### 3.1 Membrane Installation

#### 3.1.1 Membrane Installation - General

Firestone recommends for each system the following panel widths.

<table>
<thead>
<tr>
<th>System</th>
<th>Panel width (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ballasted-Inverted</td>
<td>up to 3.05</td>
</tr>
<tr>
<td>M.A.S.</td>
<td>up to 2.00</td>
</tr>
<tr>
<td>Fully adhered</td>
<td>up to 3.05</td>
</tr>
</tbody>
</table>

Prior to the installation of the roofing membrane, the contractor must check if the roof substrate complies with Firestone’s design instructions. Any defects in the substrate need to be corrected and the final surface has to be prepared to meet the requirements previously outlined. It is important that the substrate is free of any sharp objects and/or products that may damage the membrane. Wipe the substrate or install a geotextile when required.

Place the TPO roll as close as possible to its final position. Inspect the wrapper and TPO roll for damage before and during the installation. Unroll the TPO membrane and prior to any attachment, cutting or welding, allow each panel to relax a minimum of 30 minutes. Cut a cross-shaped opening above every drain to evacuate excess ponding water, in case of sudden rainfall.

The TPO panels shall be installed in a fashion so that field and flashing splices are installed to shed water. Straight cuts are very important for a neat and easy application.

Allow ample material for splicing determined by the type of seam and tie-ins.

Temporary ballasting during installation may be required to keep the membrane in place until it is secured to the substrate. Suggested temporary ballasting includes sand bags and other non-abrasive materials such as rubber tires, etc. Never leave the project without temporary ballasting loose laid sheets.
3.1.2 Membrane Installation - Mechanically Attached (M.A.S.)

- **Applicability**
  This technique is applicable for the mechanically attached system M.A.S..

- **Installation Instructions**
  Consult the wind design calculation for information about the density and position of the plates and fasteners and the size of local wind zones (zones of high wind pressure, such as perimeter, ridge, base of roof step, base of penthouse, etc.).

Select the size of the panels in function of the wind uplift requirements. Consult the table below to identify the most appropriate panel width.

<table>
<thead>
<tr>
<th>Spacing between fastener rows (m)</th>
<th>Panel width (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.35</td>
<td>1.50</td>
</tr>
<tr>
<td>1.85</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Position adjoining sheets with a side overlap of 150 mm in case of a mechanical anchoring in the seam and a minimum of 75 mm for seams with no mechanical anchoring. Allow the membranes to relax a minimum of 30 minutes.

Orient TPO panels so that any exposed (cut) edges of a panel are used as the bottom panel in splices whenever possible. If cut edges are exposed, they must be sealed with Firestone Cut Edge Sealant or TPO General Purpose Sealant.

The inside edge of the membranes are mechanically attached to the substrate with approved plates and fasteners. The plates need to be positioned at least 20 mm in from the edge of the membrane.

In the central zone of the roof, the membrane shall be mechanically attached with approved plates and fasteners in the side laps of the membrane. On metal decks it is important that the membranes run as much as possible perpendicular to the direction of the flutes of the deck, to avoid overloading of the structure.

At perimeters and in zones of higher wind pressure, the TPO membrane may be either fully adhered to the substrate following the technique described hereafter or mechanically attached in the overlap. When wind calculations require an even smaller spacing between fastener rows than mentioned in the table above, a 2.00 m wide membrane may be cut in half on site to produce a panel width of 1.00 m providing spacing between fastener rows of 0.85 m.

A row of fasteners and plates shall be installed along the inside edge of the perimeter sheets, to separate the perimeter zones from the central zone of the roof. In the case of a fully adhered perimeter zone, care must be taken not to apply Bonding Adhesive onto the inside portion of the perimeter sheets located beyond the fastening plates.

When working onto a continuous support (concrete, wood, …), an alternative layout for TPO sheets may be used for practical reasons. In this layout, perimeter zone panels are laid parallel to the parapet. Field zone panels can be laid in the most practical direction.

The fasteners must be properly engaged in the deck. Use caution not to overdrive fasteners, as this will reduce the pull-out value of the fastener. An electric screw gun with an automatic clutch control or an automatic installation tool may be used. Once the tools have been set, all fastener installation will be consistent.

The end and side laps of adjoining sheets shall be spliced as outlined in the following section.
3.1.3 Membrane Installation with Bonding Adhesive

- **Applicability**
  This technique is applicable for fully adhered systems and as an alternative to mechanical attachment in the perimeter zones of the mechanically attached system.

- **Installation Instructions**
  Position adjoining sheets with a minimum overlap of 75 mm and allow to relax a minimum of 30 minutes.

  Orient TPO panels so that any exposed (cut) edges of a panel are used as the bottom panel in splices whenever possible. If cut edges are exposed, they must be sealed with Firestone Cut Edge Sealant or TPO General Purpose Sealant.

  Fold the first membrane back, evenly onto itself so as to expose the underside and the substrate. The sheet fold should lay smooth so as to minimize the formation of wrinkles during and after installation.

  Before bonding, remove excess dust or other contaminants. Wipe the substrate and the mating surface of the sheet with a stiff broom.

  The TPO-sheets are to be fully adhered with TPO Bonding Adhesive. Stir the Bonding Adhesive before and during application to achieve a uniform mix with no sediment on the bottom. Properly mixed adhesive is critical for desired performance and uniformity of the bond.

  The Bonding Adhesive must be roller applied in a thin even coat on both mating surfaces. Firestone recommends a two-man operation to facilitate equal drying times. Apply Bonding Adhesive to lighter coloured surface and/or shady surfaces first to aid in drying. Avoid globs or puddles of adhesive during application. An excess of adhesive will prolong the drying time and reduce production. Use large solvent resistant rollers with short hairs to apply the adhesive evenly. Care must be taken not to apply Bonding Adhesive over an area that is to be welded to another sheet. Use a chalkline to mark the splicing area that has to remain clean.

  Let the solvents evaporate naturally until the adhesive is tacky. Drying time will differ with various climatic conditions and coverage rate. Never use a hot air dryer to accelerate this process. Solvent-based adhesives tend to surface-flash during cold weather, forming an outer skin on the surface before the entire adhesive has had sufficient time to flash off.

  Touch the surface with a clean, dry finger to check the adhesive for dryness. As you are touching the adhesive, push straight down to check the mass of adhesive under its surface for stringing. Push forward on the adhesive at an angle to ensure that it is dry throughout its thickness. If either motion exposes wet or stringy adhesive when the finger is lifted then it is not ready for mating. Allow extra time for the adhesive film to properly flash off before retesting. Adhering two surfaces that have not completely flashed off will result in blisters and bubbles in the membrane, caused by the trapped solvents.

  As the first sheet is flashing off, lay out the adjoining sheets and allow them to relax.

  Bond the membrane, starting at the fold. Roll the previously coated portion of the sheet into the coated substrate, slowly and evenly to minimize wrinkles.

  Compress the bonded half to the substrate with a stiff brush to ensure proper contact. Extra compression will strengthen the bond. Repeat the bonding procedure to complete the bonding of the sheet.

  Take special precautions when the outside temperature is below 10°C, when the dew point is near the ambient outside temperature. Certain combinations of temperature and humidity may cause condensation on the surface of the Bonding Adhesive. This is referred to as “blushing”. If this condition occurs, do not mate the surfaces. Wait until the ambient air conditions no longer cause condensation, dry the surface with clean, dry rags, apply a thin additional layer of adhesive and proceed.
3.1.4 Membrane Installation with Ballast

- **Applicability**
  This technique is applicable for ballasted and inverted systems.

- **Installation Instructions**
  Position adjoining sheets with a minimum overlap of 75 mm and allow to relax a minimum of 30 minutes. Orient TPO panels so that any exposed (cut) edges of a panel are used as the bottom panel in splices whenever possible. If cut edges are exposed, they must be sealed with Firestone Cut Edge Sealant or TPO General Purpose Sealant.

Cover loosely laid roofing sections as soon as possible with:
- **Gravel**, in the form of round, smooth, river washed aggregate without broken pieces of adequate size (nominal 16-32 mm). Make sure that the roofing membrane is completely covered. A ballast of minimum 50 kg/m² is required. However this may not always provide complete membrane coverage or meet local requirements.
- **Graduated, crushed gravel**. This type of ballast contains broken pieces and may damage the TPO membrane during installation. Firestone therefore recommends installing a geotextile (min. 200 gr/m²) between ballast and membrane.
- **Concrete pavers**, with smooth trowel finish. Install a geotextile directly beneath the concrete pavers.
- **Other types of ballast** may be used (earth, poured concrete, etc.) for other types of applications (parking decks, green roofs, etc.) but require a specific study. Consult local standards for type, adequate size, and minimum weight of ballast and consult Firestone’s Technical Department for appropriate detailing.
- **In case of re-roofing**, existing gravel may be re-used on the new roofing system provided it is of adequate size and weight. It is recommended to install a geotextile (min. 200 gr/m²) between the TPO membrane and the recovered gravel.

Do not stock pile ballast on the roof deck. Spread the ballast over the TPO membrane as specified, using soft tools (rubber-tyre buggies, squeegees, etc.), avoid direct contact with the membrane when projected. Spread the ballast around details by hand/foot so as not to damage the freshly installed detail. Any ballast that is displaced by a walkway pad, should be distributed around the pad so as to maintain the specified average coverage rate.

On roofs with a flat edge, the installation of TPO walkway pads within 3 m of the roof edge is not allowed. Use concrete pavers.

For Inverted Systems, install the extruded polystyrene insulation directly over the TPO membrane. The insulation boards shall be installed within 6 mm of all projections. Do not bond the insulation boards to the membrane or to each other. Unroll a protection mat over the insulation overlapping at side laps a minimum of 100 mm and at end laps a minimum of 150 mm. The mat shall extend up at all vertical penetrations 10 mm above the ballast.