

# **Firestone TPO Roofing System for Green Roofs**

The specifications herein described are general guidelines created from information provided to Firestone Building Products by project specifiers and design professionals. They are intended to facilitate and assist in the selection of roof materials, not as a substitute for the judgment of a design professional. The ultimate selection of a specification for a particular roof remains the responsibility of the building owner and their design professionals.

For the build-up of the green roof layers on top of the TPO membrane we refer to the green roof designers and/or specialists.

When also a Photovoltaic System will be installed in combination with this green roof, please also consult our specifications for TPO Enviro-Ready Roofing Systems.

## **1 Preparation of the Roof Substrate**

### **1.1 New Roof**

#### **1.1.1 General**

Roof slope should be a minimum of 2% to allow for adequate drainage of the roof taking into account the deflection of the roof.

The roof surface will be made clean, dry, smooth and free of contaminants such as grease, animal fats, coal tar and oil based products. All sharp edges, fins and rough surfaces that could damage the membrane will be removed or if they can't be removed, isolated from the membrane with a leveling layer.

It is essential that the roof structure is capable of supporting the imposed load of the new roofing system, also taking the saturated condition of the green roof into account. When necessary, the advice of a Structural Engineer should be sought in this respect.

#### **1.1.2 Substrate Type: Metal Decking**

Metal decks require a minimum thickness of 0.75 mm for galvanized steel. Deck should be installed without inducing stresses (over-stretching/compressing) that could cause the flutes to bend. The deck should be fixed to the substrate using sufficient fasteners as per the manufacturer's specifications.

#### **1.1.3 Substrate Type: Wooden Decks**

The deck needs to consist of wooden boards with a minimum thickness of 18 mm. Thickness of the boards depends on the distance between the purlins. Wooden panels should be kept dry before and during the waterproofing works.

#### **1.1.4 Substrate Type: Concrete**

Concrete needs to be structurally sound and dry to the touch. Concrete should have aged for a minimum of 2 weeks before starting any roofing works.

## **1.2 Reroofing**

### **1.2.1 General**

Roof slope should be a minimum of 2% to allow for adequate drainage of the roof taking into account the deflection of the roof.

All outlets must be protected to prevent debris entering and causing blockage of down pipes.

The roof surface will be made clean, dry, smooth and free of contaminants such as grease, animal fats, coal tar and oil based products. All sharp edges, fins and rough surfaces that could damage the membrane will be removed or if they can't be removed, isolated from the membrane with a leveling layer.

It is essential that the roof structure is capable of supporting the imposed load of the new roofing system, also taking the saturated condition of the green roof into account. When necessary, the advice of a Structural Engineer should be sought in this respect.

### **1.2.2 Substrate Type: Metal Decking**

Metal decks require a minimum thickness of 0.75 mm for galvanized steel. Metal decks will be inspected for their deflection and assessed for their pullout resistance when necessary.

### **1.2.3 Substrate Type: Wooden Decks**

The deck needs to consist of wooden boards with a minimum thickness of 18 mm. Thickness of the boards depends on the distance between the purlins. Wooden decks will be fully examined for their quality (dryness) and pullout resistance. Any wet or unsound portions will be replaced with new material prior to the installation of the membrane system.

### **1.2.4 Substrate Type: Concrete**

Concrete needs to be structurally sound and dry.

### **1.2.5 Existing Membrane: Smooth Bitumen**

All debris and non-adherent areas of the existing bitumen roof finish will be removed. Blisters and buckles will be cut open and sealed, defects will be repaired by gentle warming and redressing.

### **1.2.6 Existing Membrane: Granule Surfaced Bitumen**

All chippings, debris and non-adherent areas of the existing bitumen roof finish will be removed from the surface. Blisters and buckles will be cut open and sealed, defects will be repaired by gentle warming and redressing.

A separation layer of geotextile (min. 200 gr/m<sup>2</sup>) or an insulation board or a half-inch (12.7 mm) thick Firestone ISOGARD™ HD Cover Board or equivalent will be installed prior to the installation of the roofing membrane.

### **1.2.7 Existing Membrane: Thermoplastic Membrane**

The existing thermoplastic membrane will be cut at the perimeter and all flashings will be removed from the upstands and penetrations. When necessary, the membrane will be cut at equidistant intervals to release the tension out of the membrane.

A separation layer of geotextile (min. 200 gr/m<sup>2</sup>) or an insulation board or a half-inch (12.7 mm) thick Firestone ISOGARD™ HD Cover Board or equivalent will be installed prior to the installation of the roofing membrane.

### **1.2.8 Existing Membrane: EPDM Membrane**

All debris will be removed from the existing roof surface. All non-adherent parts of the existing EPDM membrane at upstands and penetrations will be removed.

In case of a fully adhered roofing system, an insulation board or a half-inch (12.7 mm) thick Firestone ISOGARD™ HD Cover Board or equivalent will be installed prior to the installation of the roofing membrane.

## **2 Vapour Control Layer**

### **2.1 General**

The necessity, type and thickness of the vapour control layer need to be determined based upon the designation of the building and the regional climatic conditions.

All installations need to be in accordance with the recommendations of the manufacturer and the method of fixation needs to be adapted to both the substrate and the roofing system to be installed.

Dress to provide sufficient edge protection to new thermal insulation at perimeter, abutments and details etc.

## **3 Insulation & Cover Board**

### **3.1 General**

Use insulation boards with a high compressive strength. If necessary a half-inch (12.7 mm) thick Firestone ISOGARD™ HD Cover Board or equivalent will be installed on top of the insulation.

The thermal resistance of the total package of insulation and cover boards requires minimum R-value of ... m<sup>2</sup>K/W (check your local and/or National Standards).

### **3.2 Insulation Type**

#### **3.2.1 Mineral Wool (MW)**

Mineral wool boards have a minimum compressive strength of 40 kPa; UEAtc class C.

In case of a fully adhered membrane application, install a suitable overlayment (e.g. a half-inch (12.7 mm) thick Firestone ISOGARD™ HD Cover Board or equivalent) prior to the installation of the TPO membranes.

#### **3.2.2 Perlite (EPB)**

Perlite boards have a minimum compressive strength of 200 kPa.

In case of a fully adhered membrane application, install a suitable overlayment (e.g. a half-inch (12.7 mm) thick Firestone ISOGARD™ HD Cover Board or equivalent) prior to the installation of the TPO membranes.

#### **3.2.3 Polyurethane (PUR)**

Polyurethane boards have a minimum compressive strength of 120 kPa with an acceptable facer with sufficient delamination strength.

#### **3.2.4 Polyisocyanurate (PIR)**

Polyisocyanurate boards have a minimum compressive strength of 120 kPa with an acceptable facer with sufficient delamination strength.

##### **3.2.4.1 Firestone ISO 95+ GL**

Manufacturer needs to be ISO 9001:2008 and ISO 14001:2004 certified. The foam technology does not contribute to the depletion of the earth's ozone layer (zero ODP) and uses a HCFC-free blowing agent.

The polyisocyanurate insulation boards consist of closed-cell polyiso foam core laminated on both sides to a black

glass reinforced mat facer of app. 150 g/m<sup>2</sup>. The boards will comply with the following characteristics when tested in accordance with EN 13165:

- Dimensions: 1.22 m x 2.25 m
- Thickness: from 25.4 mm to 101.6 mm
- Compressive strength:  $\geq 138$  kPa
- Thermal conductivity:  $\leq 0.029$  W/mK

Keep insulation dry at all times. Do not install over wet, damp or uneven substrates.

The insulation boards comply to following certifications, but not limited to: CE marked according to EN 13165, ASTM C1289 Type II Class 1, UL Classified, FM Class 1 Approved.

#### **3.2.4.2 Firestone RESISTA AK**

Manufacturer needs to be ISO 9001:2008 and ISO 14001:2004 certified. The foam technology does not contribute to the depletion of the earth's ozone layer (zero ODP) and uses a HCFC-free blowing agent.

Firestone polyisocyanurate insulation boards consist of closed-cell polyiso foam core laminated on both sides to a gastight multi-layered aluminium complex. The boards will comply with the following characteristics when tested in accordance with EN 13165:

- Dimensions: 1.2 m x 0.6 m,  
1.2 m x 1.2 m,  
1.2 m x 2.4 m
- Thickness: from 30 mm to 140 mm
- Compressive strength:  $\geq 150$  kPa
- Thermal conductivity:  $\leq 0.023$  W/mK

Keep insulation dry at all times. Do not install over wet, damp or uneven substrates.

The insulation boards comply to following certifications, but not limited to: CE marked according to EN 13165, FM Class 1 Approved.

#### **3.2.5 Expanded polystyrene (EPS)**

Expanded polystyrene boards have a minimum compressive strength of 120 kPa.

Direct contact between polystyrene boards and contact adhesives and/or primers must be avoided.

In case of a fully adhered membrane application, install a suitable overlayment (e.g. a half-inch (12.7 mm) thick Firestone ISOGARD™ HD Cover Board or equivalent) prior to the installation of the TPO membranes.

### **3.2.6 Extruded polystyrene (XPS)**

Extruded polystyrene boards have a minimum compressive strength of 300 kPa.

Polystyrene boards are meant to be used in inverted roof systems and thus can only be installed on top of the TPO membrane.

## **3.3 Cover Board Types**

### **3.3.1 ISOGARD HD**

Manufacturer needs to be ISO 9001:2008 and ISO 14001:2004 certified. The foam technology does not contribute to the depletion of the earth's ozone layer (zero ODP) and uses a HCFC-free blowing agent.

Firestone ISOGARD HD is a high-density, closed-cell, polyisocyanurate board with a coated fiberglass facer on both sides designed for use as a cover board. The boards will comply with the following characteristics when tested in accordance with EN tests:

- Dimensions: 1.22 m x 2.25 m
- Thickness: 12.7 mm
- Weight: 1.8 kg/m<sup>2</sup>
- Compressive strength: >= 800 kPa

Keep cover board dry at all times. Before board is placed on the roof deck, the surface must be clean, dry, free of debris, water, ice or snow and suitably prepared.

### **3.3.2 DensDeck Roof Board**

DensDeck Roof Board exists of a high-density gypsum core, bonded on front and back with fiberglass mats. The boards provide an excellent fire barrier, wind-uplift properties, flute spanning that stiffens and provides increased foot traffic resistance to the roof deck. The boards will comply with the following characteristics:

- Dimensions: 1.22 m x 2.44 m
- Thickness: 6.4 mm, 12.7 mm, 15.9 mm
- Weight: 5.9 kg/m<sup>2</sup>, 9,8 kg/m<sup>2</sup>, 12.2 kg/m<sup>2</sup>

Keep cover board dry at all times. Before board is placed on the roof deck, the surface must be clean, dry, free of debris, water, ice or snow and suitably prepared.

## **3.4 Attachment of Insulation and/or Cover Boards**

### **3.4.1 Thermal Insulation loose laid (only for Ballasted Roofing System)**

Install the boards on above underlay, loose laid with end joints staggered. When installing two layers of boards,

ensure that the joints of both layers do not coincide. Install fully in accordance with manufacturers instructions. Install in any one day only as much boards as can be protected by the completed roofing system that same day.

#### **3.4.2 Thermal Insulation and/or Cover Boards mechanically attached**

Install the boards on above underlay with end joints staggered. When installing two layers of boards, ensure that the joints of both layers do not coincide. Mechanically fix to pattern and frequency advised by manufacturer, all in accordance with national wind uplift standards. Install fully in accordance with manufacturers instructions. Use Firestone insulation plates and fasteners or equivalent. Install in any one day only as much boards as can be protected by the completed roofing system that same day.

#### **3.4.3 Thermal Insulation and/or Cover Boards adhered**

Install the boards on above underlay with end joints staggered. When installing two layers of boards, ensure that the joints of both layers do not coincide.

Adhere the boards using Firestone Twin Pack Insulation Adhesive or an equivalent adhesive system, according a pattern as advised and approved by manufacturer, all in accordance with national wind uplift standards.

Firestone insulation boards shall not be larger than 1.2 m x 1.2m. Install fully in accordance with manufacturers instructions.

Install in any one day only as much boards as can be protected by the completed roofing system that same day.

#### **3.4.4 Thermal Insulation Boards Inverted Roof**

Install XPS boards loose laid over membrane with end joints staggered. Install fully in accordance with manufacturers instructions. The installation of a vapour open separation layer (geotextile) between the insulation and the green roof is required. The insulation boards must be immediately (temporarily) ballasted after installation.

## **4 Firestone TPO Roofing Membrane**

### **4.1 Products**

TPO Membranes and accessories need to be supplied from the same manufacturer. Manufacturer needs to be ISO 9001:2008 and ISO 14001:2004 certified.

#### **4.1.1 Roofing membrane: Firestone UltraPly™ TPO membrane 1.5 mm (0.059")**

The Firestone UltraPly TPO membrane is a flexible thermoplastic polyolefin (FPO) roofing membrane made from the incorporation of an ethylene propylene rubber into a polypropylene matrix and produced with a polyester weft-inserted reinforcement. The membrane can be supplied in the following dimensions and colors:

- Thickness: .059" (1.5 mm);
- Weight: 1.525 kg/m<sup>2</sup>;
- Length: 30.50 m;
- Width: 1.00 m; 1.50 m; 2.00 m;
- Color: white; gray;

Dimension of the membrane will be chosen in view of the dimensions, complexity of the roof and in function of a wind uplift calculation as determined by national standards.

The membrane complies with the following characteristics when tested in accordance with EN 13956:

- Tensile strength (L/T):  $\geq 1200$  N/50 mm
- Elongation at break:  $\geq 20$  %
- Tear Resistance (L/T):  $\geq 400$  N
- Static loading:  $\geq 20$  kg (on soft and hard support)
- Resistance to impact:  $\geq 2000$  mm (on soft support)  
 $\geq 800$  mm (on hard support)
- Joint peel resistance:  $\geq 300$  N/50mm
- Joint shear resistance:  $\geq 800$  N/50mm
- Cold foldability:  $\leq -40$  °C
- Durability/UV-exposure: Pass EN 1297 (>7500h)

The TPO membrane is resistance to root penetration according FLL/EN 13948.

The membrane has been assessed for its properties according to EN 13956 (CE mark), ASTM D-6878, DIN V 20000-201, is FM approved and carries following certificates, but not limited to: ETA, ATG, KOMO, ETN, Atex.

#### **4.1.2 Roofing membrane: Firestone UltraPly™ TPO membrane 1.8 mm (0.071")**

The Firestone UltraPly TPO membrane is a flexible thermoplastic polyolefin (FPO) roofing membrane made from the incorporation of an ethylene propylene rubber into a polypropylene matrix and produced with a polyester weft-inserted reinforcement. The membrane can be supplied in the following dimensions and colors:

- Thickness: .071" (1.8 mm);
- Weight: 1.815 kg/m<sup>2</sup>;
- Length: 30.50 m;
- Width: 1.00 m; 1.50 m; 2.00 m;
- Color: white; gray;

- Durability/UV-exposure: Pass EN 1297 (>7500h)

Dimension of the membrane will be chosen in view of the dimensions, complexity of the roof and in function of a wind uplift calculation as determined by national standards.

The membrane complies with the following characteristics when tested in accordance with EN 13956:

- Tensile strength (L/T):  $\geq 1200$  N/50 mm
- Elongation at break:  $\geq 20$  %
- Tear Resistance (L/T):  $\geq 400$  N
- Static loading:  $\geq 20$  kg (on soft and hard support)
- Resistance to impact:  $\geq 2000$  mm (on soft support)  
 $\geq 1000$  mm (on hard support)
- Joint peel resistance:  $\geq 300$  N/50mm
- Joint shear resistance:  $\geq 800$  N/50mm
- Cold foldability:  $\leq -35$  °C
- Durability/UV-exposure: Pass EN 1297 (>7500h)

The TPO membrane is resistance to root penetration according FLL/EN 13948.

The membrane has been assessed for its properties according to EN 13956 (CE mark), ASTM D-6878, DIN V 20000-201, is FM approved and carries following certificates, but not limited to: ETA, ATG, KOMO, ETN, Atex.

## **4.2 Roofing System**

Ponding water, snow, frost and/or ice present in more than trace amounts, must be removed from the work surface prior to installing the system.

For larger roof surfaces it is highly recommended to divide the roof in several compartments. The different installed compartments will be indicated on the roof plan.

### **4.2.1 Fully Adhered System (recommended)**

Install the Firestone UltraPly TPO single-ply roofing membrane loose laid on a suitable substrate as close to its final position as possible, and allow to relax a minimum of 30 minutes before attachment or splicing. Adjoining sheets are overlapped at least 75 mm. Layout the Firestone UltraPly TPO membranes in a fashion so that field and flashing seams are installed to shed water. Orient the TPO sheets so that any exposed (cut) edges of a sheet are used as the bottom sheet in splices whenever possible.

The TPO sheets are to be fully adhered with with solvent or Water Based Bonding Adhesive on a compatible substrate. The adhesives must be roller applied in a thin even coat on both mating surfaces. Allow sufficient time for the adhesive to flash off before mating the surfaces. All strictly in accordance with Firestone specifications.

All TPO strips are heat-welded to form a continuous, watertight membrane (see § 4.3.2).

#### **4.2.2 Ballasted System (only for roof slopes < 5%)**

Install the Firestone UltraPly TPO single-ply roofing membrane loose laid on a suitable substrate as close to its final position as possible, and allow to relax a minimum of 30 minutes before attachment or splicing. Adjoining sheets are overlapped at least 75 mm. Layout the Firestone UltraPly TPO membranes in a fashion so that field and flashing seams are installed to shed water. Orient the TPO sheets so that any exposed (cut) edges of a sheet are used as the bottom sheet in splices whenever possible.

All TPO strips are heat-welded to form a continuous, watertight membrane (see § 4.3.2).

The TPO membranes must be (temporarily) ballasted immediately after installation.

The TPO membranes must be sufficiently ballasted, strictly calculated in accordance with local standards for wind uplift, but always with min. 50 kg/m<sup>2</sup>. If the substrate of the green roof is resistant against erosion, the weight of the green roof (in dry condition) may be taken into account. If necessary additional ballast must be installed.

When the green roof is removed, another (temporary) layer of ballast must be installed.

#### **4.2.3 Inverted System (only for roof slopes < 5%)**

Install the Firestone UltraPly TPO single-ply roofing membrane loose laid on a suitable substrate as close to its final position as possible, and allow to relax a minimum of 30 minutes before attachment or splicing. Adjoining sheets are overlapped at least 75 mm. Layout the Firestone UltraPly TPO membranes in a fashion so that field and flashing seams are installed to shed water. Orient the TPO sheets so that any exposed (cut) edges of a sheet are used as the bottom sheet in splices whenever possible.

All TPO strips are heat-welded to form a continuous, watertight membrane (see § 4.3.2).

The TPO membranes must be (temporarily) ballasted immediately after installation.

Finally the TPO membranes must be sufficiently ballasted, strictly calculated in accordance with local standards for wind uplift, but always with min. 50 kg/m<sup>2</sup>. If the substrate of the green roof is resistant against erosion, the weight of the green roof (in dry condition) may be taken into account. If necessary additional ballast must be installed.

When the green roof is removed, another (temporary) layer of ballast must be installed.

## **4.3 Roof Details**

### **4.3.1 General**

Around all perimeters and around each roof detail a green-free zone of app. 50cm wide must be foreseen. In these zone(s) the vegetation will be replaced by gravel or a row/rows of tiles.

Use smooth, river-washed ballast with rounded edges and corners preferably between 20 mm - 40 mm nominal diameter. The diameter of the gravel is also depending on the height of the roof.

### **4.3.2 Seaming**

All splices need to be hot air welded.

Set-up of the welding equipment is the responsibility of the installer. The air intake, temperature and speed of the machine must be adjusted to provide proper seam strength.

Seams made with an automatic welder must be a minimum of 38 mm wide. Seams made with hand welders must be a minimum of 50 mm wide. The weld shall be executed and pressured with a pressure roller.

Any visible cut edges with scrim exposed shall be covered with UltraPly TPO Cut Edge Sealant or TPO General Purpose Sealant.

### **4.3.3 Base Tie-in**

At all changes in angles greater than 15%, the membrane must be restrained using one of the approved 'Base Tie-in' methods as per the Firestone specifications.

#### **4.3.3.1 Detail 1: Base Tie-in with Fasteners and Plates**

The TPO membrane should be mechanical attached with Firestone HD Seam Plates, Metal Batten Bars or a TPO Coated Metal strip and fasteners or other approved plates and fasteners as close as possible at the angle change, max. every 300 mm o.c. The TPO membrane must extend 15 mm beyond the edge of the plates.

Plates and fasteners are either installed on the flat roof substrate or on the wall. The selection for vertical or horizontal attachment is related to the ease of application (thickness of insulation and nature of the substrate).

#### **4.3.3.2 Detail 2: Base Tie-in with UltraPly TPO Coated Metal**

Mechanical fasten the UltraPly TPO Coated Metal to the supporting structure using appropriate fasteners, all according the Firestone guidelines. Position the fasteners not closer than 15 mm from the metal edge.

Heat weld the field TPO membranes to the TPO Coated Metal flashing. Seams must meet requirements mentioned in § 4.3.2.

#### **4.3.4 Vertical flashings roof edges and penetrations**

Vertical facings are either flashed with the Firestone UltraPly TPO Coated Metal or with a separate strip of UltraPly TPO membrane which is fully adhered with Bonding Adhesive and/or mechanically attached, all according the Firestone Technical Guidelines. If necessary, install a suitable overlayment (e.g. a half-inch (12.7 mm) thick Firestone ISOGARD™ HD Cover Board or equivalent) to ensure the adherence of the TPO membranes.

The required height for the TPO flashing should be determined by local regulations. Do not flash over existing through-wall flashings, weep holes and overflow scuppers.

On top of the upstands, the TPO membrane or TPO Coated Metal is mechanically attached and finished with an applicable detail (see further).

#### **4.3.5 Corners**

All corners should be finished using the UltraPly TPO Pre-molded Corners (inside or outside) or field fabricated corners from UltraPly TPO Unsupported Flashing.

The corners are heat welded into place according the Firestone Technical Guidelines.

#### **4.3.6 Wall Termination**

##### **4.3.6.1 Termination Bar Detail**

The TPO membrane will be secured with a Firestone Termination Bar, used in conjunction with Firestone water repellent sealant Water Block between the membrane and the substrate under compression behind the termination bar. The termination bar must be installed directly into the wall surface and mechanically fixed at maximum 200 mm centers using appropriate fasteners. A bead of Firestone General Purpose Sealant is applied along the top edge of the termination bar.

##### **4.3.6.2 Counterflashing Detail**

The TPO membrane will be mechanically fastened with a metal batten strip. A bead of Firestone General Purpose Sealant is applied along the top edge of the TPO membrane. A separate metal counterflashing is secured to the vertical face above the membrane termination. The counterflashing will cover the top of the fastening system by a minimum of 100 mm.

#### **4.3.7 Roof Edge Termination**

##### **4.3.7.1 Metal Coping Terminations**

The membrane shall be returned over the upstand and secured to the horizontal surface of the parapet. If necessary, a suitable timber plate will be installed, mechanically fixed to the top of the parapet to provide an even substrate. The metal coping will be installed, ensuring full protection of the top of the upstand detail.

##### **4.3.7.2 Concrete Coping Terminations**

The membrane will be stopped at sufficient distance of the wall edge so as to allow a good adhesion of the mortar to the wall without compromising the watertightness of the detail. The coping stone will be installed, ensuring full protection of the top of the upstand detail.

##### **4.3.7.3 Metal Roof Edge**

Allow the TPO membrane to pass over the edge sufficiently. If necessary, install a wood nailer at the roof edge to provide a suitable edge detail. Install the appropriate metal edge profile fastened to roof edge at maximum 100 mm on centre, using appropriate fasteners. The horizontal flange of the metal profile and the TPO membrane shall be prepared with Single-Ply Prime and flashed using Firestone self-adhesive UltraPly TPO QuickSeam Flashing. Ensure an adequate overlap of 75 mm beyond the inner edge of the profile.

##### **4.3.7.4 Metal Roof Edge from UltraPly TPO Coated Metal**

Allow the TPO membrane to pass over the edge sufficiently. If necessary, install a wood nailer at the roof edge to provide a suitable edge detail. Install the metal edge profile, fabricated from TPO Coated Metal, fastened to roof edge at maximum 100 mm on centre, using appropriate fasteners. Weld the TPO membrane onto the TPO Coated Metal.

#### **4.3.8 Pipe Penetrations**

##### **4.3.8.1 General**

All pipes must be anchored to the deck. Metal edges used at pipe penetrations must have rounded corners.

All TPO components should be protected from direct contact with steam or heat sources when the in-service temperature of the penetration is in excess of 60 °C. In such cases the flashing can be installed directly to an intermediate insulated cool sleeve.

All penetrations must allow flashing terminations of a minimum height determined by local regulations.

#### **4.3.8.2 Pre-molded Pipe Flashing**

Pipe penetrations accessible from the top side and with a maximum diameter of 203 mm, can be flashed in using Firestone UltraPly TPO Pipe Flashing. Heat weld the boot to the surrounding TPO membrane around the base of the penetration and secure on top using a stainless steel clamping ring. Finish by applying a bead of General Purpose Sealant around the entire circumference of the Pipe.

#### **4.3.8.3 Field Fabricated Pipe Flashing**

Field fabricated flashing of pipes is to be executed using UltraPly TPO Unsupported Flashing, in accordance with the Firestone Technical Guidelines. This method is to be used where the top of the pipe is not accessible and/or the pipes are larger than 203 mm in diameter. The UltraPly TPO Unsupported Flashing is secured on top using a stainless steel clamping ring. Finish by applying a bead of General Purpose Sealant around the entire circumference of the Pipe.

#### **4.3.8.4 Pipe Clusters and Unusual Shaped Penetrations**

Install pre-fabricated penetration pockets around the penetrations. Up to a pipe diameter or cluster of 90 mm a pre-molded UltraPly TPO Penetration Pocket can be used, for larger openings a pocket can be made out of TPO Coated Metal. Fill the penetration pockets with Firestone Pourable Sealant, so as to shed water. The Pourable Sealant shall be a minimum of 50 mm deep, use filler as required. All installed in accordance with the Firestone Technical Guidelines.

#### **4.3.9 Water Drains**

Number and dimensions of the outlets are in accordance with national regulations.

##### **4.3.9.1 Rainwater Outlets incorporating a Clamping Ring**

Install roof outlets, providing a clean even finish on the mating surfaces between the clamping ring and the drain bowl. Position the TPO membrane, and then cut a hole for the outlet to allow 10 to 20 mm of membrane to extend inside the clamping ring past the drain bolts. Install Firestone water repellent sealant Water Block beneath the membrane, where the clamping ring seats. Install the outlet clamping ring and clamping bolts. Tighten the clamping bolts to achieve constant compression and install gravel/leaves guard.

#### **4.3.9.2 Rainwater Outlet/Scupper incorporating an Insert Piece**

The TPO membrane sheet must be in place prior to installation of the insert piece. Cut a hole to the size of the insert piece, over the centre of the outlet.

Install a pre-fabricated or pre-molded compatible TPO drain insert piece and weld it to the field TPO membrane. The drain insert flanges, or the TPO membrane around it, shall be fastened using Firestone HD Seam Plates and Fasteners or an appropriate fastening system.

Heat weld a piece of UltraPly TPO membrane or UltraPly TPO Unsupported Flashing to the flange and onto the field membrane, covering the fasteners.

#### **4.3.10 Roof expansion joints**

The membrane is mechanically attached at both sides of the expansion joint using Firestone HD Seam Plates and Fasteners or an appropriate fastening system, maximum 300 mm on centre. A compressible tube is added to allow for excess membrane. The expansion joint is then covered with a reinforced UltraPly TPO cover piece onto the TPO membrane. Ensure there is enough excess membrane to accommodate building movement.

#### **4.3.11 Walkway Pads**

Walkways shall be installed in specific areas such as access points to the roof (doorways, ladders, ...) and on roof parts subjected to traffic more frequent than once per month.

##### **4.3.11.1 UltraPly TPO Walkway Pads**

Prior to heat weld the UltraPly TPO Walkway Pad (white) to the TPO membrane with textured side up. The TPO membrane needs to be clean and free of dirt, dust and debris. Install the Firestone UltraPly TPO Walkway Pads as per Firestone specifications.

In a Ballasted Roofing System the UltraPly TPO Walkway Pad will be substituted by concrete pavers.

##### **4.3.11.2 UltraPly TPO X-Tred Walkway Pads (for Fully Adhered Systems only)**

X-Tred Walkway can be installed loose laid on top of the existing roof assembly. For wind speeds higher than 85 km/h the Walkway pads must be secured to the roof membrane system as per Firestone specifications.

##### **4.3.11.3 Concrete pavers**

Place a layer of protection mat or an additional layer of TPO membrane underneath the pavers (min. 50 mm beyond the paver) to isolate them from the roofing membrane.

## 5 Green Roof Vegetation

In order to avoid mechanical damage during the installation of the green roof and/or during maintenance a protection layer must be installed on top of the TPO membranes.

For the build-up of the green roof layers on top of the TPO membrane we refer to the green roof designers and/or specialists. A list of plants that must be avoided (plants that generate rhizomes) can be found on, but not limited to, [www.fbb.de](http://www.fbb.de).

## 6 Notes

The Firestone Building Products specifications will be strictly followed for all products supplied by the company. Prior to installation, Firestone Building Products must approve any deviation from the specifications. The works shall only be installed by an authorized contractor. A Firestone approved Contractor Certificate with validity date shall be provided before start of the works.

Installations must comply with all current relevant standards, codes of practice, and the Building Regulations.

A Firestone standard 10 years warranty shall be issued to the building owner on completion.

All materials shall be stored clear of ground and moisture with weather protective covering. Keep all adhesives, sealants and primers away from sources of ignition.

Do not apply roofing membrane during inclement weather or when ambient conditions will not allow proper application.

At the end of the working day: Temporarily seal the membrane to the deck to prevent any water infiltration. Temporary closures that ensure that moisture does not damage any completed section of the new roofing system are the responsibility of the roofing contractor. Completion of flashings, terminations and temporary closures shall be completed as required to provide a watertight condition. Ensure protection of warm deck insulation by temporary seal. Ensure that the sequence of laying enables temporary sealing of loose membrane edges to be down the slope and not against the flow of water. On resumption of work cut away the tail of the membrane from completed area and remove from roof.

Adequate temporary protection must be provided over the installed membrane during the works program, particularly at temporary walkways, access points to the roof, roofing material stockpiles etc. in order to prevent damage.

Safety scaffolding, rubbish skips, access ladders etc. should be agreed with the client and in accordance with the current Health and Safety regulations.

To avoid discussions because of any mechanical damage inflicted after the TPO was installed, we strongly recommend testing the water tightness of the TPO Roofing system

immediately after installation and before the installation of the green roof.

The main contractor shall ensure that all areas of the finished roofing system shall be protected from roofing related work traffic and other trades until completion of all works.