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## Guidelines for SINTEF Technical Approval for

- Bitumen-based roofing membranes
  - Roofing membranes of PVC, TPO or rubber
  - Roofing shingles
  - Bitumen-based membranes for bridges
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## 1. General information about SINTEF Technical Approval

General information about SINTEF Technical Approval procedures is available at <https://www.sintefcertification.no/portalpage/index/180>

## 2. Properties to be included in the approval and how the properties are determined

SINTEF Technical Approval for roofing membranes and roofing shingles shall normally include a documentation of product properties presented in clause 2 and in table 1-3 in the end of this document. SINTEF Technical Approval for bituminous membranes for bridges shall normally include a documentation of product properties presented in clause 2, in the section for bituminous membranes for bridges, and in table 4 in the end of this document.

If the product properties have already been tested according to recognised methods, and the results are thoroughly documented, either in English or a Scandinavian language, the documentation should be submitted together with the application. If no such documentation exists, SINTEF, or other independent control bodies listed in the NANDO base, must carry out a full type testing in accordance with the methods and criteria mentioned below. Note that fire testing is not offered by SINTEF.

### Fire technical properties

Fire technical classification  $B_{ROOF}(t_2)$  is specified according to EN 13501-5 on a defined underlay, with tests carried out according to CEN/TS 1187, Test 2. Approval of the different substrates are assessed according to a defined sequence of testing. The testing sequence and consequences of different results are described in the flow chart in the end of this document.

### Material properties

Material properties on newly manufactured membrane (fresh material) are tested in accordance with methods in the product standard for the current product category. The results must satisfy the minimum values given in Table 1, 2, 3 or 4. In certain cases lower values may be accepted. A more thorough assessment will then be necessary and documentation of suitability will be required through e.g., compensatory values on other properties or field investigations.

### Performance tests

#### *Resistance to wind load on bitumen-based roofing membranes and membranes of PVC, TPO or rubber*

Resistance against wind load is tested and documented according to EN 16002; "Determination of the resistance to wind load of mechanically fastened flexible sheets for roof waterproofing". Wind load testing in consistence with EOTA ETAG 006 "Systems of Mechanically Fastened Flexible Roof Waterproofing Membranes" pt. 5.1.4.1 is accepted as supplementary documentation in cases with several system variables.

The test shall be performed in consistence with the rules given in leaflet No. 544.206 in Byggeforskersiens Byggedetaljer, and TPF Informerer No. 5, published by Takprodusentenes Forskningsgruppe.

Fasteners specified in the approval must have a SINTEF Technical Approval, an ETA or another equivalent follow-up. Dimensional capacity at break for the roofing system, per fastener, must be evaluated for each system, but should be at least 500N. If lower, a thorough assessment must be done. It is the design capacity per fastener, with the safety factor used in Norway ( $\gamma_m = 1.3$ ), that should be stated in the approval.

#### *Water tightness under pulsating air pressure on roofing shingles*

Performance test of roofing shingles concerning water tightness against rain showers shall be tested and documented according to Method NT Build 421 "Roofs; Water tightness Under pulsating Air Pressure", and SINTEF's own procedure for roofing shingles. The test shall be performed in consistence with the rules given in leaflet No. 544.105 in Byggeforskersiens Byggedetaljer. See SINTEF's recommended minimum performance in table 3.

## Durability

Durability assessment shall always be performed. It will normally be carried out as accelerated laboratory ageing, where a limited number of properties are tested after ageing.

### Ageing methods for the different types of product:

- Bituminous membranes: Exposure to elevated temperature at 70°C for 12 weeks, according to EN 1296
- Roofing membranes of PVC / TPO: Long term exposure to the combination of UV radiation, elevated temperature and water according to EN 1297 (1000 hours UV, 1200 hours in total)
- Roofing shingles: UV-exposure and possible resistance to blistering according to EN 544.

More details regarding durability for each type of product are shown in Table 1, 2, 3 and 4.

The lower part of the tables gives recommended performances to the durability of bituminous roofing membranes, roofing membranes of PVC, TPO or rubber and roofing shingles. The chosen tests after ageing are a basis to make it possible to judge the durability of the membrane as a complete product, but also to evaluate the bituminous coating and the reinforcement. Too large changes of the properties after ageing will not be approved, see points a) to e) below.

The following guidelines apply to the residual properties for roofing membranes after standard ageing:

- a) The properties shall, as a main rule, not change more than 20% compared to fresh material.
- b) If a) is not fulfilled, but the change lies between 20 and 30 % reduction compared to fresh material, the property shall not exceed 15% below the control limit for fresh material.
- c) If b) is not fulfilled, but the change is greater than 30%, the property shall not be poorer than the control limit for fresh material.
- d) Changes greater than 35 % will not be accepted.
- e) Residual properties after ageing shall never be poorer than the min./max. values shown in the bottom of table 1 – 4.

The residual properties for a product shall be judged in each case. E.g. for a roll product a low elongation value at max load can be compensated by high tensile strength value. Likewise, a low tensile strength value can be compensated by high elongation value.

## FTIR material characterization

FTIR material characterization shall be tested for the product. The FTIR material characterization is carried out applying an attenuated total reflectance (ATR) accessory (single reflection) with a diamond crystal, in the wavelength range 4000 cm<sup>-1</sup> (2.5 µm) to 400 cm<sup>-1</sup> (25 µm), in an atmosphere with minimized CO<sub>2</sub> and H<sub>2</sub>O content through purging.

## Environmental properties

SINTEF Technical Approval must always include information about prioritized environmental toxins, inside climate influences, influence of soil and groundwater and waste managing.

Requirements concerning material and product properties related to impact on the environment is available at; <https://www.sintefcertification.no/file/index/1867>

### *Leaching test*

For roofing membranes it is necessary to perform leaching-test following the Norwegian TEK 17 § 9-2 and limitations 3 "Helse, hygiene og miljø" in the "Building Product Regulation" together with the standard-committee CEN/TC 351 (Construction Products – Assessment of the release of Dangerous Substances / WG 1 Leaching of soil, groundwater and surface water).

Bituminous roofing membranes produced by manufacturers who are members of EWA (European Waterproofing Association AISBL) do not need leaching testing if a similar product has already been tested. What is considered a similar product is assessed in each case. The composition of the product is checked against the composition of previously tested products. If a product with similar composition has already been tested for leaching and has been evaluated satisfactorily, it will not be necessary to test the new product. Otherwise, new leaching test is required. For roofing membranes produced by non-EWA members, the procedure is similar, with the difference that through the EWA cooperation there is now a large number of leaching tests, that can be included in the assessment whether a new leaching test is necessary or not.

### **Declaration of Performance (DoP) and declared values in a Technical Approval**

SINTEF is obliged to control conformity between manufacturer's values in the Declaration of Performance (DoP) and the values declared in the SINTEF Technical Approval.

### **SINTEF's recommended minimum performances for Technical Approval**

SINTEF's recommended minimum performances for approval are given in Table 1 for **bituminous roofing membranes**, Table 2 for **roofing membranes of PVC, TPO or rubber**, table 3 for **roofing shingles** and for **bituminous membranes for bridges** in Table 4. For membranes which may also be used for other building purposes special property requirements can be required.

*Bitumen-based roofing membranes. See Table 1*

Table 1 lists the type of tests that has to be carried out and recommended performances applicable to membranes used in *mechanically fastened systems, ballasted systems, and systems torched, welded or glued to the underlay systems*. It is a clear advantage for the products used in the last mentioned system to have an elongation larger than 10%. For built-in membranes documentation of adhesion of granules (EN 12039) and peel resistance (EN 12316-1) is not required.

*Roofing membranes of PVC, TPO or rubber. See Table 2*

Table 2 lists the type of tests that has to be carried out and recommended performances applicable to roofing membranes of PVC, TPO or rubber used in mechanically fastened systems, or ballasted membranes.

*Roofing shingles. See Table 3*

Table 3 lists type of tests that has to be carried out and recommended performances applicable to roofing shingles with mineral and/or synthetic reinforcement. The field of application for the roofing shingles is pitched roofs down to 15°, with load-bearing, ventilated roof boards of wood or plywood.

*Bituminous membranes for bridges. See Table 4*

Table 4 lists type of tests that has to be carried out and recommended performances applicable to reinforced bitumen sheets for waterproofing of concrete bridge decks and other trafficked areas of concrete. All approvals for membranes for bridges must include a hearing at the Norwegian Directorate of Public Roads

*Additional requirements for water-pressure membranes and / or parking decks*

- Waterproof at 150 kPa according to NS-EN 1928, method B, modified from 24 hours to 1 hour.
- Resistance to root penetration according to NS-EN 13948 when the membrane is used in connection with soil cover and planting.

If the root resistance has not been tested (in such applications) the root resistance must be ensured by a separate root barrier to protect the membrane from plant roots.

Note: Membranes categorized as water pressure membranes shall on SINTEF Certifications website be placed under both product types "Flexible sheet roofing" and "Water-pressure membranes".

**Common references to SINTEF Building Research Design Guides and other information sheets**

525.002 *Takformer, taktyper og oppbygning*

525.207 *Kompakte tak*

525.304 *Terrasse på etasjeskiller av betong for lett eller moderat trafikk*

525.306 *Takterrasser med beplantning*

525.307 *Tak for biltrafikk og parkering. Del I og II*

544.202 *Takfolie. Egenskaper og tekking*

544.203 *Asfalttakbelegg. Egenskaper og tekking*

544.204 *Tekking med asfalttakbelegg eller takfolie. Detaljløsninger*

544.206 *Mekanisk feste av asfalttakbelegg og takfolie på flate tak*

525.306 *Terrasser med beplantning på bærende betongdekker*

525.307 *Tak for biltrafikk og parkering*

TPF Informerer no. 5 *"Innfesting av fleksible takbelegg, dimensjonering og utførelse*

*Beregningsprogram for beregning av vindkrefter på tak"* (utgitt av Takprodusentenes Forskningsgruppe)

**3. Description of the manufacturer's factory production control**

As a basis for the approval SINTEF must receive a copy of the description of the manufacturer's control plan for the product. This may be the relevant part of the manufacturer's quality control system for the product, or other documentation describing the manufacturer's factory production control. The person responsible for the factory production control shall be identified.

The control plan shall as a minimum describe:

- control and reception of raw materials
- control and supervision of production
- control of properties for finished product
- control and supervision of marking and storage
- calibration procedures of important instruments used for production and product control
- training of new employees

including the control frequency, how the controls are performed and by whom.

The factory production control description shall also include what measures are taken when faults are observed in the production or in the product.

**4. Supervisory production control**

The production shall be subject to a supervisory product and production control performed by an independent body. General description of how the supervisory product and production control are performed is available at; <https://www.sintefcertification.no/PortalPage/Index/283#content>

The agreement includes one annual inspection of the production of the product to make sure that the quality system works according to purpose. An independent inspection organ shall perform the inspection. Samples of the approved product are collected once a year for control testing of its properties (on both fresh and aged material, if appropriate). SINTEF, or another third party organization specified in the NANDO base, shall perform the control testing. In addition, annually control of fire property, according to CEN/TS 1187 test 2, shall be performed by a third party organization.

If annual control does not pass the holder of the Approval will be notified with a letter. Depending on the severity of the nonconformity different corrective actions must be implemented. For the most severe incidents withdrawal of the Technical Approval might be necessary. See examples in paragraph below.

SINTEF's project manager for the surveillance control is responsible for the communication with the holder. Approval manager in SINTEF Certification forwards the formal notice when a Technical Approval is withdrawn.

**Annual surveillance control of roofing membranes declared with class B<sub>ROOF</sub> (t2)**

The requirement for a passed result at type testing with 3 parallel samples on each wind velocity is maximum damaged length on 800 mm for each single specimen, and maximum 550 mm in average for each wind velocity. See EN 13501-5.

Control testing of B<sub>ROOF</sub>(t2), according to CEN/TS 1187:2012 test 2, is performed annually. The control testing is performed on the substrates the product is approved for, and with minimum 2 single tests:

- 1 for wind velocity 2 m/s
- 1 on wind velocity 4 m/s

Criteria for passed result for a control test (only 1 single sample on each wind velocity) is not described in the test standard nor the classification standard. But practice has been:

- Passed: Damaged length (l) of membrane or substrate  $l < 550$  mm
- Not clearly passed: Damaged length (l) of membrane or substrate  $550 > l < 800$  mm
- Not passed: Damaged length (l) of membrane or substrate  $l > 800$  mm

When annual control test does not pass the following guidelines apply:

- 1) Damaged length (l) of membrane or substrate  $550 > l < 800$  mm, or missing fire report
  - Holder is notified that a new control test must be performed, respite 2 months
  - Producer is simultaneously asked to find an explanation to the deviation, respite 4 weeks
  - If new control test passes the matter is considered to be sorted
  - If new control testing does not pass the holder is notified that the Approval will be withdrawn in 2 weeks unless there is an obvious defect in the production which can be adjusted.  
New test is performed as a full type test.
- 2) Damaged length (l) of membrane or substrate  $l > 800$  mm
  - Holder is notified that a new control test must be performed, respite 2 months
  - Producer is simultaneously asked to find an explanation to the deviation and to present a plan for possible corrective actions and planned time for new control testing, respite 4 weeks
  - Producer must be asked to consider blocking the stock, or possibly reclassification
  - If new control test passes the matter is considered to be sorted
  - If new control testing does not pass the holder is notified that the Approval will be withdrawn in 2 weeks unless there is an obvious defect in the production which can be adjusted.  
New test is performed as a full type test.
- 3) When test results are worse than 1) and 2), for instance at complete flash-over
  - Holder is notified that a new control test must be performed as a full type testing, with 3 parallel samples on each wind velocity, respite 1 month
  - Holder must immediately order new fire test and simultaneously investigate if there are obvious defects in the production or testing procedure that can be adjusted.
  - Producer must be asked to consider blocking the stock, or possibly reclassification
  - If new type test passes the matter is considered to be sorted
  - If new type testing does not pass the holder is notified that the Approval will be withdrawn immediately.

## **5. Application for SINTEF Technical Approval and project management**

Information regarding application and project management for SINTEF Technical Approval is available at; <https://www.sintefcertification.no/file/index/2980>

## **6. More information**

Further information about SINTEF Technical Approval can be found on [www.sintefcertification.no](http://www.sintefcertification.no).

Table 1. SINTEF's recommended minimum performance to issue a SINTEF Technical Approval for bituminous roofing membranes. Properties according to product standard EN 13707.

| Property  | Method EN  | Unit                    | Type of requirement                                   | SINTEF's recommended minimum performance |                              |                               |
|---|--|-------------------------|---|--|------------------------------|-------------------------------|
|   |  |                         |   | Underlay                                 | Top layer                    | Single layer                  |
| Width and Width tolerance <sup>6)</sup>   | 1848-1   | m                       | Minimum   | MLV                                      | MLV                          | MLV                           |
| Length and Length tolerance <sup>6)</sup>   | 1848-1   | m                       | Minimum   | MLV                                      | MLV                          | MLV                           |
| Straightness <sup>6)</sup>  | 1848-1   | mm/10 m                 | Maximum   | 20                                       | 20                           | 20                            |
| Weight, Weight tolerance, or Thickness, Thickness tolerance   | 1849-1   | kg/m <sup>2</sup> or mm | Mean value  | MDV                                      | MDV                          | MDV                           |
| Visual defects  | 1850-1   | -                       | -   | Pass                                     | Pass                         | Pass                          |
| Dimensional stability   | 1107-1   | %                       | Maximum   | 0,6                                      | 0,6                          | 0,6                           |
| Flexibility at low temperature  | 1109   | °C                      | Maximum   | -15                                      | -15 <sup>1)</sup>            | -15                           |
| Flow resistance at elevated temperature   | 1110   | °C                      | Minimum   | 90                                       | 90                           | 90                            |
| Water tightness   | 1928 (A)   | -                       | Tight at 10 kPa                                       | Pass                                     | Pass                         | Pass                          |
| Adhesion of granules <sup>3)</sup>  | 12039  | g                       | Maximum   | -  | 2.5                          | 2.5                           |
| Resistance to tearing (nail shank)  | 12310-1  | N                       | Minimum   | 150                                      | -                            | 150                           |
| Tensile strength  | 12311-1  | N/50 mm                 | Minimum   | 400                                      | 400                          | 600                           |
| Elongation  | 12311-1  | %                       | Minimum   | 10                                       | 10                           | 10                            |
| Peel resistance of joints<br>- Average peel resistance<br>- Max. peel resistance <sup>4)</sup>  | 12316-1  | N/50 mm                 | Minimum   | 50 <sup>4)</sup>                         | -                            | 50 <sup>4)</sup>              |
| Shear resistance of joints  | 12317-1  | N/50 mm                 | Minimum   | 400                                      | -                            | 600                           |
| Resistance to - Impact at +23 °C<br>- Impact at -10 °C<br>- Static loading  | 12691:2006 (A)<br>12691:2001 <sup>5)</sup><br>12730:2015 (A) | mm<br>mm<br>kg          | Min. height<br>Max. diameter <sup>5)</sup><br>Minimum | 500<br>-<br>15 <sup>7)</sup>             | 500<br>-<br>15 <sup>7)</sup> | 500<br>30<br>20 <sup>7)</sup> |
| Water tightness after stretching at low temperature (10% at -10°C)  | 13897  | %                       | Minimum   | -  | -                            | 10                            |
| Durability (Artificial ageing by long term exposure to elevated temperature, EN1296; + 70 °C for 12 weeks). Maximum accepted change will be evaluated in relation to the requirements for fresh products. |  |                         |   |  |                              |                               |
| Flexibility at low temperature  | 1109   | °C<br>°C                | Maximum<br>Max. change <sup>2)</sup>                  | -6<br>+ 10                               | -6<br>+ 10                   | -6<br>+ 10                    |
| Tensile strength  | 12311-1  | N/50 mm<br>%            | Minimum<br>Max. change <sup>2)</sup>                  | 400<br>- 20                              | 400<br>- 20                  | 600<br>- 20                   |
| Elongation  | 12311-1:   | %<br>%                  | Minimum<br>Max. change <sup>2)</sup>                  | 10<br>- 20                               | 10<br>- 20                   | 10<br>- 20                    |

- not relevant

MLV Manufacturer's limiting value  
MDV Manufacturer's declared value

<sup>1)</sup> Only top side out

<sup>2)</sup> Maximum change in relation to fresh product. Max. temperature for aged material: -6°C.

<sup>3)</sup> Modified to only give the result of weight loss of granules in gram according to EN 544.

<sup>4)</sup> For fully welded overlap joints, SINTEF has requirements for minimum recommended value for average peel resistance. Value for maximum peel resistance is usually not required, but can be included in approval documents if desired and available.

For partially welded overlap joints, additional resistance to max. peel resistance is required: ≥200 (preferably 250) (Partially welded means that the weld does not cover the entire width of the overlap)

<sup>5)</sup> Diameter on puncture tool: 10, 15, 20 and 30 mm

<sup>6)</sup> The property is not necessary to test in connection with type testing. But the results in the producer's FPC must be checked against given tolerances and possible minimum performance in this document.

<sup>7)</sup> SINTEF can accept products that do not achieve SINTEF's recommended minimum performance for static load. The product's achieved performance must then be stated as a control limit and the following must be specified in the approval *"The product has limited resistance to static load. In the installation- and operational phase it must therefore be protected against strain from ladders, scaffolding etc., e.g. with a separate protective layer on top of the roofing membrane."*

Additional properties might be necessary to test for products with special fields of application. This must be evaluated in each case.

For double layer bituminous roofing membranes, overall value (for the double layer in total) of relevant properties may be stated, if desired. SINTEF has no recommended minimum performance for these values, and the values are not subject to surveillance control.

Table 2. SINTEF's recommended minimum performance to issue a SINTEF Technical Approval for roofing membranes of PVC, TPO or rubber. Properties according to product standard EN 13956.

| Property  | Method EN   | Unit                    | Type of requirement  | SINTEF's recommended minimum performance |                                     |
|---|---|-------------------------|--|--|-------------------------------------|
|   |   |                         |  | Mechanically fastened                    | Ballasted                           |
| Width and Width tolerance <sup>5)</sup>   | 1848-2  | m                       | Tolerance Minimum/Maximum  | -0,5/+5 %                                | -0,5/+5 %                           |
| Length and Length tolerance <sup>5)</sup>   | 1848-2  | m                       | Tolerance Minimum/Maximum  | -0/+5 %                                  | -0/+5 %                             |
| Straightness <sup>5)</sup>  | 1848-2  | mm/10 m                 | Maximum  | 50                                       | 50                                  |
| Flatness <sup>5)</sup>  | 1848-2  | mm/10 m                 | Maximum  | 10                                       | 10                                  |
| Weight and Weight tolerance or Thickness, Thickness tolerance   | 1849-2  | kg/m <sup>2</sup> or mm | Tolerance Minimum/Maximum  | -5/+10 %<br>-5/+10 %                     | -5/+10 %<br>-5/+10 %                |
| Visual defects  | 1850-2  | -                       | -  | Pass                                     | Pass                                |
| Flexibility at low temperature  | 495-5   | °C                      | Maximum  | -30 <sup>4)</sup>                        | -30 <sup>4)</sup>                   |
| Dimensional stability   | 1107-2  | %                       | Maximum  | 0,5                                      | 0,5                                 |
| Watertightness  | 1928 (A)  | -                       | Tight at 10 kPa  | Tight                                    | Tight                               |
| Resistance to tearing   | 12310-2   | N                       | Minimum  | 180                                      | 80                                  |
| Tensile strength  | 12311-2 (A)   | N/50 mm                 | Minimum  | 600                                      | 380                                 |
| Elongation  | 12311-2 (A)   | %                       | Minimum  | 10                                       | 180                                 |
| Peel resistance of joints <sup>3)</sup><br>- Average<br>- Max.  | 12316-2   | N/50 mm                 | Minimum  | 150 <sup>3)</sup><br>200 <sup>3)</sup>   | -                                   |
| Shear resistance of joints  | 12317-2   | N/50 mm                 | Minimum  | 600                                      | 380                                 |
| Resistance to - Impact at +23 °C<br>- Impact at -10 °C<br>- Static loading <sup>6)</sup><br>- Static loading <sup>8)</sup>  | 12691 (A)<br>12691:2001<br>12730 (A) <sup>6)</sup><br>12730 (C) <sup>8)</sup> | mm<br>mm<br>kg<br>kg    | Min. height<br>Max. diameter <sup>2)</sup><br>Minimum<br>Minimum | 400<br>15<br>20 <sup>7)</sup><br>20      | 400<br>20<br>20 <sup>7)</sup><br>20 |
| Durability (Artificial ageing by long term exposure to the combination of UV radiation, elevated temperature and water, EN 1297). Maximum accepted change will be evaluated in relation to the requirements for fresh material. |   |                         |  |  |                                     |
| Flexibility at low temperature  | 495-5   | °C                      | Maximum<br>Max. change <sup>1)</sup>                             | -20<br>+ 10                              | -20<br>+ 10                         |
| Tensile strength  | 12311-2 (A)   | N/50 mm<br>%            | Minimum<br>Max. change <sup>1)</sup>                             | 600<br>- 20                              | 380<br>- 20                         |
| Elongation  | 12311-2 (A)   | %<br>%                  | Minimum<br>Max. change <sup>1)</sup>                             | 10<br>- 20                               | 180<br>- 20                         |

- not relevant

<sup>1)</sup> Maximum change in relation to fresh product

<sup>2)</sup> Diameter on puncture tool: 10, 15, 20 and 30 mm

<sup>3)</sup> Mode of failure (A / B / C) should always be reported. Best possible type of breach is B and C.

Average peel resistance shall be evaluated when the majority of tested specimens show failure mode A (peeling of the joint itself)

Maximum peel resistance is evaluated when the majority of tested specimens show fracture type B (break outside the joint) and / or C (delamination of the sheet).

Both mean and maximum peel resistance must be reported.

<sup>4)</sup> For thickness 1,2 mm: -30 °C, for thickness ≥ 1,5 mm: -25 °

<sup>5)</sup> The property is not necessary to test in connection with type testing. But the results in the producer's FPC must be checked against given tolerances and possible minimum performance in this document.

<sup>6)</sup> Method A: Substrate of EPS (quality CS (10) 150, with 40 mm limitation of downward movement of puncturing tool. Method A is required by SINTEF in connection with initial type testing and surveillance control.

<sup>7)</sup> SINTEF can accept products that do not achieve SINTEF's recommended minimum performance for static load, method A. The product's achieved performance must then be stated as a control limit and the following must be specified in the approval *"The product has limited resistance to static load. In the installation- and operational phase it must therefore be protected against strain from ladders, scaffolding etc., e.g. with a separate protective layer on top of the roofing membrane."*

<sup>8)</sup> Testing with 10 mm limited downward movement of ball on puncturing tool according to standard is performed in connection with type testing

Additional properties might be necessary to test for products with special fields of application. This must be evaluated in each case.

Table 3. SINTEF's recommended minimum performance to issue a SINTEF Technical Approval for roofing shingles. Properties according to product standard EN 544.

| Property                                      | Method EN                  | Unit             | Type of requirement | SINTEF's recommended minimum performance |
|---|----------------------------|------------------|---------------------|--|
| Width and Width tolerance <sup>2)</sup>       | 544                        | mm               | Maximum             | 1200 ± 3                                 |
| Height and Height tolerance <sup>2)</sup>     | 544                        | mm               | Minimum             | 250 ± 3                                  |
| Mass of bitumen                               | 544                        | g/m <sup>2</sup> | Minimum             | 1300                                     |
| Flow resistance at elevated temperature, 90°C | 1110                       | mm               | Maximum             | 2  |
| Adhesion of granules                          | 12039                      | g                | Maximum             | 2,5                                      |
| Resistance to tearing (nail shank)            | 12310-1                    | N                | Minimum             | 100                                      |
| Tensile strength L <sup>3)/</sup> T           | 12311-1                    | N/50 mm          | Minimum             | 600/400                                  |
| Water tightness under pulsating air pressure  | NT Build 421 <sup>4)</sup> | Pa               | Minimum             | 150 <sup>5)</sup>                        |
| <b>Durability</b>                             |                            |                  |                     |  |
| Water absorption                              | 544                        | %                | Maximum             | 2  |
| Resistance to blistering <sup>1)</sup>        | 544                        | -                | Visual              | No blisters                              |
| Resistance to UV radiation <sup>6)</sup>      | 1297                       | -                | Visual              | No cracks/damages                        |

<sup>1)</sup> Resistance to blistering is only relevant for shingles with other reinforcement than glass (type 3 and 4), polyester (type 6) and glass/polyester (type 7) according to EN 544.

<sup>2)</sup> The property is not necessary to test in connection with type testing. But the results in the producer's FPC must be checked against given tolerances and possible minimum performance in this document

<sup>3)</sup> Longitudinal (L) = Direction of production

<sup>4)</sup> Nordtest Method NT Build 421 Roofs; Water tightness Under Pulsating Air Pressure

<sup>5)</sup> Tight under driving rain at 150 Pa pressure

<sup>6)</sup> 60 cycles according to. EN 1297 (300 hours UV + 60 hours water; totally 360 hours)

Table 4. SINTEF's recommended minimum performance to issue a SINTEF Technical Approval for bituminous membranes for bridges according to EN 14695 and EN 13707.

| Property  | Test method EN           | Unit                    | Type of requirement                  | SINTEF's recommended minimum performance |
|---|--------------------------|-------------------------|--------------------------------------|--|
| Width and Width tolerance <sup>3)</sup>   | 1848-1                   | m                       | Minimum                              | MLV                                      |
| Length and Length tolerance <sup>3)</sup>   | 1848-1                   | m                       | Minimum                              | MLV                                      |
| Straightness <sup>3)</sup>  | 1848-1                   | mm/10 m                 | Maximum                              | 20                                       |
| Weight, Weight tolerance, or Thickness, Thickness tolerance   | 1849-1                   | kg/m <sup>2</sup> or mm | Mean value                           | MDV                                      |
| Visual defects  | 1850-1                   | -                       | -                                    | Pass                                     |
| Dimensional stability   | 1107-1                   | %                       | Maximum                              | 0,6                                      |
| Flexibility at low temperature  | 1109                     | °C                      | Maximum                              | -15                                      |
| Flow resistance at elevated temperature   | 1110                     | °C                      | Minimum                              | 90                                       |
| Water tightness (10 kPa)  | 1928 (A)                 | -                       | Tight                                | Tight                                    |
| Water tightness (150 kPa)   | 1928 (B)                 | -                       | Tight                                | Tight                                    |
| Tensile strength  | 12311-1                  | N/50 mm                 | Minimum                              | 600                                      |
| Elongation  | 12311-1                  | %                       | Minimum                              | 10                                       |
| Shear resistance of joints <sup>5)</sup>  | 12317-1                  | N/50 mm                 | Minimum                              | 600                                      |
| Resistance to<br>- Impact at +23 °C<br>- Impact at -10 °C<br>- Static loading   | 12691 (A)                | mm                      | Minimum height                       | 500                                      |
|   | 12691:2001 <sup>2)</sup> | mm                      | Maximum diameter <sup>2)</sup>       | 30                                       |
|   | 12730 (A)                | kg                      | Minimum                              | 20 <sup>7)</sup>                         |
| Water tightness after stretching at low temperature 10% at -10°C  | 13897                    | -                       | Minimum                              | Tight                                    |
| Bond strength   | 13596                    | N/mm <sup>2</sup>       | Minimum                              | 0,7                                      |
| Shear strength  | 13653                    | N/mm <sup>2</sup>       | Minimum                              | 0,2                                      |
| Resistance to root penetration  | 13948                    | -                       | Pass <sup>6)</sup>                   | <sup>6)</sup>                            |
| Water absorption  | 14223                    | % by weight             | Maximum                              | <sup>4)</sup>                            |
| Determination of crack bridging ability   | 14224, modified          | -                       | Pass                                 | <sup>4)</sup>                            |
| Compatibility by heat conditioning  | 14691                    | %                       | Minimum                              | <sup>4)</sup>                            |
| Determination of resistance to compaction of an asphalt layer   | 14692                    | -                       | Pass                                 | <sup>4)</sup>                            |
| Determination of the behaviour of polymer bitumen sheets during application of mastic asphalt   | 14693                    | -                       | Maximum                              | <sup>4)</sup>                            |
| Determination of resistance to dynamic water pressure after damage by pre-treatment <sup>3)</sup>   | 14694                    | -                       | Tight                                | <sup>4)</sup>                            |
| Dimension stability at 160 °C <sup>3)</sup>   | 14695, Annex B           | %                       | Maximum                              | <sup>4)</sup>                            |
| Durability (Artificial ageing by long term exposure to elevated temperature, EN1296; + 70 °C for 12 weeks). Maximum accepted change will be evaluated in relation to the requirements for fresh products. |                          |                         |                                      |  |
| Flexibility at low temperature  | 1109                     | °C<br>°C                | Maximum<br>Max. change <sup>1)</sup> | -6<br>+ 10                               |
| Tensile strength (L/T)  | 12311-1                  | N/50 mm<br>%            | Minimum<br>Max. change <sup>1)</sup> | 600<br>- 20                              |
| Elongation (L/T)  | 12311-1                  | %<br>%                  | Minimum<br>Max. change <sup>1)</sup> | 10<br>- 20                               |

- not relevant

MLV Manufacturer's limiting value

MDV Manufacturer's declared value

<sup>1)</sup> Maximum change in relation to fresh product. Max. temperature for aged material: -6°C.

<sup>2)</sup> Diameter on puncture tool: 10, 15, 20 and 30 mm

<sup>3)</sup> The property is not necessary to test in connection with type testing. But the results in the producer's FPC must be checked against given tolerances and possible minimum performance in this document.

<sup>4)</sup> SINTEF has not recommended a minimum performance. The properties must be documented in a test report from a neutral testing institute and declared in the Technical Approval.

<sup>5)</sup> Bituminous membranes for bridges must have fully welded overlap joints

<sup>6)</sup> If the root resistance has not been tested (in soil covered structures) the root resistance must be ensured by a separate root barrier to protect the membrane from plant roots.

<sup>7)</sup> SINTEF can accept products that do not achieve SINTEF's recommended minimum performance for static load. The product's achieved performance must then be stated as a control limit and the following must be specified in the approval *"The product has limited resistance to static load. In the installation- and operational phase it must therefore be protected against strain from ladders, scaffolding etc., e.g. with a separate protective layer on top of the roofing membrane."*

Additional properties might be necessary to test for products with special fields of application. This must be evaluated in each case.

## Flow chart for fire testing of exposed<sup>\*1</sup> roofing membranes of bitumen and PVC/ TPO/rubber



\*1 – Roofings embedded in constructions or lying under pebble ballast do not need any class B<sub>ROOF</sub> (t2)

\*2 –Exposed roofings in scattered small house settlements do not need to achieve B<sub>ROOF</sub> (t2)

### Remarks:

- If the membrane does not pass EPS as a substrate, it is required to test the substrates the roofing membrane is approved for according to the Technical Approval
- If the membrane is to be approved on PIR, only the tested PIR product can be approved – i.e. all PIR products are not approved. The product name of the PIR product must therefore be stated in the approval.
- Mineral wool is often more difficult to pass than wood particle board, even if mineral wool is described as incombustible, lightweight.
- Incombustible, heavy substrates are normally not tested.