Bridges and viaducts
Waterproofing solutions for large scale infrastructure

POLYGlass®

Adds value!
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Waterproofing of bridges and viaducts, and large infrastructure elements in general, is crucial to their operational performance, safety and long service life.

All man-made structures, especially bridge and viaduct decks, are under constant physical and chemical attack from rainwater, freeze-thaw cycles and traffic, which results in wear induced by loads, vibrations and mechanical strain. These negative effects are further compounded by road salting during the winter months. Systems designed to protect structures of this kind are therefore receiving more attention, particularly waterproofing membranes. Indeed, harmonised standards have even been issued at a European level specifically concerning bridge and viaduct waterproofing: notably, reference standard EN 14695, as described below.

In detail, waterproofing is installed between the substrate and the road surfacing produced with a hot mix asphalt (binder course), which is applied at a high temperature directly on top of the actual waterproofing membrane.

Polyglass SpA has a series of systems and materials designed specifically for this particular field of application, meeting both regulatory requirements and the needs of our leading customers. Our solutions are suitable both for waterproofing new structures and for refurbishment and remedial work on existing ones.
The best defence against chemical and physical attacks
Polyglass offices and factories in the world
Since 2008 Polyglass becomes part of the Mapei Group

Polyglass products range

- Waterproofing SBS membranes
- Waterproofing self-adhesive membranes
- Insulating systems
- A complete range of solutions
- Liquid and paste waterproofing materials and accessories
- Systems for thermal-acoustic insulation
- Ultralight waterproofing membranes
- Waterproofing synthetics membranes

75 years of presence in the construction world
2.1 billion euros turnover 2012
55,000 thousand customers in the world
5 continents in which the group is present
7,500 group employees

Mapei group establishment
93

1957
1968
1980
1990
2008
2009

First factory in USA
Establishment Zanchetta
Establishment Polyglass
Adeso line launch
Redoxene and Mapeplan launch

Since 2008 Polyglass becomes part of the Mapei Group

WATERPROOFING
SBS MEMBRANES

WATERPROOFING
APP MEMBRANES

SELF-ADHESIVE
WATERPROOFING
MEMBRANES

ULTRALIGHT
WATERPROOFING
MEMBRANES

WATERPROOFING
SYNTHETICS
MEMBRANES

A COMPLETE
RANGE OF
SOLUTIONS
SPECIFIC CHARACTERISTICS FOR A CERTIFIED QUALITY

The waterproofing of reinforced concrete slabs for road decks (bridges or viaducts) was already being done with bituminous products in the late 70s, building up the various layers directly on site. For over twenty years now, the waterproofing practice of installing modified bitumen and polyester nonwoven reinforcement on site has been replaced or supplemented with the installation of prefabricated polymer distilled bitumen membranes.

Standard EN 14695-2010 issued by the European Committee for Standardisation has been in force since January 2010, certifying membranes that can be applied as a waterproofing layer and overlaid directly with the binder course.

The standard specifies the characteristics and performance of reinforced bituminous membranes for waterproofing bridge and viaduct decks and all other concrete surfaces trafficked by vehicles where the waterproofing system is bonded to the concrete deck and overlaid with a binder course or asphalt.

In addition to the usual tests to determine thickness, cold flexibility, ultimate tensile strength, etc., the specific new EN 14695-2010 standard also entails testing specifically designed for this particular type of application.

Membranes are also tested following application to verify:
- adhesion to the concrete substrate and to the binder course (pull-off test);
- resistance to heat and dimensional stability of the carrier; and bond strength of the bituminous compound.

**GOOD MECHANICAL STRENGTH PROPERTIES**

- to adapt and move with the decks as they move and flex.

**EXCELLENT MECHANICAL STRENGTH**

- to withstand high mechanical stress without breaking or cracking, both during installation (laying of road surfacing) and when in service (vehicle traffic).

**COMPLIANCE AND CERTIFICATION**

- to standard EN 14695-2010.
Given the critical nature and special requirements of the work, the membranes used on structures of this kind must have certain characteristics and higher performance than traditional products in terms of specific strength and resistance properties and, above all, must meet the following basic requirements:

- **SUPERIOR ADHESION BOTH** to the substrate underneath (road deck) and to the road surfacing on top (binder course), to avoid the risk of the surfacing slipping/sliding once in service.

- **RESISTANCE TO HIGH THERMAL STRESS (HIGH TEMPERATURES)** so that the binder course can be applied at a high temperature directly on top of the membrane without the risk of it being damaged, shrinking or punctured (reference standards UNI EN 11071 and UNI EN 14695 Annex B).

- **COMPLIANCE AND CERTIFICATION** to standard EN 14695-2010.

- **RESISTANCE TO WATER and percolating solutions (road salt)**, where applicable, and to freeze-thaw cycles.

- **HIGH MECHANICAL STRENGTH AND PUNCTURE RESISTANCE** to allow for paving equipment used in the laying and compacting of the road surfacing to be driven over and parked on the membranes.

- **BRIDGES WATERPROOFING MEMBRANES REQUIREMENTS**
Polyglass Systems and Materials

Drawing on forty years of experience gained in developing and manufacturing waterproofing products, we provide engineers in the industry with an extensive range of membranes, comprising both traditional products and membranes produced with the innovative Reoxthene Technology, which is suitable for solving the issues associated with waterproofing the surfaces in question. All these types of membranes share a spunbond polyester nonwoven carrier featuring a high mass per unit area and superior technical performance.

Membranes traditional line

**POLYBOND HP**
Plastomeric Polymer Distilled Bitumen Membrane with cold flexibility down to -15 °C with surface finish (top side of membrane) in sand or polyester nonwoven film.

**POLYFLEX HP**
Plastomeric Polymer Distilled Bitumen Membrane with cold flexibility down to -20 °C with surface finish (top side of membrane) in sand or polyester nonwoven film.

**ELASTOFLEX HP**
Elastomeric Polymer Distilled Bitumen Membrane with cold flexibility down to -20 °C with surface finish (top side of membrane) in sand or polyester nonwoven film.

Membranes Reoxthene Technology line

**EVOLIGHT HP**
Ultra-light Plastomeric Polymer Distilled Bitumen Membrane with cold flexibility down to -10 °C with surface finish (top side of membrane) in sand or polyester nonwoven film. Product with no CaCO₃ calcium carbonate filler, with high-performance bituminous compound.

**POLYFLEX HP LIGHT**
Ultra-light Plastomeric Polymer Distilled Bitumen Membrane with cold flexibility down to -20 °C with surface finish (top side of membrane) in sand or polyester nonwoven film. Product with no CaCO₃ calcium carbonate filler, with high-performance bituminous compound.

For more information, refer to the product data sheets.
<table>
<thead>
<tr>
<th>TEST METHOD</th>
<th>TECHNICAL CHARACTERISTICS</th>
<th>UNIT OF MEASURE</th>
<th>NOMINAL VALUES</th>
<th>NOMINAL VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 1848-1</td>
<td>LENGTH</td>
<td>m</td>
<td>≥10</td>
<td>≥10</td>
</tr>
<tr>
<td>EN 1848-1</td>
<td>WIDTH</td>
<td>m</td>
<td>≥1</td>
<td>≥1</td>
</tr>
<tr>
<td>EN 1848-1</td>
<td>STRAIGHTNESS</td>
<td>mm/10 m</td>
<td>EXCEEDS</td>
<td>EXCEEDS</td>
</tr>
<tr>
<td>EN 1849-1</td>
<td>THICKNESS</td>
<td>mm</td>
<td>4-5 (±0,2)</td>
<td>4-5 (±0,2)</td>
</tr>
<tr>
<td>EN 1849-1</td>
<td>MASS PER UNIT AREA</td>
<td>kg/m²</td>
<td>NPD</td>
<td>NPD</td>
</tr>
<tr>
<td>EN 12039</td>
<td>INITIAL AMOUNT OF MINERAL</td>
<td>g/m²</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>EN 1028-B</td>
<td>WARTERTIGHTNESS</td>
<td>kPa</td>
<td>EXCEEDS</td>
<td>EXCEEDS</td>
</tr>
<tr>
<td>EN 1028-B</td>
<td>WARTERTIGHTNESS AGAINST</td>
<td>kPa</td>
<td>EXCEEDS</td>
<td>EXCEEDS</td>
</tr>
<tr>
<td>EN 13987</td>
<td>WARTERTIGHTNESS AFTER</td>
<td>%</td>
<td>NPD</td>
<td>NPD</td>
</tr>
<tr>
<td>EN 13501-5</td>
<td>EXTERNAL FIRE PERFORMANCE</td>
<td>–</td>
<td>FRclass</td>
<td>FRclass</td>
</tr>
<tr>
<td>EN 13501-1</td>
<td>REACTION TO FIRE</td>
<td>–</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>EN 12316</td>
<td>PEEL RESISTANCE</td>
<td>N/50 mm</td>
<td>NPD</td>
<td>NPD</td>
</tr>
<tr>
<td>EN 12317</td>
<td>SHEAR RESISTANCE</td>
<td>N/50 mm</td>
<td>800 (±20%)</td>
<td>800 (±20%)</td>
</tr>
<tr>
<td>EN 12311-1</td>
<td>TENSILE PROPERTIES</td>
<td>N/50 mm</td>
<td>1200 (±20%)</td>
<td>1200 (±20%)</td>
</tr>
<tr>
<td>EN 12310-1</td>
<td>RESISTANCE TO TEARING</td>
<td>N</td>
<td>200 (±30%)</td>
<td>200 (±30%)</td>
</tr>
<tr>
<td>EN 14223</td>
<td>WATER ABSORPTION</td>
<td>%</td>
<td>≤0,5</td>
<td>≤0,5</td>
</tr>
<tr>
<td>EN 12891-A</td>
<td>RESISTANCE TO IMPACT</td>
<td>mm</td>
<td>≥1750</td>
<td>≥1750</td>
</tr>
<tr>
<td>EN 12730-A</td>
<td>RESISTANCE TO STATIC LOAD</td>
<td>Kg</td>
<td>≥25</td>
<td>≥25</td>
</tr>
<tr>
<td>EN 1108</td>
<td>FORM STABILITY UNDER CYCLIC TEMPERATURE CHANGE</td>
<td>%</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>EN 1109</td>
<td>COLD FLEXIBILITY</td>
<td>°C</td>
<td>≤-15</td>
<td>≤-20</td>
</tr>
<tr>
<td>EN 1110</td>
<td>FLOW RESISTANCE AT ELEVATED TEMPERATURE</td>
<td>°C</td>
<td>≥120</td>
<td>≥140</td>
</tr>
<tr>
<td>EN 1107-1</td>
<td>DIMENSIONAL STABILITY</td>
<td>%</td>
<td>≤0,5</td>
<td>≤0,5</td>
</tr>
<tr>
<td>EN 14695</td>
<td>ARTIFICIAL AGING BEHAVIOUR</td>
<td>°C</td>
<td>≤0</td>
<td>≤10</td>
</tr>
<tr>
<td>EN 1110</td>
<td>ARTIFICIAL AGING BEHAVIOUR (FLOW RESISTANCE)</td>
<td>°C</td>
<td>120 (±10)</td>
<td>140 (±10)</td>
</tr>
<tr>
<td>EN 13596</td>
<td>BOND STRENGTH</td>
<td>N/mm²</td>
<td>≥0,8</td>
<td>≥0,8</td>
</tr>
<tr>
<td>EN 13653</td>
<td>SHEAR STRENGTH</td>
<td>N/mm²</td>
<td>≥0,3</td>
<td>≥0,2</td>
</tr>
<tr>
<td>EN 14224</td>
<td>CRACK BRIDGING ABILITY</td>
<td>°C</td>
<td>NPD</td>
<td>≤-15</td>
</tr>
<tr>
<td>EN 14691</td>
<td>COMPATIBILITY BY HEAT CONDITIONING</td>
<td>%</td>
<td>≥100</td>
<td>≥100</td>
</tr>
<tr>
<td>EN 14692</td>
<td>RESISTANCE TO COMPACTION</td>
<td>–</td>
<td>WATERPROOF</td>
<td>WATERPROOF</td>
</tr>
<tr>
<td>EN 14693</td>
<td>BEHAVIOUR OF BITUMEN SHEETS DURING APPLICATION OF MASTIC ASPHALT</td>
<td>%</td>
<td>NPD</td>
<td>≤5</td>
</tr>
<tr>
<td>EN 14694</td>
<td>WARTERTIGHTNESS (500 kPa - 1000 CYCLES)</td>
<td>–</td>
<td>EXCEEDS</td>
<td>EXCEEDS</td>
</tr>
<tr>
<td>EN 1850-1</td>
<td>VISIBLE DEFECTS</td>
<td>–</td>
<td>ABSENT</td>
<td>ABSENT</td>
</tr>
<tr>
<td>EN 1397</td>
<td>ARTIFICIAL AGING BEHAVIOUR (VISIBLE DEFECTS)</td>
<td>–</td>
<td>EXCEEDS</td>
<td>EXCEEDS</td>
</tr>
<tr>
<td>EN 12039</td>
<td>ADESION OF GRAUNLES</td>
<td>%</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>EN 1931</td>
<td>WATERVAPOR PROPERTIES</td>
<td>μ</td>
<td>20000</td>
<td>20000</td>
</tr>
</tbody>
</table>

**POLYBOND HP**

**POLYFLEX HP**

**ELASTOFLEX HP**

**EVO LIGHT**

**EVO LIGHT HP**

**POLYFLEX HP LIGHT**
Integral and complementary components of waterproofing systems for bridges and viaducts are the adhesion promoters (primers), which have the function to block the dust and saturate the porosity of the concrete surfaces to increase the adhesive strength of bituminous membranes with the substrates. Polyglass offers a full range of primers to meet the different technical needs.

**Adhesion-promoting primers**

**BITUMINOUS PRIMER: POLYPRIMER HP 45 PROFESSIONAL**
POLYPRIMER HP 45 Professional is a high-performance bituminous primer made with blown bitumen and selected fast-drying solvents. It is used as a primer to promote adhesion on concrete surfaces and stop dusting, allowing the quick application of the polymer bitumen membranes.

<table>
<thead>
<tr>
<th>TECHNICAL CHARACTERISTICS</th>
<th>VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DENSITY AT 20 °C</td>
<td>0,89-0,91 kg/l</td>
</tr>
<tr>
<td>SOLIDS CONTENT AT 130 °C</td>
<td>49-51%</td>
</tr>
<tr>
<td>DRYING TIME 20 °C</td>
<td>1-2 HOURS</td>
</tr>
<tr>
<td>SPREADING RATE</td>
<td>200-350 g/m²</td>
</tr>
</tbody>
</table>

**BITUMINOUS PRIMER: IDROPRIMER**
IDROPRIMER is a water-based bituminous primer made with selected bitumen, with the added advantage of being inflammable and odourless; for this reason it can be applied in residential areas. It is used as a primer to promote adhesion and block dust before applying the polymer bitumen membranes.

<table>
<thead>
<tr>
<th>TECHNICAL CHARACTERISTICS</th>
<th>VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DENSITY AT 20 °C</td>
<td>0,95-1,05 kg/l</td>
</tr>
<tr>
<td>SOLIDS CONTENT AT 130 °C</td>
<td>32-37%</td>
</tr>
<tr>
<td>DRYING TIME 20 °C</td>
<td>4-6 HOURS</td>
</tr>
<tr>
<td>SPREADING RATE</td>
<td>200-300 g/m²</td>
</tr>
</tbody>
</table>
PRIMER: EPOXY PRIMER

EPOXY PRIMER is a two-component epoxy primer (A+B) for priming substrates and levelling compounds before applying bridge waterproofing systems using polymer bitumen membranes. It has low viscosity even at low temperatures and exhibits excellent penetration into the substrate. The material, once suitably prepared, shall be applied to the substrate by roller, brush or rubber trowel. A light sprinkling of quartz sand (such as Quarzo 1,2 from Mapei S.p.A.) is required over the primer while still wet.

<table>
<thead>
<tr>
<th>TECHNICAL CHARACTERISTICS</th>
<th>VALUES COMPONENT A</th>
<th>VALUES COMPONENT B</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPEARANCE</td>
<td>FLUID</td>
<td>FLUID</td>
</tr>
<tr>
<td>COLOUR</td>
<td>TRANSPARENT YELLOW</td>
<td>TRANSPARENT YELLOW</td>
</tr>
<tr>
<td>DENSITY (g/cm³)</td>
<td>1,1</td>
<td>0,95</td>
</tr>
<tr>
<td>VISCOSITY BROOKFIELD (mPas)</td>
<td>1350</td>
<td>50</td>
</tr>
<tr>
<td>SHELF LIFE IN A COOL, DRY AREA ITS ORIGINAL, UNOPENED PACKAGING</td>
<td>24 MONTHS</td>
<td>24 MONTHS</td>
</tr>
<tr>
<td>HAZARD CLASSIFICATION ACCORDING TO EC 1999/45</td>
<td>IRRITANT, DANGEROUS TO THE ENVIRONMENT</td>
<td>CORROSIVE</td>
</tr>
</tbody>
</table>

For more information, refer to the product data sheets.
STANDARDS AND CERTIFICATIONS

Standard EN 14695:2010 entitled “Flexible sheets for waterproofing - Reinforced bitumen sheets for waterproofing of concrete bridge decks and other trafficked areas of concrete - Definitions and characteristics” specifies the characteristics and performance of reinforced bitumen membranes for waterproofing of bridge decks and other trafficked areas of concrete where the waterproofing system is bonded to the concrete deck and overlaid by asphalt. The standard also specifies the test methods used for verifying the characteristics and performance.

Only membranes intended for use in waterproofing bridges, viaducts and other trafficked areas, overlaid with hot mix asphalt, fall within the scope of the above-mentioned standard.
By way of explanation, a by no means exhaustive list is given below of specific tests for membranes designed for this purpose.

- **Dimensional stability at 160 °C** simulates the carrier’s behaviour during the laying of the asphalt.

- **Shear strength** measures the ability to withstand shear stress that occurs between the concrete substrate, the membrane and the asphalt as a result of traffic-induced stress.

- **Resistance to compaction of a layer of asphalt** simulates the possible damage a waterproofing membrane could incur while the hot mix is being laid.

- **The membrane’s watertightness** is instead determined with a pressure (500 kPa) delivered in pulses for 1000 cycles; this test is much tougher than the usual tests for membranes intended for other purposes.

- **Bond strength** measures the strength of the membrane’s adhesion to the concrete substrate.
**SINGLE-LAYER BUILD-UP**

1. Substrate - Reinforced concrete slab  
2. POLYPRIMER HP 45 Professional or IDROPIMER bituminous primers or EPOXY PRIMER  
3. POLYGLASS bridge waterproofing membrane (type: POLYBOND HP, POLYFLEX HP, ELASTOFLEX HP, EVOLIGHT HP or POLYFLEX HP LIGHT - recommended thickness: 5 mm)  
4. Reinforced strip with POLYGLASS waterproofing membrane  
5. Vertical turn-up with POLYGLASS bridge waterproofing membrane  
6. Road surfacing - Binder course and wearing course per design  
7. Guardrail

**DUAL-LAYER BUILD-UP**

1. Substrate - Reinforced concrete slab  
2. POLYPRIMER HP 45 Professional or IDROPIMER bituminous primers or EPOXY PRIMER  
3. POLYGLASS bridge waterproofing membrane, first layer (type: POLYBOND HP, POLYFLEX HP, ELASTOFLEX HP, EVOLIGHT HP or POLYFLEX HP LIGHT - recommended thickness: 4 mm)  
4. POLYGLASS bridge waterproofing membrane, second layer (type: POLYBOND HP, POLYFLEX HP, ELASTOFLEX HP, EVOLIGHT HP or POLYFLEX HP LIGHT - recommended thickness: 4 mm)  
5. Road surfacing - Binder course and wearing course per design  
6. Guardrail
EXPANSION JOINT DETAIL

1. Substrate - Reinforced concrete slab
2. POLYPRIMER HP 45 Professional or IDROPRIMER bituminous primers or EPOXY PRIMER
3. POLYGLASS SBS reinforcing membrane
4. POLYGLASS bridge waterproofing membrane (type: POLYBOND HP, POLYFLEX HP, ELASTOFLEX HP, EVOLIGHT HP or POLYFLEX LIGHT HP)
5. Road surfacing - Binder course and wearing course per design
6. Mortar bedding
7. Expansion joint
8. Infill mortar acting as a buffer
9. Flashing
10. Drainage pipe
One particular field of application of the Polyglass waterproofing membranes covered herein is the waterproofing of parking decks, on which the bituminous surfacing (binder course) is laid directly on top of the waterproofing membranes.

In this specific case, we need to bear in mind that the build-ups may be more complicated. Indeed, parking decks can be complex in geometry and can include insulation and accommodate services of various kinds on their surface.

Whatever the case, the build-up must comprise a dual layer of polymer distilled bitumen membranes. Consequently, it is advisable to employ the services of a Polyglass engineer to determine what type of waterproofing system will best serve your individual needs, with an in-depth look at any and all details that the deck might feature.

A number of build-ups without insulation are given below by way of example, including details likely to be encountered as standard.

### BUILD-UP

1. Substrate - Reinforced concrete slab
2. POLYPRIMER HP 45 Professional or IDROPRIMER bituminous primers
3. POLYGLASS deck waterproofing membrane (first layer) - recommended thickness: 5 mm
4. POLYGLASS deck waterproofing membrane (second layer) - recommended thickness: 4 mm
5. Road surfacing - Binder course and wearing course per design.
1. Substrate - Reinforced concrete slab  
2. POLYPRIMER HP 45 Professional or IDROPRIMER bituminous primers  
3. POLYGLASS deck waterproofing membrane (first layer)  
4. POLYGLASS deck waterproofing membrane (second layer)  
5. Road surfacing - Binder course and wearing course per design  
6. Protective kerb  
7. Pavement  
8. Turn-up protected with mesh and plaster  
PARKING DECKS

DECK GRATE DETAIL

1. Substrate - Reinforced concrete slab
2. POLYPRIMER HP 45 Professional or IDROPIMER bituminous primers
3. POLYGLASS deck waterproofing membrane (first layer)
4. POLYGLASS deck waterproofing membrane (second layer)
5. Road surfacing - Binder course and wearing course per design
6. Lower flashing
7. Upper flashing in stainless steel or galvanized steel
8. Mechanical fixing
9. Metal grate suitable for vehicle/pedestrian traffic

* It is the job of the Designer to determine the correct size for the metal grate based on the intended use of the deck.
1. Substrate - Reinforced concrete slab -
2. POLYPRIMER HP 45 Professional or IDROPRIMER bituminous primers -
3. POLYGLASS reinforcing waterproofing membrane -
4. POLYGLASS deck waterproofing membrane (first layer) -
5. POLYGLASS deck waterproofing membrane (second layer) -
6. POLYGLASS protective waterproofing membrane -
7. Road surfacing - Binder course and wearing course per design -
8. Outlet -
9. Frame and grate suitable for vehicle traffic.
SUBSTRATE PREPARATION

Concrete substrates must be even, smooth, sound, clean and dry in order for the waterproofing system to be applied correctly. The deck must be given a suitable gradient to encourage rainwater to run off correctly, as specified by the designer. In some cases, specific preparation work may be required to bring substrates up to scratch.

APPLICATION OF ADHESION-PROMOTING PRIMERS

To stop dusting and boost the bitumen membranes’ bond strength, once substrates have been suitably prepared, they must be coated by roller, block brush or airless spray equipment with a bituminous or epoxy primer to promote adhesion. All surfaces to be treated must be clean, perfectly dry, free of loose parts and oily or greasy residues. The waterproofing membranes can only be laid once the primer has dried completely and, in any case, no earlier than 24 hours after priming.
INSTALLING WATERPROOFING MEMBRANES

Polymer bitumen membranes are applied using a heat-welding process whereby they are torched onto the substrate by heating the underside correctly with a specific propane torch. The membranes must be laid with a suitable overlap. Side laps must be at least 100 mm, while end laps must be at least 150 mm. The rolls must be laid in a staggered pattern so as to avoid four sheets overlapping at any one point (end laps).

STORAGE PROCEDURES

Keep the product in a dry place out of sunlight. Do not stack pallets on top of each other and, in any case, store the rolls upright. Contact with solvents or organic liquids can damage the product. Do not install with excessively high or low temperatures and, whatever the case, be careful not to puncture the product in any way (footwear with spikes or studs, leaving anything with a small surface area sitting on top, sharp objects).
**PULL-OUT TESTS**

To check the level of adhesion of the waterproof layer, pull-out tests can be performed directly on site using a suitable portable tensile tester.

**LAYING THE BITUMINOUS BINDER**

Once the waterproofing system has been installed, the binder course is hot applied, to the thickness specified by the designer, directly on top of the membrane. This course must be applied taking extra care not to damage the waterproofing system. Installation is completed with any detail work (vertical turn-ups; connection of membranes to drains and structural joints, if any), ensuring that the structure is fully waterproofed.
REFERENCES