONS

1. BALLASTED ROOF SYSTEM

The waterproof layers used for a ballasted roof system are laid independently of the substrate.

Ensuring adequate overlaps, place the dry, waterproof layers in succession.

Once the horizontal sheets are laid, execute the vertical upstands and the details, carried out according to the instructions provided in “construction details and particulars” on www.flag.it and on the Flag CD-Rom.



2. EXPOSED ROOF (mechanically fixed)

Preliminary note:

In the case of a substrate made of corrugated sheet metal, waterproof sheets should be placed in such a way as to cross the longitudinal rib of the metal element perpendicularly.

With a concrete substrate, the waterproof sheets can be laid both perpendicularly and transversally to the direction of the support tiles.

Wind force has different effects on the roof surface, which is why three areas of influence are distinguished: inside, perimeter and angle.

The distance between the single fixings, their density and the number required in the three areas of a roof are established during the design phase for each case.

The basic criteria for the fixing design are: nature of support, shape of the roof, building height, wind speed of the area, topography of the area.

The section of liner that is placed along the roof perimeter is most exposed to wind so you always need to include a complementary fixing line with a pre-drilled bar in galvanised sheet iron at the foot of the perimeter brickwork. The corner is the most heavily affected by the wind and obviously requires the largest number of fixing points.

For more information and detailed calculations, please contact our Technical Offices.

Mechanical fixing can be carried out by two different systems:

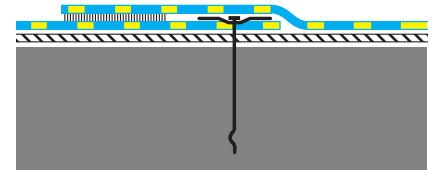
2.1 Side lap fixing system

Using this system the reinforced waterproofing membrane is fixed through the deck / substrate by appropriate fixings and distribution plates.

The membrane is fixed along its outside edge at centres determined by the wind load restrictions.

Where additional fixings are required to the perimeter and corner zones a further row of fixings can be installed along the centre of the membrane and then overlaid with a welded cover strip of membrane.

The same fixing method may be applied to a pre-drilled bar system in place of fixings and pressure plates.



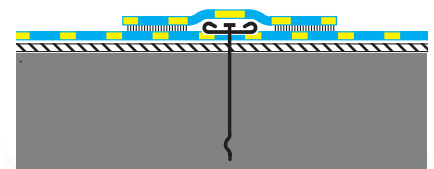
2.2 Bar fixing

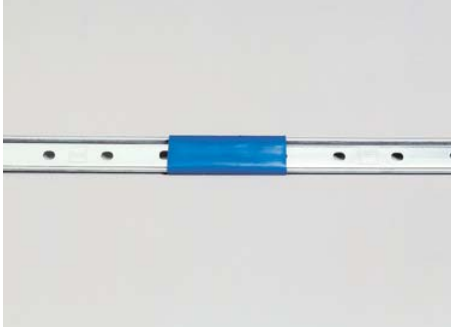
This system is used if the type of supporting element requires the positioning of the fastening line at a pre-established centre distance, owing to defects visible underneath the roofing.

The fastening lines are placed parallel to the lengthwise axis of the line. Instead of distribution plates, a pre-drilled bar in galvanised sheet iron is used for all the fastening lines, not only for those at the foot of the vertical elements.

To protect the integrity of the waterproof membrane in case of damage caused by pedestrian traffic or continuous pressure caused by overloads, with this fastening system, you always need to insert the FLAG ANTI-PUNCTURING JOINT at the junction between two adjacent bars.

This system enables the contractor to lay the waterproofing membranes on the roof and weld them together using a 5 cm standard overlap.





Once in position the bars are fixed at pre-determined centres, using appropriate screws, securing the membrane in place.

Once in place the bars are overlaid with a welded strip of membrane.

The design must provide adequate drainage between the fixing lines to allow free flow of rainwater to down-pipes and channels.

In order to prevent wind moving or damaging the membrane during the installation this operation must be carried out during the laying of the membrane.

Provide adequate drains between the fixing lines to allow the outflow of rainwater to down pipes and channels.

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