HOW TO PROTECT EXPOSED WATERPROOF COVERING LAYERS FROM FIRE

In many cases of fire, the roofing constitutes the building’s weak point as it is put under stress by the load, the flames tend to rise upwards and the fire may be fuelled by the materials of the roof itself. In Italy, the technology and legal regulations regarding protection against fire coming from the interior of a building are highly developed. It must not be forgotten however, that many serious fires often start on the roof as a result of sparks carried by the wind from a fire in a nearby building, or even from the torch used to install roofing membranes. A heavy protection consisting of a layer of gravel or of a cement hood provides sufficient fire protection. This also applies to pitched roofs, when they are finished with a membrane with metallic self-protection. Not all structures however are suitable to support heavy protection and on flat roofs and ribbed metal sheets, coats with metallic foil cannot be applied and they are not recommended for use on insulating panels which have a high thermal resistance. To assess the behaviour of the membranes in a fire, INDEX is the only company in Italy that has equipped itself with the Nord Test appliance, approved by Swedish Institute SP, Sveriges Provnings-och Forskningsinstitut, which is valid for all Scandinavian countries, including Denmark, where fire prevention regulations are particularly strict because of the high number of wooden roofs in the country.

The same test with no. UNI ENV 1187/2 has also been chosen by the European Committee for Standardization “CEN”, which has been appointed by the EU to develop the fire resistance tests, and has been classified as B_{roof}(t2), in compliance with EN 13501-5 on any roof pitch, on both combustible and incombustible surfaces.

It has passed the fire-resistance tests pursuant to ENV 1187/2
Classified as compliant with EN13501-5: B_{roof}(t2).
Firestop membranes are fire resistant membranes with harmless inorganic anti-flame additives distributed right through the membrane. The Firestop membranes are the result of IN-DEX research activities and do not have the contraindications typical of membranes that are self-protected with metal foil. They can be applied without any protection on both flat and pitched roofs, even on insulating layers with high thermal resistance.

Firestop are polymer bitumen waterproofing membranes that have been tested pursuant to the Scandinavian standard concerning reactions to external fire: Nord Test Method-Resistance to fire spread according to SS 02 48 24 – NT FIRE 006 assimilated as European method UNI ENV 1187/2. Furthermore, it has been classified as $B_{w1}$ pursuant to standards UNI EN 13501-5 on both combustible underlying surface and on incombustible underlying surface.

The fire resistant properties are long-lasting and controlled constantly at the factory. The three versions of Firestop membranes differ in terms of the type of mix: Mineral Helastopol Firestop is with elastomeric polymer-bitumen base, Mineral Elastocene Firestop is with polyolefin elastomers and copolymers polymerised with metalocene catalyst, while Firestop Polyester is with elastoplastomeric polymer-bitumen base. The reinforcement of the Firestop membranes is rugged and flexible and consists of non-woven polyester fabric; the waterproof coating is resistant to sudden temperature changes and ageing. The upper face is self-protected with hot-bonded and pressed slate granules, which represents further protection against fire; over this, there is another side overlap strip without any slate but protected with a torch-bondable Flamina strip to seal the joint. This film is also applied on the lower face of the membrane to enable fast and safe laying.

The Firestop membranes protect the whole roofing against fire when used as the last layer on visible waterproof coverings, even under photovoltaic systems. They are ideal for covering roofs made of ribbed metal sheets and wood. Furthermore, their use is also recommended on systems where fire-sensitive insulating panels will be used and as an underlayment membrane on wooden structures. The Firestop membranes can be laid on both pitched and flat roofs. It is the ideal solution under photovoltaic systems with FV panels having class 2 or equivalent fire reaction rating on roofs classified as $B_{w1}$, according to the Memorandum related to fireproofing requirements of photovoltaic systems installed on roofs of buildings in which activities subject to fire prevention control are carried out, issued by the Fire Brigade Department of the Home Office on 7th February 2012 and following clarification note dated 4th May 2012.

Another aspect referred to in the Guide of the Fire Brigade department concerns the risk of electric shock/electrocution to which Firefighters may be exposed while extinguishing a fire, for which it is important to point out that Firestop is not electrically conductive, unlike other types of coverings on which the photovoltaic panels are bonded, and is consequently an excellent isolator.

Standard UNI EN 13501-5:2009 concerns the resistance class against external fires of roof waterproofing membranes expressed with the indication “$B_{w1}$” and, according to the test method UNI ENV 1187:2007 used, the standard states 4 different but equivalent methods and the classification is expressed with the indication: $B_{w1}(t1), B_{w1}(t2), B_{w1}(t3), B_{w1}(t4)$

The 4 test methods stated by UNI ENV 1187:2007 are simply the transposition of the test methods already in force in:

- Germany, Spain and Benelux, DIN method, identified with the indication $B_{w1}(t1)$; the only one that does not include the action of the wind.
- Scandinavian countries, Nord test method, identified with the indication $B_{w1}(t2)$
- France, DM compliant method, identified with the indication $B_{w1}(t3)$
- Great Britain, BS 476 method, identified with the indication $B_{w1}(t4)$

The new memorandum dated 04/05/2012 eliminates the classification $B_{w1}(t1)$ without the wind action. The numbering after $B_{w1}(t1,2,3,4)$ does not indicate a higher or lower degree of resistance to fire, but merely identifies the test method used out of the 4 methods stated by the standard; therefore, the different methods are equivalent, but each has different rules with regard to the validity of the extension of the field of use. Each method does indeed also state the field of application for which the classification is valid. The $B_{w1}$ classification alone is not sufficient, because the field of application for which the class is valid has to be verified. The field of application is indicated on the classification certificate, together with the class, and it describes the type of substrate and pitch of the roof on which the material can be laid. Each method envisages tests that can be carried out on various substrates and in various conditions that define the field of application of the material subject of the test. Therefore, a membrane may be classified as $B_{w1}$ for a field of application limited to laying on incombustible substrates, while another material may be classified with the same $B_{w1}$ but can also be laid on combustible and incombustible substrates.

### Advantages

- The membrane is fire resistant and can be laid even on insulation products with high thermal resistance.
- It contains harmless anti-flame additives.
- It can be laid on any pitch and on both combustible and incombustible substrates.
tible substrates, hence the reason why it is important to examine the certificate to check not only the class but also the field of application for which it is valid.

The $B_{roof(t2)}$ classification is the only one that envisages more articulated extension rules on the field of application of the membrane tested on different laying surfaces; the other classifications $B_{roof(t1)}$, $B_{roof(t3)}$ and $B_{roof(t4)}$ do not envisage the possibility to extend the certificate to systems other than those tested, if not very limited cases (even just a difference in the thickness of the insulation layer may invalidate the certificate).

The FIRESTOP membranes are classified as $B_{roof(t2)}$, in compliance with UNI EN 13501-5:2009 and, having passed the UNI ENV 1187:2007 test on combustible foam polystyrene substrate, the classification allows a rather ample field of application of the membranes; they can indeed be applied on any roof pitch, on both combustible or incombustible substrates.

The $B_{roof(t2)}$ classification obtained on foam polystyrene makes them suitable for use on flat and pitched roofs alike and on combustible and incombustible substrates, provided the density is $\geq 16$ kg/m$^3$, so it is applicable: on any type of thermal insulation with density of $\geq 16$ kg/m$^3$; on wooden laying surfaces; on cement-based laying surfaces; on bituminous laying surfaces and so on.

The field of application of the FIRESTOP membranes remains that of standard waterproofing membranes and the same has been created to provide fire resistance $B_{roof}$ on waterproof coverings made up of polymer-bitumen membranes, therefore it must be laid on smooth surfaces and not directly on ribbed surfaces. It cannot be applied directly on sandwich panels whose upper face is made of ribbed metal or with reinforcement ribs, which would cause the membrane to break before time.

We also point out that a waterproof covering under a photovoltaic system must have a service life at least as long as the system itself; in the case of an old existent covering, it is recommendable always to lay a new double-layer covering according to the stratification method stated in our “Technical specifications no. 14/BIS –$B_{roof(t2)}$ classified roofs with photovoltaic systems”.

### APPLICATION FIELDS

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### CERTIFICATION

**“LAPI”** It has passed the fire-resistance tests pursuant to ENV 1187/2 and is classified compliant with EN 13501-5: $B_{roof(t2)}$. **“LAPI”** It has passed the reaction to fire test according to EN-ISO 11925-2 and it is classified according to EN13501-1: Euroclass E.
The MINERAL REFLEX WHITE treatment

The FIRESTOP membranes are produced with the topside self-protected with grey slate granules but can also be requested with special white mineral finish consisting of MINERAL WHITE REFLEX ultra-reflecting ceramic granules with high saturation and brightness. More than 90% of roofs are dark in colour and the roof surface reaches temperatures of around 80°C through solar radiation, which also negatively affects the photovoltaic panels installed on them, whose performance decreases as the temperature rises.

The technology to increase the roof’s reflection of the sun’s rays, called “Cool Roof”, is one of three strategies (cool roof, green roof and cool pavements) for reducing urban heat islands that were studied at length in the United States. Recent studies at the Lawrence Berkeley National Laboratory published in March 2014 showed, with a cost/benefit comparison, the superior effectiveness of the cool roof compared to the green roof in combating climate change. The cool roof is three times more reflective than the green roof and they estimated that if all the roofs in the world were white it could reduce the Earth’s temperature by at least 1°C.

The increase in solar reflectance of the roof surface using specific surface treatments of the waterproof covering allows you to reduce its temperature, and consequently prolong the life of the waterproof covering, improve the efficiency of the photovoltaic panels, save energy from air conditioning in summer in the rooms below, and at the same time increase the albedo, since the incident radiation fraction is reflected from the roof surface and produces the benefit of increased performance of the PV system also during dimmer daylight hours. The choice of white for the mineral self-protection of the FIRESTOP membranes, that we recommend should be of the self-protected type with MINERAL WHITE REFLEX ultra-reflecting ceramic granules, is the first applicable strategy to increase the reflection of solar radiation; the figure shows the temperatures recorded in Northern Italy in July 2007 under differently-protected bituminous surfaces.

The self-protection of the FIRESTOP membrane with MINERAL WHITE REFLEX ultra-reflecting ceramic granules with high saturation and brightness prevents further surface painting that also could affect its behaviour towards fire and also allows you to create a cool roof that fulfils the criteria of solar reflectance above 0.65 as required for “cool roof” flat roofs in Annex 1 of the Interministerial Legislative Decree of 26/06/2015 in force since 01/10/2015. The MINERAL WHITE REFLEX protection, with a Solar Reflectance Index SRI ≥ 80%, certified by the EELab of the University of Modena and Reggio Emilia, meets the CAM minimum environmental criteria for flat roofs in the Ministerial Decree of 24 December 2015 in force since 2 February 2016 in point 2.2.3 (SRI ≥ 78), those provided for by the ITACA Protocol standard UNI/PdR 13.1:2015 CRITERION C.6.8. (SRI ≥75) and those of the Protocol LEED GBC ITALY “To design, build and renovate institutional and commercial buildings” of 2009 updated on 9 February 2016 under the item SS CREDIT 7.2 - HEAT ISLAND EFFECT (SRI ≥78).

**The advantages of MINERAL REFLEX WHITE self-protection**

- It increases the efficiency of photovoltaic panels.
- You avoid painting operations and it is more durable.
- It extends the life of the waterproof covering.
- It improves comfort and you save on the costs of summer air conditioning.
- It reduces the temperature of urban heat islands and also power consumption and therefore emissions of CO₂.
HOW TO MAKE A "COOL ROOF" COVERING AND INCREASE THE PERFORMANCE OF PHOTOVOLTAIC SYSTEMS

REPLACING A ROOF SURFACE WITH MEMBRANE WITH MINERAL REFLEX WHITE SELF-PROTECTION

REFERENCES
EXAMPLES OF STRATIGRAPHY OF EXTERNAL FIRE RESISTANT ROOFING UNDER PHOTOVOLTAIC SYSTEMS

According to the Memorandum on the fireproof requirements of photovoltaic systems installed on the roofs of buildings in which activities subject to fire prevention control are carried out, issued by the Fire Brigade Department of the Home Office on the 7th February 2012 and following clarification note dated 4th May 2012:

In case 3/a of annex B - Specific assessment of the risk of spreading of the fire bearing in mind the resistance class to external fires of the roofs and roof coverings and the fire reaction class of the photovoltaic module.

The following type of coupling may be considered acceptable, generally speaking:
- photovoltaic systems with FV panels having class 2 or equivalent fire reaction rating on roofs classified as $B_{roof}(t2)$

A roof with a visible covering is the most common and widespread solution for industrial and commercial buildings, which are often very large too. Visible coverings are subject to greater stress because they are exposed directly to harsh weather conditions and, when they are laid under a photovoltaic system that has to last more than 20 years, it is important to choose long-lasting membranes.

The membranes recommended herein, of the PROTEADUO, HELASTA and FLEXTER FLEX TESTUDO series, all come with DVT Agrément of the ITC-CNR certification of their service life and relative constant periodic control. Even though their relevant EC marking is compliant, the suggested membranes can be laid in a single 4-mm layer; however, with greater safety in mind and in view of the fact that it is now very expensive to repair a roof under a photovoltaic system, it has become common practice to lay a double layer on new roofs. Another reason for laying in double layers is due to the higher resistance to external fires of the waterproof covering, requested by the Guide on the installation of photovoltaic systems issued by the Fire Brigade Department of the Home Office dated 7th February 2012 and subsequent clarification memorandum dated 4th May 2012 - case 3a. In such case, as upper layer of the new waterproof system, it is better to lay a membrane classified as $B_{roof}$, according to UNI EN 13501-5:2009 based on the results of the exposure tests of the roofs to an external fire, pursuant to UNI ENV 1187:2007. The FIRESTOP membranes are classified $B_{roof}(t2)$ in compliance with UNI EN 13501-5:2009 on both combustible and incombustible substrates. Also in the case of old coverings, especially if they are older than 10 years, it is better to apply a double layer and just apply a single layer of FIRESTOP only if the covering is not so old and still in a good state.

DETAILS OF LAYING - example of vertical joins with metal uprights of photovoltaic systems

VERTICONNECT is a vertical join with adjustable sleeves for passing cables in waterproofing layers with polymer-bitumen membranes.

It is a secure, flexible, watertight solution for vertical joins, pipes, profiles, consoles and threaded rods, etc., which cross the horizontal plane of a flat roof waterproofed with bitumen-polymer membranes.

1. VERTICONNECT application

2. Application of a finishing patch on VERTICONNECT

3. VERTICONNECT fixed on the roof

4. Join completed
New roofs

**DOUBLE-LAYER WATERPROOF COVERING IN TOTAL ADHESION (TORCH-BOND) ON THERMAL INSULATION RESISTANT TO HEAT AND ON THERMOBASE**
(valid for roof pitches ≤40%) for roof pitches between 40-100%, bonding of the waterproof covering will be integrated with mechanical nail/screw and washer fixture (diameter 50-mm) arranged every 20-cm under the end overlaps of the last layer.

**DOUBLE-LAYER WATERPROOF COVERING IN TOTAL ADHESION (TORCH-BOND) ON THERMAL INSULATION THAT IS NOT RESISTANT TO HEAT, PROTECTED BY SELF-HEAT-ADHESIVE MEMBRANE**
(valid for roof pitches ≤15%) for roof pitches between 15÷40%, bonding of the waterproof covering will be integrated with mechanical nail/screw and washer fixture (diameter 50-mm) arranged every 20-cm under the end overlaps of the last layer.

**DOUBLE-LAYER WATERPROOF COVERING IN TOTAL ADHESION (TORCH-BOND) ON SUBSTRATE HEAT-ADHESIVE MEMBRANE IN SEMIADHESION WITH STRIPS ON CEMENT-BASED SURFACES**
(valid for roof pitches ≤15%) for roof pitches between 15÷40%, bonding of the waterproof covering will be integrated with mechanical nail/screw and washer fixture (diameter 50-mm) arranged every 20-cm under the end overlaps of the last layer.

Refurbishment

**DOUBLE-LAYER IN TOTAL ADHESION (TORCH-BOND) FOR REFURBISHMENTS ON OLD DRY ROOFS**
(valid for roof pitches ≤40%) for roof pitches between 40-100%, bonding of the waterproof covering will be integrated with mechanical nail/screw and washer fixture (diameter 50-mm) arranged every 20-cm under the end overlaps of the last layer.

**DOUBLE-LAYER IN TOTAL ADHESION (TORCH-BOND) FOR REFURBISHMENTS ON SUBSTRATE HEAT-ADHESIVE MEMBRANE IN SEMIADHESION BY STRIPS ON OLD DAMP ROOFS**
(valid for roof pitches ≤15%) for roof pitches between 15÷40%, bonding of the waterproof covering will be integrated with mechanical nail/screw and washer fixture (diameter 50-mm) arranged every 20-cm under the end overlaps of the last layer.

**SINGLE-LAYER IN TOTAL ADHESION (TORCH-BOND) FOR REFURBISHMENTS ON RECENT EXISTENT ROOFS**
(valid for roof pitches ≤40%) for roof pitches between 40-100%, bonding of the waterproof covering will be integrated with mechanical nail/screw and washer fixture (diameter 50-mm) arranged every 20-cm under the end overlaps of the last layer.
**TECHNICAL CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Standard</th>
<th>T</th>
<th>MINERAL HELASTOPOL FIRESTOP POLYESTER</th>
<th>MINERAL ELASTOCENE FIRESTOP POLYESTER</th>
<th>FIRESTOP POLYESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight</strong></td>
<td>EN 1846-1</td>
<td>±1%</td>
<td>5.0 kg/m²</td>
<td>5.0 kg/m²</td>
<td>4.5 kg/m²</td>
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<tr>
<td><strong>Roll size</strong></td>
<td>EN 1928 – B</td>
<td>±1%</td>
<td>1 x 10 m</td>
<td>1 x 10 m</td>
<td>1 x 10 m</td>
</tr>
<tr>
<td><strong>Water tightness</strong></td>
<td>EN 12311-1</td>
<td>-20%</td>
<td>650/400 N/50 mm</td>
<td>700/500 N/50 mm</td>
<td>700/400 N/50 mm</td>
</tr>
<tr>
<td><strong>Max tension force L/T</strong></td>
<td>EN 12311-1</td>
<td>-30%</td>
<td>60 kPa</td>
<td>60 kPa</td>
<td>60 kPa</td>
</tr>
<tr>
<td><strong>Resistance to tear</strong> (nail shank) L/T</td>
<td>EN 12310-1</td>
<td>-30%</td>
<td>40/40%</td>
<td>40/40%</td>
<td>40/40%</td>
</tr>
<tr>
<td><strong>Resistance to water penetration</strong></td>
<td>EN 12311-1</td>
<td>-30%</td>
<td>150/180 N</td>
<td>160/200 N</td>
<td>150/150 N</td>
</tr>
<tr>
<td><strong>Resistance to water penetration</strong></td>
<td>EN 12311-1</td>
<td>-30%</td>
<td>150/180 N</td>
<td>160/200 N</td>
<td>150/150 N</td>
</tr>
<tr>
<td><strong>Dimensional stability L/T</strong></td>
<td>EN 1107-1</td>
<td>±0.30×0.10%</td>
<td>-30/0.10%</td>
<td>-30/0.10%</td>
<td>-30/0.10%</td>
</tr>
<tr>
<td><strong>Flexibility to low temperature</strong></td>
<td>EN 1109</td>
<td>±15°C</td>
<td>-15°C</td>
<td>-20°C</td>
<td>-10°C</td>
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<tr>
<td><strong>Flow resist. at high temp.</strong></td>
<td>EN 1110</td>
<td>±10°C</td>
<td>100°C</td>
<td>100°C</td>
<td>100°C</td>
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<tr>
<td><strong>Elongation L/T</strong></td>
<td>EN 298</td>
<td>±5%</td>
<td>W1</td>
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<tr>
<td><strong>Reaction to fire</strong></td>
<td>EN 13501-1</td>
<td>E</td>
<td>E</td>
<td>E</td>
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<td><strong>External fire performance</strong></td>
<td>EN 13501-5</td>
<td>E</td>
<td>B_{mm} (1*)</td>
<td>B_{mm} (1*)</td>
<td>B_{mm} (1*)</td>
</tr>
</tbody>
</table>

Thermal specifications

- **Heat capacity**: 0.2 W/m²K
- **Heat capacity**: 0.2 W/m²K
- **Heat capacity**: 0.2 W/m²K

(*) Classified on incombustible and combustible substrate with density > 16 kg/m³.

Compliant with EN 13707 in terms of the resistance factor to steam penetration for reinforced polymer-bitumen membranes, the value of $\mu = 20,000$ may be considered, unless declared otherwise.

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**COMPOSITION OF THE MEMBRANE**

- **MINERAL HELASTOPOL FIRESTOP POLYESTER**
  - Basaltic powder with a polished finish
  - Composite polyester fabric with a polished finish
  - Composite polyester fabric with a polished finish
  - Basaltic powder with a polished finish
  - Composite polyester fabric with a polished finish
  - Selvedge
  - Flamina

- **MINERAL ELASTOCENE FIRESTOP POLYESTER**
  - Basaltic powder with a polished finish
  - Composite polyester fabric with a polished finish
  - Composite polyester fabric with a polished finish
  - Basaltic powder with a polished finish
  - Composite polyester fabric with a polished finish
  - Selvedge
  - Flamina

- **FIRESTOP POLYESTER**
  - Basaltic powder with a polished finish
  - Composite polyester fabric with a polished finish
  - Composite polyester fabric with a polished finish
  - Basaltic powder with a polished finish
  - Composite polyester fabric with a polished finish
  - Selvedge
  - Flamina

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**PRODUCT FINISHING**

- **SELF-PROTECTION WITH SLATE GRANULES**: On the non-visible face of the membrane, a protective对外 coating made up of slate granules of various colours is fully bonded. This mineral aid protects the membrane from ageing caused by UV rays.

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**INTERNET**

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